KU LEUVEN

FACULTEIT GENEESKUNDE
BIOMEDISCHE WETENSCHAPPEN

De weg naar de harmonisatie van het post-mortem beleid van UZ Leuven

Off to the harmonisation of the post-mortem policy of UZ Leuven

Masterproef voorgedragen tot het behalen van de graad van Master in de biomedische wetenschappen door

Sarah AHANNACH

Promotor: Prof. dr. Elisabeth DEQUEKER
Co-promotor: Prof. dr. Eric VERBEKEN
Begeleider: dr. Wim DEVELTER

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Wherever the art of medicine is loved, there is also a love of humanity

~ Hippocrates

Special thanks to
University Hospitals Leuven

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"Alone we can do so little; together we can do so much" – Hellen Keller

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Thank you

drops mic

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Sarah Ahannach

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List of abbreviations

BELAC	Belgian Accreditation organisation
CA	Conventional autopsy
CAP	The College of American Pathologists
CPC	Clinicopathological conference
CT	Computed tomography
FAD	Final anatomic diagnoses
ICU	Intensive care unit
ISO	International Organization for Standardization
JCAHO	Joint Commission on Accreditation of Healthcare Organizations
JCI	Joint Commission International
KPI	Key performance indicators
LAP	Laboratory Accreditation Program
LWS	Laboratorium WerkStation
MIA	Minimally invasive autopsy
MICU	Medical intensive care unit
MIR	Management, Informatie en Rapportering
MRI	Magnetic resonance imaging
NA	Data not available
NCEPOD	National Confidential Enquiry into Patient Outcome and Death
NCHS	National Center for Health Statistics
NMR	Nuclear magnetic resonance
PAD	Preliminary anatomic diagnoses
PET	Positron emission tomography
pmCT	Post-mortem Computed tomography
PMI	Post-mortem interval
PPE	Personal protective equipment
QA	Quality assurance
QC	Quality control
QCP	Quality control process
QI	Quality improvement
QM	Quality management
QS	Quality system
RIZIV	Rijksinstituut voor ziekte- en invaliditeitsverzekering

SOP	Standard operating procedure
TAT	Turnaround time
UZ Leuven	Universitaire Ziekenhuizen Leuven

Abstract

The value of post-mortem examination is repeatedly demonstrated in literature. The autopsy is an essential tool for quality assessment of diagnostic and therapeutic methods. Therefore, the aim of this study is to provide an in-depth evaluation of the current situation concerning the post-mortem policy of UZ Leuven and to work towards a harmonisation. To achieve this evaluation, a quantitative study was performed by on one hand a retrospective review of all requested clinical autopsies from 2015 to 2017 in UZ Leuven. Specifically, clinical information and questions on autopsy requests were compared to the autopsy report's conclusion and brought into perspective with the department's autopsy rate. On the other hand, by a prospective observational study of both the discrepancy between clinical and forensic autopsies and the time lag of the administrative chain from death attestation to autopsy. This study showed that overall autopsy requests were sufficiently filled out for clinical information and that this information was significantly associated with the clinically questioned information to the pathologist. Moreover, providing sufficient clinical information on the autopsy request lead to a thorough autopsy conclusion. Additionally, the probability of a new major could not be estimated given a department's autopsy rate. Furthermore, comparing forensic to clinical autopsies showed in the latter that certain external and internal procedures were not commonly performed. In conclusion, a standardized approach of clinical autopsies is strongly recommended. Therefore, the clinical autopsy can become a competent and reliable parameter to assess the current diagnostic tools and therapies in healthcare.

1 Introductory literature overview

"_ you may take notes for twenty years, from morning to night at the bedside of the sick, upon the diseases of the viscera, and all will be to you only a confusion of symptoms, _a train of incoherent phenomena. Open a few bodies, this obscurity will disappear."

Bichat (c 1800) (1)

1.1 History overview of the autopsy

Throughout history, human and animal corpses have been the origin of countless rituals. Especially the dissection of the bodies, which was intended for magico-religious, cultural and scientific grounds (1). Hippocrates of Kos (460-377 BC) was the first to state that diseases are caused naturally and are not a consequence of superstition. He therefore paved the way for making rational conclusions based on clinical signs (2). Even though his theories have been disclosed, he still laid the foundations for others to build up on. In that period, the post-mortem examination was taken as a disgrace with the uprise of different religions, where the human body was presented as the vehicle of the soul. When the Renaissance in Europe emerged, it did not only bring a movement of culture along with it but also a thirst for knowledge, which resulted in an expansion in the medical field (1).

The Italian physician, Antonio Benivieni (1443-1502), was one of the first to study and document disease progression and the link between body structure and illness (3). His research was published after his death in 1507 as *De abditis nonnullis ac mirandis morborum et sanationum causis*[1]. Secondly, the publication in 1543 of Andreas Vesalius' *De humani corporis fabrica* was a major cornerstone in the history of anatomy. Giovanni Morgagni (1682-1772) followed with a new philosophy documented in his monograph *De sedibus et causis morborum per anatomen indignatis*[2], which later would be the pillar of pathology (4). Specifically, the correlation of clinical symptoms with anatomical findings and their connection to the dysfunction of the human body were pivotal (1).

The French physician, Marie François Xavier Bichat (1771-1802), examined the changes of component tissue of the organs during the disease instead of solely focusing on organ level (1,3). Hereafter the Austrian pathologist Carl von Rokitansky (1804-1878), also known as father of the autopsy, performed his autopsies precisely according to a rigid protocol, which would later be named after him. Many refer to him as the best descriptive pathologist of his days since he approached the pathological changes systematically. The German physician, Rudolf Virchow (1821-1902) followed shortly after with a booklet on autopsy techniques in which he combined pathology, microbiology, physiology and cellular biology as the basis of a

[1] *About the hidden and incredible causes of diseases and cures*
[2] *About the seats and causes of diseases investigated by anatomical investigations*

disease (1,4). During these times, the clinical autopsy was the final chapter of the story of a disease (3). This short overview of history of the autopsy may provide some insight into the recent changes in autopsy rate.

1.2 The variety of autopsies

The word 'autopsy' can be translated from the Modern Latin *autopsia* to "an eye-witnessing, a seeing for oneself" and from the Greek *autopsia* to "a seeing with one's own eyes" (5,6). In literature, the words necropsy and post-mortem examination are used to refer to the same connotation, i.e. the standardized examination of a deceased person for scientific or medico-legal purposes. Even though the number of autopsies has been declining for decades, it is still seen as 'the' ultimate medical consultation to determine the cause of death (3,7,8).

The autopsy is subdivided into two types, namely the clinical and forensic autopsy. The clinical autopsy is often referred to in literature as the academic, medical or hospital autopsy (3,4,9). This autopsy is performed on in-hospital deceased patients by a pathologist at the request of the practicing physician and in the minority of cases at the request of the next of kin (3). Despite the fact that the patient has been admitted to a hospital, does not necessarily mean that the cause of death is known. The purpose of a clinical autopsy is not just limited to identifying the cause and manner of death, but also to confirm and revise any relevant pathology related to this matter (10,11). An autopsy can provide a clinicopathological correlation which links the obtained diagnoses with the clinical symptoms. It also determines the effectiveness of a therapy and therefore provides physicians with feedback on the accuracy of the diagnosis. In addition, the opportunity to study the course and extent of disease processes is endorsed (3,10). It further provides essential data necessary for medical quality assurance and quality improvement (7). Moreover, there is an overall known that vital statistics are not as accurate as presented (1,4,11,12). Therefore, clinical autopsies would be a powerful contribution which would ultimately result in a different approach of healthcare policy on national and international level (1,9). More specifically, perinatal and foetal autopsies could stimulate further paediatric genetic counselling and assessment (1,13). Finally, it will always stay an educational tool in the medical curriculum (1,4,9,11,14).

On the other hand, the forensic or medico-legal autopsies are performed on demand of a public prosecutor to clarify the cause of death (3,15,16). This is indicated when a suspicious death has been reported by a general practitioner or medical examiner (15,16). A thorough investigation is necessary to exclude possible criminal origin. Unlike a clinical autopsy, a forensic autopsy is more demanding and comprehensive with multiple objectives such as determining the identity of the deceased, detecting external and internal pathological abnormalities, accurately documenting and describing external and internal injuries, collecting all valuable traces,

determining the mechanism and time of death (17). Although Belgium still has no definitive guidelines regarding autopsies, the department of Forensic Medicine of UZ Leuven is the first and currently only one that obtained an accreditation for their forensic autopsies through BELAC[3] ISO 17020 (18–21).

"The forensic pathologist lets the dead tell their last story and gives them a voice in a process in which they can no longer be present."

Yves Liègeois (2016) (22)

1.3 The current routine autopsy techniques

There are multiple autopsy techniques that can be applied in different circumstances. However, there is still no consensus on which autopsy technique should be used for a specific case. Even though numerous approaches for different cases exist, pathologists accomplish better when using a technique that suits them the best. Nevertheless, this does not imply that specific guidelines are unnecessary since the lack of standardized regulations has adverse consequences on the autopsy quality. Present-day, the integrated training of pathologists consists of the preceptor passing on his experience to the pupil regarding the various techniques (7,23,24).

1.3.1 **Rokitansky autopsy technique**

The Austrian pathologist Carl von Rokitansky (1804-1878) introduced the *in situ* dissection in without the removal of organ blocks (1,7,23). The intention was to preserve any abnormal anatomic relationships between organ groups (7,25). Pathologists prefer the Rokitansky autopsy technique when there is an established infectious case such as Hepatitis B, HIV, etc. and contamination is a pendant threat (26). This method can also be used when the next of kin does not grant permission for a conventional autopsy (CA) whereby only a restrictive autopsy consent is achieved. Since the *in situ* dissection allows the pathologist to only open and examine organs without having them to be removed. Finally, this method is also preferable when the time is limited (7). The disadvantage of the Rokitansky autopsy technique is that the organs cannot be detailed examined and may thereby result in a fragmentary perspective (26).

1.3.2 **Virchow autopsy technique**

The German physician Rudolf Virchow (1821-1902), often referred to as the father of modern pathology, was one of the first to apply microscopic examination on diseased tissue (1,3,7). The aim was to recognize cellular alterations through pathology (7). In 1880 Virchow published a book on the detailed post-mortem examination technique to identify organ anomalies (7,27). The method consists of one by one organ removal (organ-by-organ approach) and further

[3] BELAC is the Belgian accreditation organisation

comprehensive dissection afterwards (7,23). In contrary to the Rokitansky autopsy technique, this method ensures a more detailed examination that demonstrates pathological changes in tissues and organs. The disadvantage of this technique is the scarification of anatomicopathological relationships since they cannot be preserved (7,26). Therefore, interpretation of regional illnesses is more difficult (7).

1.3.3 **Ghon autopsy technique**

The Austrian pathologist Anton Ghon (1866-1936) was particularly known for his work in the field of bacteriology, namely the Ghon's complex (28). Additionally, he established the *en bloc* removal method for autopsies. The now widely used Ghon autopsy technique implies the removal of the organs according to their regional and functional group, namely thoracic block, cervical block, abdominal block and urogenital block (7,23). The advantage of this technique is the preservation of the interrelationships between the distinctive organs including the vasculature and the lymphatic drainage. Another benefit is the possibility for one person to carry out the autopsy in cases of limited capacity. However, the disadvantage is the transection of the oesophagus and the aorta at the diaphragm (7,25).

1.3.4 **Letulle autopsy technique**

The French pathologist Maurice Letulle (1853-1929) described the *en mass*e removal method for autopsies, which is often confused with the Rokitansky autopsy technique (7,25). When one uses this method, the organs are removed together *in toto* and are subsequently dissected into organ blocks (7,23). The Letulle autopsy technique has the same advantage as the Ghon autopsy technique, namely the preservation of the interrelationships between the distinctive organs including the vasculature and the lymphatic drainage (7). Another advantage is the rapid pace at which the body can be prepared for removal. In addition, less dissection is necessary within the confines of the body cavity, which results into a greater safety for both the pathologist and the post-mortem assistant. It is also acknowledged as the best technique of a detailed routine examination (26). The disadvantage of this technique is the fact that it takes longer than the Virchow autopsy technique (7). As well as the necessity of having a post-mortem assistant present and the additional experience that is required to perform this technique (7,26).

1.4 The autopsy as quality control

In 1912, a report by Cabot Report stated that American hospitals were experiencing many diagnostic errors that could only be discovered by performing an autopsy. As a result, clinical autopsies were more associated with the role of a quality control tool and less as a comprehensive tool for the pathogenesis of a disease (3,4,29). Every hospital implements

quality measures to assure the level of provided care. Therefore, every department has the responsibility to comply to the upheld standards. Specifically, the pathology department should have, besides its laboratory quality management (QM) program, an autopsy QM program in place to monitor the autopsy services. If this is not the case, the use of a clinical autopsy as quality assurance goes in vain (24,30). As stated and published in the Belgian Royal decree of 15 December 2011 concerning the recognition of Laboratories of Clinical Pathology by the Minister of Public Health, each Pathology department must have a quality system based on standard operating procedures (SOP) of all stadia of activities, organisation and the qualification of the employees. Unfortunately, none is stated regarding post-mortem investigations (31). Although Joint Commission International (JCI) has quality control processes (QCP) for surgical pathology and autopsy services, these standards only affect the histopathology laboratory activities and not the post-mortem activities of the deceased patient (32). The forensic autopsy has been accredited conform the ISO 17020 since 2009 in UZ Leuven. The hospital's JCI-accreditation, the Belgian legal mandatory quality assessment concerning pathology laboratories, and the forensic autopsy BELAC ISO 17020 accreditation were of great help as a framework in the evaluation of the clinical autopsy (21). The purpose of this autopsy QM program is to deliberately improve the provided service by monitoring the entire process. On one hand this applies to the elements of procedures that over time can be enhanced according to innovative techniques or approaches. On the other hand, the administrative aspects that register all relevant data are necessary to compile statistics resulting in future policy adjustments (Addendum V.1-2) (24).

The quality assurance (QA) can be monitored through indicators in the pre-analytic, analytic and post-analytic phases discussed in segment 1.8. The quality control (QC) monitors assess procedures to adequately detect, reduce and control deficiencies within the analytic phase. Further, the QM program also includes the deliberately adjusting of the performance according to the upheld standards provided by the quality improvement (QI) monitors. The autopsy QA policy is in many hospitals part of the anatomic pathology QM plan which often includes surgical pathology and cytology. This QM plan should be revised and outlined on a yearly basis (24).

Clinical autopsies are therefore an adequate parameter for a reliable QC of the public healthcare with an extensive aim (24). Further, clinical autopsies can be utilized to monitor the diagnostic and therapeutic competence combined with the clinical decision-making of physicians, the treatment methods and the applied techniques to obtain a diagnosis (3). However, for an autopsy to be a valid QC monitor of diagnostic competence, certain requirements should be put in place (8):

- A high autopsy rate;
- Standardized guidelines concerning the autopsy procedure, clinical information availability, organ sampling and assessment;
- Sensitivity and specificity calculations of the diagnostic process;
- Analysis of the errors in post-mortem diagnosis (8).

As mentioned above, the autopsy has a crucial part in the medical curriculum by teaching students to make clinicopathological correlations and to install problem-based learning (4). A clinicopathological correlation is an element of both the analytic and the post-analytic phase focusing, respectively on a clinicopathological conference (CPC) and the clinical audit (24). A CPC consists of a presentation of clinical cases involving experts from various medical fields to stimulate clinical reasoning, maintenance of critical thinking and cultivation of systematic doubt (33). This objective correlation summarizes the clinical data of an autopsy through incorporating gross and microscopic findings combined with ancillary tests. The purpose of a CPC is not only to clarify the cause death and the events leading up to it, but also as educational and quality improvement (34). It is therefore not an observation of the autopsy's performance but rather a comprehension of the value an autopsy provides to enhance medical care (24). In this manner, new treatments, techniques and disease processes can be monitored and studied. The clinicopathological correlation ensures system quality by opening an interdisciplinary conversation. A study by the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) concluded that autopsy reports consisting of a clinicopathological correlation were graded higher regarding the report's overall quality (35).

van den Tweel *et al.* have summed up the different roles the autopsy portrays in quality assurance (4):

- The evaluation of diagnostic imaging such as magnetic resonance imaging (MRI), computed tomography (CT) scan, positron emission tomography (PET) scan;
- The evaluation of efficacy and potential adverse reactions of new drugs, new surgical techniques and genetic engineering;
- The detection of new patterns in old diseases (e.g. tuberculosis and syphilis);
- Providing information on disease course and cause of death to the next of kin of a deceased patient;
- Facilitating investigation of environmental, occupational and lifestyle-related diseases;
- Providing tissue for research;
- Teaching medical students and residents in specialty training.

More than a century ago physicians diagnosed their patients based on occurring symptoms in contrary to pathologists that based their diagnosis on the morphological discoveries during the

autopsy. At that time the clinicopathological correlation was either a contradiction or an approval of the clinician's diagnosis by the pathologist (36). This reasoning gradually shifted to a more thorough comprehension of the patient's physiology.

1.5 The discrepancy between ante- and post-mortem diagnoses

Studies regarding the value autopsies provide in a modern time with high diagnostic technologies display great discrepancies between clinical and anatomical diagnoses (table 1) (8,14,37–40). These data contribute to the case that autopsies are still beneficial in a modern medical era. According to the Goldman criteria, the autopsy diagnoses are divided into two groups, i.e. the major and minor diagnoses, which will be further divided into two subgroups (41,42). The major diagnoses are the principal underlying diseases and primary causes of death, and the minor diagnoses are the antecedent conditions, related diagnoses, and contributing causes that have an impact on the life expectancy (14,41). If the major and minor diagnoses are not reported in the death certificate or medical records, they are assumed not made clinically and viewed as missed diagnoses (41).

The Goldman criteria are applied to classify the discrepancies between ante- and post-mortem diagnoses (4,14,41,42):

- Class I error: a major missed diagnosis, that if discovered before death could have led to a change in therapy management and probably resulted in a cure or prolonged survival. The cause of the error could be that the diagnosis was unsuspected or that the test results were inconclusive, misleading, misinterpreted or not yet available.
- Class II error: a major missed diagnosis, that if discovered before death would not have led to a change in therapy management and therefore have no potential impact on the survival. One reason could be that the patient was already treated with the appropriate therapy despite the diagnosis being obscure. Another reason could be that there was no therapy available or that the patient refused further treatment.
- Class III error: a minor missed diagnosis, diseases that affect the terminal disease process but could not explicitly lead to death.
- Class IV error: a minor missed diagnosis, unrelated diagnoses that possibly could have affected the prognosis or the contribution of mechanisms to death in an already terminally ill patient.

Table 1: Overview of published papers regarding discrepancy errors between 1998 and 2012

Year	Author	Institution	Location	Autopsy rate (%)	No. of autopsies	Major error rate (%)	Class I error rate (%)
1998	Nichols *et al.* (37)	Tertiary care transplantation referral centre	Pittsburgh	NA	176	44.9	NA
1998	Burton *et al.* (43)	Medical centre	Louisiana	NA	1105	44	NA
2000	Roosen *et al.* (14)	MICU at UZ Leuven	Leuven	93	100	26	16
2000	Sonderegger *et al.* (8)	Medical Clinic at the University Hospital	Zurich	90	300	'72 – 30 '82 – 18 '92 - 14	NA
2003	Shojania *et al.* (38)	NA	NA	NA	NA	23.5	9
2007	Pastores *et al.* (42)	Medical-surgical ICU Memorial Sloan-Kettering Cancer Centre	New York	13	86	26	14
2012	Wittschreiber *et al.* (39)	Charité Institute of Pathology	Berlin	NA	1800	NA	'88 - 15.1 '08 - 10.7
2012	Winters *et al.* (40)	NA	NA	43	NA	5.5 - 28	8

MICU: medical intensive care unit; ICU: intensive care unit; NA: data not available

1.6 Decline of clinical autopsy rates

Clinical autopsy rates have been declining for the past century. Further study of reliable statistical data shows an increase in the forensic autopsy rates (3,11). However, this conclusion is refuted by recent studies displaying a similar decline for forensic autopsies as has been reported for clinical autopsies. A cross-national analysis of 35 countries from 1979 to 2007 by Kapusta *et al.* shows the decline of forensic autopsy rates and its effect on suicide mortality statistics (44). Therefore, the comprehension of this issue demands a more complex approach. A combination of many factors should be held under consideration to examine the source of

this decline (4). These factors involve social, healthcare economics, medical technology and curriculum (4,11).

1.6.1 Numbers of decline

Up until WWII the clinical autopsy rate was approximately 50%, after which it went downhill (3,43,45). By 1973 the rates plummeted to 22% and by 1984 to 13.2%. In 1995, a survey of certain North American hospitals displayed an autopsy rate as low as 7%. Further, a retrospective study of all the autopsy rates in Halifax, Nova Scotia in Canada from 1987 till 1999 showed an immense difference between the clinical and forensic autopsy rates. The clinical numbers were less than 30% with a decrease to less than 20% and the forensic numbers were greater than 40% with an increase to 62% (3). Another study by the United States National Center for Health Statistics (NCHS) revealed a decline of the clinical autopsy rate from 16.9% to 4.3% and a rise of the forensic autopsy rate from 43.6% to 55.4% over a 35 year-period (11,46). One explanation for this phenomenon could be that relatives of the deceased cannot refuse a forensic autopsy in contrast to a clinical autopsy (3). Other data regarding clinical autopsies in Australia show a decrease from 66% in 1992 to 38% in 2003 (11,47). In addition, the Danish National Institute of Health found a decline from 45% in 1970 35% in 1980 and to 16% in 1990 (11,48). Finally, in the United Kingdom an extensive reduction of clinical autopsy rates was reported, namely from 25.8% in 1979 to a remarkable 0.69% in 2013 (11,49). The autopsy rate for hospital deaths of Belgium declined from 18.9% in 2000 to 2.6% in 2014 (50). More specific for UZ Leuven, the autopsy rate declined from 30.8% in 1995 to 25.0% in 2001 and as this study showed further to 9.6% in 2017 (51). However, not every institution can present exact numbers due to the absence of regulations concerning the data coverage and definitions regarding the difference between a clinical and forensic autopsy. One should also take in mind that teaching hospitals with a pathology residence program have higher autopsy rates than non-teaching hospitals (11).

1.6.2 Hospital standards

Almost a century ago, the autopsy rate demonstrated the quality of the care that was provided by the hospital. In 1965 the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), which is now named the Joint Commission International (JCI), determined an accreditation requirement of a 25% autopsy rate for teaching hospitals and a 20% autopsy rate for non-teaching hospitals (11,45). After thorough research, The JCAHO noted that hospitals would only perform autopsies to reach the set mark instead for utilizing it as a QC tool. In 1971, the standards were dismantled under the pretence that each hospital should choose its own suitable autopsy rate. Present-day, no benchmark for an adequate autopsy rate has been agreed upon for hospital accreditation, making it not a priority to maintain a certain standard (11).

1.6.3 **Financial consideration**

There is few data available surrounding the accurate cost of a clinical autopsy (11). These costs depend greatly on the thoroughness of the research, which might include the revision of ancillary investigations: medical records, histology, microbiology, medical imaging, toxicological analysis and interpretation. A specific demand for neuropathology would only add to the cost (52). The price can range from $100.00 to $7500.00 with an estimate mean cost of $1275.00 per autopsy in the United States (11). In Belgium the price is estimated on € 535 for an exhaustive post-mortem examination. This includes a microscopic and macroscopic examination of at least the cardiovascular, pulmonary, gastro-intestinal and urogenital system as other organs relevant in the medical history of the patient with a minimum of fifteen biopsies. Noticeable is the considerable range, which relies on many variables as mentioned above (53).

Many countries differ in their policy concerning the reimbursement of the clinical autopsy. For example, in the United States the federal government provides hospitals with annual grants to cover diverse expenses. They hereby encourage the hospitals to fund different, more yielding services instead of autopsies. This kind of reasoning might have resulted from the fact that the cost of an autopsy is not included in an individual's healthcare coverage with the claim that the deceased is not a client anymore (4,11,54). Some hospitals, especially teaching hospitals, will compensate the cost of the autopsy and if this is not the case the cost will be passed on to the next of kin (11). Funding of clinical autopsies would influence the decline considerably. In Belgium, clinical autopsies are reimbursed by the government of healthcare (RIZIV[4]) (55,56).

1.6.4 **Modern techniques taking over**

In the 1950s funding for medical research received an immense boost, making it more desirable to focus on laboratory research instead of autopsies. Another commonly used argument for the decline of the autopsy rate is the daily progression of new diagnostic techniques, such as MRI, CT, PET scan, echography, etc. All these techniques have at least one characteristic in common, namely they are all non- or less-invasive. The rather misleading assumption that medical imaging and improved laboratory testing result in a higher diagnostic accuracy than a post-mortem confirmation, is alive among many clinicians (11,12,57,58). The pros and cons of modern diagnostic techniques will be further discussed in 1.9.

1.6.5 **Role of family**

One argument that is commonly used for the decline of the autopsy rate is the requirement of an autopsy consent from the next of kin. Many clinicians are overthrown by the acquisition of an autopsy consent. Not only with the reason that the whole process is distressing, but also with

[4] RIZIV, *Rijksinstituut voor ziekte- en invaliditeitsverzekering*, is a govenment agency concerning health insurance.

the idea to not further burden the grieving family after the loss of a loved one. This results in clinicians declaring a refusal for autopsy before even asking for permission (4,11,59). According to van den Tweel *et al.*, the percentage of refusal ranges from 50 to 90%. A growing multicultural society involving many ethnicities adds to the refusal percentage. Extensive studies should conclude whether non-invasive autopsies are reliable enough to serve as an alternative (4). This topic will be elaborated in 1.9.

The training clinicians receive during their medical training in requesting an autopsy consent is little to none, making it a bigger burden to eventually ask permission. This as well will be further discussed in a segment regarding the autopsy consent. Contrary to the concept that clinicians assume that family members rarely give their consent, various studies declare that this percentage may be lower than expected (59–61). When asked for permission one third of families agrees, one third at first refuses but agrees after their questions are answered and one third refuses definitely. This information demonstrates that the decline of autopsy rates cannot only be blamed on the consent process since clinicians do not offer the families the option of an autopsy (60,61). Furthermore, in Austria and some Scandinavian states a clinical autopsy can be permitted by law without the consent of the next of kin. This only applies if there is an apparent scientific, medical or educational interest (60). In Belgium, the Advice of the National Counsel of 7 May 1988 states that a clinical autopsy is allowed when there has been no explicit or implicit opposition from the patient or his/her relatives (62). For forensic autopsies, the regulations are well stipulated by law and more specific per district. Where an autopsy is deemed necessary by the public prosecutor, the family cannot oppose (22,63).

1.6.6 **Medical curriculum**

Over the years faculties of medicine have compressed the medical training and integrated a system-based approach. A fragmentation of the pathology discipline over various courses was among others an immense consequence. Students have become less in touch with the importance of pathology and its actual contribution to a diagnosis. They graduate from medical school having never attended a clinical or forensic autopsy besides the standard dissection of human cadavers in context of anatomical courses. The latter is not only caused by the lack of time, but also by the lack of opportunity due to the declining autopsy rate. In 2011 there has been a profound reformation of the Belgian education program of medical students and trainees. The compulsory presence of five autopsies and the anatomical dissection on human remains were banned out of the medical curriculum and are currently on a voluntary basis (64). These soon-to-be-doctors might eventually not notice the relevance of post-mortem examination and will probably be less likely to request permission for a clinical autopsy (3,4,11). Consequently,

this ‘out of sight, out of mind’-psychology influences the clinician’s attitude as discussed in segment 1.6.7.

1.6.7 **The clinician’s attitude**

As mentioned above, the lack of autopsy training in the medical curriculum cultivates a sceptical perspective towards the contribution an autopsy brings. The absence of confidence of clinicians is troubling yet understandable considering their educational background (3,4,11). “Why should doctors care about having autopsies performed when they don’t even understand what the procedure involves?” (3). Clinicians rather rely on more sophisticated diagnostic approaches than on the, in their opinion, outdated autopsy conclusions. Along with this overreliance, the assumption is established that diagnoses are accurate enough due to the combinational use of clinical, laboratory and radiographic data (11,60). Numerous studies have proven the discrepancies between clinical diagnoses obtained through modern techniques and diagnoses retrieved by performing an autopsy (4,11,14,38,39,41,42). Clinicians are also aware of the long turnaround time (TAT) of final autopsy reports, which can be up to months and therefore the benefit fades (4,24,65). Another reason is the fear of litigation due to a mistake of treatment, leading towards a trial concerning medical accountability (3). However, these fears are not necessarily justified since a study by Haque *et al.* found that only two out of the 6168 clinical autopsies eventually led to malpractice suits (3,66). Pathologists believe that through autopsy malpractice lawsuits would decrease, since an autopsy can provide facts that could contradict an expert’s statements regarding substandard patient care (11).

1.6.8 **Role of the pathologist**

Many pathologists strongly dislike performing autopsies and prefer to develop themselves academically with a better wage or recognition in prospect (4). They will however still declare the importance of an autopsy and its results, yet fail to battle the decline of the autopsy rates in their own work environment. Therefore, autopsy requests and reports are of a lower priority. Most hospitals will assign the responsibilities of the autopsies to junior residents instead of more experienced pathologists. Pathologists who choose to specialize in autopsies often become forensic pathologists since autopsy pathology is up until now not recognized as a subspecialty within the pathologic field (4).

1.7 Consequences of decline of autopsy rates

A fundamental question to ask is whether the autopsy will cease to exist. This question seems unlikely to be the case for forensic autopsies and certain fields of research (3,11). However, the declining numbers for the clinical autopsy rate show disturbing consequences, bearing in mind

the essence of clinical autopsies. A large cross-sectional study by Battle *et al.* showed that a higher autopsy rate in teaching hospitals than in non-teaching hospitals resulted in a lower discrepancy rate (8,11,67). Nevertheless, van den Tweel *et al.* stated that the decline in clinical autopsy rate does not correlate with an increase of error rates as one might expect (4). In addition, the growing inaccuracy of mortality statistics will affect the governmental funding of certain fields in research that carry an indispensable responsibility to the healthcare policy and epidemiologic research (4,11,12). Despite the improvement in the diagnostic field, studies show a steady percentage of approximately 10% for class I errors (4,7). It is therefore safe to assume that the healthcare has not endured an ultimate low quality. Yet this is not a consolation and one should continuously aspire to improve the provided care through quality management since errors are inevitable (8).

1.8 Autopsy quality metrics

An autopsy acquires, like any other process with a quality system in place, key performance indicators (KPI). For an active surveillance of the provided autopsy services, it is strongly recommended to monitor these KPI's, which will be described below in three segments i.e. pre-analytic, analytic and post-analytic phases (24).

1.8.1 **Pre-analytic phase**

In laboratory medicine the pre-analytic phase has been a crucial part of the quality management. Many variables are able to affect the outcome of an experiment or procedure and should therefore be closely monitored (24,68). The monitors that should be reviewed for a clinical autopsy are (24):

- Appropriate patient identification;
- Autopsy request by the clinician;
- Autopsy consent by the next of kin;
- Information regarding care and transfer of the deceased patient;
- Medical history of the patient;

Many deliberations are involved when a post-mortem examination is considered. These deliberations are of interest to three participating parties: the aim of the clinician to request an autopsy based upon specific indications; the wishes of the grieving family regarding an autopsy and providing its consent; society's investments concerning scientific and regulatory developments (60).

1.8.1.1 Autopsy request process

As mentioned above there is a higher burden for the clinicians to ask permission for a clinical autopsy (4,10,11,60). Despite clinicians being comfortable enough to ask permission for delicate and dangerous diagnostic or therapeutic procedures to improve patients' lives. This might be a result of the rather wrong perception of relatives and clinicians that the benefits are not apparent (10,60). The request process differs between countries and relies upon governmental and hospital policies (69).

Delays can occur when the autopsy consent has not been thoroughly filled out with the necessary clinical and demographic data. This also includes the signature of the appropriate person for permission of a clinical autopsy. The list of the appropriate next of kin might differ from one country to another (60).

1.8.1.2 Autopsy indications

The autopsy request should include indications on why an autopsy is requested. For forensic autopsies, the regulations are well stipulated by law and more specific per district. Here an autopsy is mandatory depending on whether the death is unnatural, unwitnessed or unexpected such as murder, suicide, unknown identity, etc. (4,16,22). This is not the case for clinical autopsies, where barely any regulations exist not in the law or hospitals. Some guidelines regarding the indications for requesting a clinical autopsy in The UC Davis School of Medicine in California as well as The Miriam Hospital and Rhode Island Hospital in association with Brown University can be consulted in the Addendum (IV.1) (70,71).

1.8.2 **Analytic phase**

During an autopsy QC (safe practices) and QA (autopsy processes) are important aspects to be held up high. To achieve this goal, the appropriate measures should be taken and for all these stated aspects, the goal is a 100% compliance (24).

1.8.2.1 Personal protective equipment

Personal protective equipment (PPE) should be worn and procedures should be set up to protect healthcare workers to any hazards. Pathologists, medical examiners and other personnel, involved in conducting an autopsy, are at risk for acquiring several infections (human immunodefiency virus, hepatitis B/C/D viruses, tuberculosis, Creutzfeldt Jakob disease, herpes and infections from other pathogenic organisms), toxicity, radiation (bodies exposed to diagnostic and therapeutic procedures) and percutaneous injuries (72–74). These occupational risks should not be underestimated since their direct contact with soft tissues, body fluids, human remains in various stages of decomposition and hazardous instruments. It is critical to not disregard a deceased's unknown background and therefore all prior and current infections

that are unaccounted for. Consequently, one should anticipate upon these four contact routes (74):

- Needle-stick injury or wound resulting from an object contaminated with blood or other body fluids;
- Entrance of blood or other body fluids onto an open wound or area of dermatitis;
- Contact of blood or other body fluids with mucous membranes of eyes, nose or wound;
- Inhalation or ingestion of aerosolized particles.

Literature recommendation regarding PPE often mention requirement of surgical gowns, surgical caps, certain types of goggles, shoe covers, FFP3 respirators and double surgical gloves for persons involved in dissection (74,75). A detailed assessment regarding this aspect has been monitored in UZ Leuven and can be consulted in the Addendum (V.3-4).

1.8.2.2 Autopsy room

The physical environment, in this case the autopsy room, is a vital element contributing to the safety of the significant people performing an autopsy and the environment. Therefore, precautionary actions should be considered and included in the hospital's policy. These actions may include immunization (e.g. hepatitis B vaccines), exposure avoidance and designated infrastructure. Even though, laboratories have principally strict agent-specific degrees of risk regulations, many institutions have applied ambiguous safety standards surrounding autopsy rooms (Addendum V.5-8). Firstly, restricted access to autopsy rooms by qualified personnel is an essential feature in autopsy precautions. Further, the autopsy rooms and the administration part of the Mortuary should be totally separated from each other. Moreover, the size of the accommodation is important to prevent overcrowding and permit free movement. Furthermore, attention should be paid to hygienic regulations, namely by cleaning and disinfecting autopsy tables, dissecting surfaces, used equipment, floors, walls, etc. In addition, directional inward airflow without re-circulation to other areas is a great necessity. The quality system (QS) of UZ Leuven has already established SOP's concerning the aforementioned principles (76). Finally, SOP's concerning the bio safety levels should be constructed (74).

1.8.2.3 Autopsy technique

A fundamental part of the analytic phase is the autopsy technique itself. The pathologist's approach can vary from case to case. It is therefore essential that the proper channels of communication between the pathologist and the deceased patient's clinical team are open. An alternative to this proceeding is a thorough clinical case review (24). The purpose of this preparation is to give the pathologist the opportunity to select the appropriate approach of autopsy. The concept of different approaches per autopsy case is already reality in forensic

institutions like the department of Forensic Medicine of UZ Leuven and The Royal College of Pathologists based in London (76–85). Here, the autopsy approach of each case is carefully considered bearing in mind the facts provided from the crime scene, family, witnesses, authorities, etc. Depending on the case the pathologist will determine the necessity of a virtual autopsy, a back dissection, *en bloc* pelvic dissection, facial dissection, etc. (76,86). For the clinical autopsy, it is proven that outlining similar approaches in a SOP is beneficial to the quality of the eventual post-mortem examination (4,24,71,87). As discussed in 1.3, no consensus has been reached on which technique should be used for certain cases. For instance, the Letulle method is broadly applied for foetal and perinatal autopsies and cases where one wants to examine the interrelationships between the distinctive organs including the vasculature and the lymphatic drainage (7,88). This part of the analytic phase is often subdivided into on one hand the gross examination and dissection and on the other hand the microscopic examination.

"In a systematic and scientific performance of an autopsy nothing is more difficult, and at the same time more important, than the insight into the reasons for pursuing a definite order of sequence in every detail of the examination."

Rudolf Virchow (1880) (7)

1.8.2.4 Ancillary investigations

In many cases a conventional autopsy is insufficient and ancillary investigations are indispensable. Currently only forensic autopsy procedures consist of such thorough examinations e.g. post-mortem imaging, toxicology, genetics, microbiology, biochemistry, etc. (76,78,89–92). As do foetal autopsies and clinical autopsies on children that combine non-invasive ancillary assessments with macroscopic and histological assessments of the brain and the internal organs. These non-invasive assessments include full clinical history, ante-mortem diagnostic studies, post-mortem plain-film radiography, external examination of the body, placental histopathological examination and laboratory tests (93).

1.8.3 **Post-analytic phase**

The importance of the post-analytic phase is commonly overlooked by institutions and literature (94). It is crucial to note that errors or complications and their prognostic and therapeutic impact on the patient's health an death can be discovered during this phase (95).

1.8.3.1 Post-autopsy care

One essential element of the post-analytic phase that should be monitored includes the post-autopsy care of the body to facilitate the family's grieving process by providing them the opportunity to view the body in an appropriate condition.

1.8.3.2 Autopsy report

Another crucial part of the post-analytic phase is the autopsy report and its integrality. The extensiveness of the report may vary depending on the hospital's policy. This can range from a detailed voluminous report to a straightforward focused report. The purpose of an autopsy report should not just be limited to the autopsy findings but should conclude the laboratory results, imaging studies and the correlation of the autopsy findings with the clinical context. In other words, it is the exhaustive evaluation and integration of the patient's clinical information incorporated with the post-mortem anatomic examination that should be sufficient to support the cause of death statement (7,30). Furthermore, the TAT is besides the autopsy report itself an essential aspect of the autopsy service quality that is often overlooked. The College of American Pathologists (CAP) imposes regulations concerning the TAT's through the Laboratory Accreditation Program (LAP). The aim of these mandates applies for 90% of the cases, i.e. four days for the preliminary anatomic diagnoses (PAD) and 60 working days for the final anatomic diagnoses (FAD) (24,30).

1.8.3.3 Clinicopathological correlation

The other elements include the correlation of previous pathology and other testing as well as CPC assessment and communication with the clinical team and/or family. The post-analytic phase also includes autopsy and clinical audits that analyse whether the autopsy diagnoses changed the current knowledge of the pathology process. It is relevant to note that not only the accuracy of the diagnosis is audited but the suitability of a therapy and the competence of the provided care. Such correlations should be performed by the pathologist who executed the autopsy and in case of major discrepancies a member of higher level with specialty expertise should get involved (e.g. QA committee). In conclusion, a standardized approach is strongly recommended to not let the benefit and utility of post-mortem examination go in vain (24,30).

1.9 The alternative autopsy: the pros and cons

As mentioned above, the lack of asking and acquiring permission for a clinical autopsy provided by relatives is one argument that emphasizes the decline of the autopsy rate (4,10,11,59,60,96). In current spirit of times, this misguided piety, of both clinicians and next of kin, catalysed the search for an alternative to the 'classical autopsy'. Therefore, new autopsy methods that are less or non-invasive are being developed to evolve with the demand (97). These new methods involve molecular autopsy, imaging techniques and targeted biopsies such as needle biopsy, endoscopic biopsy, verbal autopsy, partial autopsy, minimally invasive autopsy (MIA) and virtual autopsy (4). The less invasive autopsies can be of added value when acquiring an autopsy

consent is difficult or in cases of infectious diseases where there is a shortage of the appropriate equipment or facilities. In this optic, any post-mortem investigation is better than none.

1.9.1 The minimally invasive autopsy

The MIA is an alternative autopsy where the body is left intact after imaging by CT and MRI and image-guided tissues biopsing (96,97). Many studies argue on whether this approach is superior than the conventional one since both have their benefits and limitations. A study by Van der Linden *et al.* found that MIA samples showed better RNA quality than those from a classic autopsy, possibly due to a shorter post-mortem interval (PMI). The reduction of the PMI would improve the tissue quality more likely for MIA than it would for the CA. Therefore, molecular research on post-mortem tissues, also known as the molecular autopsy, is more feasible in combination with the MIA particularly in sudden death cases (96,98). Another study by Weustink *et al.* resulted in a failure of the MIA to detect acute myocardial infarction and endocarditis as cause of death, but a success in detecting pneumonia and sepsis (57).

Despite the lower cost of the MIA, the overall expenses of autopsy services will increase. Even though this may seem paradoxical, it is caused by the expected rise in permission by relatives of the deceased when a MIA is requested instead of a CA. This makes it thus harder to form a policy due to the increased cost and workload for radiologists and pathologists (4).

1.9.2 The virtual autopsy

The virtual autopsy, often referred to in literature as virtopsy, employs imaging techniques as CT, MRI, etc. for an extensive and systematic examination of the whole body which is less time consuming than a CA (12,99–102). The autopsy report of a clinical autopsy is largely based on the macroscopic organ morphology and microscopic examination. In contrary to forensic autopsies that include post-mortem imaging techniques such as the CT scan and the MRI (12,102,103). A study by Westphal *et al.* investigated the feasibility of unenhanced post-mortem CT (pmCT) imaging and more specific its efficiency of finding the cause of death compared to a conventional clinical autopsy (12). The discrepancy rate was equal to 33.33% and showed therefore a similarity with other studies investigating this controversy (12,57,58,100).

Like other publications, a study by Jackowsky *et al.* concluded that in-stent thromboses, coronary thromboses and myocardial infarction could not all be detected through pmCT (57,102). The same applies to the lack of external examination for signs of death like rigour mortis and punction marks. Other signs like livores, putrefaction, internal livores and intravascular gas are visible with pmCT (12,102,104). Likewise, the characteristic for organ

colour changes such as bile, stomach, nutmeg liver, icterus, etc. are not visible. Finally, it is still challenging to uncover the pathological mechanisms of a disease (12).

In contrary, certain results demonstrate the substantial contribution a pmCT can provide to the CA. The assessment of calcification and bone lesions can be done effortlessly by pmCT. Further, the use of coronary angiography for intravital examinations and the possibility to examine the pathologies of the musculoskeletal systems is a commonly overlooked advantage. Moreover, the accessibility of data from a pmCT afterwards is faster and one should not have to take into account the limitation of the radiation dose (12).

In conclusion, the CA can be complemented by the virtual autopsy since a combination of both methods ensures an improved diagnostic quality. However, the CA cannot be surpassed by the virtual autopsy since it has not yet reached the required performance level (100). The evolution and the financial cost of medical imaging will determine the importance it can play in the future as complimentary or even alternative technique regarding cases where acquiring an autopsy consent is challenging and can therefore easily be resolved by post-mortem imaging (102).

1.10 The significance of the clinical autopsy

A diagnosis is a combination of clinical cognition and diagnostic tests of which both have their benefits and limits. One cannot exist without the other, i.e. highly sensitive and specific tests as well as the selection and interpretation by the clinician are variable parameters that depend on each other and cannot be monitored (8). As a result, the autopsy is 'the' golden standard to detect diagnostic fallibility, treatment failure and cognitive bias (3,7,8). It is the only way to accurately reveal death-related major missed diagnosis and minor missed diagnosis that are incidental and contributory to the total health condition. In addition, significant findings during an autopsy could inform certain relatives of the increased risk and consequently provide them of the opportunity to take the necessary measures in hereditary instances e.g. breast cancer, congenital heart diseases, etc. (1,3,13,54). Further, due to the incorrectness of death certificates, the substantial inaccuracy of the vital statistics results in misguided finances on preventive strategies (4,11,12). The benefits an autopsy can provide for the detection of clinically silent diseases such as coronary artery disease should be strongly considered (3,105). In contrary to forensic autopsies, the purpose of clinical autopsies might not always be apparent making the fight for governmental funds the more difficult (3). Furthermore, throughout history up until now autopsies have aided the elucidation of many pathologic processes such as cardiovascular disease, shock, cancer, AIDS, etc. (3,6,10,11,106,107). Finally, environmental diseases like variants of asthma have strengthened the regulations on asbestos through the awareness of hazard due to exposure (3,108). The same applies to the identification of potential disease

outbreaks like encephalitis caused by the West Nile virus (11,109). Evidently, post-mortem examinations result in scientific development to the benefit of ante-mortem investigations.

1.11 The future of the autopsy

As previously mentioned, autopsy rates have been declining since the 1950s (3,4,43,45). It is therefore essential to break this downward spiral and start the reappraisal of post-mortem examinations. First of all, the attitude of clinicians and society towards the benefits an autopsy generates, cannot be downplayed (4). The 'out of sight, out of mind'-psychology is among other things the root of this decline. However, this lack of interest results in a delayed low-quality autopsy report that does not comply with the required regulations making the whole purpose of the autopsy go in vain (24,30). In addition, the absence of autopsies complicates the learning process to perform, interpret and report them. One solution might be to establish a subspecialisation in clinical autopsy pathology such as forensic pathology (4,110). This might reduce the workload and disinterest of the general pathologist and increase the competence and dedication of the subspecialized pathologist. As a result, other clinicians would view the subspecialized pathologist as an indispensable colleague and therefore be more likely to acknowledge the value and benefit an autopsy grants (4). Another solution might be the integration of indication-related methods in both the clinical and pathological field. Extensive scientific research can result in transparency regarding advantages and disadvantages of each therapy and autopsy technique. Particularly for autopsy services, this involves various autopsy procedures based upon the clinical question, family wishes and healthcare policies. For instance, post-mortem imaging can be combined with the selected biopsies of CA's or replace certain parts of the CA with the goal to enhance the examination and its contribution. Finally, the evolution of science itself provides society with new inventions, and particularly those technologies concerning healthcare on a diagnostic and therapeutic level (9,61). Both the government as the industry have a large share in the post-mortem examinations and therefore their funding is pragmatic and indispensable. Although many arguments have been made to explain the decline, it is unlikely the autopsy will entirely disappear in the forensic and certain other research fields (3,4,11). In conclusion, the abundance amount of literature present advocating the significance of the autopsy, illustrates there is not a complete loss of interest (3).

"Hic est locus ubi mors gaudet succurrere vitae."[5]

Anonymous (1594) (33,111)

[5] "This is the place where death delights to help the living" at the Anatomical Theatre of the University of Padua

2 The aim and objectives

2.1 General objective

The general aim is to provide an in-depth evaluation of the current situation concerning the post-mortem policy of UZ Leuven and to work towards a harmonisation. This policy can be distinguished into the clinical autopsies, under supervision of the department of Pathology, and the forensic autopsies, under supervision of the department of Forensic Medicine. The main obstacle is the lack of concrete guidelines regarding the clinical autopsies and therefore the focus will be primarily set upon its management. The goal is to work towards an accreditation of the clinical autopsy and further include it in the quality system of the department of medical diagnostics of UZ Leuven. For this master's thesis two projects have been set up to strive for harmonisation and to provide an overview of any shortcomings that could be a subject of future projects and implementations.

2.2 Specific objectives

2.2.1 **Data-analysis of clinical autopsies in UZ Leuven (2015 - 2017)**

1. All relevant data concerning clinical autopsies over a period of three years will be analysed, evaluated and improvements will be proposed.
    a. <u>Autopsy request</u>

       The autopsy requests by clinicians will be analysed for its entirety of clinical information as well the type and nature of the question. An adjustment of the current autopsy request form will be proposed.
    b. <u>Autopsy conclusion</u>

       The autopsy report and more specifically the conclusion will be evaluated for its adequacy and alignment. Since currently there is no distinct guideline for setting up a clinical autopsy report, a template will be proposed.
2. A concordance of the provided information on autopsy request and autopsy report's conclusion will be examined. The purpose is to provide an overview of expected and unexpected findings by post-mortem examination.

2.2.2 **Optimisation of clinical autopsy procedure for UZ Leuven**

1. A discrepancy between the clinical and forensic autopsy procedures will be analysed. Subsequently, remarkable findings, literature review and the current accredited forensic autopsy procedure will be used to set up a uniform procedure for the clinical autopsy.
2. An evaluation of KPI's to follow up and improve the process of clinical autopsies by analysing the time lag of the administrative chain from death attestation to autopsy. The goal is to harmonise any communications between different departments in UZ Leuven, specifically the department of Pathology and the Mortuary.

3 Material and Methods

This chapter describes the acquired data and used methods for each project separately. Firstly, a systematic literature overview to explore existing information regarding post-mortem research is described. Secondly, received data and executed analyses of the clinical autopsies in UZ Leuven from 2015 to 2017 are outlined. Lastly, acquired data from the observations of the clinical and forensic autopsies and clinical autopsy registrations from October 2017 to May 2018 will be represented. This study was approved by the institutional review board, *Onderwijs-Begeleidings-Commissie voor Medische Ethiek*, of KU Leuven on the 20th November 2017 (Addendum I).

3.1 Systematic literature review

The databases of PubMed, Web of science and Limo were screened for a systematic literature review, using the MeSh terms: "clinical autopsy" in combination with "quality control", "request", "report" and "procedure". The purpose of this review was to search for articles from 2007 to 2017 with a similar scope as this study, namely providing an overall insight into the role of clinical autopsies as quality control with regard to autopsy requests, reports or procedures. A flowchart of this review can be consulted in the Addendum (II.1) (112–114).

3.2 Data-analysis of clinical autopsies in UZ Leuven (2015 - 2017)

A quantitative research was performed to acquire insight in the clinical autopsies from 2015 to 2017 in UZ Leuven, on one hand divided into departments and on the other hand into type of autopsy. Further the content of the provided clinical information, question and pathological conclusion were classified according to an established model with reference to literature (2,14,41,42,115–118). All data in this chapter are retrospective.

3.2.1 **Clinical autopsies**

A thorough overview of the post-mortem examinations performed by the department of Pathology was obtained by requesting all relevant data regarding the clinical autopsies of UZ Leuven from 2015 to 2017 through LWS (Laboratorium WerkStation). To differentiate the clinical autopsies performed on patients deceased in UZ Leuven, each patient identification was checked and flagged individually for an in-hospital registered death through data received from MIR (Management, Informatie en Rapportering). A flowchart representing all performed queries on data from UZ Leuven and its content, can be consulted in the Addendum (II.2).

3.2.2 **Classification autopsy requests and autopsy report's conclusions**

All executed clinical autopsies from 2015 to 2017, of which the autopsy report was finished and validated on April 1st, 2018, were analysed to examine a concordance between the autopsy request (information and question provided by requesting clinician) and the autopsy conclusion (answer provided by the pathologist). It concerns a total of 282 cases: 107 cases of 2015, 99 cases of 2016 and 76 cases of 2017. These cases were further divided into departments for interpretation purposes.

3.2.2.1 Data processing and analysis of the autopsy request

The autopsy request includes besides the identification of the patient and the clinician, the clinical information and potential question provided by the clinician. For this research, each case was carefully read, analysed and classified. The classification of the autopsy report is based upon a learning method applied in training of junior residents of pathology of UZ Leuven (119). The autopsy request and classification was reviewed by a board-certified pathologist of the departments of Pathology and Forensic Medicine of UZ Leuven. The legend and schematic representation of the classification can be consulted in the Addendum (III.1-2).

3.2.2.2 Data processing and analysis of the autopsy report's conclusion

The autopsy report's conclusion of each case was carefully read, analysed and classified by a board-certified pathologist of the departments of Pathology and Forensic Medicine of UZ Leuven. This classification was developed according to an established model with reference to literature (2,14,41,42,115–118). The autopsy report itself was further reviewed when the autopsy conclusion was inadequate. The used legend and schematic representation of the classification can be consulted in the Addendum (III.2-3).

3.2.3 **Statistical analysis**

Data are represented as percentages and absolute numbers. Statistical analyses include a Fisher's exact test to determine the association between clinical information and clinical question. Further, a binary logistic regression was performed to analyse the probability of a new major based on the autopsy rate. P values of less than 0.05 were considered significant. The Fisher's exact test was performed using statistical software (GraphPad Prism version 7.04 for Windows, La Jolla California USA). The binary logistic regression was performed using statistical software (RStudio version 1.1.447 for Windows, Boston USA).

3.3 Optimisation of clinical autopsy procedure for UZ Leuven

A quantitative research was performed to research on one hand the discrepancy between the clinical and forensic autopsy procedures and on the other hand the registration of the clinical autopsy. All data in this chapter are prospective.

3.3.1 **Observation clinical and forensic autopsies**

This structured, direct and non-disguised observational study was performed in a natural setting, namely in the Mortuary of UZ Leuven. In this study full body autopsies on children and adults were included therefore, foetal and single-organ autopsies were excluded. Of the fifty observed autopsies, ten were excluded. Twenty clinical autopsies performed by nine pathologists were observed from October 2017 to May 2018. In addition, twenty forensic autopsies performed by five forensic pathologists were observed from February 2018 to May 2018. An autopsy would last for about one hour and a half to four hours.

3.3.1.1 Design of observation sheet

The observation sheet was a checklist based on Chapter 4 (Basic Postmortem Examination) of the book 'Autopsy Pathology: A manual and atlas' by Finkbeiner, Usell and Davis (7). The value of every step was considered and consulted with a board-certified pathologist of the departments of Pathology and Forensic Medicine of UZ Leuven to reduce the checklist to two pages with only the essential steps. The checklist consisted of the relevant steps in a chronologic order at which was examined whether each step was performed and by who (pathologist or mortuary technician) (Addendum VI.1-2). The observation sheet is subdivided into:

- Administration
- External inspection
- Internal examination
    - Thoracic block
    - Gastrohepatic block
    - Urogenital block

3.3.1.2 Data processing and analysis

For each step on the observation sheet the difference between clinical and forensic autopsies was investigated for the pathologist and mortuary technician. These analyses were divided into the above-mentioned preselected 'groups'. Certain steps were excluded from analysis when considered unrepresentative e.g. the heart was preserved in formaldehyde for later examination; no gallbladder was present; gender related steps; etc.

3.3.1.3 Statistical analysis

Data are represented as percentages and statistically analysed by a Fisher's exact test to determine the association between the kind of autopsy (clinical or forensic autopsy) and whether or not a step was performed. This was done apart for pathologists and mortuary technicians. P values of less than 0.05 were considered significant. All statistical analyses were performed using statistical software (GraphPad Prism version 7.04 for Windows, La Jolla California USA).

3.3.2 **Registration of clinical autopsies**

This log-based longitudinal observational study was performed in a natural setting, namely in the Mortuary of UZ Leuven. Mortuary technicians were to keep a logbook registering the time of different activities (Addendum VII). This registration was only to be done on cases where a clinical autopsy was requested. Times of sixty requested clinical autopsies from November 2017 to April 2018 were manually registered by mortuary technicians.

3.3.2.1 Design of logbook

The logbook was partially based on the test cycle monitors illustrated by Burton *et al.* (24). Additional KPI's, which were considered being beneficial, were added. This implies that the following times were registered in the logbook (Addendum VII):

- Time of death (from model III C)
- Time of discharge from department
- Time of arrival at mortuary
- Time of knowledge of a clinical autopsy request
- Time of informing the pathologist
- Time of arrival of the pathologist in the mortuary

3.3.2.2 Data processing and analysis

The acquired data were divided into four different time lags and cut-off values were implemented. Since the data were manually registered, certain data had to be excluded to achieve a representative filtered dataset for further analysis. On one hand, data that seemed illogical and impossible, will further be referred to as 'incorrect data'. On the other hand, data from cases where the autopsy was annulated, will further be referred to as 'no autopsy'. It is important to mention that only data at the level of each time lag were excluded with the sole purpose of having enough data for interpretation.

4 Results

4.1 Data-analysis of clinical autopsies in UZ Leuven (2015 - 2017)

In this section an overview of the findings regarding clinical autopsies in UZ Leuven from 2015 to 2017 is presented. Firstly, all received data were organised and the status of each autopsy was checked. Secondly, the autopsy rate of departments was analysed. Thirdly, the clinical information and question on the autopsy request as well as the pathological conclusion on the autopsy report was analysed. Lastly, these results were correlated with developed classification methods. This section will mostly cover the total data and not go any further into the differences over the three years. The tables representing the data of each year separately can be consulted in the Addendum (IV.4-16).

4.1.1 **Overview of all requested clinical autopsies from 2015 to 2017**

In table 2 the number of total requested clinical autopsies in UZ Leuven from 2015 to 2017 are represented. The data are divided into the executed and annulated autopsies with regard to the unfinished or finished status of the autopsy report on April 1st, 2018. These divisions were further subdivided into the in-hospital deaths of which alongside the percentage of the total number of requested clinical autopsies is presented. The remainder autopsies are clinical autopsies performed on foetuses, single organs and patients deceased in external hospitals.

Table 2: Total requested clinical autopsies in UZ Leuven from 2015 to 2017 subdivided in UZ Leuven deceased patients

Clinical autopsies UZ Leuven 2015-2017		2015	%	2016	%	2017	%
Executed autopsy	Finished autopsy report	143		148		126	
	of which in-house deaths	*107*	*61,8*	*99*	*52,1*	*76*	*39,6*
	Unfinished autopsy report	2		3		30	
	of which in-house deaths	*2*	*1,2*	*1*	*0,5*	*19*	*9,9*
Annulated autopsy	No autopsy report	28		39		36	
	of which in-house deaths	*27*	*15,6*	*39*	*20,5*	*36*	*18,8*
Total clinical autopsies		**173**		**190**		**192**	
Total clinical autopsies on in-house deceased patients		***136***	***78,6***	***139***	***73,2***	***131***	***68,2***

= Cases used for analysis of autopsy request and autopsy report's conclusion

An overview of the clinical autopsies from 2015 to 2017 divided into departments can be consulted in Addendum (IV.4-6). These tables give a detailed representation of the number of executed autopsies, annulated autopsies, total requested autopsies and deaths per department. It is essential to report that only the departments that ever requested a clinical autopsy on a patient deceased in UZ Leuven in this period are depicted in these tables. An overview of the types of autopsies and foetal autopsies from 2015 to 2017 can be consulted in the Addendum (IV.2-3).

4.1.2 **Autopsy rate of departments**

Table 3 shows the total autopsy rate of each department that requested an autopsy from 2015 to 2017. The top three consist of 'Medical intensive care A' (68.9%), 'Haematology isolation-unit' (30.4%) and 'Pneumology and lung transplantation' (26.9%).

Table 3: Total autopsy rate of each department in UZ Leuven that requested an autopsy from 2015 to 2017 in alphabetical order. Nine of the 33 departments, with a total autopsy rate of at least 10%, were highlighted and chronologically numbered.

Department	Percentage (%) $\left(\frac{No.of autopsies}{No.of deaths}\right)$	
Cardiac intensive care	**9,2** (17/184)	
Cardiac surgery	**23,1** (3/13)	4
Cardiology + heart transplantation (ambulatory)	**2,4** (1/42)	
Digestive oncology	**4,1** (6/147)	
Emergency service	**6,4** (19/169)	
Gastroenterology	**2,4** (1/42)	
Gastroenterology + abdominal surgery	**2,9** (1/35	
General internal medicine and allergy	**5,6** (2/36)	
General medical oncology	**2,4** (6/55)	
Geriatrics	**0,7** (1/138)	
Haematology	**1,5** (2/130)	
Haematology isolation unit	**30,4** (7/23)	2
Hepatology	**2,9** (2/69)	
Intensive care A	**10,5** (13/124)	8
Intensive care B	**4,9** (8/164)	
Intensive care C and intensive care children	**7,4** (5/68)	
Intensive care D and burn centre	**3,6** (2/55)	
Intensive medicine E and neuro intensive care	**5,7** (2/35)	
Kidney, liver, pancreas and intestinal transplantation	**5,0** (1/20)	
Medical intensive care (MIC) A	**68,9** (272/395)	1
Medical intensive care (MIC) B	**2,4** (3/124)	
Neonatal intensive care	**22,0** (11/50)	5
Nephrology	**2,9** (2/70)	
Neurology and general internal medicine	**13,3** (6/45)	7
Nose, throat and ear diseases, facial and neck surgery + dentistry	**14,3** (1/7)	6
Operating room (OR)	**4,6** (1/22)	
Palliative care unit	**0,7** (4/543)	

Pneumology	**0,6** (1/181)
Pneumology + lung transplantation	**26,9** (7/36)
Pneumology and muco	**1,6** (1/64)
Post-anaesthesia care unit	**10,0** (1/10)
Post-cardiac intensive care	**5,6** (1/18)
Rheumatology + endocrinology	**9,1** (1/11)
Total of UZ Leuven	**9,9 (411/4165)**

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Departments with a total autopsy rate ≥10% were ranked from 1 to 9

Figure 1 presents the distribution of the nine departments with a total autopsy rate of at least 10% over the three analysed years (2015-2017).

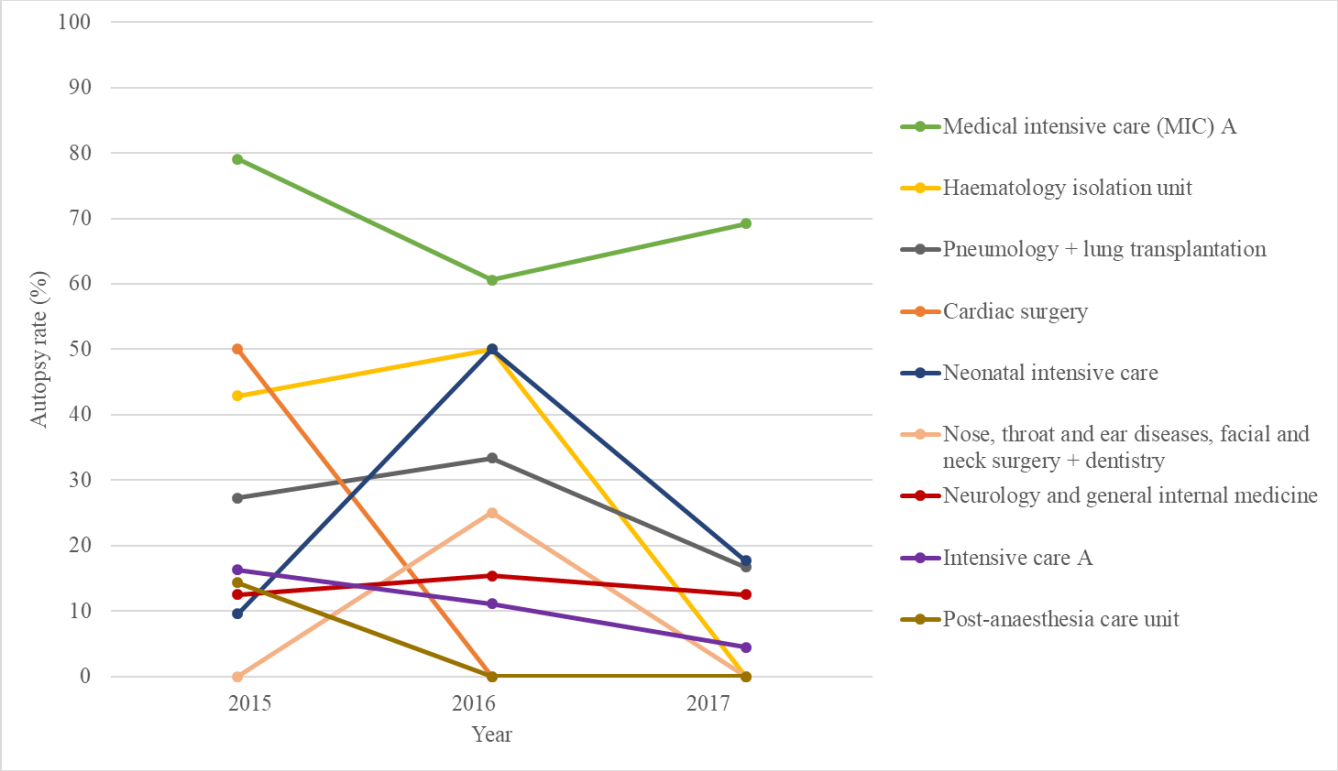


Figure 1: Autopsy rates of departments with at least 10% (2015-2017)

4.1.3 **Autopsy request**

4.1.3.1 Clinical information

The clinical information provided by the requesting clinician was analysed by evaluating and categorising its content into baseline, event and complication which was registered per case. If the information was not provided the case received a '0' for that category and if provided the case received a '1' (Addendum III.1).

Table 4 provides an overview of the 282 analysed cases regarding the clinical information. The addendum can be consulted for a specific representation of the provided clinical information per department (Addendum IV.8-11).

Table 4: Clinical information provided on autopsy request (n=282)

Clinical information	% of cases (n=282)
Baseline	75.2 (212)
Event	80.1 (226)
Complication	69.1 (195)

4.1.3.2 Clinical question

First, the clinician's question was categorised by evaluating the presence of a death hypothesis (specific question) or multiple death hypotheses (open question). In case there was no death hypothesis presented but circumferential information was provided, it was categorised under 'aspecific question'. When there was no clinical information provided and no death hypothesis was presented, the case was not further analysed. A schematic representation of this classification can be consulted in the Addendum (III.2).

Figure 2 provides an overview of the 282 analysed cases regarding the clinical question. The appendix can be consulted for a specific representation of provided per department (Addendum IV.12-15).

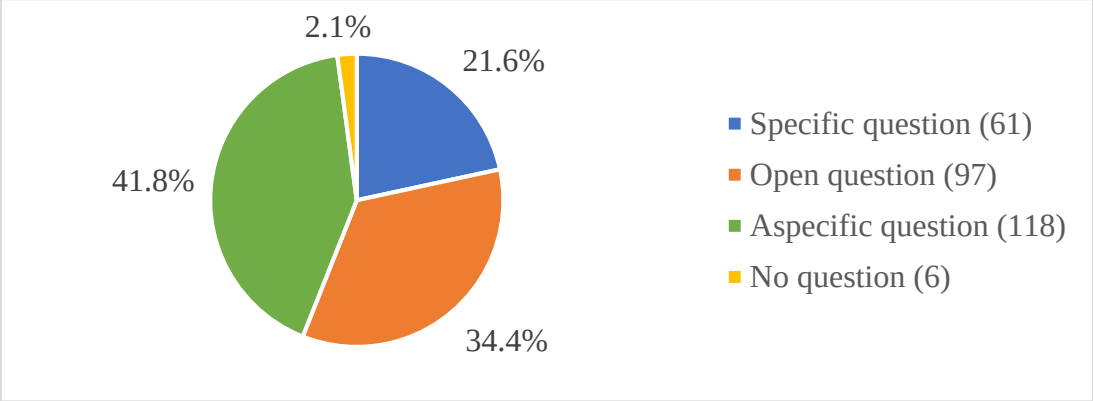


Figure 2: Clinical questions presented on autopsy requests (n=282)

Second, the nature of the question was analysed and categorised. For each question was investigated which information (baseline, event, complication) the clinician was referring to in the autopsy request. These cases received a '1' for that category and a '0' if the clinician did not refer to it in the autopsy request. Over a period of three years, 276 cases of the 282 were reviewed and analysed. Six cases had no question or information submitted and were therefore excluded from further analyses.

Baseline

The clinician provided information regarding the baseline of the patient and posed a question about it in 21.7% of the cases. In 1.8% of the cases, the baseline was not provided yet questioned. The clinician provided information regarding the baseline of the patient and did not pose a question about it in 57.2% of the cases. In 19.2% of the cases, the baseline was not provided nor questioned (table 5). The association between the provided information regarding the baseline of the patient and posed question about it, is highly significant (p = 0.0017).

Table 5: 2x2 contingency table for the interrelation between the given and questioned clinical information regarding the baseline on the autopsy request (n=276)

Baseline		QUESTIONED		Total
		Yes % (n)	No % (n)	% (n)
GIVEN	Yes	**21.7** (60)	**57.2** (158)	78.9 (218)
	No	**1.8** (5)	**19.2** (53)	21.0 (58)
Total		23.5 (65)	76.4 (211)	100 (276)

Event

The clinician provided information regarding the event of the patient and posed a question about it in 60.9% of the cases. In 5.4% of the cases, the event was not provided yet questioned. The clinician provided information regarding the event of the patient and did not pose a question about it in 23.6% of the cases. In 10.1% of the cases, the event was not provided nor questioned (table 6). The association between the provided information regarding the event of the patient and posed question about it, is highly significant (p < 0.0001).

Table 6: 2x2 contingency table for the interrelation between the given and questioned clinical information regarding the event on the autopsy request (n=276)

Event		QUESTIONED		Total
		Yes % (n)	No % (n)	% (n)
GIVEN	Yes	**60.9** (168)	**23.6** (65)	84.4 (233)
	No	**5.4** (15)	**10.1** (28)	15.6 (43)
Total		66.3 (183)	33.7 (93)	100 (276)

Complication

The clinician provided information regarding the complication of the patient and posed a question about it in 43.1% of the cases. In 7.6% of the cases, the complication was not provided yet questioned. The clinician provided information regarding the complication of the patient

and did not pose a question about it in 29.3% of the cases. In 19.9% of the cases, the complication was not provided nor questioned (table 7). The association between the provided information regarding the complication of the patient and posed question about it, is highly significant ($p < 0.0001$).

Table 7: 2x2 contingency table for the interrelation between the given and questioned clinical information regarding the complication on the autopsy request (n=276)

Complication		QUESTIONED		Total
		Yes % (n)	No % (n)	% (n)
GIVEN	Yes	**43.1** (119)	**29.3** (81)	72.5 (200)
	No	**7.6** (21)	**19.9** (55)	27.5 (76)
Total		50.7 (140)	49.3 (136)	100 (276)

Interrelationship between baseline, event and complication

The clinicians often pose a question combining the baseline, event and/or complication. Seven options with four possible combinations for the nature of a question are presented in figure 3 below. The event is questioned the most cases with 31.9% and followed with a combination of the event and complication with 25.0%. The complication questioned in 19.6% of the cases and the baseline in 10.5%. The baseline combined with event is questioned in 6.9% of the cases and combined with complication in 3.6%. Lastly, in only 2.5% of the cases the clinician questioned the baseline, event and complication.

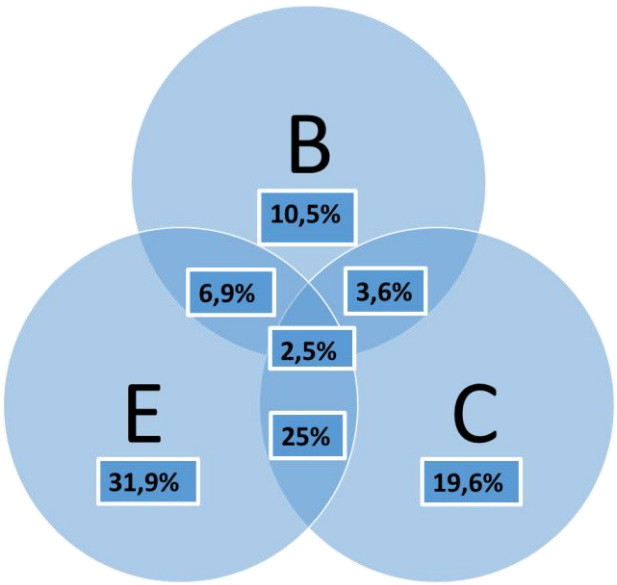


Figure 3: Venn diagram representing the nature of the clinical question (B=baseline, E=event, C=complication)

4.1.4 Autopsy report's conclusion

First was checked whether a specific, open or aspecific question was posed. If there was no clinical information provided and no question posed, the case was excluded from further analysis. Next the autopsy report's conclusion was evaluated if the pathologist's conclusion answered the clinician's question: (1) answered and (0) not answered (Addendum III.2-3).

Table 8 provides an overview of the 276 analysed cases where the autopsy report's conclusion provided an answer to the clinical question. No answer to the clinical question could be due to inadequacy of the autopsy conclusion or report. An inconclusive answer to specific and open questions was also categorised under no answer.

Table 8: Autopsy report's conclusion as an answer to the clinical question (n=276)

	% of cases (n=276)
Answer to question	88.8 (245)
No answer to question	11.2 (31)

4.1.5 Concordance between the autopsy request and autopsy report's conclusion

A major is a death-related illness and a minor is an illness that is not primary death-related but could have contributed. The incidental findings that are not death-related, are also classified under minor. In the cases where a major was confirmed or new major was found, another category was implemented, namely whether other minors where found. In cases where no major was found in the conclusion through inadequacy, the autopsy report was reviewed for the major and its adequacy. Cases where the autopsy conclusion and report were adequate but no major was found, were categorised under 'inconclusive'. A schematic representation of the classification can be consulted in the Addendum (III.3).

The concordance between the provided clinical information on the autopsy request and the autopsy report's conclusion was analysed in 276 cases. These cases were subdivided in two namely, the specific and open question which existed of 169 cases (figure 4A) and the aspecific questions which existed of 107 cases (figure 4B).

Specific and open questions

The presented major by the clinician on the autopsy request was confirmed by the autopsy report's conclusion in 46.2% of the cases without additional minors (C1) and in 19.5% of the cases with additional minors (C2). Further, the presented major by the clinician on the autopsy request was contradicted by the autopsy report's conclusion and therefore a new major was presented in 11.2% of the cases without additional minors (C3) and in 7.7% of the cases with additional minors (C4). In 5.3% of the cases the major finding was not mentioned in the autopsy

report's conclusion and was therefore inadequate but could be found in the autopsy report (C5). The autopsy report was considered inadequate in 2.4% of the cases since no extensive examination was carried out to find the major (C6). Lastly, the autopsy report was inconclusive in 7.7% of the cases (C7) (figure 4A).

Aspecific questions

In 25.2% of the cases an unexpected major was found (X1). Further, an expected major was found in 70.1% of the cases (X2). In 2.8% of the cases the major finding was not mentioned in the autopsy report's conclusion and was therefore inadequate but could be found in the autopsy report (X3). The autopsy report was considered inadequate in 1.9% of the cases since no extensive examination was carried out to find the major (X4) (figure 4B).

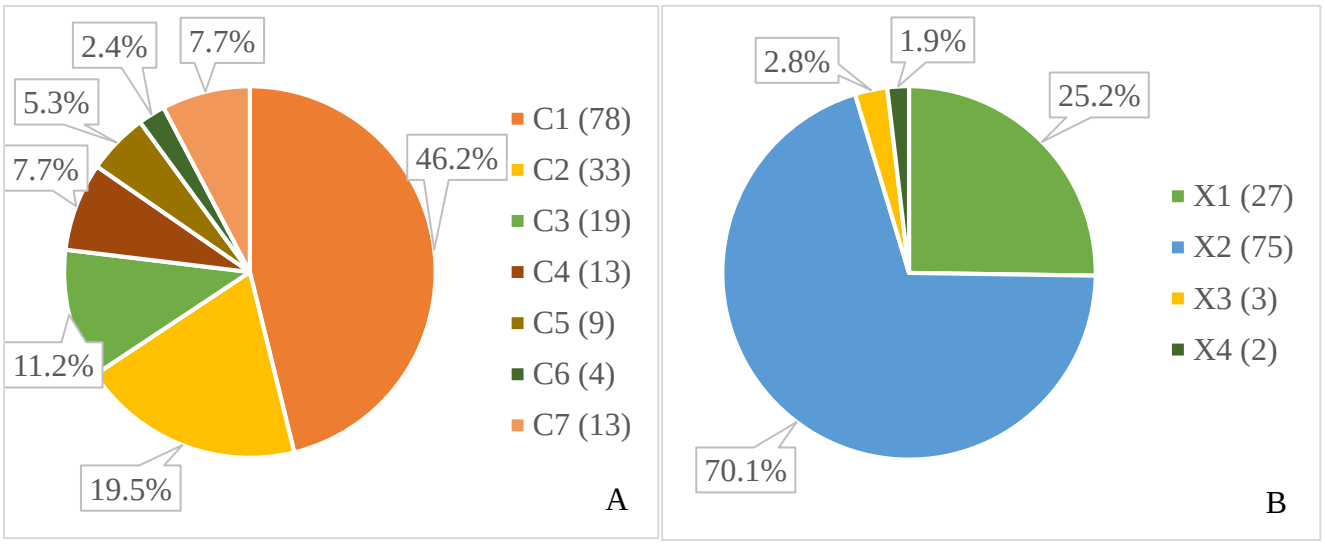


Figure 4: Graphical representation of the (A) concordance between the autopsy request and conclusion for specific and open questions (n=169); (B) concordance between the autopsy request and conclusion for aspecific questions (n=107). Legend: Confirmed major without additional minors (C1) with additional minors (C2); new major without additional minors (C3) with additional minors (C4); no major inadequate autopsy report's conclusion (C5) inadequate autopsy report (C6) inconclusive autopsy report (C7). Unexpected major (X1); expected major (X2); no major inadequate autopsy report's conclusion (X3) inadequate autopsy report (X4)

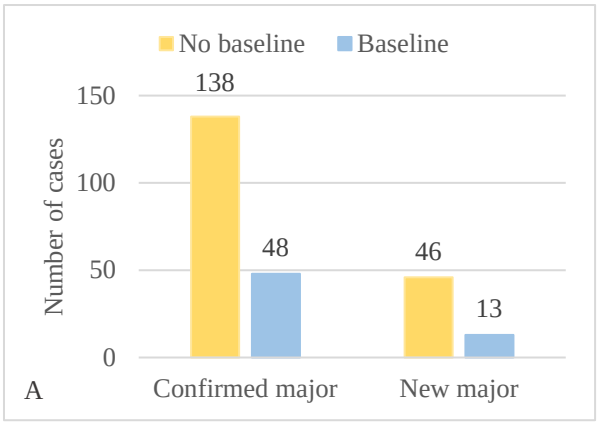
4.1.5.1 Clinical information

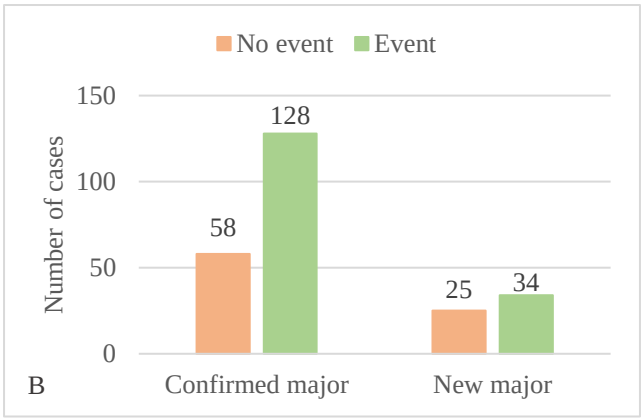
For the following analyses two groups were studied, namely the confirmed majors (C1-C2-X2) and the new majors (C3-C4-X1). There was no significant association between the provided clinical information – baseline ($p = 0.8478$), event ($p > 0.9999$) and complication (0.4020) – and the major (figure 5 A-C). Further the sample was divided into conclusive (C1-C6 and X1-X4) and inconclusive (C7). There was a highly significant association between the provided baseline ($p = 0.0078$) and whether or not a conclusion was reached. In contrary, no significant association was found between the provided clinical information regarding the event ($p > 0.9999$) and complication ($p = 0.7572$) and whether or not a conclusion was reached (figure 5 D-F).

Figure 5: The association between the major and the provided clinical information regarding the baseline (A), event (B) and complication (C). The association between the provided clinical information regarding the baseline (D), event (E) and complication (F) and whether or not a conclusion is reached.

4.1.5.2 Nature of clinical question

For the following analyses two groups are studied, namely the confirmed majors (C1-C2-X2) and the new majors (C3-C4-X1). There is no significant association found between the major and the nature of the clinical question regarding the baseline ($p = 0.6083$), event ($p = 0.1178$) and complication ($p > 0.9999$) (figure 6 A-C).





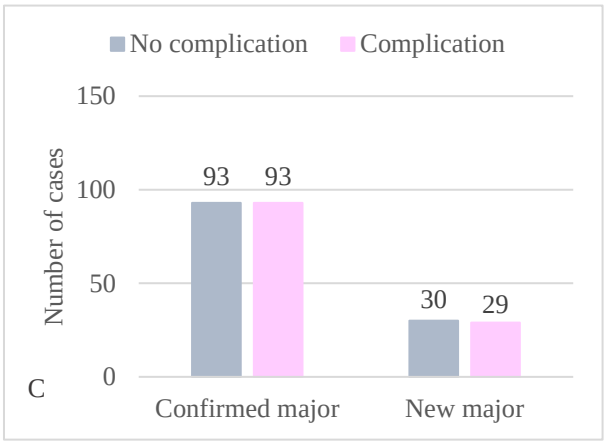


Figure 6: The association between the major and the nature of the question regarding the baseline (A), event (B) and complication (C).

4.1.5.3 Autopsy rate

For the following analyses two groups are studied, namely the confirmed majors (C1-C2-X2) and the new majors (C3-C4-X1). Figure 7 shows the relationship between the probability of a major (confirmed major '0' and new major '1') and the autopsy rate which is not significant (p = 0.1411).

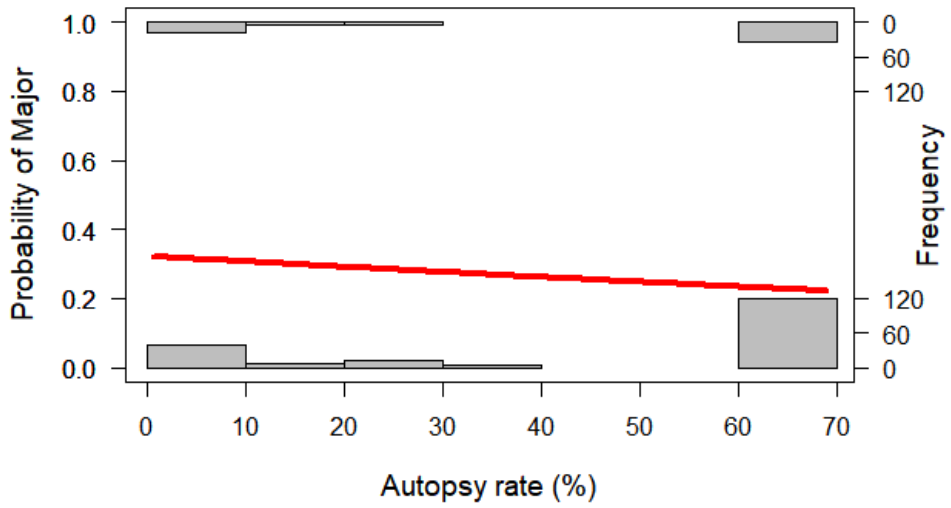


Figure 7: Logistic regression model representing the relationship between the majors (the concordance between the autopsy request and autopsy report's conclusion) and the autopsy rate (%).
(0 = confirmed major and 1 = new major)

4.2 Optimisation of clinical autopsy procedure for UZ Leuven

In this section an overview of the findings obtained by observational studies from October 2017 to May 2018 is presented. Firstly, the discrepancy between the clinical and forensic autopsy procedures was evaluated. The obtained data were divided into six segments of which only the relevant ones, those with significant differences, are demonstrated (Addendum IV.17-18). The data of the less relevant segments can be consulted in the Addendum as well as the p-values of all the groups (Addendum IV. 19-20). Secondly, the registration of clinical autopsies was analysed and as well divided into four segments regarding the time lags.

4.2.1 **Observation clinical and forensic autopsies**

Table 9 presents an overview regarding the distribution of the observations of the clinical and forensic autopsies. All nine pathologists were in their five-year residency of the department of Pathology in UZ Leuven. Three of the five forensic pathologists were in their five-year residency and two were full time, board-certified forensic pathologists of the department of Forensic Medicine of UZ Leuven. During each autopsy several mortuary technicians were assisting of which unlike the pathologists no distinguish was made.

Table 9: Number of clinical (n=20) and forensic (n=20) autopsies performed per pathologist (A-N)

	Clinical autopsies									Forensic autopsies				
Pathologist	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Autopsies	3	3	3	3	2	2	2	1	1	6	1	7	4	2

First, the administration of the autopsy takes place. The pathologist identified the patient only in 20% of the clinical autopsies, while in the forensic autopsies the deceased person was identified in 100% of the cases by the forensic pathologist. A figure of this section can be consulted in the Addendum (IV.17).

Second, the external inspection takes place. The pathologist performed an external inspection in less than 45% of the clinical autopsies, while this is performed in 100% of the cases by the forensic pathologist. There was a highly significant difference between the clinical and forensic autopsies for the pathologist for all the steps, yet only one of the seven steps showed a significant difference for the mortuary technicians (figure 8 A).

Third, the internal examination takes places. The mortuary technicians played a bigger role than the pathologist during this part of the clinical autopsy with a significant difference in seven of the sixteen steps between the clinical and forensic autopsies. In contrary to the forensic autopsy where the forensic pathologist plays a bigger role than the mortuary technicians with a significant difference in twelve of the sixteen steps between the clinical and forensic autopsies. Certain steps were barely to not performed during the clinical autopsy, namely the collection body fluids, checking for pneumothorax and the sternum (figure 8 B).

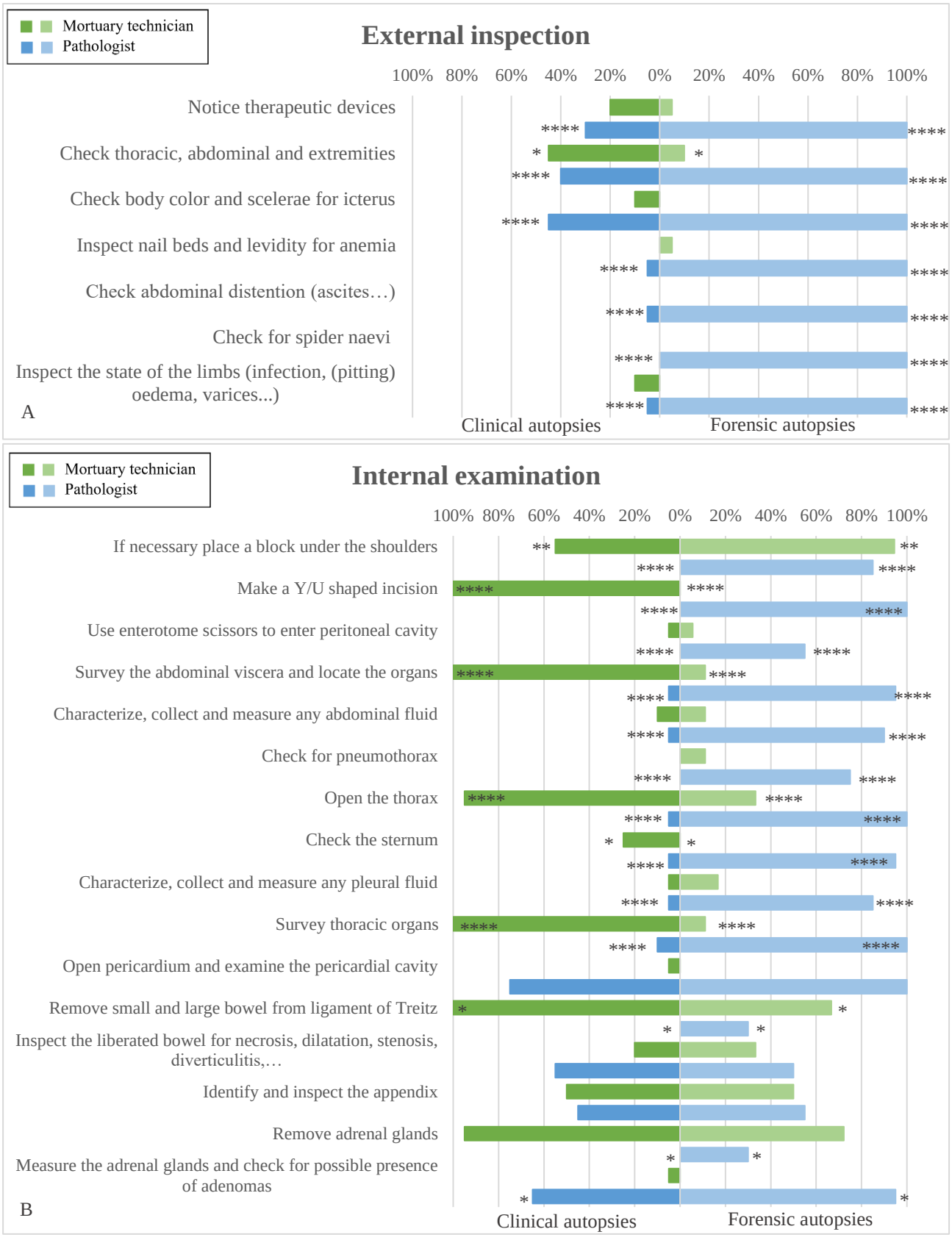


Figure 8: (A) External inspection section and (B) internal examination section of the observation sheet. (* p < 0.05, ** < 0.01, *** p < 0.001, **** p < 0.0001)

Fourth, the thoracic block is removed and examined. During this part of the autopsy the (forensic) pathologist plays the biggest role (≥ 95% of the cases) in both the clinical and forensic autopsies in contrary to the mortuary technicians. Of the 24 steps, only one was significant different for the pathologist. A figure of this section can be consulted in the Addendum (IV.17).

Fifth, the gastrohepatic block is removed and examined. Likewise, for this block the (forensic) pathologist plays the biggest role (≥ 65% of the cases) in both the clinical and forensic autopsies in contrary to the mortuary technicians. Of the fifteen steps, only two were significant different for the pathologist. A figure of this section can be consulted in the Addendum (IV.18).

Sixth, the urogenital block is examined. The mortuary technicians play a smaller role during both the clinical and forensic autopsy with a significant difference in two of the fourteen steps. During the clinical autopsies certain steps are barely (≤ 22% of the cases) performed by the pathologist due to the lack of removal of the urogenital block in contrary to the forensic autopsy where most of the steps are almost in 100% of the cases performed with a significant difference in seven of the fourteen steps (figure 9).

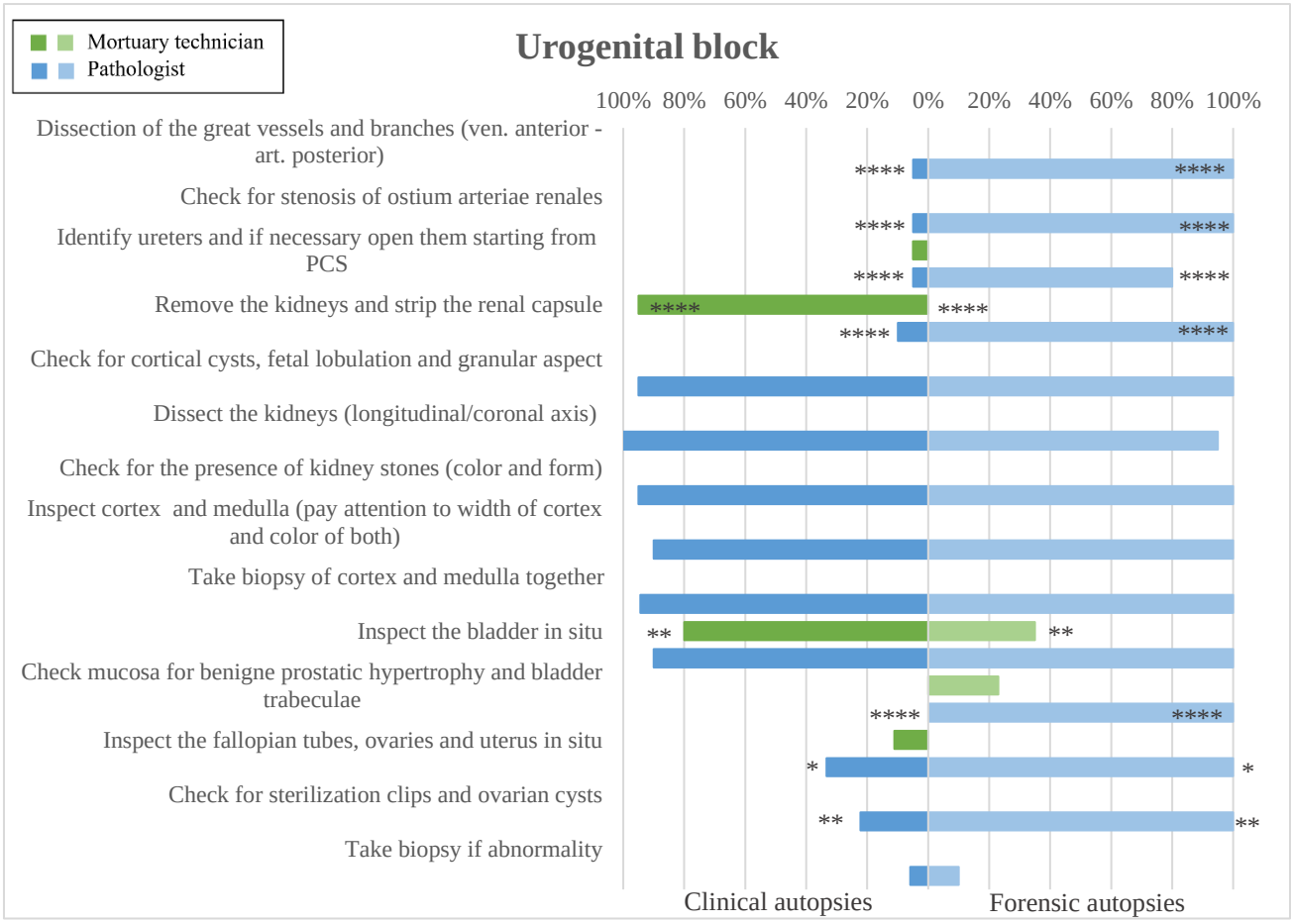


Figure 9: Urogenital block section of the observation sheet (* p < 0.05, ** < 0.01, *** p < 0.001, **** p < 0.0001)

4.2.2 **Registration of clinical autopsies**

4.2.2.1 Cut-off values and exclusion criteria

The data were divided into four different time lags and both cut-off values as exclusion criteria were put in place for interpretation purposes (table 10).

Table 10: Time lags and cut-off values in the course from the death of the patient till the start of the autopsy

	Definition	Minimum	Maximum
ΔT1	Discharge time = time lag between death of patient and discharge from department	0:00	1:00
ΔT2	Transport time = time lag between discharge from department and arrival at mortuary	0:10	17:00
ΔT3	Notification time= time lag between knowledge of autopsy by mortuary technicians and notifying of pathologist	0:00	4:00
ΔT4	Preparation time = time lag between knowledge of autopsy by pathologist and start autopsy	1:00	indefinite

The cut-off values were set up based upon the openings hours of the Mortuary (9 a.m. till 5 p.m.) and consideration was given to any ongoing autopsies which might result in a delay of notifying the pathologist. Exclusion criteria include data that seemed unlogic and impossible (incorrect data) and annulated autopsies (no autopsy).

4.2.2.2 ΔT1: time lag death of patient to discharge department

Seven of the sixty cases were excluded from the dataset due to being 'incorrect data'. These seven cases were patients with a registered time of discharge from the department before the time of death. The analyses were performed on 53 cases, of which 37 (69.8%) were discharged from the department before the maximum set up time of 1 hour. The other sixteen cases (30.2%) had a registered time of discharge from the department that exceeded the set-up time of one hour with a maximum of 15 hours and 31 minutes (table 11).

Table 11: Time lag between death of patient and discharge from department = discharge time (ΔT1)

ΔT1 Discharge time (n = 53)	
Median [minimum, maximum]	0:00 [0:00 – 15:37]
Number of cases discharged from department < 1 hour	37 (69.8%)
Number of cases discharged from department > 1 hour	16 (30.2%)

Note: 7 of the 60 were excluded due to being 'incorrect data'

4.2.2.3 ΔT2: time lag discharge department to arrival mortuary

Five of the sixty cases were excluded from the dataset due to being 'incorrect data'. From these five cases, four had a transport time less than 10 minutes which was concluded to be impossible after checking the distance from the corresponding departments to the mortuary. The fifth case had an earlier arrival time at the mortuary than discharge time from the department. The analyses were performed on 55 cases, of which ten (18.2%) arrived at the mortuary after 17

hours with a maximum of 42 hours and 30 minutes and 45 (81.8%) arrived between 10 minutes and 17 hours (table 12).

Table 12: Time lag between discharge from department and arrival at mortuary = transport time (ΔT2)

ΔT2 Transport time (n = 55)	
Median [minimum, maximum]	11:08 [0:00 – 42:30]
Number of cases discharged from department < 17 hours	45 (81.8%)
Number of cases discharged from department > 17 hours	10 (18.2%)

Note: 5 of the 60 were excluded due to being 'incorrect data'

4.2.2.4 ΔT3: time lag knowledge autopsy and notifying pathologist

Six of the sixty cases were excluded from the dataset due to being 'incorrect data'. Further, in twelve cases the autopsy was annulated. The analyses were performed on 42 cases, of which in twenty cases (47.6%) the pathologist was informed after 4 hours with a maximum of 90 hours. In 22 cases (52.4%) the pathologist was informed within 4 hours (table 13).

Table 13: Time lag between knowledge of autopsy by mortuary technicians and notifying of pathologist = notification time (ΔT3)

ΔT3 Notification time (n = 42)	
Median [minimum, maximum]	11:24 [0:00 – 90:00]
Number of cases pathologist notified < 4 hours	20 (47.6%)
Number of cases pathologist notified > 4 hours	22 (52.4%)

Note: 18 of the 60 were excluded due to being 'incorrect data' or 'no autopsy'

4.2.2.5 ΔT4: time lag notification pathologist to start autopsy

Seven of the sixty cases were excluded from the dataset due to being 'incorrect data'. Further, in thirteen cases the autopsy was annulated. The analyses were performed on forty cases, of which in fourteen cases (35.0%) the pathologist had more than 1 hour to prepare for the autopsy. In 26 cases (65.0%) the pathologist had less than 1 hour preparation time (table 14).

Table 14: Time lag between knowledge of autopsy by pathologist and start autopsy = preparation time (ΔT4)

ΔT4 Preparation time (n = 40)	
Median [minimum, maximum]	0:40 [0:00 – 21:20]
Number of cases preparation time < 1 hour	14 (35.0%)
Number of cases preparation time > 1 hour	26 (65.0%)

Note: 20 of the 60 were excluded due to 'incorrect data' or 'no autopsy'

4.2.2.6 Association between ΔT3 and ΔT4

At last, the association between ΔT3 and ΔT4 was analysed to check whether a 'late' notification time (< 4 hours) of the pathologist actually lead to a 'short' preparation time (< 1 hour). Of the 41 cases, in sixteen cases (41.0%) the mortuary technicians informed the pathologist later than 4 hours resulting in a preparation time of the pathologist shorter than 1 hour and in six cases (15.4%) the pathologist had still more than 1 hour preparation time. Further, in ten cases (25.6%) the pathologist had less than 1 hour preparation time even though the mortuary technicians informed the pathologist within 4 hours of knowledge of the autopsy and in seven cases (17.9%) the pathologist had still more than 1 hour preparation time (table 15).

Table 15: Association between ΔT3 (notification time) and ΔT4 (preparation time)

		ΔT4		Total
		<1h % (n)	>1h % (n)	% (n)
ΔT3	<4h	**25.6** (10)	**17.9** (7)	43.6 (17)
	>4h	**41.0** (16)	**15.4** (6)	56.4 (22)
Total		66.7 (26)	33.3 (13)	100 (39)

Note: 21 of the 60 were excluded due to 'incorrect data' or 'no autopsy'

Figure 10 displays the median time lags of the administrative chain from death attestation to autopsy. This whole process had a median time of 23 hours and 12 minutes.

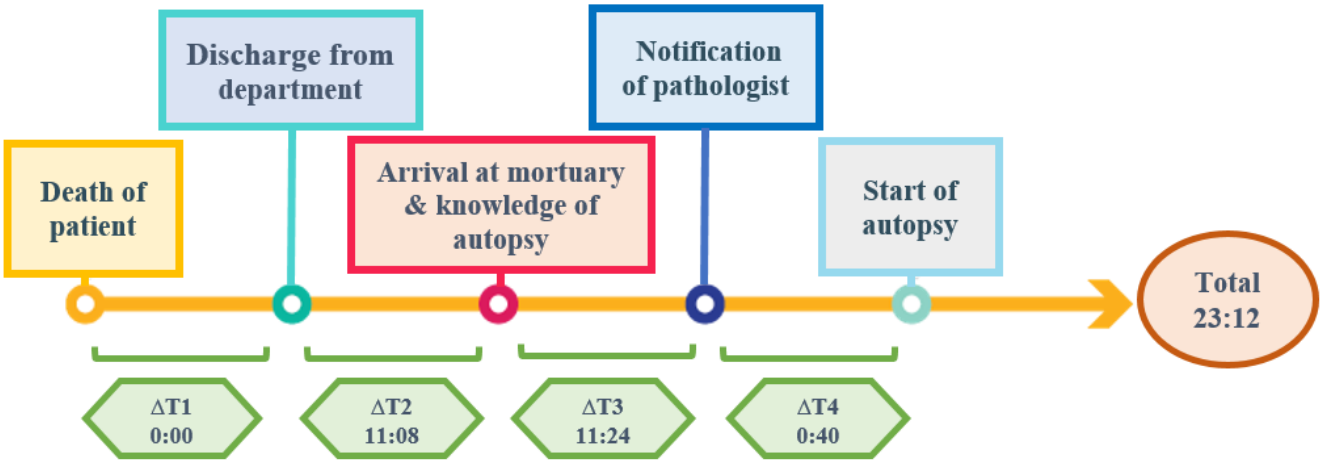


Figure 10: Median time lags of the administrative chain from death attestation to autopsy in hours. Legend: ΔT1: discharge time; ΔT2: transport time; ΔT3: notification time; ΔT4: preparation time

5 Discussion

The aim of this master's thesis was to give an in-depth overview of the current situation concerning the post-mortem policy of UZ Leuven and to work towards a harmonisation. On one hand by gaining insight into the role of clinical autopsies as a contribution to healthcare quality control. On the other hand, by investigating the current management regarding clinical autopsies. In this chapter the acquired results are first discussed and compared to relevant literature in the same order as previously mentioned. Second, the limitations of this project are described. Lastly, recommendations for future research concerning this subject will be outlined.

5.1 Data-analysis of clinical autopsies in UZ Leuven (2015 - 2017)

The autopsy rate of each hospital department was examined to determine whether certain departments request a clinical autopsy on a frequent basis. The purpose of this study was to select the departments with a consistent high autopsy rate and investigate if specific autopsy procedures to the departments were required. This study shows that four departments retain a stable autopsy rate (with a variation of 20%), namely 'Medical intensive care (MIC) A', 'Pneumology + lung transplantation', 'Neurology and general internal medicine' and 'Intensive care A'. The five other departments display an irregular autopsy rate over the three years. More specific, the departments of 'Neonatal intensive care', 'Haematology isolation unit' and 'Nose, throat and ear diseases, facial and neck surgery and dentistry' present a noticeable higher autopsy rate in 2016 compared to 2015 and 2017. Finally, the departments of 'Cardiac surgery' and 'Post-anaesthesia care unit' depict only an autopsy rate in 2015 with no autopsies performed in the next two years (figure 1). These results show a strong variability and suggest that a longer period of time should be analysed prior to drawing firm conclusions. The UZ Leuven overall autopsy rate over the studied three years was 9.5% which is above the national Belgian autopsy rate of 2.6% in 2014 and the overall median rate of 8.3% found in a study of 418 institutions by Baker *et al.* As represented in the international literature the teaching hospitals, as UZ Leuven, have a higher autopsy rate (50,120,121). A study by Sinard *et al.* concluded that the autopsy rate is the lowest in emergency departments or general surgery departments in contrary to departments with foetal, medicine, cardiothoracic surgery and paediatric deaths, which have the highest autopsy requests (61). Our study did not support the results of Sinard *et al.* as stated above with a low variable paediatric autopsy rate (61).

Many studies discuss the autopsy rate in the context of the discrepancy between pre- and post-mortem diagnoses but only limit themselves to intensive care units (ICU) (14,42,122). The reason for this is the common relatively high autopsy rate for ICU's and therefore decreases the chance on bias. Several studies have shown that certain elements influence the results of post-mortem studies, namely a lower autopsy rate would lead to selection bias (14,115). Since

autopsies only being performed on patients whose deaths are unexplained, would have a higher probability of unexpected findings. Therefore, the worldwide decline of autopsy rates makes the interpretation of clinical discrepancy rates more difficult and less representative (115). This study showed no significant relationship between the probability of a new major and the autopsy rate. Therefore, the probability of a new major cannot be estimated given the autopsy rate of a department. However, the rather scare population and period of time this study depicted, should be taken into account. Subsequently, this finding demonstrates that departments with a lower autopsy rate would not necessary have a higher discrepancy rate and vice versa. Since one might argue that the culture in ICU's facilitates an autopsy request on a large number of their deceased population. While a department with a low autopsy rate would have mostly specific requests and would therefore give the impression that autopsies were performed as a confirmation of the clinical tentative diagnosis. Following this theory, one might expect an increase in error rate which would give a bias view. The advantage of this study is its retrospectivity and therefore the autopsy rate is not influenced by an increased attention to the whole autopsy process. This factor should be considered when a follow-up study is performed and awareness to post-mortem examination is made.

The autopsy requests and reports of the included cases were profoundly examined with the purpose to discover any shortcomings and formulate alternatives to adjust where possible. When focussing on the clinical question, it is noticeable that only in 55% of the cases the clinicians would present one death hypothesis or more. In a relevant 41.8% of the cases no death hypothesis was presented and only circumferential information was provided (figure 2). In these cases, it was up to the pathologist to assume which issue the clinician was hinting at. One could argue that a clinician might purposely exclude certain information from the autopsy request under the assumption that too much information might bias the pathologist. This study showed that overall the autopsy requests were sufficiently filled out for the clinical information (baseline, event and complication) in particular (table 4). In 89% of the cases, these posed questions were answered in the autopsy report's conclusion. The other cases would involve, on one hand inadequate autopsy reports and/or conclusions and on the other hand inconclusive answers (table 8). It is necessary to mention that unlike certain other hospitals the autopsy request form of UZ Leuven does not encourage clinicians in any direction to provide specific information, since the clinician has the freedom to address any information one sees necessary (123–125).

Further, the nature of each clinical question was analysed in terms of odds that clinicians would question certain information with or without providing it. These were highly significant for baseline, event and complication and therefore demonstrate the association of the provided information with the questioned information by the clinician to the pathologist. To our

knowledge, there has not been any exhaustive research performed concerning the autopsy request form in the post-mortem field. The non-comparative nature of this study makes it challenging to draw any firm conclusions. However, radiology request forms have been subject to several studies and can be used as comparison to some lengths since here clinicians might also live under the assumption that more information would bias the radiologist (126–128). A study carried out by Jumah *et al.* analysed, among other parameters, the clinical details which were left blank in 23% of the cases (127,129). In a more recent study by Triantopoulou *et al.* the radiology request forms missed clinical details in 14% of the cases (127,130). These results seem to be higher than our findings, where only in 2.1% of the cases the clinical information and question were left blank. These blank autopsy requests were excluded from further analysis since strict categorisation standards regarding the content of the provided information was set up. Based upon these findings, an advanced autopsy request form was proposed and implemented (Addendum VIII).

In this study, an overall major discrepancy rate of 21.4% was found between the provided clinical information on the autopsy request and the autopsy report's conclusion in all patients that underwent a clinical autopsy between 2015 and 2017 in UZ Leuven and of whom the autopsy report was finalized. Due to the non-comparative nature of this research the results will be compared with findings in literature categorised according to the Goldman criteria (cfr. 1.5) (38,41). The above-mentioned rate falls within the range of discrepancy rates (5% to 32%) reported in literature particularly for ICU patients (42). It is essential to mention that most studies only focus on a specific group or department like ICU since their autopsy rate is mostly the highest among other departments. Therefore, a comparison with 'MIC A' of this study which has an autopsy rate of 68.9% and an overall discrepancy rate of 20.2% is more representative (table 3). A study by Roosen *et al.* of the MICU of UZ Leuven in 2000 revealed a 16% of class I major missed diagnoses which if known before death would have led to a change in therapy. Unlike the 10% class II major missed diagnosis that would not have led to a change in management. However, it should be considered that one patient could have multiple missed diagnoses in contrary to this study where each case could only fit into one category. Similar to this research, Roosen *et al.* revealed an overall discrepancy rate of 26% in MICU with an autopsy rate of 93% (14). This finding is remarkable since the discrepancy rates are similar and almost two decades have passed including improvements to diagnostic techniques. The same conclusions were drawn in certain studies investigating the change of discrepancy rate over several decades. Here, results show a clear stability of the discrepancy rates between pre- and post-mortem diagnoses since 1912 despite advances in laboratory and imaging techniques to reach a diagnosis (7). A capital conclusion is that although clinicians presume that technical evolution has empowered clinical diagnostics, the discrepancy rate of missed

majors has not significantly decreased yet stabilized. However, other studies contradict this outcome like a study by Sonderegger *et al.* that investigated diagnostic errors over three decades, registered a significant decline of major discrepancies (1972, *30%* - 1982, *18%* - 1992, *14%*) (8). Another study by Shojania *et al.* involved a systematic literature review from 1966 to 2002 and found a significant decline in diagnostic errors of 19.4% per decade. Over these 40 years the median error rate was 23.5% for major errors that independently from the hospital's autopsy rate would range from 8.4% to 24.4% (38). The contradiction of these studies in literature with the achieved results by this study is relative since different criteria have been applied.

In addition, no significant association between the confirmed or new major and the provided clinical information (baseline, event and complication) was found (figure 5 A-C). However, providing sufficient clinical information on the autopsy request would lead to a thorough autopsy conclusion of the case. More specifically for the baseline, which might imply that mentioning the patient's medical history on the autopsy request is essential. Further, it did not concern which clinical information the requesting clinician was referring to in the clinical question since no significant association was found between the nature of the question (baseline, event or complication) and the confirmed or new major (figure 6 A-C). Due to the non-comparative nature of this research the results cannot be correlated with numbers from literature.

Lastly, the evaluation of the quality of the autopsy report resulted in an overall inadequate autopsy report's conclusion of 4.3%. In these cases, the pathologist failed to mention the major in the conclusion but it could still be found in the autopsy report. In 2.2% of the cases the autopsy report was inadequate since no extensive examination was carried out to find the major (figure 4 A-B). One explanation for this outcome is the lack of a harmonised procedure regarding autopsy reporting. To combat this issue a structured template for the autopsy report, which included all relevant findings, was set up (Addendum IX.1-13). Further, attention has been made to the autopsy report's conclusion which should contain all major and minor findings as well as an answer on the clinician's question(s).

5.2 Optimisation of clinical autopsy procedure for UZ Leuven

A discrepancy between the clinical and forensic autopsy procedures was analysed to achieve a comprehensive overview of the different approaches. Firstly, it was noteworthy that the pathologist rarely checks the identification of the patient regarding clinical autopsies in contrary to forensic autopsies (Addendum IV.16). To prevent foreseeable errors, the pathologist should always double check the patient's identification using the wristband and/or ankle strap. Secondly, a significant difference in several steps was found between the clinical and forensic

autopsies regarding the role of the pathologist in both the external inspection and internal examination. In contrary to the mortuary technicians where this difference was present in less steps for both the external inspection and internal examination (figure 8 A-B). An explanation for this finding is that in clinical autopsies the pathologist mostly arrived at the mortuary after the mortuary technicians removed all the organ blocks. In contrast to the forensic autopsies, where the presence of the forensic pathologist is required and mandatory since every step of the autopsy process happens under their supervision. Furthermore, the thoracic as well as the gastrohepatic block show only a significant difference in few steps for the pathologist and none for the mortuary technicians (Addendum IV.16-17). These results make sense in that up until now only the (forensic) pathologists are trained to examine organ blocks according to a uniform procedure (76). Lastly for the urogenital block, the results were significant for several steps for both the pathologist and mortuary technicians (figure 9). This difference can be justified by the fact that the urogenital block is not entirely removed during clinical autopsies and only the kidneys are thoroughly examined. Since the removal of the urogenital block can occasionally be a considerable source of information (e.g. nephrology department), the implementation of case-specific autopsy procedures can include this certain step.

It was also noticeable that seldom a supervising pathologist was present during the clinical autopsies. An explanation might be that autopsy pathology is up until now not recognized as a subspecialty within the pathologic field. Therefore, pathologists who choose to specialize in autopsies often become forensic pathologists (4,110). Lastly, comparing the forensic pathologists, working with a uniform ISO accredited procedure, to the observed pathologists, it could be noticed that in the latter the external examination was performed too hesitant and that some internal section procedures were not commonly nor uniformly performed (76). Therefore, it would be a great contribution to the clinical autopsy procedure if the mortuary technicians could participate and support the pathologists during certain parts of the autopsies like for example the external inspection. However, it is a general requirement that the pathologist is present from the start of the clinical autopsy, which is already the case in forensic autopsies. Subsequently to these remarkable findings, literature review and the current accredited forensic autopsy procedure, a uniform procedure for the clinical autopsy was set up (Addendum X.1-14). Since the autopsy procedure is part of the analytic phase, it is fundamentally important that a harmonised procedure is pursued in such matter that the clinical autopsy can become a competent and reliable parameter to assess the current diagnostic tools and therapies in healthcare.

The aim of the project concerning the registration of the clinical autopsies was to have a detailed understanding of the time lag of the administrative chain from death attestation to autopsy to propose adjustments where necessary. It would take up to a median time of 23 hours and 12

minutes from the death of the patient to the start of the autopsy (figure 10). There are several links in the chain that affect this time lag. First, in 30.2% of the cases the patients were discharged from the department more than 1 hour after death. This delayed discharge would add to the patient's stay on the department even after death. It is remarkable to notice that in 11.7% of the cases the patient had already been discharged from the department before death (table 11). This means that the electronic administrative records of the deceased were not finalized before transportation to the Mortuary.

Second, the median time between the discharge from the department to the arrival at the mortuary is 11 hours and 8 minutes. One should take into account that deceased patients can only be transported to the mortuary between its openings hours, namely 9 am till 5pm. Therefore, a patient deceased shortly after 5 pm will have to stay at the department till the next morning which is approximately 16 hours. It is noticeable that in 18.2% of the cases the patients were transported to the mortuary exceeding the acceptable time (17 hours), with in one case even up to 42 hours and 30 minutes (table 12). In order to delay decomposition, it is compulsory to take appropriate measures to cool the body as soon as possible in the Mortuary. One way to decrease a deceased patient's stay at the department, is raising awareness of all departments and to allow transportation outside the openings hours of the Mortuary. This would implement a broader accessibility and thus staffing.

Third, the median time between the knowledge of the autopsy by mortuary technicians and the notification of the pathologist is 11 hours and 24 minutes. A time lag of 4 hours was considered acceptable since on-going autopsies could delay the notification of the pathologist. In 52.4% of the cases the pathologist was notified after 4 hours, with in one case even up to 90 hours (table 13). When studying the data closely, one could argument that in 31.8% of the cases a weekend was involved. Since there is always a pathologist on call, this argument is considered invalid. Further, the late notification of the pathologist cannot be assigned to the end of the workday since this phenomenon would take place both in the beginning and at the end of the workday.

Fourth, the median time between the notification of the pathologist and the start of the autopsy, which is also considered to be the pathologist's preparation time, is 40 minutes (table 14). In this time the pathologist should be able to study the patient's medical files thoroughly and if necessary contact the requesting clinician to discuss the case. The appropriate preparation time is set up to 1 hour. Lastly, a 'late' notification time (< 4 hours) of the pathologist lead to a 'short' preparation time (< 1 hour) in 41.0% of the cases (table 15). This discrepancy can be explained by the fix start hour of an autopsy (09.30 – 10.30 a.m.) and the variable notification time. Therefore, it is essential to mention that notifying the pathologist as soon as possible is feasible. Any delays in the aforementioned chain could result in a delay of the family's grieving

process, since the deceased would be held up at the Mortuary instead of a funeral home. The harmonisation of this process is an important part of the post-autopsy care and therefore the post-analytic phase. The hospital is currently working on a new application within the electronic patient record LWS/KWS that emphasizes a uniform autopsy request for the clinician with automated registration of the autopsy and notification of the pathologist.

5.3 Study limitations

Even though a profound study was performed, several limitations can be assigned to this project. These limitations are mainly due to a lack of time to extensively research certain facets.

The first limitation concerns the fact that only departments that requested an autopsy over the span of three years (2015-2017) were analysed, which partially explains the skewed results. One should therefore analyse a longer period to allow the drawing of any firm conclusions regarding the differences in either autopsy rates and major discrepancies per department. This study could help to provide an overview of fluctuations of the overall autopsy rate.

Second, only autopsy requests and reports of performed autopsies with a finished autopsy report over these three years were included in the analyses. Due to the lack of sufficient data it was considered to be irrelevant to correlate the provided information and asked questions with the departments separately. The same applies to the discrepancy between the autopsy request and autopsy report's conclusion.

Thirdly, one should keep in mind that in this study the patient's medical files were not analysed as well as the length of stay in the hospital. Therefore, we cannot firmly conclude that the newly acquired post-mortem diagnoses were missed by the clinician. These cases should be examined more closely to rule out the fact that the clinician was aware of the diagnoses but just did not find it necessary to mention it on the autopsy request form.

The fourth limitation involves the low number of observations (20 clinical and 20 forensic autopsies), which was not enough to perform an intra- and interindividual analysis. In addition, it was not possible to examine the pathologist's individual technique.

Lastly, no firm conclusions regarding the time lag between the death of the hospitalised patient and discharge from the department as well as the arrival at the mortuary can be drawn. Since only cases where a clinical autopsy was requested, were included in this study.

5.4 Recommendations for future research

To our knowledge, this project is the first one of its kind and therefore future research into the post-mortem examination field is highly recommended. The below mentioned suggestions can also be analysed in different hospitals in Belgium or elsewhere for comparison purposes.

First, a follow-up study can be performed on the preselected cases by this project that showed a discrepancy between the clinical information on the autopsy request and autopsy report's conclusion. These cases can then be thoroughly investigated by examining the medical files and evaluating for each case whether it really concerns a missed diagnosis. A next step can be to categorise more specifically which pathologies are commonly missed and outline the advantages and disadvantages of each therapy and autopsy technique.

As mentioned in the limitations of this project, only a span of three years was analysed. Therefore, it is highly recommended to follow each department over a longer time span thus one can obtain a detailed understanding of the fluctuations of autopsy rates per department. Consequently, in response to these data case-specific autopsy procedures per department can be set up. A next step can be to investigate outcome effect and contribution of a combination of the conventional autopsy and post-mortem imaging.

Further, it is of great value to the hospital's quality management system to perform similar analyses over a span of three years that could then be used to compare and evaluate the implementations that resulted from this study. The relevance can be found in the fact that after our study certain guidelines regarding clinical autopsies are implemented such as a standardized clinical autopsy procedure, a structured training of junior pathology residents, harmonised documentation regarding autopsy requests and reports, improved regulations concerning the time planning of clinical autopsies, etc. (Addendum VIII-IX-X). These guidelines might affect the data on each aspect separately.

Another facet that can be exploited is upgrading to an electronic autopsy request and report approach. For example, by implementing templates and auto texts regarding the autopsy report. Consequently, the pathologist would be able to establish a preliminary version of the autopsy report shortly after the autopsy which can be electronically accessed by the requesting clinician. A final autopsy report, which would include the results of additional testing like microscopic examination, can then be completed on a later basis. A next step can be to analyse the TATs and whether a lack of preparation time affects the integrality of the autopsy report.

Lastly, another interesting field to exploit, is the analysis of indications for requesting a clinical autopsy. This can be accomplished on one hand by prospectively interviewing each clinician after a clinical autopsy is requested and on the other hand by setting up a broad survey that can be filled out by each clinician in the hospital. The relevance of this project is to investigate the clinicians' mentality of requesting an autopsy and related to these data flexible guidelines for requesting a clinical autopsy can be implemented. This way clinicians can have clarity on when a clinical autopsy is feasible and can provide an added value to the current diagnostic and therapeutic methods, scientific research and overall hospital quality assessment.

6 Conclusion

In conclusion, UZ Leuven scores higher than the current Belgian autopsy rate of hospital deaths. However, over the past two decennia a decline in autopsy rates is registered in UZ Leuven. This corresponds with the international decline in autopsy rates over the past century. A combination of many factors should be held under consideration to properly interpret this decline. These factors involve first and foremost the lack of an agreed upon benchmark for an adequate autopsy rate concerning hospital accreditation. Furthermore, both the financial consideration as the role of family are an essential obstacle. In addition, the never-ending evolution of modern diagnostic techniques leads to the rather misleading assumption that a post-mortem confirmation of a diagnoses is irrelevant and dispensable. Moreover, the lack of autopsy training in the medical curriculum cultivates a sceptical perspective of clinicians towards the contribution an autopsy brings. Lastly, the absence of recognition of a subspecialty in autopsy pathology certainly contributes to a decline. The importance of post-mortem examination is put into perspective when great discrepancy rates between clinical and anatomical diagnoses are demonstrated.

Analysing the time lag of the administrative chain from death attestation to autopsy is essential to prevent any delays which could affect post-mortal alterations and thus macro- and microscopic interpretations but also the family's grieving process. By evaluating these KPI's, the autopsy services undergo an active surveillance. An automation of these steps would result into a transparent and traceable flow of the post-mortem policy of UZ Leuven.

The clinical autopsy procedure should be harmonised like the uniform BELAC ISO 17020 accredited forensic autopsy procedure. The sole purpose of this harmonisation is to work towards an accreditation of the clinical autopsies. Therefore, the clinical autopsy can become a competent and reliable parameter to assess the current diagnostic tools and therapies.

The documentation involved in the autopsy process should be closely monitored and regulated, particularly the autopsy request and report process. The autopsy request should include besides the patient's and clinician's demographic data also the relevant clinical information, questions and perhaps one or more death hypotheses. The autopsy report should contain an exhaustive evaluation and integration of the patient's clinical information incorporated with the post-mortem anatomic examination. Therefore, an upgrade to an electronic approach would deliver great benefits to the quality management system of UZ Leuven.

Finally, a standardized approach is strongly recommended to not let the benefit and utility of post-mortem examination go in vain. This study can be used to evaluate the aforementioned implementations. We hope that the awareness, clarity and profit concerning clinical autopsies will increase in UZ Leuven, since the quality of healthcare not only relies upon the diagnostic and therapeutic methods but also on the assessment of these through post-mortem examinations.

Nederlandse samenvatting

Inleiding

UZ Leuven scoort met een autopsieratio van 9,6% in 2017 hoger dan de huidige Belgische autopsieratio van ziekenhuissterfgevallen van 2,6% in 2014 (50). In de afgelopen twee decennia is er echter een daling van deze autopsieratio's geregistreerd in UZ Leuven, namelijk van 30,8% in 1995 naar 25% in 2001 tot 9,2% in 2017 (51). Deze trend wordt helaas de afgelopen eeuw ook internationaal waargenomen en beschreven (3,24,45). De achteruitgang van het absolute aantal autopsies is multifactorieel. Deze factoren zijn in de eerste plaats het ontbreken van een consensus omtrent een benchmark over een adequaat autopsieratio met betrekking tot de ziekenhuisaccreditatie (11). Vervolgens zijn de financiële overwegingen, doorgaans onder gehonoreerd voor de arts maar wel partieel gefactureerd aan de nabestaanden, de socio-culturele beladen pejoratieve connotatie en de piëteit van de aanvragende arts essentiële obstakels (4,11). Verder leidt de technische diagnostische revolutie met een amalgaam aan moderne diagnostische technieken tot de nogal misleidende veronderstelling dat een bevestiging van een diagnose aan de hand van post-mortem onderzoek irrelevant en overbodig is (11,12,57,58). Bovendien cultiveert het gebrek aan autopsietraining in het medische curriculum een sceptisch perspectief van clinici op de bijdrage die een autopsie met zich meebrengt (4,11,64). Ten slotte draagt de afwezigheid van een erkenning van een subspecialisatie in autopsiepathologie zeker ook bij tot deze afname (4,110). Het belang van post-mortemonderzoek wordt in het juiste perspectief geplaatst wanneer op wetenschappelijk vlak (grote) discrepanties tussen klinische en post-mortem diagnoses worden aangetoond (8,14,38–40,42). Alsook op menselijk vlak de nabestaanden een laatste antwoord krijgen met het oppperste respect voor de overledene.

Elk ziekenhuis voert kwaliteitsmaatregelen in om het niveau van de geleverde zorg te verzekeren. Bijgevolg, heeft elke afdeling de verantwoordelijkheid om te voldoen aan de vooropgestelde, geaccepteerde normen. Het lijkt daarom opportuun dat er op de afdeling Pathologie naast een laboratorium kwaliteitsbeheersingsprogramma tevens een autopsie kwaliteitsbeheersingsprogramma zou bestaan teneinde de kwaliteitsborging van de autopsie service te bewaken (24,68).

Het doel van een autopsie kwaliteitsbeheersingsprogramma is om het hele autopsieproces in al zijn facetten te toetsen aan de normen van het kwaliteitssysteem. Zodoende wordt dit proces transparanter, traceerbaarder en meer uniform wat zowel de patholoog, de clinicus als de nabestaanden ten goede komt. Het nut van de klinische autopsie is enerzijds de toetsing van de diagnostische en therapeutische competentie aangaande de klinische besluitvorming, behandelingsmethoden en toegepaste technieken (3,131). Anderzijds zijn de besluiten van autopsies een primordiaal element in de statische analyses van de gezondheidsstatistieken die

op zich het fundament zijn voor toekomstige federale beleidsplannen binnen het Volksgezondheidbeleid (3,4,11).

Doelstelling

Het algemeen doel is om toe te werken naar een accreditatie van de klinische autopsie en deze verder op te nemen in het kwaliteitssysteem van de afdeling Zone Medische Diagnostiek van UZ Leuven, meer specifiek voor de dienst Pathologische Ontleedkunde. Het belangrijkste obstakel is het ontbreken van concrete richtlijnen met betrekking tot het beheer van klinische autopsies. Bijgevolg, werd het post-mortem beleid van UZ Leuven geëvalueerd door deze masterthesis op te delen in twee projecten. Het eerste project omvat een diepgaande evaluatie van alle klinische autopsies van 2015 tot en met 2017 in UZ Leuven. Het tweede project omvat een analyse omtrent de verschillen tussen de klinische en forensische autopsie procedures alsook de KPI's[6] om het tijdsproces van klinische autopsies op te volgen en te verbeteren.

Materiaal en methoden

Voor het eerste project werd er een kwantitatief onderzoek uitgevoerd om inzicht te verwerven in alle aangevraagde klinische autopsies van 2015 tot en met 2017, enerzijds onderverdeeld in afdelingen en anderzijds in type autopsies. Vervolgens werd de inhoud van de voorziene klinische informatie, vraag en pathologische conclusie geclassificeerd volgens een vastgesteld model met verwijzing naar literatuur (2,14,38,41,42,115–119). Alle gegevens zijn retrospectief.

Voor het tweede project werd er ook een kwantitatief onderzoek uitgevoerd waarbij alle gegevens prospectief zijn. Aan de ene kant werd de discrepantie tussen klinische en forensische autopsieprocedures geanalyseerd aan de hand van een geparametreerde observationele studie. In de periode van oktober 2017 tot en met mei 2018 werden twintig klinische autopsies, uitgevoerd door negen ASO[7]-pathologen, en 20 forensische autopsies, uitgevoerd door vijf pathologen (waarvan drie ASO's), geanalyseerd. Daarnaast werd een log-gebaseerde longitudinale observationele studie uitgevoerd aan de hand van registraties van relevante activiteiten omtrent klinische autopsies. Er werden 60 klinische autopsies manueel geregistreerd door de mortuariumtechnici tussen november 2017 en april 2018.

Resultaten

Project 1

Deze studie toont de top drie van afdelingen met de hoogste autopsieratio's over de drie jaren heen, namelijk 'Medische intensieve geneeskunde A' (68,9%), 'Hematologie isolatie eenheid (30,4%) en 'Pneumologie en longtransplantatie' (26,9%).

[6] KPI; key performance indicator
[7] ASO; arts-specialist in opleiding

De klinische informatie voorzien op de autopsie aanvraag werd geanalyseerd door het evalueren en categoriseren van de inhoud in *baseline* (75,5%), *event* (80,1%) en c*omplication* (69,1%). Vervolgens werd de klinische vraag gecategoriseerd in aanwezigheid van één doodshypothese (specifieke vraag – 21,6%) of meerdere doodshypotheses (open vraag – 34,4%). In het geval er geen doodshypothese werd voorgesteld, maar circumferentiële informatie werd verstrekt, werd deze gecategoriseerd onder 'aspecifieke vraag' (41,8%). Wanneer er geen klinische informatie werd verstrekt en er geen doodshypothese werd voorgesteld, kon de casus niet verder worden geanalyseerd (2,1%).

Ten tweede werd de aard van de vraag geanalyseerd en gecategoriseerd. Voor elke vraag werd onderzocht naar welke informatie (*baseline, event* en *complication*) de clinicus verwees in de klinische vraag op de autopsieaanvraag. De associatie tussen de verstrekte klinische informatie omtrent de *baseline*, *event* en *complication* van de patiënt en de vraag hieromtrent, was zeer significant. Het besluit van het autopsieverslag gaf een antwoord op de klinische vraag in 88,8% van de gevallen. Geen antwoord (11,2%) op de klinische vraag kan te wijten zijn aan de ontoereikendheid van het autopsiebesluit of -verslag. Een inconclusief antwoord op specifieke en open vragen werd ook gecategoriseerd onder geen antwoord.

Vervolgens werd de concordantie tussen de autopsieaanvraag en het autopsiebesluit bepaald. Voor de specifieke en open vragen werd de voorgestelde major zonder minors in 46,2% van de gevallen bevestigd en met minors in 19,5%. Verder werd in 11,2% van de gevallen een nieuwe major zonder minors gevonden en met minors in 7,7%. In 5,3% van de gevallen werd de major niet vermeld in het autopsiebesluit, maar wel in het autopsieverslag. Het autopsieverslag werd ontoereikend geacht in 2,4% van de gevallen omdat er geen uitgebreid onderzoek werd uitgevoerd om de major te vinden. Ten slotte was het autopsieverslag inconclusief in 7,7% van de gevallen. Voor de aspecifieke vragen werd in 25,2% van de gevallen een onverwachte major gevonden. Verder werd in 70,1% van de gevallen een verwachte major gevonden. In 2,8% van de gevallen werd de major niet vermeld in het autopsiebesluit, maar wel in het autopsieverslag. Het autopsieverslag werd voor de aspecifieke vragen ontoereikend geacht in 1,9% van de gevallen omdat er geen uitgebreid onderzoek werd uitgevoerd om de major te vinden.

Er werd geen significante associatie gevonden tussen de verstrekte klinische informatie en de major. Verder, werd er een significante associatie gevonden tussen de verstrekte klinische informatie omtrent de *baseline* en het al dan niet verkrijgen van een conclusie. Vervolgens werd er geen associatie gevonden tussen de major en de aard van de vraag met betrekking tot de *baseline, event* en *complication*. Tenslotte werd in de beperkte populatie geen associatie gevonden tussen de waarschijnlijkheid van een nieuwe major en de autopsieratio.

Project 2

Tijdens de administratie, identificeerde de patholoog de patiënt slechts in 20% van de klinische autopsies, terwijl in de forensische autopsies de overledene in 100% van de gevallen door de forensisch patholoog werd geïdentificeerd. Vervolgens werd een externe inspectie uitgevoerd bij minder dan 45% van de klinische autopsies, terwijl dit in 100% van de gevallen werd uitgevoerd door de forensisch patholoog. Er was een significant verschil tussen de klinische en forensische autopsies voor de patholoog, maar geen significant verschil voor de mortuariumtechnici. Hierna vond de interne examinatie plaats, waarbij de mortuariumtechnici een grotere rol speelden dan de patholoog. In tegenstelling tot de forensische autopsie waarbij de forensisch patholoog een grotere rol speelde dan de mortuariumtechnici. Verder werden bepaalde stappen nauwelijks uitgevoerd tijdens de klinische autopsie, namelijk het verzamelen van lichaamsvloeistoffen, het controleren op pneumothorax en het borstbeen. Tijdens het thoracaal en gastrohepatisch blok speelde de (forensische) patholoog de grootste rol (≥ 95% van de gevallen) in zowel de klinische als forensische autopsie in tegenstelling tot de mortuariumtechnici. Tenslotte speelden de mortuariumtechnici een kleinere rol bij het urogenitaal blok tijdens zowel de klinische als forensische autopsies. Bij de klinische autopsies werden bepaalde stappen nauwelijks (≤ 22% van de gevallen) uitgevoerd door de patholoog vanwege het niet geheel verwijderen van het urogenitale blok in tegenstelling tot de forensische autopsies, waarbij de meeste stappen in bijna 100% van de gevallen werden uitgevoerd.

Het tijdsproces van de administratieve keten vanaf het overlijden van een patiënt tot autopsie heeft een mediaan van 23 uur en 12 minuten. Meer specifiek, in 30,2% van de gevallen werd de patiënt na de maximaal ingestelde tijd van 1 uur uitgeschreven van de dienst. Vervolgens duurde het in 18,2% van de gevallen langer dan 17 uur voordat de overleden patiënt in het mortuarium arriveerde. In 52,4% van de gevallen werd de patholoog pas na 4 uur op de hoogte gebracht van een autopsie. Voorts had de patholoog in 65% van de gevallen slechts minder dan 1 uur voorbereidingstijd. Tenslotte resulteerde in 41,0% van de gevallen een 'late' notificatietijd (> 4 uur) van de patholoog in een 'korte' voorbereidingstijd (< 1 uur).

Discussie

Project 1

Deze studie toonde geen significant verband aan tussen de waarschijnlijkheid van een nieuwe major en de autopsieratio. Dit vindt zijn verklaring mogelijk in enerzijds de lage onderzochte populatie alsook in de internationaal gepubliceerde ‘overall new major’ waarbij ondanks maximale diagnostische technische onderzoeken autoptisch toch een nieuwe major wordt gevonden. Bijgevolg lijkt het er op dat de waarschijnlijkheid van een nieuwe major niet voorspeld kan worden aan de hand van de autopsieratio van een afdeling.

Verder toonde deze studie aan dat in het algemeen de autopsieaanvragen voldoende ingevuld waren voor de klinische informatie (*baseline, event* en *complication*). Voorts, was de associatie tussen deze klinisch informatie en aard van de klinische vraag zeer significant voor zowel *baseline* als *event* als *complication*. Bovendien werd er geen verband gevonden tussen de bevestigde of nieuwe major en de verstrekte klinische informatie (*baseline, event* en *complication*). Toch zien we dat voldoende klinische informatie op de autopsieaanvraag leidt tot een grondigere besluitvorming van de zaak. Meer specifiek voor de baseline, wat impliceert dat het vermelden van de medische geschiedenis van de patiënt op de autopsie aanvraag van essentieel belang is. Vanwege de niet-vergelijkende aard van dit onderzoek kunnen de resultaten niet worden gecorreleerd met cijfers uit de literatuur.

Project 2

Door middel van een vergelijking tussen de forensische pathologen, werkend met een uniforme, ISO 17020-geaccrediteerde procedure, en de geobserveerde klinische pathologen, kon opgemerkt worden dat in het laatste de externe lijkschouwing te hesitant werd uitgevoerd en dat sommige interne secties niet werden uitgevoerd (76). Bijgevolg, zou het een grote bijdrage zijn aan de autopsieprocedure als de mortuariumtechnici konden deelnemen en de pathologen ondersteunen tijdens bepaalde delen van de autopsie zoals bijvoorbeeld de externe inspectie. Aangezien de autopsieprocedure deel uitmaakt van de analytische fase, is het van fundamenteel belang dat er een geharmoniseerde procedure wordt gevolgd zodoende de klinische autopsie een bekwame en betrouwbare parameter kan worden om de huidige diagnostische hulpmiddelen en therapieën in de gezondheidszorg accuraat te beoordelen.

Eventuele vertragingen in de administratieve keten vanaf het overlijden van een patiënt tot autopsie hebben pejoratieve repercussies op de werking van het mortuarium, de uitvoerende patholoog alsook op de nabestaanden. De harmonisatie van dit proces is een belangrijk onderdeel van de post-autopsiezorg en daarmee de post-analytische fase.

<u>Conclusie</u>

Dit onderzoek heeft geleid tot het opstellen van een SOP voor klinische autopsies met naast een sequentiële beschrijving van elke stap tevens geassocieerde voorstellen aangaande het autopsie aanvraagformulier, staalafname en registratie. Hierbij is de betrachting een gestandaardiseerde aanpak van het post-mortem onderzoek met integratie binnen het kwaliteitssysteem. We hopen dat het bewustzijn, de duidelijkheid en de bijdrage met betrekking tot klinische autopsies zullen toenemen in UZ Leuven, aangezien de kwaliteit van de gezondheidszorg niet alleen afhankelijk is van de diagnostische en therapeutische methoden, maar ook van de beoordeling ervan door middel van post-mortem onderzoeken.

List of figures

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I Addendum: Approval institutional review board

KU LEUVEN

UZ LEUVEN

GROEP BIOMEDISCHE WETENSCHAPPEN
HERESTRAAT 49, O&N II – BUS 700
BE-3000 LEUVEN

English version below.

Ons kenmerk: MP001468
Uw kenmerk: Masterproef studie: Klinische en gerechtelijke autopsies: wie kan wat van elkaar leren ?
Leuven, 20-11-2017

DEFINITIEF GUNSTIG ADVIES

Geachte Els Dequeker
Geachte Sarah Ahannach

De Onderwijs-Begeleidings-Commissie voor Medische Ethiek (OBC) heeft in delegatie van het Ethisch Comité voor Onderzoek van de Universitaire Ziekenhuizen KU Leuven (EC) het vermeld protocol onderzocht en besproken op haar vergadering van 20-11-2017

De Commissie heeft geen bezwaar tegen het project mits vertrouwelijke behandeling van de gegevens en naleving van de Belgische wetgeving omtrent privacy.

De Commissie is van oordeel dat er vanuit ethisch standpunt geen bezwaren zijn bij de voorgestelde studie, zoals ze werd beschreven in het protocol. Ze verleent dan ook een gunstig advies over deze studie.

Dit gunstig advies van de Commissie houdt niet in dat zij de verantwoordelijkheid voor de geplande studie op zich neemt. U blijft hiervoor dus zelf verantwoordelijk. Bovendien dient u er over te waken dat uw mening als betrokken onderzoeker wordt weergegeven in publicaties, rapporten voor de overheid enz., die het resultaat zijn van dit onderzoek.

U wordt eraan herinnerd dat bij klinische studies iedere door u waargenomen ernstige verwikkeling onmiddellijk zowel aan de opdrachtgever (desgevallend de producent) als aan het Ethisch Comité moet worden gemeld, ook al is het oorzakelijke verband met de studie onduidelijk.

Dit gunstig advies betreft de indiening van 11-11-2017 en wordt gegeven voor de duur van de Masterproef van de betrokken student(en).

Elke wijziging aan het protocol doet dit gunstig advies vervallen. U dient in dat geval een amendement voor advies voor te leggen aan de commissie die eerder uw dossier goedkeurde.

Met vriendelijke groet,

Prof. dr. Paul Herijgers
Voorzitter
Onderwijs-Begeleidings-Commissie voor Medische Ethiek KU Leuven

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Aandachtspunten (indien van toepassing)

Het Ethisch Comité wenst de hoofdonderzoeker/promotor van de studie te wijzen op zijn/haar verantwoordelijkheid betreft de privacy van de persoons-/patiëntgegevens bij contact met de patiënt

II Addendum: Flowcharts for data collection

1. Flowchart systematic literature overview

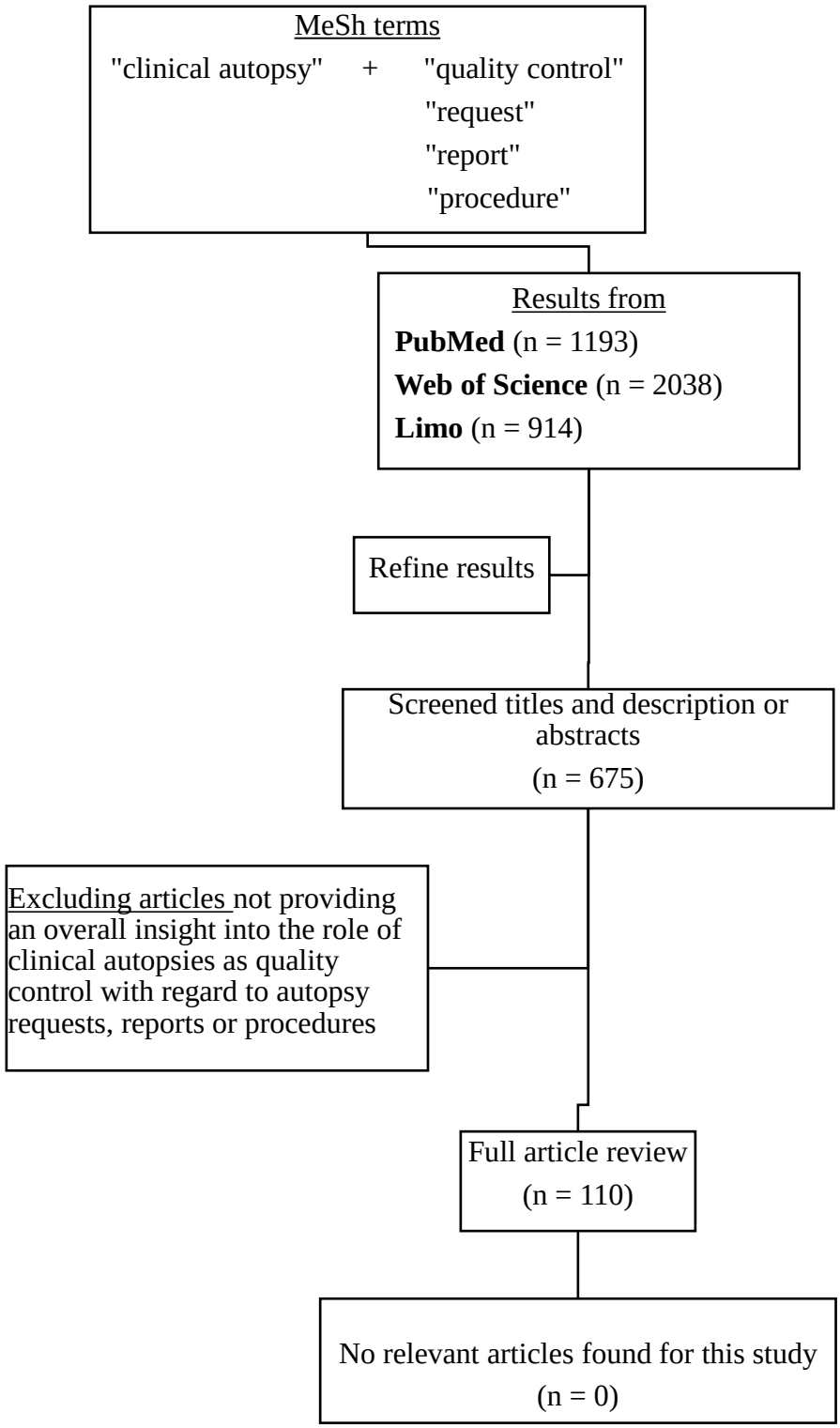


Figure 1: Flowchart of systematic review of articles from PubMed, Web of Science and Limo between 2007 and 2017 – searching for articles with a similar scope as this study, namely providing an overall insight into the role of clinical autopsies as quality control with regard to autopsy requests, reports or procedures.

2. Flowchart queries and data-cleaning

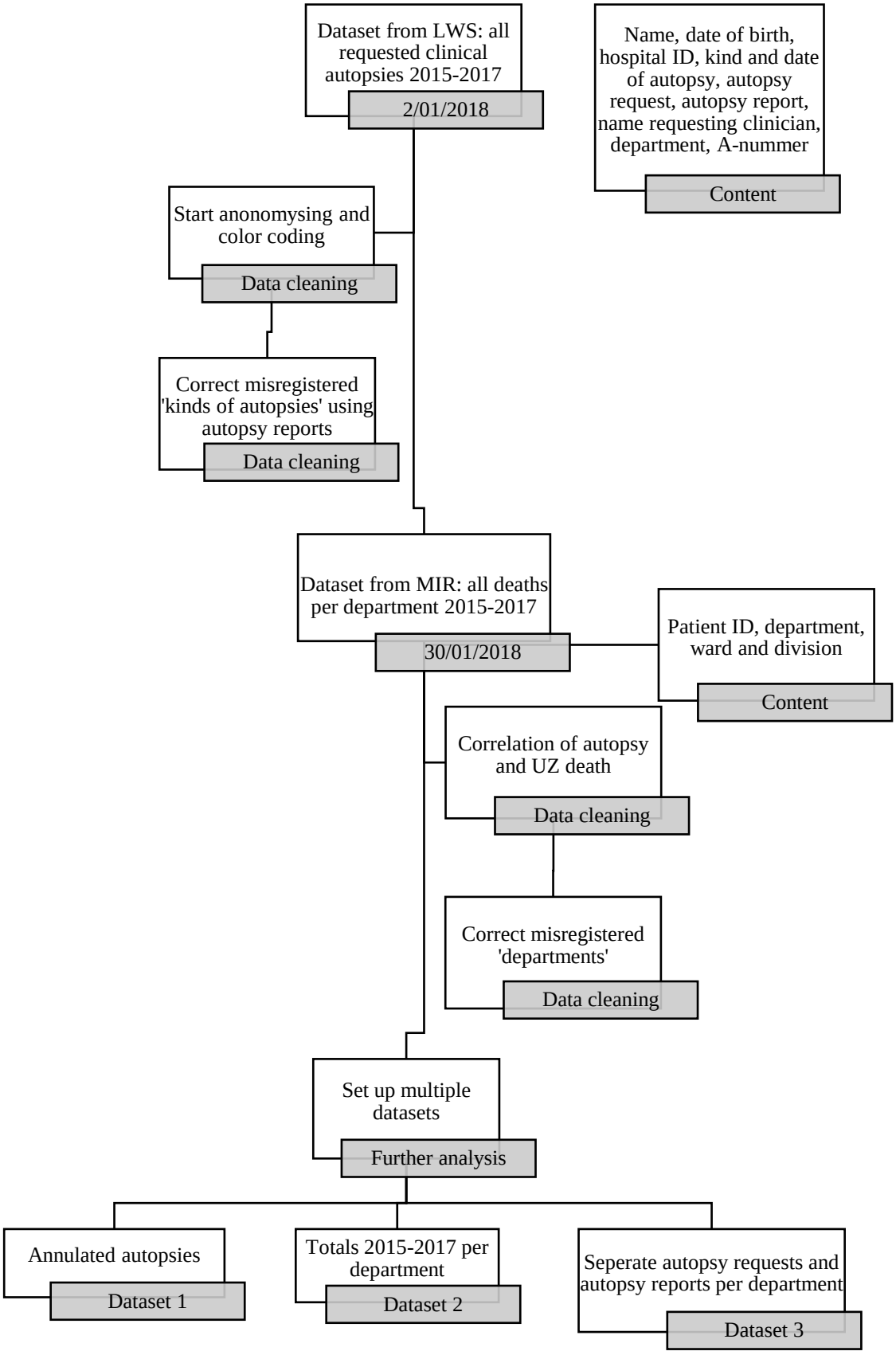


Figure 2: Flowchart of requested queries and data-cleaning

III Addendum: Schemes for data analysis

1. *Model study approach*

Common literature revolves around the medical assessment by comparing pre-mortem clinical diagnoses and post-mortem autopsy findings (14). These studies investigate several parameters around the medical assessment of a hospital. In contrary to this study, which revolves around the quality assessment of the post-mortem policy of UZ Leuven (figure 3).

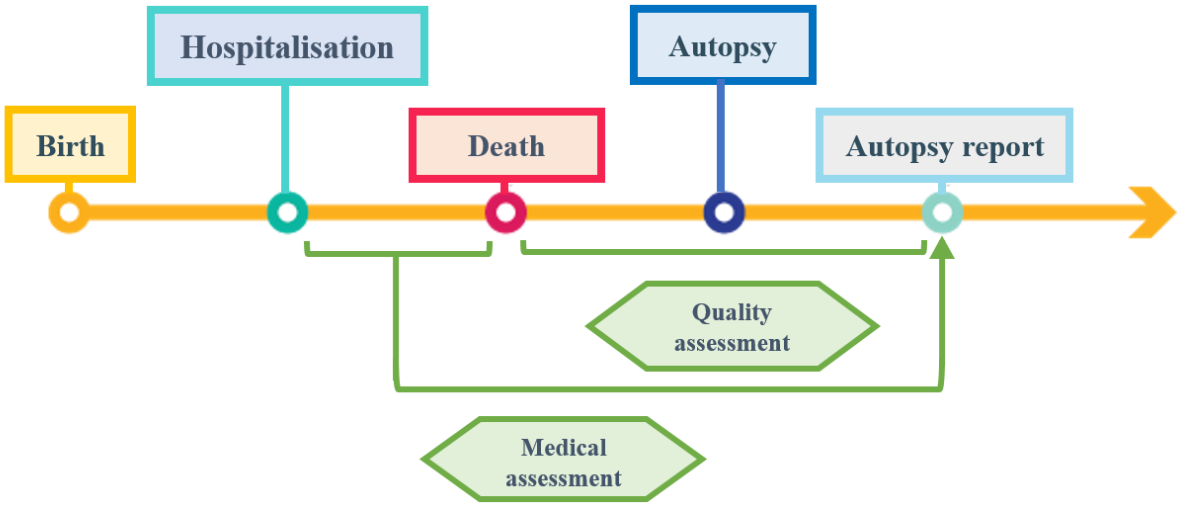


Figure 3: Schematic representation dividing the focal point of common literature (Medical assessment) and this master's thesis (Quality assessment).

2. *Classification clinical autopsies*

Table 1: Legend for analysis of the autopsy request divided in clinical information and clinical question

Clinical information	
B	Baseline: history of patient
E	Event: reason for hospitalisation
C	Complication: condition that aggravates an already present disease
Clinical question	
S	Specific question: a death hypothesis is presented
O	Open question: multiple death hypotheses are presented
A	Aspecific question: no death hypothesis is presented; only circumferential information is provided
N	No question: no information or question is submitted

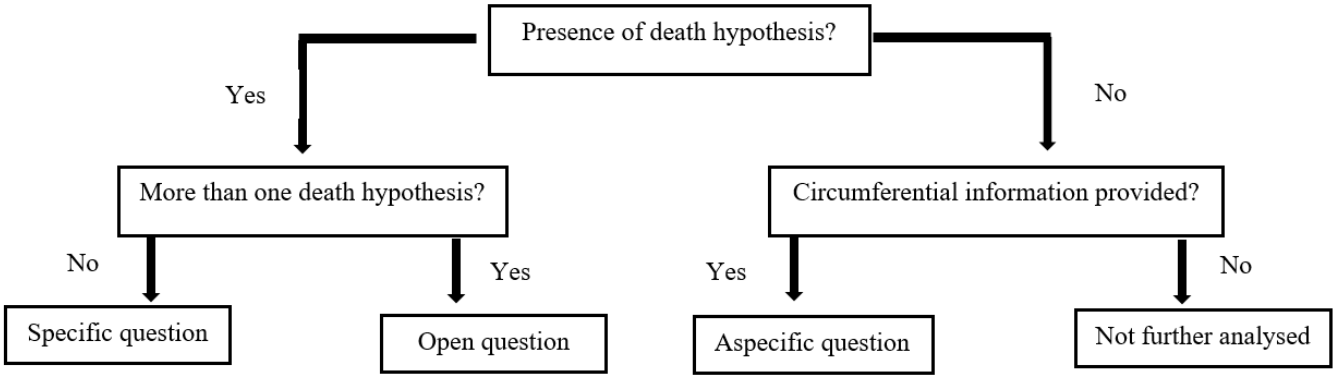


Figure 4: Schematic representation of the classification of the clinical question on the autopsy request

Table 2: Legend for analysis of the autopsy report's conclusion

Pathological answer	
0	The clinician's question was not answered.
1	The clinician's question was answered.

Table 3: Legend for analysis of concordance between autopsy request and autopsy report's conclusion

Specific and open questions	
C1	The presented major by the clinician on the autopsy request was confirmed by the autopsy report's conclusion and no other minors were found.
C2	The presented major by the clinician on the autopsy request was confirmed by the autopsy report's conclusion and other minors were found.
C3	The presented major by the clinician on the autopsy request was contradicted by the autopsy report's conclusion and therefore a new major is presented. Other minors were not found.
C4	The presented major by the clinician on the autopsy request was contradicted by the autopsy report's conclusion and therefore a new major is presented. Other minors were found.
C5	The autopsy report's conclusion was inadequate: the major finding was not mentioned in the conclusion but could be found in the report.
C6	The autopsy report's conclusion was inadequate: no extensive examination was carried out to find the major.
C7	The autopsy report was inconclusive
Aspecific questions	
X1	An unexpected major was found.
X2	An expected major was found.
X3	The autopsy report's conclusion was inadequate: the major finding was not mentioned in the conclusion but could be found in the report.
X4	The autopsy report's conclusion was inadequate: no extensive examination was carried out to find the major.

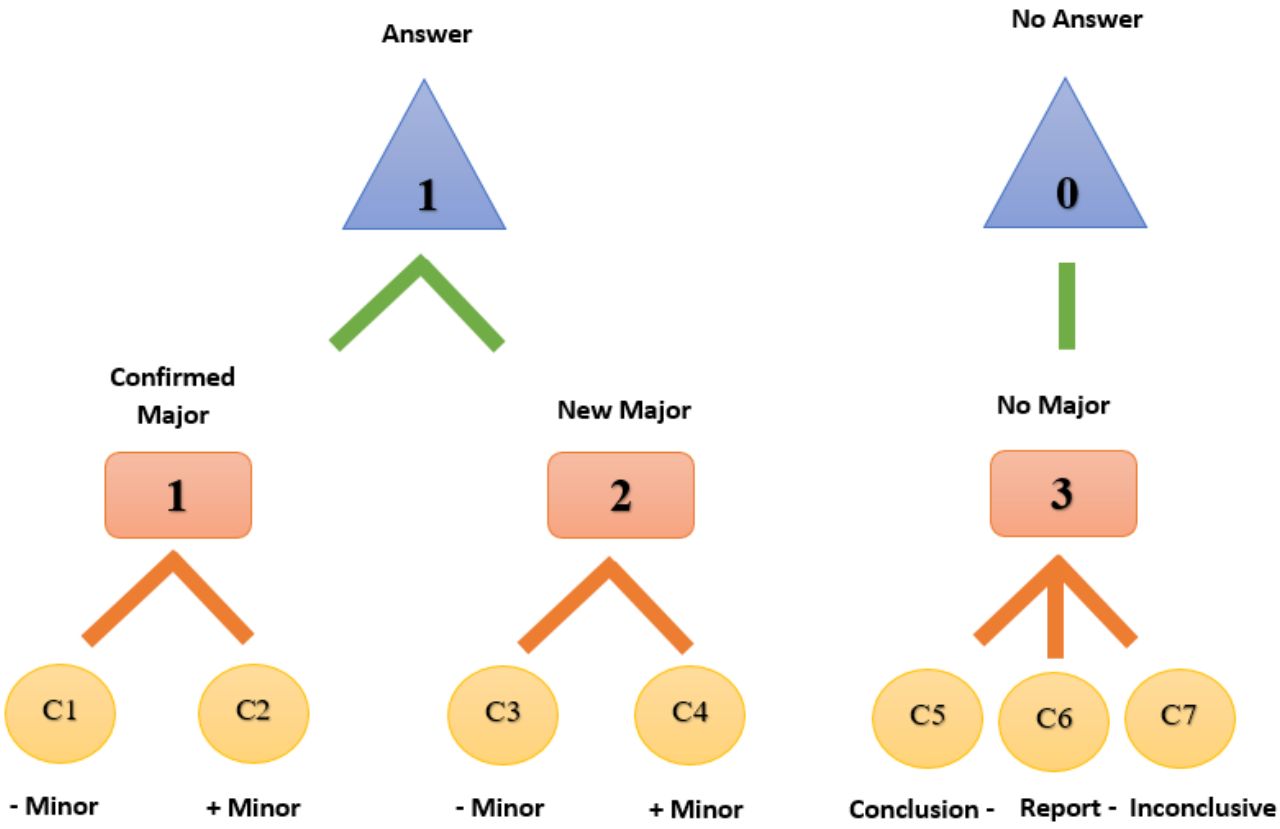


Figure 5: Schematic representation for analysis of autopsy reports for specific and open questions

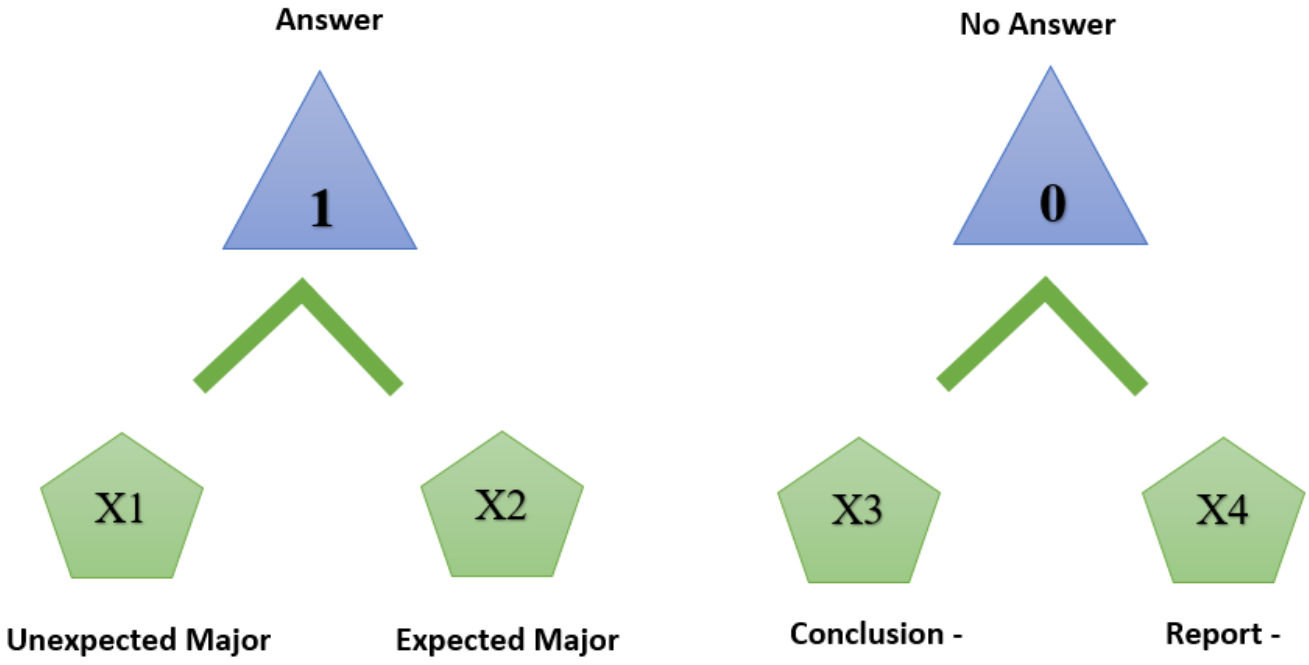


Figure 6: Schematic representation for analysis of autopsy reports for aspecific questions

IV Addendum: Supplementary figures and tables

1. List of autopsy indications

Table 4: Guidelines regarding the indications for requesting a clinical autopsy in The UC Davis School of Medicine in California as well as The Miriam Hospital and Rhode Island Hospital in association with Brown University (70,71).

List of indications for requesting a clinical autopsy
Unknown or unanticipated cause of death on clinical grounds
Investigations regarding the effectiveness of therapy/extent of disease
Disclosure of a known or suspected illness which may affect survivors or recipients of transplanted organs
Relatives are concerned and require reassurance
Suspicion of genetic diseases
Death during clinical trials
Sudden, unexpected or unexplained deaths in the hospital that are not subject to forensic medical jurisdiction
Unexpected or unexplained deaths during or following any dental, medical or surgical diagnostic or therapeutic procedure
Deceased suffered from medical condition that is of educational interest
Deceased suffered from high risk infection or contagious disease
Suspicion of environmental or occupational hazards
Obstetric deaths
Natural deaths that are ordinarily subject to forensic medical jurisdiction; - Persons dead on arrival at the hospital; - Deaths within 24 hours of admission in the hospital; - Deaths in which person sustained an injury while being hospitalized;
Consultations from outside facilities with specific autopsy coverage contracts

2. *Types of autopsies*

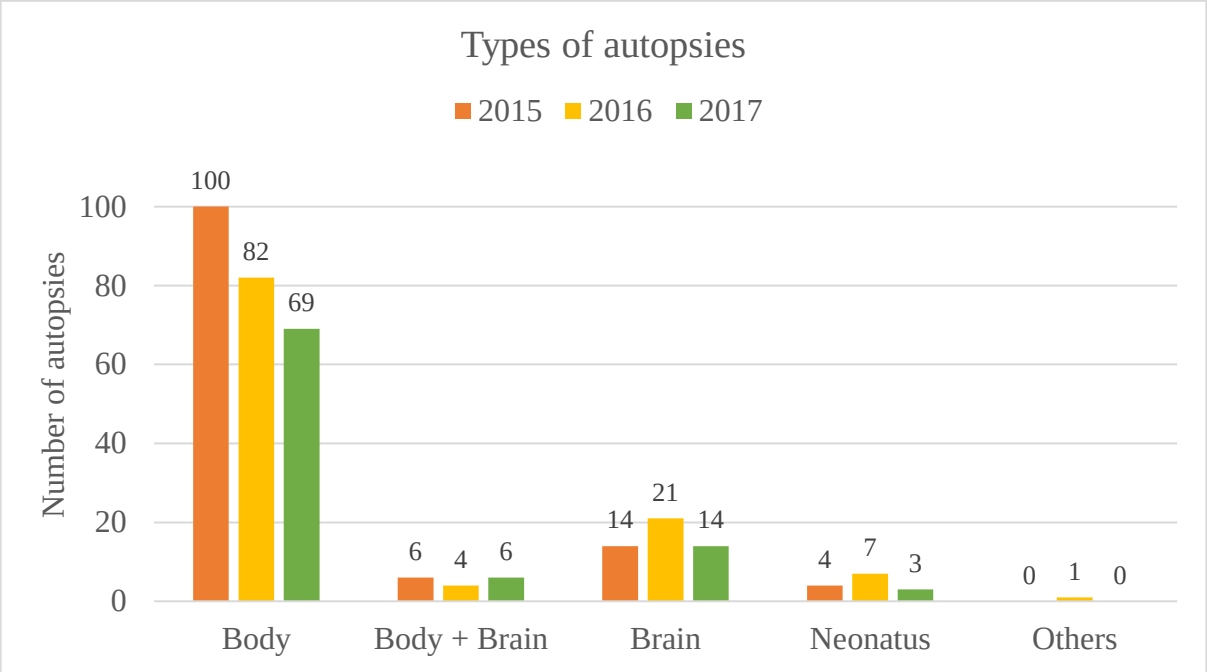


Figure 7: Types of autopsies (2015-2017) of all executed autopsies with a finished autopsy report on 1st April 2018. The foetal autopsies were excluded from this overview.

3. *Foetal autopsies*

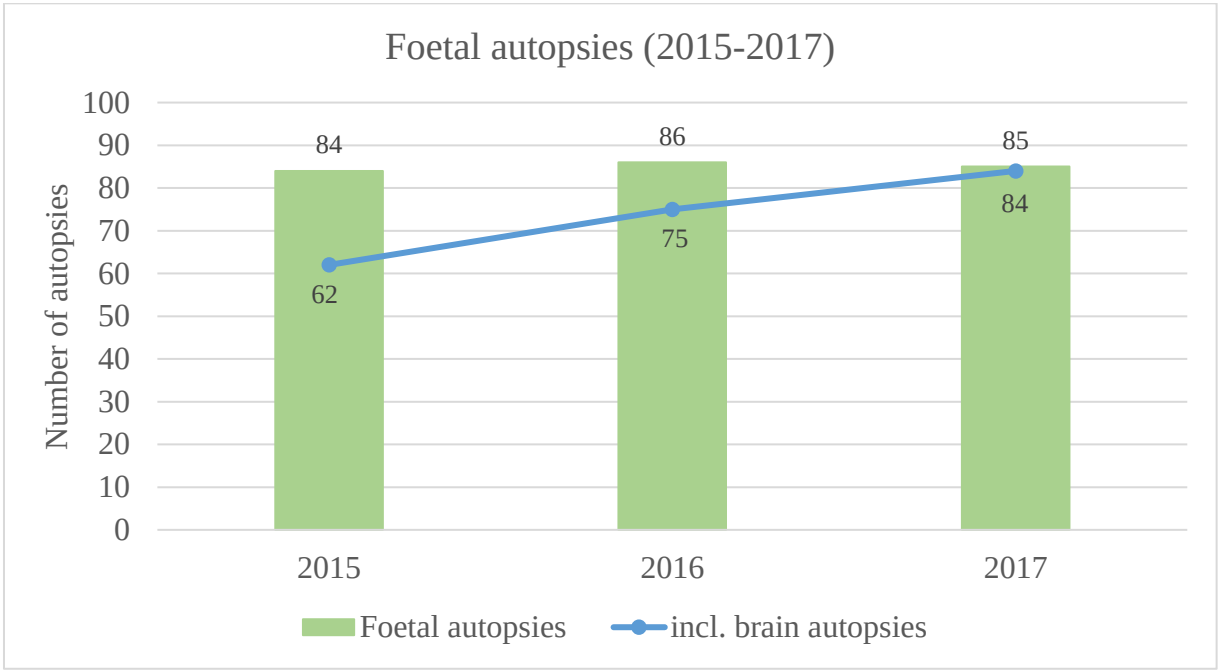


Figure 8: Foetal autopsies performed between 2015-2017

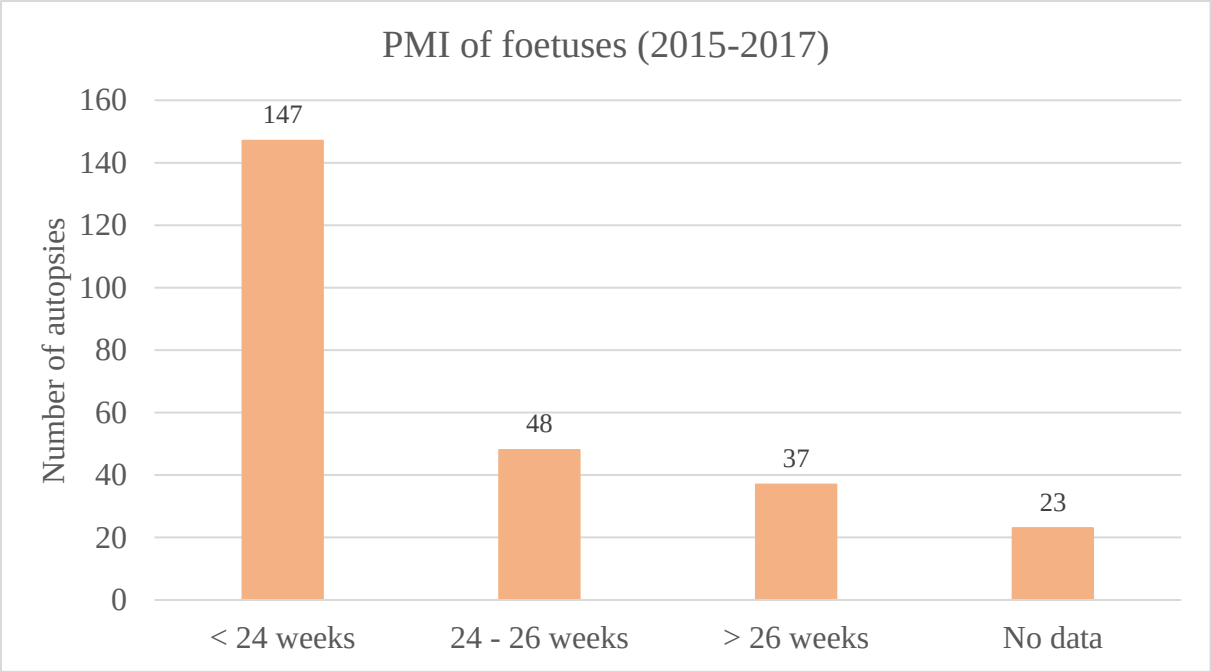


Figure 9: Post-menstrual interval (PMI) of foetuses undergoing an autopsy.
24 weeks = scientific threshold for viability of foetus; 26 = legal threshold for viability of foetus

4. Overview of all clinical autopsies per department 2015-2017

Table 5: Clinical autopsies on in-house deceased patients of 2015 in UZ Leuven. Only departments that requested an autopsy between 2015 and 2017 are presented.

Clinical autopsies 2015				
Department	Executed autopsies	Annulated autopsies	Total requested autopsies	Total deaths
Cardiac intensive care	2	0	2	46
Cardiac surgery	2	1	3	6
Cardiology + heart transplantation (ambulatory)	1	0	1	16
Digestive oncology	3	0	3	48
Emergency service	8	3	11	98
Gastroenterology	1	0	1	15
Gastroenterology + abdominal surgery	0	0	0	6
General internal medicine and allergy	1	0	1	13
General medical oncology	1	0	1	46
General medical oncology	0	0	0	37
Geriatrics	0	0	0	43
Haematology	0	0	0	45
Haematology isolation unit	3	0	3	7
Hepatology	0	0	0	22
Intensive care A	7	0	7	43
Intensive care B	2	0	2	60
Intensive care C and intensive care children	1	0	1	20
Intensive care D and burn centre	1	0	1	23
Intensive medicine E and neuro intensive care	0	0	0	10
Kidney, liver, pancreas and intestinal transplantation	0	0	0	8
Medical intensive care (MIC) A	66	21	87	110
Medical intensive care (MIC) B	1	0	1	48
Neonatal intensive care	2	0	2	21
Nephrology	1	0	1	32
Neurology and general internal medicine	2	0	2	16
Nose, throat and ear diseases, facial and neck surgery + dentistry	0	0	0	3
Operating room (OR)	0	0	0	10
Palliative care unit	0	1	1	187
Pneumology	0	0	0	52
Pneumology + lung transplantation	3	0	3	11
Pneumology and muco	1	0	1	26
Post-anaesthesia care unit	0	1	1	7
Post-cardiac intensive care	0	0	0	9
Rheumatology + endocrinology	0	0	0	5
Totaal	109	27	136	1380

Table 6: Clinical autopsies on in-house deceased patients of 2016 in UZ Leuven. Only departments that requested an autopsy between 2015 and 2017 are presented.

Clinical autopsies 2016				
Department	Executed autopsies	Annulated autopsies	Total requested autopsies	Total deaths
Cardiac intensive care	2	3	5	71
Cardiac surgery	0	0	0	2
Cardiology + heart transplantation (ambulatory)	0	0	0	15
Digestive oncology	1	0	1	53
Emergency service	2	1	3	85
Gastroenterology	0	0	0	12
Gastroenterology + abdominal surgery	1	0	1	12
General internal medicine and allergy	1	0	1	10
General medical oncology	1	0	1	44
General medical oncology	2	0	2	38
Geriatrics	1	0	1	47
Haematology	2	0	2	44
Haematology isolation unit	3	1	4	8
Hepatology	1	0	1	28
Intensive care A	2	2	4	36
Intensive care B	2	0	2	35
Intensive care C and intensive care children	2	0	2	28
Intensive care D and burn centre	1	0	1	11
Intensive medicine E and neuro intensive care	1	0	1	12
Kidney, liver, pancreas and intestinal transplantation	1	0	1	6
Medical intensive care (MIC) A	56	30	86	142
Medical intensive care (MIC) B	1	1	2	44
Neonatal intensive care	6	0	6	12
Nephrology	0	0	0	25
Neurology and general internal medicine	2	0	2	13
Nose, throat and ear diseases, facial and neck surgery + dentistry	1	0	1	4
Operating room (OR)	1	0	1	5
Palliative care unit	2	1	3	174
Pneumology	1	0	1	69
Pneumology + lung transplantation	3	0	3	9
Pneumology and muco	0	0	0	22
Post-anaesthesia care unit	0	0	0	1
Post-cardiac intensive care	0	0	0	3
Rheumatology + endocrinology	1	0	1	3
Totaal	100	39	139	1361

Table 7: Clinical autopsies on in-house deceased patients of 2017 in UZ Leuven. Only departments that requested an autopsy between 2015 and 2017 are presented.

Clinical autopsies 2017				
Departments	Executed autopsies	Annulated autopsies	Total requested autopsies	Total deaths
Cardiac intensive care	7	3	10	67
Cardiac surgery	0	0	0	5
Cardiology + heart transplantation (ambulatory)	0	0	0	11
Digestive oncology	2	0	2	46
Emergency service	5	0	5	113
Gastroenterology	0	0	0	15
Gastroenterology + abdominal surgery	1	0	0	17
General internal medicine and allergy	0	0	0	13
General medical oncology	0	0	0	49
General medical oncology	2	0	2	41
Geriatrics	0	0	0	48
Haematology	0	0	0	41
Haematology isolation unit	0	0	0	8
Hepatology	1	0	1	19
Intensive care A	2	0	2	45
Intensive care B	4	0	4	69
Intensive care C and intensive care children	2	0	2	20
Intensive care D and burn centre	0	0	0	21
Intensive medicine E and neuro intensive care	1	0	1	13
Kidney, liver, pancreas and intestinal transplantation	0	0	0	6
Medical intensive care (MIC) A	68	31	99	143
Medical intensive care (MIC) B	0	0	0	32
Neonatal intensive care	3	0	3	17
Nephrology	0	1	1	13
Neurology and general internal medicine	2	0	2	16
Nose, throat and ear diseases, facial and neck surgery + dentistry	0	0	0	0
Operating room (OR)	0	0	0	7
Palliative care unit	0	0	0	182
Pneumology	0	0	0	60
Pneumology + lung transplantation	1	0	1	6
Pneumology and muco	0	0	0	16
Post-anaesthesia care unit	0	0	0	2
Post-cardiac intensive care	0	1	1	6
Rheumatology + endocrinology	0	0	0	3
Totaal	95	36	131	1424

5. *Autopsy rate per department*

Table 8: Autopsy rates per department (2015-2017)

Department Percentage (%) $\left(\frac{No.of autopsies}{No.of deaths}\right)$	2015	2016	2017
Cardiac intensive care	4.4 (2/46)	7.0 (5/71)	14.9 (10/67)
Cardiac surgery	50.0 (3/6)	0.0 (0/2)	0.0 (0/5)
Cardiology + heart transplantation (ambulatory)	6.3 (1/16)	0.0 (0/15)	0.0 (0/11)
Digestive oncology	6.3 (3/48)	1.9 (1/53)	4.4 (2/46)
Emergency service	11.2 (11/98)	3.5 (3/85)	4.4 (5/113)
Gastroenterology	6.7 (1/15)	0.0 (0/12)	0.0 (0/15)
Gastroenterology + abdominal surgery	0.0 (0/6)	8.3 (1/12)	0.0 (0/17)
General internal medicine and allergy	7.9 (1/13)	10.0 (1/10)	0.0 (0/13)
General medical oncology	1.2 (1/83)	3.7 (3/82)	2.2 (2/90)
Geriatrics	0.0 (0/43)	2.1 (1/47)	0.0 (0/48)
Haematology	0.0 (0/45)	4.6 (2/44)	0.0 (0/41)
Haematology isolation unit	42.9 (3/7)	50.0 (4/8)	0.0 (0/8)
Hepatology	0.0 (0/22)	3.6 (1/28)	5.3 (1/19)
Intensive care A	16.3 (7/43)	11.1 (4/36)	4.4 (2/45)
Intensive care B	3.3 (2/60)	5.7 (2/35)	5.8 (4/69)
Intensive care C and intensive care children	5.0 (1/20)	7.1 (2/28)	10.0 (2/20)
Intensive care D and burn centre	4.4 (1/23)	9.1 (1/11)	0.0 (0/21)
Intensive medicine E and neuro intensive care	0.0 (0/10)	8.3 (1/12)	7.7 (1/13)
Kidney, liver, pancreas and intestinal transplantation	0.0 (0/8)	16.7 (1/6)	0.0 (0/6)
Medical intensive care (MIC) A	79.1 (87/110)	60.6 (86/142)	69.2 (99/143)
Medical intensive care (MIC) B	2.1 (1/48)	4.6 (2/44)	0.0 (0/32)
Neonatal intensive care	9.5 (2/21)	50.0 (6/12)	17.7 (3/17)
Nephrology	3.1 (1/32)	0.0 (0/25)	7.7 (1/13)
Neurology and general internal medicine	12.5 (2/16)	15.4 (2/13)	12.5 (2/16)
Nose, throat and ear diseases, facial and neck surgery + dentistry	0.0 (0/3)	25.0 (1/4)	0.0 (0/0)
Operating room (OR)	0.0 (0/10)	20.0 (1/5)	0.0 (0/7)
Palliative care unit	0.5 (1/187)	1.7 (3/174)	0.0 (0/182)
Pneumology	0.0 (0/52)	1.5 (1/69)	0.0 (0/60)
Pneumology + lung transplantation	27.3 (3/11)	33.3 (3/9)	16.7 (1/6)
Pneumology and muco	3.9 (1/26)	0.0 (0/22)	0.0 (0/16)
Post-anaesthesia care unit	14.3 (1/7)	0.0 (0/1)	0.0 (0/2)
Post-cardiac intensive care	0.0 (0/9)	0.0 (0/3)	16.7 (1/6)
Rheumatology + endocrinology	0.0 (0/5)	33.3 (1/3)	0.0 (0/3)
Total of UZ Leuven	**9.9 (136/1380)**	**10.2 (139/1361)**	**9.6 (136/1424)**

6. *Clinical information on autopsy requests per department*

Table 9: Clinical information provided on autopsy request per department (2015-2017)

Department	Total performed autopsies	No. of times baseline was stated (%)	No. of times event was stated (%)	No. of times complication was stated (%)
Cardiac intensive care	8	6 (75)	5 (62)	8 (100)
Cardiac surgery	2	1 (50)	2 (100)	1 (50)
Cardiology + heart transplantation (ambulatory)	1	1 (100)	1 (100)	0 (0)
Digestive oncology	5	5 (100)	4 (80)	2 (40)
Emergency service	15	11 (73)	13 (87)	10 (67)
Gastroenterology	1	0 (0)	1 (100)	0 (0)
Gastroenterology + abdominal surgery	1	1 (100)	1 (100)	0 (0)
General internal medicine and allergy	2	1 (50)	2 (100)	0 (0)
General medical oncology	5	5 (100)	2 (40)	4 (80)
Geriatrics	1	1 (100)	0 (0)	0 (0)
Haematology	2	2 (100)	2 (100)	0 (0)
Haematology isolation unit	6	5 (83)	6 (100)	4 (67)
Hepatology	2	1 (50)	2 (100)	0 (0)
Intensive care A	11	7 (64)	9 (82)	9 (82)
Intensive care B	8	2 (25)	8 (100)	6 (75)
Intensive care C and intensive care children	4	4 (100)	3 (75)	3 (75)
Intensive care D and burn centre	2	1 (50)	2 (100)	2 (100)
Intensive medicine E and neuro intensive care	2	2 (100)	1 (50)	0 (0)
Kidney, liver, pancreas and intestinal transplantation	1	1 (100)	1 (100)	0 (0)
Medical intensive care (MIC) A	171	133 (78)	145 (85)	135 (79)
Medical intensive care (MIC) B	2	2 (100)	2 (100)	2 (100)
Neonatal intensive care	11	10 (91)	11 (100)	9 (82)
Nephrology	1	1 (100)	0 (0)	1 (100)
Neurology and general internal medicine	5	5 (100)	1 (20)	1 (20)
Nose, throat and ear diseases, facial and neck surgery + dentistry	1	0 (0)	1 (100)	1 (100)
Operating room (OR)	1	0 (0)	1 (100)	0 (0)
Palliative care unit	2	2 (100)	1 (100)	0 (0)
Pneumology	1	1 (100)	1 (100)	1 (100)
Pneumology + lung transplantation	6	5 (83)	4 (67)	2 (33)
Pneumology and muco	1	1 (100)	0 (0)	1 (100)
Post-anaesthesia care unit *	0	-	-	-
Post-cardiac intensive care *	0	-	-	-
Rheumatology + endocrinology	1	1 (100)	1 (100)	0 (0)
Total of UZ Leuven	**282**	**212 (75)**	**226 (80)**	**195 (69)**

**The requested autopsy was annulated*

Table 10: Clinical information provided on autopsy request per department of 2015

Department 2015	Total performed autopsies	No. of times baseline was stated (%)	No. of times event was stated (%)	No. of times complication was stated (%)
Cardiac intensive care	2	2 (100)	2 (100)	2(100)
Cardiac surgery	2	1 (50)	2 (100)	1 (50)
Cardiology + heart transplantation (ambulatory)	1	1 (100)	1 (100)	0 (0)
Digestive oncology	3	3 (100)	2 (67)	2 (67)
Emergency service	8	6 (75)	7 (88)	7 (87)
Gastroenterology	1	0 (0)	1 (100)	0 (0)
Gastroenterology + abdominal surgery	0	-	-	-
General internal medicine and allergy	1	1 (100)	1 (100)	0 (0)
General medical oncology	1	1 (100)	0 (0)	1(100)
Geriatrics	0	-	-	-
Haematology	0	-	-	-
Haematology isolation unit	3	3(100)	3(100)	2(67)
Hepatology	0	-	-	-
Intensive care A	7	5 (71)	6(86)	5 (71)
Intensive care B	2	1(50)	2(100)	1(50)
Intensive care C and intensive care children	1	1(100)	1 (100)	0(0)
Intensive care D and burn centre	1	0(0)	1 (100)	1 (100)
Intensive medicine E and neuro intensive care	0	-	-	-
Kidney, liver, pancreas and intestinal transplantation	0	-	-	-
Medical intensive care (MIC) A	64	54 (84)	52 (81)	50 (78)
Medical intensive care (MIC) B	1	1(100)	1 (100)	1(100)
Neonatal intensive care	2	2 (100)	2(100)	2 (100)
Nephrology	1	1 (100)	0 (0)	1 (100)
Neurology and general internal medicine	2	2 (100)	0 (0)	0 (0)
Nose, throat and ear diseases, facial and neck surgery + dentistry	0	-	-	-
Operating room (OR)	0	-	-	-
Palliative care unit	0	-	-	-
Pneumology	0	-	-	-
Pneumology + lung transplantation	3	3 (100)	2 (67)	2 (67)
Pneumology and muco	1	1 (100)	0 (0)	1 (100)
Post-anaesthesia care unit	0	-	-	-
Post-cardiac intensive care	0	-	-	-
Rheumatology + endocrinology	0	-	-	-
Total of UZ Leuven	**107**	**83 (78)**	**79 (74)**	**72 (67)**

Table 11: Clinical information provided on autopsy request per department of 2016

Department 2016	Total performed autopsies	No. of times baseline was stated (%)	No. of times event was stated (%)	No. of times complication was stated (%)
Cardiac intensive care	2	1 (50)	0 (0)	2 (100)
Cardiac surgery	0	-	-	-
Cardiology + heart transplantation (ambulatory)	0	0	0	0
Digestive oncology	1	1 (100)	1 (100)	0 (0)
Emergency service	2	1 (50)	2 (100)	1 (50)
Gastroenterology	0	-	-	-
Gastroenterology + abdominal surgery	1	1 (100)	1 (100)	0 (0)
General internal medicine and allergy	1	0(0)	1 (100)	0 (0)
General medical oncology	3	3(100)	2 (67)	3 (100)
Geriatrics	1	1 (100)	0 (0)	0 (0)
Haematology	2	2 (100)	2 (100)	0 (0)
Haematology isolation unit	3	2 (67)	3 (100)	2 (67)
Hepatology	1	1 (100)	1 (100)	0 (0)
Intensive care A	2	1 (50)	1 (50)	2 (100)
Intensive care B	2	0 (0)	2 (100)	2 (100)
Intensive care C and intensive care children	2	2 (100)	1 (50)	2 (100)
Intensive care D and burn centre	1	1 (100)	0 (0)	0 (0)
Intensive medicine E and neuro intensive care	1	1 (100)	0 (0)	0 (0)
Kidney, liver, pancreas and intestinal transplantation	1	1 (100)	1 (100)	0 (0)
Medical intensive care (MIC) A	55	38 (69)	46 (84)	47 (86)
Medical intensive care (MIC) B	1	1 (100)	1 (100)	1 (100)
Neonatal intensive care	6	6 (100)	6 (100)	5 (83)
Nephrology	0	-	-	-
Neurology and general internal medicine	2	2 (100)	1 (50)	1 (50)
Nose, throat and ear diseases, facial and neck surgery + dentistry	1	0 (0)	1 (100)	1 (100)
Operating room (OR)	1	0 (0)	1 (100)	0 (0)
Palliative care unit	2	2 (100)	1 (50)	0 (0)
Pneumology	1	1 (100)	1 (100)	1 (100)
Pneumology + lung transplantation	3	2 (67)	2 (67)	1 (100)
Pneumology and muco	0	0	0	0
Post-anaesthesia care unit	0	-	-	-
Post-cardiac intensive care	0	-	-	-
Rheumatology + endocrinology	1	1 (100)	1 (100)	0 (0)
Total of UZ Leuven	99	72 (73)	80 (81)	71 (71)

Table 12: Clinical information provided on autopsy request per department of 2017

Department 2017	Total performed autopsies	No. of times baseline was stated (%)	No. of times event was stated (%)	No. of times complication was stated (%)
Cardiac intensive care	4	3 (75)	3 (75)	4 (100)
Cardiac surgery	0	-	-	-
Cardiology + heart transplantation (ambulatory)	0	-	-	-
Digestive oncology	1	1 (100)	1 (100)	0 (0)
Emergency service	5	4 (80)	4 (80)	2 (40)
Gastroenterology	0	-	-	-
Gastroenterology + abdominal surgery	0	-	-	-
General internal medicine and allergy	0	-	-	-
General medical oncology	1	1 (100)	0 (0)	0 (0)
Geriatrics	0	-	-	-
Haematology	0	-	-	-
Haematology isolation unit	0	-	-	-
Hepatology	1	0 (0)	1 (100)	0 (0)
Intensive care A	2	1 (50)	2 (100)	2 (100)
Intensive care B	4	1 (25)	4 (100)	3 (75)
Intensive care C and intensive care children	1	1 (100)	1 (100)	1 (100)
Intensive care D and burn centre	0	-	-	-
Intensive medicine E and neuro intensive care	1	1 (100)	1 (100)	0 (0)
Kidney, liver, pancreas and intestinal transplantation	0	-	-	-
Medical intensive care (MIC) A	52	41 (79)	47 (90)	38 (73)
Medical intensive care (MIC) B	0	-	-	-
Neonatal intensive care	3	2 (67)	3 (100)	2 (67)
Nephrology	0	-	-	-
Neurology and general internal medicine	1	1 (100)	0 (0)	0 (0)
Nose, throat and ear diseases, facial and neck surgery + dentistry	0	-	-	-
Operating room (OR)	0	-	-	-
Palliative care unit	0	-	-	-
Pneumology	0	-	-	-
Pneumology + lung transplantation	0	-	-	-
Pneumology and muco	0	-	-	-
Post-anaesthesia care unit	0	-	-	-
Post-cardiac intensive care	0	-	-	-
Rheumatology + endocrinology	0	-	-	-
Total of UZ Leuven	76	57 (75)	67 (88)	52 (68)

7. Clinical question on autopsy requests per department

Table 13: Clinical question provided on autopsy request per department (2015 – 2017)

Department	Total performed autopsies	No. of specific questions (%)	No. of open questions (%)	No. of aspecific questions (%)
Cardiac intensive care *	8	3 (38)	4 (50)	0 (0)
Cardiac surgery	2	0 (0)	1 (50)	1 (50)
Cardiology + heart transplantation (ambulatory)	1	0 (0)	0 (0)	1 (100)
Digestive oncology	5	3 (60)	1 (20)	1(20)
Emergency service	15	2 (13)	12 (80)	1 (7)
Gastroenterology	1	0 (0)	0 (0)	1 (100)
Gastroenterology + abdominal surgery	1	0 (0)	1 (100)	0 (0)
General internal medicine and allergy	2	0 (0)	1(50)	1(50)
General medical oncology	5	1(20)	4(80)	0 (0)
Geriatrics	1	1 (100)	0 (0)	0 (0)
Haematology	2	0 (0)	2 (100)	0 (0)
Haematology isolation unit	6	4(67)	1(17)	1 (17)
Hepatology	2	0 (0)	0 (0)	2 (100)
Intensive care A *	11	5 (45)	4 (36)	1 (9)
Intensive care B	8	2 (25)	5 (63)	1 (13)
Intensive care C and intensive care children	4	1 (25)	2 (50)	1 (50)
Intensive care D and burn centre	2	0 (0)	1 (50)	1 (50)
Intensive medicine E and neuro intensive care	2	0 (0)	1 (50)	1 (50)
Kidney, liver, pancreas and intestinal transplantation	1	0 (0)	1 (100)	0 (0)
Medical intensive care (MIC) A ***	171	33 (19)	40 (25)	93 (54)
Medical intensive care (MIC) B	2	2 (100)	0 (0)	0 (0)
Neonatal intensive care	11	2 (18)	5 (45)	4 (36)
Nephrology	1	1 (100)	0 (0)	0 (0)
Neurology and general internal medicine	5	1 (20)	3 (60)	1 (20)
Nose, throat and ear diseases, facial and neck surgery + dentistry	1	1 (100)	0 (0)	0 (0)
Operating room (OR)	1	0 (0)	0 (0)	1 (100)
Palliative care unit	2	0 (0)	1 (50)	1 (50)
Pneumology	1	0 (0)	1 (100)	
Pneumology + lung transplantation *	6	0 (0)	2 (33)	3 (50)
Pneumology and muco	1	0 (0)	0 (0)	1 (100)
Post-anaesthesia care unit	0	-	-	-
Post-cardiac intensive care	-	-	-	-
Rheumatology + endocrinology	1	0 (0)	1 (100)	0 (0)
Total of UZ Leuven	**282**	**61 (22)**	**97 (34)**	**118 (42)**

** Number of times no clinical question was provided*

Table 14: Clinical question provided on autopsy request per department of 2015

Department 2015	Total performed autopsies	No. of specific questions (%)	No. of open questions (%)	No. of aspecific questions (%)
Cardiac intensive care	2	1 (50)	1 (50)	0 (0)
Cardiac surgery	2	0 (0)	1 (50)	1 (50)
Cardiology + heart transplantation (ambulatory)	1	0 (0)	0 (0)	1 (100)
Digestive oncology	3	1 (33)	1 (33)	1 (33)
Emergency service	8	0 (0)	8 (100)	0 (0)
Gastroenterology	1	0 (0)	0 (0)	1 (100)
Gastroenterology + abdominal surgery	0	-	-	-
General internal medicine and allergy	1	0 (0)	0 (0)	1 (100)
General medical oncology	1	0 (0)	1 (100)	0 (0)
Geriatrics	0	-	-	-
Haematology	0	-	-	-
Haematology isolation unit	3	3(100)	0 (0)	0 (0)
Hepatology	0	-	-	-
Intensive care A	7	3 (43)	4 (57)	0 (0)
Intensive care B	2	1(50)	0 (0)	1(50)
Intensive care C and intensive care children	1	0 (0)	1 (100)	1 (100)
Intensive care D and burn centre	1	0 (0)	0 (0)	1 (100)
Intensive medicine E and neuro intensive care	0	-	-	-
Kidney, liver, pancreas and intestinal transplantation	0	-	-	-
Medical intensive care (MIC) A	64	16 (25)	11 (17)	37 (81)
Medical intensive care (MIC) B	1	1(100)	0 (0)	0 (0)
Neonatal intensive care	2	0 (0)	2(100)	0 (0)
Nephrology	1	0 (0)	1 (100)	0 (0)
Neurology and general internal medicine	2	1 (50)	1 (50)	0 (0)
Nose, throat and ear diseases, facial and neck surgery + dentistry	0	-	-	-
Operating room (OR)	0	-	-	-
Palliative care unit	0	-	-	-
Pneumology	0	-	-	-
Pneumology + lung transplantation	3	0 (0)	1 (33)	2 (67)
Pneumology and muco	1	0 (0)	0 (0)	1 (100)
Post-anaesthesia care unit	0	-	-	-
Post-cardiac intensive care	0	-	-	-
Rheumatology + endocrinology	0	-	-	-
Total of UZ Leuven	**107**	**27 (25)**	**32 (30)**	**48 (45)**

Table 15: Clinical question provided on autopsy request per department of 2016

Department 2016	Total performed autopsies	No. of specific questions (%)	No. of open questions (%)	No. of aspecific questions (%)
Cardiac intensive care *	2	1 (50)	0 (0)	0 (0)
Cardiac surgery	0	-	-	-
Cardiology + heart transplantation (ambulatory)	0	-	-	-
Digestive oncology	1	1 (100)	0 (0)	0 (0)
Emergency service	2	0 (0)	1 (50)	1 (50)
Gastroenterology	0	-	-	-
Gastroenterology + abdominal surgery	1	0 (0)	1 (100)	0 (0)
General internal medicine and allergy	1	0 (0)	1 (100)	0 (0)
General medical oncology	3	0 (0)	3 (100)	0 (0)
Geriatrics	1	1 (100)	0 (0)	0 (0)
Haematology	2	0 (0)	2 (100)	0 (0)
Haematology isolation unit	3	1 (33)	1 (33)	1 (33)
Hepatology	1	0 (0)	0 (0)	1 (100)
Intensive care A *	2	0 (0)	0 (0)	1 (50)
Intensive care B	2	0 (0)	2 (100)	0 (0)
Intensive care C and intensive care children	2	1 (50)	1 (50)	0 (0)
Intensive care D and burn centre	1	0 (0)	1 (100)	0 (0)
Intensive medicine E and neuro intensive care	1	0 (0)	0 (0)	1 (100)
Kidney, liver, pancreas and intestinal transplantation	1	0 (0)	1 (100)	0 (0)
Medical intensive care (MIC) A	55	12 (22)	19 (35)	24 (44)
Medical intensive care (MIC) B	1	1 (100)	0 (0)	0 (0)
Neonatal intensive care	6	1 (17)	3 (50)	2 (33)
Nephrology	0	-	-	-
Neurology and general internal medicine	2	0 (0)	1 (50)	1 (50)
Nose, throat and ear diseases, facial and neck surgery + dentistry	1	1 (100)	0 (0)	0 (0)
Operating room (OR)	1	0 (0)	0 (0)	1 (100)
Palliative care unit	2	0 (0)	1 (50)	1 (50)
Pneumology	1	0 (0)	1 (100)	0 (0)
Pneumology + lung transplantation*	3	0 (0)	1 (33)	1 (33)
Pneumology and muco	0	-	-	-
Post-anaesthesia care unit	0	-	-	-
Post-cardiac intensive care	0	-	-	-
Rheumatology + endocrinology	1	0 (0)	1 (100)	0 (0)
Total of UZ Leuven	**99**	**20 (20)**	**41 (41)**	**35 (35)**

** Number of times no clinical question was provided*

Table 16: Clinical question provided on autopsy request per department of 2017

Department 2017	Total performed autopsies	No. of specific questions (%)	No. of open questions (%)	No. of aspecific questions (%)
Cardiac intensive care	4	1 (25)	3 (75)	0 (0)
Cardiac surgery	0	-	-	-
Cardiology + heart transplantation (ambulatory)	0	-	-	-
Digestive oncology	1	1 (100)	0 (0)	0 (0)
Emergency service	5	2 (40)	3 (60)	0 (0)
Gastroenterology	0	-	-	-
Gastroenterology + abdominal surgery	0	-	-	-
General internal medicine and allergy	0	-	-	-
General medical oncology	1	1 (100)	0 (0)	0 (0)
Geriatrics	0	-	-	-
Haematology	0	-	-	-
Haematology isolation unit	0	-	-	-
Hepatology	1	0 (0)	0 (0)	1 (100)
Intensive care A	2	2 (100)	0 (0)	0 (0)
Intensive care B	4	1 (25)	3 (75)	0 (0)
Intensive care C and intensive care children	1	0 (0)	1 (100)	0 (0)
Intensive care D and burn centre	0	-	-	-
Intensive medicine E and neuro intensive care	1	0 (0)	1 (100)	0 (0)
Kidney, liver, pancreas and intestinal transplantation	0	-	-	-
Medical intensive care (MIC) A ***	52	5 (10)	12 (23)	32 (62)
Medical intensive care (MIC) B	0	-	-	-
Neonatal intensive care	3	1 (33)	0 (0)	2 (67)
Nephrology	0	-	-	-
Neurology and general internal medicine	1	0 (0)	1 (100)	0 (0)
Nose, throat and ear diseases, facial and neck surgery + dentistry	0	-	-	-
Operating room (OR)	0	-	-	-
Palliative care unit	0	-	-	-
Pneumology	0	-	-	-
Pneumology + lung transplantation	0	-	-	-
Pneumology and muco	0	-	-	-
Post-anaesthesia care unit	0	-	-	-
Post-cardiac intensive care	0	-	-	-
Rheumatology + endocrinology	0	-	-	-
Total of UZ Leuven	**76**	**14 (18)**	**24 (32)**	**35 (46)**

** Number of times no clinical question was provided*

8. *Supplementary tables: data-analysis of results section*

Table 17: Clinical information provided on autopsy request (2015 – 2017)

Clinical information	% of cases in 2015 (n=107)	% of cases in 2016 (n=99)	% of cases in 2017 (n=76)
Baseline	77.6 (212)	72.7 (212)	75.0 (212)
Event	73.8 (226)	80.8 (226)	88.2 (226)
Complication	67.3 (195)	71.7 (195)	68.4 (195)

Table 18: Clinical question provided on autopsy request (2015 – 2017)

Clinical question	% of cases in 2015 (n=107)	% of cases in 2016 (n=99)	% of cases in 2017 (n=76)
Specific question	25.3 (27)	20. (20)	18.4 (14)
Open question	29.9 (32)	41.4 (41)	31.6 (24)
Aspecific question	44.9 (48)	35.4 (35)	46.1 (35)
No question	0.0 (0)	3.0 (3)	6.0 (3)

Table 19: Pathological answer provided in autopsy report's conclusion (2015 – 2017)

	% of cases in 2015 (n=107)	% of cases in 2016 (n=96)	% of cases in 2017 (n=73)
Answer to question	86,9 (93)	89,6 (86)	90,4 (66)
No answer to question	13,1 (14)	10,4 (10)	9,6 (7)

Table 20: Pathological answer provided in autopsy report's conclusion (2015 – 2017).
A: Specific and open question (C1-C7) – B: Aspecific question (X1-X4)

A	% of cases in 2015 (n=62)	% of cases in 2016 (n=68)	% of cases in 2017 (n=39)	B	% of cases in 2015 (n=45)	% of cases in 2016 (n=28)	% of cases in 2017 (n=34)
C1	45,2 (28)	42,7 (29)	53,9 (21)	**X1**	31,1 (14)	17,9 (5)	23,5 (8)
C2	12,9 (8)	26,5 (18)	18,0 (7)	**X2**	62,2 (28)	78,6 (22)	73,5 (25)
C3	17,7 (11)	7,4 (5)	7,7 (3)	**X3**	4,4 (2)	3,6 (1)	0,0 (0)
C4	6,5 (4)	10,3 (7)	5,1 (2)	**X4**	2,2 (1)	0,0 (0)	2,9 (1)
C5	3,2 (2)	5,9 (4)	7,7 (3)				
C6	4,8 (3)	1,5 (1)	0,0 (0)				
C7	9,7 (6)	5,9 (4)	7,7 (3)				

9. *Discrepancy between clinical and forensic autopsies*

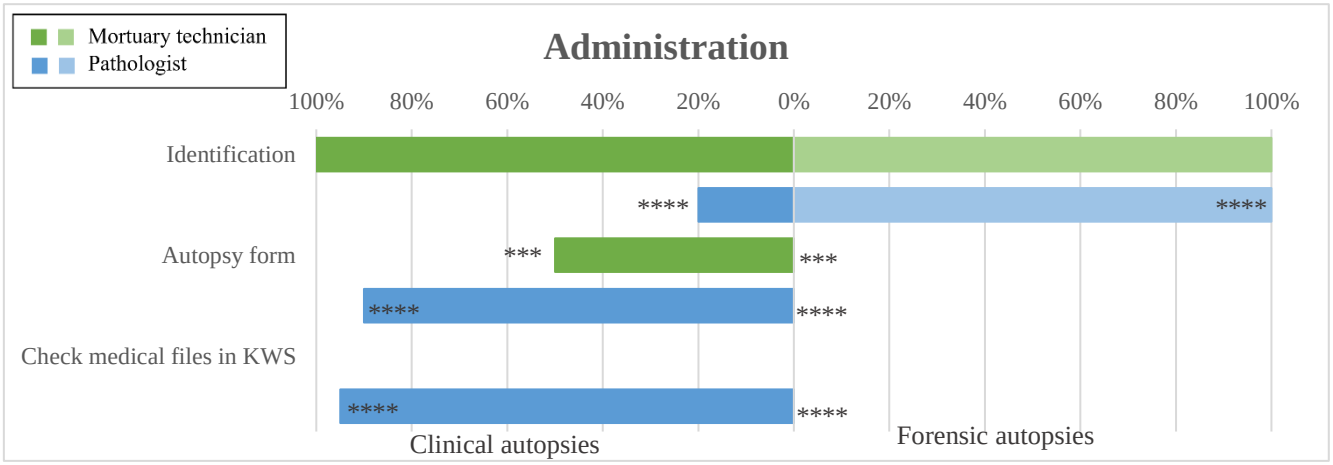


Figure 10: Administration section of the observation sheet
(* p < 0.05, ** < 0.01, *** p < 0.001, **** p < 0.0001)

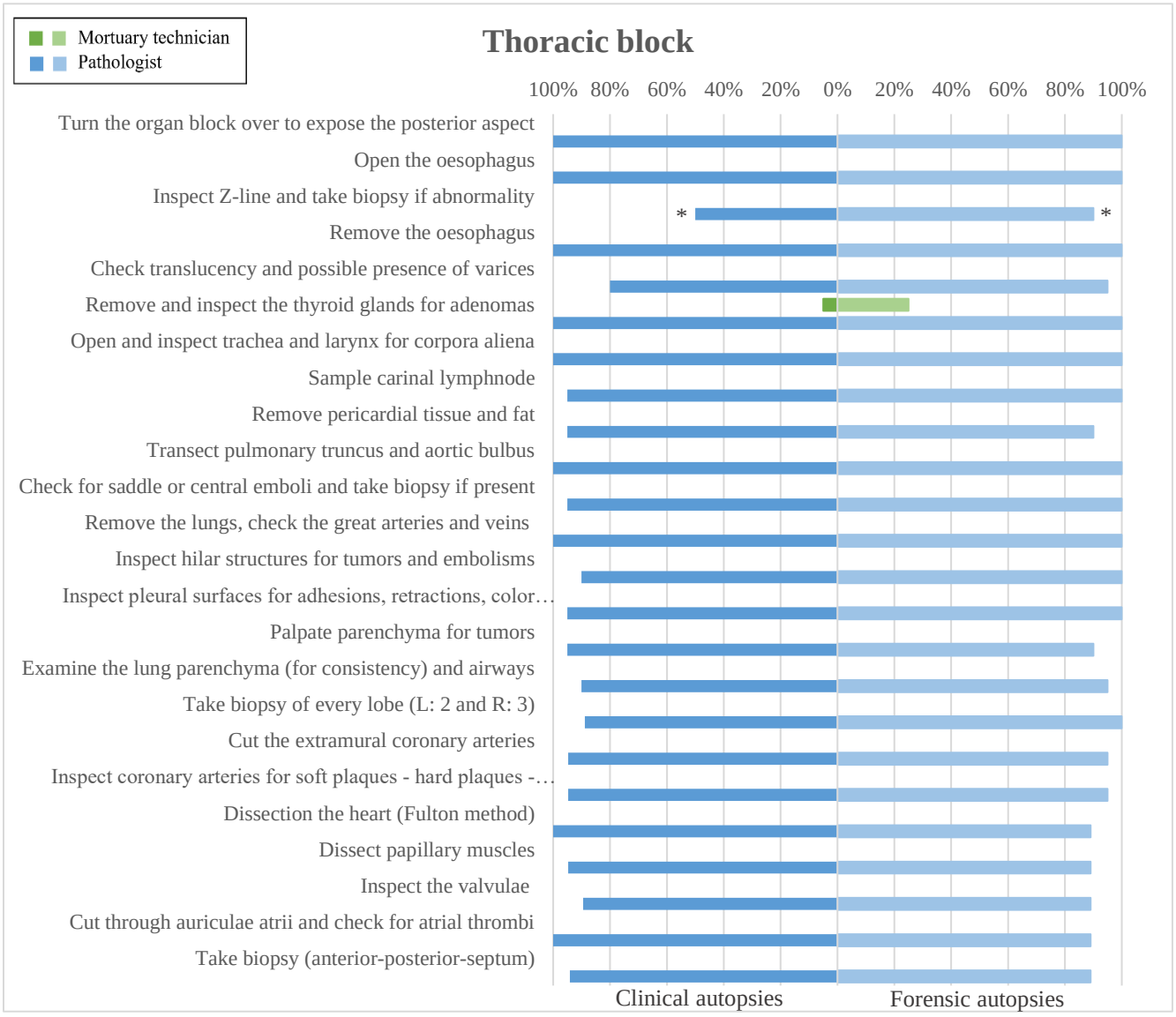


Figure 11: Thoracic block section of the observation sheet
(* p < 0.05, ** < 0.01, *** p < 0.001, **** p < 0.0001)

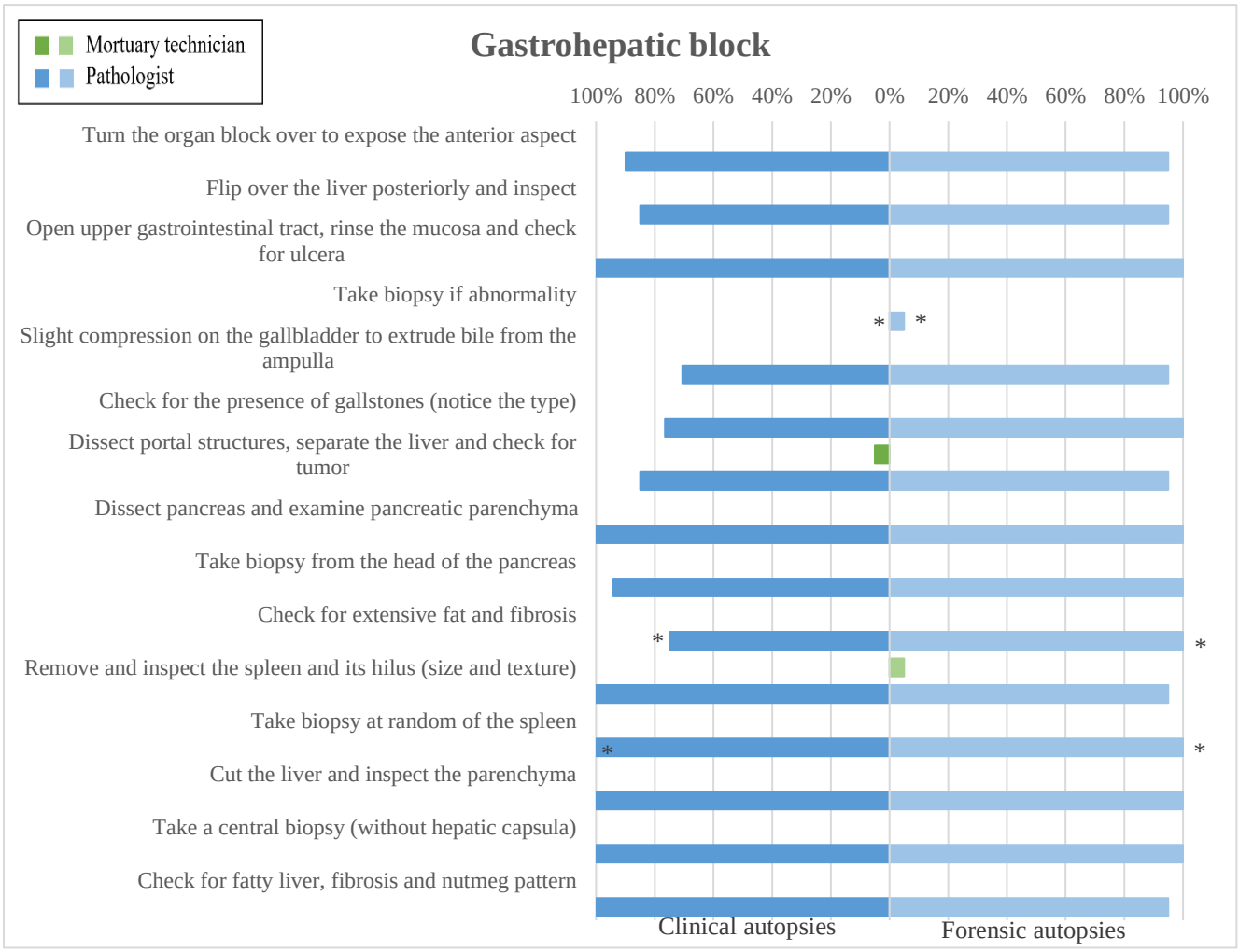


Figure 12: Gastrohepatic block section of the observation sheet
(* p < 0.05, ** < 0.01, *** p < 0.001, **** p < 0.0001)

Table 21: P-values of statistical analysis of role of pathologist and mortuary technician between clinical and forensic autopsies (Fisher's exact test) – green = significant (p < 0.05)

	Pathologist	Mortuary technician
Administration		
Identification	<0,0001	>0,9999
Autopsy form	<0,0001	0,0004
Check medical files in KWS	<0,0001	>0,9999
External inspection		
Notice therapeutic devices	<0,0001	0,3416
Check thoracic, abdominal and extremities	<0,0001	0,031
Check body color and scelerae for icterus	0.0001	0,4872
Inspect nail beds and levidity for anemia	<0,0001	>0,9999
Check abdominal distention (ascites…)	<0,0001	>0,9999
Check for spider naevi	<0,0001	>0,9999
Inspect the state of the limbs (infection, (pitting) oedema, varices...)	<0,0001	0,4872
Internal examination		
If necessary place a block under the shoulders	<0,0001	0,0084
Make a Y/U shaped incision	<0,0001	<0,0001
Use enterotome scissors to enter peritoneal cavity	0.0001	>0,9999
Survey the abdominal viscera and locate the organs	<0,0001	<0,0001
Characterize, collect and measure any abdominal fluid	<0,0001	>0,9999
Check for pneumothorax	<0,0001	0,2308
Open the thorax	<0,0001	<0,0001
Check the sternum	<0,0001	0,0471
Characterize, collect and measure any pleural fluid	<0,0001	0,605
Survey thoracic organs	<0,0001	<0,0001
Open pericardium and examine the pericardial cavity	0,0471	>0,9999
Remove small and large bowel from ligament of Treitz	0,0202	0,0202
Inspect the liberated bowel for necrosis, dilatation, stenosis, diverticulitis, …	>0,9999	0,4801
Identify and inspect the appendix	0,7524	>0,9999
Remove adrenal glands	0,0202	0,1818
Measure the adrenal glands and check for possible presence of adenomas	0,0436	>0,9999
Thoracic block		
Turn the organ block over to expose the posterior aspect	>0,9999	>0,9999
Open the oesophagus	>0,9999	>0,9999
Inspect Z-line and take biopsy if abnormality	0,0138	>0,9999
Remove the oesophagus	>0,9999	>0,9999
Check translucency and possible presence of varices	0,3416	>0,9999
Remove and inspect the thyroid glands for adenomas	>0,9999	0,1818
Open and inspect trachea and larynx for corpora aliena	>0,9999	>0,9999
Sample carinal lymphnode	>0,9999	>0,9999
Remove pericardial tissue and fat	>0,9999	>0,9999
Transect pulmonary truncus and aortic bulbus	>0,9999	>0,9999
Check for saddle or central emboli and take biopsy if present	>0,9999	>0,9999
Remove the lungs, check the great arteries and veins	>0,9999	>0,9999

Inspect hilar structures for tumors and embolisms	0,4872	>0,9999
Inspect pleural surfaces for adhesions, retractions, color shades, ...	>0,9999	>0,9999
Palpate parenchyma for tumors	>0,9999	>0,9999
Examine the lung parenchyma (for consistency) and airways	>0,9999	>0,9999
Take biopsy of every lobe (L: 2 and R: 3)	0,2176	>0,9999
Cut the extramural coronary arteries	>0,9999	>0,9999
Inspect coronary arteries for soft plaques - hard plaques - stent (permeability)	>0,9999	>0,9999
Dissection the heart (Fulton method)	0,4865	>0,9999
Dissect papillary muscles	>0,9999	>0,9999
Inspect the valvulae	>0,9999	>0,9999
Cut through auriculae atrii and check for atrial thrombi	0,4865	>0,9999
Take biopsy (anterior-posterior-septum)	>0,9999	>0,9999
Urogenital block		
Dissection of the great vessels and branches (ven. anterior - art. posterior)	<0,0001	>0,9999
Check for stenosis of ostium arteriae renales	<0,0001	>0,9999
Identify ureters and if necessary open them starting from PCS	<0,0001	>0,9999
Remove the kidneys and strip the renal capsule	<0,0001	<0,0001
Check for cortical cysts, fetal lobulation and granular aspect	>0,9999	>0,9999
Dissect the kidneys (longitudinal/coronal axis)	>0,9999	>0,9999
Check for the presence of kidney stones (color and form)	>0,9999	>0,9999
Inspect cortex and medulla (pay attention to width of cortex and color of both)	0,4872	>0,9999
Take biopsy of cortex and medulla together	0,4737	>0,9999
Inspect the bladder in situ	0,4872	0,0095
Check mucosa for benigne prostatic hypertrophy and bladder trabeculae	<0,0001	0,2228
Inspect the fallopian tubes, ovaries and uterus in situ	0,0114	>0,9999
Check for sterilization clips and ovarian cysts	0,0032	>0,9999
Take biopsy if abnormality	>0,9999	>0,9999
Gastrohepatic block		
Turn the organ block over to expose the anterior aspect	>0,9999	>0,9999
Flip over the liver posteriorly and inspect	0,605	>0,9999
Open upper gastrointestinal tract, rinse the mucosa and check for ulcera	>0,9999	>0,9999
Take biopsy if abnormality	>0,9999	>0,9999
Slight compression on the gallbladder to extrude bile from the ampulla	0,0752	>0,9999
Check for the presence of gallstones (notice the type)	0,036	>0,9999
Dissect portal structures, separate the liver and check for tumor	0,605	>0,9999
Dissect pancreas and examine pancreatic parenchyma	>0,9999	>0,9999
Take biopsy from the head of the pancreas	0,4595	>0,9999
Check for extensive fat and fibrosis	0,0471	>0,9999
Remove and inspect the spleen and its hilus (size and texture)	>0,9999	>0,9999
Take biopsy at random of the spleen	>0,9999	>0,9999
Cut the liver and inspect the parenchyma	>0,9999	>0,9999
Take a central biopsy (without hepatic capsula)	>0,9999	>0,9999
Check for fatty liver, fibrosis and nutmeg pattern	>0,9999	>0,9999

V Addendum: Quality improvement projects

Project 1: Misregistatie staalsoorten bij klinische autopsies

In samenwerking met

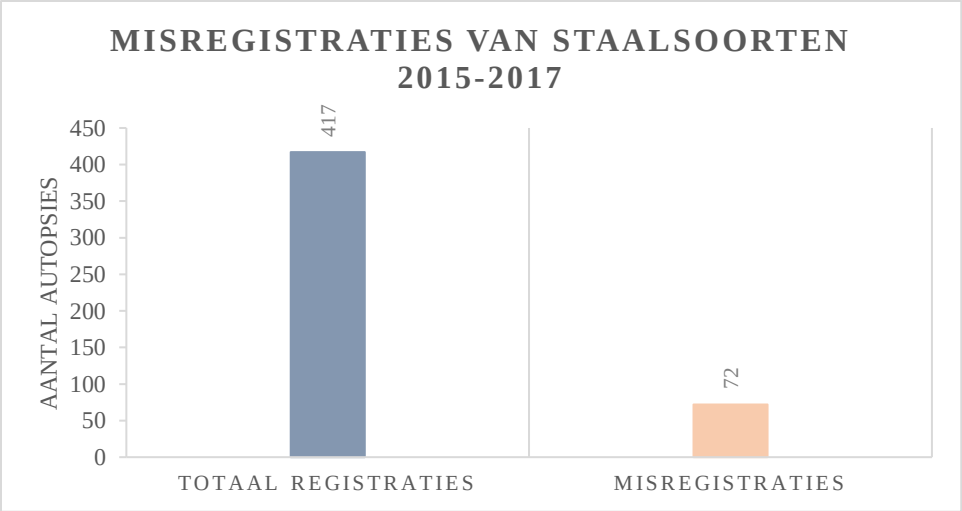
- Prof. dr. Elisabeth Dequeker, kwaliteitszorgcoordinator Zone Medische Diagnostiek
- Yasmina Abakkouy, 1ste master studente biomedische wetenschappen

Algemeen

In kader van een 'Quality improvement project' van de klinische autopsies werd er een analyse uitgevoerd omtrent de registraties van staalsoorten. Meer specifiek, werd enkel data geanalyseerd van de uitgevoerde klinische autopsies waarvan de autopsie was aangevraagd tussen 1/01/2015 en 31/12/2017 en het autopsieverslag was afwerkt op 1 april 2018. Deze staalsoorten omvatten de mogelijkheden waaruit de patholoog kan kiezen met betrekking tot het type autopsie. Na een kritische analyse van de opgevraagde data in kader van deze masterproef, kon vastgesteld worden dat deze staalsoorten occasioneel gemisregistreerd werden door pathologen. Misregistraties werden geconstateerd na de geregistreerde staalsoorten te vergelijken met de overeenkomstige autopsieverslagen.

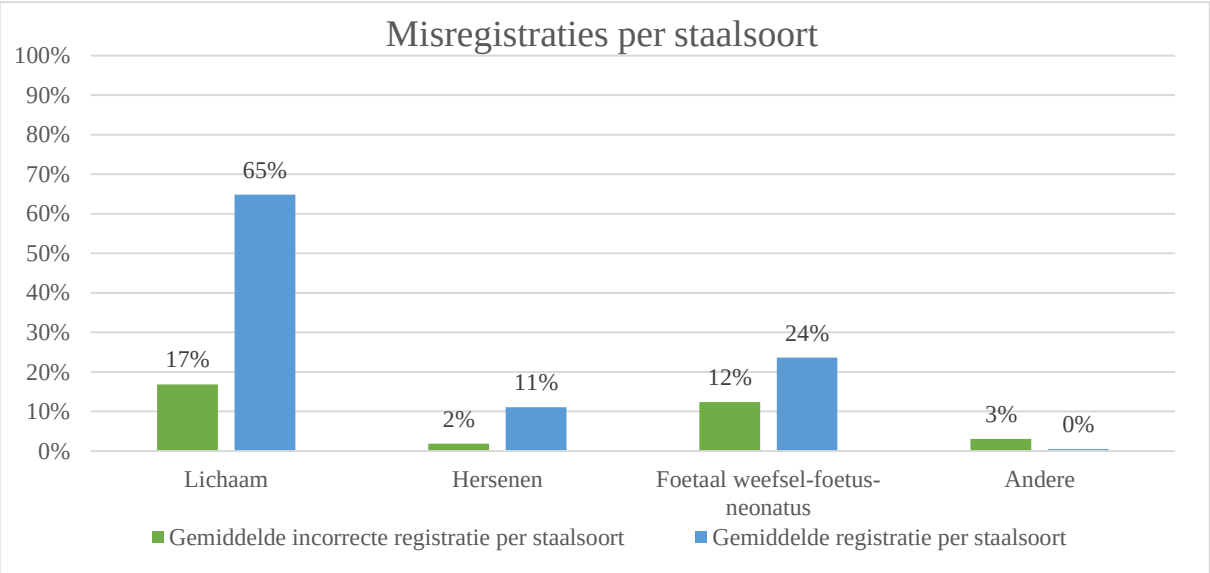
Bevindingen

In figuur 1 wordt het totaal aantal misregistraties van de staalsoorten over de drie jaren heen weergegeven (2015-2017). In 17,3% van de registraties werd er een misregistratie van de staalsoorten vastgesteld.



Figuur 1: Aantal misregistraties van staalsoorten en totaal aantal registraties (2015-2017)

In figuur 2 worden de gemiddelde misregistaties en totaal gemiddelde registraties per staalsoort ten opzichte van het totaal aantal autopsies met elkaar vergeleken.



Figuur 2: De gemiddelde misregistratie naast de gemiddelde registratie per staalsoort ten opzichte van het totaal aantal autopsies (2015-2017).

Conclusie en aanbevelingen

De resultaten van dit 'Quality improvement project' geven aan dat het invoeren van een eenduidige richtlijn omtrent de registaties van staalsoorten gunstig zou zijn. Verder onderzoek is vereist om de gevolgen en impact van deze misregistaties na te gaan. Verder is het aangeraden om de aandacht te vestigen op de correcte registratie van staalsoorten. Dit kan onder andere door middel van een eenduidig classificatiesysteem waarbij de patholoog enkele keuzemogelijkheden heeft die conform zijn met de autopsie aanvraag.

Project 2: risico-analyse van forensische autopsies

In samenwerking met

- Prof. dr. Elisabeth Dequeker, kwaliteitszorgcoordinator Zone Medische Diagnostiek
- Nancy Vanderheyden, kwaliteitsverantwoordelijke Forensische Geneeskunde
- Manon Valter en Flo Elsen, 1ste master studenten biomedische wetenschappen

Algemeen

In kader van een 'Quality improvement project' van de geaccrediteerde forensische autopsies conform BELAC ISO 17020, werd er een risico-analyse uitgevoerd. Meer specifiek, werden de risico's op staalverwisseling en gezondheid van de aanwezigen onderzocht. Dit verslag behandelt beknopt de bevindingen omtrent de persoonlijke beschermingsmiddelen (PBM). Naast de meer dan 20 forensische autopsies geobserveerd in het kader van dit master's thesis project werden door studenten 1ste master biomedische wetenschappen nog 9 supplementaire forensische autopsies geobserveerd, waarbij onder andere aandacht werd besteed aan de opvolging van de kledijvoorschriften van de forensische pathologen, het mortuariumpersoneel, medewerkers van het laboratorium voor technische en wetenschappelijke politie (LTWP) en andere aanwezigen.

Voorschrift

De algemene regel (zie procedure XXX) voor het bijwonen van forensische autopsies luidt dat men voorzien zou moeten zijn van een operatiepak (broek en T-shirt), overschort, mondmasker, haarkapje, handschoenen (alsook veiligheidshandschoenen voor personen die mee de autopsie uitvoeren) en afwasbare schoenen. Verder is het dragen van een veiligheidsbril bij het openzagen van schedel met een schedelzaag vereist.

Bevindingen

De medewerkers van het LTWP droegen in de meeste gevallen wel een overshort. Het dragen van een mondmasker en haarkapje werd regelmatig toegepast maar niet altijd. Vervolgens werden handschoenen in beperkte mate gedragen, alsook beschermende schoenen (eigen werkschoenen voorzien door het LTWP).

Het mortuariumpersoneel droeg regelmatig enkel een operatiepak en geen overschort waarbij de armen ontbloot waren tijdens de autopsie. Het dragen van handschoenen werd wel gerespecteerd, hoewel er slechts in beperkte mate gebruik werd gemaakt van veiligheidshandschoenen. Vervolgens werd het dragen van een mondmasker en haarkapje grotendeels gerespecteerd, maar ook dit was niet de regel.

De forensische pathologen namen de kledijvoorschriften in acht. Slechts in beperkte mate werd er geen overschort of mondkapje gedragen.

Bij de andere aanwezigen werd er zelden tot geen aandacht besteed aan de PBM's. In beperkte mate werd er een mondmasker gedragen.

Conclusie en aanbevelingen

Hoewel er kledijvoorschriften luiden in het mortuarium, worden deze niet altijd ter harte genomen. Het is aangeraden een opleiding te voorzien omtrent de risico's van het niet dragen van PBM's, alsook affiches met deze voorschriften in de kleedkamers en op de deuren van de autopsiezalen te hangen. Grondige literatuuronderzoek omtrent mogelijke contaminatie bij het afnemen van stalen en de vergelijking van de literatuur omtrent PBM's bij klinische en forensische autopsies kunnen de voorschriften verder ondersteunen of een aanleiding geven om deze aan te passen. Aangezien de bovenstaande bevindingen interpretaties zijn aan de hand van kwalitatief onderzoek, is het opvolgen van deze aspecten met behulp van een gestructureerd observatieblad sterk aangewezen.

Project 3: risico-analyse omtrent besmettingsgevaar

In samenwerking met
- Prof. dr. Elisabeth Dequeker, kwaliteitszorgcoordinator Zone Medische Diagnostiek
- Nancy Vanderheyden, kwaliteitsverantwoordelijke Forensische Geneeskunde

3. Indeling risicogroepen

De onderstaande indeling is gebaseerd op de Europese richtlijnen omtrent de bescherming van de werknemers tegen de risico's bij blootstelling aan biologische agentia op het werk [1,2].

Groep 1: De biologische agentia die tot deze groep behoren, zullen onwaarschijnlijk een ziekte bij de mens veroorzaken.

Groep 2: De biologische agentia die tot deze groep behoren, kunnen een ziekte bij de mens veroorzaken en een gevaar vormen voor de werknemers. Het is onwaarschijnlijk dat deze zich zou kunnen verspreiden in de samenleving. In dit geval is er meestal een effectieve profylaxe of behandeling beschikbaar.

Groep 3: De biologische agentia die tot deze groep behoren, kunnen een ernstige ziekte bij de mens veroorzaken en een groot gevaar vormen voor de werknemers. Het kan een risico vormen voor de verspreiding in de samenleving. In dit geval is er meestal een effectieve profylaxe of behandeling beschikbaar.

Groep 4: De biologische agentia die tot deze groep behoren, kunnen een ernstige ziekte bij de mens veroorzaken en een groot gevaar vormen voor de werknemers. Het kan een enorm risico vormen voor de verspreiding in de samenleving. In dit geval is er meestal geen effectieve profylaxe of behandeling beschikbaar. De biologische agentia die tot deze groep behoren, moeten verwerkt worden in een L2 laboratorium.

Groep 5: De biologische agentia die tot deze groep behoren, kunnen een ernstige ziekte bij de mens veroorzaken en een groot gevaar vormen voor de werknemers. Het kan een enorm risico vormen voor de verspreiding in de samenleving. In dit geval is er meestal geen effectieve profylaxe of behandeling beschikbaar. De biologische agentia die tot deze groep behoren, moeten verwerkt worden in een L3 laboratorium.

Groep 6: De persoon is reeds besmet geweest met biologische agentia vanuit groep 2 of 3.

Legende tabel 1 [3]:

1= Recente laboratorium verworven infecties wereldwijd

2 = Laboratorium verworven infecties in Vlaanderen (2007-2012)

3 = Laboratorium verworven infecties zowel in Vlaanderen als wereldwijd

Groep	1	2	3	4	5	6
Bacteriën	n.v.t.	- Bacillus cereus[1] - Bordetella pertussis - Campylobacter[2] - Chlamydia pneumoniae/trachomatis - Clostridium[1] botulinum / perfrigens/ tetani/difficele - E. Coli (niet-pathogeen) - Helicobacter pylori - Legionella pneumophila - Leptospirosis bacteria - Listeria monocytogenes - Mycoplasma[2] pneumoniae - Neisseria meningitidis[1]/ gonorrhoeae - Pseudomonas aeruginosa - Salmonella[3] typhimurium - Shigella[3] sonnei[1]/ dysenteriae (andere dan Type 1) - Staphylococcus aureus[1] - Streptococcus pneumoniae /pyogenes - Treponema pallidum - Vibrio cholerae - Yersinia enterocolitica/ pseudotuberculosis	- Bacillus anthracis[1] - Brucella[3] canis/abortus - Burkholderia mallei/ pseudomallei[1] - Chlamydophila psittaci[1] - E. Coli (verotoxin: O157:H7)[1] - Francisella tularensis (Type A)[1] - Mycobacterium tuberculosis[3] - Salmonella[3] typhi - Shigella dysenteriae (Type1) - Yersina pestis	n.v.t.	n.v.t.	*

Virussen	n.v.t.	- Adenoviridae en Coronaviridae - Caliciviridae: Norwalk virus - Herpesviridae[2]: cytomegalovirus/ Epstein-Barr virus/ Herpes simplex virus type 1 en 2/ Varicella-Zoster/ Humaan Herpes virus 7 en 8 - Molluscum contagiosum virus: Vaccinia virus[1] - Orthomyxoviridae: Influenza type A, B en C + vogelgriepvirus[2] - Papoviridae: Humaan papillomavirus - Paramyxoviridae: mazelen en bof virus/ RSV - Parvoviridae : humaan parvovirus B19[2] - Picornaviridae: Hepatitis A/ Polio en rhinovirussen - Poxviridae: Cowpox virus[1] - Reoviridae: humaan rotavirus	- Caliciviridae: hepatitis E - Flaviviridae: Dengue virus[1]type 1-4 / Hepatitis C/ West Nile fever virus/ Yellow fever - Hepadnaviridae: Hepatitis B/D - Molluscum contagiosum virus: monkeypox virus - Retroviridae: HIV[2] - Rhabdoviridae: rabies virus	- Molluscum contagiosum virus: Variola virus – smallpox -Flaviviridae: zika virus -Coronaviridae: SARS[1] en MERS -Enterovirus: poliovirus - Nairoviridae: Krim-Congo hemorragische koorts -Lassa virus -Flaviviridae: Kyasanur Forest disease virus, Omsk hemorragische koorts virus, Russian spring summer encephalitis -Arenaviridae: Guanarito virus, Junin virus, Machupo virus, Sabia virus -Paramyxoviridae: Nipah virus, Hendra virus	- Filoviridae: Ebola and Marburg virus[1] - Creutzfeldt-Jakob disease	*
Parasieten	n.v.t.	- Ascaris lumbricoides/suum - Leishmania - Schistosoma - Toxoplasma gondii[2] - Trypanosoma - Wuchereria bancrofti	- Echinococcus: granulosus/ multilocularis/ vogeli - Leishmania brasiliensis / donovani - Naegleria fowleri - Plasmodium falciparum - Trypanosoma brucei gambiense[2]/ rhodesiense/ cruzi	n.v.t.	n.v.t.	*
Fungi	n.v.t.	- Aspergillus fumigatus - Candida albicans/ tropicalis - Trichophyton verrucosum[2] - Dermatophyte[2]	- Blastomyces dermatitidis Histoplasma capsulatum	n.v.t.	n.v.t.	*

Tabel 1: Indeling biologische agentia in zes risicogroepen [1,4].

4. Inperkingsniveau

De laboratoria van UZ Leuven worden ingedeeld afhankelijk van de generieke inperkingsmaatregelen en andere beschermingsmaatregelen. Deze indeling gebeurt aan de hand van het referentiedocument dat door de Dienst Bioveiligheid en Biotechnologie gebruikt wordt als bijlage aan de adviezen die afgeleverd worden aan de bevoegde overheden of aan de kennisgevers in het kader van de regionale besluiten inzake ingeperkt gebruik van genetisch gemodificeerde organismen en/of pathogenen.

Voor specifieke voorzorgmaatregelen per laboratorium, raadpleeg de brochure omtrent bioveiligheid van het Vlaams Interuniversitair Instituut voor Biotechnologie [5].

5. Bronnen

[1] Directive 2000/54/EC of the European Parliament and the Council of 18 September 2000 on the protection of workers from risks related to exposure to biological agents at work (seventh individual directive within the meaning of Article 16(1) of Directive 89/391/EEC).

[2] Koninklijk besluit van 4 augustus 1996 betreffende de bescherming van de werknemers tegen de risico's bij blootstelling aan biologische agentia op het werk, Belgische Staatsblad, 1 oktober 1996.

[3] N. Willemarck, B. Brosius, B. Van Vaerenbergh, A. Leunda, A. Baldo, C. Dai Do Thi. Laboratory-Acquired Infections in Flanders (2007-2012) [Internet]. Brussels: Wetenschappelijk Instituut Volksgezondheid; 2012 [cited 31/10/2017]. Available from http://www.biosafety.be/CU/PDF/2012_LAI_reportFlanders2007_2012_SBB_2505_59.pdf

[4] Advisory Committee on Dangerous Pathogens. Biological agents: Managing the risks in laboratories and healthcare premises [Internet]. Health and Safety Executive; 2002 [cited 31/10/2017]. Available from http://www.hse.gov.uk/biosafety/biologagents.pdf

[5] J. Bury, R. Dekeyser. Bioveiligheid in het laboratorium [Internet]. Zwijnaarde: Vlaams Interuniversitair Instituut voor Biotechnologie; 2004 [cited 31/10/2017]. Available from http://www.bornbunge.be/Lab/doc/bioveiligheid_in_labo.pdf

VI Addendum: Observation sheet clinical and forensic autopsies

	M	P
Administration		
Identification		
Autopsy form		
Check medical files in KWS		
External inspection		
Notice therapeutic devices		
Check thoracic, abdominal and extremities		
Check body color and scelerae for icterus		
Inspect nail beds and levidity for anemia		
Check abdominal distention (ascites, …)		
Check for spider naevi		
Inspect the state of the limbs (infection, (pitting) oedema, varices, ...)		
Internal examination		
If necessary place a block under the shoulders		
Make a Y/U shaped incision		
Use enterotome scissors to enter peritoneal cavity		
Survey the abdominal viscera and locate the organs		
Characterize, collect and measure any abdominal fluid		
Check for pneumothorax		
Open the thorax		
Check the sternum		
Characterize, collect and measure any pleural fluid		
Survey thoracic organs		
Open pericardium and examine the pericardial cavity		
Remove small and large bowel from ligament of Treitz		
Inspect the liberated bowel for necrosis, dilatation, stenosis, diverticulitis, …		
Identify and inspect the appendix		
Remove adrenal glands		
Measure the adrenal glands and check for possible presence of adenomas		
Thoracic block		
Turn the organ block over to expose the posterior aspect		
Open the oesophagus		
Inspect Z-line and take biopsy if abnormality		
Remove the oesophagus		
Check translucency and possible presence of varices		
Remove and inspect the thyroid glands for adenomas		
Open and inspect trachea and larynx for corpora aliena		
Sample carinal lymphnode		
Remove pericardial tissue and fat		
Transect pulmonary truncus and aortic bulbus		
Check for saddle or central emboli and take biopsy if present		
Remove the lungs, check the great arteries and veins		

Inspect hilar structures for tumors and embolisms		
Inspect pleural surfaces for adhesions, retractions, color shades, ...		
Palpate parenchyma for tumors		
Examine the lung parenchyma (for consistency) and airways		
Take biopsy of every lobe (L: 2 and R: 3)		
Cut the extramural coronary arteries		
Inspect coronary arteries for soft plaques - hard plaques - stent (permeability)		
Dissection the heart (Fulton method)		
Dissect papillary muscles		
Inspect the valvulae		
Cut through auriculae atrii and check for atrial thrombi		
Take biopsy (anterior-posterior-septum)		
Urogenital block		
Dissection of the great vessels and branches (ven. anterior - art. posterior)		
Check for stenosis of ostium arteriae renales		
Identify ureters and if necessary open them starting from PCS		
Remove the kidneys and strip the renal capsule		
Check for cortical cysts, fetal lobulation and granular aspect		
Dissect the kidneys (longitudinal/coronal axis)		
Check for the presence of kidney stones (color and form)		
Inspect cortex and medulla (pay attention to width of cortex and color of both)		
Take biopsy of cortex and medulla together		
Inspect the bladder in situ		
Check mucosa for benigne prostatic hypertrophy and bladder trabeculae		
Inspect the fallopian tubes, ovaries and uterus in situ		
Check for sterilization clips and ovarian cysts		
Take biopsy if abnormality		
Gastrohepatic block		
Turn the organ block over to expose the anterior aspect		
Flip over the liver posteriorly and inspect		
Open upper gastrointestinal tract, rinse the mucosa and check for ulcera		
Take biopsy if abnormality		
Slight compression on the gallbladder to extrude bile from the ampulla		
Check for the presence of gallstones (notice the type)		
Dissect portal structures, separate the liver and check for tumor		
Dissect pancreas and examine pancreatic parenchyma		
Take biopsy from the head of the pancreas		
Check for extensive fat and fibrosis		
Remove and inspect the spleen and its hilus (size and texture)		
Take biopsy at random of the spleen		
Cut the liver and inspect the parenchyma		
Take a central biopsy (without hepatic capsula)		
Check for fatty liver, fibrosis and nutmeg pattern		

VII Addendum: Logbook registration clinical autopsies

REGISTRATION CLINICAL AUTOPSY

In order to gain a good understanding of the time lag of the administrative chain from death attestation to autopsy, it is necessary to carry out specific registrations of each clinical autopsy for a few months. The goal is to harmonise any communications between different departments in UZ Leuven, specifically the department of Pathology and the Mortuary.

Autopsy code	**Time of death**		**Discharge department**		**Arrival at mortuary**		**Knowledge autopsy**		**Notification pathologist**		**Arrival pathologist**	
	date	hour	date	hour	date	hour	date	hour	date	hour	date	hour

VIII Addendum: Proposed template for autopsy request

UNIVERSITAIRE ZIEKENHUIZEN LEUVEN

UZ LEUVEN | PATHOLOGISCHE ONTLEEDKUNDE

Aanvraagformulier voor klinische autopsie

Identificatie patiënt	Identificatie aanvragende arts
Naam en voornaam: Inschrijvingsnummer: Geboortedatum en geslacht: Straat en nummer: Postnummer en gemeente: Etiket	Naam: Naam Supervisor: Ident.nr Supervisor: Datum aanvraag: Stempel en handtekening Supervisor:

Datum overlijden: Uur overlijden:	Dienst: Graad besmettingsrisico:
Aard onderzoek: autopsie □ lichaam □ foetus >24w	hersenautopsie □ ja □ nee
	studie □ ja □ nee
Ziektegeschiedenis:	
Huidige klinische diagnose en/of reden van hospitalisatie:	
Vermoedelijke doodsoorzaak:	
Specifieke vraagstelling?	

IX Addendum: Proposed template for autopsy report

UNIVERSITAIRE ZIEKENHUIZEN LEUVEN

UZ LEUVEN | PATHOLOGISCHE ONTLEEDKUNDE

Rapportering klinische autopsie

I. Uitwendige schouwing

We ontvingen het lichaam van een ### jarige ### (m/v) ter autopsie.

1. Algemene lijkbevindingen

Het betreft het verzorgde / onverzorgde lichaam van een normaal gebouwde / magere / zwaarlijvige volwassen man / vrouw overeenkomstig // die er jonger / ouder uitziet dan de kalenderleeftijd.

Er zijn geen bijzondere lichamelijke kenmerken.

[BESCHRIJF eventueel littekens, huidskleur, tekens reanimatie, verbanden, heelkundige hechtingen,…]

Voeg 'Werkbladen klinische autopsie' toe ter aanvulling.

2. Hoofd

De behaarde hoofdhuid is intact. Er is een stabiel aanvoelen van de gelaatsschedel en schedeldak.

De ogen zijn gesloten. / open. De bleke conjunctivae (oogbindvliezen) zijn zonder stuwingstekens; geen puntvormige bloedinkjes. // De conjunctivae (oogbindvliezen) oogbindvliezen zijn gestuwd met geprononceerde haarvaatjes. Er zijn puntbloedinkjes in het oogbindvlies aan de binnenzijde van de oogleden (conjunctivale petechiën). // Er is gele verkleuring van oogbindvliezen en oogwit (icterus).

De neus en oren zijn zonder bijzonderheden. // Bleek / gestuwd neusslijmvlies. // Er is een intact / geperforeerd neusseptum. // Dwarse oorlelgroeven.

De mond is gesloten. // De mond staat licht / wijd open.

3. Hals en nek

Er zijn geen abnormale waarnemingen bij palpatie en manipulatie. // Lijkstijve nek. // Er is abnormale beweeglijkheid van de nekwervels bij palpatie en manipulatie.

De hals is uitwendig zonder bijzonderheden.

4. Romp

Er is een stabiele schoudergordel en ribbenrooster, evenals bekkengordel. Buikwelving onder / op / boven borstniveau.

De mannelijke / vrouwelijke genitale en anale regio is zonder bijzonderheden.

De rug is zonder bijzonderheden.

5. Ledematen

Er is een normale stand en houding van de ledematen zonder abnormale beweeglijkheden: geen aanwijzingen voor majeure fracturen.

II. Inwendige schouwing

1. Hoofd

1.1 Schedel

- Geen bloedingen in de slaapspieren. Geen bloedingen in scalpvlies (galea aponeurotica) noch botvlies (periost). // Er zijn bloedingen in BESCHRIJF

- Het beenderige schedeldak is intact; geen fracturen. // Er is een breuk van het schedeldak: BESCHRIJF // Er zijn breuken van het schedeldak: BESCHRIJF

- Het harde hersenvlies (dura mater) is zonder bijzonderheden; de brugaders (of ankervenen) zijn intact. Er is geen bloedophoping in de extra- of subdurale ruimte. // Er is een bloedophoping in de extradurale / subdurale ruimte (extraduraal / subduraal hematoom): BESCHRIJF (lokalisatie/omvang).

- De hersenen nemen een normaal schedelvolume in. Er is een normaal patroon van windingen en groeven. // De hersenen vullen de schedelpan voluit. // De hersenen voelen stevig aan (toegenomen consistentie). // De hersenwindingen zijn afgeplat, de hersengroeven zijn ondiep: hersenzwelling. // De opvallend smalle windingen en diepe brede groeven duiden op hersenschrompeling (atrofie). // De hersenen zijn licht verweekt (beginnende liquefactie). // De hersenen zijn sterk verweekt (geliquifieerd) en vloeien als een grijze slappe massa af.

- Het zachte hersenvlies (pia mater / subarachnoïdea) is zonder bijzonderheden. // Het zachte hersenvlies (pia mater / subarachnoïdea) is gezwollen (oedemateus). // Het zachte hersenvlies (pia mater / subarachnoïdea) is bloedgestuwd. // Het zachte hersenvlies (pia mater / subarachnoïdea) toont een lokale / diffuse bloeding (subarachnoïdale bloeding) / over de linker / rechter hersenhelft. // Er is een bloeding in het zachte hersenvlies (pia mater / subarachnoïdea) aan de hersenbasis.

- De voorachterwaarste doorsnede in situ naar Flechsig toont een normale schors (grijze stof) en witte stof, en normale diepe kernen (basale ganglia). De ventrikels (hersenkamers) zijn niet gedilateerd. // De ventrikels (hersenkamers) zijn gedilateerd. // De ventrikels (hersenkamers) zijn vernauwd.

- De durale veneuze sinussen zijn gevuld met bloed. // De durale veneuze sinussen zijn bloedledig. // De durale veneuze sinussen bevatten premortale / postmortale stolsels.

- De naakte schedelbasis is intact; geen fracturen. // De schedelbasis is gebroken: BESCHRIJF

1.2 Hersenen

- De beide cerebrum zijn symmetrisch ontwikkeld. Er zijn geen letsels aan het hersenoppervlak.

- De cerebellum en hersenstam zijn zonder bijzonderheden. // De cerebellaire tonsillen zijn geprononceerd. // Er zijn tekens van inklemming met cerebellaire / uncale inklemmingsgroeven.

- Het ringvorming netwerk van hersenslagaders aan de hersenbasis (circulus van Willis) is normaal aangelegd. Ze zijn soepel met normaal kaliber en zonder tekens van arteriosclerose. // Ze zijn stijf / hard / verkalkt // uitgezet / tortueus / en tonen enkele / meerdere doorschijnende atheroomplaten: arteriosclerose stadium I / II / III / IV (op schaal van I tot IV). // Ze liggen ingebed in een basale subarachnoidale bloeduitstorting. // Er is een lokale uitstulping van de arteria ### met een diameter van ### mm (cerebraal aneurysma) / met ruptuur.

- De hersenen worden in formol gefixeerd voor verder gedetailleerd onderzoek. // De semiserieel opgesneden hersenen en hersenstam tonen een bewaarde en symmetrische architectuur met normale differentiatie van de witte en grijze stof en van de centrale kerngebieden (basale ganglia). De substantia nigra is goed gepigmenteerd. Er is een normale cerebellaire corticale arborisatie. De nuclei dentati en nuclei olivares inferiores zijn goed identificeerbaar. De hersenkamers (ventrikels) zijn normaal. // De grote hersenkamers (laterale ventrikels) zijn gedilateerd / vernauwd. // Er is linkszijdige / rechtszijdige verplaatsing van de gyrus cingulus (falciene herniatie). // Er is deviatie van de middellijn naar links / rechts.

- Er zijn geen intracerebrale of intraventriculaire bloedingen; er zijn geen ruimte-innemende processen noch zones van verweking. // Er zijn puntvormige bloedinkjes in de intacte / gescheurde hersenbalk (corpus callosum) / witte stof.

2. <u>Thoracaal blok (borstwand / borstholte)</u>

- Het intacte diafragma reikt tot de ###de tussenribruimte/rib links en ###de tussenribruimte/rib rechts.

- Bij incisie van de 2de tussenribruimte blijken de longen normaal ontplooid en weg te zinken. // Bij incisie van de 2de tussenribruimte zijn de longen gecollabeerd (pneumothorax). // Bij incisie van de 2de tussenribruimte blijven de longen opgezet.

- De vorm van de thorax is zonder bijzonderheden. // De thorax is klokvormig. // De thorax is uitgehold (pectus excavatum). // De thorax heeft een uitpuilend borstbeen (pectus carinatum).

- Beschrijving inhoud

- linker borstholte (pleuraholte): ### ml helder citrijngeel (sereus) vocht / geelbruin (serosanguinolent) vocht / donkerrood (bloederig) vocht (pleurale serosanguinolent effusie of vochtuitstorting) // bloeduitstorting (hemothorax) // etterig vocht (pyothorax / empyeem)

- rechter borstholte (pleuraholte): ### ml helder citrijngeel (sereus) vocht / geelbruin (serosanguinolent) vocht / donkerrood (bloederig) vocht (pleurale serosanguinolent effusie of vochtuitstorting) // bloeduitstorting (hemothorax) // etterig vocht (pyothorax / empyeem)

- Het borstbeen (sternum) en ribbenrooster zijn intact. De ribben hebben een normale stevigheid. // De ribben tonen een toegenomen breekbaarheid. // De ribben zijn broos. // De beenderige borstkas is gebroken: ### fracturen

- Het mediastinum is zonder bijzonderheden. // Er is vetophoping in het mediastinum. // Er is een kleine thymusrestant. // Forse thymus (zwezerik). // Er is een bloeduitstorting (hematoom) in het mediastinum: beschrijf

- De goed ontplooide longen nemen hun normaal volume in de borstholte in. // De longen zijn toegeklapt (gecollabeerd). // De longen zijn sterk uitgezet en genaken / overlappen elkaar op de middellijn.

- De parietale pleura en de viscerale pleura liggen vrij. // De parietale pleura en de viscerale pleura zijn plaatselijk / diffuus verkleefd / vergroeid / links / rechts. // De parietale pleura toont plaatselijk / diffuus witte littekens / harde platen (hyaliene plaques) links / rechts (pleurale hyalinose).

- *De thoracale organen worden en bloc verwijderd uit de thoraxholte.*

2.1 Cardiovasculair stelsel

2.1.1 Het hart

a) Pericard en uitwendig examinatie hart

- Beschrijving inhoud hartzakje (pericardholte): ### ml helder citrijngeel (sereus) vocht / geelbruin (serosanguinolent) vocht / donkerrood (bloederig) vocht // bloeduitstorting (hemopericard) // etterig vocht. // ### g bloedklonters.

- Het parietale pericard en viscerale pericard liggen vrij. // Het parietale pericard en viscerale pericard zijn verkleefd / vergroeid.

- Het pericard neemt zijn normale plaats in. // Het pericard is in volume toegenomen door een vergroot hart.

- Het hart en de grote borstbloedvaten (truncus pulmonalis, arteriae pulmonales, vena cava superior, aorta) bevatten een normale hoeveelheid vloeibaar donker bloed zonder bloedstolsels. // Het hart en de grote borstbloedvaten (truncus pulmonalis, arteriae pulmonales, vena cava superior, aorta) bevatten

vloeibaar donker bloed en postmortale bloedstolsels. // Bloedledig hart en grote borstbloedvaten (truncus pulmonalis, arteriae pulmonales, vena cava superior, aorta). // Bloedarm hart en grote borstbloedvaten (truncus pulmonalis, arteriae pulmonales, vena cava superior, aorta). // Stapeling (pooling) van veel donker vloeibaar bloed in hart en grote borstbloedvaten (truncus pulmonalis, arteriae pulmonales, vena cava superior, aorta).

- Het hart is uitwendig zonder bijzonderheden. // Het hart is uitgezet. // Het hart is rechtszijdig / linkszijdig uitgezet. // De sulcus interventricularis anterior van het hart eindigt rechts van de apex. // Het hart is opvallend vergroot en verzwaard. // De apex is volledig afgerond. // Er is een belangrijke / uitgesproken afzetting van vet op het epicard t.h.v. de sulcus atrioventricularis en interventricularis. // Er is een melkvlek (witte verkleuring van het hartvlies) op de voorwand van het rechterhart. // Het hart is klein en bruin: zgn. seniele (bruine) atrofie. // Er is een epicardiale bloeding (bv. doorbraakbloeding).

b) Coronaire arteries

- De coronaire arteries worden seriëel dwars gesectioneerd (interval ± 4 mm).

- De coronaire arteries ontspringen normaal en hebben een linker / rechter dominant verloop. Ze zijn zonder bijzonderheden. // Ze liggen aan het oppervlak. // Ze liggen ingebed in vetweefsel. // Ze zijn soepel en smal zonder tekens van arteriosclerose.

- Ze zijn verwijd / rigide / tortueus. // Er is lokale / diffuse arteriosclereuze aantasting t.h.v. de:

- arteria coronaria dextra: enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde arteriosclerose (stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten; excentrische / concentrische vernauwing tot 25 % (stenosegraad 1) / tussen 25 - 50 % (stenosegraad 2) / tussen 50 - 75 % (stenosegraad 3) / tot meer dan 75 % (stenosegraad 4) / tot meer dan 90 % (kritische stenose)
- arteria coronaria sinistra: enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde (arteriosclerose stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten; excentrische / concentrische vernauwing tot 25 % (stenosegraad 1) / tussen 25 - 50 % (stenosegraad 2) / tussen 50 - 75 % (stenosegraad 3) / tot meer dan 75 % (stenosegraad 4) / tot meer dan 90 % (kritische stenose)
- LAD of Ramus InterVentricularis Anterior: enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde (arteriosclerose stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten; excentrische / concentrische vernauwing tot 25 % (stenosegraad 1) / tussen 25 - 50 % (stenosegraad 2) / tussen 50 - 75 % (stenosegraad 3) / tot meer dan 75 % (stenosegraad 4) / tot meer dan 90 % (kritische stenose)
- Ramus circumflexus: enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde (arteriosclerose stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten; excentrische / concentrische vernauwing tot 25 % (stenosegraad 1) / tussen 25 - 50 % (stenosegraad 2) / tussen 50 - 75 % (stenosegraad 3) / tot meer dan 75 % (stenosegraad 4) / tot meer dan 90 % (kritische stenose).

c) Hartdissectie

- Het hart wordt geopend volgens de bloedstroomrichting en ontleed naar de methode van Fulton / American Heart Association method.

- De atria en ventrikels zijn zonder bijzonderheden. // De atria / ventrikels zijn gedilateerd. // Er zijn postmortale / premortale stolsels in de atria / ventrikels.

- Het interatriaal septum en het interventriculair septum zijn intact. Het foramen ovale is gesloten. // Het foramen ovale is open maar klepcompetent. // Het foramen ovale is wijd open (### mm). // Er is een defect (### mm) in het interatriaal septum en het interventriculair septum.

- De binnenwand van het hart (endocard) is zonder bijzonderheden. // Er zijn (tigroïde) endocardiale bloedingen aan de binnenwand van de linkerkamerwand (linkerventrikel) t.h.v. het uitstroomgebied (shockfenomeen). // Er is witte verdikking (verlittekening) van de binnenwand (endocard) van de linker ventrikel: endocardiale fibrose.

- De semilunaire kleppen (pulmonalis- en aortaklep) en atrioventriculaire kleppen (tricuspidalis- en mitralisklep) zijn zonder bijzonderheden. // De klepbladen van de aortaklep / mitraalklep zijn verdikt / verhard / verkalkt: (ouderdoms)sclerose. // De aortaklep is tweebladig: bicuspiede aortaklep. // De klepbladen van de mitraalklep zijn zacht verdikt: mitraalklep-prolaps. // Er zijn vegetaties op aortaklep / mitraalklep: endocarditis. // De chordae tendineae zijn vergroeid / verkort / verbreed.

De ventrikelwand is zonder bijzonderheden. // De spierwand van de linkerventrikel is symmetrisch verdikt zonder vernauwing van de ventrikelholte (excentrische linkerventrikelhypertrofie). // De spierwand van de linkerventrikel is symmetrisch verdikt met vernauwing van de ventrikelholte (concentrische linkerventrikelhypertrofie). // De spierwand van de linkerventrikel is sterk asymmetrisch verdikt en verzwaard met vernauwing van het uitstroomgebied van de ventrikelholte (hypertrofische cardiomyopathie). // De linker linkerventrikelwand is anterieur / lateraal / posterieur sterk verdund en verlittekend / aan de basis / apex / in het midden. // De rechter ventrikelwand is sterk verdund en vervet (aritmogene rechter ventriculaire cardiomyopathie).

Het myocard is zonder bijzonderheden. // In het linker ventrikel myocard is er een zone / zijn er zones van bleke / donkere verweking (recent infarct) // is er / zijn er witte littekens zonder / met verdunning van de wand // t.h.v. het basale deel / middendeel / apicale deel van de linker voorwand / achterwand / septum.

d) Maten en gewichten

Hartspiermassa[8]	gemeten waarde	normale richtwaarde
totaal	xx g	xx g
linker ventrikel (+ septum)	xx g (dikte: xx mm)	xx g (15 mm)
rechter ventrikel	xx g (dikte: xx mm)	xx g (2 – 5 mm)
Ventrikelindex		
links / rechts	xx	2.3 – 3.3
Crux (posterior)		
Horizontale breedte	xx cm	9 – 9.5 cm
Verticale lengte	xx cm	9 – 9.5 cm
Pericard		
Bloedklonters	xx g	

2.1.2 De bloedvaten

a) Pulmonaal vaatstelsel

- De grote truncus pulmonalis, arteriae pulmonales en venae pulmonales zijn zonder bijzonderheden. // De binnenwand van de grote longbloedvaten is vineus / rozerood van kleur.

- De binnenwand van de truncus pulmonalis en arteriae pulmonales toont gele streperige vetafzettingen / atheromatose (pulmonale hypertensie). // De stam van de truncus pulmonalis is geheel / gedeeltelijk verstopt door premortale bloedklonters: zadelembool. // De arteriae pulmonales zijn geheel / gedeeltelijk verstopt door premortale bloedklonters: longembool. // De linker / rechter arteria pulmonalis is geheel / gedeeltelijk verstopt door premortale bloedklonters: longembool.

b) Arterieel vaatstelsel

- De aorta thoracalis en aorta abdominalis, de arteriae iliacae, de arteriae renales en de oorsprong van de truncus coeliacus en arteria mesenterica zijn zonder bijzonderheden. // De omtrek van de buikaorta (2 cm boven de bekkensplitsing) meet x mm. // De binnenwand van de grote slagaders is vineus / rozerood van kleur.

- Er is arteriosclereuze aantasting van
  - aorta thoracalis: enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde (arteriosclerose stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten
  - aorta abdominalis: enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde (arteriosclerose stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten
  - arteriae iliacae: enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde (arteriosclerose stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten

[8] Naar: Hangartner JRW, Marley NJ *et al.* The assessment of cardiac hypertrophy at autopsy. Histopathology; 1985(9);12:1295-1306.

- arteriae renales: enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde (arteriosclerose stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten. // Ostium is licht / matig / ernstig / kritisch vernauwd.
- truncus coeliacus: (stam van lever- en maagslagaders): enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde arteriosclerose stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten
- arteria mesenterica superior: enkele / meerdere // zachte (arteriosclerose stadium I op schaal van I tot IV) / harde (arteriosclerose stadium II op schaal van I tot IV) / verkalkte (arteriosclerose stadium III op schaal van I tot IV) / geulcereerde (arteriosclerose stadium IV op schaal van I tot IV) atheroomplaten.

c) Aderlijk (veneus) stelsel

- De vena cava superior en vena cava inferior zijn zonder bijzonderheden. // De binnenwand van de grote aders is vineus / rozerood van kleur.

2.2 Respiratoir stelsel

- De trachea en stambronchi zijn zonder bijzonderheden. // In de trachea en stambronchi is er bleek / rozerood grofblazig / fijnblazig schuim (schuimprop). // In de trachea en stambronchi is er weinig / veel bloed. // In de trachea en stambronchi is er bleek / geel / bloederig / taai slijm. // In de trachea en stambronchi is er vloeibare / vaste maaginhoud.

- De longen (links 2-lobbig, rechts 3-lobbig) zijn bleek en licht. // De longen (links 2-lobbig, rechts 3-lobbig) zijn sterk ontplooid en belucht (acuut emfyseem). // De longen (links 2-lobbig, rechts 3-lobbig) zijn gedeeltelijk / geheel gecollabeerd . De longen (links 2-lobbig, rechts 3-lobbig) zijn bleek. // De longen (links 2-lobbig, rechts 3-lobbig) zijn donker en verzwaard.

- Het longvlies (viscerale pleura) is glad en transparant. // De viscerale pleura is reticulair / vlekkerig / diffuus beladen met zwart antracotisch pigment in kleine / matige / grote hoeveelheid. // De viscerale pleura toont een rood dambordpatroon (bloedaspiratie). // Er zijn rode stipvormige spots van Tardieu / roodbruine Paltaufse vlekken op de viscerale pleura.

- De longconsistentie is normaal. // De longconsistentie is elastisch indrukbaar. // De longconsistentie is stevig. / De longconsistentie is vlezig.

- Het longparenchym is bleek rozig en droog. // Het longparenchym is donker en vochtig. // Er loopt weinig / veel / overvloedig / bleek / bloederig / schuimig vocht af: bloedstuwing / oedeem.

- Er zijn geen afgegrensde letsels. // Er zijn diffuus verspreide donkere vlekjes (antracose). // Er zijn omschreven bleke / donkere / stevige / licht verheven / granulaire letsels (ontstekingshaarden). // De longbloedvaten en luchtwegtakjes puilen niet uit boven het snedevlak. // De longbloedvaten en luchtwegtakjes puilen uit boven het snedevlak.

3. Abdominaal blok (buikwand / buikholte / retroperitoneum)

- De buikholte is vrij van vocht. // De buikholte bevat een geringe hoeveelheid helder geel (sereus) vocht. // De buikholte bevat een geringe hoeveelheid geelbruin (serosanguinolent) vocht. // Er is een toegenomen hoeveelheid donkerrood (bloederig) vocht in de buikholte (pleurale serosanguinolent effusie of vochtuitstorting). // Er is een bloeduitstorting in de buikholte (hemoperitoneum). // Er is etterig vocht in de buikholte (peritonitis).

- Het parietale peritoneum en viscerale peritoneum liggen vrij. // Het parietale peritoneum en viscerale peritoneum zijn plaatselijk / diffuus verkleefd / vergroeid t.h.v. de linker / rechter onderbuik (fossa iliaca) / leverloge / miltloge / kleinbekken. // Er is een etterig beslag op het parietale peritoneum / viscerale peritoneum: purulente peritonitis.

- De ingewanden nemen hun normale anatomische plaats in met normale dimensies van organen en maagdarmstelsel. De lever reikt tot ### cm onder de ribbenboog.

- De appendix is aanwezig. // De appendix ontbreekt.

- De buisvormige maag is ledig. // De volle maag bevat ###. //

- Lege urineblaas. // Normaal gevulde urineblaas. // Overvolle urineblaas. //

- De maag, de darmen en de urineblaas zijn sterk uitgezet. // De maag en darmen zijn met gas opgezet. // Het colon is opvallend lang en kronkelig (dolichocolon). // Er is (postmortale) dorsale hypostase in de (declieve) dundarmlissen. // Er is (postmortale) ventrale hypostase in de (voorste) dundarmlissen. // Er is groene verkleuring t.h.v. de galblaasstreek / t.h.v. de ileocaecale overgang.

- Het omentum en het mesenterium zijn zonder bijzonderheden. // Er is een belangrijke vettoename in het omentum en het mesenterium: intra-abdominale stapeling van vet (inwendige obesitas).

- De bekkenholte is zonder bijzonderheden. // De uterus en ovaria zijn zonder bijzonderheden. // De uterus en ovaria zijn atroof. // De uterus is vergroot. // Het linker / rechter ovarium is vergroot / met cyste / met cysten. // De tubae uterinae zijn afgebonden met clips (sterilisatie).

- De retroperitoneum is zonder bijzonderheden. // Er is stapeling van vet in de nierloge. // Er is een bloeding in retroperitoneaal hematoom.

- De testes bevinden zich in het scrotum. // Er is links / rechts een hydrocoele.

3.1 Gastro-intestinaal stelsel

- De slokdarm is zonder bijzonderheden. // Het slijmvlies van de slokdarm schilfert af (autolyse). // In de slokdarm is er vloeibare / vaste maaginhoud. // Er zijn slokdarmvarices.

- De maag is zonder bijzonderheden. // De slijmvliesplooien van de maag zijn afgevlakt. // De slijmvliesplooien van de maag zijn zeer prominent. // De squamocolumnaire overgang is vervaagd. // Er zijn aftoide letseltjes in het slijmvlies van de maag. // Er is een ulcus van de maag. // Er zijn bloedingen in het slijmvlies van de maag. // Het slijmvlies van de maag is congestief.

- Het duodenum is zonder bijzonderheden. // Het duodenum is leeg. // Het duodenum bevat weinig / veel vloeibare / vaste maaginhoud / verteringsbrij. // De inhoud van het duodenum is groen slijmig.

3.2 Hepatobiliair stelsel

- De lever is normaal. // De lever is opvallend bleek, anemisch. // De lever is vergroot en verzwaard. // De lever is week. // De lever is zacht en bleekbruin (suggestief voor steatose). // De lever is donker gezwollen; op snede loopt bloed af (congestie). // De lever toont op snede een donkerrood gestippeld aspect (acute congestie). // De lever toont op snede een muskaatnootbeeld (chronische congestie). // De lever is geschrompeld. // De lever is hard met fijnhobbelig oppervlak en fijnknobbelig parenchym: micronodulaire cirrose. // De lever is hard met grofhobbelig oppervlak en grofknobbelig parenchym: macronodulaire cirrose.

- De galweg (ductus choledochus) is functioneel / anatomisch doorgankelijk en mondt normaal uit in het duodenum. De poortader (vena portae) is zonder bijzonderheden.

- De galblaas is afwezig. // De galblaas is zonder bijzonderheden. // De galblaas is slap en leeg. // De galblaas is sterk uitgezet. // De gal is bleek / lichtbruin / bleekgroen / donkergroen / donkerbruin van kleur. // Er is cholesterolosis. // Er zijn galstenen (cholecystolithiase).

- De alvleesklier (pancreas) is zonder bijzonderheden. // De bleke / donkere alvleesklier (pancreas) toont een normale klierarchitectuur en is zacht / stevig / hard. // Er is een tumorale verharding van ### x ### cm.

- De milt is normaal. // De milt is klein / groot, // bleek / donker. Het kapsel is glad / gerimpeld // verhard met hyalijne platen. Het miltvlees (parenchym) is bleek / donker // stevig / slijkerig // wit gestippeld. // De milt is fors en donker; het miltvlees is week en bloederig: slijk- of moddermilt.

3.3 Urogenitaal stelsel

- Het pyelocalicieel stelsel en de ureters zijn zonder bijzonderheden. // Er zijn steentjes in het pyelocalicieel: nefrolithiase. // Het pyelocalicieel stelsel en de ureters zijn sterk verwijd: hydro-ureteronefrose.

- De nieren zijn normaal. // De nieren zijn opvallend bleek en anemisch. // De nieren zijn donker en gezwollen; de cortex en medulla zijn donker en moeilijk te onderscheiden: congestie. // De nieren tonen op snede een gezwollen bleke cortex en opvallend donker medulla: shocknieren. // De verkleinde /

geschrompelde, // bleke / donkere nieren hebben een glad / granulair / egaal / hobbelig / rood gespikkeld / rood gevlamd / ingedeukt oppervlak. // Het parenchym is op snede bleek / donker en toont een normaal brede / verdikte / verdunde bleke / donkere schors, goed / moeilijk / niet te onderscheiden van bleke / donkere medulla.

- De blaas is zonder bijzonderheden. // De blaas is geschrompeld. // De blaas is sterk uitgezet. // De wand van blaas is verdikt. // De binnenwand is glad / trabeculair. // Het slijmvlies van de blaas is bleek / hemorrhagisch. // De blaasdriehoek (trigonum) heeft een knobbelvormige verdikking (prostaathypertrofie met middenkwab).

- De normaal grote / kleine / vergrote prostaat is stevig / hard en toont op snede een homogeen / nodulair aspect.

- De teelballen (testikels of testes) zijn normaal groot / verkleind / vergroot met bleek / donker snedevlak. // Er is een hydrocoele / spermatocoele links / rechts.

- De eierstokken (ovaria) en baarmoeder (uterus) zijn normaal. // De eierstokken (ovaria) en baarmoeder (uterus) zijn klein. // Er is een geel lichaampje (corpus luteum) in het linker / rechter ovarium. // De baarmoeder (uterus) homogeen / hobbelig vergroot. // De baarmoederholte is leeg / bevat een IUD / bloederig vocht.

- De baarmoederhals (cervix) en schede (vagina) tonen geen bijzonderheden. De baarmoedermond is rond / spleetvormig.

3.4 Endocrien stelsel

- De schildklier is normaal. // De schildklier is symmetrisch / asymmetrisch vergroot. // De consistentie is week / vlezig / stevig / hard. Op snede is het parenchym homogeen / nodulair.

- De bijnieren zijn normaal en tonen op snede een goed onderscheidbare homogene geel-bruine cortex en grijze medulla. Geen gezwellen; geen bloedingen. // De bijnieren liggen ingebed in vet. // De bijnieren zijn hypertroof / opvallend atroof. // De bijnieren zijn autolytisch verweekt

3.5 Lymfoïd stelsel

- Er zijn geen adenopathiën. // Er zijn adenopathiën gelocaliseerd in de ###. De grootste klier is ### x ### cm.

- Het beenmerg werd gepreveleerd.

4. <u>Overige waarnemingen</u>

- …

5. Orgaangewichten

5.1 Vrouw

Orgaan[9]	Gemeten gewicht in gram	Normaal gewicht (vrouw)[10]
Hersenen		1240 (1000 – 1500)
Hart		(200 – 280)
Linker long		325 – 480
Rechter long		360 – 570
Lever		1350 – 1450
Pancreas		90 (70 – 110)
Milt		130 – 160
Linker nier		120 – 175
Rechter nier		120 – 175
Linker bijnier		± 4
Rechter bijnier		± 4
Schildklier		35 (30 – 70)
Thymus		20 – 25
Baarmoeder		70 (33 – 41[11] / 102 – 117[12])

5.2 Man

Orgaan[13]	Gemeten gewicht in gram	Normaal gewicht (man)[14]
Hersenen		1360 (1100 – 1600)
Hart		(270 – 360)
Linker long		325 – 480
Rechter long		360 – 570
Lever		1400 – 1500
Pancreas		60 – 135
Milt		140 – 170
Linker nier		115 – 220
Rechter nier		115 – 220
Linker bijnier		± 5
Rechter bijnier		± 5
Schildklier		40 (30 – 70)
Thymus		20 – 25
Prostaat		15 – 40

[9] De normale gewichten zijn slechts indicatief; de reële gewichten variëren volgens leeftijd, gestalte en lichaamsgewicht.
[10] Naar: (1) Finkbeiner WE, Ursell PC, Davis RL. Autopsy Pathology. A manual and atlas. Philadelphia: Churchill Livingstone; 2004. (2) Ludwig J. Handbook of autopsy practice. Totowa: Humana Press; 2002.
[11] Nulliparus (geen geboorten).
[12] Multiparus (meerdere geboorten).
[13] De normale gewichten zijn slechts indicatief; de reële gewichten variëren volgens leeftijd, gestalte en lichaamsgewicht.
[14] Naar: (1) Finkbeiner WE, Ursell PC, Davis RL. Autopsy Pathology. A manual and atlas. Philadelphia: Churchill Livingstone; 2004. (2) Ludwig J. Handbook of autopsy practice. Totowa: Humana Press; 2002.

6. Conclusie

6.1 Macroscopische bevindingen

6.2 Microscopische bevindingen

6.3 Bespreking

6.3.1 Klinische informatie en vraagstelling

6.3.2 Majeure bevindingen

6.3.3 Mineure bevindingen

6.3.4 Repliek klinische vraag

X Addendum: SOP clinical autopsy and attachments

UNIVERSITAIRE ZIEKENHUIZEN LEUVEN

UZ LEUVEN | PATHOLOGISCHE ONTLEEDKUNDE

SOP klinische autopsie

Doelgroep

Alle bevoegde personen.

Verantwoordelijkheden

Alle bevoegde personen zijn verantwoordelijk voor het naleven van de procedure bij de klinische autopsie in een zo veilig mogelijke omgeving zoals beschreven in SOP DIAA-DG0XX-PR.

Doel en principe

Het doel van de klinische autopsie is de exacte doodsoorzaak te achterhalen of een antwoord trachten te bieden aan de klinische vraagstelling. Vaak zijn hiervoor bijkomende onderzoeken nodig, zodoende de exacte of mogelijke doodsoorzaak pas weken tot maanden na de autopsie kan gekend zijn. Het is de patholoog (arts-specialist in opleiding) die de autopsie uitvoert onder supervisie van een arts staflid anatomopathologie. Hij/zij kan zich laten bijstaan door een collega patholoog of ASO (arts-specialist in opleiding), een staflid of co-assistent in de anatomopathologie en wordt geassisteerd door een mortuariumtechnicus.

Het principe is een gestandaardiseerde werkwijze, ten einde deze zo snel en efficiënt mogelijk uit te voeren en het bezoek aan de overledene na de autopsie zo veel als mogelijk toe te laten. De hiernavolgende standaardprocedure is afgeleid van de autopsietechniek volgens Ghon [1][2]. Er kan door de patholoog geheel of gedeeltelijk van worden afgeweken.

Werkwijze

Uitwendige – en inwendige lijkschouwing

Aanvang en voorbereiding - algemene principes

- Bij aanvraag tot autopsie brengen de mortuariumtechnici de patholoog op de hoogte dat er een autopsie zal doorgaan en de datum en het uur waarop deze zal plaatsvinden worden vastgelegd of na registratie via de slotenplanning in KWS. Het overbrengen van het lichaam gebeurt door een verpleegkundige van de afdeling in kwestie of de centrale dienst voor transport. De procedure voor het binnenbrengen en de ontvangst van de overledene op het mortuarium UZ Leuven, campus Gasthuisberg, staat beschreven in de procedure XXX.
- De patholoog vergewist zich van de juiste identiteit van de patiënt door controle van de aanvraag van klinische autopsie, het pols- en enkelbandje.
- Indien de patholoog oordeelt dat het uitvoeren van medische beeldvorming nuttig of noodzakelijk is voor het bepalen van de doodsoorzaak, wordt deze uitgevoerd volgens proedure XXX.
- Nabestaanden hebben ten allen tijde het recht tot afscheid nemen. Dit wordt binnen het kader van gangbare afspraken en beschikbare pathologen zoveel mogelijk gerespecteerd.

- De schouwing wordt uitgevoerd met geëigende kledij, bestaande uit een operatiehemd en -broek, schort (stof of plastiek), handschoenen en een mondmasker. De kledij bevindt zich in de kleedruimte en handschoenen, mondmaskers en haarmutsen zijn voorradig in de autopsieruimte. Voor aanvang van de autopsie controleert de patholoog of de medewerkers en alle aanwezigen aan de kledijvoorschriften voldoen. Het dragen van veiligheidshandschoenen bij de eigenlijke inwendige schouwing wordt sterk aanbevolen. Tijdens de autopsie dient er op toegezien te worden dat handschoenen die visueel beschadigd zijn onmiddellijk gewisseld worden en dat er eveneens nieuwe handschoenen worden aangetrokken bij het wisselen tussen technische naar administratieve taken, waarbij er geen documenten met bevuilde handschoenen gemanipuleerd worden. De patholoog controleert de nalevind van de regels.
- Er wordt altijd eerst voor aanvang nagegaan of beeldvorming gevraagd of relevant is (zie XXX). Vervolgens wordt er een uitwendige lijkschouwing uitgevoerd, waarna de inwendige schouwing volgt.
- Bij de aanvang van de autopsie worden de bevoegd verklaarde assisterende artsen, de mortuariumtechnici en de aanwezige personen met naam en functie mee op het macroscopieblad geregistreerd (zie 'Macroscopieblad'). Dit document wordt bij het autopsiedossier gevoegd.
- Waar nodig geacht kan men de bevindingen fotografisch documenteren met het beschikbare fototoestel op het mortuarium (CANON Powershot A480)
- De autopsie en de aangewende autopsietechnieken, inclusief afname van histologische stalen van het lichaam, vallen onder de verantwoordelijkheid van de patholoog. De autopsie wordt uitgevoerd door de patholoog bijgestaan door minstens één tot twee (soms meerdere, mits toestemming van de patholoog) mortuariumtechnici, waarbij de technische handelingen ook kunnen worden verricht door de mortuariumtechnicus onder toezicht van de patholoog. De mortuariumtechnici staan in voor de voorbereiding van de autopsiezaal en het instrumentarium, de overbrenging van het lichaam uit de koelkamer naar de autopsietafel, het meten, wegen en noteren [onder toezicht van de patholoog], het verzamelen, labelen (kleefetiketten worden voorafgaand aan de autopsie afgedrukt) en inventariseren van de stalen (histologie, biochemie, microbiologie,...) [onder toezicht van de patholoog], het reinigen en de lijktooi.
- De manipulaties aan en rond het lichaam dienen door ieder met de nodige voorzichtigheid en aandacht voor hygiëne te worden uitgevoerd. In het bijzonder moeten snij-, steek- en prikincidenten worden vermeden door de correcte technieken aan te wenden, de nodige afstand te bewaren (vb. niet met 2 obducenten op dezelfde plaats snijden), veiligheidshandschoenen te dragen, naalden onmiddellijk in de naaldcontainers te deponeren enz.. (prikongevallen, snijongevallen en bloedspatten). Scherp instrumentarium dat niet in gebruik is, wordt op de versnijdtafel gelegd. De nodige zorgvuldigheid wordt aan de dag gelegd om opspatten van bloed en lichaamsvochten te vermijden, de omgeving zo zuiver mogelijk te houden, de kledijvoorschriften na te leven (om rechtstreeks contact met de huid/slijmvliezen te vermijden) enz. Bij het openzagen van de schedel met de schedelzaag wordt zoveel als mogelijk gebruik gemaakt van de afzuiging verbonden aan de zaag.
- Bij gelijktijdige uitvoering bepaalt de patholoog in principe (tenzij anders aangewezen) zijn/haar positie aan de autopsietafel en zal de assisterende medewerker/mortuariumtechnicus aan de andere zijde plaatsnemen.
- De patholoog beslist over de af te nemen stalen in het licht van de klinische probleemstelling. Bij elke autopsie wordt voor zover mogelijk steeds een standaardset aan stalen voor histologie afgenomen. Indien relevant beslist de patholoog tot bijkomende staalname (microbiologie, biochemie, toxicologie, DNA,...)

UITWENDIGE LIJKSCHOUWING

1. Het lichaam, gelegen op de brancard, wordt gewogen door de mortuariumtechnicus (brutogewicht) met behulp van de weegeenheid op de hefwagen, volgens de procedure XXX.
2. De mortuariumtechnicus schuift het lichaam met behulp van een rolslede op de autopsietafel.
3. De toestand waarin het lichaam zich bevindt, wordt gedetailleerd geïnspecteerd en beschreven door de patholoog. De bevindingen worden neergeschreven of rechtstreeks gedicteerd.
4. De persoonlijke voorwerpen (inclusief juwelen) worden afzonderlijk geregistreerd op een formulier en bij het dossier gevoegd (zie XXX). Op dit formulier wordt eveneens geregistreerd aan wie en wanneer deze voorwerpen desgevallend overhandigd zijn geworden.

5. De mortuariumtechnicus meet het lichaam met de voorziene meetlat zo nauwkeurig mogelijk: de totale lichaamslengte (midden voetzool-bovenrand hoofd in gestrekte rugligging), de knie- (midden voetzool-knieplooi), bil- (midden voetzool-bilplooi), schouderhoogte (midden voetzool-bovenrand schouder), schouderbreedte, voor- en achterwaartse borsthoogte. Deze gegevens worden, n*et al.*s alle orgaangewichten en fluida-volumes, op het witte bord in de autopsiezaal neergeschreven en daarna geregistreerd op het macroscopieblad of rechtsreeks op het macroscopieblad. In specifieke gevallen worden bijkomende afmetingen opgetekend: vb. armomtrekken ter hoogte van de bicepsbuik (rechts- of linkshandigheid), beenomtrekken vb. bij vermoeden flebothrombose/longembolie (dijen: 10 of 15 cm boven de knieschijf; kuiten).
6. Het hoofd, de romp, de bovenste en onderste ledematen evenals de genitaalstreek worden gedetailleerd onderzocht en beschreven door de patholoog. Bij het uitwendig onderzoek van het lichaam zal de patholoog, indien nodig, gebruik maken van schetsen en tekeningen die bij het dossier worden gevoegd (zie XXX).
7. Ten vroegste na het onderzoek van de ogen (met dubbel omklappen van de bovenste oogleden) door de patholoog kan deze of de mortuariumtechnicus overgaan tot afname van oogvocht (door middel van spuit met naald in de oogbol aan de buitenste canthus), indien dit vereist is.
8. Na het onderzoek in rugligging wordt het lichaam omgedraaid naar buikligging door de mortuariumtechnicus met bijstand van de patholoog en/of van een tweede mortuariumtechnicus.
9. De rug, onderste en bovenste ledematen worden gedetailleerd geïnspecteerd en beschreven.
10. Indien aangewezen, wordt door de patholoog een staal genomen van het ruggenmerg door middel van een nekpunctie (transcutane cisterna magna punctie).
11. Op beslissing van de patholoog kan eventueel (indien aangewezen) eerst worden overgegaan tot rugautopsie (kan evenwel ook na de klassieke autopsie) of wordt het lichaam terug naar rugligging gedraaid. Beschrijving zie 'Inwendige lijkschouwing' punt 29.
12. Waar relevant kan van de uitwendige letsels een gedetailleerd letselbilan worden opgesteld (met grafische voorstelling op lichaamsschema's) met het optekenen van de anatomische locatie, afmetingen tov referentiepunten, voetzoolhoogte (midden voet-onderrand letsel in anatomische positie van het lichaam), lengte/breedte/diepte/diameter, wond(rand)kenmerken enz.

INWENDIGE LIJKSCHOUWING

De mortuariumtechnicus zal nuttige bevindingen op vraag van de patholoog noteren. De patholoog kan ook gebruiken maken van de 'Werkbladen klinische autopsie' om relevante bevindingen tijdens te autopsie te documenteren. De afmetingen en orgaangewichten worden aansluitend aan de meting op het witte bord in de autopsiezaal of rechtsreeks op het macroscopieblad genoteerd (zie 'Macroscopieblad'). De patholoog is verantwoordelijk voor de afname en registratie van biopsies (voor histologie) volgens procedure XXX.

Alle tijdens de autopsie gebruikte bladen en schema's worden voorzien van het A-nummer (etiket) en worden bij het dossier gevoegd.

1. De mortuariumtechnicus zet de instrumenten, dissectietafel en genummerde biopsie recipiënten klaar.
2. De lijkopening gebeurt in de regel door middel van een I-vormige incisie doorheen huid en onderhuids vetweefsel, beginnend aan de onderzijde van het ene oor via de halsbasis naar de onderzijde van het andere oor. Vanuit het midden van deze U-snede wordt een lange verticale incisie over het sternum en de buik, rond de navel, naar de pubis gemaakt tot op de spierlaag.
3. De buikholte
    - Geopend door splijten (insnijden of doorknippen met behulp van de knopschaar) van de buikspieren en klieven van het buikvlies op de middellijn (linea alba) met lateraalwaarts lospreparereren.
    - Insnijden van de buikspieren.
    - In situ inspectie van de buikinhoud en van de buikorganen.
    - Opmeten van eventueel aanwezige vloeibare inhoud.
    - Eventueel afname van bacteriologische stalen (zie bijlage), indien aangewezen. Overgaan tot openen en inspectie van urineblaas. Indien nodig kan met overgaan tot het verzamelen van blaasinhoud, afname van perifeer bloed en openen van de maag met verzamelen van de maaginhoud; dit kan ook uitgesteld worden tot na openen van

de borstkas. Tussen elke staalafname met behulp van een pollepel of ander instrument wordt deze telkens gereinigd onder stromend leidingwater; hetzelfde geldt voor het hergebruik van maatbekers. Onderstaande stappen kunnen uitgevoerd worden indien de patholoog dit nodig acht:

- De urine of het spoelvocht[3] wordt na het openen van de urineblaas, gepreleveerd met behulp van spuit en/of pollepel en afgezonderd in een plastic recipiënt; ook prelevatie met spuit en naald vóór openen van de urineblaas is mogelijk; de hoeveelheid en uitzicht worden geregistreerd.
- Afname van perifeer bloed d.m.v. proximaal afbinden met klemmen, aanprikken van de vena iliaca externa of femoralis met naald en collecteren in spuit of doorhalen van de vena iliaca externa of femoralis en opvangen met pollepel of ander recipiënt; de mortuariumtechnicus verdeelt het bloed over het gewenste aantal tubes.

- Openen van de maag langs de grote maagbocht, inspectie en uitscheppen van de inhoud uit de maag en overbrengen in het vergiet boven de maatbeker; vloeibare en vaste maaginhoud wordt gescheiden en afzonderlijk opgemeten en afgezonderd in standaard recipiënt; de aard en de hoeveelheid worden geregistreerd. Alternatieve methode: clippen van de maag en extractie van de maag (met maaginhoud), waana openen van de maag, inspectie en uitscheppen van de inhoud.

4. De hoogte/stand van beide diafragmakoepels ten opzichte van de ribben wordt bepaald en geregistreerd waar relevant.
5. De pneutest wordt gedaan door een insnede ter hoogte van de tweede of derde tussenribruimte parasternaal met voorzichtig klieven van achtereenvolgens de intercostaalspier en het borstvlies (na inspectie van de long doorheen het transparante longvlies).
6. Openen van de borstkas door overknippen van het kraakbenig deel van de ribben net naast de overgang tussen kraakbeen en bot. Losnijden van borstvlies en verwijderen van de borstplaat (borstbeen of sternum met kraakbenige ribdelen); inspectie van de binnenzijde van de borstplaat.
7. De patholoog inspecteert de thoraxorganen in situ met eventuele voorafgaand staalnamen voor bacteriologisch onderzoek indien aangewezen.
8. De patholoog inspecteert de borstholte en meet en beschrijft eventuele vergroeiingen en het pleuravocht. Het eventuele vocht in elke borstholte wordt afgezonderd (met pollepel) en waar relevant (indien bloederig) opgemeten in een maatbeker; registratie van aard en hoeveelheid.
9. Het hartzakje wordt geopend; de inhoud wordt opgemeten met registratie van aard en hoeveelheid.
10. Indien centraal of hartbloed vereist is voor een DNA-test, kan het worden afgenomen (1) uit het rechter hart door doorhalen van de onderste holle ader (vena cava inferior) na afklemming (doorsnijden boven de afklemming) en eventueel uit (2) het linkerhart bij doorsnijden van de longaders (pulmonale venen). De mortuariumtechnicus verdeelt dit over de gewenste tubes. Het hart kan worden uitgenomen na doorhalen (met knopschaar) van de aorta ascendens en truncus pulmonalis langs de sinus transversus; in situ inspectie op centrale longembolen door openknippen van de linker en rechter longslagader (arteria pulmonalis); oplichten van de hartpunt en doorsnijden van de vier longaders (venae pulmonales); uitlichten van het losgemaakte hart. Alternatief (en gebruikelijk) kan het hart ook *en bloc* met het thoracaal orgaanblok worden uitgehaald.
11. Uitsnijden van het thoracaal orgaanblok als volgt:
    - oplichten van de longen beiderzijds voor telkens paravertebraal insnijden van het borstvlies en naar boven te verlengen met doorhalen van de grote bloedvaten aan de halsbasis thv het sleutelbeen
    - doorhalen van luchtpijp (trachea) en slokdarm, eventueel na ondertunneling en afbinden (om inhoud luchtpijp te vrijwaren van inloop van vb. bloed of uitloop van vb. braaksel of vocht)
    - uitlichten van slokdarm-luchtpijp aan de halsbasis en met zachte, gedoseerde tractie uit het thoracaal orgaanblok lostrekken van de wervelzuil (desgevallend met scherp klieven van de zachte verbindingsweefsels)
    - volledig oplichten van thoracaal blok, met achterlaten van het van middenrif (diafragma) en klieven van slokdarm en borstaorta thv de passage door het middenrif.
12. Uitsnijden van het darmstelsel na plaatsen van 2 parallele klemmen ter hoogte van de hoek van Treitz (proximale jejunum), klieven van de darm tussen de twee klemmen en lossnijden van de darmsteel (mesenterium) tegen de darmwand tot aan de dikdarm (caecum); lossnijden van de

aanhechting van het dikdarmkader aan de buikachterwand tot aan de rectosigmoidale overgang; doorsnijden van het rectosigmoid in het kleinbekken. Alternatief (indien de dundarm naderhand niet moet worden geopend) kan het darmstelsel *en bloc* worden uitgehaald door klieven van de darmsteel tegenaan de pancreaticoduodenale oorsprong.

13. De darmen worden tijdens het verwijderen geïnspecteerd en in een schaal opgevangen; indien aangewezen worden de darmen voor inspectie van inhoud en slijmvlies geopend; desgevallend wordt darminhoud bemonsterd.
14. Vervolgens uitsnijden van het lever-maag-milt-pancreas-duodenumblok als volgt:
    - vrijmaken van de milt en lever, losmaken van het middenrif (diafragma)
    - oplichten onderaan van darmvaatsteel (mesenterium) met dwars klieven van de oorsprong van de dundarmslagader (arteria mesenterica superior) en van de truncus coeliacus.
15. Tenslotte wordt het diafragma in één blok met de retroperitoneale organen (buikaorta en bekkenslagaders, nieren en bijnieren, ureters, prostaat/vrouwelijke genitalia), de urineblaas en de dikdarmstomp losgemaakt van ribbenrooster, wervelkolom, en kleinbekken met doorhalen van urethra, vagina en rectosigmoid voor hun respectieve uitwendige mondingen. De bijnieren kunnen voorafgaand worden afgezonderd.
16. Hersenautopsie:
    - Hersenenautopsie <u>zonder verdenking van infectieuze ziektes</u> analoog niveau L3/L4. Neem contact op met XXX. Zij zullen de niet-gefixeerde hersenen ophalen, het zelf verwerken en kunnen ook beslissen of aanvullende staalnames nodig zijn voor een bepaalde neurologische vraag.
        - Het openen van de schedel gebeurt door dwars insnijden van de hoofdhuid achter de beide oren, van oor tot oor, over de kruin. Losmaken van de hoofdhuid tot aan de wenkbrauwen en het achterhoofd. Inspectie van de weke delen (hoofdhuid, slaapspieren, botvlies) en het schedelbot en vrijprepareren van de slaapspieren met insnijden.
        - De patholoog inspecteert de galea aponeurotica (scalpvlies) en het periost (botvlies). Het botvlies wordt, indien aangewezen, afgeschraapt ter opsporing van schedelbarsten. Vervolgens openzagen van schedel met oscillerende zaag en verwijderen van het schedeldak (indien mogelijk na losmaken van het harde hersenvlies of dura mater). De hersenvliezen worden in formaline gefixeerd. Hij/zij preleveert hersenvocht d.m.v. wissers, indien aangewezen. Vervolgens worden de hersenen uitgehaald na insnijden van de hersentent (tentorium cerebelli) en doorhalen van het (verlengde) ruggenmerg onder de hersenstam. De hersenstam, kleine en grote hersenen worden in toto verwijderd. De schedelbasis wordt gestript. De patholoog inspecteert de schedelbasis.
        - De rechter hersenhelft wordt na dissectie van de circulus arteriosus Willisii en van de hersenstam met kleine hersenen natief in frontale sneden van ca. 1 cm dikte gelamelleerd. De hersenstam en de kleine hersen worden perpendiculair tot de Meynert hersenstamas in 5 mm dikke sneden gelamelleerd. De lamellen van de grote, kleine hersen en de hersenstam worden fotografisch gedocumenteerd. Het natief weefsel wordt in de UZ Leuven biobank in -80 grad diepvriezers gestockeerd.De linker hersenhelft wordt in toto in formaline voor 2-3 weken gefixeerd. De circulus arteriosus Willisii wordt evenwel in formaline gefixeerd.

    <u>Opmerkingen:</u>

    - De patholoog mag beslissen in plaats van de rechter de linker hemisfeer natief te versnijden en der rechter hemisfeer in formaline te fixeren als dit voor diagnostische reden.

    - Hersenenautopsie <u>bij verdenking van een infectieuze ziekte</u> analoog L3/L4 nieveau (bv. Creutzfeldt-Jacob, HIV-infectie, Hepatitis B / C, tuberculose, syfilis, meningitis, herpes encefalitis, de ziekte van Whipple)nodig is.
        - Het openen van de schedel gebeurt door dwars insnijden van de hoofdhuid achter de beide oren, van oor tot oor, over de kruin. Losmaken van de hoofdhuid tot aan de wenkbrauwen en het achterhoofd. Inspectie van de weke delen (hoofdhuid, slaapspieren, botvlies) en het schedelbot en vrijprepareren van de slaapspieren met insnijden.
        - De patholoog inspecteert de galea aponeurotica (scalpvlies) en het periost (botvlies). Het botvlies wordt, indien aangewezen, afgeschraapt ter opsporing

van schedelbarsten. Vervolgens openzagen van schedel met oscillerende zaag en verwijderen van het schedeldak (indien mogelijk na losmaken van het harde hersenvlies of dura mater). De hersenvliezen worden in formaline gefixeerd. Hij/zij preleveert hersenvocht d.m.v. wissers, indien aangewezen. Vervolgens worden de hersenen uitgehaald na insnijden van de hersentent (tentorium cerebelli) en doorhalen van het (verlengde) ruggenmerg onder de hersenstam. De hersenstam, kleine en grote hersenen worden in toto verwijderd. De schedelbasis wordt gestript. De patholoog inspecteert de schedelbasis.

- Het versnijden van de hersenen gebeurd na formolisatie. Daartoe worden de hersenen in de regel met een dun touw aan de arteria basilaris opgehangen (ondergedompeld) in een emmer formol.

Opmerkingen:

- Gelieve steeds bevroren materiaal bij routine hersenautopsies te collecteren opdat het breedste spectrum van diagnostische testen in kader van bepaling doodoorzaak en onderliggende ziektes kan aangeboden worden.

Uitzonderingen:

- In geval van vermoeden voor / gekende Creutzfeldt-Jacob ziekte moeten de hersenen in formol worden gefixeerd en alle stalen moeten naar het L3-Labo gebracht worden. Het mortuarium kent deze procedure en van ons kant is Petra Weckx verantwoordelijk voor deze weefsels.

20. Indien relevant geacht (intubatie trauma) kan pas na uitruiming van (de schedel en) de romp overgegaan worden tot de hals dissectie in bloedledigheid met opwaarts vrijprepareren van huid en onderhuidse vetweefsel tot tegen de onderkaak en de kin. De halsspieren worden één na één afzonderlijk losgemaakt en ingesneden, daarna openen van halsaders en -slagaders.
21. Het halsorgaanblok (bestaande uit tong, gehemeltepijlers en huig, farynxachterwand en larynx met strotklep) wordt *en bloc* voorzichtig uitgesneden door klieven van de mondvloer aan de achterrand van de onderkaak en het klieven van de weke weefsels lateraal en achteraan.
22. De dissectie van het larynxblok bestaat uit het insnijden van de tongspier en het vrijleggen van tongbeen en schildkraakbeenhoornen. In de regel wordt de larynx (strottenhoofd) niet opengeknipt. Wanneer aangewezen worden tongbeen en larynx bewaard in formol voor gedetailleerde dissectie naar de methode van Maxeiner[4].
23. De patholoog inspecteert de lege borstholte en het ribbenrooster (op fracturen), de wervelzuil (op misvormingen/trauma) en het kleinbekken. Het ribbenrooster kan getest worden op stevigheid/verhoogde broosheid: (poging tot) manueel breken (tussen 2 vingers) van een rib (osteoporosetest).
24. Bij een mannelijk lichaam worden de teelballen via het lieskanaal uit de balzak (scrotum) gehaald en overlangs ingesneden.
25. Het thoracaal orgaanblok wordt als volgt gedissecteerd:
    - ventraal losmaken van het hart (zie hoger) met openen van de longslagaders
    - dorsale benadering met achtereenvolgens openen en losmaken van de slokdarm, openen van de luchtwegen tot tegen (of in) de longen
    - losmaken van de longen door doorsnijden van de longhili (vaatsteel)
    - openen van de borstaorta (anterieure benadering)
    - wegen van (bloedledig) hart (na openen) en longen
    - dissectie longen (overlangse snede, desgevallend dwars lamelleren)
    - dissectie van het hart volgens de methode van Fulton (alternatief: mediane dwarse ventrikelsnede en fixatie; dissectie volgens de American Cardiovascular Society voorschriften na formolisatie)

      Alternatieve methode dissectie van het thoracale blok: posterieure benadering [5]
    - na verwijdering van het thoracale blok wordt dit met de facies posterior naar boven gelegd. Met knopschaar van proximaal naar distaal openen van de oesophagus met inspectie van de mucosa. Vrijdisseceren van de oesophagus, inspectie van het submucosale vaatnet door middel van translucentie. Met rechte schaar openen van de pars membranacea van de trachea via de hoofdstam bronchi tot aan de splitsing van de lobaire bronchi. Inspectie van de mucosa/inhoud
    - inspectie van de hilaire weiknopen
    - vrijdisseceren van de trachea met doorhalen van de hoofdstambronchi. Inspectie van de facies posterior van het hart met visualisatie van het crux venorum (kruising van de aorta met de arteria pulmonalis). Openen van de truncus pulmonalis en openen van

de arteriae pulmonales naar distaal. Openen van de venae pulmonales. Openen van de aorta van distaal tot aan de bulbus aortae met inspectie van het endotheel, de aortaklep en de ostia arteriae coronariae.
    - scheiden van de longen en het hart.
    - wegen van (bloedledig) hart (na openen) en longen
    - dissectie longen (overlangse snede, desgevallend dwars lamelleren)
    - mits gelocaliseerde letsels, gebeurd de standaard bioptafname centraal in de longen
    - dissectie van het hart volgens de methode van Fulton (alternatief: mediane dwarse ventrikelsnede en fixatie; dissectie volgens de American Cardiovascular Society voorschriften na formolisatie)
    - de papillaire spieren worden gedissecteerd, vervolgens worden de kleppen geïnspecteerd en dissecteert men de hartoortjes (inspectie van atriale tromboses).
26. Het lever-maag-milt-pancreas-duodenum (gastrohepatisch) blok wordt als volgt gedissecteerd:
    - ventrale benadering met naar bovenklappen van de lever waardoor zicht op de hilus
    - openen van duodenum-maag van distaal naar proximaal via de grote maagbocht
    - functionele galafvloei test (drukken op de galblaas; tevoorschijn komen van gal thv papil van Vater); afname van gal indien vereist.
    - openen van poort- en miltader vanaan de leverhilus tot het mesenterium en de milt
    - losmaken milt (doorsnijden milthilus), pancreas, maag en lever
    - inspectie maagwand; dwars lamelleren van lever, milt en pancreas na wegen.
    - mits gelocaliseerde letsels, gebeurd de standaard bioptafname in het hoofd van de pancreas, centraal bij de lever en random bij de milt.
27. Het retroperitoneaal (urogenitaal) blok wordt als volgt gedissecteerd:
    - ventrale distale benadering: openen van de urethra en blaas, de ureters (vanuit de blaasmondingen of vanuit de nierhilus), openen van vagina en baarmoeder, openen van het rectum, openen van de onderste holle ader (vena cava inferior) en de nieraders
    - dorsale craniale benadering: openen van de aorta, bekkenslagaders en nierslagaders
    - losmaken (door decapsulatie) van de nieren uit het omgevend vetweefsel en doorhalen van de nierhilus
    - Indien nodig dissectie van baarmoeder, eileiders, of prostaat door dwars lamelleren na wegen
    - dissectie van de nieren (overlangs halveren en lamelleren) na wegen.
28. De patholoog zal alle organen na weging beschrijven, versnijden en eventueel bemonsteren. Het bemonsteren voor histologisch onderzoek gebeurt gestructureerd (XXX). Er wordt standaard per relevant orgaan (minimum) 1 biopsie genomen (uitz. longen: 1 per kwab; hart: 1 tot 2 per hartkamerwand). Indien er aanwijzingen zijn voor pathologie - anomalie, kan/kunnen er bijkomend(e) biopt(en) gepreleveerd worden van het desbetreffende orgaan. Er worden ook biopsies genomen van een relevante selectie van letsels en/of verwondingen.
29. Indien de patholoog het wenselijk acht (ikv diepveneuze trombose), wordt een dissectie van de rug en/of ledematen verricht.
    - Hierbij wordt de huid op de rug ingesneden doormiddel van een T-vormige incisie (*horizontale incisie hoog thoracaal tot beide tot aan de beide deltoïdeusspieren met over de middellijn een verticale incisie tot laag lumbaal*).
    - Vervolgens vrij maken van de huid met onderhuids vetweefsel ten opzichte van de spierfascia. Hierdoor ontstaat er een zicht op de oppervlakkige rugspieren.
    - Losmaken van de trapeziusspier van caudaal naar craniaal (*voornamelijk losmaken van de spier ter hoogte van de processus spinosi en door met een breedvlakkig mes tussen de laterale randen van de trapezius en de onderliggende spierlaag te snijden*) toe met omklappen van de spier over het achterhoofd.
    - Doorsnijden van de latissimus dorsi over de middellijn (*fascia thoracolumbalis*) en vervolgens beide flappen naar lateraal omslaan. Gelijkaardig doorsnijden en naar buiten openklappen van de rhomboideus spieren.
    - Hierdoor ontstaat er een zicht op de diepere laag van de rugspieren en de achterzijde van het ribbenrooster.
    - Insnijden van de lange rechte rugspieren en de m. subscapularis.
    - Op indicatie kan er een uitbreiding van de rugautopsie naar de bovenste en onderste ledematen uitgevoerd worden. Aangaande de ledematen wordt de huid ingesneden tot op de spieren met vervolgens los prepareren van de huid en het onderhuids vetweefsel. De spieren worden ingesneden tot op het onderliggende bot. Bloedvaten kunnen

desgevallend worden gedissecteerd en geopend. Botten van de ledematen kunnen desgevallend worden vrij gelegd.
    - Alle afwijkingen (bv. kneuzingen, fracturen, trombi, …) worden geregistreerd.
30. Enkel in daartoe geëigende, uitzonderlijke, toestanden kan het aangewezen zijn dat andere of bijzondere dissectietechnieken (conform autopsiehandboeken) moeten worden aangewend (vb. dissectie van het ruggenmerg, dissectie van de halswervelkolom, perifere vaatdissecties, wonddissecties, …).
31. Alle (versneden) organen worden door de mortuariumtechnicus terug in de lege borst- en buikholte geplaatst.
32. De mortuariumtechnicus zal overgaan tot het dichtnaaien van het lichaam en staat in voor de lijktooi (zie XXX).
33. De mortuariumtechnicus en patholoog controleren op het einde van de autopsie de staalnamen. Alle stalen worden vergeleken met de registratie op het stalenblad (zie 'Microscopieblad) en na worden etiketten afgeprint waarop autopsienummer, aard van het staal en inventarisatienummer zijn vermeld (zie eveneens XXX). Deze etiketten worden op de stalen gekleefd en pas hierna mogen de stalen worden gestockeerd volgens procedure XXX. De stalen worden, afhankelijk van de aard, in de daartoe voorziene en noodzakelijke ruimten ondergebracht (zie XXX)
34. Het microscopieblad wordt ingevuld met aanduiden van de aard van de genummerde orgaanbiopten en aangevraagde kleuringen per orgaanbiopt (zie XXX). Dit microscopieblad wordt elektronisch of manueel ingevuld en ofwel samen met de biopsierecipiënten overgemaakt aan pathologische ontleedkunde, ofwel rechtsreeks naar pathologische ontleedkunde verzonden. De dienst pathologische ontleedkunde staat in voor het verwerken van de biopsies (XXX).
35. De mortuariumtechnicus zal na registratie van de stalen op het stalenblad de weefselstalen voor histologie en vriescoupe (zo snel mogelijk) overbrengen naar Pathologische ontleedkunde volgens de procedure XXX. En eventuele additionele stalen (microbiologie, biochemie,...) stockeren op het mortuarium volgens de procedure XXX.

    In principe wordt de overbrenging van de stalen gegroepeerd tot één of twee keer per week (afhankelijk van het aantal autopsies). In afwachting van de verdeling naar de verschillende labo's, zullen de stalen op de daarvoor voorziene locaties binnen het mortuarium bewaard worden.

36. De mortuariumtechnicus zal alle gebruikte instrumenten grondig schoonmaken (met detergent (Aniosyme DD1) en een chlooroplossing (Suma tab)). Hittebestendige materialen worden bijkomend gereinigd in de instrumentenwasmachine.
37. Het lichaam wordt, na plaatsen op de brancard, door de mortuariumtechnicus terug in de koelcel geplaatst met behulp van de hefwagen.
38. Na autopsie kan een laatste groet gebracht worden aan het lichaam van de overledene (zie procedure XXX).

Van elke autopsie wordt verslaggeving gedaan volgens procedure (zie 'Rapportering klinische autopsie').

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[1] M.T. Sheaff, D.J. Hopster, Post Mortem Technique Handbook, Springer, 2001
[2] W.E. Finkbeiner, P.C. Ursell, R.L. Davis, Autopsy Pathology. A manual and atlas, Churchill Livingstone, 2004
[3] Hierbij wordt de toegevoegde hoeveelheid fysiologische vloeistof genoteerd
[4] Instructions for the complete preparation of the larynx (Z. Rechtsmed 1986; 96(1): 11-6)
[5] Coton & Cross, The hospital Autopsy (1993)

Disclaimer(s)

Algemene disclaimer UZ Leuven procedures

Werkbladen klinische autopsie

Obducent:

Datum overlijden:

Datum autopsie:

Besmettingsgraad:

Etiket

Uitwendige schouwing:

1. Algemeen

Voedingstoestand:
□ normaal
□ obesitas
□ cachectisch

Huidskleur:
□ onopvallend/blank
□ anemisch
□ icterisch
□ _____

Lijkverschijnselen:
□ Livores
□ Rigor mortes
□ Autolyse

Petechiën:
□ locatie: _____
□ uitgebreidheid: _____

2. Hoofd

Pupillen:
□ isocoor
□ afwijkend:_____

Conjunctiva:
□ niet afwijkend
□ afwijkend:_____

Sclera:
□ wit
□ icterisch

3. Thorax

Mammae:
□ noduli
□ retractie tepel
□ afwijkend:_____

Litteken(s):
□ nee
□ ja/ schets

Chirurgische wonden:
□ nee
□ ja/ schets

4. Abdomen

□ onder
□ op
□ boven hoogte van de thorax

Medusa hoofden:
□ nee
□ ja/schets

Litteken(s):
□ nee
□ ja/ schets

Chirurgische wonden:
□ nee
□ ja/ schets

5. Rug en ledematen

Litteken(s):
□ nee
□ ja/ schets

Chirurgische wonden:
□ nee
□ ja/ schets

Decubitus:
□ nee
□ ja/ schets

Oedeem:
□ nee
□ perifeer oedeem
□ opgezwollen buik

Asymmetrische kuiten (DVT):
□ nee
□ ja

Inwendige schouwing:

1. *Hals organen*

Larynx: □ niet afwijkend □ afwijkend:_____
Trachea: □ niet afwijkend □ afwijkend:_____
Schildklier: □ niet afwijkend □ afwijkend:_____

2. *Cardiorespiratoir systeem*

Ribben: □ niet afwijkend □ afwijkend:_____
Diafragma: □ niet afwijkend, hoogte rechts ____ en links ____ □ afwijkend:_____
Mediastinum: □ niet afwijkend □ afwijkend:_____
Hilus-LK: □ niet afwijkend □ afwijkend:_____
Pulmonal art.: □ niet afwijkend □ afwijkend:_____

Longen		**rechts**	**links**
Pleuraholte	Pleuravocht		
Pleura	Adhesie		
	Antracose		
Bronchien	Afwijkingen (stuwing, bronchitis, …)		
Parenchym	Afwijkingen (tumor, embolie, atelectase, emfyseem, hypostase, stuwing, oedeem, pneumonie, …)		

3. *Hart & bloedvaten*

Hartzakje: □ vocht ca. _____ml □ sereus □ sanguinolent □ purulent

Pericard/ Epicard: □ niet afwijkend
□ afwijkend:_____

Coronairen (atherosclerose, stenose, trombose)**:**
Rechter coronair: □ niet afwijkend □ afwijkend: _____
Linker stam: □ niet afwijkend □ afwijkend: _____
LAD: □ niet afwijkend □ afwijkend: _____
RCX: □ niet afwijkend □ afwijkend: _____

Hartholten en myocard:

	Linker atrium	**Linker ventrikel**	**Rechter atrium**	**Rechter ventrikel**
Afwijkend (hypertrofie, dilatatie, littekens, verweking)				

Kleppen:
□ niet afwijkend □ afwijkend:_____

Foramen ovale: □ gesloten □ te sonderen, klepcompetent □ open
Aorta thoracalis: □ niet afwijkend □ afwijkend: _____
Atherosclerose: □ afwezig □ graad I □ graad II □ graad III □ graad IV
Aorta abdominalis: □ niet afwijkend □ afwijkend: _____
Atherosclerose: □ afwezig □ graad I □ graad II □ graad III □ graad IV
Bekkenvaten: □ niet afwijkend □ afwijkend:_____
Atherosclerose: □ afwezig □ graad I □ graad II □ graad III □ graad IV

4. *Abdomen:*

Buiksitus: □ niet afwijkend □ inhoud,_____
□ adhesies/vergroeiingen
Peritoneum: □ niet afwijkend
□ afwijkend:_____

Oesophagus: □ niet afwijkend slijmvliezen,_____
□ varices
Maag: □ niet afwijkend slijmvliezen,_____
Inhoud: □ leeg □ voedselresten □ bloed

Darmen:

	Duodenum	**Dunne darm**	**Dikke Darm**	**Appendix**	**Rectum**
Afwijkingen (ischemie, operatie, poliepen, divertikels, …)					

Papil van Vater: □ doorgankelijk □ niet doorgankelijk

Lever: □ niet afwijkend □ afwijkend:_____
Leverrand: □ scherp □ afgerond
Duim-wijsvingertest: □ te makkelijk □ normaal □ te moeilijk □ niet

Galblaas: □ niet afwijkend □ afwijkend:_____
Galwegen: □ niet afwijkend □ afwijkend:_____
Pancreas: □ niet afwijkend □ afwijkend:_____
Milt: □ niet afwijkend □ afwijkend:_____
Lymfeklieren: □ niet afwijkend □ afwijkend:_____

5. <u>Urogenitaal stelsel:</u>

Nieren	**Rechts**	**Links**
Afwijkingen (schors/merg, atrofie, anemie, stuwing, nefrosclerose, stenen, cysten, …)		
A. renalis		
- atherosclerose		
- stenose		

Bijnieren:
rechts □ niet afwijkend links □ niet afwijkend
□ afwijkend:_____ □ afwijkend:_____

Ureters: □ niet afwijkend
□ afwijkend:_____

Blaas en Urethra:
□ niet afwijkend Slijmvliezen: □ niet afwijkend
□ inhoud: _____ □ katheter laesie
□ afwijkend:_____ □ afwijkend:_____

<u>Mannelijk voortplantingssysteem</u> *<u>vrouwelijk voortplantingssysteem</u>*

Prostaat: **Uterus:**
□ niet afwijkend □ niet afwijkend
□ afwijkend:_____ □ afwijkend:_____

Testis/ Epididymis: **Adnexen:**
□ niet afwijkend □ rechts/links niet afwijkend
□ afwijkend:_____ □ afwijkend:_____

UNIVERSITAIRE ZIEKENHUIZEN LEUVEN

UZ LEUVEN | PATHOLOGISCHE ONTLEEDKUNDE

Macroscopieblad klinische autopsie

Obducent:

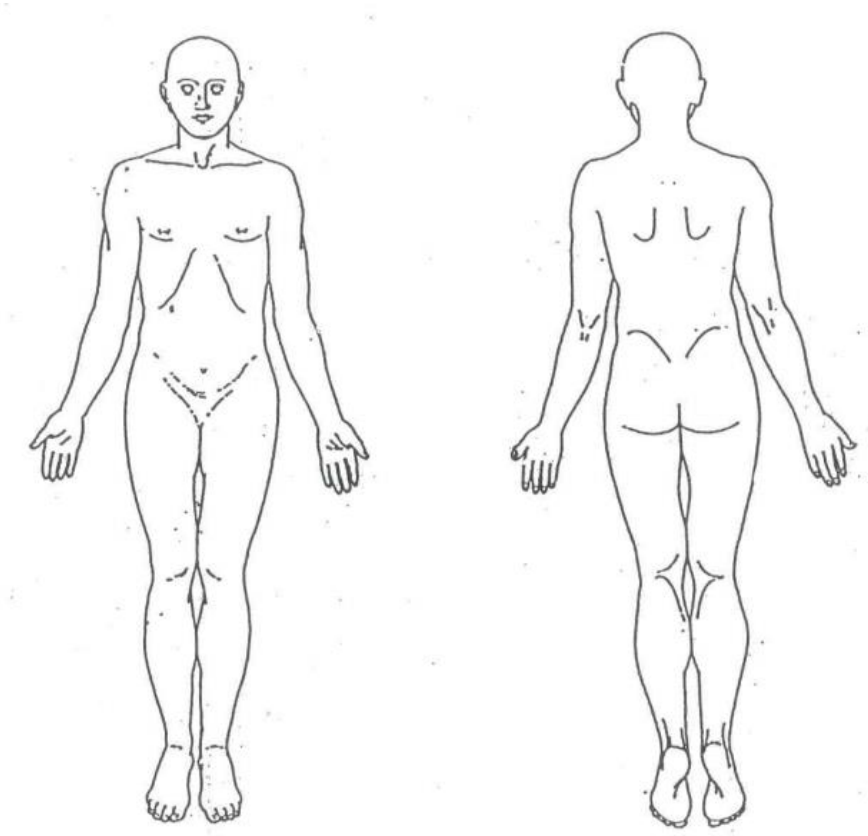
Datum overlijden:

Datum autopsie:

Besmettingsgraad:

Etiket

Orgaan	Gewicht (g)
Lichaam	
Hersenen	
Schildklier	
Linker ventrikel	
Rechter ventrikel	
Linker Long	
Rechter Long	
Lever	
Milt	
Pancreas	
Linker nier	
Rechter nier	
Linker bijnier	
Rechter bijnier	



Hartspiermassa	Gemeten waarde
Totaal	g
Linker ventrikel (+septum)	g
Rechter ventrikel	g
Crux (posterior)	
Horizontale breedte	cm
Verticale lengte	cm
Spierdikte	
Linker ventrikel	mm
Rechter ventrikel	mm
Pericard	
Bloedklonters	g

Registratie aanwezigen:

Naam + Voornaam	Functie

UNIVERSITAIRE ZIEKENHUIZEN LEUVEN

UZ LEUVEN | PATHOLOGISCHE ONTLEEDKUNDE

Microscopieblad klinische autopsie

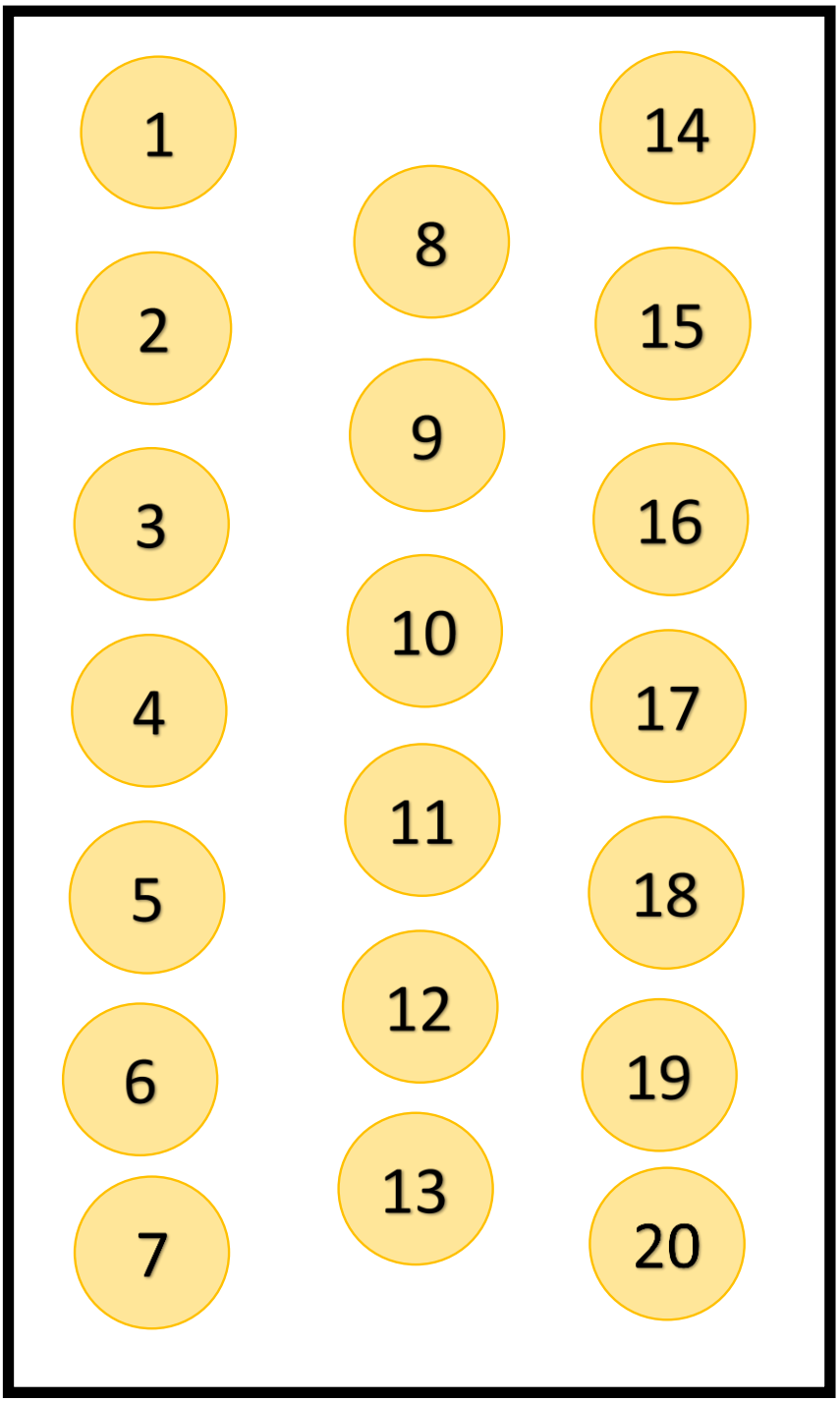
Aanvrager: _____

Opmerking voor Pathologische Ontleedkunde: Graag eerstelijnscontrole aub bij:
Hall's – Perl's - Rhodizonaat

Nr.	Orgaanbiopt	H.E.	Andere	
1	Lever	X	Hall's	
2	Milt	X		
3	Pancreas	X		
4	Linker nier en bijnier	X	PAS op nier	
5	Rechter nier en bijnier	X	PAS op nier	
6	Schildklier	X		
7	Beenmerg	X		
8	Linker long bovenkwab	X		
9	Linker long onderkwab	X		
10	Subcarinale weiknoop	X		
11	Rechter long bovenkwab	X		
12	Rechter long middenkwab	X		
13	Rechter long onderkwab	X		
14	Linker hartkamer AA	X		
15	Linker hartkamer AB	X		
16	Linker hartkamer SA	X		
17	Linker hartkamer SB	X		
18	Linker hartkamer PA	X		
19	Linker hartkamer PB	X		
20	Rechter hartkamer	X		
21	Mesencephalon*	X		
22	Cerebellum*	X		
23	Cerebrum 1*	X		
24	Cerebrum 2*	X		
25				
26				
27				
28				
29				
30	Vriescoupe long		ORO	

* Orgaanbiopt bij hersenautopsie

1. Lever
2. Milt
3. Pancreas
4. Linker nier en bijnier
5. Rechter nier en bijnier
6. Schildklier
7. Beenmerg
8. Linker long bovenkwab
9. Linker long onderkwab
10. Subcarinale weiknoop
11. Rechter long bovenkwab
12. Rechter long middenkwab
13. Rechter long onderkwab
14. Linker hartkamer AA
15. Linker hartkamer AB
16. Linker hartkamer SA
17. Linker hartkamer SB
18. Linker hartkamer PA
19. Linker hartkamer PB
20. Rechter hartkamer



Live as if you were to die tomorrow. Learn as if you were to live forever.

~ Mahatma Gandhi