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Autopsy: the benefits for medicine and society throughout history

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SUMMARY
Autopsies have played a crucial role in human medicine, forming a key foundation of medical knowledge. These final medical-anatomical procedures remain irreplaceable, shedding light on diagnoses, optimizing treatments, preventing disease spread, educating healthcare professionals, and influencing state jurisdiction. Despite the decline in the number of autopsies performed in recent decades, their medical-social significance remains essentially unchanged. Even today, autopsies contribute indispensably to the advancement of medicine and the benefit of society as a whole.

Keywords: autopsy – history of autopsies – significance of autopsies – anatomical autopsy – clinical autopsy – forensic autopsy

Pitva: benefity pro medicínu a společnost napříč historií

SÚHRN
Pitvy zohrávali kľúčovú úlohu vo vývoji humánnej medicíny, možno ich teda právom označiť za kľúčové východisko medicínskeho poznania. Tieto finálne medicínsko-anatomické úkony tvoria aj v súčasnosti virtuálnu *axis cognitionis medicinae*, pričom naďalej zostávajú imanentne nenahraditeľné z viacerých dôvodov. Nálezy a závery pitiev vnášajú svetlo do klinického bremena diagnóz, majú *eo ipso* priamy impakt na optimalizáciu liečebných postupov, prevenciu šírenia chorôb, vzdelávanie zdravotníckych pracovníkov a tiež ovplyvňujú štátnu jurisdikciu. História identifikuje tri hlavné typy pitiev: pitvu anatomickú, ktorá skúma štruktúru a funkciu ľudského tela; pitvu klinickú, zameranú na príčinu, lokalizáciu a patogenézu chorôb a pitvu forenznú, ktorá definuje smrť indivíduа z aspektu násilných javov a dejov, vonkajších i vnútorných. Takéto typy pitiev vygenerovala historická spoločenská objednávka na univerzitách v Padove, Viedni, Berlíne a Lipsku. V súčasnosti, napriek poklesu počtu vykonaných pitiev v ostatných desaťročiach, zostáva ich medicínsko-sociálny význam v podstate nemenný. Aj dnes pitvy zomrelých nezastupiteľne prispievajú k rozvoju medicíny a prospechu celej spoločnosti. Hoci niektoré kultúry či religiózne spoločenstvá majú aj dnes voči pitvám často neprekonateľné výhrady, pitvami získané poznatky i napriek tomu výrazne zlepšili zdravie mnohých, aj v týchto krajinách. Ukazuje sa, že aj napriek neskutočnému tempu rozvoja biofyziky a medicínskych vied či technológií zostane pitva ako symbolické gnozeologicky determinované vloženie ruky odborníka do tela mŕtveho nenahraditeľným zdrojom poznania.

Kľúčové slová: pitva – história pitiev – význam pitiev – anatomická pitva – klinická pitva – súdna pitva

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Hic locus est ubi mors gaudet succurrere vitae..[*]
Inscription on the Entrance of Autopsy Theatre, University of Vienna

Autopsy of deceased human, also known as a dissection or necropsy, is a medical examination of a body after death. It is a current medical procedure performed surgically to determine the thanatogenesis – the cause of death and the mechanisms or circumstances that led to the fatal outcome (1). The modern autopsy is defined as the systematic external and internal examination of a body to establish the presence or absence of diseases or injury in the deceased through gross examination of the body and microscopic investigation of the tissues (2).

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[*] *- Toto je miesto kde sa smrť raduje pomáhajúc životu…*

HISTORICAL DEVELOPMENT OF SOCIETY´S APPROACH TO AUTOPSY

The history of autopsies is a long and fascinating journey that has greatly benefited our understanding of human health and disease. Before the Renaissance, the performance of autopsies was unsystematic and depended more on the individual progress of countries or individuals. Here's a glimpse into its timeline:

- throughout history, various activities contributed to the advancement of knowledge about human anatomy, such as the treatment of severe internal injuries, the opening of bodies as part of sacrifices, or the simple observation of badly mutilated corpses
- the first mentions of cadavers being autopsied for the purpose of verifying diagnoses are found in Egyptian Heliopolis and date back to the 5th millennium BC (3). Later examples include the Jewish Talmud and the Indian physician Sushruta, who provided instructions for dissection and described the composition of the human body
- the earliest documented dissections for studying disease were performed by the Alexandrian physicians Herophilus and Erasistratus around 300 BCE. They established the first an-

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atomical school, publicly dissected bodies, and wrote the first anatomical manual, which included descriptions of organs and tissues

- Galen of Pergamum (129-216), a prominent Greek physician, made a significant advancement by being the first to correlate a patient's symptoms with his findings from examining deceased bodies, specifically focusing on the "affected part." This approach paved the way for the development of autopsies, although he did not dissect human bodies himself due to religious and cultural restrictions

- the Medieval Period largely discouraged autopsies due to religious beliefs and taboos surrounding the dead body. This period represented an intermediate stage between external inspection and dissection. Cruentation (the ordeal of the bier) was a simple test: the suspected murderer would approach the dead body and strike its wounds. Evidence of guilt was revealed if fresh bleeding occurred, the body twitched, or foam appeared at the mouth. The success of this method likely stemmed from the fact that the killer was often susceptible to psychological intimidation and would give himself away (4)

- Avicenna, also known as Ibn Sina (980-1037), was a prominent figure who significantly advanced the practice of autopsies during the Islamic Golden Age. His book, *The Canon of Medicine*, became a cornerstone of medical knowledge for centuries. It included a dedicated chapter with detailed descriptions of functional neuroanatomy, likely based on his autopsy observations. Thus, during the decline of European science, Islamic countries preserved and developed previously achieved knowledge

- Pope Innocent III, in an attempt to save two Italian clerics who were involved in the untimely deaths of men struck on the head during skirmishes, demanded medical evidence to assist them. His decretals issued in 1209 provided fundamental canon law for the formal appointment of doctors to the courts to give evidence about the cause of death and the nature of wounds (4). Thus, endowed with the authority of the Church, secular authorities soon turned to dissection in the name of justice.

Education gradually began to return from Islamic countries back to Europe. Since then, autopsies have played a critical role in the advancement of medicine and continue to be important for several reasons:

- leading to more accurate diagnoses and improved treatments
- helping prevent the spread of disease
- training the next generation of medical professionals
- aiding the criminal justice system.

GENERAL TYPES OF AUTOPSIES

Historically, three basic types of autopsies are recognized (2):

1. **The normal anatomy autopsy** studies the structure and function of the human body. This type of autopsy was largely established at Italian universities. In Padua, Andreas Vesalius (1514-1564) (Fig. 1) challenged prevailing medical knowledge based on Galen's work by performing dissections on human cadavers. He wrote his famous series of books on human anatomy, *"De Humani Corporis Fabrica Libri Septem."* The anatomic theatre was located directly in the main building at Padua University – Palazzo Bo. Later, the study of human anatomy progressed further, especially in the Netherlands. In our countries, Bohemia and Slovakia, the unforgettable name of Dr. Ioannes Iessenius should be remembered due to his fundamental contributions to the development and popularization of autopsy dissection techniques.



Fig. 1. Andreas Vesalius (1514-1564) (source: public domain).

2. **The clinical autopsy** studies the cause, locus, etiology, and pathogenesis of disease. Its origin was also at Padua University. The 18th century witnessed the work of Giovanni Battista Morgagni (1682-1771) (Fig. 2), often referred to as the "father of anatomical pathology." He meticulously performed autopsies to study the cause and locus of diseases, documented autopsy findings, and correlated them with patients' medical histories, laying the groundwork for modern pathological practices based on autopsies. He was the author of the famous book *"De Sedibus et Causis Morborum per Anatomen Indagatis,"* where the clinical observations of about 700 patients were compared with their later postmortem findings. The father of modern microscopic histology is considered to be Marie François Xavier Bichat (1771-1802), a renowned French anatomist and pathologist. He studied tissues as the cause of disease and death.

Further major developments in clinical pathology were achieved at Paris Hospital and later in Vienna by Professor Carl Freiherr von Rokitansky (1804-1878) (Fig. 3), known for his autopsy of Ludwig van Beethoven. His handbooks on general and special pathology represent the dawn of modern clinical autopsies. Another important pioneer of clinical autopsies was Professor Rudolf Virchow (1821-1902) (Fig. 4), founder of the Museum of Pathology, which still stands in the Charité area of Berlin. His book *Die Sections-Technik im Leichenhaus des Charité Krankenhauses* standardized autopsy procedures in practice. Virchow also developed methods for forensic autopsy.

Clinical autopsies were responsible for the discovery of many previously unknown diseases. For a large part of history, clinical autopsies also became the main method for research in medicine. Autopsy still remains the "gold standard" for determining the cause and manner of death, thus being superior to external examinations with consideration of the clinical history of patient. However, it is important to note that today's pathology

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JO. BAPTISTÆ
MORGAGNI
P. P. P. P.
DE SEDIBUS, ET CAUSIS
MORBORUM
PER ANATOMEN INDAGATIS
LIBRI QUINQUE.
DISSECTIONES, ET ANIMADVERSIONES, NUNC PRIMUM EDITAS, COMPLECTUNTUR PROPEMODUM INNUMERAS, MEDICIS, CHIRURGIS, ANATOMICIS PROFUTURAS.
Multiplex præfixus eſt Index rerum, & nominum accuratiſſimus.
TOMUS PRIMUS
DUOS PRIORES CONTINENS LIBROS.
EDITIO SECUNDA
Ab Auctore recognita, atque a mendis omnibus expurgata.
PATAVII,
MDCCLXV.
SUMPTIBUS REMONDINIANIS.
SUPERIORUM PERMISSU, AC PRIVILEGIO.

Fig. 2. Morgagni, J.N.: De Sedibus et Causis Morborum per Anatomen Indagatis, 1765 (source: public domain).

is experiencing a sharp decline in interest in performing autopsies, a trend that appears to be worldwide (5, 16). In some EU countries, including the Slovak Republic, clinical autopsies are primarily performed by forensic specialists.

3. **The forensic autopsy** is crucial in determining the cause and manner of violent deaths, particularly by interpreting the influence of external violence on the process of dying. Since the 17th century, professors of forensic medicine at the University of Leipzig were requested to perform autopsies rather than just wound inspections.

A significant role in the development of forensic medicine was played by Johann Ludwig Casper (1796-1874), known for advocating a more systematic and detailed approach to autopsies. His emphasis on consistency and adherence to established autopsy and investigation procedures helped ensure the accuracy and reliability of information obtained from autopsies. His focus on the standardization of forensic procedures and applications, based on thorough knowledge, was crucial in highlighting the role of autopsies within the evolving field of forensic medicine. Casper also wrote a fundamental handbook of forensic medicine based on his personal experience with autopsies.

Another famous handbook on forensic medicine, as well as an atlas of forensic medicine, was written by Professor Eduard von Hofmann (1837-1897) in Vienna. In recent decades, a notable development in forensic radiology has been observed. Modern forensic radiology uses sophisticated non-invasive imaging techniques, such as CT scans or MRI, and has even established the term "virtual autopsy" instead of traditional autopsy, where anatomical data concerning the state of internal organs within the human body are obtained solely through imaging methods (6, 14).



Fig. 3. Carl Freiherr von Rokitansky (1804-1878) (source: public domain).

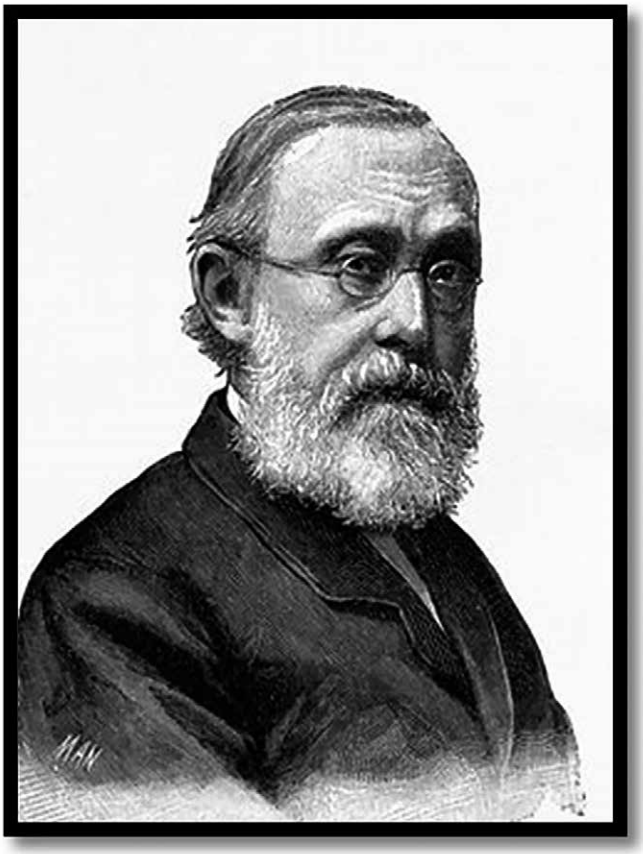


Fig. 4. Rudolf Virchow (1821-1902) (source: public domain).

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While the term "virtual autopsy" sounds modern and practical, it cannot replace the traditional autopsy. There are many specific sensations during a traditional autopsy (such as the gentle smell of toxins or the consistency of organs) that can be detected by a skilled examiner and cannot be evaluated by even the most sophisticated imaging techniques. Modern imaging in forensic medicine is essential for objective and precise documentation of findings (3, 6, 9), but to clarify the cause and manner of death, the traditional autopsy remains the gold standard (14).

DISCUSSION AND CONCLUSION

The number of autopsies performed has declined in recent decades due to various factors, but their importance remains undeniable. Autopsies offer a wide range of benefits that contribute to both medicine and society as a whole.

Medical Benefits:

Determining Cause of Death: This is perhaps the most crucial benefit. When the cause of death is unclear and cannot be established through medical history and clinical tests, an autopsy can provide definitive answers (4). This helps families understand what really happened and allows clinicians to improve future diagnostic approaches.

Validating Diagnoses: Autopsies can confirm or refute a suspected diagnosis made during a patient's lifetime. This helps clinicians refine their diagnostic skills and improve patient care (15, 16).

Understanding Disease Processes: By thoroughly examining the organs and tissues, autopsies can disclose how particular diseases progress and affect the body. This knowledge is vital for developing new treatments and therapies (10).

Evaluating Treatment Effectiveness: Autopsies can assess how well a particular treatment worked or if there were unexpected side effects. This information guides future treatment strategies (10, 15).

Identifying New Diseases: Sometimes, autopsies may uncover previously unknown diseases or variations in existing ones. This can lead to the development of new diagnostic tools and treatments (2, 7).

Societal Benefits:

Legal Investigations: In cases of suspected foul play, autopsies are essential for determining the cause and manner of death, even in criminal cases. This helps to enforce the law and promote justice in the country (11, 17).

Public Health: By identifying infectious diseases or environmental hazards that might have contributed to a death, autopsies have a direct impact on the protection of public health (7, 12).

Medical Education: Autopsies are a valuable learning tool for medical students and residents. They provide a firsthand opportunity to observe the effects of diseases on the human body (8).

Medical Research: As mentioned earlier, autopsies are crucial for validating findings from new technologies used in medical research (2, 10).

Overall, autopsies are still a valuable tool for medicine, research, and society. They provide insights that would be impossible to obtain through other means, ultimately contributing to a better understanding of the human body (normal anatomy autopsies), improving healthcare and disease prevention (clinical autopsies), and playing an irreplaceable role in suppressing criminality (forensic autopsies). There may be some religious concerns about autopsies in Arab Muslim countries, where the Holy Book Al-Qur'an and Islamic law codex Sharia state that the deceased should be buried as soon as possible, ideally by sundown. In such situations, an autopsy may delay the burial process (1, 13). The performance of an autopsy, whether for teaching, diagnostics, or ruling out or confirming a violent death, remains extremely important. A society that does not perform autopsies becomes less healthy, more vulnerable, and more dangerous.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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