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Human Autopsy: A Review of its Evolution, Current Trend and BenefitsUmar, A. ^{1*}, Mohammed, I. ¹, Adisa, J.O. ², Abubakar, M.S. ³, Abdullahi, U.F. ¹, Umar, N.A. ⁴, Sani, M.S. ¹ and Abubakar, U. ¹

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Summary

The term autopsy also known as post-mortem examination or necropsy is the dissection and examination of the body after death to discover the cause of death or the extent of disease. In other words, autopsy implies to a thorough clinicopathologic examination of the deceased body not just to find the cause of death but also to evaluate the pathologies of the events that leads to death. The main objective of such investigation is to ascertain a verdict whether the death was due to a natural, accidental, suicidal or homicidal cause. There are different types of autopsies, with forensic or medico-legal and clinical or hospital as the most common types. In Nigeria, medico-legal autopsy dates back to 1917. This study was carried out to review the evolution of autopsy over time, the current trend and the benefits of this clinicopathologic procedure, thereby providing an insight into this very important but yet often neglected clinical and forensic technique. Different search engines were used in obtaining the literature such as; Google, Google Scholar, PUBMED, ResearchGate and some pathology textbooks. The history of autopsy is connected with that of anatomy and medicine in general, which dates back to about 4000 BCE. Post-mortem examination is the gold standard to ascertain the cause of death, more especially in settings with suspicious, obscure, sudden, unnatural, litigious or criminal deaths.

Keywords: Autopsy, Clinicopathologic, Forensic, Homicidal, Medico-legal

1.0 Introduction

The term autopsy also known as a post-mortem examination is a highly specialized surgical procedure and consists of a thorough examination of a dead body to determine the cause and manner of death and also to evaluate the extent of any disease or injury. It is the gold standard to ascertain the cause of death, more especially in settings with suspicious, obscure, sudden, unnatural, litigious or criminal deaths (Sulegaon *et al.*, 2025). In other words, autopsy implies to a thorough clinicopathologic examination of the deceased body in order not just to primarily find the cause of death but also to evaluate the pathologies of the events that leads to death (Ngbea *et al.*, 2015).

The main reasons for performing an autopsy or post-mortem examination are to: establish the cause of death; correlate findings with pre-mortem diagnosis; identify unrelated diseases; confirm or dismiss genetic implications for the family; audit care and treatment given prior to death; characterize new disease; determine the effects of treatment; prevent the spread of communicable diseases; study pathogenesis of disease; enhance research; influence health policy; assess medico-legal implications; benefit and comfort bereaved relatives; and educate medical personnel and students (Sheaff and Hopster, 2005).

A study to assess the knowledge and perception of post-mortem examination among doctors and nurses in a tertiary hospital in Sokoto, Nigeria, revealed a fair to good knowledge of autopsy, and many respondents expressed positive attitudes and perceptions with respect to post-mortem

examination (Kaoje *et al.*, 2016). A recent similar study in Bayelsa State, Nigeria, showed that participants have adequate knowledge and positive attitude towards autopsies, and suggested the need to enhance public awareness of the benefits of autopsies (Eric *et al.*, 2025). Another similar study among selected healthcare workers at a tertiary hospital in Freetown, Sierra Leone, reported that over 80% of the respondents demonstrated good to fair knowledge and a positive attitude towards autopsy. But only over half of the participants demonstrated a positive perception towards autopsy (Duduyemi *et al.*, 2025).

1.1 Types of Autopsies

Post-mortem examination methods can be broadly classified into two main types; conventional and virtual or medical imaging methods. Autopsy methods can also be further classified into the following different types:

1.1.1 Medico-Legal, Forensic or Coroner's autopsies

This is a special type of scientific examination of a dead body carried out under the laws of the country mainly for the protection of its citizens and to assist in the identification and prosecution of the guilty person in cases of unnatural deaths. The outcomes derived from such autopsies are permissible evidence in court (Bandesha *et al.*, 2025). The main objective here is to find out the cause and manner of death in the case of accidental, suicidal and homicidal deaths. The examinations are generally performed as prescribed by applicable law, in cases of violent, suspicious or sudden deaths without medical assistance or during surgical procedures (Izegbu *et al.*, 2006).

1.1.2 Clinical, Hospital or Pathological Autopsies

These are autopsies performed to diagnose a particular disease or for research purposes. The autopsies aim to determine, clarify or confirm medical conditions that remained unknown or unclear prior to the patient's death (Ngbea *et al.*, 2015).

1.1.3 Anatomical or Academic Autopsies

These are post-mortem examinations performed by students of anatomy for study purpose only. This type of autopsy is important in training

students in medical colleges all over the world (Ngbea *et al.*, 2015). It has been suggested that in order to prepare medical students for the ethical, emotional and professional aspects of forensic pathology, additional support and guidance to address the psychological challenges associated with autopsy observations should be provided (Maqsood *et al.*, 2023).

1.1.4 Virtual or Medical Imaging Autopsies (Virtopsy)

Virtual autopsy is performed using non-invasive imaging techniques such as Computer Tomography (CT) scans, Magnetic Resonance Imaging (MRI), and 3D surface scanning to examine the body after death. It gives detailed insights into the internal structures, injuries, and pathological conditions without the need for traditional dissection. Virtopsy complements traditional autopsies and has been increasingly utilized in forensic investigations to minimize post-mortem invasiveness (Kumar and Vats, 2024). It can be employed as an alternative to conventional autopsies for broad and systemic examination of the whole body as it is less invasive and time consuming, aids better diagnosis, and renders respect to some religious beliefs with regard to prohibition of dead body mutilation (Kumar *et al.*, 2023; Tejaswi and Periya, 2013). The integration of virtual autopsy alongside artificial intelligence (AI) in forensic pathology represents a significant advancement in modern forensic medicine (Kumar and Vats, 2024).

A study has revealed that virtual autopsy using post-mortem computed tomography (PMCT) was unable to conduct all the assessment used to compose a cause of death or injuries sustained. While PMCT in conjunction with the conventional forensic autopsy does improve the overall number of injuries identified. Therefore, it has been suggested that PMCT should serve as supplementary examination to the conventional forensic autopsy in cases of unnatural, sudden or unexplained deaths (Speelman, 2024). Another study has shown the efficacy of virtual autopsy using post-mortem computed tomography (PMCT) in detecting neck injuries in cases of suicide by hanging, in comparison to using the conventional autopsy technique only (Slong *et al.*, 2025).

1.2 Methods of Conventional Autopsy Examination

There are two main methods of carrying out conventional autopsy or post-mortem examination:

1.2.1 Letulle method: This is a post-mortem technique originally developed by Carl von Rokitansky (1804 - 1878); it involves removing all related organs of the body as one piece. Example, removing the neck and chest organs together as one piece. This is useful when the body is needed urgently. There are different modifications of this technique (Rafindadi, 2003).

1.2.2 Virchow method: This is an autopsy technique developed by Rudolf Virchow (1821 - 1902); it involves removing the body organs one by one for examination. In other words, it is a technique designed to identify abnormalities in organs and retain important anatomic relationships when necessary for demonstrations (Rafindadi, 2003).

1.3 Hazards and Risks Associated with Autopsy Examination

All autopsies are considered as potentially hazardous. Therefore, adequate care should be observed during all post-mortem examinations. The following are some of the potential hazards associated with post-mortem examinations:

- (a) Hazards from sharp instruments like knives, blades and needles.
- (b) Hazards from highly contagious diseases like HIV, viral hepatitis B and tuberculosis.
- (c) Radiation related hazard in virtual or medical imaging autopsies.
- (d) Physical risks such as slip and fall accidents and related injuries.

In addition, apart from observation of strict safety guidelines, carefulness and common-sense measures are necessary in order to avoid the risks associated with autopsy techniques as mentioned above (Desai, 2023; Rafindadi, 2003).

2.0 Evolution of Autopsy

The history of post-mortem or autopsy is intimately connected with that of anatomy and medicine in general. According to the Egyptian historian Manetho, the king-physician Athotis

(about 4000 BCE) wrote books on medicine, the first of which contained some anatomic descriptions. Autopsy technique has evolved over a long period of time resulting in modifications of the conventional method and introduction of modern and less invasive methods of examinations, such as the virtual autopsy (Connolly *et al.*, 2016).

2.1 The Origin of Autopsy

The origin of autopsy was traced to human knowledge of anatomy through the practice of haruspicy; the inspection of animal entrails, particularly the liver, to predict the future, a form of divination that was widespread in the ancient world, performed at least as early as the fourth century BCE in Babylonia (Ngbea *et al.*, 2015).

In the beginning of seventh century, the Arabs armies pushed westward across Persia, Byzantine, Syria, Egypt, and Northern Africa and into Spain until their advance was stopped by Charles Martel in 732 CE. The armies spared Juni Shapur from destruction, thereby developing its medical school which later became a center of medical teaching for the Islamic world until late in the ninth century, when Baghdad gained greater prominence. The most important works in medicine sprang from the Caliphate empire and included those of Arabic and Jewish physicians such as Rhazes (860-932 CE), Avicenna (980-1037 CE), and Avenzoar (1070-1162 CE) within the next three centuries (Connolly *et al.*, 2016). Most of the advances recorded then were in pharmacology rather than pathology, for Islam prohibits mutilation of the dead bodies of human (Wan-Hassan *et al.*, 2023).

It was not until 1231 CE that the first law authorizing human dissection, which is generally credited to Frederick II (1194-1250 CE), the Holy Roman Emperor, was enacted. During the thirteenth and fourteenth centuries, restriction against opening the human body after death was eased. According to Chiari, a physician of Cremona performed autopsies on victims of the plague of 1286 CE. The Pope apparently authorized opening of bodies during the Black Death (1347-1350 CE) to determine the cause of the disease (Connolly *et al.*, 2016).

Rudolph Virchow (1821-1902) made immense contribution to the development of pathology for which he will always be remembered. He set out a series of procedures necessary to accurately identify the cause of death and also created the first template database of clinical and pathological report, often incorporating microscopic tissue analysis (Gulczynski *et al*, 2025). Morbid anatomy or autopsy pathology was considered the science of medicine for most of the 18th and 19th centuries. Today, the autopsy and the knowledge that derives from it do not hold the position they once did in the profession's history. There is a belief in the medical community that a complete autopsy is necessary to find out the cause of death (Herath and Herath, 2024).

2.2 Autopsy in the Twentieth Century

The beginning of the twentieth century witnessed the standardization of post-mortem dissection procedures, improvements in techniques of tissue embedding, microtomy and histochemistry. Leaders of medicine in North America, including Sir William Osler (1849-1919) who is regarded as the father of modern medicine, stressed the importance of autopsy in both undergraduate and postgraduate medical education. Osler spent three months in Berlin under Virchow and five months in Vienna, primarily with Rokitansky. After his return to Montreal in 1874, Osler began a decade-long service at McGill University and Montreal General Hospital, where he performed about 800 autopsies in addition to his clinical and teaching duties (Connolly *et al.*, 2016).

In the United States, the hospital autopsy rate, which was about 12% in 1910, elevated to about 50% by the late 1940s with the overall rate compounded by the increasing percentage of deaths occurring in-hospital (Rothman, 2014). Autopsy rates then started to decline in United States hospitals after 1955, due largely to the change in autopsy rate policy for accredited hospitals and the difficulty community hospitals had in maintaining those rates (Shojania and Burton, 2008). The Center for Medicare and Medicaid Services in 1986 eliminated minimum autopsy requirements specified in its Conditions of Participation for Hospitals, instead specifying that the medical staff should attempt to secure

autopsy in all cases of unusual deaths and of medico-legal and educational interest (Connolly *et al.*, 2016).

Towards the end of the twentieth century, the national autopsy rate in the United States, including forensic cases, fell below 10%, and to nearly 5%, if deaths caused by accidents, homicide, and suicide are excluded (Sinard, 2001). Alarming, many community hospitals performed few if any autopsies each year. Meanwhile, the autopsy rates at academic medical centers appear to have leveled off since 2001 to about 15% to 20% due to continuing interest in autopsies by families, clinical teams, and pathologists in this setting (Shojania and Burton, 2008).

Here in Nigeria, there is no precolonial or colonial record of hospital autopsy rates; however, medico-legal autopsies date back to 1917, then the law stipulated that only sudden death that involved the European colonial masters were to be reported to the coroner for autopsy, as reported in laws guiding birth and death in Nigeria published in 1948. That same year, medico-legal autopsy was extended to every Nigerian as reported in coroners' laws of Northern Nigerian published in 1963 (Mandong *et al.*, 2006).

2.3 Autopsy Today

The clinical or non-forensic autopsy continues to be a key aspect of medicine today, with increasing relevance in modern trends, such as quality assurance or improvement, measurement of clinical outcomes, infection control, and personalized medicine. While advances in radiology, biopsy techniques, and diagnostic tests have made major strides in providing accurate diagnoses in patients, they also often raise many smaller questions for autopsy (Connolly *et al.*, 2016).

In the 21st century, the non-medico-legal autopsy rate in most hospitals worldwide has declined to a mere fraction of its previous rates. The decline has been most evident in the last 20 years and correlates with the rise in the prominence of the radiological, epidemiological, molecular approach to medicine. However, the number of medico-legal autopsies is increasing worldwide (Herath and Herath, 2024).

In Nigeria, the autopsy rate in most of our teaching hospital continues to fall due mainly to the shift in terminal care in those hospitals. In some of these hospitals, the rate of autopsy is almost zero. Similar fall in autopsy rate has been reported in some countries such as Australia, Denmark, Japan, Sweden and the United Kingdom (Ngbea *et al.*, 2015).

A retrospective study of the autopsies conducted between 1984 and 2003 at the Department of Pathology, University College Hospital, Ibadan, Nigeria, revealed that autopsy rate at the hospital declined from an average of 19% in 1984 to 3.6% in 2003 (Oluwasola *et al.*, 2007). In another 18 years retrospective study on the rate of autopsy in Jos, Nigeria, the researchers discovered only an average of 23.4 cases of medico-legal autopsies per annum, which portrays a great concern in teaching, research and medical audit (Ngbea *et al.*, 2015). Another retrospective study carried out at Enugu State University Teaching Hospital, Nigeria, from January, 2013 to December, 2017 revealed an average of 1.2 autopsies per annum (Ohayi *et al.*, 2021). On the contrary, a recent study in Lahore, Pakistan revealed that the number of medico-legal autopsies is rising. This has been attributed to the rapid increase in population, high unemployment rate, income disparities, substance abuse, increased traffic density, paltry infrastructure amenities, and diverse types of diseases (Bandesha *et al.*, 2025).

3.0 The Major Benefits of Autopsy

Despite the obvious decline in the rate of autopsies in most hospitals worldwide, the procedure still has its supporters who believe that autopsy has a place in establishing public trust in medicine and remains a focal point for the integration of medical knowledge. While its detractors question the risk and cost effectiveness of the procedure, therefore are advocating that non-forensic autopsy should be left with relics of the past since there are more sophisticated ways of arriving at conclusive diagnosis now (Khan and Verma, 2025; Connolly *et al.*, 2016). The following are some of the major benefits of autopsies:

3.1 Benefit to the Physician and Health Care Organization

As the golden standard for evaluating the accuracy of diagnosis and the outcome of therapy, it provides a unique opportunity for physicians to co-relate their physical and laboratory findings with pathologic changes of diseases. Through autopsy findings, pathologist alerts hospital infection committee of a possible contagion (Khan and Verma, 2025).

3.2 Benefit to the Family of the Deceased

It may reveal a hereditary or contagious disease thereby alerting the family of the deceased to the danger. It removes guilt on the part of the immediate family for believing that they might have contributed in the death of the deceased member. It also provides accurate data for determination of insurance or workers benefits (Khan and Verma, 2025; Keys *et al.*, 2008).

3.3 Benefit to Law Enforcement and Jurisprudence

The medico-legal autopsy is focused on establishing the cause of death, time and manner of death including circumstance proceeding and surrounding death, therefore providing a key component of crime investigation. The forensic pathologist must be called upon in the court to present evidence obtained at the scene and the findings from the autopsy (Connolly *et al.*, 2016).

3.4 Benefit to Public Health

Autopsy contributes to public health surveillance through detection of contagious disease, identification of environmental hazard and contribution to vital statistics. It can also help in combating global terrorism by identifying the agents in bio-terrorism (Nolte *et al.*, 2007).

3.5 Benefit to Medical Discovery and Applied Clinical Research

Modern molecular techniques coupled with autopsy have helped in identifying diseases related to emerging and re-emerging infectious agents. It also helps to evaluate toxic effects of the latest drugs, accuracy of imaging techniques and the efficacy of new therapies (Khan and Verma, 2025).

3.6 Benefit to Medical Education

Autopsy aids in the education of students in medicine, and other health related disciplines by providing teaching materials for anatomy, histology and pathology museum. Postmortem conference helps in patient care and quality assurance (Hooper and Geller, 2007).

3.7 Benefit on Reducing Maternal Mortality

It is essential to understand the etiologies of maternal mortality in order to reduce maternal deaths. The main causes of maternal mortality worldwide are haemorrhage, pregnancy related infections, hypertensive disorder, abortion and some other direct and indirect causes. In a situation where death occurs due to one of these causes, a meticulous clinical autopsy would reveal the cause of such maternal death, so that action plan could be taken to prevent future occurrence (Khan and Verma, 2025).

4.0 Conclusion

The dissection and examination of the body after death to discover the cause of death or the extent of disease is known as autopsy. It involves both external and internal examination of the body and recording all findings. All cases of unnatural and natural deaths with unknown causes should be investigated.

The Egyptian historian Marentho traced the origin of autopsy to the anatomical description written by the King physician Athotis around 4000 BCE. The origin of autopsy has also been traced to the human knowledge of anatomy through the practice of haruspicy.

Autopsy techniques have evolved over a long period of time resulting in modifications of the conventional method and introduction of modern and less invasive methods of examinations, such as the virtual autopsy using Computed Tomography (CT) scans and Magnetic Resonance Imaging (MRI) techniques.

In Nigeria, medico-legal autopsies date back to 1917. In the 21st century, the non-medico-legal autopsy rate in most hospitals worldwide has declined. Despite the recent decline in the rate of autopsies, the procedure still has its benefits to

physicians, public, medical community, jurisprudence and the family of deceased.

Authors' contributions

This review was carried out in collaboration among all authors. Authors UA, MI, AJO and AMS designed the study, wrote the protocol and first draft of the manuscript. Authors AUF, UNA, AU and SMS managed the literature searches. All authors read and approved of the final manuscript.

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