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## Short Communication

### Virtual Autopsy – A Boon or Bane?

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#### Abstract

**Virtual autopsy**, or "virtopsy," is a modern technique that uses imaging technologies like CT and MRI scans to perform non-invasive post-mortem examinations. Unlike traditional autopsies, which require physical dissection, virtopsy offers a less invasive alternative. This article explores the benefits and challenges of virtual autopsy in modern medicine. Supporters highlight its ability to preserve the dignity of the deceased, avoid contamination, provide detailed 3D images for accurate analysis, and create a permanent digital record. It is especially valuable in cases where religious beliefs oppose traditional autopsies and in forensic investigations requiring quick, non-invasive methods. However, critics point out its high costs, need for specialized equipment, and limitations in replacing the accuracy of traditional autopsies in complex cases. Accessibility is also a concern, particularly in developing countries. In conclusion, while virtual autopsy offers significant advantages, its challenges highlight the need for an integrated approach that combines innovation with traditional practices to advance post-mortem examinations.

#### 1. Introduction

Virtual autopsy, known as "virtopsy," is a modern technique that uses imaging technologies like CT and MRI scans to conduct non-invasive post-mortem examinations, unlike traditional autopsies that involve physical dissection. The term virtopsy was coined by Thali et al.<sup>1</sup> It is a combination of terms Virtual and Autopsy, where virtual is derived from the latin word "Virtus" which means Useful, efficient and good". Virtopsy uses imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI) to perform non-invasive post-mortem examinations, in contrast to traditional autopsies,

which involve the dissection of the body to determine the cause of death.<sup>2,3</sup> Introduced in the early 21st century, virtopsy addresses challenges such as the invasiveness of conventional autopsies, cultural or religious objections to dissection, and risks of exposure to infectious agents. It provides detailed visualization of internal structures and permanent digital records, enhancing diagnostic accuracy and forensic investigations. Supporters highlight its ability to improve efficiency, enable remote collaboration among experts, and offer a less invasive option for families. However, critics note its high costs, need for specialized equipment,

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and limited accessibility in resource-poor settings, such as peripheral hospitals. Additionally, while imaging can reveal structural abnormalities, it may not always detect certain pathological conditions as effectively as traditional autopsies and also will not detect, touch, smell and sight senses,<sup>4, 5</sup> subtle injuries, colour changes, inflammatory changes or toxicological findings. Doubts are also raised regarding the legal admissibility of virtopsy findings in court, as well as the ethical implications of virtual autopsies, including issues of consent, privacy, and the potential for misuse of digital data.

This article evaluates the role of virtual autopsy, or "virtopsy," in forensic medicine by analyzing its benefits, limitations, and implications for integration into modern forensic practices, aiming to determine whether it serves as a valuable advancement or poses significant challenges.

## 2. Pros (Boon):

- a. **Non-Invasiveness:** Virtual autopsy offers a non-invasive alternative to traditional autopsies, preserving the integrity of the deceased's body and also respecting cultural and religious sensitivities that prohibit invasive procedures.
  - b. **Accessibility:** In areas with limited forensic expertise, virtopsy allows off-site examinations and consultations through digital imaging.<sup>4</sup>
  - c. **Time efficiency:** Virtual autopsy can be conducted more quickly than traditional autopsies, leading to faster turnaround times for investigation results. This can facilitate prompt resolution of legal proceedings and provide closure for the deceased's family.
  - d. **Comprehensive Imaging:** Advanced imaging modalities used in virtual autopsies, such as CT and MRI, enable detailed visualization of internal organs, soft tissues, and skeletal structures. This clear imaging helps identify injuries, pathology, and the cause of death.
  - e. **Minimization of Contamination Risks:** Since virtual autopsies do not involve physical manipulation of the body, there is a reduced risk of contamination or exposure to infectious agents, benefiting both forensic pathologists and supporting staff.<sup>5</sup>
  - f. **Archival Capabilities:** Digital records of virtual autopsies can be stored electronically, creating valuable archives for medical research, education, and training.<sup>5, 6</sup>
- a. **Accuracy and Reliability:** Virtual autopsy techniques rely heavily on imaging technologies to reconstruct the body's internal structures and identify pathologies. While these methods can provide detailed images, they may not always offer the same level of diagnostic accuracy as traditional autopsies. Factors such as image artefacts, tissue degradation, and limitations in resolution can affect the reliability of virtual autopsy findings, leading to potential misinterpretations or missed diagnoses.
  - b. **Limited Tissue Sampling:** Unlike traditional autopsies, virtual autopsy techniques do not allow for the collection of tissue samples for histological analysis. As a result, certain types of pathologies, such as microscopic changes or subtle injuries, may be overlooked. This limitation can impact the comprehensive assessment of the cause and manner of death, particularly in cases where detailed tissue examination is necessary for accurate diagnosis.
  - c. **Cost and Accessibility:** The equipment and expertise required to perform virtual autopsies, including specialized imaging systems and trained radiologists, can be costly and may not be readily available in all healthcare settings. This limitation can restrict access to virtual autopsy services, particularly in resource-limited regions or underserved communities, where traditional autopsies may be the only feasible option.
  - d. **Inability to Assess Tissue Texture, Consistency and soft tissue injuries:** Virtual autopsies lack the tactile feedback and ability to assess tissue texture and consistency that traditional autopsies provide. Imaging techniques can detect skeletal injuries relatively well, but have limitations in detecting subtle or small soft tissue injuries, such as contusions or small lacerations.<sup>7</sup>
  - e. **Dependence on Imaging Interpretation:** Virtual autopsies rely heavily on the interpretation of medical images by radiologists and forensic pathologists. Interpretation errors or differences in expertise among interpreters can impact the accuracy and reliability of findings.
  - f. **Lack of Ancillary Testing:** Traditional autopsies allow for ancillary testing, such as histopathology,<sup>8</sup> toxicology, and microbiology, which can provide valuable additional information. Virtual autopsies may face limitations in sample collection for such testing.

## 3. Cons (Bane):

- g. **Limited Ability to Address Decomposed or Charred Bodies:** Virtual autopsies may face challenges in accurately assessing decomposed or charred bodies, where imaging quality may be compromised due to tissue breakdown or artefacts
- h. **Ethical and Legal Considerations:** Virtual autopsies may raise ethical and legal considerations regarding consent, privacy, and the admissibility of findings in court. Some jurisdictions may require traditional autopsies for legal purposes, particularly in cases involving suspicious or criminal deaths.<sup>9-12</sup>

#### 4. Conclusion

Virtopsy employs CT and MRI scans for non-invasive post-mortem examinations. It offers non-invasiveness, enabling remote consultations and faster results compared to traditional autopsies. However, it has limitations, including potential diagnostic inaccuracies, image interpretation errors, high costs, limited legal acceptance in some jurisdiction, and ethical issues concerning consent and data privacy. Virtopsy's effectiveness depends on available resources and case-specific needs.

Collaboration among forensic, legal, and ethical stakeholders is essential to develop clear guidelines addressing these challenges. Currently, virtopsy serves as a valuable complementary tool, particularly in cases with cultural or logistical constraints, but its diagnostic limitations and high costs prevent it from fully replacing conventional methods, indicating it is more of a complementary tool than a universal solution at present.

**Conflict of interest-** None to declare

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