

Forensic Pathology: Tech, Challenges, Autopsy's Evolving Role

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Introduction

The landscape of forensic pathology is continually evolving, driven by the need for more efficient and less invasive diagnostic methods. A prime example of this innovation is the exploration of postmortem computed tomography with full-body computed tomography angiography. This advanced imaging technique has emerged as a viable alternative to traditional forensic autopsy, particularly for COVID-19 patients. Its utility is especially pronounced in specific circumstances where conventional autopsy might present considerable challenges or be subject to restrictions, ensuring that critical postmortem investigations can still proceed effectively [1].

Delving into the complexities of mortality, a comprehensive understanding of sudden unexpected death in adults remains a cornerstone of forensic investigation. Reviews in this area consistently underscore the crucial and irreplaceable role of a thorough autopsy. Such examinations are fundamental in determining the underlying pathology responsible for these abrupt deaths, simultaneously offering invaluable insights into established diagnostic protocols and uncovering common findings that can guide future medical and legal practices [2].

In scenarios where the initial cause and manner of death remain unclear, forensic autopsies gain significant depth through the application of targeted ancillary studies. Research consistently demonstrates the effectiveness of these specialized investigations during autopsies. Their strategic deployment proves instrumental in resolving ambiguous cases, ultimately leading to a substantial improvement in diagnostic accuracy and providing much-needed clarity in complex forensic pathology contexts [3].

The global COVID-19 pandemic presented unprecedented challenges and also spurred significant research into the disease's systemic impact. A systematic review and meta-analysis focusing on COVID-19 autopsy findings provides a critical synthesis of pathological observations. This extensive overview offers a comprehensive understanding of how the disease affects the body's various systems, thereby aiding substantially in unraveling its pathogenesis and guiding public health responses [4].

Advancements in genetic analysis are profoundly impacting pediatric forensic investigations, particularly concerning sudden unexpected death in children. Innovative research now highlights the significant role of rapid whole-genome sequencing in accurately determining the cause of such deaths. This cutting-edge approach demonstrates considerable potential for enhancing diagnostic precision in pediatric cases and offers promising avenues for improving genetic counseling for affected families, marking a crucial step forward in understanding these tragic events [5].

Autopsy maintains an essential, even indispensable, role in public health, particularly in the accurate identification and confirmation of infectious diseases. A systematic review assessing the diagnostic value of autopsy in this context reinforces its critical importance. This practice serves not only as a vital tool in public health surveillance but also deeply enhances our understanding of pathogen impact and contributes significantly to improving the quality and completeness of epidemiological data, thereby informing disease prevention and control strategies [6].

The emergence of new psychoactive substances (NPS) presents a growing and complex challenge for forensic pathologists worldwide. This evolving landscape necessitates specialized approaches during autopsies. Current reviews meticulously outline the persistent issues and propose future strategies aimed at improving the detection and interpretation of these substances. This proactive stance is vital for effective public health responses and mitigating the societal impact of NPS [7].

For patients afflicted with rare diseases, the journey to a definitive diagnosis can often be prolonged or, tragically, remain incomplete during their lifetime. Here, the clinical autopsy plays an indispensable and profound role. Studies emphasize its critical importance in accurately identifying the underlying causes of death in these specific patient populations. By doing so, clinical autopsy not only brings closure but also significantly contributes to the broader medical knowledge base surrounding rare conditions [8].

The realm of postmortem investigation is experiencing a transformative shift with the evolving application of imaging technologies. This dynamic landscape of postmortem imaging in forensic pathology is being thoroughly explored, not as a replacement, but as a crucial complementary tool to traditional autopsy. Discussions actively focus on its current practical applications and anticipate its substantial future potential to considerably enhance investigative processes, offering non-invasive insights that can augment conventional findings [9].

The global COVID-19 pandemic brought unprecedented disruption across all sectors, and forensic autopsy practices were no exception. Examinations detail the profound influence this health crisis exerted on professionals worldwide. It chronicles the essential adaptations made and the significant challenges encountered by those in the field, simultaneously suggesting proactive strategies to improve resilience within forensic autopsy practices for future public health emergencies, highlighting a global perspective on these critical services [10].

Description

Forensic pathology continues to evolve significantly, driven by a constant pursuit of enhanced diagnostic precision and adaptation to new challenges. Central to this evolution is the enduring role of autopsy in determining causes of death, whether sudden and unexpected in adults [C002] or due to complex underlying pathologies like rare diseases, which often remain undiagnosed during life [C008]. These fundamental examinations provide critical insights and contribute substantially to medical knowledge, reinforcing autopsy's irreplaceable value in understanding human mortality.

The COVID-19 pandemic introduced unique demands and transformations in forensic autopsy practices globally. This period highlighted the profound influence of a widespread health crisis, necessitating significant adaptations from professionals in the field [C010]. In response to these challenges, alternative methods emerged. For instance, postmortem computed tomography with full-body computed tomography angiography proved to be a viable and practical alternative to traditional forensic autopsy for COVID-19 patients, especially when conventional methods were restricted [C001]. Furthermore, extensive systematic reviews and meta-analyses synthesized the pathological findings from autopsies performed on COVID-19 patients, offering a comprehensive overview of the disease's systemic impact and aiding in a better understanding of its pathogenesis [C004]. These collective efforts were vital for informing public health and clinical responses during the pandemic.

Beyond traditional visual examinations, modern forensic pathology leverages advanced diagnostic tools and targeted ancillary studies to resolve indeterminate cases. The effectiveness of these specialized studies during forensic autopsies, particularly when the initial cause and manner of death are unclear, significantly improves diagnostic accuracy and clarity [C003]. Emerging genetic technologies also play a pivotal role; rapid whole-genome sequencing, for example, has shown significant impact in determining the cause of sudden unexpected death in pediatric cases, enhancing diagnostic precision and improving genetic counseling for families [C005]. These technological advancements exemplify the field's commitment to more precise and comprehensive investigations.

The scope of forensic autopsy extends to critical public health domains, including the diagnosis of infectious diseases. Autopsy holds significant diagnostic value in identifying and confirming infectious diseases, reinforcing its critical role in public health surveillance, understanding pathogen impact, and improving epidemiological data [C006]. Simultaneously, forensic pathologists confront new and complex challenges, such as those posed by the increasing prevalence of new psychoactive substances (NPS). Dealing with NPS during autopsies requires updated strategies for improved detection, interpretation, and subsequent public health responses, ensuring the field can address contemporary toxicological threats effectively [C007].

The future of forensic pathology is increasingly integrating non-invasive and complementary tools. Postmortem imaging, encompassing various techniques, represents an evolving landscape within the field. This approach is not intended to replace traditional autopsy entirely but rather to serve as a powerful complementary tool. Ongoing discussions focus on its current practical applications and its substantial future potential to enhance investigative processes, offering insights that can streamline and inform comprehensive postmortem examinations [C009].

Conclusion

Forensic pathology is a dynamic field constantly adapting to new medical challenges, technological advancements, and evolving public health needs. Recent research highlights a shift towards integrating advanced diagnostic tools and imaging techniques, such as postmortem computed tomography with angiography, as

a viable alternative or complement to traditional autopsy, particularly evident in cases involving COVID-19 where conventional methods face restrictions. Studies on the pandemic's impact detail widespread adaptations and challenges in forensic practice, emphasizing the need for resilience and innovative approaches. A foundational aspect of the field remains the comprehensive autopsy for determining causes of sudden unexpected death in adults and for identifying underlying pathologies in patients with rare diseases, contributing significantly to medical knowledge. Furthermore, targeted ancillary studies enhance diagnostic accuracy in indeterminate cases, while rapid whole-genome sequencing shows promise in pediatric sudden unexpected deaths by improving diagnostic precision and genetic counseling. The diagnostic value of autopsy is also reinforced in identifying infectious diseases, critical for public health surveillance and epidemiological data. However, new challenges like the proliferation of new psychoactive substances require updated strategies for detection and interpretation to inform public health responses. Overall, the literature emphasizes the indispensable role of postmortem examinations, whether traditional or technologically augmented, in advancing medical understanding, informing legal processes, and safeguarding public health.

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Conflict of Interest

None.

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