Advancements in surgical pathology: Emerging techniques and technologies for accurate diagnosis.

Luis Novo*

Department of Pathology, Northwestern University, USA

Introduction

Surgical pathology is an essential branch of pathology that involves the examination of tissue samples obtained during surgical procedures. Accurate diagnosis in surgical pathology is crucial for guiding appropriate treatment decisions and improving patient outcomes. In recent years, there have been remarkable advancements in surgical pathology, driven by the integration of emerging techniques and technologies. This article aims to explore these advancements and their impact on improving diagnostic accuracy [1].

Digital pathology has emerged as a game-changer in surgical pathology. It involves the digitization of glass slides, enabling pathologists to view and analyze specimens using digital imaging systems. This technology facilitates remote access, collaboration, and telepathology, allowing pathologists to consult with experts located anywhere in the world. Digital pathology also supports the development of artificial intelligence (AI) algorithms for automated image analysis, aiding in faster and more accurate diagnoses [2].

Next-generation sequencing has revolutionized the field of genomics and is now being extensively utilized in surgical pathology. NGS enables comprehensive analysis of genetic alterations, including mutations, gene fusions, and copy number variations, providing valuable insights into tumor biology and personalized treatment strategies. NGS-based molecular profiling has particularly transformed the diagnosis and management of cancer, allowing for targeted therapies and improved patient outcomes [3].

Immunohistochemistry and in situ hybridization techniques have undergone significant advancements in recent years. These techniques enable the visualization and detection of specific proteins and nucleic acids within tissue samples. IHC and ISH are essential tools in surgical pathology for confirming or ruling out certain diagnoses, subclassifying tumors, and predicting therapeutic response. The development of novel antibodies and probes, as well as automation platforms, has enhanced the accuracy and efficiency of these techniques [4].

Mass spectrometry imaging is an emerging technique that allows for the simultaneous analysis of multiple molecules within tissue sections. By generating molecular maps, MSI provides valuable spatial information about the distribution of proteins, lipids, and metabolites in tissues. This technology has shown promise in various applications, including tumor classification, identification of prognostic markers, and assessment of drug penetration in tissues. MSI has the potential to revolutionize surgical pathology by complementing traditional microscopic examination with molecular information [5].

Conclusion

Advancements in surgical pathology have significantly improved diagnostic accuracy, enabling more precise and personalized patient care. The integration of emerging techniques and technologies, such as digital pathology, next-generation sequencing, immunohistochemistry, mass spectrometry imaging, and liquid biopsy, has expanded the diagnostic capabilities of surgical pathologists. These advancements hold immense promise for enhancing disease detection, subclassification, prognostication, and treatment selection. As the field continues to evolve, it is crucial for pathologists to stay abreast of these emerging techniques and technologies to deliver the highest quality of care to patients.

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***Correspondence to:** Luis Novo, Department of Pathology, Northwestern University, USA, E-mail: Christopher.felicelli@nm.org

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