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Advancing anatomical diagnosis through digital pathology: Current applications and future perspectives.

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Introduction

Digital pathology has revolutionized anatomical diagnosis by integrating advanced imaging technologies, computational tools, and Artificial Intelligence (AI) into traditional histopathology workflows. By digitizing glass slides into high-resolution Whole-Slide Images (WSIs), digital pathology enables pathologists to analyze tissue samples remotely, enhancing diagnostic accuracy, efficiency, and collaboration. This essay explores the current applications of digital pathology in anatomical diagnosis and its promising future perspectives, supported by key references. [1].

Digital pathology is widely applied in the diagnosis of various diseases, particularly in oncology. Whole-slide imaging systems allow pathologists to examine tissue samples for cancers such as lung, breast, and prostate carcinomas with greater precision. For instance, the integration of digital tools with immunohistochemistry, as highlighted in studies like improves the identification of specific markers like p40 for pulmonary squamous cell carcinoma, enhancing diagnostic specificity. Digital platforms also facilitate telepathology, enabling remote consultations and second opinions, which is critical in underserved regions. Additionally, digital pathology supports quantitative analysis, such as tumor grading and biomarker quantification, as seen in the MSK-IMPACT assay described by which uses next-generation sequencing for molecular profiling of solid tumors. This allows for personalized medicine approaches, tailoring treatments based on genetic alterations, such as ALK gene rearrangements in non-small cell lung cancer.Furthermore, digital pathology streamlines multidisciplinary tumor boards by enabling real-time sharing of WSIs, improving decision-making in complex cases like neuroendocrine tumors.[2].

AI and machine learning are transforming digital pathology by automating tasks like cell counting, tumor detection, and pattern recognition. For example, AI algorithms can differentiate typical and atypical pulmonary carcinoid tumors, reducing diagnostic errors often seen in small biopsy specimens.These tools also enhance workflow efficiency by prioritizing cases and reducing turnaround times, as discussed by particularly for non-small cell lung cancer diagnosis on small samples. [3]

The future of digital pathology lies in the seamless integration of AI, cloud-based platforms, and advanced molecular diagnostics. AI-driven predictive models are expected to improve prognostic assessments, such as predicting treatment responses to immunotherapies like pembrolizumab in PD-L1-positive lung cancers. The development of standardized protocols for WSI validation and storage will address current challenges related to data management and interoperability. Moreover, advancements in preanalytic variables, as noted by Roy-Chowdhuri and Stewart will optimize sample preparation for digital analysis, ensuring consistency across laboratories.[4].

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The incorporation of 3D imaging and multispectral analysis could further enhance the visualization of complex tissue architectures, potentially improving the classification of tumors like large cell neuroendocrine carcinomas Additionally, digital pathology is poised to expand into education and training, with virtual slide libraries enabling global access to rare case studies. However, challenges such as high costs, regulatory hurdles, and the need for robust cybersecurity must be addressed to fully realize its potential.[5].

Conclusion

Digital pathology is reshaping anatomical diagnosis by enhancing accuracy, enabling remote collaboration, and integrating AI-driven insights. Its future holds immense promise for precision medicine, provided technological and regulatory challenges are overcome.

References

1. Rogy MA, Mirza DF, Kovats E, et al. Pneumatosis cystoides intestinalis (PCI). Int J Colorectal Dis. 1990; 5:120-4.
2. Jansen JB, Temmerman A, Tjhie-Wensing JW. Endoscopic removal of large colonic lipomas. Ned Tijdschr Geneeskd. 2010; 154:A2215.
3. Waxman I, Saitoh Y, Raju GS, et al. High-frequency probe EUS-assisted endoscopic mucosal resection: A therapeutic strategy for submucosal tumors of the GI tract. Gastrointest Endosc. 2002; 55(1):44-9.
4. Van Cutsem E, Oliveira J. Advanced colorectal cancer: ESMO clinical recommendations for diagnosis, treatment and follow-up. Ann Oncol. 2009;20:61-3.
5. Ansa BE, Coughlin SS, Alema-Mensah E, et al. Evaluation of colorectal cancer incidence trends in the United States (2000–2014). J Clin Med. 2018;7(2):22.

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