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Histopathology- as an approach for diagnostic test

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ABSTRACT
Histopathology is a well-established field of study that focuses on the examination of diseases at the cellular and tissue levels. In recent years, it has become increasingly important in both medical and veterinary research. One significant advancement in histopathology is the introduction of immunohistochemistry, which has greatly contributed to the diagnosis of tumors. Other recent developments, such as digital pathology, multiplex immunohistochemistry, immunofluorescence, brain mapping, neuroimaging studies, and artificial neuronal networking, have also revolutionized diagnostic methods. Molecular pathobiology, which has mainly evolved from biopsy and autopsy, has become an integral part of histopathological testing. It is considered the gold standard for determining the final diagnosis of various lesions in the human body. However, this approach is not without limitations. The presence of artifacts, which are morphological and cytological changes caused by the various steps involved in tissue processing, can affect the accuracy of histopathological analysis. These artifacts can render the tissue unusable and hinder the interpretation of the results. Therefore, it is crucial to identify the most common artifacts encountered during histopathological examination and to differentiate them from actual tissue constituents. This article aims to discuss the typical artifacts that may be observed during slide examination and provide guidance on how to recognize and address them.
KEYWORDS: *Artifact, diagnosis, histopathology, microtome, tissue specimen*

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INTRODUCTION

Histopathology: Histopathology (compound of three Greek words: ἱστός histos "tissue", πάθος pathos "suffering", and -λογία -logia "study of") refers to the microscopic examination of tissue in order to study the manifestations of disease. Specifically, in clinical medicine, histopathology refers to the examination of a biopsy or surgical specimen by a pathologist, after the specimen has been processed and histological sections have been placed onto glass slides. In contrast, cytopathology examines free cells or tissue micro-fragments (as "cell blocks") (1-3). Histopathology is the diagnosis and study of diseases of the tissues, and involves examining tissues and/or cells under a microscope. Histopathologists are responsible for making tissue diagnoses and helping clinicians manage a patient's care. Histopathology is being exercised in most parts of the world and is still in the developmental phase in various developing countries.This branch contributes a significant portion in the cutting edge effective diagnosis in pathology through highlighting the unique microarchitecutral and morphological results. For long, the histopathologists studied their pathological diagnostic reports exclusively on the tissue growth patterns and cell morphology with usual heamatoxylin and eosin (H&E) and few (if any) special stained slides.The micro array analysis of DNA and proteomics make likely to figure a comprehensive gene expression belongs to tissue neoplasia and helps in diagnosis, susceptibility and prognosis. Such tests are being done in conjunction with preceding histopathology for better results. Artificial neuronal networking is introduced by a surgical pathologist in whom an artificial neuron is working like physiologically normal one by passing information (4). The telepathology is dealing with obtaining, spreading, and broadcasting of histopathological pictures through the telecommunication networks viz. internet and satellite. This practice will make the study of whole-slide easy and will let the prompt distributions of the images for early diagnosis and detail disease process. Now most of the short-commings are being overcomed and the imminent archetype of histopathology is hypothesized to be digital in the near future. By this means the histopathologists will confirm diagnosis via virtual images analysis on computers instead of as usual morphometry and the digitized tissue could categorize into various histological grading for quantitative analysis, which results

in provision of rapid and improved prospects for diagnosis and treatment of tumorous tissues (5,6). In the current thrilling time of pathology, we are challenged with the novel boundary of cutting-edge science and technology, which progress and speed up the diagnostic histopathological technique. But still it is not less than a challenge for achieving such procedures successfully so as to route all the information enclosed.

Position of histopathology in the modern science

Disease is developed from the molecular level followed by cellular and tissue level It is utmost necessary to grab any disease in the stage when it creates changes in the tissues. In histopathology we study scientifically the changes in the affected tissues under the microscope**.**

Though this is an ancient procedure, and still being adopted in medical sciences. This section of pathology enjoying a considerable portion of detail study of most of the humans as well as animal ailments. This outlet of scientific study reserved a substantial position in the modern techniques in effective disease diagnosis. In histopathology the microarchitectural detail of tissue is being highlighted. For this the tissues are being stained with various categories of stains. Although this practice is a time-consuming process, however, some improvements have been made in such protocol during the modern era. The new developments in the current novel technologies improved the earlier conventional disease diagnostic procedures, making enabled such practice in a rapid way.

The manual protocol is replaced with the automated machines. In recent times the histological image of life sciences is processed in medical sciences, same to that of the engineer. Tremendous improvements have been made in such medical image processing technology. Due to the improvement of the information technology, the tissue imaging technique is the most acceptable, efficient and reliable mean to detect the cancer and other diseases (7, 8).

Importance of Histopathology

Numerous applications in practically all areas of the life sciences. The term Histopathology was created by combining the two disciplines of histology (the study of live tissue) and pathology (the study of alterations brought on by a disease agent to an organism). Thus, histopathology enables the identification of alterations to the normal state of living tissues and positively their causative agent that are not visible to the unaided eye.

The "gold standard" of diagnostic instruments for specialised training, suitable staining, and accurate tissue visualisation is histopathology. Culture, isolation, and morphological evaluation can also be employed to detect the presence of fungus in tissue or swab samples (9, 10).

Improvements in Histopathology

In the technologically advanced world, histopathology is being practiced alongside molecular techniques, while less developed countries are still working towards standardizing this technique. Histopathology experts primarily rely on prepared slides to analyze growth patterns, infiltrated cells, and tissue morphology using conventional staining protocols [6]. The most commonly used staining method in histopathology is Hematoxylin and Eosin (H& E), although various specific stains are currently being developed [5]. These specific stains aim to identify affected tissues by applying different dyes. Several successful laboratories have developed and implemented special stains, which facilitate differentiation and identification of tissues on slides. These stained slides are then subjected to rapid computerized histomorphometric diagnosis.

Recent advances in Histopathology [11-13**]**

Recent advancements in the field of Histopathology have provided valuable insights into the understanding of both healthy and diseased tissues. Researchers have explored the concept of mutational signatures, which are indicative of damaged DNA that has been incorrectly repaired. These signatures offer valuable clues about the mutagenic agents involved. The authors of this study have summarized the existing knowledge on mutational signatures, including copy number changes, structural rearrangements, single- or double-base substitutions, and minor insertions/deletions. Further analysis of these understudied signals will contribute to basic research, cancer prevention, and cancer treatment.

In recent years, the use of in situ technologies and single cell genomics has revolutionized the field of single cell DNA sequencing. These advancements have allowed researchers to examine the spatial aspects of intra-tumoral heterogeneity and conduct lineage tracing. This has provided new insights into the evolutionary dynamics of cancer, including its initiation, progression, metastasis, and therapy resistance. The knowledge gained from these technologies will undoubtedly aid in the discovery and use of innovative medicines, as well as the design of combination therapies for cancer.

Another area of focus in cancer genomics is the study of structural changes in cancer genomes. Structural variants have been found to be significant aberrations in late-stage cancer biology and intra-tumor heterogeneity. Understanding the evolutionary paths of these variants provides valuable insights into

clonal dynamics in tumors. Additionally, single cell RNA sequencing is a rapidly developing field with diverse applications.

Lineage tracing has also evolved over time, with various techniques being used to track the lineage of cells. These techniques include the use of mitochondrial DNA mutations, X-linked enzyme heterogeneity assays, monitoring of DNA methylation and its variation, and whole genome sequencing to detect somatic mutations. The authors of this study emphasize the use of mathematical models to quantify the clonal architecture of healthy and diseased tissues.

While pathologists have always recognized the importance of the tissue microenvironment in maintaining tissue structure and homeostasis, molecular categorizations of diseases have often overlooked these characteristics. This is particularly evident in cancer, where modifications to various cell types can impact the growth and proliferation of cancer cells. Therefore, it is crucial to consider the role of the tissue microenvironment in understanding disease progression and developing effective treatments.

FUTURE PROSPECTS:

The practice of pathology has undergone significant changes in the molecular age, with histopathologists now operating at the intersection of traditional morphological science and molecular science. As molecular diagnosis becomes increasingly relevant in histopathological diagnosis, it is necessary for policy makers to reconsider the accreditation and reaccreditation process for modern histopathologists in light of these rapid changes. This includes incorporating training in molecular skills such as telemedicine, telepathology, digital imaging, and an understanding of the economic aspects of the field. This review aims to explore the evolving nature of this "science of art" and the characteristics that define the modern histopathologist. With advancements in biotechnology and molecular biology, histopathologists must not only be proficient in traditional techniques but also stay updated with the latest scientific and technological advancements. As molecular diagnosis threatens to supersede histopathological diagnosis, it is crucial for histopathologists to embrace and integrate these recent advancements into their practice. Given the rapidly changing environment, it is evident that histopathologist certification must undergo significant changes, including the reaccreditation of practicing individuals. The current accreditation process typically involves rigorous training followed by an examination that grants a lifelong license to practice pathology. However, it is the responsibility of the pathologist to actively stay informed about new technologies and diagnostic trends. While primary accreditation assesses the capabilities of new practitioners, reaccreditation evaluates the actual practices of established practitioners. Therefore, the accreditation and reaccreditation procedures should encompass not only traditional histopathological techniques but also fields such as biotechnology, telecommunication, information communication technology, professional photography, and even economics. While other factors like socio-psychological aspects, hospital administration, and quality control may also be relevant, they are beyond the scope of this discussion. The authors of this review have proposed various methods and tools, such as recording educational activities, testing knowledge and interpretative skills, assessing diligence, and peer review/appraisal, to assess the ongoing competence of practicing pathologists.

Table 1. ADVANTAGES & DISADVANTAGES

Agent	Advantages	Disadvantages
Xylene	Known Product	Noxious Smell
	Prodct high quality slides	High Toxicity Classified as hazardous waste due to flammability and toxicity Flammable Causes dermatitis, penetrates skin possible carcinogen
1.7% dish washing soap	Nontoxic, nonflammable Produces high quality slides did not affect/compromise the stain quality Accepatable consistency Lack of offensive odor cheap and safe	

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