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Role of Histopathology in unveiling mysterious in Forensic Pathology

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ABSTRACT
Histopathology, the microscopic examination of tissue samples, plays a crucial role in unravelling mysteries in forensic pathology. It provides valuable insights into the cause, manner, and circumstances of death, aiding forensic pathologists in their quest for truth and justice. This article delves into the significant role of histopathology in forensic pathology, examining its importance in various aspects of forensic investigations and highlighting its scope and techniques. It detects tissue pathological changes that can indicate life-threatening diseases like myocardial infarction, pulmonary embolism, and brain hemorrhage etc. Histopathology helps identify and characterize catastrophic injuries like gunshot wounds, which require detailed analysis of the injury dynamics and causes. Histopathology helps forensic investigators find rare lesions unnoticed during the patient's life. Histopathology is essential in forensic pathology when macroscopic studies fail to determine death. Studies have found discrepancies between macroscopic and microscopic data, underlining the need to combine investigations to better diagnosis. Forensic medicine examines tissue with H&E, PAS, Masson's Trichrome, Congo red for amyloid detection, Prussian blue for iron deposits, and microorganism stain for infections. Histopathology examination can reveal heart, lung, liver, renal, and COVID-19 pathology. As forensic science continues to evolve, incorporating advances in microscopy and molecular techniques, histopathology remains at the forefront, unveiling the truth beyond the surface and providing answers to the most perplexing forensic mysteries.

Key Words: *Histopathology, Forensic Histopathology, Autopsy, Pathology*

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I. INTRODUCTION

Autopsy (Post mortem histopathology examination) refers to the practice of personally viewing or examining something. The term "autopsy" is derived from the Greek words "autopsia," which combines "autos" (oneself) and "opsis" (eye). The main prerequisite for doing an autopsy is to collect information pertaining to the precise cause and manner of death. It provides details regarding the deceased's death to both the person conducting the investigation and the family members. It is also helpful in histopathological examination for the identification of uncommon lesions that were missed when the patient was alive. [1]

There exist four primary categories of autopsies: 1) Medicolegal or forensic autopsies are performed to determine the cause of death in cases involving legal or criminal investigations. 2) Clinical or pathological autopsies are performed to identify and examine a specific ailment. 3) anatomical or academic autopsies, which are performed for research purposes; and 4) virtual or medical imaging autopsies, which utilize MRI and CT scan like imaging techniques. [2,3]

This Review article specifically examines medicolegal/forensic autopsies histopathology, which are conducted in accordance with relevant legislation, in instances of violent, suspicious, or sudden death, cause of death not clear as well as deaths resulting from medical malpractice or surgical interventions. Forensic

histopathology focuses on the examination of cellular and tissue changes that can be visible under a light microscope and may provide insights into the cause of death (COD).

Throughout the course of evolution, human beings have faced numerous challenges in their quest for survival and acquisition of knowledge. In ancient times, the first organized dissection of cadavers was carried out on animals. The study of animal dissection captivated humans and motivated them to explore the anatomy of the human body. Andreas Vesalius' treatise on anatomy, titled "De humani corporis fabrica" and published in 1543, introduced the concept of pathologic anatomy.[4]

Both clinical and medicolegal autopsies necessitate histopathology examinations. The cause of death following an examination is determined by combining pertinent clinical history, laboratory investigations data with microscopic and visual data. To achieve an accurate postmortem diagnosis, pathologists and forensic specialists must communicate effectively. [3,5,6]

In addition to providing information about the cause of death (COD), forensic histopathology examinations and gross evaluations of specimens also provide information about the pathophysiology and demographics of disease, aid in the development of new disease preventive measures, and provide a retrospective quality assessment of clinical diagnosis. [7,8,9]

HISTORICAL ASPECTS OF FORENSIC AUTOPSY HISTOPATHOLOGY PRACTICE

The history of the autopsy extends over a substantial period, commencing before the birth of Christ (BC) and persisting to the present era. Herophilos and Erasistratus were the innovative scientists who performed the initial anatomical dissections of the human body.[10]

Charaka (400 BCE) and Sushruta (600 BCE) were two of the most respected medical practitioners in ancient India. They were the pioneers of surgical procedures that were used for the study of anatomy and organ function as well as for the treatment of surgical conditions. Animal sacrifice was the primary way that was utilized, and the practice of wrongly burying the deceased was performed as a supplementary method. Moreover, medical professionals conducted examinations on the patients. [11,12]

The inaugural Bengal Medical School was established in 1822 in Calcutta, presently known as Kolkata. Subsequently, in 1835, it underwent a conversion into Bengal Medical College, which is currently recognized as Kolkata Medical College. [13] This event signified the commencement of the advancement of pathology in India during the British Raj. Chandigarh's Post Graduate Institute of Medical Education and Research (PGIMER) has published an additional piece that presents a comprehensive study comparing one thousand autopsies performed over the period of five years.[14] The study conducted by Lanjewar et al. in India is the fourth largest study worldwide and it encompasses all facets of autopsy, including specimen preservation and enhancements to autopsy techniques.[15]

KEY ROLE (EXAMPLES) OF HISTOPATHOLOGY IN FORENSIC PATHOLOGY OR INVESTIGATION

Histopathology is a crucial component of forensic investigations as it offers essential information on the cause, manner, and circumstances of death. Here is a detailed explanation of its role, substantiated by references:

Cause of Death Determination: Histopathological examination assists in diagnosing the cause of death by finding pathology alterations in tissues. Histopathology especially autopsy helpful in detecting life-threatening illnesses such myocardial infarction, pulmonary embolism, and brain haemorrhage. These conditions may not be easily detectable from external examination alone. Histopathological findings are often correlated with clinical history, radiological imaging, and other forensic evidence to establish a comprehensive understanding of the cause of death. Myocardial infarction will show coagulative necrosis, neutrophilic infiltrate and fibrosis like histopathology features and support the diagnosis. This multidisciplinary approach enhances the accuracy of cause of death determination. [3,5,16]

Identification of Trauma especially gunshot: The histopathology findings in gunshot wounds as outlined by Shrestha et al. include the examination of the wound track, which reveals tissue destruction, hemorrhage, and foreign material such as bullet fragments. The entry wound typically shows an abrasion collar and soot deposition, whereas the exit wound is often irregular and lacks soot or stippling. Microscopic analysis can identify the presence of gunpowder particles and tissue reaction to these particles, helping to determine the range of fire. Additionally, histological examination can reveal vital reactions like inflammation and hemorrhage, which can differentiate between antemortem and postmortem wounds.[17]

Role of Histopathology in Postmortem wound dating **:** The research conducted by Vinay et al., which was published in the American Journal of Forensic Medicine and Pathology in June 2017, examines the process of determining the age of wounds after death utilizing both a detailed visual assessment and the microscopic examination of tissue samples. The objective of the study was to ascertain the dependability of evaluating abrasions in order to estimate the postmortem time of damage. The authors conducted a detailed analysis of abrasions using both macroscopic and microscopic techniques in order to identify connections between changes in the physical appearance of wound tissues and the time that has passed since the injury occurred. This study enhances the field of forensic pathology by offering valuable insights on the chronological development of abrasions following death. As a result, it improves the precision of determining the age of wounds during postmortem examinations. In summary, the results provide significant insights for forensic professionals engaged in ascertaining the temporal aspects of injuries in medicolegal inquiries. [18]

Identification of Disease Conditions in the field of medicine and science: The cited article discusses the authors' viewpoint on the lasting significance of the autopsy in the fields of medicine and science. Autopsies are crucial in elucidating the substantial impact they have on comprehending cardiovascular and infectious disorders, including congenital heart disease, atherosclerosis, TB, and viral infections. Atherosclerosis shows vessel intima thickening with calcification and inflammation while Tuberculosis shows granulomatous inflammation. Although there are obstacles such as decreasing autopsy rates and diminished impact of pathology in medical education and clinical practice, the authors remain hopeful about the prospects of autopsies in the future, especially in research that employs new molecular techniques on tissue samples obtained from autopsies. They highlight the vital importance of academic pathologists in tackling these problems and advocating for the ongoing significance of autopsies in increasing medical understanding and enhancing patient care.[19]

The Scope of Forensic Histopathology contrast to Surgical Histopathology

Forensic pathology determines death causes and provides legal evidence. Despite similarities, medico-legal autopsy involves unique situations not encountered in ordinary surgical pathology. Forensic pathology uses histopathology to discover microscopic aberrations. These include myocarditis, amniotic fluid embolism, and fat embolism. Hypothermia, electrocution, drowning, and fire deaths also shows morphological changes which can support underlying pathological condition.[20]

THE SIGNIFICANCE OF HISTOPATHOLOGY IN THE CONTEXT OF FORENSIC PATHOLOGY

When a macroscopic examination fails to reveal the cause of death, forensic pathologists turn to histopathology as an additional investigative tool. Finding the COD, understanding the pathophysiology, and establishing the clinical diagnosis are all greatly assisted by post-mortem exams, which include both macroscopic and microscopic inspections, according to multiple clinical and MLA autopsy studies. According to Roulson et al., histopathology is still the most reliable method when it comes to identifying a death's cause and checking the precision of other diagnostic procedures, clinical diagnoses, and death certificates.[21]

Studies on the utility of microscopy in medical autopsy have demonstrated notable disparities between macroscopic and microscopic findings.

In order to determine the use of histopathology in a separate study conducted in 2006, Langlois examined the medicolegal autopsies of 638 adults in Sydney, Australia. This study investigated the presence of obstructions in the heart, lungs, and kidneys. He saw a significant amount of discrepancy in the diagnosis of the lungs, both at a macroscopic and microscopic level, particularly with regards to the diagnosis of pneumonia. One of the challenges examined was the limited consensus between the macroscopic assessment of coronary artery constriction and the microscopic evaluation. Based on his statement, histopathology was believed to have played a role in the cause of death in around 53% of cases, either by providing, confirming, or changing the cause of death. Significant disparities were identified in the cardiac and pulmonary structures when comparing macroscopic and microscopic analyses.[22]

Hunt et al. initiated a study with the objective of evaluating the diagnostic precision of histopathologists in the identification of bronchopneumonia. It was discovered that there were significant difficulties in getting consistent diagnoses, with frequent differences between macroscopic and microscopic judgments. This implies possible constraints in depending exclusively on macroscopic observations for diagnosis. The results emphasize the significance of combining macroscopic and microscopic tests to improve the accuracy of diagnosis in instances with bronchopneumonia. Grossly it shows consolidation which is patchy and microscopically it shows bronchioles exudation with inflammatory cells. This study emphasizes the necessity of employing thorough evaluation methods in histopathological practice in order to guarantee accurate diagnosis.[23]

Other reference articles on the differences between antemortem and postmortem diagnosis based on histological results are included below in **Table No 01.**

Scheimberg's paper "The genetic autopsy" highlights the importance of histopathology in identifying prenatal anomalies as a crucial part of the genetic autopsy procedure. Histopathological investigation enables a thorough assessment of fetal tissues, offering valuable information about structural defects, developmental abnormalities, and genetic illnesses. By conducting thorough examination, histopathologists have the ability to detect and describe several kinds of fetal abnormalities, such as congenital deformities, chromosomal aberrations, and genetic disorders.[28]

One research aimed to assess the efficiency of the standard histology procedure in forensic autopsy. A prospective study of 428 autopsy cases were included a standardised histological investigation. Approximately 40% of the cases demonstrated the histology-determined mode of death, which was not obvious during gross anatomical examinations. Microscopic examinations helped to determine the cause of death in one-third of the instances. In over 49% of cases, histology revealed further information about the deceased's prior condition. Histology provided more detailed documentation of severe injuries in around 22% of the cases. Findings were suggesting that standard histology for major organs should be included in routine forensic autopsy.[29]

Histopathology Examination Technique

Histology refers to the microscopic structure of tissues, while histopathology refers to the microscopic changes in tissue caused by disease. Tissue is commonly prepared for microscopy by putting it in a fixative, typically 10% buffered neutral formalin. The length of fixation varies based on the tissue type and size, with smaller pieces often necessitating 6-7 hours for fixing. Following fixation, the material is processed using alcohol as a dehydrator, cleared with xylene or toluene, and then impregnated with wax to be embedded in a block. Next, make a block cut with a microtome, also referred to as a microtomy. After a tissue slide is created, it can be stained with chemical stains for histochemistry (Hematoxylin and eosin used commonly) or immunohistochemistry.[16]

HISTOPATHOLOGICAL EXAMINATION BY USING SPECIAL STAINING

The conventional procedure entails applying Hematoxylin and Eosin (H&E) stains to all acquired sections, followed by any additional stains that may be required. Forensic practice commonly utilizes a limited selection of histochemical stains in regular use. These include stains for connective tissue, stains for iron, stains for membranes, and stains for microorganisms.[16]

Periodic Acid Schiff Reaction

The Periodic Acid Schiff Reaction Stain, also referred to as the PAS stain, is a technique employed to examine structures that contain a substantial amount of carbohydrate molecules.

These structures include the intestinal brush border, renal tubular cells, mucus, and reticular fibres of connective tissue.[30] The PAS stain is valuable for detecting glycogen in the Armanni-Ebstein lesion, a condition that can manifest in diabetic ketoacidosis. Additionally, it is beneficial for showing the presence of fungi in tissue when there is suspicion. It shows membranous thickening in basement membrane of kidney in certain nephrotic syndrome.

Masson's Trichrome Stain

Masson's Trichrome Stain is a staining method that results in a multi-coloured appearance on the tissue. Despite its red counterstains, this substance is renowned for its capacity to dye collagen fibres blue. Masson's Trichrome stain can be used to detect the presence of cardiac fibrosis, pulmonary fibrosis, chronic renal disease, and muscular dystrophy in patients who have died from these conditions.[31]

Amyloid detection by Congo red

Congo red has the ability to give amyloid strands a red and orange colour, making it a useful tool for studying amyloidosis. Tissues stained with Congo red and containing a high concentration of amyloid will display a clear and strong "apple" green birefringence when examined under a microscope using polarized light. Cardiac involvement is a common cause of death in amyloidosis. In cases of suspected cardiac amyloidosis, it can be utilized to visually confirm the presence of amyloid in tissue.[32]

The Prussian blue stain

The Prussian blue stain is a valuable tool for detecting and characterizing iron deposits throughout the body. The iron is stained with a blue colour. One useful technique for diagnosing iron buildup diseases like hemochromatosis or hemosiderosis is staining liver tissue and looking for iron near the peri-portal hepatocytes or along the sinusoidal lining. As with chronic illness-related anemia, an excessive buildup of iron in the bone marrow may be a sign of ineffective red blood cell generation. Conversely, the absence of a response to the

Prussian blue stain may suggest low amounts of iron, such as in the case of iron deficiency anemia.[33] The presence of hemosiderin, which typically appears within 48-72 hours, can assist in determining the age of injuries.

Microorganism Stain

Infections frequently result in mortality. Not all cases necessitate specific study, hence, the majority of instances can visually indicate the existence of pneumonia or meningitis, and microbiological investigations can identify the responsible organism(s). A regular Gram stain is employed to visualize bacteria in tissue. Fungi can be visualized using a PAS or Grocott stain. The latter stain also detects organisms like Pneumocystis jiroveci. Mycobacteria can be stained using the Ziehl–Neelsen staining method.[16]

ROLE OF HISTOPATHOLOGY IN THROMBOEMBOLIC LESION

An often-encountered issue in forensic medicine involves the assessment of blood vessel lumens for the presence of thrombi or emboli. Histology is highly beneficial in determining the diagnosis in such instances. There is a blood clot that formed before death in the vein. This clot contains "lines of Zahn," which are layers of red blood cells, white blood cells, and fibrin deposited in the vessel. This blood clot, known as a postmortem clot, dislodged from the arteries during the autopsy. The "chicken fat" appearance is a result of the gravitational separation of different components in the blood.

Examining the lung tissue for amniotic fluid emboli is crucial when investigating deaths that occur around the time of childbirth. These emboli typically occur after childbirth, but can also be observed in situations of miscarriage, damage to a pregnant abdomen, amnioinfusion, and the administration of uterine stimulants.[34] **Figure 01** displays a photomicrograph showing Diabetic Nephropathy in a patient who died from kidney disease caused by diabetes. The image shows the presence of Kimmelsteil Wilson nodular lesions in the glomerulus, as well as persistent interstitial inflammation and fibrosis.

ROLE OF HISTOPATHOLOGY IN FORENSIC NEUROPATHOLOGY

Oura, Hakkarainen, and Sajantila's study presents a comprehensive examination of the existing literature on forensic neuropathology over the last ten years. The subject matter encompasses several facets of forensic neuropathology, such as cranial trauma, neurodegenerative disorders, and the application of imaging methodologies. The study focuses on the progress made in diagnostic techniques, including immunohistochemistry, and addresses the difficulties encountered in conducting neuropathological examinations in forensic settings. In the synthesis, a grand total of 122 unique papers were ultimately included. The predominant focus of study was on traumatic intracranial injury, with immunotechniques being the most widely used method. Overall, it provides useful insights into the present condition of forensic neuropathology and identifies areas for additional research and advancement.[35]

ROLE OF HISTOPATHOLOGY IN CARDIAC FORENSIC PATHOLOGY

The study conducted by Duncanson and Mackey-Bojack, which was published in the journal Acad Forensic Pathol in 2018, specifically investigated the histologic examination of the heart in forensic autopsy. A thorough examination was carried out to analyze histological findings associated with different cardiac conditions such as myocardial infarction, arteritis, valvular heart disease, myocarditis, cardiomyopathy, neurocardiogenic injury, and left ventricular hypertrophy. These conditions are frequently encountered in forensic investigations. The study highlighted the significance of thorough scrutiny and analysis of minute characteristics under a microscope to ascertain the reason and manner of death, especially in instances involving abrupt cardiac incidents. In summary, the research offered significant insights into the importance of histology in forensic pathology, emphasizing its essential role in comprehending cardiovascular disorders and their forensic consequences.[36]

Figure 02 illustrates the histopathological findings of an autopsy performed on a patient who died from myocardial infarction. The photomicrograph displays the presence of interstitial fibrosis, necrosis, and chronic inflammation.

ROLE OF HISTOPATHOLOGY IN LUNG & LIVER FORENSIC PATHOLOGY

The article authored by Bijwe et al. in 2022, published in the International Journal of Medical Reviews and Case Reports, presents a cross-sectional observational study that examines the histopathological analysis of lung and liver samples. The study focuses on 38 lung specimens and 22 liver specimens received over a six-month period at a tertiary care hospital's Department of Pathology. The study sought to examine the histological characteristics of lung and liver tissues collected from autopsies, offering insights into several pathological disorders that impact these organs, such as pneumonia, pulmonary edema, alveolar hemorrhage, tuberculosis, liver cirrhosis, and fatty liver. The authors conducted a thorough analysis and discovered typical histological alterations linked to respiratory and hepatic disorders, providing insight into their diagnostic importance. Moreover, the study emphasized the significance of combining histopathological findings with clinical and radiographic data to

achieve precise illness diagnosis and effective treatment. In summary, the research improves our comprehension of lung and liver diseases, highlighting the importance of studying tissue abnormalities in medical and legal investigations.[37]

The cited Study of lung and liver specimens after death showed a significant occurrence of abnormal findings. The most frequently observed lung conditions were diffuse alveolar oedema, congestion, and bronchopneumonia. In the liver, the main issues were sinusoidal and vascular congestion, cirrhosis, and steatosis. The findings highlighted a greater prevalence of these abnormalities in males. Histopathological investigation was crucial in discovering different disease processes and unexpected results that were not evident during the person's lifetime or at the moment of death. This underscores the significance of comprehensive autopsy in order to ascertain the precise cause of death and enhance our understanding of medical matters on a wider scale.[38]

Figure 03 displays a histopathology image of a patient who died from chronic liver cirrhosis. The image reveals the presence of bridging fibrous septa and spherical parenchymal nodules consisting of hepatocytes.

ROLE OF HISTOPATHOLOGY IN FORENSIC RENAL PATHOLOGY

The 2021 study conducted by Neha et al., which was published in the Indian Journal of Forensic Community Medicine, examined abnormal observations in the kidneys during medicolegal autopsy. The process entailed a comprehensive analysis of kidney tissues acquired from postmortem examinations to identify and describe different pathological alterations. The authors emphasized prevalent kidney diseases observed in medicolegal instances, such as inflammatory disorders, degenerative alterations, and structural abnormalities. The participants deliberated on the importance of these abnormal findings in ascertaining the reason and mode of death, specifically in instances involving renal ailments or traumas. Furthermore, the study highlighted the significance of combining histopathological data with other forensic evidence to provide precise medicolegal findings. The study unequivocally demonstrates that the kidneys most frequently exhibited pathological diseases such as acute necrosis of the tubules, chronic pyelonephritis, glomerulosclerosis, nephritis of the interstitial space, renal cysts, nephrolithiasis, and others. While the renal diseases did not directly cause the fatalities, they may have played a role in contributing to them to some degree. In summary, the research enhances our comprehension of renal pathology in the field of forensic medicine and emphasizes the significance of examining the kidneys in postmortem investigations.[39]

Figure 04 displays the histopathological findings of a patient who died from kidney failure caused by chronic pyelonephritis. The findings reveal the presence of chronic inflammation in the interstitial tissue, tubules undergoing thyroidisation, and glomerulosclerosis.

ROLE OF HISTOPATHOLOGY IN DEATH DUE TO COVID -19

The systematic study conducted by Hammoud et al., which was published in Cureus in June 2022, thoroughly investigates the histological observations in cases with COVID-19. The study amalgamates data from diverse research publications to ascertain shared histological characteristics reported in patients with COVID-19. The report emphasizes the discovery of specific conditions in the lungs, including diffuse alveolar damage, hyaline membrane formation, and microthrombi. Additionally, it notes the presence of vascular inflammation and endothelial damage in other organs. In addition, the review examines the existence of viral particles and viral inclusion bodies in the affected tissues. The authors also investigate the correlation between histological alterations and clinical outcomes, providing insights into the mechanisms that underlie the pathology of COVID-19. The majority of the lung samples (84.4%) had diffused alveolar damage (DAD). At 51.2% of cases, cardiac hypertrophy was found; at 62%, arteriosclerosis; and at 59.3%, steatosis, the most common pathological abnormality in the kidneys and hepatobiliary system, respectively. We can learn more about the pathophysiology, diagnosis, and therapy of SARS-CoV-2 through autopsy examinations, which could improve patient care. In summary, the article offers significant information about the histopathological aspects of COVID-19, which helps to enhance our understanding of how the illness affects various organ systems. [40]

Yadav et al.'s 2021 Cureus publication examines Indian COVID-19 autopsy protocols, methodologies, and experiences. This document examines COVID-19 autopsies in India and their methods. The study analyses autopsy challenges such safety, sample collection, and interpretation. It also stresses the importance of autopsy to understand COVID-19's pathology and organ effects. The authors provide their personal experiences and insights into autopsy' diagnostic value in understanding illness development and recognizing related issues. Overall, the article sheds light on the role of autopsy in COVID-19 research and postmortem studies in illness understanding. [41]

Figure 05 displays a histopathological photomicrograph of a patient who died from mucormycosis as a complication in a COVID patient. The image reveals the presence of broad ribbon-like hyphae.

II. CONCLUSION

Histopathology is a valuable tool in forensic pathology, offering microscopic information that complements the larger-scale observations. Histopathology is essential for solving mysteries and ensuring justice by diagnosing or supporting the cause of death by specific morphological alteration in tissue. Histopathology remains one of the most reliable methods for determining the cause of death, even with the advancements in autopsy methods. Moreover, studies of histopathology examination in autopsies give an awareness about true prevalence of the disease and helps in identifying various lesions that were undiagnosed. Histopathology examinations enhance our comprehension of complex cases and assist in solving perplexing forensic mysteries. This type of article also provides an enriching experience for the pathologist to acquire knowledge in this usually neglected aspect of histopathology.

Table 01: Differences between antemortem and postmortem diagnosis following histological findings:

Serial Number	Reference Article	Year of study & Type of study	Discrepancy rate	Main Finding
1	Goldman et al. [24]	Comparative study 1983	29%	Highlighted importance of autopsies in identifying clinically significant findings.
2	Lanjewar et al. [15]	Retrospective study 2018	31%	Infection and cardiac cause
3	Costache et al. [25]	Retrospective study 2014	24%	Pulmonary embolism
4	Shojania et al. [26]	Review metanalysis	24-38%	Factors contributing to discrepancies included diagnostic tests and clinical setting.
5	Kuijpers et al. [27]	Comparative study 2014	36%	Discrepant findings persist at autopsy, even in the era of high-tech medicine. Therefore, autopsies still should serve as a very important part of quality control in clinical diagnosis and treatment.

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Figure 01: Photomicrograph of Diabetic Nephropathy

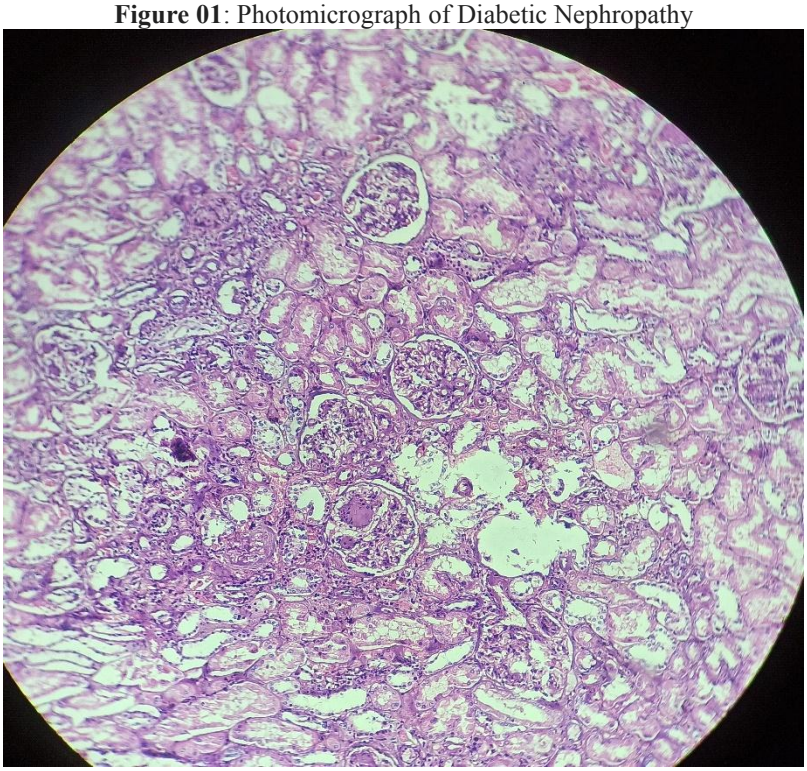

Figure 02: Photomicrograph of Myocardial Infarction

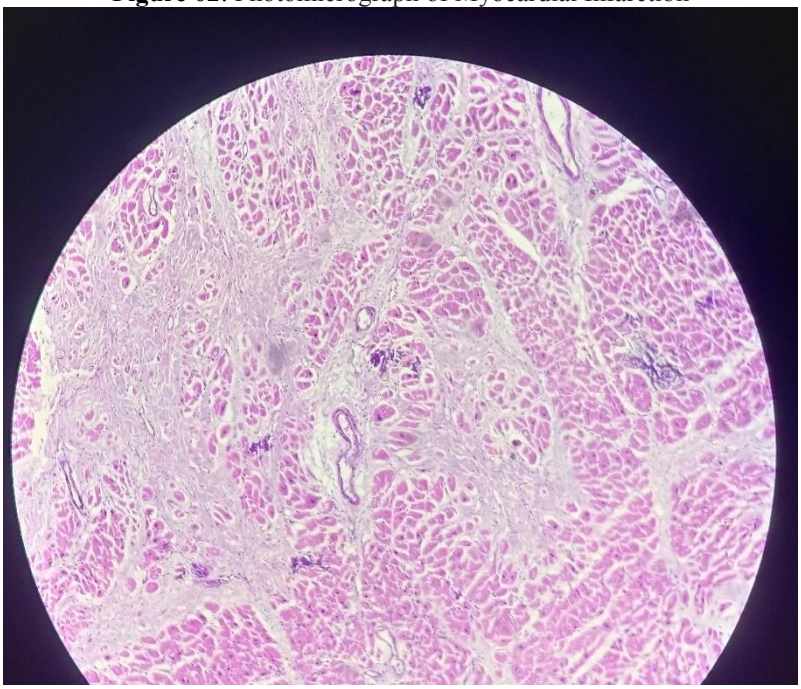

Figure 03: Photomicrograph of Liver Cirrhosis

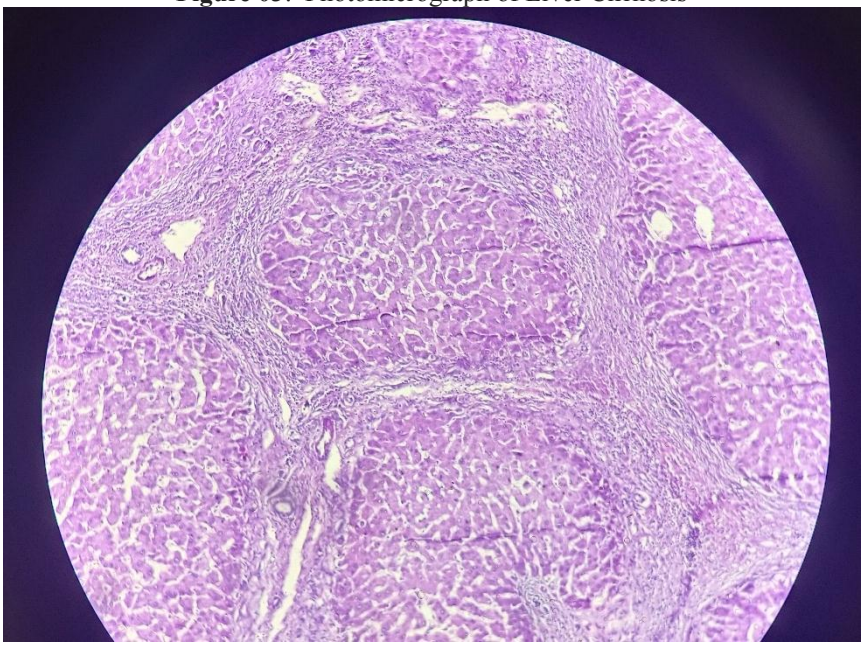

Figure 04: Photomicrograph of Chronic Pyelonephritis

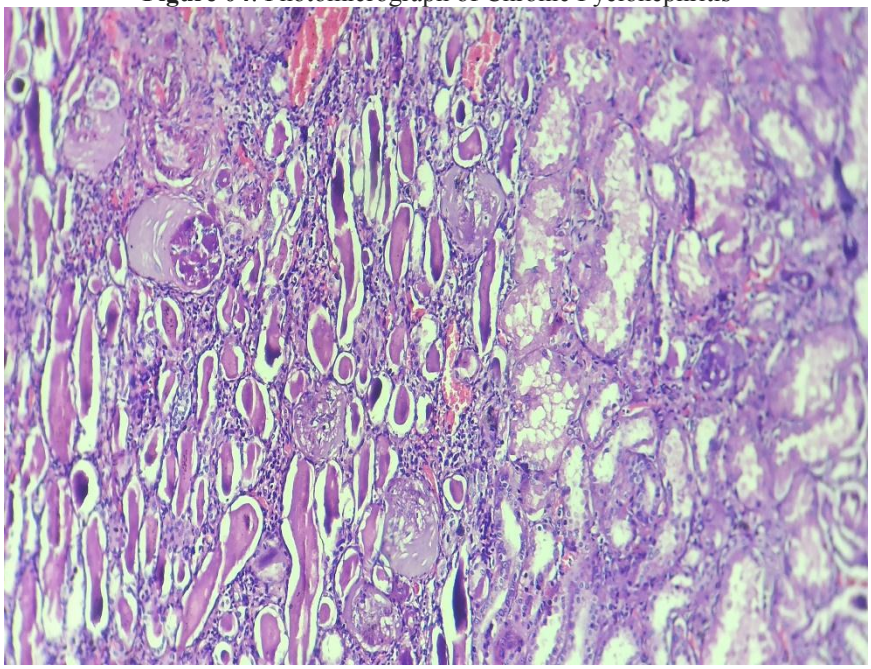

Figure 05: Photomicrograph of Mucormycosis