Original Article

The Role of Digital Pathology in Enabling Remote Operations During the COVID-19 Pandemic and Beyond A Pathologist's Perspective For the Future Opportunity

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ABSTRACT

Significant progress has been made in the area of digital pathology during the past 20 years. With rapid scanners, whole slide imaging (WSI) can now create high-resolution digital duplicates of glass slides. **Objective:** To assess the fundamental understanding of digital pathology among Pakistani pathologists practicing in labs throughout the country. **Methods:** The current study was cross sectional study carried out at the Department of Pathology, Gomal Medical College, Medical Teaching Institute, Dera Ismail Khan, Pakistan for a period of six months. This study was proforma based and pathologists across the country were included in the study. All the data from the questionnaire was entered and analyzed by employing IBM SPSS version 24. **Results:** A total of 210 pathologists were enrolled, amongst which 84 (40%) were males and 126 (60%) were females. Pathologists familiar with the Digital Pathology idea were 147 (70%) while 63 (30%) pathologists were not familiar with the digital pathology. Amongst 210 pathologists, 157 (74.77%) pathologists have ideas about digital microscopes. Pathologists having knowledge of pathology slide scanner ideas were 147 (70%) while 63 (30%) pathologists were observed as having no knowledge of pathology slide scanners. Pathologists familiar with the idea of artificial intelligence were 96 (45.71%) while 114 (54.29%) participants were not familiar with the artificial intelligence. **Conclusions:** In spite of the fact that digital pathology is very promising and has resulted in a shift in the thought pattern of pathologists practicing in underdeveloped countries such as Pakistan, there are still challenges to overcome such as expense, technical assistance, regulation, and validation needs.

INTRODUCTION

The microscopic examination of diseased tissues is referred to as histopathology. In order to do histopathological analysis, a light microscope must be used to examine tissue samples. Microscopic examination of histopathologic slides is widely considered to be the gold standard for medical diagnosis. Histopathologists use a visual examination of tissue abnormalities, architecture, and different cellular characteristics to detect malignant areas and malignancy in practice [1]. Significant progress has been made in the area of digital pathology during the past 20 years. With rapid scanners, whole slide imaging (WSI) can now create high-resolution digital duplicates of glass slides. Whole-slide imaging may be used on slides stained with hematoxylin and eosin (H&E), as well as

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particular histochemical stains like mucicarmine, trichrome, iron, and immune-histochemical stains. These digital pictures may be seen remotely with zooming capabilities comparable to that of a traditional objective lens [2]. WSI scanners create diagnostic-quality pictures with a spatial resolution that enables the identification and characterization of essential histologic characteristics like nucleoli and viral inclusions. Slides may be annotated using the viewer software and image management system, that comes with WSI scanners, and collaborative capabilities are accessible to assist with digital sign-out, consultation, teaching, quality assurance, and research [3-7]. Many pathology firms have begun to include digital pathology technologies into their workflow in recent years. Although some pathologists employ such technologies selectively for a variety of tasks, establishing a fully digital workflow requires the purchase of relevant equipment, incorporation into the workflow, faculty and staff training, and connection with the laboratory information system (LIS)[7-9]. The covid-19 epidemic became the most serious worldwide health catastrophe of our time in 2020 [10]. Due to the ongoing development of new information about the virus, the need for digital pathology and remote services has increased in labs and hospitals, in order to handle new safety and practice limits [11-13]. Because of a number of factors, digital pathology is still not widely employed in Pakistan. One explanation might be the high cost of digital pathology instruments such as pathology slide scanners and digital microscopes in underdeveloped nations. However, in the aftermath of the COVID-19 epidemic, when most activities were halted and work-from-home opportunities arose, the necessity for tele-pathology provides a glimmer of hope for pathologists to maintain their job. The purpose of this research was to determine the fundamental understanding of digital pathology among Pakistani pathologists practicing in labs throughout the country. A secondary goal of our study was to determine the role of digital pathology in the current epidemic and in the future.

M E T H O D S

The current study was a cross-sectional study carried out at the Department of Pathology, Gomal Medical College, Medical Teaching Institute, Dera Ismail Khan, Pakistan. The duration of the study was six months after. This study was proforma based and pathologists across the country were included in the study. Google Docs was used for this online study. The inclusion criteria of the current study was all the pathologist of both the gender and any age working in the laboratories across the country and willing to participate in the study. The exclusion criteria of the current study were all pathologists confined to academics only and not willing to participate in the study. Pathologists from major cities were included in the study. Totally, 210 pathologists were included by using the WHO calculator for sample size. Hematologists, microbiologists, and histo-pathologists participated as second opinions. In this online survey, 14 questions were inquired by using Google forms and informed consent was taken from all the participants. Out of 14 questions, 13 were close-ended while only one question was open-ended. The open-ended question was about the perception of pathologists about digital pathology. All the data from the questionnaire was entered and analyzed by employing IBM SPSS version 24. Data was divided into continuous variables and categorical variables. Continuous variables were documented in the form of mean and standard deviations whereas frequencies and percentages were documented for categorical variables.

R E S U L T S

In the current study, pathologists were enrolled from different disciplines. A total of 210 pathologists were enrolled, amongst which 84 (40%) were males and 126 (60%) were females (Figure 1). The mean age in the current study was 38 years with a standard deviation of 6.4. Based on specialty, the majority of the pathologists were histopathologists followed by microbiologists and hematologists. There were 126 (60%) histo-pathologists, 45 (21.43%) were microbiologist while 39 (18.57%) were histo-pathologist. On the basis of designation, 147 (70%) were consultant pathologists whereas 63 (30%) were resident pathologists (Figure 2). Pathologists familiar with the Digital Pathology idea were 147 (70%) while 63 (30%) pathologists were not familiar with the digital pathology. Amongst 210 pathologists, 157 (74.77%) pathologists have an idea about digital microscopes whereas 53 (25.23%) pathologists have no idea about the digital microscope. Pathologists having knowledge of pathology slide scanner ideas were 147 (70%) while 63 (30%) pathologists were observed as having no knowledge of pathology slide scanners. In the current study, 137 (65.2%) pathologists were observed with difficulty in their daily duties during COVID-19 pandemics while 73 (34.8%) pathologists were observed as having no difficulty in COVID-19 pandemic. In the case of availability of slide scanners and digital microscopes, 168 (80%) pathologists were in support of routine pathology from home whereas 42 (20%) participants were not in this favor. The idea of telepathology after the COVID-19 pandemic was supported by 189 (90%) whereas 21 (10%) were not in this favor. The idea of a whole slide scanner was observed in 126 (60%) participants while 84 (40%) participants were not familiar with the idea of a whole slide scanner. Pathologists familiar with the idea of artificial intelligence were 96 (45.71%) while 114 (54.29%) participants were not familiar with the

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artificial intelligence. Knowledge of the Digital Pathology Association was observed in 73 (34.76%) participants while 173 (65.24%) pathologists were observed as having no knowledge of Digital Pathology Association. When participants were questioned about their views on digital pathology and the potential changes it may bring to traditional pathology practice, 189 (90%) pathologists supported it as a component of modern pathology, whereas 21 (10%) pathologists were opposed to it (Table 1).
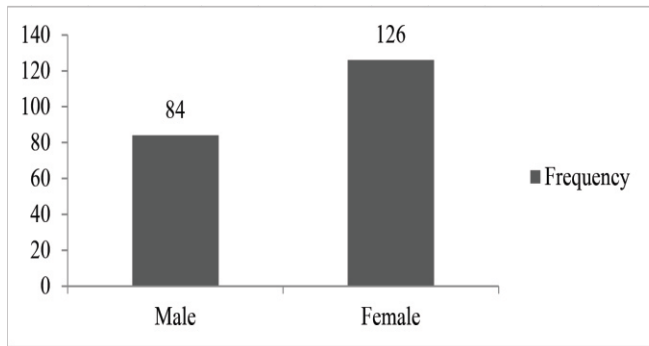

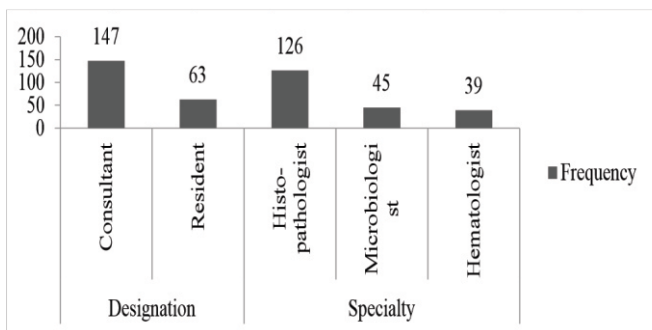**Figure 1:** Distribution of participants based on gender

Figure 2: Distribution of pathologist based on designation and specialty

Survey questions	Response	
	Yes Frequency (%)	No Frequency (%)
Digital Pathology idea	147 (70%)	63 (30%)
Familiarity with digital microscope	157 (74.77%)	53 (25.23%)
knowledge of pathology slide scanner	147 (70%)	63 (30%)
Difficulty in their daily duties during Covid-19	137 (65.2%)	73 (34.8%)
Support of routine pathology from home	168 (80%)	42 (20%)
Tele-pathology after the covid-19 pandemic	189 (90%)	21 (10%)
whole slide scanner familiarity	126 (60%)	84 (40%)
Idea of artificial intelligence	96 (45.71%)	114 (54.29%)
Knowledge of Digital Pathology Association	73 (34.76%)	173 (65.24%)

Table 1: Questionnaire response of the pathologists

DISCUSSION

According to the literature, pathologists have been using whole slide imaging and digital pathology for almost two decades now [14]. The College of American Pathologists recommended Whole Slide Imaging for the purpose of diagnosis in guidelines of pathology Guideline in 2013 [15]. However, in underdeveloped countries, adoption was delayed due to the high prices of pathology slide scanners, as well as extra hidden expenses such as staff and pathologist training, digital slide system for storage, technical assistance, and legislative or licensing charges [15]. The total discordance ratio among digital and glass slide diagnostic was 7.6%, according to a systematic assessment of 38 relevant research published before 2015. There were 17 studies that showed a discordant rate of more than 5%, and 8 studies that showed a discordant rate of more than 15% [16]. The cumulative discordance rate was reduced to 4% and severe inconsistencies were reduced to 1% in a subsequent interpretation of the same sample [17]. A more recent analysis found that disagreements ranged from 1.7-13 percent in research published in 2018 [18]. Substantial discordant rates of 4.9 percent [19] and 3.6 percent [20] between diagnoses made by digital and glass slides were found in two multicentric, randomized, non-inferiority investigations. In addition, research from a single, major academic institution found that diagnostic equivalence was 99.3 percent generally [8]. Unfortunately, digital pathology technologies are not widely used in Pakistan, and many pathologists are unfamiliar with the technology. They continue to operate according to established rules. In the current study, pathologists familiar with the Digital Pathology idea were 70%, 74.77% of pathologists have an idea about digital microscope, 70% of participants have knowledge of pathology slide scanner, 65.2% of pathologists were observed with difficulty in their daily duties during Covid-19 pandemics, 80% pathologists were in support of routine pathology from home in the case of availability of slide scanner and digital microscope and less than 50% pathologist were familiar with the idea of artificial intelligence. In accordance with our study, a previous study reported similar results [21]. Typically, digital technologies are exclusively used for educational strategies. After the slides are turned into virtual presentations, the usage of artificial intelligence and machine - learning is one step away. But, in industrialized nations, digital pathology is yet in its infancy. Measurement of estrogen and progesterone receptors in breast carcinoma and calculation of Ki 67 and mitotic activity are the applications of digital pathology. Digital pathology has disadvantages in difficult cases when further staining or molecular investigations are necessary for diagnosis and the need for paraffin block. Pathologists are hesitant to move to digital pathology for this reason, as well as challenges such as uniformity in slide processing stages, validation of digital slides, picture quality inconsistency, and technological issues [11,12,14,15]. We wish to demonstrate the relevance of digital pathology, as well as its fundamental definitions and acceptability among Pakistani pathologists, in this research. In an age of

hopelessness and gloom brought on by this horrific epidemic that claimed the lives of over 1.5 million people in just one year, Digital Pathology and its technologies certainly present a glimmer of light and an alternative option. This epidemic has no end in sight, yet the majority of the pathologists in this survey believed that we must alter our approach if we are to survive it. The recent clearance of a WSI system by the US Food and Drug Administration for implementation in primary surgical pathology diagnostic has opened new vistas for pathologists' adoption in everyday practice [15]. In general, pathologists were positive in their responses to digital pathology. We advocate incorporating digital pathology into existing resident training programs based on our results. When students and residents learn about digital pathology from the start, they will be better able to use and apply it in their daily work, which will make them better pathologists. Finally, our study reveals that, as the profession develops, pathologists are increasingly accepting of digital pathology being progressively adopted for particular uses that are incorporated into present practice rather than a radical shift.

CONCLUSIONS

In spite of the fact that digital pathology is very promising and has resulted in a shift in the thought pattern of pathologists practicing in underdeveloped countries such as Pakistan, there are still challenges to overcome such as expense, technical assistance, regulation, and validation needs. The industrialized countries must assist our country's pathologists in learning the biomechanics and practicalities of digital pathology instruments in order to assist mankind in overcoming this pandemic that has immobilized the planet, regardless of geographical boundaries or economic level.

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