Original Article

DIGITAL PATHOLOGY ENABLING REMOTE OPERATIONS DURING COVID-19 PANDEMIC AND BEYOND-PATHOLOGIST PERSPECTIVE FOR FUTURE OPPORTUNITIES

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ABSTRACT

Objective: Digital Pathology has become widespread across the globe not only for research and educational purpose but also for primary diagnosis. Digital pathology tools not only provide qualitative results but also help in remote consultation. Developing nations are still struggling and relying on conventional methods for primary diagnosis. The main hindrance behind this slow adoption is that digital pathology tools are very expensive and require trained technical staff. This survey was conducted to know the basic knowledge of digital pathology terminologies and the pathologist's opinion working in Pakistan.

Material and Methods: Cross sectional survey of pathologists was conducted across the country during September– October 2020. Around 150 pathologists from different sub specialties took part in this online survey conducted through google forms. We asked 14 questions, 13 questions were close ended and last question was asked regarding pathologist perception about digital pathology. Descriptive statistics were used to present the data.

Results: A total of 147 pathologists completed the survey. Out of 147, majority were histopathologists (36.7%), 74% were consultants. 75% had the idea of digital pathology while rest had no idea. 68% pathologists found difficulty in routine working during Covid-19 pandemic. 95% pathologists were in favor that digital pathology is a helpful tool for diagnosis. Conclusion: Though results were not very encouraging but at least majority of pathologists had an idea of this novel technique. What we need is the use of these tools and techniques by the established organizations and developed countries.

Key Words: COVID-19, Digital pathology, Pathologists.

INTRODUCTION

Histopathology is the microscopic study of diseased tissues. Histopathological analysis is performed by examining thin slices of tissues under light microscope. The microscopic study of histopathologic slides is commonly regarded as the gold standard for clinical diagnosis. In practice, histopathologists visually examine the irregularities of tissue, architecture, and various cellular features to determine cancerous regions and malignancy [1].

It has been about two decades since the introduction of the whole slide imaging (WSI) scanner. During this time, various WSI devices have transformed the field of pathology [2]. Digital pathology is a novel technology and is currently being implemented worldwide [3]. Artificial intelligence (AI) is the simulation of human mind in computer systems.

Computer programmes are developed such that they can think and act like humans. They can mimic the learning and problem-solving behavior of humans. Deep learning is a type of machine learning used in AI that mimics the human brain function. It can process unstructured data and use it to create networks for decision making and problem solving. Digital and computational pathology, partnered with AI software and machine learning, set the stage for a groundbreaking shift in laboratory operations.

Digital pathology enables the pathologist to perform most of their work at home. Numerous validation studies have been published indicating that WSI is a reliable tool for routine diagnosis in surgical pathology [4,5,6,7]. Digital pathology enables full section low magnification "bird's-eye" view, comparison of different tissue sections on the same screen (particularly helpful in evaluating interval changes in samples taken at different time, or different stains from the same sample), on-screen measurement tools for tumor size and clearance measurements and direct connectivity to image analysis software [8,9]. Tissue image analysis, when

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performed correctly, can result in the generation of tissue-derived readouts that are precise and highly reproducible [10]. In Pakistan, digital pathology is still not used on routine basis because of few reasons. One of the reasons may be that digital pathology tools like pathology slide scanners and digital microscopes are expensive for people of developing countries. In addition, AI based software's are also quite expensive. But in the era of Covid-19 pandemic where most of the activities got stuck and work from home emerged, the need of telepathology gives a ray of hope for the pathologists to continue their work. This study was conducted to find out the basic knowledge of digital pathology among the Pakistani pathologists working in laboratories of different parts of the country as no such study has been carried out previously. We also aimed to evaluate the importance of digital pathology and AI tools in this pandemic and beyond. As this was the first study of its kind, so there were certain limitations in the study. For example, we did not ask the age of pathologists, if we had asked, we would have been able to stratify and also make the groups of pathologists and their perception with respect to their age.

MATERIAL AND METHODS

This was a cross sectional, proforma based study conducted by the researchers across the country in major cities. A total of 147 pathologists took part in the study. The study was conducted from 1st September to 1st October 2020. Histopathologists, microbiologists and hematologists participated in the study as second opinions and referrals are required in these disciplines. Only those pathologists were selected who were working in laboratories. Those confined to only academics were not included. The survey was conducted online. A total of 14 questions were asked through Google forms. We asked 14 questions; 13 questions were close ended and one last question was open ended which asked about the pathologist own perception about digital pathology. Descriptive statistics were used to present the data. Frequencies were calculated for each question.

RESULTS

Pathologists from different disciplines took part in the survey. In a total of 147 pathologists, 54(36.7%) were male and 93(63.3%) were females. Majority were from histopathologists 47 (32%), followed by hematologists and microbiologists respectively. There were 38(25.9%) residents and 91 (74.1%) consultants (Table-I) who took part in the study. Pathologists who had the idea of digital

pathology were 111(75.5%), while 38 (25.9%) had no idea of digital pathology. 106(72.1%) pathologists knew about digital microscope while rest of the pathologists were not aware of it (Table-II). 102(69.4%) pathologists had knowledge of pathology slide scanner. Out of 147 pathologists, 100 (68%) found difficulty in working during Covid-19 pandemic. 125 (85%) pathologists were in favor that routine pathology can be possible from home if the labs have the facility of digital microscope or slide scanner (Table-II). 140(95%) pathologists were in favor of telepathology for remote areas even after the end of this global pandemic. 82(55.8%) pathologists had the idea of whole slide scanner (WSI). Less than 50% (72, 49.5%) pathologists were aware of artificial intelligence and deep learning. 45 (30.6%) pathologists knew about the Digital Pathology Association (DPA) (Table-II). Lastly when we asked the opinion of participating pathologists about digital pathology and the change it can bring in the conventional practice of pathology, overwhelming majority favored digital pathology as the feature of modern pathology. Only 10 (6.8%) pathologists were not in favor of it.

Table-I: Pathologists in the survey.

Gender	Designation	Speciality
Male (36%)	Consultant (74%)	Histopathology (60%)
Female (64%)	Resident (26%)	Other (40%)

Table-II: Survey results of questionnaire filled by pathologists.

Questions	Yes	No
Idea of digital pathology	75 %	25 %
Idea of digital microscope	72 %	28 %
Idea of pathology slide scanner	68 %	31 %
Difficulty in routine duties during Covid-19 pandemics	68 %	22 %
Possibility of routine pathology work from home	85 %	15 %
Role of telepathology for second opinion in remote areas both in Covid-19 pandemic and beyond	95 %	5 %
Idea of whole slide imaging (WSI)	44%	55 %
Idea of Artificial intelligence (AI) and deep learning (DL) in pathology image analysis	51%	49 %
Knowledge of Digital Pathology Association (DPA)	31%	69 %

DISCUSSION

It has been a matter of more than two decades since the introduction of digital pathology and whole slide imaging (WSI) in pathology practice [11]. In 2013 College of American Pathologists has given its recommendation for validating Whole Slide Imaging (WSI) for Diagnostic Purposes in Pathology Guideline [12]. But this adaptation was very slow in

developing nations mainly because the costs of pathology slide scanners were very high (US \$100,000 to US \$1,500,000 per piece) and additional hidden costs of training of staff and pathologists, technical support, digital slide storage systems, and regulatory or licensing costs [12].

In Pakistan unfortunately digital pathology tools are not routinely practiced and a large number of pathologists are not familiar with this technology. They still work on conventional norms. It was observed that about 75% of pathologists had the idea of digital pathology and less than 50% knew how to use artificial intelligence and deep learning in pathology. Digital tools are usually limited for educational purpose only. Use of artificial intelligence and deep learning is one step ahead after the slides become virtual. However, use of digital pathology is still in the initial stages in developed countries. Some of the uses are quantification of estrogen and progesterone receptor in breast cancer, for estimation of Ki 67 and mitotic count. Limitations in the use of digital pathology arise in challenging cases where additional stains or molecular studies need to be performed for diagnosis and paraffin block is required. Due to this reason and issues like standardization in the steps of slide processing, calibration of digital slides, variability in the image quality and technical problems, pathologists are reluctant to switch to digital pathology [11,12].

In this study we try to highlight the importance of digital pathology, its basic definitions and acceptance among Pakistani pathologists. Digital Pathology and its applications defiantly provides a ray of hope and alternate choice in the era of hopelessness and darkness due to this deadly pandemic which took away more than 1.5 million precious lives in just a span of one year. No one knows how long we will have to face this pandemic but surely, we will have to change our strategy as most of the pathologists agreed in this study.

The recent approval of US FDA to a WSI system for its use in primary surgical pathology diagnosis has opened new horizons for wider acceptance by pathologists in routine practice [11].

CONCLUSION

Though digital pathology and its applications are highly promising and have resulted in a change in the thought process of pathologists working in developing countries like Pakistan but still face barriers like cost, technical support, regulatory and validation requirements also need to be adequately addressed, especially for the developing nations. The developed nations need to guide the pathologists of our country to learn the dynamics and technicalities of digital pathology tools in order to help the entire humanity to come out of this pandemic which has paralyzed the world irrespective of geographical borders and economic status of countries.

AUTHORS CONTRIBUTION

Talat Zehra: Conceptualized the study, literature review, developed survey tool, coordinated the overall study, analyzed data and initial draft writing.
Mahin Shams: Reviewed the initial draft and made recommendations for changes, contributed to the interpretation of study findings and discussion section.
Zareen Irshad: Coordinated the hematologists across the country.
Atiya Batool: Coordinated the pathologists from Lahore.
Hassan Tariq: Coordinated the pathologists from Islamabad, Peshawar and Quetta.

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