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Are Saudi Radiologic Specialists Having Ability of Image Interpretation?

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Abstract **Original Research Article**

Background: Diagnostic radiography has multiple applications across the full spectrum of health care. Radiographic technologist use state-of-the-art equipment to produce high-quality images. The current manuscript aimed to test the ability of radiographer to interpret images they produced. ***Materials and Methods***: 100 cases produced by various imaging modalities were collected from two main hospital in Taif city, King Abdul Aziz specialist hospital and King Fiasal hospital, 70 and 30 respectively. Radiographers who have more than five years' experience in radiography in radiography job allowed to initiate preliminary reports, then these reports compared to final reports by expertise radiologists. In addition to that, all images cases were followed by researchers to obtained accuracy, specificity and sensitivity for each modality. ***Results:*** the highest frequency obtained from conventional x-ray imaging which has lowest specificity (66.6%) and highest sensitivity compared to other modalities. The highest percentage of correct diagnosis was associated with ultrasound imaging that has both high sensitivity and specificity; where computed tomography (CT) has the lowest percentage of correct diagnosis (86.6%), while most reports from CT was laying with final reports lines. ***Conclusion and recommendations***: Highest percentage of correct diagnosis obtained for most modality. Study limitation was on the limited number of sample, In the future we recommend to adopt the idea of research by the associations working in the field of radiology by expanding samples and recommend the academic institutions to increase courses that enable the student's radiographers to interpret images.
Keywords: Radiology, Images, Interpretation, Radiographers.

INTRODUCTION

Diagnostic Radiography is the production of high quality images for the purpose of diagnosis of injury or disease [1]. It is a pivotal aspect of medicine and a patient's diagnosis and ultimate treatment is often dependent on the images produced. Diagnostic radiography uses both ionizing and non-ionizing radiation in the imaging process. The equipment used is at the high end of technology and computerization within medicine. Radiology is known as the science of using medical imaging to help diagnose and, in some cases, treat diseases in the human body. Many different imaging modalities or techniques are a part of radiology including x-ray, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound and more [2, 9]. The history of radiology started with Wilhelm Roentgen in 1895[3]. Wilhelm was able to take the first x-ray, which was for his wife and won the Nobel Prize in physics in 1901 due to his new discovery. He had experimented with passing electric currents through a tube and by doing so, was able to figure out how to turn this experiment into an X-ray. The ability to take an x-ray was a huge advancement in the medical community. It allowed for the diagnosis of fractures, broken bones, ailments and much more. It wasn't long after Wilhelm's discovery that machines were produced and x-ray technology became a commonly used diagnostic procedure throughout the medical community [3]. Clinical radiologists (radiologists) are qualified medical doctors, they are well trained to perform and interpret medical images to diagnose and sometimes treat injuries and diseases of all parts of the body. patients may referred to a clinical radiologist by general physician or consultant to see internal anatomical parts function of specific organ, the radiographers generally use x-rays, alongside other imaging modalities, to see inside a patient's body and help diagnose what is wrong with them, In the radiology department the radiographer is an essential part of the team allows the doctor (Radiologist) to see the area of the body they are diagnosing or treating in real time [4]. The radiographer ensures that the utilization of radiation is safely monitored and handles the radiographic instrument and adjusts it correctly to suit the specific required investigation. In a current decade, diagnostic radiographer/medical imaging technologist is a key

member of the health care team in radiologic performance. They are responsible for producing high quality medical images that assist medical specialists and practitioners to describe, diagnose, monitor and treat a patient's injury or illness. Much of the medical equipment used to gain the images is highly technical and involves state of the art computerization. A diagnostic radiographer/medical imaging technologist needs to have the scientific and technological background to understand and use the equipment within a modern radiology department as well as compassion and strong interpersonal skills [6]. They need to be able to demonstrate care and understanding and have a genuine interest in a patient's welfare. The diagnostic radiographer/medical imaging technologist will also need to be able to explain to the patient the need for the preparation and post examination care as well as the procedure to be undertaken. The diagnostic radiographer/medical imaging technologist is able to work in a highly advanced technical profession that requires excellent people skills. It is an exciting and rewarding profession to embark on and great opportunities await the graduate.

Radiologists went through multiple stages and different names starting from technical technician and multiple qualifications of diplomas of one year, two years and three years and finally in this last decade stages bachelor's degree and master's and doctorate.

The missing link for radiographer's role in the field of health is currently based on the reading of radiographs or even the initial diagnosis and preliminary opinion on the report. This research is based on the test of the ability of the radiologic technologist to realize the image content disease appearance radiographically, as the radiographic technologist is one who is close to the patient during the work of radiography. Here in the Kingdom of Saudi Arabia radiographic technologist is developed in his skill in last two decades quickly, and most of them facing many challenges during their work, and to our best of knowledge no previous study was done in Saudi Arabia to assess or even evaluate the ability of radiographers to interpret imaging which they are produced for their patients.

Our aim of the current work was to measure the ability of radiographer to implement radiologic report, also was to develop and improve role of radiographer and correlate between Saudi radiographers role with the international standards available in many countries.

MATERIALS AND METHODS

The type of our research was analytical study. The study took place in King Abdul-Aziz specialized hospital (KAASH) from January 22, 2019 until March 12, 2019 and also on (king Faisal hospital) from February 16 2019 until March 9, 2019. Researchers met with 11 radiographers and three clinical radiologist in (King Abdul-Aziz specialized hospital) 3 radiographers and two clinical radiologist excluded from sample because their experience were under five years. Researchers collected70 cases, and allow radiographer to make initial report then expertise radiologist interpret the images, researchers compare between the two report is it positive or negative or it is within the line of diagnostic but not accurate diagnose, but in (king Faisal hospital) we only collect 30 cases due to the delayed process of ethical approve. Researchers met with 9 radiographers and 2clinical radiologist and exclude 4 radiographers and 1 clinical radiologist because their experience was less than 5 years. Our next step was designing special data collection sheet. The types of the modalities in which researchersincluded in this studywere (x-ray computed tomography-magnetic resonance imagining and ultrasound).

All cases were followed after they referred back to department who request the image for each patient, in order to calculate sensitivity, accuracy and specificity.

Sensitivity (also called the true positive rate, the recall, or probability of detection [6, 7] in some fields) measures the proportion of actual positives that are correctly identified as such (e.g., the percentage of correct diagnose image which are correctly identified as having the condition).

$$Sensitivity = TP/TP + FN. \quad \text{.....[1] [7]}$$

Specificity relates to the test's ability to correctly reject healthy patients without a condition. Consider the example of a medical test for diagnosing a disease. Specificity of a test is the proportion of healthy patients known not to have the disease, who will test negative for it. Mathematically, this can also be written as:

$$Specificity = TN/TN + FP \quad \text{.....[2] [7]}$$

The accuracy of a test is its ability to differentiate the patient and healthy cases correctly. To estimate the accuracy of a test, we should calculate the proportion of true positive and true negative in all evaluated cases. Mathematically, this can be stated as:

$$Accuracy = TP + TN/TP + TN + FP + \text{.....[3] [7]}$$

Microsoft excel computer program version 2010 was used to analyze data. Ethical approved letter was written from administration of college of applied medical science, Taif University to ministry of health (MOH) in Taif and they in turn focused researchers to aforementioned hospitals, in which data were collected.

Study limitation was on the narrow time of data collection, analyzed and finalized this project so

sample size was too low for this type of study, which need large size and collaboration of national radiological societies, as this work improved radiographer's task in our hospitals

RESULTS

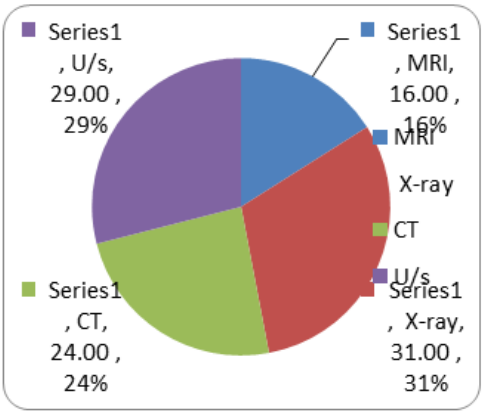

Fig-1: frequency of each imaging modality

Figure 1 shown above demonstrated the frequency of each imaging modality among this study, the highest frequency was for conventional x-ray as this modality is more common in most imaging department.

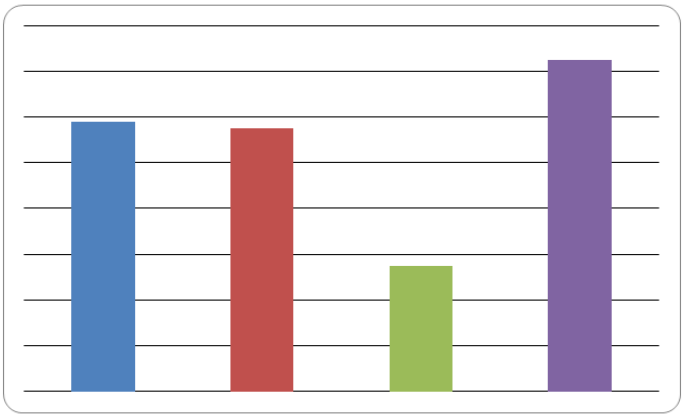

Fig-2: Percentage of correct diagnosis for each modality

Figure 2 shown above demonstrated the percentage of correct imaging reports that matched the radiologist report by 100% and not lied only on the line reports for each imaging modality, the highest correct report was for ultrasound initial reports which represent 97%., and the lowest one was for CT initial report.

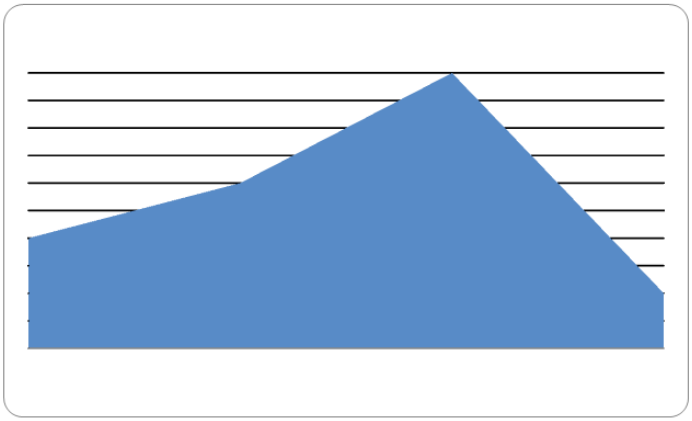

Fig-3: Shown the number of technologist reports, which agree with final report for each imaging modality

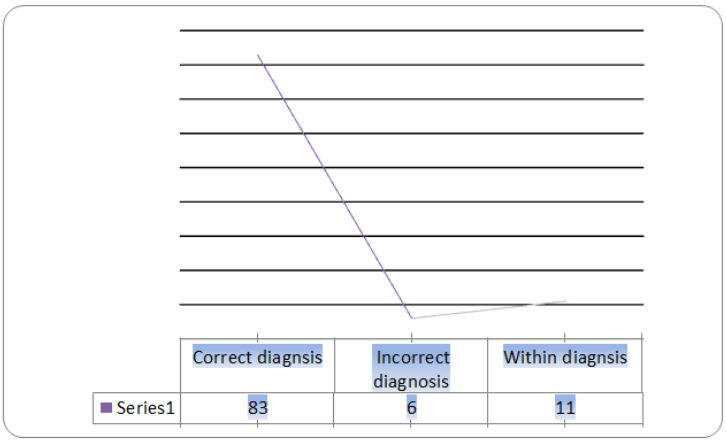

Fig-4: No of correct diagnosis, incorrect diagnosis and diagnose that within the line of final diagnosis

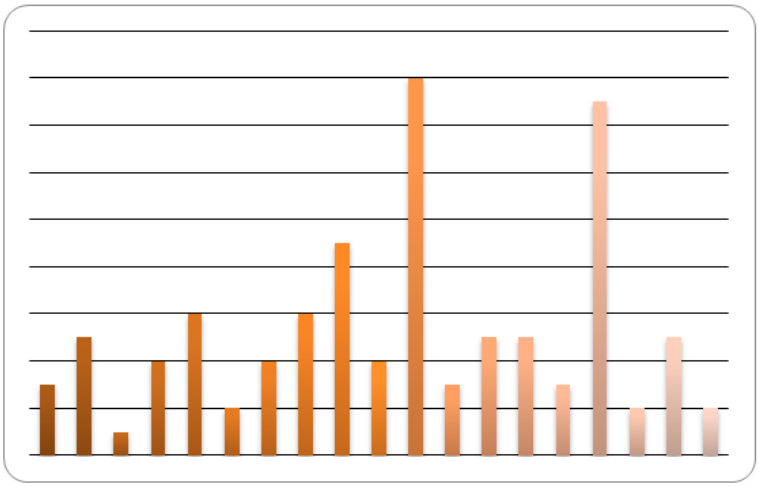

Fig-5: No of each case for different imaging modality

Figure 4 above, shown clearly that failed diagnose was 6% percentage, while correct diagnose was highly 83%.

Figure 4 explained the most exams that diagnosed as diseases case were joint disorder and chest, while the least exam was kidney tumor.

Table-1: Statistical analysis of accuracy, specificity and sensitivity

Imaging modality	frequent	TP	TN	FP	FN	Specificity	Accuracy	sensitivity
Conventional X-ray	31	29	2	1	0	66.6%	96.8%	100%
CT	24	21	3	1	1	75%	92.3%	95.4%
MRI	16	15	1	0	0	100%	100%	100%
U/s	29	28	1	0	0	100%	100%	100%

TP= true positive -TN= true negative – FP=false positive –FN= false negative

DISCUSSION

The current manuscript was performed to measure the ability of radiologic technologist to interpret the image, Figure 1 showed the various imaging modalities performed in intended hospitals, it showed that x-ray images were the most frequent tests during the phase of data collection for this project, and this showed normal distribution, due to that x-ray investigations were the most requested for different cases and do not required specialists or consultant to request it, according to practice in our hospitals as general practitioners can request it, this finding matched the finding of American College of Radiology and Radiological Society of North America (ACRRSNA)[8] that reported conventional x-ray is most commonly referred investigation for most imaging department.

Figure 2: revealed the percentage of correct diagnosis for each modality, the highest percentage was for ultrasound imaging (96%), and this may due to that ultrasound modality is skill dependent, in addition to that The accuracy of the image produced however, relies heavily on the operator, and ultrasound images do not provide the same level of clarity that is produced by some of the advanced diagnostic imaging modalities

such as MRI, CT, or nuclear medicine. Remind also that radiologic technologist has excessive training in ultrasound imaging interpreting, this result matched the report of American Institute of ultrasound in Medicine (AIUM written by Tayal) [9] to guide ultrasound report, they mentioned that the error of ultrasound error report in America is too low around 3%per year.

Figure 3 clearly represented that the highest number of technologist reports that agree with the lines of radiologist report was higher for computed tomography, this may due to computed tomography considered complicated imaging modality in getting true diagnosis, in addition to that when linking this finding with figure two finding , in which the CT was the least correct diagnosis, as the most diagnosis was not completely agree with final report, also this finding disagree for somewhat with Baker GR *et al*. [10], who reports the most common error in diagnostic modalities found on conventional x-ray modality which has relationships among errors in the diagnostic process, delay and misdiagnosis, and adverse patient outcomes.

Table 1 showed statistical analysis of sensitivity, accuracy and specificity, all these values were obtained by calculating TP,TN,FP and FN, and these values were offered by following each imaging reports to referral departments. As example if the reports were clearly agree with what was done by referral department (surgical procedure or any other procedure that build on the image report).MRI and ultrasound were have highest sensitivity, specificity and accuracy compared to CT and conventional x-ray.

CONCLUSION AND RECOMMENDATIONS

Highest percentage of correct diagnosis obtained for ultrasound, MRI, conventional x-ray and CT (96.5, 93.8, 93.2 and 86.8% respectively).

Study limitation was on the limited number of sample, In the future we recommend to adopt the idea of research by the associations working in the field of radiology by expanding samples and also recommend the academic institutions to increase courses that enable the students' radiographers to interpret images.

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