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Evaluation of chest radiographs to determine the knowledge of final year Ghanaian radiography students

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Abstract

Background Radiography students, at some point during their work practices, have to understand reasons for X-ray examinations, and to assess the image quality in terms of normal and abnormal patterns. These practices suggest that radiographers should have a basic knowledge in the evaluation of radiographic images.

Aim: This study sought to answer the research question: Are students knowledgeable in evaluating a chest radiograph?

Method Information concerning chest image evaluation was collected from radiography students by means of a Likert scale questionnaire. Data collected included: knowledge on chest anatomy, chest imaging technique, image contrast, and PACEMAN criteria. The collected data were analysed using Statistical Package for Social Scientists version 21, and presented descriptively.

Results The study revealed that 77% of the respondents were knowledgeable in chest anatomy. A knowledge gap was established in radiographic image contrast and imaging technique. Almost 60% of the respondents were of the opinion there was a need for them to be knowledgeable in radiographic image evaluation.

Conclusion The study identified knowledge gap in radiographic image contrast, image evaluation procedure and technique among student radiographers.

Keywords chest radiography; radiographic images; image quality

Introduction

Radiographic image quality is said to be the exact representation of patients' anatomy on an image, hence, for an image to satisfy diagnostic requirements, it has to meet image quality criteria. This suggests that all images should be specific, accurate and predictive relating to the condition at hand.[1] A study by Coche et al[2] indicated that reading radiographs can be a very difficult and challenging task. It is important to understand readers' limitations and basic anatomy, as well as the need to have a systematic system of scrutiny.[3] According to the Commission of European Community,[4] the aim of a radiology department is to perform the most appropriate examinations of the highest quality, and produce the lowest achievable dose, that result in the correct diagnosis. McEntee[5] proposed that the ability of a radiographic image to answer clinical queries relates to the capability of the image to demonstrate disease and define anatomical structures. These anatomical structures can be used to assess the performance of aspects of radiographic imaging technique, and once the anatomical structures have been specified and the level of visualisation quantified, observers can mark the quality of an image.[5]

Students are not required to refer for radiographic imaging, but they do under certain circumstances.[6] In New Zealand physiotherapists were recognised by the Accident Compensation Commission (ACC) as being able to refer patients for X-ray and ultrasound (US) imaging, as they also do in Australia.[7] However, in Canada it is a delegated act for radiographers to refer patients for radiographic imaging.[8] In Ghana, although radiographers are not legally required to write X-ray referrals, they do assess radiographs requested by referring clinicians, when patients present for radiographic examinations. This implies that radiographers should have a basic knowledge in evaluating the radiographic images of patients who find themselves in their unit. McAdams et al[9] in their study indicated that even when images are subjected to the best technical conditions, they are of little value unless interpreted by an expert reader.

Literature indicates different levels of radiographers' knowledge in image evaluation. In a study by Westbrook and Talbot,[10] only a few radiographers had adequate knowledge regarding image quality. In another study, radiographers were found to have knowledge in image analysis, although the study suggested deeper interpretation with optimisation in their work performance.[11]

This study sought to address the question on whether students were knowledgeable in assessing chest radiographs, and whether they were able to identify any depicted abnormalities. In doing this, a PACEMAN evaluation tool (P-Position, A-Area, C-Collimation, E-Exposure, M-Markers, A-Aesthetics, N-Name) was helpful in assessing the capability of judging the quality of the images. A study by Larsson et al[11] concluded that radiographers needed more reflective actors in the image production process when working. This influenced the use of PACEMAN in this evaluation. Its use was essential in the evaluation as it revealed a knowledge gap among the respondents in terms of assessing chest images in this study. The result of the study could influence policy on the curriculum and the required training needed for radiography students in Ghana. The aim of the study was to motivate students in their learning, and improve their knowledge for implementation upon completion of their programme. The findings should facilitate and improve patient management in Ghana.

Method

A quantitative descriptive survey design was employed in this study as it investigated students' knowledge of evaluating chest images. Data were obtained from responses of 31 final year radiography students of the University of Ghana. They were deemed to have sufficient knowledge of chest images because of their clinical studies. The study site was the imaging department in the Korle-Bu Teaching Hospital, which is the largest teaching hospital in Ghana. A previously validated questionnaire containing closed-ended questions with 5 point Likert scale was used. This questionnaire was in the public domain, and therefore the authors modified and used it for the study. The scale assessed the knowledge of the radiography students in the areas of chest anatomy, image contrast, and chest imaging technique. The respondents had to select whether they agreed, disagreed, or did not know, to establish the level of their knowledge of the posed questions. One author administered the questionnaire from April to May 2016. The completed questionnaires' data were analysed using Statistical Package for Social Sciences (SPSS 21 software, Chicago, IL). Descriptive statistics of frequencies and percentages were calculated.

Approval for the study was obtained from the research ethics committee of a higher education institution. The ethics approval was supported by written permission for the study to be conducted at the study site. All respondents gave written informed consent prior to the commencement of the study. Potential respondents were informed that there were no associated risks with the survey and that withdrawal at any point in the study would not affect them in any way. They were assured of anonymity and the confidentiality of information they voluntarily provided. The study did not involve any experiment or any threat to internal validity.

Results

A total of 31 questionnaires were distributed to all final year radiography students in the University of Ghana. There was a 100% response rate. The age range of the respondents was 20-35 years. Males comprised 51.6% of the respondents. The majority of respondents (58.6%) felt it was not important for students to have knowledge in radiographic image evaluation. The questionnaire covered radiographic image contrast, chest anatomy, image techniques, and PACEMAN image evaluation. The results are presented in Tables 1 to 4.

Discussion

To the best of our knowledge, this study is the first to be conducted to assess the knowledge of final year radiography students on image evaluation of a chest radiograph in Ghana. Radiographic image contrast is very important in assessing image quality. According to Kumar[12] contrast is the general balance in film blackness and details that makes it possible to tell abnormal from normal on an image. From the responses provided in Table 1, it is evident that an overwhelming majority (77.5%) of the respondents did not know much about image contrast. Only 35% agreed that pathologies could affect image contrast. This suggests that only a few would be able to state whether a structure appears different than what is expected. What is known is that organs in the thoracic cage vary in densities ranging from dense bone to very low density air filled lungs. Hence, if insufficient radiation is exposed to the patient, not much will be able to penetrate the patient to reach the image receptor causing the image to appear light. It will lack the range of shades of grey needed for diagnostic purposes.[13] Only 12.9% knew that over-exposure does not make the image look white, and the organs in the thoracic cage vary in densities ranging from dense bone to very low density air filled lungs.

Table 1. Responses to image contrast questions

NO	STATEMENT	AGREED (%)	DISAGREED (%)	DON'T KNOW (%)
1	Image contrast is a film that is overall too black	10 (32.30%)	7 (22.6%)	14 (45.2%)
2	Overexposure makes the image look too white	9 (29%)	4 (12.9%)	18 (58.1%)
3	A very black radiograph is under exposed	10 (32.3%)	6 (19.40%)	15 (48.4%)
4	Contrast is the visual difference of regions on a radiograph	9 (29%)	7 (22.6%)	15 (48.4%)
5	Pathologies cannot affect image contrast	7 (22.6%)	11 (35.5%)	13 (41.9%)
6	Radiographic image quality is a balance in image blackness, detail and contrast	12 (38.7%)	5 (16.1%)	14 (45.2%)

Table 2. Responses to chest anatomy statements

NO	STATEMENT	AGREED (%)	DISAGREED (%)	DON'T KNOW (%)
1	Good inspiration (being able to count just 5 posterior ribs above the diaphragm).	6 (19.4%)	8 (25.8%)	17 (54.8%)
2	The number of ribs that can be counted on a chest radiograph is important.	19 (61.3%)	4 (12.9%)	8 (25.8%)
3	Visualisation of ribs, trachea and carina are important on a chest radiograph	11 (35.5%)	3 (9.7%)	17 (54.8%)
4	It is very important to demonstrate the cardiac shadow and costo-phrenic angles on all radiographs	16 (51.6%)	5 (16.1%)	10 (32.3%)
5	Cutting off the diaphragm and the costo-phrenic angles doesn't obscure any form of pathologies	5 (16.1%)	13 (41.9%)	13 (41.9%)

Table 3. Responses to imaging technique questions

NO	STATEMENT	AGREED (%)	DISAGREED (%)	DON'T KNOW (%)
1	Scatter radiation contributes to the blackness of the final image.	7 (22.6%)	5 (16.1%)	19 (61.3%)
2	Strength of film chemicals does not affect the final appearance of the image.	5 (16.1%)	15 (48.4%)	11 (35.5%)
3	Patient movement during imaging blurs the final radiographic imaging.	17 (54.8%)	5 (16.1%)	9 (29%)
4	Improper patient position could obscure some pathology.	22 (71%)	3 (9.7%)	6 (19.4%)

Table 4. Responses to PACEMAN image evaluation criteria questions

NO	STATEMENT	AGREED (%)	DISAGREED (%)	DON'T KNOW (%)
1	Anatomical side markers are not important on chest radiograph.	6 (19.4%)	7 (54.8%)	8 (25.8%)
2	A chest radiograph can be mounted anyhow to demonstrate abnormalities	10 (32.3%)	12 (38.7%)	9 (54.8%)
3	Rotation is when the medial ends of the clavicles are equidistant from the spines	5 (16.1%)	9 (29%)	17 (54.8%)
4	A chest image may be evaluated without the patient identity stated on it.	4 (12.9%)	13 (41.9%)	14 (45.2%)
5	A chest radiograph should demonstrate the area just above the lung apices to the level of the diaphragm	9 (29%)	8 (25.8%)	13 (41.9%)

Normally, the contents of the thoracic cage must be demonstrated on all chest radiographs. The study showed that the majority of the respondents were correct in agreeing to the statements about chest anatomy (Table 2). With regard to the demonstration of chest anatomy or contents on the radiograph, 61% accepted that this was necessary. In chest radiography, being able to count the number of ribs demonstrated is vital.[14] According to Whitley[15] it is an indication of good inspiration during the examination. A good inspiration will display 5-6 anterior ribs and 8-10 posterior ribs.[16] This demonstrates the entire air filled lungs. As shown in Table 2, 51.6% of the respondents agreed that it is very important to demonstrate the trachea, cardiac shadow, costophrenic angles, and the diaphragm on a chest radiograph.[14] This suggests they were aware that these structures should be inspected on a chest radiograph in order to be able to detect any deviation in both positioning and appearance during their patient management. Since the respondents also agreed on the demonstration of the cardiac shadow, this implies that they will be able to recognise cardiomegaly or the loss of the silhouette sign on a chest radiograph.

Scatter radiation does not carry any patient information; it causes distortion in the sharpness on a resultant image.[15] As shown in Table 3, 16% of the respondents disagreed with the statement, and 61% did not have any idea. This suggests that they were not well informed about the effect of scatter radiations on the appearance of a radiograph. The projection used to obtain a chest image is important especially in assessing cardiac measurements. If a patient undergoes chest radiography for query cardiomegaly, a PA (postero-anterior) projection is preferred to avoid wrong diagnosis[14,17] because the heart appears a bit magnified on an AP (antero-posterior) projection. The majority of respondents (71%) agreed with this statement. The few who disagreed would not be able to detect obscurity resulting from wrong patient position, and this may affect patient management. This is particular relevant if a newly qualified radiographer is posted to work single-handed in a department.

A chest image must include patient identity.[18] Of concern is that 42% of the respondents disagreed with this statement; 46% did not have any idea (Table 4).

Conclusion

The study has identified that the majority of the final year radiography students had very little knowledge in radiographic image contrast, image evaluation procedure and technique. Most did not see the need for them to have knowledge in chest image evaluation. It was also established that the respondents had little knowledge in image evaluation procedure, and were ignorant of the need for the PACEMAN 'rules'.

In view of these findings it is important for policy-makers to review the radiography programme and introduce a course in radiographic image evaluation. The knowledge gap identified could be bridged through an introduction of a course in radiographic image evaluation in the University of Ghana's the radiography programme.

Conflict of interest

The authors declare that there are no conflicts of interest.

Contributions of each author

KAK (University of Ghana) and WKA (University of Ghana) were the main researchers; PLA (University of Ghana) was responsible for data collection; KAK, WKA PLA captured and presented the results; DKM and AD assisted with interpretation of the results. PLA and KAK drafted the manuscript. WKA and DKM provided critical comments and recommendations regarding literature review.

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