Routine Chest Radiograph Interpretation Skills of Medical Officers at an Outpatient Setting

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Abstract

In Malaysia, chest radiograph is a part of compulsory investigations during routine medical examination. Majority of these chest radiographs are interpreted by medical officers at the outpatient clinic. This study was to determine the concordance of chest radiograph interpretations between medical officers and radiologist. Medical officers’ report of routine chest radiographs at the outpatient clinic Hospital Universiti Sains Malaysia over a 6-month period were compared to that of a radiologist. Of 408 chest radiographs reported, the concordance of interpretation between medical officers and radiologist was 93.6% (382 of 408). Medical officers correctly interpret 98.2% (378/385) of normal chest radiograph compared to 17.4% of abnormal chest radiographs (4/23). Therefore, routine chest radiograph interpretations of normal radiographs by medical officers were generally accurate. However, they were weak in interpreting abnormal chest radiographs. Medical officers need to be trained on detecting abnormalities on chest X-ray since most routine chest X-ray reporting is done based on their interpretation.

Key words: Concordance, chest Radiographs, chest X-ray, routine medical examination, X-ray interpretation

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Introduction

In Malaysia, all students are required to do routine medical examination (RME) prior to university enrollment. Chest radiograph is a part of compulsory investigations during RME. Majority of these chest radiographs are interpreted by medical officers at the outpatient clinic. They are given the responsibility to make fitness decision based on their chest radiograph interpretation. The practice is due to a shortage of radiologists in Malaysia especially in the public hospitals as well as the increasing number of student intake each year. Radiologist reporting of their chest radiographs would be time consuming and labour intensive. At the moment, the interpreting skills of chest radiograph by medical officers has not been properly assessed.

The term “medical officers” in Malaysian health care setting means those who have finished their undergraduate training and a one or two-year of “housemanship” training where they are working under supervision of a specialist. However, radiology is not one of the compulsory rotations during this period. The training in radiology of these medical officers relies on their radiology teaching during medical student years and indirectly during their ‘housemanship’ rotations. Following their housemanship year, they are considered as qualified medical officers and can work and make decision independently. There will be no further training unless if they are working in radiology department where radiograph reporting is part of their routine work.

Studies have shown that radiologists perform better in radiograph interpretations compared to non-radiologists\(^{1-3}\). It was also shown that radiology training results in better interpretation of radiographs\(^{3}\). In a primary care setting, primary care physician and residents made low reporting errors of just below 10% \(^{4-6}\). However, it is worth to remember that these primary care physicians have done specialty training. Studies on those without any training are lacking. A study on junior doctors working at an accident and emergency department showed that they have missed 35% of radiographs with abnormalities\(^{7}\). Therefore, this study was done to determine the concordance of chest radiograph interpretations between medical officers and radiologist.

Materials and Methods

A cross sectional study was done at the outpatient clinic Hospital Universiti Sains Malaysia (HUSM). HUSM is a teaching hospital and has its own outpatient clinic. The clinic is mainly run by medical officers. Each year, about one thousand RMEs are performed at the clinic. There are also family physicians working in the clinic. All chest radiographs for RME in HUSM outpatient clinic are reported by medical officers. There will be no repeat review by family physicians or radiologists unless requested. During the study period, there were 12 medical officers working at the clinic. They had various duration of working experience ranging between 2 and 20 years but most of them were junior doctors. None of them had any formal training in radiology post graduation except a radiology conference which is held one hour a month by the clinic. During the radiology conference, a few chest radiographs will be presented to the radiology colleagues for discussion and interpretation.

Instruction was made so that all RMEs were only attended by medical officers. Medical officers reported the chest films in the normal environment using a standard viewing box. They had the advantage of knowing the students’ medical history and physical examination findings and were allowed to review their medical record. Any radiographs which need radiologist or family physician consultation were excluded from the study. A qualified radiologist with eight years working experience in radiology was appointed to report these chest radiographs. The report by the radiologist was considered the “gold standard”. Since the chest films were required to be returned to the students, reporting by radiologist was done using Picture Archiving and Communication System (PACS). PACS is a system where images can be stored and retrieved electronically. The images were viewed in high resolution (2 megapixel) gray scale monitor. The radiologist was not provided with the students’ medical history and physical examination findings. Chest radiographs which were not available in PACS were also excluded from the study as the radiologist was not able to provide the report. The medical officers and the radiologist reported the chest radiographs using a standard reporting form prepared by the researcher. The radiologist reported the chest radiographs at a later date and was blinded from the initial medical officers’ report. Chest radiographs were described as either normal or abnormal. Normal chest radiograph was defined as chest radiograph with no detected radiographic abnormality. Abnormal chest radiograph was when it was reported other than “normal”. If the chest radiographs were abnormal then the final impression should be recorded. Correct interpretation of chest radiographs by medical officers was defined as when their reports noted to be the same as the radiologist’s. Concordance was later calculated as the percentage of correctly interpreted chest radiographs.

Data entry and descriptive analysis was done using Statistical Package for Social Sciences version 12.0.1 (SPSS Inc. Chicago, IL, USA).
Results
Four hundred and fourteen chest radiographs were reported by medical officers. None of the 414 chest radiographs needed any radiologist or family physician referral during the consultation. However, six chest radiographs were not available in PACS. Only 408 (99.0%) were included in the analysis. Eleven (2.7%) and 23 (5.6%) chest radiographs were reported as abnormal by medical officers and radiologist respectively. Medical officers had correctly interpreted 382 of 408 chest radiographs which gave concordance of 93.6%. Out of 11 chest radiographs reported to have abnormal findings by medical officers, four findings were in agreement with the radiologist’s report. The percentage of medical officers correctly interpreted the normal chest radiographs were higher compared to that of abnormal chest radiographs (98.2% (378/385) vs. 17.4% (4/23)) (Table I).

Table 1. Chest radiographs interpretation by medical officers and radiologist

<table>
<thead>
<tr>
<th></th>
<th>Radiologist’s report</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abnormal</td>
<td>Normal</td>
</tr>
<tr>
<td>Medical officers’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>report</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>378</td>
</tr>
<tr>
<td>Total</td>
<td>23 (5.6%)</td>
<td>385 (94.4%)</td>
</tr>
</tbody>
</table>

Medical officers had wrongly diagnosed 3 cases of scoliosis, 2 cases of tenting of diaphragm and 1 case each of left atrial enlargement and right atrial enlargement. Medical officers had not been able to diagnose any case of hyperinflated lungs, residual bronchopneumonia, interstitial lung changes and tuberculosis (Table II).

Table 2. Summary of comparison between chest radiograph findings by medical officers and radiologist

<table>
<thead>
<tr>
<th>Chest radiograph findings*</th>
<th>Number diagnosed by radiologist</th>
<th>Number diagnosed by medical officers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>True +ve</td>
</tr>
<tr>
<td>Scoliosis</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Hyperinflated lungs</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Bronchopneumonia</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Cardiomegaly</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Interstitial lung changes</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Tenting of diaphragm</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Pulmonary tuberculosis</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Fracture clavicle</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Left atrial enlargement</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Right atrial enlargement</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Discussion
In medical practice, interpretation of any investigation is usually guided by history and physical examination findings. In this study where the population was mostly healthy asymptomatic individuals, the assumption of normality was high. This is reflected by the low percentage of abnormal radiographs. The radiologist had agreed on four of 11 abnormal and 378 of 385 normal radiological findings made by medical officers. This gives high concordance of 93.6%. However, this high value was probably influenced by the high number of normal chest radiographs. Primary care doctors have been shown to be better in interpreting normal radiographs that the abnormal ones [6]. In this study, medical officers had missed 19 chest
radiographs with abnormal findings as well as wrongly interpret seven normal chest radiographs. Eighteen of these abnormal chest radiographs would not have led to any major health implication on the students as all of them were asymptomatic for the respective problems. However, the implication of missing one case suspicious of pulmonary tuberculosis would affect the student’s health and people around the student. Medical officers seemed to have missed all the abnormalities involving the lungs which were hyperinflated lungs, bronchopneumonia, pulmonary tuberculosis, and interstitial lung changes. It showed that medical officers were weak in interpreting lesion involving the lung parenchyma.

One study showed that the sensitivity of radiologists in interpreting chest radiographs was considerably greater than that of family practitioners (89% vs. 80%).8 Interestingly, the study also showed radiologists were better than family practitioner in diagnosing lung lesions including one missed case of active tuberculosis. In the same study, family practitioners were shown to be able to easily recognize cardiomegaly. In contrast, this study revealed that medical officers had missed 3 of 4 cases of cardiomegaly on chest radiograph. One case of cardiomegaly identified by medical officer on chest radiograph was probably guided by a history of being a known case of congenital heart disease. As it is known, RME is done in the outpatient setting where the number of patients is large and duration of consultation is limited by time. Another factor is that during RME, there is a tendency for these students to not reveal their symptoms because of fear of being unfit for enrollment. It is possible that these factors lead to doctors overlooking chest films especially in patients who are expected to be healthy. However, one study had shown that among radiologists, reporting speed did not have an effect on accuracy of radiographs interpretation [9].

There are a few weaknesses in this study. It is obvious that the selection of the chest radiographs was from healthy individuals who were mainly asymptomatic. This has lead to a high proportion of normal chest radiographs. It is probably better if we had used a selection of abnormal chest radiographs to truly assess medical officers’ capability to interpret chest radiographs. However, we thought that for them to be able to detect abnormalities, they have to be able to recognize what is normal. It was shown by seven normal chest radiographs which were misinterpreted as abnormal. We also used a report by a single radiologist as a “gold standard”. It would be better if the report was from a consensus opinion from a few radiologists although interpretation by different radiologists may also vary [10]. However, in our setting, we thought that it was not practical to do so. Interpretation by the radiologist by using PACS might have influenced the quality of reporting as it was shown that the system improves interpreting performance.11 It this study, we also did not look into the background training and working experience in each medical officer as we did not intend to assess them individually. Despite that, one study showed that interpretive skills were not influenced by level of training and experience [2,7].

Conclusion
As a conclusion, this study showed a high concordance between medical officers and radiologist in routine chest radiograph interpretations. However, medical officers were weak in interpreting abnormal chest radiographs especially findings involving to the lungs. This is especially obvious when a case as important and common as pulmonary tuberculosis was missed. The lesson from this study is that although these enrolling university students are expected to be healthy, accidental findings are always possible. However, referring all routine chest radiographs to radiologists is probably unnecessary as the majority of the radiographs are normal. It was also found that there was little added benefit in referring all radiographs to radiologists especially when the initial doctor is confident with his/her findings.12 Despite that, since at the moment we have to rely on medical officers to interpret chest radiographs for RME, interpretation errors should be minimized. This is especially when the findings are of clinical importance.

Our recommendation is that medical officers should be encouraged to discuss any case with the family physician or radiologist if they are in doubt. They should receive more proper and frequent training in radiograph interpretation. The training can be either formal or informal. This is because radiographs are one of the commonest radiological investigations ordered in the outpatient setting.

Acknowledgement
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References

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