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ORIGINAL ARTICLE

Accuracy of chest radiograph interpretation by emergency physicians

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Abstract Chest radiographs are one of the most complex imaging modalities to interpret. The objective of this study was to assess how accurately emergency physicians interpreted chest radiographs in relation to radiologist reports. Radiological descriptions of chest radiographs from 667 emergency department (ED) patients, aged 14 to 84 years, were retrospectively reviewed. The overall level of agreement and agreement for different categories (congestive heart failure, pneumonia, and other) were assessed in 312 cases for which reports were available. Statistical analysis was done using the chi-square test, and interobserver agreement was calculated. The proportion of agreement between emergency physician and radiologist reports for normal, congestive heart failure, and pneumonia cases was 84.3%, 41.4%, and 41.4%, respectively. Emergency department physicians frequently missed specific radiographic abnormalities, and there was considerable discrepancy between their interpretations and those of trained radiologists. The agreement for some diagnostic categories such as pneumonia and congestive heart failure was low. This study's findings emphasize the need for improving interpretive skills among ED physicians.

Keywords Emergency department · Radiologist · Chest radiographs

Introduction

In the health care delivery system, the field of diagnostic radiology has grown quickly since the discovery of X-rays in 1895 [1], and the use of radiological investigations is increasing 5–10% per year universally [2–4]. Emergency departments (EDs) and their importance as a patient care service are growing at all health care facilities. Patients seen in the ED often undergo radiological examinations for evaluation of their medical and surgical conditions. Radiographic examinations frequently contribute important information to the medical decision-making process in the ED. The treating physician in the ED does not always have the time or the opportunity to consult an on-call radiologist and therefore has to rely on personal experience and basic skills. Radiographs are often initially interpreted by an emergency medicine physician, and decisions are made on the basis of this interpretation. The means and merits of selecting patients for radiography in accident and other ED cases and the radiological skills of emergency medicine physicians and radiologists have been studied recently. Discordance of radiograph interpretation in EDs with the evaluations by radiologists is commonly reported in different studies as ranging from 0.3% to 17% [5–8], with one study reporting up to 58% discordance by primary care physicians. The current study was carried out with the objective of quantifying the accuracy of chest radiograph interpretation by emergency medicine physicians in relation to interpretation by radiologists.

Materials and methods

The chest radiographs of 667 patients from a 2-month period were retrospectively collected. The study population consisted of patients aged 14 years and older treated in the ED during June and July 2001 at an 800-bed Canadian university teaching hospital. I retrieved and reviewed patients' medical records from the ED and extrapolated clinical and demographic details into a database including

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age, sex, diagnosis, disposition, resident versus consultant, ED radiology report, radiologist report, and code and revisit to the ED within a 1-week period if discharged from the ED following a chest radiograph. The chief complaints recorded for all patients were grouped into five major categories: chest pain, shortness of breath, trauma, neurological manifestation, and other. I also grouped the final diagnosis for each patient into one of five categories: cardiac, respiratory, soft tissue injury (STI) and chest pain not yet diagnosed (CPNYD), other, and no diagnosis. The emergency reports were also grouped into five categories—normal, nil acute, congestive heart failure, pneumonia infiltrate, and other—and I examined the differences between resident and consultant reports. The same groupings were made for the radiology reports, and I also recorded how radiologists coded the films: "A" represented agree, meaning that the main radiologist agreed with the emergency physician interpretation; "N" stood for no report being done by an emergency physician; and "D" stood for disagreement between the radiologist's and the emergency physicians' interpretations. In addition to these records, I looked at the disposition of all patients.

Data analysis

The data were entered in MS Excel and analyzed using SPSS Pc version 16.0 statistical software. Descriptive statistics (mean, standard deviation, and proportion) were used to describe the study variables. The accuracy of emergency physician reports was compared with the radiologist's interpretations. Differences in proportions were assessed using the chi-square test, and interobserver agreement was also tested by kappa coefficient. For all statistical analysis, a two-tailed p value of 0.05 was considered statistically significant.

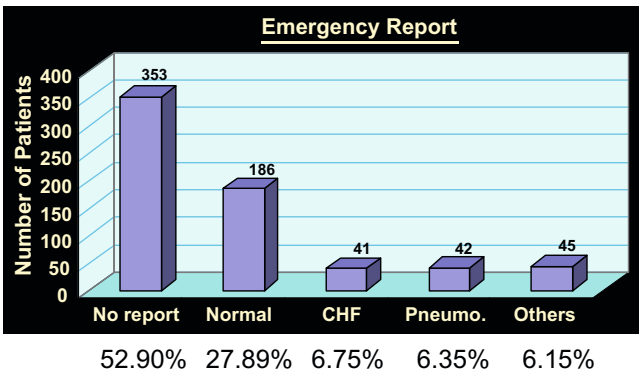

Fig. 1 Distribution of emergency physician interpretations of 667 chest radiographs. *CHF* congestive heart failure; *Pneumo* pneumonia

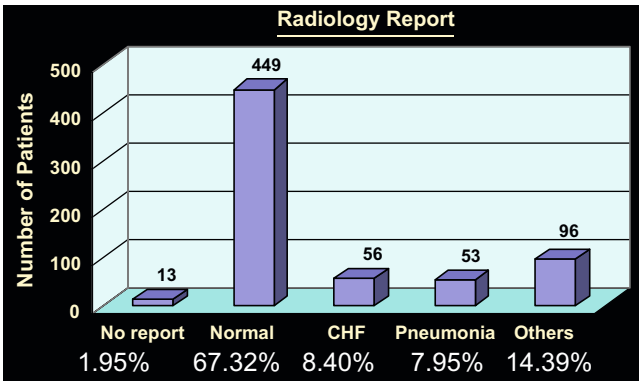

Fig. 2 Distribution of radiologist interpretations of 667 chest radiographs. *CHF* congestive heart failure

Results

Of 667 patients, 50.2% were male and 49.8% were female, and their ages ranged between 14 and 84 years (mean±SD 61.8±10.6 years). The most frequent complaints were chest pain (31.5%), shortness of breath (20.2%), trauma and musculoskeletal injury (15.4%), neurological symptoms (12.3%), and other (cardiac arrest, abdominal pain, fever, hypoxia, etc.; 20.5%). Diagnoses that frequently required chest radiographs were cardiac (26.1%), respiratory (16.0%), STI and CPNYD (20.5%), other (cardiac arrest, cerebral vascular accident, and surgical conditions) in 32.4%, and no diagnosis in 5%. The distribution of disposition of 667 patients from the ED were discharged (411; 61.6%) or admitted (253; 37.9%); three patients (0.4%) died.

Assessment of radiographs

The distribution of assessment of 667 radiographs by emergency physicians and radiologists is given in Figs. 1 and 2.

Table 1 Agreement between ED and radiology reports

ED	Radiology				Total
	Normal (nil acute)	CHF	Pneumonia + infiltrate	Other	
Normal	156	5	5	19	186
CHF	14	17	2	8	41
Pneumonia + infiltrate	14	5	17	5	42
Others	22	4	3	16	45
Total	206	31	27	48	312

After excluding 353 and two cases that lacked ED and radiology reports, respectively, the remaining 312 cases were assessed in relation to the radiologist's report (Table 1).

A statistically significant association exists between the distribution of categories in the ED reports and those of radiology (χ^2=150.25, p<0.0001). The proportions of ED and radiology reports were similar in 206 cases (66%) for all four categories. For each classification, the ED reports were similar to those of radiology in 84.3% of normal cases, 41.4% of congestive heart failure cases, 41.4% of pneumonia cases, and 35.5% of other cases. Additionally, kappa=0.395 (p<0.0001) indicated that the relationship between emergency physician and radiologist reports was statistically significant. Of the remaining 106 (34%) cases with conflicting diagnoses, 68 (64.1%) patients were discharged and 38 (35.9%) were admitted.

Discussion

The overall increased use of X-ray examination by EDs over the past 10 years has stemmed not only from refinement of emergency medicine but also from the increasing workloads in radiology departments [9–13]. Attempts to rationalize referral habits and to develop systems for selective yet safe X-ray reporting have been compounded by other factors, including the changing expectations of patients and the threat of litigation. There is no consensus of opinion at present on selecting patients for radiography or on selective reporting by radiologists. Chest radiography is a very commonly used investigation but detailed interpretation of the resultant film is relatively complicated. It has been reported that the chest radiograph is the most common radiograph to be misinterpreted by observers, especially in EDs [5–8].

The results of this study reveal emergency physicians' practices regarding chest X-ray interpretation and their accuracy in relation to radiologist interpretations. The results indicate that 66% of emergency reports were in agreement with those of radiologists. Numerous studies have examined the interobserver reliability of radiographic interpretation in the ED. Each study was designed in a different manner thus making standardization difficult [5, 6, 8, 14]. This study shows a higher proportion of disagreement (34%) between ED physicians and radiologists. This could be due to ED physicians being less meticulous in interpreting or recording findings. Also, due to the methods used, the radiology report did not represent a consensus of opinion since different radiologists instead of one expert chest radiologist made the final interpretation of the radiographs. In our hospital, as in other teaching hospitals, the chest radiographs are read by various general radiologists, a practice that precludes comparison with other studies. In the current study, the emergency physicians agreed with the senior radiologist in only 41.4% cases of congestive heart failure and 41.4% of pneumonia cases; however, there was agreement in 84.3% of normal cases. Campbell et al. [15] found that only 45.3% of emergency physician diagnoses of pneumonia were in agreement with radiologist report of pneumonia. A study that assessed the accuracy of X-ray film interpretation by nonradiologist physicians revealed a significant need of training in diagnostic radiology for hospital and primary health care physicians [16]. This study indicated that radiograph evaluation entails subjectivity, variability, and uncertainty when performed not only by physicians and emergency medicine physicians but also by experienced chest radiologists.

In conclusion, the different ways to improve ED physicians' knowledge and skills for proper interpretation are (1) by teaching radiology as part of their residency, (2) by organizing periodical radiology training programs, and (3) by including radiology in continuing medical educational programs. Additionally, cooperation between emergency physicians and radiologists as well as an efficient callback system when abnormalities are found are essential. Finally, periodical institution-based guidelines need to be established for emergency physicians to follow for classifying and assessing radiographs in order to reduce the disagreement with radiologists.

References

1. IAEA/WHO Expert Committee (1972) The medical uses of ionizing radiation and radioisotopes. WHO Technical Report Series 492. WHO, Geneva
2. Evans KT (1977) The radiologist's dilemma. Br J Radiol 50:299–301
3. Clinical audit in diagnostic radiology (Editorial). BMJ 2 (6085):479–480
4. Hall FM (1976) Over utilization of radiological examinations. Radiology 120:443–448
5. Brunswick JE, Ilkhanipour K, Seaberg D et al (1996) Radiographic interpretation in the emergency room. Am J Emerg Med 14:346–348. doi:10.1016/S0735-6757(96)90045-5
6. Mayhue FE, Rust DD, Aldag JC et al (1989) Accuracy of interpretation of emergency department radiographs: effect of confidence levels. Ann Emerg Med 18:826–830. doi:10.1016/S0196-0644(89)80205-7
7. Preston CA, Marr JJ, Amaraneni KK et al (1998) Reduction of "callbacks" to the ED due to discrepancies in plain radiograph interpretation. Am J Emerg Med 16:160–162. doi:10.1016/S0735-6757(98)90036-5
8. Espinosa JA, Nalan TW (2000) Reducing errors made by emergency physicians in interpreting radiographs: longitudinal study. BMJ 320:737–740. doi:10.1136/bmj.320.7237.737
9. de Lacey GJ (1976) Clinical and economic aspects of the use of X-rays in the accident and emergency department. Proc R Soc Med 69(10):758–759

10. de Lacey GJ, Barker A, Wignall BK, Reddy JR, Harper J (1979) Reasons for requesting radiographs in an accident department. BMJ 1:1595–1597
11. de Lacey GJ, Brabdbrook S (1979) Rationalizing requests for X-ray examinations of acute ankle injuries. BMJ 1:1597–1598
12. Brand DA, Frazier WH, Kohlhepp WC et al (1982) A protocol for selecting patients with injured extremities who need X-rays. N Engl J Med 306:333–339
13. Raison JCA (1976) Medical and legal aspects of the increasing demand for diagnostic radiology. Proc R Soc Med 69:755–756
14. Lufkin KC, Smith SW, Matticks CA et al (1998) Radiologist's review of radiographs interpreted confidently by emergency physicians infrequently leads to changes in patient management. Ann Emerg Med 31:202–207. doi:10.1016/S0196-0644(98)70307-5
15. Campbell SG, Murray DD, Hawass A et al (2005) Agreement between emergency physician diagnosis and radiologist reports in patients discharged from an emergency department with community-acquired pneumonia. Emerg Radiol 11:242–246. doi:10.1007/s10140-005-0413-4
16. Basulaiman MO, Elzubier AG (1996) X-ray film interpretation by hospital outpatient departments and primary health care center physicians in Dammam, Saudi Arabia. Ann Saudi Med 16:629–632