Impact of Clinical History on Film Interpretation

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We performed a study to determine whether clinical history gives a positive or negative influence on X-ray film interpretation. One hundred and nine patient's radiograms, consisting of 55 normal and 54 abnormal cases (136 abnormalities), were interpreted twice by three pairs of residents in radiology and a pair of qualified radiologists, without clinical history first and with clinical history next. The interpreters recorded diagnosis and confidence level of normal or abnormal findings on a six-point scale. Analysis of receiver operating characteristic (ROC) curves showed that knowledge of clinical history improved diagnostic accuracy. Residents, especially beginners, should be advised to obtain clinical history whenever they read radiograms.

Key Words: Diagnostic radiology, radiology and radiologist, observer performance, ROC curves, film interpretation

During the interpretation of radiograms, clinical history or impression given by the referring physician could possibly establish preconceptions about the nature and location of suspected abnormalities. Concerning the influence of preconception on a reader's ability of correct interpretation, three different opinions exist. First, is the view that the availability of clinical history influences in a positive way and helps to increase diagnostic accuracy (Schreiber 1963; Potchen et al. 1979; Berbaum et al. 1986; Berbaum et al. 1988). Second is that the availability of clinical history may increase false positive diagnosis (Eldevik et al. 1982; Swensson et al. 1985). Third is that knowledge of clinical history does not affect the accuracy of interpretation (Good et al. 1990). Such controversies seem to

have resulted from different study models adopted by different researchers. Film interpretations are affected by many unknown external sources, and interpreters themselves may differ in their clinical experience, radiological knowledge, and in their tendency to interpret. The degree of difficulty of radiograms may also affect the interpretation.

The purpose of our study was to determine whether the clinical history gives a positive or negative influence on X-ray film interpretation in general radiological reading practice.

MATERIALS AND METHODS

Case sample

One hundred and nine subjects including 55 normal and 54 abnormal cases were selected from patients undergoing various chest, abdomen and bone radiographies either with or without contrast media. Of the 54 abnormal cases, 38 had single, nine had two, four had three, two had four, and one had five abnormalities. The total abnormalities were 136 in 54 cases. The abnormalities consisted of multiple diseases which could commonly encountered in general radiological reading practice and could be

Table 1. Abnormal cases

Chest	pneumonia, tuberculosis, metastasis of malignancy, pneumothorax, pleural effusion, heart disease, at-electasis
Abdomen	gallstone, urinary tract stone, ascites, pneumoperitoneum, liver cirrhosis with splenomegaly, intussus-ception, peptic ulcer, intestinal tumor, esophageal varix, renal cyst
Bone	fracture, tumor

diagnosed with conventional radiographic examinations (Table 1).

Cases were collected retrospectively and their X-ray findings were confirmed by a combination of clinical, laboratory, surgical findings and other diagnostic imaging studies, including computed tomography, angiography and ultrasonography. Clinical histories were obtained from either a physician's radiological request paper or a patient's chart. However, definite diagnostic information such as "proven lung cancer", "confirmed rib fractures" and "admission for lithotripsy treatment of renal stone" was modified lest it influence the film interpretation. Two board-certified radiologists who worked as general radiologists for five and eleven years sampled the cases and did not participate in the subsequent film interpretation.

X-ray film interpretation

All radiograms were read by 8 interpreters. They consisted of 4 group; 2 first-, 2 second-, and 2 third-year residents and 2 board-certified radiologists. Each interpreter independently read the films twice, without history first and then with history later. The interval between the first and the second reading was approximately 1 month. The first year residents were in 5 months' training. The two board-certified radiologists were general radiologists with 5 and 6 years' experience, respectively. The interpreters were asked to describe the diagnosis and also rate their confidence level on an ordinal scale ($+3=$almost definitely abnormal, $+2=$probably abnormal, $+1=$suspiciously abnormal, $-1=$possibly normal, $-2=$probably normal, $-3=$almost definitely normal). Films were presented in random order and the time required for reading was not restricted.

Analysis of data

Observer performance was measured by an area (Az) under ROC curve which was obtained by

means of the maximum-likelihood curve-fitting algorithm for rating data. A computer program RSCORE-J (9) was used. One-way analysis of variance (ANOVA) and a test of contrast were used to compare the performance difference of three resident groups and board-certified radiologist group. A paired t-test was used to compare the observer performance witout and with history.

RESULTS

The observer performance of each interpreter was presented in Table 2. For all interpreters the mean areas under the ROC curves without and with history were 0.75 ± 0.12 and 0.84 ± 0.08, respectively, and the difference is statistically significant ($P<0.02$, Paired t-test).

The performances of the four paired groups are summarized in Table 3. Pooled ROC points and curves without history (1a) and with history (1b) are presented in Figure 1. In the group without history, one-way ANOVA shows statistically significant difference among 4 pairs of interpreters at $P=0.08$ level. Since only 4 pairs of Az values were compared, a significance level of 0.10 is adopted. In the group with history, no significant difference among the 4 pairs of interpreters ($P=0.33$ ANOVA) is shown. All first-year, second-year and third-year residents showed improvements in interpretation with clinical history, but staff radiologists showed a little improvement with clinical history (ANOVA, contrast, $P=0.03$).

DISCUSSION

The results of our study suggest that the knowledge of clinical history improves diagnostic accuracy for interpreters of various levels of knowledge

Table 2. Individual data of areas (Az) under ROC curves for film interpretation

| Interpreter	Area under ROC curve		
	History(−) (A)	History (+) (B)	Difference (B-A)
1st-year resident (1)	0.47	0.84	+0.37
1st-year resident (2)	0.67	0.76	+0.09
2nd-year resident (1)	0.75	0.90	+0.15
2nd-year resident (2)	0.67	0.73	+0.06
3rd-year resident (1)	0.79	0.87	+0.08
3rd-year resident (2)	0.78	0.88	+0.10
Board-Certified radiologist (1)	0.92	0.95	+0.03
Board-Certified radiologist (2)	0.88	0.91	+0.03
Mean±SD	0.75±0.12[a]	0.84±0.08[a]	

a P<0.02, Paired t-test
ROC = Receiver Operating Characteristic

Table 3. Group data of areas (Az) under ROC curves for film interpretation

Groups of Interpreters	Mean Area under ROC curve (SD)		
	History(−)	History (+)	Total
1st-year resident	0.61 (0.14)	0.77 (0.06)	0.69 (0.13)
2nd-year resident	0.71 (0.05)	0.83 (0.13)	0.77 (0.10)
3rd-year resident	0.76 (0.01)	0.85 (0.01)	0.81 (0.05)
Board-Certified radiologist	0.90 (0.03)	0.92 (0.02)	0.91 (0.03)
P[a]	0.08	0.33	0.03

a ANOVA
ROC = Receiver Operating Characteristic
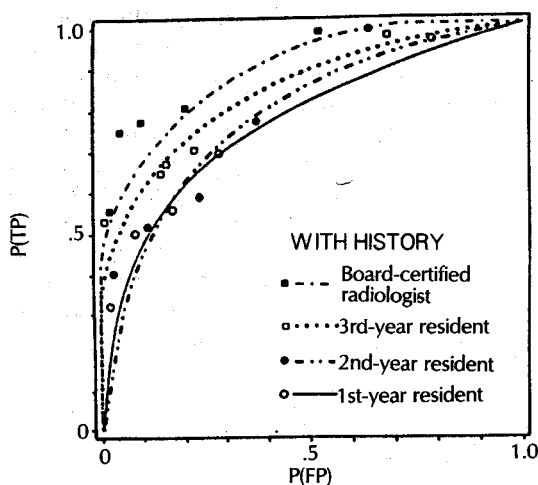
Fig. 1a. Pooled Detection Receiver Operating Characteristic Points and Curves for Film Interpretation without Clinical History in 4 Paried Groups.
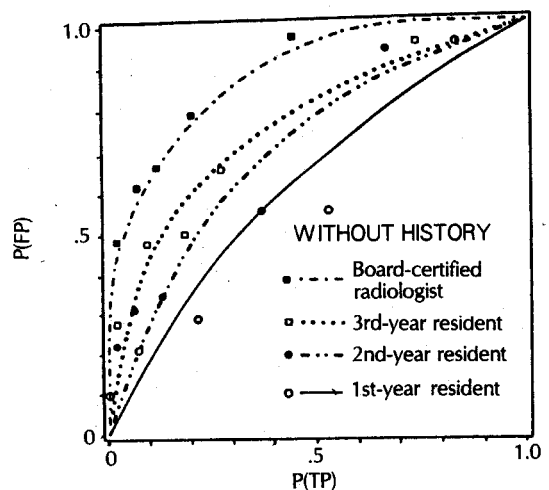
Fig. 1b. Pooled Detection Receiver Operating Characteristic Points and Curves for Film Interpretation with Clinical History in 4 Paried Groups.

and experience in radiology.

Since Schreiber (1963) reported that over-all performance of interpreters is improved by a knowledge of patient's findings, many studies have reported the importance of clinical history as a factor of roentgen interpretation (Potchen et al. 1979; Berbaum et al. 1986; Berbaum et al. 1988). Berbaum et al. (1986, 1988) noticed that appropriate clinical history improves perceptual performance. Doubilet et al. (1981) reported that there is a statistically significant increase of true positive rating in the presence of a suggestive history as compared to non-suggestive history, though there is a concomitant increase of false positives. On the other hand, Eldevik et al. (1982) suggested a tendency of observers to interpret questionable myelographic or computed tomographic findings as positive when they correlate with clinical findings. Swensson et al. (1985) noticed that searching films with specific preconceptions substantially increases false reports of nodules with little improvement in already high true-detection rate. The third opinion implies no gain from knowledge of clinical history. Recently Good et al. (1990) reported that knowledge of clinical history does not affect the accuracy of chest interpretation.

The diverse results of influence of clinical history on film interpretation might be due to 1) different combination of interpreters with various levels of knowledge in radiology and with various characteristics of personal attitude to clinical history, 2) different manner of using history and 3) other factors related to the study method.

Rhea et al. (1979) reported that the first-year residents in the eleventh month of training make a relatively greater number of errors than the second-year residents in twenty-third month of training on the initial interpretation. Our results showed a similar phenomenon that low grade residents made a greater number of errors than those of high grade residents or staff radiologists, when the clinical history was not provided. Although there was a tendency that the diagnostic accuracy improved with increasing experience, the difference among residents is not statistically significant because of large standard deviations in first-year and second-year residents.

There is a statistically significant difference in performance between resident groups and staff radiologist group when clinical history was not provided (ANOVA P=0.08). The first-year residents were inferior to the other interpreters. Although our study had a limitation that a small number of interpreters

participated, there was a gradual improvement of performance from lower to higher rank in film interpretation without history. On the other hand, there is no significant difference in performance among the 4 pairs of interpreters when clinical history was provided. It is strongly suggested that clinical history is definitely beneficial in film interpretation, especially for less experienced interpreters.

It is interesting to note that the improvement of performance was dependent on individuals when clinical history was provided. There were two interpreters (one first-year resident and one second-year resident) who showed dramatic improvement with history. Both of them showed poorer results without history than those of their counterparts, but with history they showed significant improvement in film interpretation, reaching nearly the same level of performance of their counterparts. This may well imply that there are individuals who are greatly influenced by history. Some are easily influenced by the history while others stubbornly keep their initial opinion. Different characteristics of people likely contribute in differing results.

Our study has used the commonly encountered clinical histories of patient's chief complaints and/or the referring physician's impression such as dyspnea, hematuria, hunger pain, trauma history, suspicion on fracture, routine test for physical check, etc. The content and usage of clinical history was quite different among previously published studies. The quantity and quality of clinical history might differently influence an interpreter's preconceptions, which could be one of the reasons why previous studies showed diverse results on the same question.

In conclusion, the results of our study suggest that knowledge of clinical history aids in interpretation, especially for the less experienced interpreters. So residents in radiology should be advised to obtain clinical history whenever they read the film. This does not mean board-certified radiologists no longer need clinical history for a better film interpretation. Bundy (1984) emphasized the legal importance of the medical history for practicing diagnostic radiologists. Clinical history may help interpreters judge more definitely when the radiographic feature alone is ambiguous and more specifically when the radiographic feature is nonspecific.

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