Comparison Between Conventional Radiography and Thoravision in the Study of the Normal Chest

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THE CHEST roentgenogram done with the conventional technique employing the film-screen system shows a few limits proper of the modality, the most evident being a narrow latitude; thus, a correct simultaneous evaluation of the different anatomic components of the chest—presenting wide differences in photon attenuation (7 to 10 times greater in the mediastinum versus the lung)—is often difficult to achieve.

This problem can be probably overcome by the digital system, based on the selenium detector, recently put on the market (Thoravision, Philips Medical Systems, Hamburg, Germany). Briefly, the detector is composed of a thin layer of amorphous selenium on the surface of which, before radiation exposure, a positive even electric charge is applied, subsequently neutralized by the impinging x-photons. The spatial distribution of the charges (corresponding to the latent image) is thus “read” by special probes and directly digitized.¹ Radiolucent detectors located before the selenium layer survey the amount of impinging x-photons, stopping their emission the very moment their intensity reaches the optimal value; this avoids exposure errors.

MATERIALS AND METHODS

One hundred and fifty patients, all over 40 years of age and referred to the University of Verona Department of Radiology with different clinical conditions requiring the performance of a chest roentgenogram, had in the same sitting—after giving their informed consent—two posterior-anterior view chest films. The first film was produced with a conventional system (Siemens x-ray tube; kV and mAs according to the patient body habit—mean values of 100 and 6.4, respectively; 3M Trimax XLA film with “slow” screen—class 100; fixed antiscatter grid with a 12:1 ratio); the second was performed with the previously mentioned digital system (kV: 150; mAs selected by the machine according to the prefixed exposure values—usually 2 and 4, according to the patient body habit; air gap = 15 cm).

With the 300 films thus achieved, two series were defined, each including one of the films—either digital or conventional, randomly chosen—of the 150 studied patients.

The two series of films were analyzed—in different sessions with an interval of a few days and with constant environmental conditions—by three observers with different experience (ranging between 2 and 20 years) in chest radiology. Each observer was asked to evaluate the films and give a score, ranging between 1 and 10, to the quality of representation, on the chest film, of six different anatomic components of the chest (soft

tissues, ribs, vertebrae, peripheral lung fields, retrocardiac region, and hila).

RESULTS

The evaluation of all observers points to a qualitative advantage of the modality with selenium detector versus the conventional system; the difference is statistically significant ($P < 0.001$). The global score given by the three observers to the two series of chest films is summarized in Table 1.

DISCUSSION

The selenium system, compared with the conventional system, has a superior sensitivity to the x-rays; the spatial resolution, although lower, is nevertheless sufficient for the needs of chest radiology. The very wide latitude provides high-quality images with exposure levels between 4 orders of magnitude (between 10^{-5} and 10^{-1} R) versus the 2 orders of magnitude of the conventional detector; this is due to the existing linear relation binding the detector answer to its exposure, unlike the sigmoid curve of the film-screen system. The signal-to-noise ratio is also higher.¹ These physical parameters allow one to foresee more informative images with the Thoravision system than with the conventional technique. This result was in fact presented in a comparison study²; however, it was performed on a limited number of patients and was possibly affected by the conditioning of the observers asked to review “side by side” the couples of chest roentgenograms, the nature of which (digital or conventional) is easy to assess, belonging to each patient.

This study, besides presenting the fair global advantage of the selenium system, also shows a minor range of the scores given by the observers to the different evaluated anatomic components of the chest: this is due to the association between wide detector latitude and automatic exposure control. In

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Table 1. Mean Global Score Provided by the Three Observers to the Quality of the Chest Roentgenograms of 150 Patients, Obtained With the Conventional System and With Thoravision

Observer	Mean Chest Roentgenogram Score	Mean Thoravision Score	Significance
1	4.49	5.32	$P < 0.001$
2	5.02	5.55	$P < 0.001$
3	5.81	6.68	$P < 0.001$

the pool of images obtained with the conventional system, on the contrary, one has to consider a certain amount with suboptimal exposure, the limited diagnostic reliability of which is enhanced by the low latitude. Thus, the digital system, as compared with the conventional system, provides images with greater diagnostic reliability and decreases the costs—related to dosimetry, time, and materials—caused by the necessity to repeat films of unacceptable quality.

Extending the comparison between Thoravision

and the conventional system to the possibility of identifying pathologic images, the superiority of the former modality is confirmed, although it is less significant than in the anatomic evaluation; this is probably due to the greater objectivity of the observers in providing a qualitative score to some certainly existing normal structures than to anomalies possibly not present. The personal data on the comparison between Thoravision and conventional system will be published shortly.

Finally, one has to consider that the preceding results, favorable to Thoravision, may be further improved: the digital images were obtained according to the manufacturer's instructions, which does not correspond to the maximum achievable quality. According to personal data that are now being evaluated, the lowering of the employed kV—thus allowing the best exploitation of the sensitivity of selenium to the x-rays, maximum with middle energies³—and/or the use of the antiscatter grid⁴ may provide images of still higher quality.

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