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PRELIMINARY REPORT ON A NEW MODE OF CT-SCANNING OF THE THORAX

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Abstract—The A.A. advocate a "longitudino–axial" mode of CT-scanning in examinations of the thorax and suggest it as the standard mode in children and adults of small stature. The full development of the method is at present limited by the design of both hardware and software of the current generations of CT-scanners. The rationale behind the new mode is that the images obtained by standard radiography and longitudino–axial scans will be similar and thus more familiar to radiologists and more easily comparable.

CT-scanning "Longitudino–axial" mode Radiography Thorax

INTRODUCTION

Veiga-Pires and Kaiser [4] described a mode of longitudino–axial CT-scanning which they applied mostly in the examination of the spine and abdomen. They also indicated the possibility of its application in the examination of the thorax. McLoud *et al.* [2], among others, assessed the comparative value of standard radiography and CT-scanning in examination of chest pathology and stated that the latter can provide not only incremental but also diagnostic information on the lungs and mediastinum not obtainable by conventional radiographic techniques.

In this study we look into the potential of longitudino–axial scanning in the chest and evaluate the incremental information that could be derived. The clinical situations in which patient management may be influenced by extra data available remain the same as those of conventional thorax CT-scanning.

METHODS

Due to limitations in design of the Delta-50 CT-scanner at our disposal, our method has been restricted so far to the examination of children and adults of small stature. The patient is introduced into the gantry opening feet first in supine and/or lateral decubitus at an angle varying between 20 and 45° to the table. The gantry is then tilted to the maximum angle of 20° cephalad (Fig. 1). At present, in the best of circumstances, the sum of the angles of gantry and patient tilt does not exceed 65° to the horizontal. We therefore fall short of the ideal situation of "complete parallelism" of gantry and patient or total lengthwise "inclusion" of the patient within the gantry opening. The maximum angle of patient inclination in relation to the gantry opening is conditioned by his comfort and his being within the circle of reconstruction.

The largest circle of reconstruction available must be used. Scanning factors are those standard in conventional CT-scanning. Due to the relatively long scanning times of the Delta-50, cooperative patients are instructed, for comfort, to hold their breath in moderately full inspiration. With non-cooperative patients, anaesthesia may be required and the scans done in inspiration and apnoea (for window settings refer to illustrations). With this mode attenuation coefficient readings may be faulty, especially at the levels where the body of the patient touches the circle of reconstruction, but with the design modifications suggested by Veiga-Pires *et al.* [5] these shortcomings can eventually be overcome.

DISCUSSION

It is our contention that if CT-scans of the thorax were to show a close graphic similarity to conventional radiographs they would appear more familiar to radiologists and more easily comparable. Furthermore, they could serve to establish a pattern for use with the hybrid CT-scanners soon

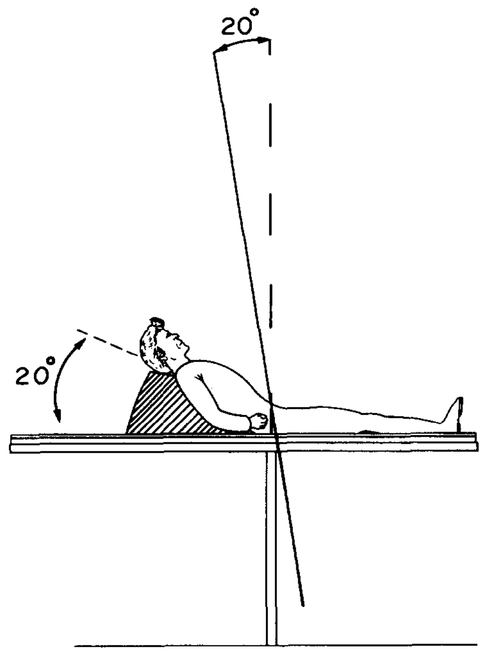

Fig. 1. Diagram showing relative position of patient and gantry in longitudino–axial CT-scanning.

to appear on the market [3] and for use with the expanded selection of scanning modes soon to come from Nuclear Magnetic Resonance (NMR) [1]. The longitudino–axial mode produces "coronal" cuts of the whole thorax (Fig. 2.1) resembling conventional chest films, which, however, offer the possibility of window zooming whenever lung tissue, mediastinal contents, vessels, thoracic cage soft tissues particularly in the axillae and supraclavicular fossae, distal neck and cervico-thoracal spine have to be specifically scrutinized (Figs 2.1–2.8). Theoretically, lateral longitudino–axial scans of the thorax are also possible.

The number of patients examined by us by means of the longitudino–axial mode is limited, but the purpose of this paper is to indicate the possibility of potential incremental information obtainable by this method and to show the graphic comparability between conventional radiography and CT-scans of the chest (Figs 2.6 and 2.7).

In this paper we have neither intended to describe in detail the pathology as seen on the exemplary illustrations of the longitudino–axial mode of CT-scanning of the thorax nor to propose, at this stage, the production of an anatomical atlas of such scans.

We believe that CT-scans of the thorax which graphically resemble standard chest radiographs may be easier to interpret as they correspond more closely to the standard patterns of cumulative information imprinted during the radiologists' conventional training and life experience.

Figures 2.1–2.6 and 3.1 and 3.2 are sample illustrations of the images obtained with longitudino–axial mode scanning.

During investigation for thymoma in a child with a clinical picture suggesting myasthenia gravis we were able to obtain the images illustrated in Figs 2.1–2.6. No evidence of mediastinal tumour was elicited. In Fig. 2.1 the upper reaches of the thorax are well shown together with the root of the neck, the soft tissues of the shoulders and axillae, a cross section of centrally placed trachea, body of D1, segments of the clavicles, the posterior mediastinum, the region of the upper lobes of the lungs and segmental lengths of the upper ribs. In Fig. 2.2 a more complete picture emerges where supraclavicular fossae and axillae, clavicles and both first ribs are outlined in great extension as well as mediastinum and lungfields. Longitudinal segments of ribs are also shown and the lung pattern can be elicited. At different window settings (Fig. 2.3) the lung pattern is observed, but the soft tissues, ribs and distal end of the sternum are brought to the fore. Figures 2.4 and 2.5 show variations in window settings, on a more posterior plane than those in the previous illustrations, picturing the thoracic cage and soft tissues as well as mediastinal contents and lung vascular pattern.

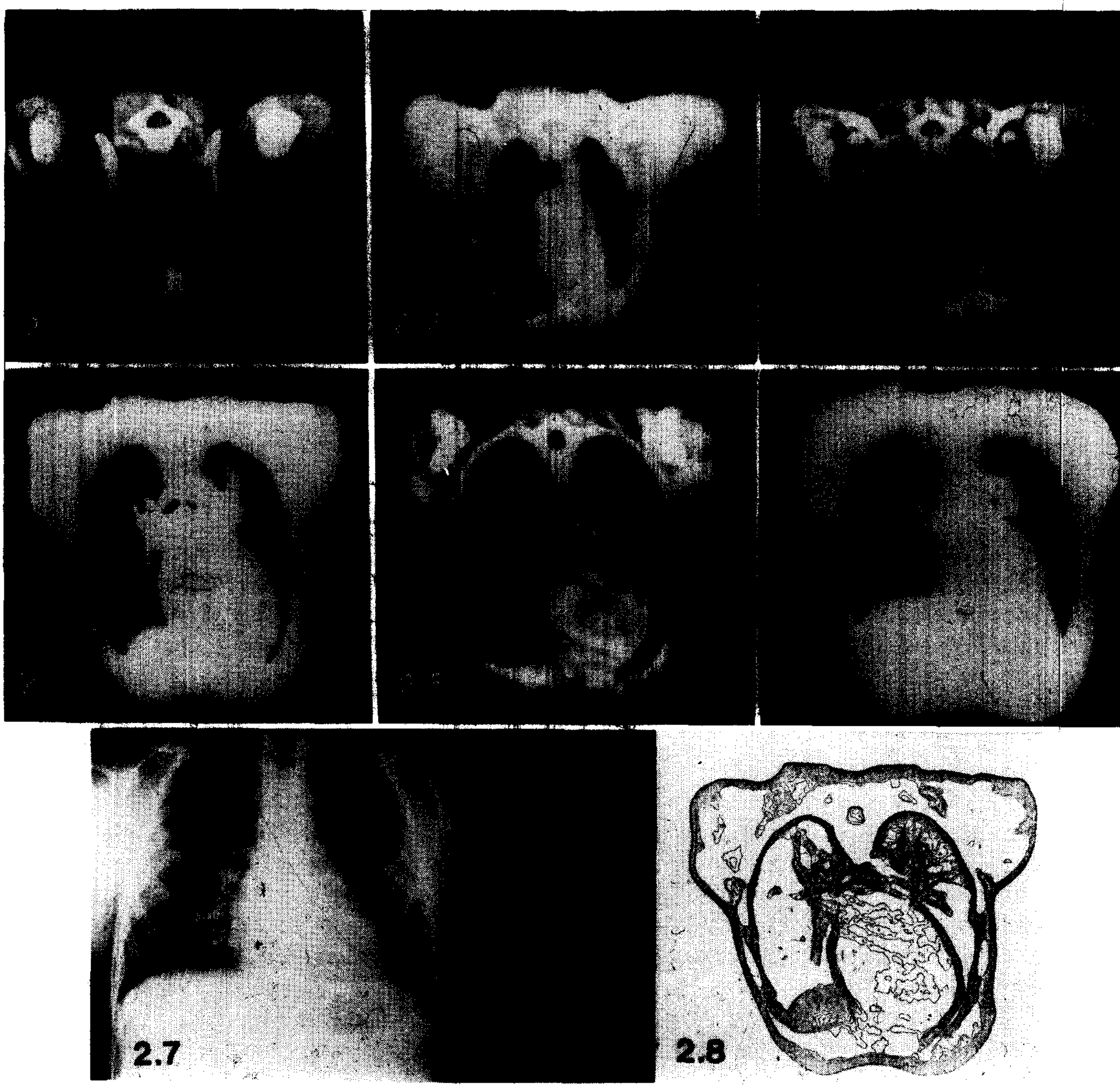

Fig. 2. Thoracic longitudino–axial cuts in child. Fig. 2.1 structures of upper thorax illustrated. Good demonstration of supraclavicular fossae and axillae, trachea, posterior mediastinum and upper lobes of lungs. Fig. 2.2 and Fig. 2.3 a more anterior plan is shown at different window settings. W.L. – 190 and W.W. 1363 and W.L. 39 and W.W. 340 respectively. Lungs, mediastinum and thoracic cage shown extensively. Figs 2.4 and 2.5 show a more posterior plan than Figs 2.1 and 2.2 at window settings W.L. – 567 and W.W. 438 and W.L. 44 W.W. 322 respectively. Thoracic cage, soft tissues, mediastinum and lung vascular pattern demonstrated. Note decubitus hypostasis in upper lobes in Fig. 2.4. Figs 2.6 and 2.7: longitudino–axial scan and conventional radiograph child's thorax respectively, set side by side for comparison. Fig. 2.8 print out of Fig. 2.6 individualizing the major thoracic structures and underlining anterior upper abdominal wall.

In Fig. 2.4 the vascular pattern of the lungs is outlined and decubitus hypostasis in the upper lobes clearly enhanced. (This particular patient was examined in supine position, head down.) The carina and main pulmonary arteries stand out prominently. In the region of the right mid lobe there is an area of poor vascularization which at the time of the examination was not fully evaluated and may represent a temporary vascular shunting. Figure 2.6 is a "good chest radiograph" that can be compared with the conventional chest X-ray of the child in Fig. 2.7. Figure 2.8 represents a print out of Fig. 2.6 with pulmonary arteries, cardiac outline, right diaphragmatic dome and anterior upper abdominal wall well individualized.

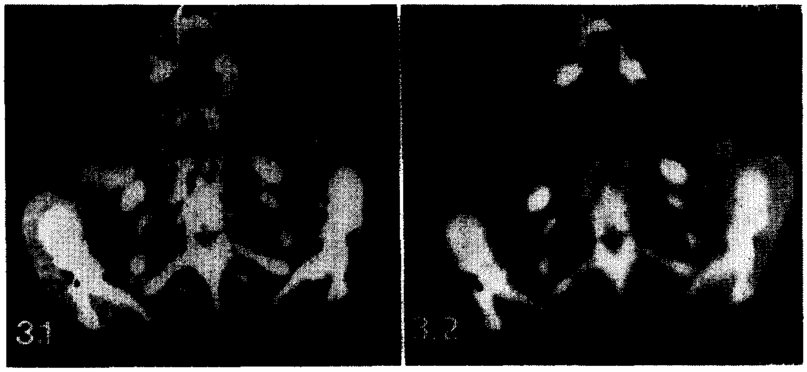

Fig. 3. Longitudino–axial cuts of upper thoracal region in adult. Fig. 3.1 neck structures and apical regions of thorax demonstrated. Fig. 3.2 same image at higher window settings and smoothing. W.L. 355 and W.W. 1117. Note shoulder joints.

Figures 3.1 and 3.2 shows the longitudino–axial cuts in the neck and upper thoracal region in a patient referred for evaluation of an extension of a carcinoma of the oesophagus. Because of their novel appearance and just to show the potential of the method we selected only these two pictures out of this case's series of scans. The remainder of the cuts throughout the thorax and upper abdomen showing the length and extension of the oesophageal lesion gave incremental information, in comparison with an earlier barium swallow, as to the extent of involvement of the thoracic aorta and gastric fundus by the process. There was also good correlation with the surgical findings. In Fig. 3.1 some of the neck structures can be well identified, but equally the lung apeces, the structures of the supraclavicular fossae, the shoulder girdles, the first thoracal vertebrae and ribs are demonstrated with advantage. No adenopathies were identified in the supraclavicular fossae. Figure 3.2 is the same as Fig. 3.1 at higher window settings and with smoothing. Noteworthy here are the well delineated shoulder joints and scapulae.

We believe that these illustrations are sufficiently striking to make our point and demonstrate the potential of the longitudino–axial mode of CT-scanning in the investigation of the pathology of the thorax and neck.

In our view, if CT-scanners are to remain in the armamentary of medical imaging, they must be redesigned—in parallel with all the other medical hardware and software improvements—to allow more generalized use of direct forms of the longitudino–axial mode and the widest range of reconstruction modes.

CONCLUSION

In our hands longitudino–axial mode of whole-body CT-scanning has proved helpful in the examination of spine and abdomen. We believe that the application of the method to the thorax can be also of advantage in obtaining incremental information in thoracic pathology as against conventional CT-scanning and radiography. Reconstruction modes based on longitudino–axial CT-scanning can, when required, be processed with success equal to that of conventional CT-scanning.

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