Radiol Oncol 1992; 26: 212-7.

The importance of computed and conventional tomography in pulmonary diseases

Šerif Bešlić, Faruk Dalagija, Antun Lovrinčević, M. Ibralić, Z. Merhemić

University Medical Center, The Institute of Radiology and Oncology, Sarajevo, Bosnia and Hercegovina

Eighteen years have passed since the use of the first computed tomography (CT) unit and over 10 years from its use at our Institute. During that period the important technologic improvement of the units occurred as well as an increase in the indications for it suse. During 1991, the authors analysed a group of 34 patients; all had the conventional tomographies (TMG) and CT. Based on the parameters presented in the work, the diagnostic contribution of both methods was analysed, respectivelly. In almost all our cases, CT provided an additional and important information, comparing to the conventional TMG, so, the question of its usefulness has been raised. The aim of the paper was to show the contribution of CT in comparison with the conventional TMG in order to prevent diagnostic misinterpretations and reduce treatment expenses.

Key words: lung diseases-radiography; tomography; tomography, x-ray computed

Introduction

During the last years, conventional tomography (TMG) was exposed to the competition of two new methods of visualization, computed tomography (CT) and magnetic resonance (MR). The principle of the conventional tomography is erasure; some levels in the body are selected for presentation, while the structures at the surrounding levels become practically invisible, with the intentional provocation of the unclearness. The plane of the cross-section is selected individually, depending on pathology.[1, 2, 3] The development of digital techniques in radiology, set them as the imperative. They are based on the principles of manipulation by digital (numerical) data.[3, 4] Information about the absorption of irradiation during its transfer through the object, is presented in the form of analogous information; i. e., an analogous video signal is transformed into digital information, expressed in so-called digital binary numerical system. The transformation of information takes place in analogous-digital (A/d) convertor. The digital information presented numerically, may be computerized, and according to the need, using the D/a conversion, it can be transfered into an analogous information again, usually in video TV signal.[4] Besides the conventional TMG apparature there are modern digital techniques – CT and MR available for the evaluation of thoracic organs at our Institute. CT provides the axial sections of human body in the form

Correspondence to: Šerif Bešlić, M. D., The Institute of Radiology and Oncology, UMC, Moše Pijade 25, 71000 Sarajevo, Bosnia and Hercegovina.

UDC: 616.24-073.756.8

of anatomic images, expressed by different absorptions of x-rays through the tissue. The differentiation of four radiologic densities (air, liquid, solid tissue, bone) is more sensitive in CT.[5] We have modest experience with MR, and a unit of small power – 0.04 T (Tesla). Having all those modern techniques of visualization at the disposal, from the first moment it became clear to us that it is important for the physician to define the algorithm of examinations, which enables the most appropriate diagnostic information, having in mind the comfort of the patient and economic limitations. The development of new radiologic techniques would cause some of them to be abandoned and others reduced. Therefore, the aim of our paper was to confirm our experience about the absolute advantage of CT by the objective parameters, in order to facilitate diagnostic procedure, avoiding TMG whenever possible. Our investigation is preliminary, and it has to be broadened by new cases, especially in the hilar region.

Material and method

During 1991, 34 patients were investigated. They underwent conventional TMG in the first phase, followed by CT. The total of 34 patients underwent both methods. Their mean age was 53 years (12 to 77 years). There were 18 males and 16 females. Besides the disease history, all patients had the conventional radiography for the orientation and planning of examinations.

Tomographies were performed on Siemens tomograph, with the possibility of slice determination from 1 to 10 mm. The most frequent slice thickness was 5 mm, frontal plane, rarely saggital and back oblique, at the angle of 55°. During the examination, the patients were positioned as is according to the plane of section.

CT examinations were performed on Somatom SF and DR "Siemens" units, with slice thickness 4 and 8 mm, at the dorsal decubitus plane and using contrast material. According to the referral diagnoses, the patients were divided into four groups: patients with infiltrative and expansive processes of the lung parenchyma, mediastinal tumors, hilar adenopathies and solitary lung metastases (Table 1). Two radiologists analysed the tomograms independently as well as the corresponding CT scans of the same patient. The following parameters were analysed: the expenses of examination, technical quality of the tomograms and scans, the contribution of the particular technique, densitometrically, in the complex radiologic image, topographically, morphologically, in small and large thoracic lesions (2 and over 5 cm), sensitive diffuse parenchymal lesions, in the analysis of the tumor nature or vascular pseudotumor, in mediastinum, hilar, pleural region, as well as the contribution relating to the associated lesions (Staging), evaluation of operability and aspiration biopsy. The advantage of the particular method was marked by "–" or "+". The mark "+" presented a greater contribution.

Results

Table 1 shows 34 patients with different pathologies. All patients underwent conventional, most frequently frontal TMG and CT scans, and were analysed on the basis of the objective parameters (Table 2). CT was superior in the image quality, which was 69 % in TMG, and 100 % in CT. The contribution of conventional TMG in hilar region, especially in the central hilar obstruction processes was 37.1 % and 100 % in CT. The advantages of CT relating to the TMG in hilar region, in hilar adenopathies have still been evaluated, and the results will be presented later. Relating to other parameters, such as densitometry, analysis of sensitive diffuse parenchymatous lesions, small and large thoracic solid lesions, analysis in the mediastinum and relating to the satellite lesions (axial sections eliminate the superposition), the evaluation of operability, transthoracic aspiration biopsy, CT is advantageous. The only advantage of tomography is in the low cost of the method. All other advantages presented on Table 2, refer radiologist to the use of CT,

Table 1. Distribution of 34 patients according to referral diagnoses.

Infiltrative and expansive processes of lung parenchyma	Hilar adenopathy	Lung metastases	Mediastinal tumors
1. Tu hili sin.	Lymphadenopathia hili dex.	Meta. pulmo sin. (Ca mucinosum tiliae)	Tu gl. thyroideae
2. Infiltratio (Tu.) hili dex.	Sarcoidosis hilo-pulm.	Ca mammae dex.	Tu mediastini
3. Pancoast apicis sin.	Lymphadenitis hili I. dex.	Meta pulm. I. dex.	Teratoca. mediastini
4. Infiltratio lobi sup. p. I. dex.	Sarcoidosis	Neo mammae dex. (Meta pulm.)	Tu mediastini
5. Infiltratio pulm. I. sin.	Adenopathia hili bill.	Meta pulmo. (Seminoma testis)	Tu mediastini
6. Infiltratio pulm. I. sin.	Sarcoidosis	Meta pulmo I. dex.	Tu mediastini (Laryngitis chr.)
7. Infiltratio lobi sup. p. I. dex.	Sy. Lupus erithematodes	Infiltratio rotunda pulm. I. sin.	Tu mediasthini (paratrachealis I. dex.)
8. Infiltratio lobi sup. p. I. dex.	Erythema nodosum		
9. Infiltratio pulm. I. sin.	Lymphadenopathia hili et mediastini		
10. Inflit. pulm. I. dex.			
11. Infiltr. lobi sup. p. I. sin. spec.			
Total 11	9	7	7

which would reduce the time of investigation and the expenses of treatment in the final balance.

Discussion

The recent technological improvement in radiology is indisputable. In this study, we correlated the contribution of conventional TMG and CT, in different chest diseases (Table 1 and 2). Analysing our results and correlating them with the literature data, a great consistency of the results is evident. Central, lobar and segmental bronchi, which are frequently the site of a malignant expansive process, as well as the mediastinum, are better presented by CT[3,6] (Figure 1, 1a). CT is the "window" to the

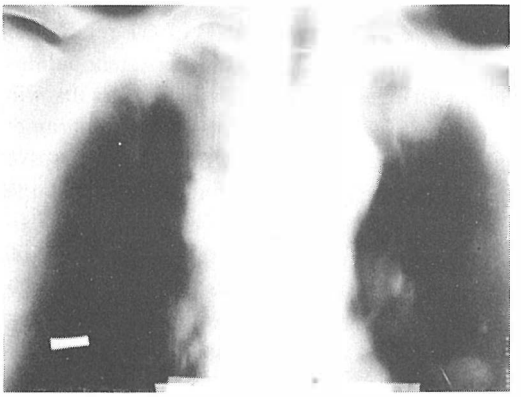

Figure 1. Frontal tomogram: irregular intensive shadowing in the upper pole of the right hilus.

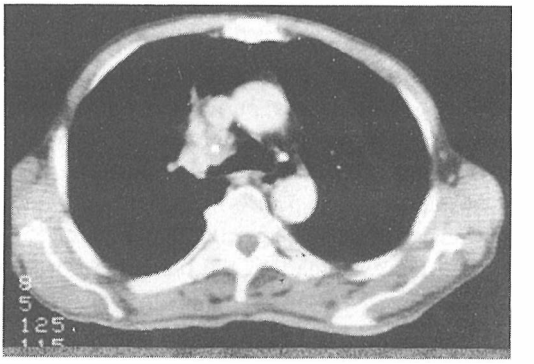

Figure 1a. Transversal CT slice at the level of tracheal bifurcation: clear presentation of the relations of tumorous mass and lumen of the right main bronchus and vena cava superior (Op. P. H. D.: Ca bronchi epiderm).

Table 2. Comparison of the possibilities of diagnostic techniques.

Possibilities	Conventional TMG	CT	MR
1. Principle of the activity	x-ray irradiation by the erasure	x-ray irradiation, slices	Magnetic field power + radio-waves + slices
2. Slice thickness	1 – 10 mm	2 to 8 mm	5; 7; 10 mm
3. Section plane	individually	Axial	individually
4. Complete thorax	–	+	+
5. Exposition time	0.5 – 6 sec.	2 – 5 sec.	10 sec. min sequences with more slices
6. Manipulations	Radiographer	Digital data	Digital data
7. Ionizating irradiation	++	+	–
8. Expenses	+/++	++	+++
9. Technical quality of the image	69 % +	100 % +	
10. The capacity of differentiation of two zones in density (densitometry) (air-solid; fat-liquid; calcium)	–	+	Natural contrast
11. Unexplained x-ray image	–	+	
12. Topographic presentation	–	+	
13. Morphologic presentation	–	+	
14. Small thoracic lesions (nodus, infiltration, enlightment)	–	+	
15. Large thoracic lesions	–	+	
16. Subtle diffuse parenchymatous lesions (interstitial syndrome)	–	+	Lack of protons
17. The nature of tumor or vascular pseudotumor (contrast material-bolus)	–	+	
18. Mediastinum	–	+	
19. Hilar region	37,1 %	100 %	
20. Pleura and interlobar septum	–	+	
21. Associated lesions	–	+	
22. The evaluation of operability	–	+	
23. Transthoracic aspiration biopsy	–	+	

human body, so that some regions, such as the thymus lodge, have become completelly accessible. We have analysed the presence of the enlarged lymphnodes and relations of bronchial and vasculary structures with expansive infiltrative process in the hilar region, which still present a problem for the analysis. The conventional TMG has contributed significantly in 37.1 % of cases, CT in 100 % of cases. Vock reports the contribution of frontal TMG in 59 %, TMG at the angle of 55° in 61 %, and CT in 82 %. The variations in the results can partially be explained by the fact that we mostly performed frontal TMG with few exceptions, by small series, including the central expansive processes where CT is superior, by the low technical quality of tomograms which satisfied our criteria in only 69 % of cases, while the technical quality of CT scans was satisfactory in 100 %. We shall present an accurate information an this comparation in hilar region after a more detailed investigation on homogeneous series, (hilar pathology) which is under way. By the help of a contrast bolus, CT contributed

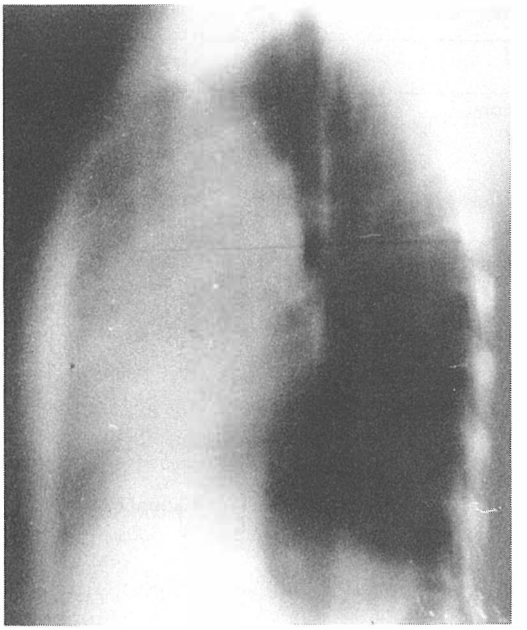

Figure 2. Profile tomogram, soft-tissue shadowing of the frontal mediastinum.

significantly to the differentiation of tumors or vascular pseudotumor, with an evident improvement in densitometric, morphologic, and topographic presentation of the associated lesions which is very important in the evaluation of operability. Relating to the lung parenchyma, the indications for scanning are constantly widened. Small thoracic lesions and subtile diffuse parenchymatous lesions in the frame of the interstitial syndrome, are better analysed by CT, especially the subpleural regions and interlobar septa. The scanner differentiates two zones of different densities ten times better than TMG. It identifies small infiltrations and enlightment[7] CT detects pulmonary nodes sized 0.4–4 mm (TMG detects nodes sized 5 to 10mm) with 10%–30% more contribution.[3, 6, 7] CT is usede for the detection of pulmonary metastases.[3] CT examination detects more metastatic lesions than x-ray of the lungs in 66%.[8] In 80–90% of the cases, metastases in lung parenchyma are localized subpleuraly.[3] Small diffuse calcifications may be presented and analysed densitometrically only by CT.[3] The superiority of CT is proved in the interstitial syndrome.[6] CT sensibility and specifity is about 90% in diffuse lung parenchymal involvement.[3] For the time being, lung parenchyma is in the domain of CT.[6] CT is indicated in the cases of

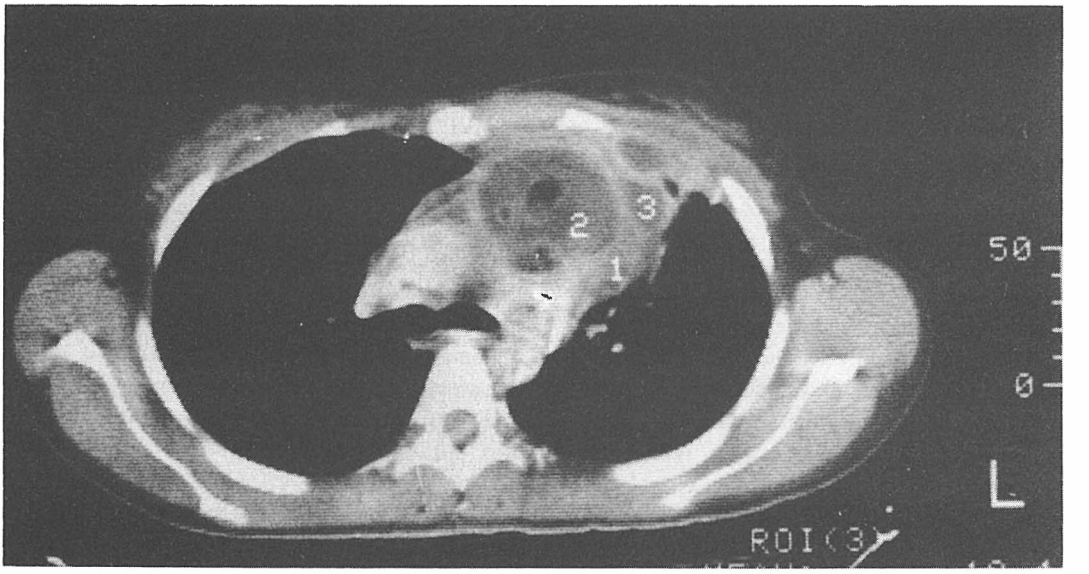

Figure 2a. Transversal CT slice at the level of tracheal bifurcation: clear presentation of the relation between the voluminous cystic tumorous mass of the front mediastinum and thoracic wall and vascular structures (Op. P. H. D.: teratoma cysticum).

neccessary topographic and morphologic accuracy, and in the suspected expansive or infiltrative processes in the mediastinum.[7] (Figure 2 and 2a).

But, this does not refer to every examination and apparature. Remy reports that inadequately obtained scans can be more dangerous than naive unclearness of TMG. In a number of indications CT replaces conventional TMG, which is frequently difficult for interpretation for an unexperienced as well as an experienced radiologist.[3] The examples of accurate indications for TMG are extremelly rare.[7] Therefore the use of lung TMG in the time of CT is questionable. Giron's categorical answer is negative.[5] TMG has to be performed when there is no scanner (out of order, overloaded, geographically distant) and in patients, whose state can be aproximally satisfactorily explained by tomography. If some indications remain to the lung TMG, it is more for the lack of scanner. Complex shadowing detected by conventional radiography has been immediatelly investigated by CT.[9] Conventional lung TMG becomes unnecessary when there is a CT available.

Conclusion

The development of digital technique has resulted in is an important improvement in relation to the conventional techniques. Our preliminary investigation, although performed on a small series, definitely shows the superiority of CT over the conventional TMG which would most probably be omitted, where CT is available. Lung parenchyma is now in digital technique since MR has been developed. But, because of the lack of protons in lung parenchyma it is not able to provide an adequate analysis. The fast development of technology brings about new surprises. Some radiologic techniques will be abandoned, while others will replace them.

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