THE VALUE OF COMPUTER TOMOGRAPHY IN THE DIAGNOSIS OF THYMUS TUMORS

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UDC 616.438-006-073.756.8:681.31

KEY WORDS: computer tomography (CT), diagnosis, tumors of the thymus.

The extensive use of roentgenography, roentgenotomography, pneumomediastinography, and angiography for the diagnosis of thymus tumors is unsuccessful in some cases. The prospects for increasing the accuracy of diagnosis are linked with the use of computer tomography (CT), by means of which the structures of the mediastinum can be differentiated more precisely [8] and the location of pathological formations [4], the invasiveness of growth of thymomas [2], and involvement of the pleura [5, 6] and great vessels of the mediastinum [3, 7] can be determined accurately. However, most reports of the use of CT have been based on a relatively small number of observations.

We therefore set out to summarize our comparatively great experience of the use of CT for the diagnosis of thymus tumors.

EXPERIMENTAL METHOD

During the last 3 years CT has been carried out at the A. V. Vishnevskii Institute of Surgery, Academy of Medical Sciences of the USSR, on 115 patients with various pathological changes in the thymus (Table 1). The Somatome DR-2 (Siemens, West Germany) computer tomograph was used for the investigation. In 19 cases the investigation was preceded by pneumomediastinum, and in 25 cases by intravenous injection of a contrast substance. In 40 cases punch biopsy of the pathological formations in the mediastinum was performed under CT control.

EXPERIMENTAL RESULTS

The picture of the hyperplastic thymus gland in lateral projection on CT, especially preceded by pneumomediastinum, closely resembles that of the gland obtained by pneumomediastinography. In transverse sections of the level of the arch of the aorta, among the mediastinal fat, whose coefficient of absorption (CA) is −40 to −70 Hounsfield units (HU) it is possible to identify oval regions with CA up to +5 to +20 HU, corresponding to separate parts of the hyperplastic thymus gland. Small thymomas up to 3-5 cm in diameter are clearly visible as circular formations with homogeneous structure (CA = +25 to +50 HU) and with clear smooth outlines. They lie anteriorly to the arch of the aorta, above or below it, and they usually do not extend beyond the limits of the median shadow of the mediastinum (Fig. 1). With larger benign thymomas the unevenness and undulation of the external outline of the tumor can be observed. Thymomas acquire an irregular oval shape, and are displaced to the left or to the right, shifting the mediastinal pleura. The structures of the tumors becomes less homogeneous. Areas of microcystic degeneration appear. This is manifested as a local decrease in CA to +5 to +15 HU. Calcified foci with CA = +200 to +450 HU are found in long-existing thymomas, of whatever size. Malignant thymomas and carcinoma of the thymus as a rule are diagnosed late, and for that reason the CT scan is characterized by bilateral widening of the median shadow. The tumors frequently occupy the whole of the retrosternal space and they are irregular in shape, with numerous accessory nodes of different sizes, with uneven polycyclic contours. Their structure is nonhomogeneous, and regions of the tumor of moderate density with CA = +25 to +55 HU alternate with indistinctly outlined, irregularly shaped foci of low density, detectable macroscopically on CT — regions of "melting" measuring 0.5-1.5 cm with CA = +5 to +15 HU. The malignant nature of the tumor is indicated by the discovery of a metastable lesion of the pleura and pericardium on CT, evidence of which is given by multiple local thickenings

Laboratory of Computer Tomography, A. V. Vishnevskii Institute of Surgery, Academy of Medical Sciences of the USSR, Moscow. Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 103, No. 2, pp. 238-240, February, 1987. Original article submitted June 3, 1986.

 0007-4888/87/0002-0274$12.50

TABLE 1. Character of Pathological Changes in the Thymus in the Group of Patients Studied

Type of pathological changes in the thymus	Number of patients	
	total	treated surgically
Thymoma	67	59
Thymolipoma	2	2
Cyst of the thymus	2	2
Hyperplasia of the thymus	44	38

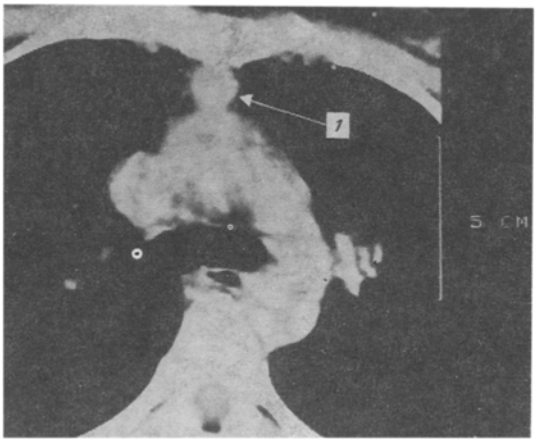

Fig. 1. Typical location of small benign thymoma (arrow) anteriorly to the arch of the aorta.

or oval formations measuring from 0.5 to 1.5 cm, with CA = +20 to +35 HU. On the parietal pleura deformation of the pericardium can be seen, with fluid in the pericardial sac.

A thymoma, if situated typically in the anterolateral zones, is surrounded by tissues which differ considerably in density, and this factilitates the identification of the tumor boundaries, especially if pneumomediastinum has been induced. In the presence of marked deformation of the mediastinal pleura, when the tumor shadow crosses into the lung field, close adhesion or invasion of the mediastinal pleura or even of the lung may be suspected. In thymomas whose diameter exceeds 5-7 cm the posterior border of the tumor is indistinctly differentiated from the great vessels of the mediastinum and the pericardium. Sagittal reconstruction through the thymoma and the organ concerned, when the presence or absence of interposition of less dense tissues between the posterior border of the thymus tumor and the pericardium can be better visualized, may help to establish invasion of the pericardium, aorta, or superior vena cava in these cases.

Cysts of the thymus on CT are round in shape, with clear smooth outlines, a homogeneous structure of low density (A = +5 to +20 HU), and with a clearly identifiable thin capsule.

To obtain clearer demarcation of thymus neoplasms from surrounding vessels, to detect aneurysms, and to differentiate lung tumors from mediastinal, 25 patients were investigated by methods of image intensification by intravenous injection of iodine-containing preparations in a volume of 100 ml, consisting of 60 ml of 76% verografin to 40 ml of physiological saline. A more effective technique is dynamic CT scanning accompanied by intravenous injection of 30 ml of contrast material at the rate of 3 ml/sec, followed by automatically programmed serial scanning (5-7 photographs with a speed of 5 scans per minute) (Angio-CT). Under these circumstances better contrast can be obtained at any desired point of the section, which is not always possible with the usual method of injection of the contrast material, the superior vena cava, aorta, and the brachiocephalic veins can be visualized better, and the integrity of their outlines or deformations of various kinds as a result of spread of the tumor process can be visualized better. Changes of this kind are observed most clearly by reconstruction of the picture through the arch of the aorta or the superior vena cava (Fig. 2).

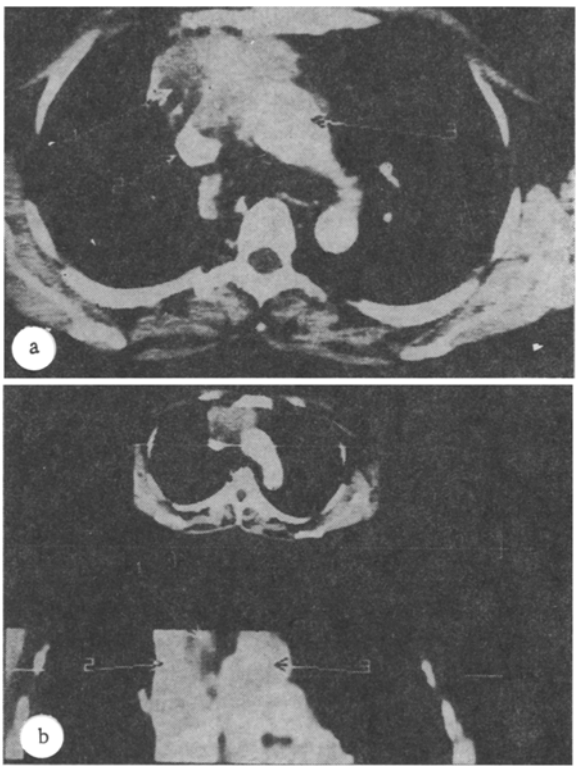

Fig. 2. Angio-CT. Superior vena cava and arch of aorta are contrasted: 1) thymoma, 2) superior vena cava, 3) arch of aorta. a) Deformation of superior vena cava along anteromedial contour due to invasion of tumor; b) reconstruction of scan, deformation of medial contour of superior vena cava can be seen.

The necessity of morphological verification arises in patients with symptomless tumors of the anterior mediastinum or with inoperable thymomas of considerable size before the patient is sent for radiotherapy or chemotherapy.

We used a technique of narrow-angle punch biopsy under CT control [1] on 37 patients with neoplasms of the thymus. The manipulation began with the choice of scan reflecting most adequately the location of the neoplasm and its relations with other anatomical structures, and with fewest metallic markers on the skin. Under local anesthesia, at an angle calculated beforehand, the needle was inserted to the required depth in the necessary direction. The exact position of the tip of the needle was determined by a control scan or by repeated tomography, after which aspiration biopsy was performed (Fig. 3). In 31 of 37 patients cytological investigation of the biopsy material gave additional information of the character of the neoplasm.

The precise visualization of a pathological formation and the structures surrounding it by CT creates the conditions necessary for safe targeted puncture not only when fine needles are used. Biopsy was performed on three patients using a needle with a bore of 0.7 mm, and a column of tissue was obtained for histological investigation.

In all cases CT enabled the pathological formation to be localized most accurately, and it provided additional information to that yielded by other diagnositic methods on the invasiveness of the tumor and the state of the other thoracic organs. Despite the wide range of diagnostic manipulations under CT control required by a group of patients who were quite seriously ill, the patients tolerated all the investigations well without any complications, and in one-third of cases admission to hospital was not required.

It can thus be concluded from these investigations that the simplicity and safety of the method, the value of the information obtained, the possibility of shortening the duration and facilitating the investigation of patients through elimination of the need for other complex invasive diagnostic techniques, and the possibility of conducting the investigation on outpatients all spell out the advantages of CT over other methods of diagnosis of diseases of the thymus gland. CT is currently the most effective method of diagnosis of thymus tumors and it

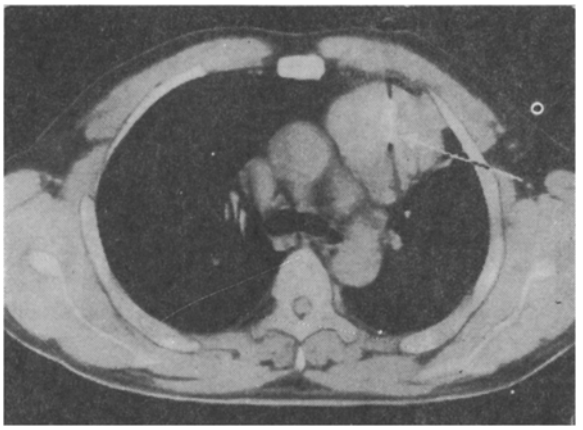

Fig. 3. Aspiration biopsy with a wide-bore needle under CT control (arrow indicates needle in tumor).

should be introduced with all speed into clinical practice on a wide scale. Improvements of diagnosis will facilitate the early implementation of rational therapeutic tactics and will ultimately improve the results of treatment of patients with neoplasms of the thymus.

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