The importance of CT scan in the clinical-morphological and anatomical assessment of mediastinal lymphomas

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Abstract
The study points out the value of CT scan in the investigative algorithm of mediastinal lymphomas. Thirty-eight cases of mediastinal malignant lymphoma were evaluated in a statistical retrospective study. CT scan was used for staging the disease in 25 cases and for post-therapeutic evaluation in the other 13 cases. The CT scan for staging purpose has shown the presence of significant isolated and confluent enlarged lymph nodes in the mediastinum in all 25 cases. Post-therapeutic evaluation of the 13 cases examined by CT showed six remissions, five reductions of lymph node masses and two extra nodal extensions. CT scan is the imaging method of choice in the clinico-morphological and anatomical assessment of mediastinal lymphomas.

Keywords: mediastinal lymphomas, CT scan, lymph nodes.

Introduction

Morbid entities commonly encountered in oncological pathology, malignant lymphomas are neoplastic transformations situated predominantly in the lymphoid tissues, and generically delimited in the form of two major variants: Hodgkin’s disease and non-Hodgkin lymphomas [1, 2].

Though both tumoral disorders infiltrate reticulo-endothelial cells, they are distinct and fundamentally different entities, both as far as their cellular typology and as their location, presence of systemic symptoms, presence of chromosomal translations and treatability are concerned.

More than two-thirds of the cases of non-Hodgkin lymphomas, and approximately 70% of the cases of Hodgkin’s disease, present persistent, painless peripheral lymphadenopathy.

The regional location of adenopathies, age and the presence or absence of systemic symptoms may plead for one of these two major variants; at the same time, they rule out certain underlying bacterial, viral or parasitic infections and help differentiate the two variants from metastatic adenopathies of certain adjacent neoplasms.

Mediastinal adenopathies are present in 20% of the cases of non-Hodgkin lymphomas and in 60% of the cases of Hodgkin’s disease. A key element in mediastinal adenopathies is differential diagnosis from sarcoidosis, infections and other mediastino-pulmonary tumors [3].

Primary abdominal involvement accompanied by enlargement of the spleen and massive adenopathy, more common in non-Hodgkin lymphomas and rather uncommon in Hodgkin’s disease, requires a thorough imagistic investigation in order to differentiate it from other neoplasms.

As non-Hodgkin lymphomas may often be accompanied by primary extra-lymphatic damage (bony, cutaneous, testicular, medullar and of the central nervous system), exploratory algorithms are of utmost importance in diagnostic accuracy [4].

The primary lymphoma of the central nervous system, although initially considered as representing 1% of the total number of non-Hodgkin lymphomas, is currently encountered more frequently due to the spreading of the HIV infection and of the massive use of immunosuppressing medication in transplant patients.

The existence of a wide range of primary and secondary manifestations, both at lymphatic (peripheral, mediastinal and abdominopelvic) and at extralymphatic (pulmonary, hepatic, splenic, bony, medullar, cephalic, urinary apparatus and digestive tract) levels, turns imagistic exploration into an important step in establishing the diagnosis, determining the stage and post-therapeutic assessment of malignant lymphomas.

Mediastinal adenopathies, morbid entities of the lymph nodes characterized by their enlargement and structural alterations in response to any inflammatory, leukemic, tumoral or dysmetabolic pathological process located in the mediastinum, generate what professor I. Hagiéganu called: “a conflict with the surrounding organs due to the compressive and irritating effect exerted upon adjoining structures”.

Owing to the great number of organs located in the mediastinum, adenopathies induce multiple manifestations by compression: nervous, cardio-circulatory, respiratory or digestive, exteriorized through symptoms and clinical signs which, corroborated, yield typical mediastinal syndromes which help determine the site and topography of the compression.

These compressive syndromes determined by mediastinal adenopathies are accompanied by signs and symptoms characteristic for the underlying disorder,
and taken together they allow the physician to establish a presumptive etiological diagnosis.

Classical radiology only visualizes pathological mediastinal lymph nodes that induce an alteration of mediastinal contour and of the pleural reflexion lines, being unable to visualize lymph nodes situated inside the mediastinal contours or in those cases when they are hidden by other tumoral masses existing in the mediastinum. At the same time, radiological imaging offers little information as to the relations and/or infiltration of the structures adjacent to mediastinal adenopathies [5–7].

CT scan is at present the investigatory method of choice in mediastinal adenopathies, revealing their presence in areas difficult to visualize by classical radiological imaging or in the cases they are hidden by other tumoral masses. CT scan also manages to reveal accurately the relations and/or infiltration of adjoining structures.

Thus, by rigorously visualizing and quantifying all mediastinal lymph-node groups, CT scan has become a requisite in determining the progressive stage of broncho-pulmonary cancer and of malignant lymphomas, providing strict criteria for therapeutic conduct, prognosis and damage assessment [8–10].

Material and methods

Thirty-eight patients with mediastinal malignant lymphomas were included in a retrospective statistical analysis carried out by CT scan in the CT Laboratory of the Military Hospital in Timișoara, during January 1995–December 2003.

Clinical, biological and histopathological exams were carried out in the Department of Hematology, Timișoara, in order to establish diagnosis, the stage of the disease, proper therapeutic conduct and, in some of the cases, post-therapeutic assessment.

Each case was analyzed starting from the clinical, biological, epidemiological and histopathological data corroborated with the results of the CT scan. The images obtained by scanning were reexamined in various density frames in order to assess morphological alterations of mediastinal lymph nodes.

In order to establish adenopathies, lymph node and tumoral masses, and their relationships with the adjoining structures, each case underwent a thoracic scanning using a PICKER IQ PREMIER apparatus.

Scanning was carried out for contiguous sections with a width of 10 mm and consecutive steps of 10 mm, starting cranially to the pulmonary apex until the arch of the aorta, from where scanning continued at a distance of 5 mm through the hilum of the lung, returning to 10 mm sections through the inferior thorax, liver and suprarenal glands.

Scanning was carried out natively and after the administration of non-ionic contrast medium, in 150–200 ml dosage (300–350 mgI/ml) with an automatic syringe, at a pace of 2–3 ml/s, examination starting 35–45 s after initial injection.

CT scan required that the patient be scanned in profound blocked inspiration, using a mediastinum window 300–500 UH wide and with its centre between 0–60 UH.

For a greater accuracy in the interpretation of the results, the images obtained were processed using the REVERSE AND DUAL WINDOW techniques.

Once the mediastinal adenopathy was revealed, it was studied in detail in 3 mm thin contiguous sections, rigorously analyzing specific CT semiological elements: shape, contour, dimensions, density, the presence or absence of calcifications, iodophilia and relation to the interstice.

The differential diagnosis of adenopathies was made by: the successive analysis of the sections in order to determine the possible continuity of the suspected lesion into adjacent vascular structures, intravenous administration of contrast medium in order to identify mediastinal vascular axes, the study of density and topography.

The positive diagnosis of mediastinal adenopathy was made based on the dimension criteria established by Webb et al. (cited by [6]), according to which any lymph node with a transverse diameter larger than 10 mm is considered to be pathological, except for those of the superior paratracheal group where the limit descends to 7 mm, and for the subcarinal ones where the limit rises to 11 mm.

The presence and location of mediastinal adenopathies was quantified according to the classification of mediastinal lymph nodes of the American Thoracic Society as follows:

- group 1 includes supraclavicular and scalenar lymph nodes;
- groups 2 r. and 2 l. refer to right, respectively left superior paratracheal lymph nodes;
- group 3 includes pre- and retrotracheal lymph nodes;
- groups 4 r. and 4 l. delimit right, respectively left inferior paratracheal lymph nodes;
- group 5 belongs to the lymph nodes located in the aortopulmonary window;
- group 6 includes the lymph nodes of the anterior mediastinum ventral to the ascending aorta;
- group 7 contains subcarinal lymph nodes;
- group 8 holds the paraesophageal lymph nodes;
- group 9 refers to the lymph nodes between the sheets of the pulmonary ligament;
- groups 10 r. and 10 l. identify right, respectively left tracheo-bronchial lymph nodes;
- groups 11 r. and 11 l. indicate the intrapulmonary lymph nodes on each side;
- group 12 quantifies lobar lymph nodes;
- group 13 contains segmental lymph nodes;
- group 14 descends to the level of diaphragmatic lymph nodes.

Malignant lymphomas were assessed using the histological classification of non-Hodgkin lymphomas according to the Formulation of the Work Group and equivalent Rappaport terminology, while in the case of Hodgkin’s disease the Rye classification was used. Stages were assessed according to the Ann Arbor criteria.
Results and discussions

The systematic analysis of each of the 38 cases was carried out by the successive examination of the images, using the standard mediastinal density window corroborated with the processing with REVERSE AND DUAL WINDOW techniques, revealing the presence of significant mediastinal adenopathies in all cases.

CT scan was used for diagnosis and determining of the stage in 25 cases (Table 1), and for post-therapeutic assessment in 13 cases (Table 2).

Consequently, 22 cases of mediastinal Hodgkin’s disease and three cases of non-Hodgkin mediastinal lymphomas were diagnosed and stadialized.

Post-therapeutic assessment in 12 cases of mediastinal Hodgkin’s disease and in one case of non-Hodgkin mediastinal lymphoma resulted in the following: reduction of adenopathic mass in five cases, remissions in six cases and extra-lymphatic secondary determinations in two cases (Table 3).

We are presenting below the sites of mediastinal lymphadenopathies in the 25 cases of malignant lymphomas stadialized by CT scan (Figure 1).

Between the parenthesis are illustrated the number of lymph nodes: mediastinal lymph node groups 1 (5); 2 r. (14); 2 l. (8); 3 (6); 4 r. (13); 4 l. (6); 5 (6); 6 (17); 7 (4); 8 (–); 9 (–); 10 r. (6); 10 l. (5); 11 r. (5); 11 l. (3); 12 r. (–); 12 l. (–); 13 r. (–); 13 l. (–); 14 (–).

The statistical analysis of the sites in the 25 cases of malignant lymphomas revealed the existence of mediastinal adenopathies in all the cases which, according to their frequency, where divided into the following lymph node groups:

- right paratracheal – 30%;
- anterior mediastinal – 19%;
- left paratracheal – 16%;
- aorto-pulmonary window – 7%;
- pre- and retrotracheal – 7%;
- tracheobronchial – 7%;
- supraclavicular and scalenar – 6%;
- left tracheobronchial – 6%;
- subcarinal – 4%.

All these locations are typical ones for mediastinal Hodgkin’s disease, which presented the predominant type of stadialized intrathoracic malignant lymphoma, namely 22 cases.

CT diagnostic criteria of mediastinal lymphadenopathies in the 25 cases of malignant lymphomas stadialized by CT scan:

Round-oval shape
- Isolated – 57 lymph nodes;
- Conglomerate – 33 lymph nodes.

Contour
- Net – 48 lymph nodes;
- Diffuse – 42 lymph nodes.

Transverse diameters
- 0.5–1 cm – 9 lymph nodes;
- 1–2 cm – 23 lymph nodes;
- 2–3 cm – 17 lymph nodes;
- >3 cm – 41 lymph nodes.

Density
- Homogenous – 26 lymph nodes;
- Non-homogenous – 42 lymph nodes;
- Low-density centre – 22 lymph nodes.

Iodophilia
- Slight – 28 lymph nodes;
- Annular – 23 lymph nodes.

Relation with the interstice (margins covering towards the parenchyma) – 8 lymph nodes.

Marginal calcifications – 3 lymph nodes.

On thoracic CT scan, mediastinal adenopathy appeared as a distinct mass located in the mediastinum and characterized by the following semiological elements: shape, contour, density, the presence or absence of calcifications, iodophilia and, in the case of hilar locations, groups 10 r. and 10 l. respectively, there was also a specific relation with the interstice (Figure 2).

If the sites and round or oval shape depending on the position of the section plane, parallel or perpendicular, on the long axis of the lymph node, were constant and defining diagnostic elements, the other semiological characteristics had a certain variability, whose clinicomorphological correlation made possible the formulation of susceptibility indicators for an etiopathogenic diagnosis, confirmed by cyto- and histopathological data.

Adenopathies have most often occurred in isolated form, seldom as conglomerates, and the lymph node contour was either net or diffuse in equal proportion.

The dimensional criterion represented the major, determinant semiotic element of CT scan diagnosis of mediastinal adenopathy, the main element being the transverse diameter of the scanned lymph node. In most cases the lymph nodes were larger than 3 cm, followed by: 1–2 cm, 2–3 cm and 0.5–1 cm.

Densitometry of the lymph nodes revealed a predominant lack of homogeneity with the frequent presence of central low density, especially post-radiotherapy (Figure 3).

Table 1 – Results of the clinical and histopathological diagnosis in the 25 cases of mediastinal malignant lymphomas stadialized by thoracic CT scan

<table>
<thead>
<tr>
<th>Lymphomas</th>
<th>Stage</th>
<th>I</th>
<th>II</th>
<th>IIIB</th>
<th>IVB</th>
<th>No. of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hodgkin lymphomas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymphocyte predominance</td>
<td>–</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Nodular sclerosis</td>
<td>–</td>
<td>9</td>
<td>–</td>
<td>–</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Mixed cells</td>
<td>–</td>
<td>4</td>
<td>–</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Lymphocyte depletion</td>
<td>–</td>
<td>3</td>
<td>–</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>19</td>
<td>–</td>
<td>3</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Non-Hodgkin lymphomas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low degree of malignancy –</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Intermediate degree of</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>malignancy – mixed follicular</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>High degree of malignancy –</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>lymphoblastic</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1 – Isolated and confluent adenopathies situated at prevascular level in mediastinal Hodgkin’s disease; mixed cell form

Figure 2 – Bulky, confluent adenopathies at the level 2 r. and 4 r., as well as isolated ones in group 6, in mediastinal Hodgkin’s disease; lymphocyte depletion form. In group 4 r. the lesion occurs in a lymph node with sequelar calcification causing its marginal displacement

Figure 3 – Homogeneous mass situated behind the manubrium of the sternum, located in the thymic lounge in a case of mediastinal Hodgkin’s disease; nodular sclerosis form
The importance of CT scan in the clinical-morphological and anatomical assessment of mediastinal lymphomas

**Table 2 – Results of the clinical and histopathological diagnosis of the 13 cases of malignant lymphomas assessed post-therapeutically by thoracic CT scan**

<table>
<thead>
<tr>
<th>Results</th>
<th>Hodgkin lymphoma</th>
<th>Non-Hodgkin lymphoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>Post chemo- + radiotherapy</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>Postradiotherapy</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>–</td>
</tr>
<tr>
<td>Depletion of adenopathic mass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post chemo- + radiotherapy</td>
<td>3</td>
<td>–</td>
</tr>
<tr>
<td>Postradiotherapy</td>
<td>2</td>
<td>–</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>–</td>
</tr>
<tr>
<td>Extension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymph nodes + vertebral</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Iliopubic</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>2</td>
</tr>
</tbody>
</table>

**Table 3 – Results of the thoracic CT scan post-therapeutic evaluation of the 13 cases of mediastinal malignant lymphomas**

<table>
<thead>
<tr>
<th>Lymphomas</th>
<th>Stage</th>
<th>No. of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HODGKIN LYMPHOMAS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymphocyte predominance</td>
<td>IIA</td>
<td>3</td>
</tr>
<tr>
<td>Nodular sclerosis</td>
<td>IIA</td>
<td>7</td>
</tr>
<tr>
<td>Mixed cells</td>
<td>IIB</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td><strong>NON-HODGKIN LYMPHOMAS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low degree of malignancy – mixed follicular</td>
<td>IIB</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Conclusions

CT scan is the investigative method of choice in the diagnosis and assessment of mediastinal lymphomas owing to its possibilities of revealing all pathological mediastinal lymph node groups.

References


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