

ANTERIOR DIAPHRAGMATIC LYMPH NODES

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ABSTRACT

In evaluating patients for malignant disease, involved or uninvolved anterior diaphragmatic lymph nodes (ADLNs) may be observed at computed tomography (CT) evaluation of either the chest or abdomen. While ADLNs have been described on both chest radiography and CT, lymph nodes lateral to the cardiophrenic angles have not been as well illustrated. In this review, we examine the anatomy of the entire group of ADLNs and emphasize the importance of the more laterally placed ADLNs.

ADLNs were identified at CT in 125 patients. Lymphoma (41%) was the malignancy most commonly associated with enlarged ADLNs followed by breast cancer (12%), colon cancer (10%) and lung cancer (6%). Twenty other malignancies accounted for 30% of the series. ADLNs lateral to the cardiophrenic angles were half as common as the other ADLNs. Right-sided nodes were more common than left-sided ones. Of 71 patients with two or more CT scans, 53 showed change in size of the nodes on follow-up examination.

Our data do not support prior reports that suggest that a particular site of origin of malignancy exclusively involves one side or other of the ADLNs.

In our experience, knowledge of the location and appearance of the entire group of ADLNs, including those nodes lateral to the cardiophrenic angles, has

been useful in planning radiotherapy portals in Hodgkin disease, as well as staging and follow-up of other malignancies.

The lymph nodes in the cardiophrenic angles have been the subject of several recent reports (1-6). However, the cardiophrenic angle nodes represent only a portion of the paired anterior diaphragmatic lymph node (ADLN) chains. In this report, we attempt to demonstrate the entirety of these nodal chains and offer our experience with them.

Anatomical considerations

The anatomy of the anterior diaphragmatic lymph nodes is shown in *Fig. 1*, a composite from Rouviere (7) and Nagaishi (8). Rouviere describes a median and two lateral lymphoid aggregates of nodes. The median aggregation of one to three nodes is situated behind the xiphoid and may be absent. The lateral aggregations, which are usually present, are on the diaphragm on either side of midline. They are behind the anterior end of the seventh rib and the seventh costal cartilage and the adjoining sixth intercostal space. Each usually contains one to three nodes which are generally transversely oriented. Whenever there are several nodes they are almost always in line, parallel to the seventh costal cartilage. Nagaishi (8) describes the nodes as

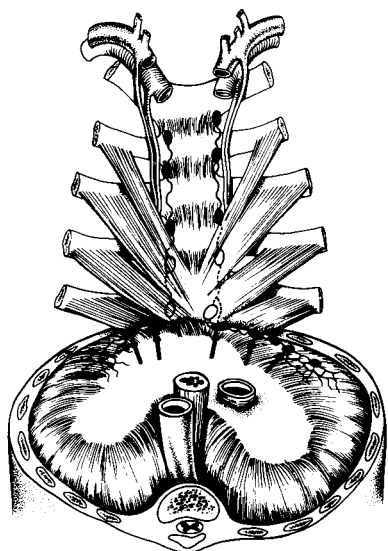


Fig. 1. Posterior perspective of the superior surface of the diaphragm demonstrates the ADLNs (arrows).

being on the anterior edge of the diaphragm.

The afferent lymphatic vessels to the ADLNs are from the greatest part of the diaphragm and the diaphragmatic pleura, the anterior and superior surfaces of the liver in the superior epigastric region, and from the anterior abdominal wall (7). The anterior diaphragmatic nodes normally drain to the internal mammary nodes.

MATERIALS AND METHODS

During a fourteen month period, 125 patients were identified in whom ADLNs were seen at computed tomography (CT). Most of the CT scans were performed on GE-9800 or Siemens DR-3 scanners. Some patients had prior studies on older scanners and a few patients with scans from other institutions performed on various other scanners were included. There were 72 patients in whom two or more scans at different times were available. Only one CT scan was available in the remaining 53 patients.

CT scans of the chest were obtained on inspiration at 8-10mm scan intervals

with 8-10mm collimation. CT scans of the abdomen were obtained on expiration at 8-16mm scan intervals with 8-10mm collimation. Intravenous contrast material (150cc of meglumine diatrizoate) was used unless contraindicated. Comparison of follow-up studies was generally of the same scanner, body part, and technique, but even when different there were no observable differences on any but the smallest structures.

All CT scans were retrospectively reviewed. Diaphragmatic attachments, vascular structures, pulmonary metastases, and fluid, thickening, or cysts of the pericardium were excluded. The remaining rounded and/or ovoid structures with CT characteristics similar to the other lymph nodes were considered to be ADLNs. Each lymph node was measured. The lymph nodes were separated into cardiophrenic angle nodes and retroxiphoid nodes in one group and nodes lateral to the cardiophrenic angles in another group. Particular attention was directed to the more laterally placed ADLNs. These nodes were more difficult to appreciate as they were often not surrounded by fat and could be mistaken for diaphragmatic insertions (Fig. 2).

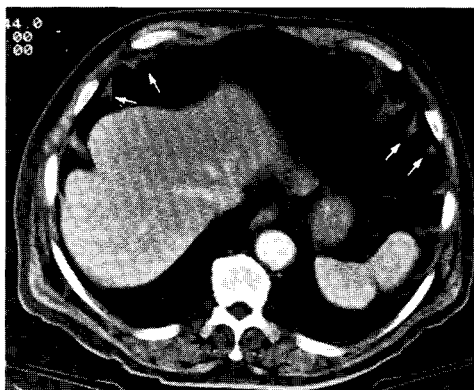


Fig. 2. Characteristic triangle-shaped densities (arrows) represent diaphragmatic insertions.

Histologic confirmation of the nature of these lymph nodes was not obtained. However, malignancy was histologically proven in all but one patient. In patients without known reason for adenopathy, ADLNs measuring up to

8mm (9) and 3.5mm (10) have been reported. Lymph nodes ≥ 1 cm were suspected to be involved by malignancy. Development of disease as indicated by a definite increase in size or response to therapy as indicated by a definite decrease in size of the ADLNs were taken as supportive evidence of malignant involvement.

RESULTS

Lymphoma was the most common malignancy with 51 (41%) patients (non-Hodgkin lymphoma 36, and Hodgkin disease, 15). There were 15 (12%) patients with breast cancer, 12 (10%) with colon cancer, 8 (6%) with lung cancer and 38 (30%) with twenty other carcinomas and sarcomas including three patients with unknown primary malignancies.

There were 95 patients with at least one ADLN ≥ 1 cm in greatest diameter and 30 without nodes that measured at least one centimeter. Nodes were present bilaterally in 53 patients. Only right-sided nodes were seen in 58 patients and only left-sided nodes in 14 patients. Cardiophrenic angle nodes (*Fig. 3*) were

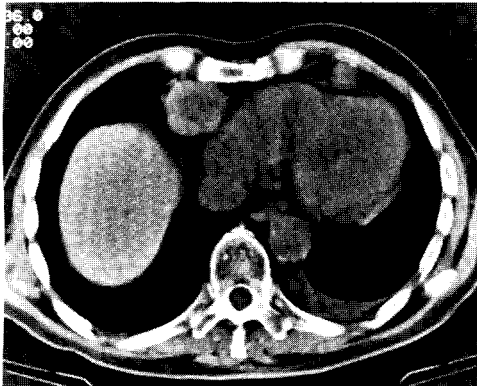


Fig. 3. A patient with melanoma and a huge right cardiophrenic angle node. The upper portion of a left ADLN can be seen.

more common than nodes lateral to the cardiophrenic angles (*Fig. 4*) 100:51 on the right and 60:30 on the left. However, nodes lateral to the cardiophrenic angles presented without cardiophrenic

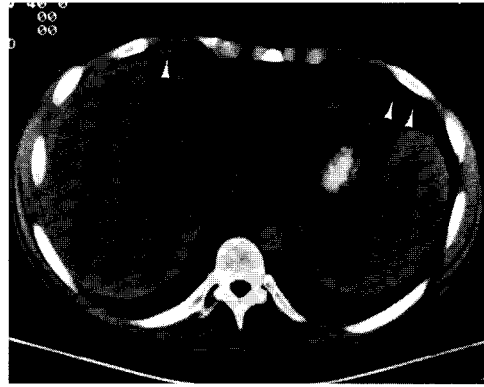


Fig. 4. Enlarged ADLNs extending lateral to the cardiophrenic angles (arrowheads) are seen in a patient with nodular poorly differentiated histiocytic lymphoma. Periesophageal and gastrohepatic adenopathy is also present.

angle nodes on the left seven times and on the right eleven times.

There were 71 patients with more than one CT scan of at least a month's interval. Of these, 21 showed decrease in the size of the ADLNs, 30 showed increase in the size of the ADLNs, 2 showed initial improvement on therapy and then worsening, and 17 showed no interval change. Examples are depicted in *Figs. 5 and 6*.

DISCUSSION

Our findings add to the prior reports regarding cardiophrenic angle nodes in lymphoma (2-6). None of the cited papers specifically discuss nodes lateral to the cardiophrenic angles. Our findings also differ regarding the laterality of involvement in lymphoma. Cho (3) reports eight patients with right-sided involvement, six with left-sided disease but none with bilateral disease. Vock (5) notes right-sided involvement in four patients, left-sided in five and bilateral nodes in three. Our 51 patients with lymphoma had bilateral involvement in 24 patients, right-sided involvement in 22 and five with left-sided disease. Of these, involvement of the lateral nodes was present 23 times on the right and 13 times on the left. Specifically, seven of

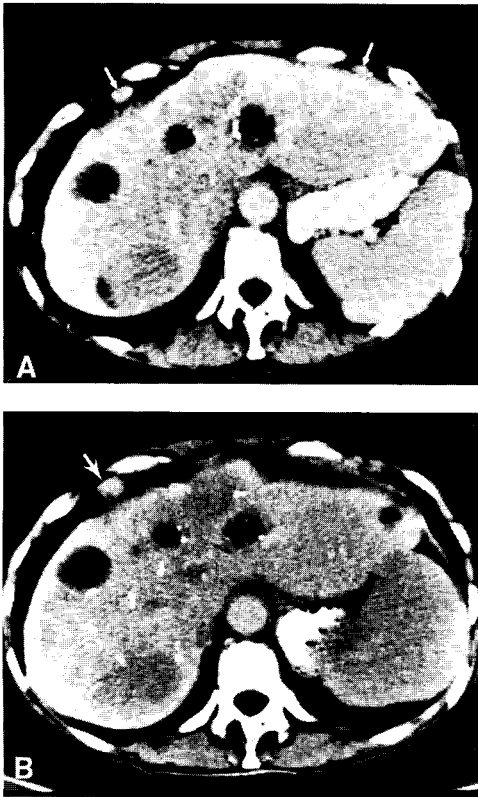


Fig. 5. (A) Hepatic carcinoid metastases treated by embolization. Laterally situated ADLNs are present bilaterally (arrows). (B) Sixteen months later there is progression of the hepatic metastases and the right-sided ADLN has enlarged (arrow).

the 12 patients with Hodgkin disease had involvement of the lateral nodes.

We agree with Cho (3) in that the detection of ADLNs usually is not crucial in staging lymphoma because the disease is usually present at other nodal sites. Castellino (6) found nodes in the cardiophrenic angles in 8% (16 of 203) of patients with Hodgkin disease. Of these 16, 14 were found only at CT and this finding altered therapy in three patients (1.5% of the series). It is important to recognize adenopathy of the more laterally placed ADLNs. Failure to include the lateral component of involved ADLNs might lead to treatment failure following radiotherapy.

Our observations call into question the suggestions by Vock and Hodler (5)

regarding the site of origin of the primary malignancy based on laterality of diaphragmatic nodes. Exclusively unilateral involvement was not always seen in supradiaphragmatic tumors as they suggested. In eight lung cancer patients, bilateral nodes were seen in three. Bilateral ADLNs were also seen in two patients with mesothelioma and one with thymoma. Right cardiophrenic angle nodes were not the only finding with ovarian cancer as Vock and Hodler suggested (5). Our three patients with ovarian cancer had bilateral nodes in two and right-sided involvement in one.

The most frequent cause of ADLN adenopathy in our patient population was lymphoma (41%). Sussman, et al (10) found a similar percentage (40%) as a cause of paracardiac adenopathy. Aronberg, et al (9) evaluated a group of patients in whom bronchogenic carcinoma was the major indication. In this study enlargement of diaphragmatic lymph nodes was most frequently caused by bronchogenic carcinoma (27%). Lymphoma (10%) was among the less common causes. These differences are almost certainly due to patient selection.

Hepatic metastases as well as other intraperitoneal disease may predispose to right-sided involvement (Fig. 5). A portion of the liver is drained by the right ADLN chain (7) and peritoneal fluid flow is directed primarily to the right side (5). Of 12 patients with colon cancer, six had right-sided disease only, four had bilateral involvement and two had left-sided disease only. All 12 patients had either hepatic metastases (11) and/or extension of disease elsewhere in the peritoneal cavity (6). These frequencies reflect the general trend of malignancies below the diaphragm in which ADLNs are seen.

Laterality was not of help in predicting the site of the primary malignancy. However, the laterality of nodes was similar for both lymphomas and malignancies originating below the diaphragm. Sussman, et al (10) have suggested bilateral disease, multiple nodes, nodes greater than 2 cm in diameter, a

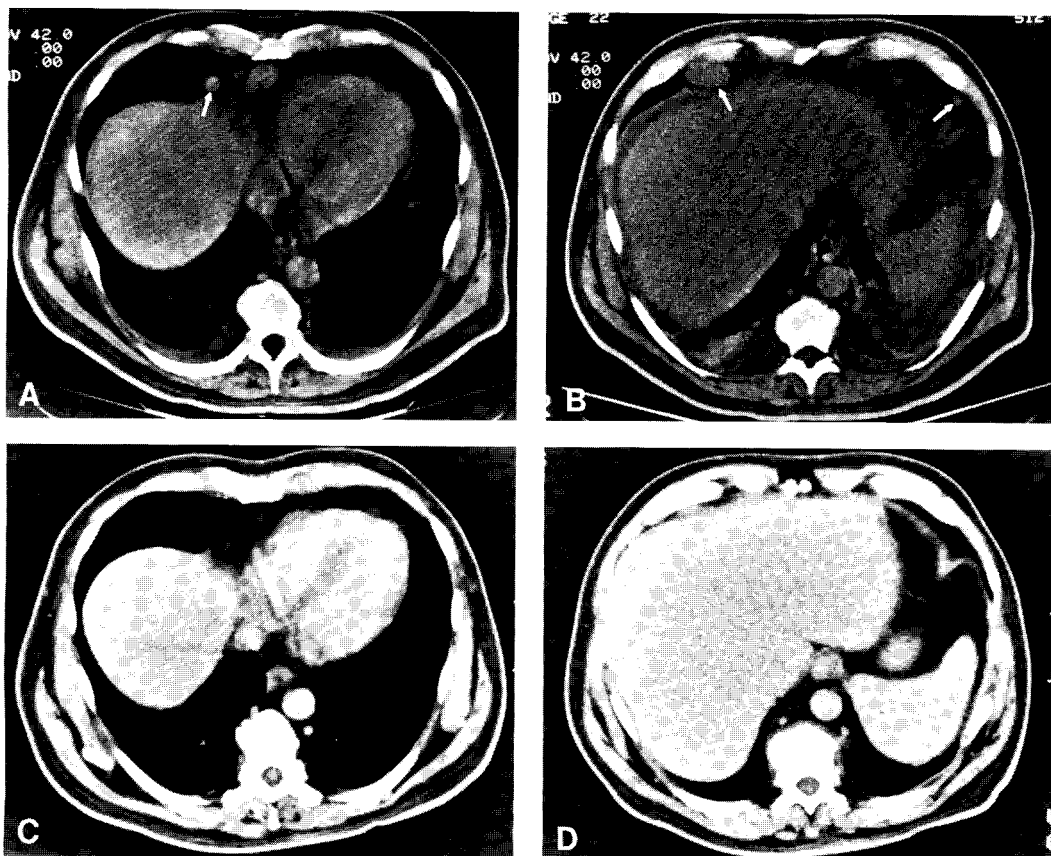


Fig. 6. (A) Patient with diffuse histiocytic lymphoma in whom a right cardiophrenic angle lymph node is seen with a small medial ADLN adjacent to it. A smaller more laterally placed ADLN (arrow) is also present. (B) More laterally placed ADLNs are present bilaterally on an image 1cm lower (arrows). (C) Seven weeks after therapy, an image corresponding to (A) demonstrates resolution of adenopathy. (D) An image from the follow-up study corresponding to (B) also shows resolution of adenopathy.

lobulated or "matted" appearance, and pericardial effusion or thickening favor lymphoma. We have found these criteria to be nonspecific in determining the type of malignancy.

The frequency of malignant involvement increases with size. One cm has been used as a criterion for enlarged lymph nodes elsewhere in the chest and is a useful size to limit false positive diagnoses. However, many nodes less than one centimeter in maximum diameter were noted that subsequently increased in size with worsening of disease. Some large nodes decreased to the point of disappearing with therapy (Fig. 6). There also should be some

nodes of ≥ 1 cm that are related to granulomatous or other nonmalignant disease. If the presence of ADLN adenopathy would alter the type of therapy, biopsy should be performed. Specific ADLN biopsy was not indicated in any of our patients.

Anterior diaphragmatic lymph nodes may be identified in a broad range of malignant disease. How often these lymph nodes are identified is probably related to the type and stage of malignancy in a patient population. While the enlarged lymph nodes are not specific for diagnosis of a particular malignancy, the presence of anterior diaphragmatic lymphadenopathy may alter therapy. Stan-

dard mediastinal radiation therapy portals are altered in the presence of adenopathy in the more laterally situation ADLNs.

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