Ultrasonographic Evaluation of Neck and Supraclavicular Lymph Nodes Metastasized from Lung Cancer

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The significance of ultrasonography in the evaluation of metastasized neck and supraclavicular lymph nodes from lung cancer was analyzed. By ultrasonography, the lymph nodes could be visualized clearly as low-echogenic round areas, and the size could be precisely measured in three dimensions. It was also possible to diagnose whether or not the lymph node adhered to the surrounding tissues and to determine the relationship and the connection of supraclavicular lymph node and upper mediastinal lymph node. The therapeutic effect related to the size of the lymph node was evaluable by ultrasonography. Therefore, the ultrasonographic approach to the neck and supraclavicular lymph nodes metastasized from lung cancer is considered to be useful for clinical use.

(Key words: clinical staging of lung cancer, enlarged lymph nodes, low echogenic round area, 7.5 MHz linear array scanner)

Introduction

Swelling of neck and supraclavicular lymph nodes is an important physical finding to determine the extent of lesions in patients with malignant diseases and various infectious diseases. Until recently, there has been no diagnostic approach other than palpation. Although palpation is very important and is indispensable as a physical examination, it is not objective and the size of the lymph node can not be measured accurately. In particular, a deep supraclavicular lymph node is a key node because it is located at the entrance of the venous system, but palpation is not sufficient for precise evaluation.

We previously reported the usefulness of ultrasonography in the evaluation of pleural and chest wall invasion of lung cancer (1), chest wall tumor (2) and the approach to mediastinal tumor (3). By ultrasonography, the lesion can be determined in real time and various soft tissues such as subcutaneous tissue, muscle, pulsatile vascular system, thyroid gland and lymph nodes can be clearly discriminated.

Here, we applied ultrasonography to cases with metastasized lymph nodes and studied the usefulness in the evaluation of lymphadenopathy.

Subjects and Methods

Subjects were 28 patients (25 were primary lung cancer, 1 gastric cancer, 1 breast cancer, and 1 tuberculosis) with a swollen neck and supraclavicular lymph nodes detected by palpation, and 12 lung cancer patients with swollen upper mediastinal lymph nodes detected by X-ray CT without palpable neck and supraclavicular lymph nodes.

Ultrasoundographic equipment used were models SSD-256, SSD-650 (Aloka, Japan), and SAL-50A (Toshiba, Japan) with 3.5, 5.0 and 7.5 MHz linear array scanners.

For the coupling medium, water-soluble ultrasound transmission gel (Aquasonic; Parker Co. Orange, N.J., USA) was applied to the skin without a water path. The scanners were placed in contact with the skin just in the area of the lymph nodes in various sections, such as horizontal, sagittal, frontal and oblique section, changing the angle between the scanner and skin. Multiple photographs and video films were taken. For the detection of small lymph nodes, multiple photographs were taken at different contact angles of the chest wall and scanner.

The scale shown in each ultrasonogram corresponds to a width of one centimeter. The focus zone was set...
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from 0 to 8 cm in depth.

The pathologically altered structures along with the lymph nodes were surgically resected and histopathologically examined after operation (8 cases) and ultrasonically guided aspiration (12 cases), and compared with the findings of the ultrasonogram.

Results

The rounded or oval shaped, low echogenic areas which could be ultrasonographically visualized in more than two dimensions were defined as lymph nodes. By this definition, 56 lymph nodes were detected in the ultrasonograms. Fourteen lymph nodes in 8 patients were surgically resected and 12 lymph nodes in 12 patients were aspirated using fine needles under the guide of ultrasonography. All of these nodes were pathologically and cytologically revealed to be metastasized lymph nodes. Thus, it was suggested that these low echogenic areas corresponded to lymph nodes.

A typical ultrasonogram of a supraclavicular lymph node is demonstrated in Fig. 1 A. This was recorded from a patient with lung cancer of epidermoid carcinoma with a 3.5 MHz scanner. As shown in this picture, the oval shaped, low echogenic lesion which is in the center of the picture is a lymph node (arrows), and the low echogenic areas which are on the left side are the transsectional slice of muscles (M), with the other area being connective tissue. The shape of the lymph node can be visualized, but its margin is not clear. It was difficult to distinguish the lymph node from the muscle by the inner pattern of echo dots in a single dimension.

The same lymph node which was recorded with a 7.5 MHz scanner is shown in Fig. 1 B. In this ultrasonogram, the margin of the lymph node is more clearly visible. From the echo dot pattern, the lymph nodes could be distinguished from the muscle and tendon. The lymph node echo pattern was fine and homogenous and relatively low echogenic, whereas that of the muscle and tendon had relatively high echo dots, which were scattered diffusely throughout the area.

In 12 cases which had enlarged lymph nodes in the upper mediastinum, four supraclavicular lymph nodes which could not be palpated were visualized by ultrasonography. Upon surgical resection, these were revealed to be soft metastasized lymph nodes. Histologically, one of these nodes was poorly differentiated squamous cell carcinoma and three were adenocarcinomas. None of the palpable nodes were missed by ultrasound investigation. Although four cases were false-positive by palpation (the tendon of the sternocleidomastoid muscle and the internal carotid artery were mistaken as enlarged lymph nodes), these could be differentiated from lymph nodes by ultrasonography.

Typical ultrasonograms of neck lymph nodes are demonstrated in Fig. 2. The ultrasonograms (A and B) are recorded from the patient with lung cancer in cross sectional scanning; ultrasonogram A was recorded in horizontal section and ultrasonogram B was recorded in sagittal section, and these pictures were taken with the lymph node at the maximum diameter by changing the angle between the scanner and the skin. We could measure the size of the lymph node in three dimensions. Because the size of the lymph node on the echogram was nearly equal to the size when resected surgically, the size of the lymph node can be considered to be measurable by means of ultrasonogram.

In Fig. 3, two echograms show supraclavicular lymph nodes with and without adhesion to the surrounding tissue. In ultrasonogram A, the lymph node has no adhesion to the surrounding tissue and thus it could be judged by means of palpation. The oval shaped, low echogenic lymph node is clearly visible and the surface is
Fig. 2. Echograms demonstrate neck lymph node in cross sectional scanning, and the size of lymph node can be measured in three dimensions. The size of the lymph node was almost equal to that which was resected surgically.

Smooth. In ultrasonogram B, the low echogenic lymph node which irregularly extends to the connective tissue at the bottom is clearly visualized. But in this patient, the only hard bulging which was palpable was in the supraclavicular region.

Figure 4 shows deep supraclavicular lymph nodes which are clearly demonstrated by ultrasonography. In this case, the size of the deep supraclavicular lymph node was measured with echogram and the upper mediastinal lymph node was measured with X-ray CT before and after irradiation therapy. These 2 lymph nodes seemed to be one in the same by palpation. The lymph node size reduction rate in the same dimension were almost equal,
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46.7% and 49.9%, respectively.

Discussion

Due to the recent advances and variability in the types of therapy, it is increasingly more important to evaluate critically the extent of malignancy and infection before therapy. The enlarged neck and supraclavicular lymph nodes are the most important factors in the selection of the therapy and in the estimation of the prognosis of patients with malignancy or infection. But few approaches to determine specifically these lymph nodes have been proposed.

The ultrasoundographic approach is useful due to its clear discrimination of various soft tissues (1). When ultrasonography is used to visualize the neck and supraclavicular region, soft tissues such as subcutaneous tissue, pulsatile artery, muscle, tendon and lymph node can be discriminated (4-6).

In this study, ultrasonographic evaluation of neck and supraclavicular lymph nodes was carried out. In particular, the following six factors were checked:

1) Is it possible to evaluate the shape and the inner echo pattern of the lymph node by ultrasonography?
2) Are there any lymph nodes which can be visualized but cannot be palpated? Are there any tissues which are suspected to be lymph nodes by palpation but cannot be visualized by ultrasonography?
3) Is it possible to measure the size of the lymph node in three dimensions?
4) Is it possible to diagnose whether the lymph node adheres to or invades into the surrounding tissue or not?
5) Is it possible to evaluate the relationship and connection of the supraclavicular lymph node and the upper mediastinal lymph node?
6) Is it possible to evaluate the reduction rate in size of the lymph node in ultrasonograms which were taken before and after the therapy?

Lymph nodes are generally visualized as relatively low echogenic round or oval areas, and the outline is clearly visible by high frequency ultrasound such as 5.0 MHz or 7.5 MHz. In this study, no palpable lymph nodes were missed by ultrasonography; the 5.0 and 7.5 MHz scanners showed high sensitivity for the detection of the lymph nodes. It is generally thought that with an increase in ultrasound scanner frequency, the ultrasonogram is more fine and clear. But high frequency ultrasound cannot penetrate the tissue deeply. Because the neck and supraclavicular lymph nodes are usually located superficially (within a 5-cm depth), a relatively high frequency ultrasound, such as 5.0 or 7.5 MHz, can readily penetrate to the depth of the lymph nodes, and can visualize them very clearly. The minimum diameter of lymph nodes which can be detected by a 7.5 MHz scanner is 2 mm. Although it is very difficult by ultrasonogram to diagnose whether the lymph node is physiological or pathological, the round shaped lymph nodes with a diameter of more than 1 centimeter are highly likely to be pathological like metastasized lymph nodes.

It is important to note that the lymph nodes which were visualized by ultrasonography and pathologically confirmed after surgical resection of the specimen, were not always palpable. Therefore, based on these findings, patients who have the enlarged lymph nodes in the upper mediastinum should be examined by ultrasonographic examination for detection of the lymph nodes.

The inner echo pattern of lymph nodes is composed of relatively low and fine dots, which are homogeneous. In an ultrasonogram of the neck and supraclavicular region, the transverse section of muscle somewhat resembles lymph node; Fig. 2 shows their differential characteristics. There are numerous muscle fiber bundles and fat tissue and fascia between the bundles in muscular system, which cause a relatively high echo in the ultrasonogram of transverse muscle sections. Therefore muscle echos are composed of relatively high echo dots, and the echo level is relatively high. Echo patterns can be studied with histograms of the various ultrasonographic levels (7). Here, the histogram method was not investigated as the absolute level is affected by the depth of the lymph node and the surrounding tissue. The important structures of the neck which should be differentiated from lymph nodes by palpation are digastic muscle, omohyoid muscle, external carotid artery, internal jugular vein, sternocleidomastoid muscle, scalene muscle and trapezius muscle (6). In this study, by palpation the tendons of the sternocleidomastoid muscle were mistaken to be a lymph node in three patients and the internal carotid artery was misidentified as a lymph node in one patient. Ultrasonography, however, distinctly revealed the identity of the tendons and the carotid artery clearly. Although in this study we could not distinguish between the enlarged lymph nodes metastasized from lung cancer and the lymph nodes which were enlarged because of tuberculous granuloma, in the near future it will be possible to distinguish the two by ultrasonography in an increasing number of patients (8-11). But large lymph nodes of greater than 1 cm diameter which have perifocal edema and invasion to the surrounding tissue seems to be highly likely as metastasized lymph nodes, and from that viewpoint, the histogram method will be useful.

The size of neck and supraclavicular lymph nodes is generally evaluated by palpation only, although the size of the mediastinal lymph nodes can be measured by X-ray CT and ultrasonographic esophagoscopy. We measured the size of the neck lymph nodes by ultrasonography, and then the lymph nodes were resected surgically. The size determined by ultrasonography was nearly equal to the size of that resected. The measurements were made independently by several investigators, and the size difference was negligible.
Metastasized or granulomatous lymph nodes sometimes invade into the surrounding tissue, such as subcutaneous tissue, muscle, nervous system and vascular system, and then cause edema, circulatory failure and severe pain. It is very critical to know whether the lymph node is adherent to the surrounding tissue or not. Although the adhesion of a lymph node can be evaluated to some extent by palpation, ultrasonography facilitates very precise visualization of these conditions; ultrasonography is the only method by which one can approach visualization of adhesive conditions. The depth of the lymph node can be evaluated, as well as the complete shape of the lymph node as shown in Fig. 4.

It is generally difficult to estimate the three-dimensional connection of the supraclavicular lymph nodes and upper mediastinal lymph nodes; supraclavicular lymph nodes are typically evaluated by palpation and the upper mediastinal lymph nodes are visualized by X-ray CT. Ultrasonography visualizes these lymph nodes in a free slice by means of changing the angle, and the position can be precisely evaluated. Magnetic resonance computed tomogram (MRCT) can also visualize various slices of tomogram (12), but it is not as clear by MRCT. Considering the cost and the length of time for examination, ultrasonography is more efficient than MRCT.

The evaluation of the mass reduction effect of the lymph node during chemotherapy and irradiation therapy is indispensable, and ultrasonography can be very useful for this. But it is impossible to measure directly the size of the lymph node both before and after the therapy, therefore the two reduction rates were compared; one was calculated by ultrasonography and the other by X-ray CT, regarding the deep supraclavicular lymph node which can be visualized by both ultrasonography and X-ray CT. The two measurements were almost equal in the same dimension, and therefore it can be proposed that evaluation by ultrasonography of the therapeutic effect is very useful.

Recently, numerous cases of malignancy have been treated surgically and increasingly better survival rates have been reported. When operability is determined, the evaluation of the neck and supraclavicular lymph nodes is necessary for the clinical staging of the malignant disease.

In conclusion, it can be suggested that this ultrasonographic approach can delineate the metastasized neck and supraclavicular lymph nodes from lung cancer and is sufficient for daily clinical use.

References

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