ORIGINAL ARTICLE

HELICAL CT SCAN IN EVALUATION OF METASTATIC NECK ADENOPATHY

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ABSTRACT

Objective: To determine the diagnostic accuracy of helical computed tomography (CT) in detection of metastatic neck lymphadenopathy with histopathological correlation.

Design: Comparative cross sectional study.

Patients and Methods: This study was conducted in the Departments of Diagnostic Radiology and Pathology, Karachi from August 2005 to June 2006. A group of 51 patients was included in this study. Helical CT scan was carried out after an IV bolus injection of approximately 100 ml. of contrast medium. CT scans were evaluated for metastatic lymphadenopathy i.e. abnormality of nodal size and architecture and irregular nodal enhancement. The radiological findings on the CT scans were compared with the pathological findings.

Results: The study included 51 patients with age ranging from 22 to 77 years. Correct assessment of malignancy was made on CT scan in 48 patients. CT scan was false positive in one and false negative in two patients.

Conclusion: Contrast enhanced Helical CT proved to be accurate for preoperative evaluation and subsequent management of cervical metastatic neck adenopathy.

Keywords: Helical computed tomography(CT). Cervical lymphadenopathy.Malignant

INTRODUCTION

Regional metastasis is one of the most important factors in the prognosis and treatment of patients with head and neck cancers. In addition, because lymphatic metastasis is a frequent event that impacts prognosis, a decision to treat the lymph nodes in the neck has to be made in almost all patients, even if metastases are not apparent, clinically. It is therefore important to assess, as reliably as possible, whether a patient has regional lymph node metastases or not.[1]

CT scanning is now used routinely for the preoperative evaluation of the neck because, presumably, it helps decreasing the incidence of occult cervical lymphadenopathy.

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Introduced in 1998, multiple spiral CT scanning promises further improvement of temporal and spatial resolution (in the longitudinal axis). This technique permits rapid scanning of large volumes of soft tissue during quiet breathing. The volumetric helical data permits optical multiplanar data and 3-dimentional reconstruction. Improvement of the assessment of tumor spread and lymph node metastases in arbitrary oblique planes is another advantage of spiral technique.[2]

This study was done to prospectively evaluate the CT scans of patients with suspected metastatic neck lymphadenopathy over a ten month period and compare there findings with those seen on histopathology, which was taken as a gold standard.

PATIENTS AND METHODS

This is a cross sectional comparative study of 51 patients presented in outpatient clinics or admitted with suspected head and neck masses or cervical lymphadenopathy. All patients were referred to the department of radiology for CT scan from August 2005 to June 2006.

Out of the 51 patients 34 were males and 17 were females. The age ranged from 22 to 77 years and mean age was 49±1 years.

CT scanning of the neck for evaluation of subjective symptoms, palpable masses, or known conditions began with a general neck survey examination prior to more detailed and focused protocols.

The patients were imaged supine while breathing quietly. Scanning was started from the base of the skull to the clavicles with contiguous 4- or 5-mm-thick slices. A digital lateral scout radiograph is done in the beginning as it assists in planning. Intravenous contrast was administered with a power injector through a venous catheter. Total volume and injection rates of contrast were tailored to the patient size, venous access, and general medical conditions.

Scanning was performed with a collimation of 5 mm, a pitch 1, 120 KVP, and 200 mA. CT examination was carried out after an IV bolus injection of approximately 100 ml. (1.5 - 2 ml/kg of body weight) of Iopamidol at a rate of 3.0 ml/sec.

An initial delay of 30 to 35 seconds, from the start of the injection to the beginning of scanning, allowed adequate intravascular contrast enhancement. An examination requiring two ranges usually requires infusion of more intravenous contrast.

CT scans were evaluated by radiologists experienced in reporting head and neck studies and each scan was reviewed by two radiologists. The image interpretation was done on the basis of primary diagnostic criteria and supportive features for metastatic neck lymphadenopathy. These criteria are shown in table 1. CT scans were interpreted as positive for metastatic nodes if two or more of diagnostic criteria were present.

Pathologic analysis was the reference standard by which imaging was judged. The specimen collected for histopathology was either obtained with excisional biopsy or en bloc dissection with adequate surgical margins and maximum nodal yield.

The total number of nodes, number of benign nodes, number of malignant nodes, number of necrotic malignant nodes, and maximum dimension of the nodes were recorded for each patient. For the purpose of correlating imaging and pathologic findings, nodes were divided into the following regions on each side of the neck: submental, submandibular, parotid, upper internal jugular (above the level of the hyoid), middle internal jugular (between the hyoid and cricoids), lower internal jugular (below the cricoids), posterior triangle, and supraclavicular fossa. This allowed the surgical specimen to be correctly oriented to ensure accurate identification of each individual node for correlation of pathologic and radiologic findings. CT results were compared with findings obtained at histopathologic examination. The final diagnosis of metastatic neck lymphadenopathy was confirmed at histopathologic examination.

The true-positive, true-negative, false-positive, and false-negative results were recorded. The causes of false-negative or false-positive result were recorded at the time of correlation of pathologic and radiologic findings. Positive cases, including true positive and false negative and negative cases, including true negative and false positive cases were calculated. Then sensitivity, specificity, positive and negative predictive values (PPV and NPV respectively) and accuracy were calculated.

RESULTS

Correct assessment of malignancy was made in 48 out of 51 patients' scan (94%). Incorrect assessment was made in 3 scans (6%). Out of 48 scans correctly evaluated 39 were true positive for malignancy and 9 were true negative. Out of the 3 CT scans proven to be incorrectly evaluated, malignancy was falsely interpreted as positive in one patient who had enlarged non necrotic nodes and negative in two patients, who had lymph nodes within upper limits of normal size without appreciable necrosis or rim enhancement.

Size of the lymph node was an important primary diagnostic criterion. Measurements of nodal size were made by means of a comparison with a centimeter scale printed on each image. The nodal size cutoff point was taken 10mm.In 40 patients with positive CT findings for metastatic neck adenopathy, enlarge nodes were found in 33 patients (82.5%). In rest of the 7 patients (17.5%) other two criteria suggestive of metastasis with supportive features were present .In 11 patients with negative CT findings for metastasis six nodes out of 11, had size within normal limits.

Detection of nodal necrosis is the most reliable sign for diagnosing metastasis. In 40 patients with positive CT for metastatic neck adenopathy 31 patients (77.5%) had areas of central necrosis >3mm.

The third diagnostic criterian was irregular post contrast enhancement. In 40 patients with a positive CT for metastasis 27 patients (67.5%) had abnormal rim enhancement of nodes on post contrast studies. Apart from these diagnostic criteria, few supportive features for diagnosing metastatic neck adenopathy were also identified and they included presence of primary tumor in head and neck region, abnormal shape of node and lymph node adipose metaplasia.

Out of 40 positive CT scans 28 patients (70%) had concomitant primary neck mass as supportive feature. Out of twenty eight, 27 patients (96.4%) had squamous cell carcinoma of oro and naso pharynx and 1 patient (3.5%) had lymphoma. Out of remaining 12 patients, seven patients had primary tumor in abdomen found on further evaluation.

Out of 40 positive CT scans 27 patients (67.5%) had round shaped lymph nodes instead of normal bean shape. Area of adipose metaplasia larger than 1 mm (minimal diameter) was found in 17 patients (42.5%) out of 40 positive CT scans for metastatic adenopathy.

Metastatic neck lymph adenopathy was correctly excluded prospectively in 9 out of 51 patients (specificity, 90%). The overall accuracy was 94% for diagnosing metastatic neck adenopathy.
The positive and negative predictive values were 97% and 81% respectively

DISCUSSIONS

The important role of the Computed Tomography in oncologic neck imaging is, first, to provide accurate pretreatment staging of the tumor for planning medical, surgical, and radiation interventions and, second, to monitor response to therapy and provide surveillance after curative treatment.
Cervical nodal metastases have a major influence on the prognosis of patients with head and neck tumors. These metastases influence not only the risk of local recurrence, but also the risk of distant metastases.[1-3]
Adults with suspected neck mass were included in our study, who were referred by physicians or surgeons. The aim of this study was detection of metastases with the help of CT in malignant nodes and not to compare the different imaging modalities for the detection of malignant nodes.

Pathologic-radiologic correlation of each node provided the mean to compare CT and histopathology. The CT interpretation used by us was based on the diagnostic criteria described in many studies.

There is a large range of overlap in sizes between benign and malignant lymph nodes. Both the minimum and maximum axial diameter was taken to predict tumor positive nodes in our study. 42 patients out of 51 evaluated for nodal metastasis had enlarged lymph nodes.

33 cases out of 42 were positive for metastasis. In our study sensitivity, specificity and accuracy of CT for accurate measurement of lymph node was 100%. We also found that by increasing the minimal axial diameter by 1mm for lymph nodes in the subdiagastric region, optimal value for sensitivity, specificity and accuracy can be obtained.

In a study done by Micheal et al. they took the minimum axial diameter criteria for diagnosing metastatic lymphadenopathy. The most useful minimal axial diameter in their study was between 10 and 12 mm.[4] Necrosis was chosen because it is frequently found in nodal metastases from carcinomas of the head and neck and because the identification of necrosis with imaging is a reliable sign of a metastatic node.[5-7]

In our study, CT accurately diagnosed necrosis in 33 cases while it was unable to diagnose in 2 cases, in one false negative case the patient was 47 years old male patient, known case of CA larynx, the size of the lymph node was within upper limit of normal and there was no obvious necrosis.

Another patient who was a 53 years old lady, also had lymph nodes within upper limit of normal in sub mental and sub mandibular regions on histopathology, and it turned out to be malignant with small necrotic area of about 3mm.

The sensitivity, specificity, and accuracy of CT for detection of necrosis were calculated from the total group of benign and malignant nodes.
In our study the sensitivity, specificity, and accuracy for detecting nodal necrosis is about 93%, 100%, and 82% respectively.
In the king et al.[8] study, necrosis in metastatic nodes was used as the main criteria and they also compared different imaging techniques like CT, MRI and Ultrasound. In their studies the results of each modality were compared for sensitivity, specificity and accuracy. In their study CT

analysis for detection of necrosis in 89 malignant nodes showed accuracy, sensitivity and specificity of 92%, 91% and 93% respectively.

In another study by Micheal etal.[4] the sensitivity of the criterion of tumor necrosis, cystic tumor growth or tumor keratinazation in area larger than 3mm was 32% per node with a specificity of 100%. Contrast-enhanced CT is considered to be the best modality for identification of necrosis. A sensitivity of 74% and a specificity of 94% have been reported for areas of necrosis larger than 3 mm.[4]

In our study irregular contrast enhancement in the nodes, caused by tumor necrosis, cystic tumor growth or (avascular) keratinization was used as a predictor of malignancy.

27 patients out of 40, with positive CT for metastasis 27 patients had abnormal rim enhancement.
In the Micheal etal.[4] study, irregular contrast enhancement was the most specific criterion with a specificity of 100%
In our study 6 patients out of 9, who were true negative for metastasis had enlarged, necrotic nodes with thick rim of enhancement , unlike metastasis where there is irregular enhancement . Out of 6 nodes 4 had calcification. Histopathology revealed chronic granulamatous disease –tuberculosis.

The presence of a conglomerate nodal mass on CT scan with central lucency and thick rim of enhancement and minimally effaced facial planes has been reported to be suggestive of tuberculous adenitis, especially if the patient has a strongly reactive tuberculous skin test.[9-11] The enhanced walls of these multichambered masses are thicker than those usually defined as rim enhancement of necrotic nodes secondary to metastatic carcinomatous disease.[12] Calcification of lymph nodes is also considered to be highly suggestive of tuberculous adenitis.[13]
Out of 40 patients with positive CT scan 28 (70%) had concomitant primary neck mass. Out of 28 patients. 27 patients (96.4%) had squamous cell carcinoma of oro and naso pharynx while only one patient (3.5%) had lymphoma.

In the remaining 12 patients, 7 had primary tumor in abdomen, on further evaluation.
If the primary site itself is not visible the pattern of adenopathy may suggest primary location. Knowledge of the lymphatic drainage of the head and neck proves valuable in such instances.[14,15] (Table 2)
Out of 40 patients with positive CT scan 27 (67.5%) had rounded shape of lymph nodes instead of normal bean shape.
Non metastatic nodes were characteristically shown on CT images as discrete and kidney-shaped, with soft-tissue structures in the hilum composed of fat tissue concaving into the central portion of the node.[16]
Area of adipose metaplasia larger than 1mm was found in 17 patients (42.5%) out of 40 with positive CT scans for metastatic adenopathy.

Table 1: Diagnostic criteria for metastatic neck adenopathy

Primary Criteria	Supportive Features
1) Abnormal size of the node	1) Presence of primary tumor in head and neck region
2) Abnormality of internal architecture, including necrosis.	2) Abnormal shape
3) Irregular enhancement after contrast.	3) lymph node adipose metaplasia

Table 2: Probable source of nodal metastasis

Level 1	Oral cavity, submandibular gland.
Level 2	Nasal pharynx, oral pharynx, parotid, superglottic larynx.
Level 3	Oral pharynx, hypopharynx, superglottic larynx.
Level 4	Subglottic larynx, hypopharynx, esophagus, thyroid.
Level 5	Nasal pharynx, oral pharynx.
Level 6 & 7	Thyroid, larynx, lung.

Note: Bilateral nodes are common with cancers of soft palet, tongue, epiglottis, and nasal pharynx.

CONCLUSION

The study shows that contrast enhance helical CT can be used to evaluate metastatic neck adenopathy using the following radiological criteria:

1. Nodes with minimal axial diameter of more than 10 mm should be considered metastatic.

2. All nodes that show irregular enhancement on CT and are surrounded by a rim of enhanced tumor or lymph node tissue should be considered metastatic.

3. Presence of central necrosis greater than 3 mm should also be considered metastatic can be detected by contrast enhanced helical CT.

   Use of this rapid, man-operator dependent and highly accurate examination may decrease delays in appropriate medical or surgical therapy as well as unnecessary delayed observation.

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