Predictive Ability of the CT to Evaluate Cervical Lymph Nodes in Head and Neck Tumours

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Abstract
Objective: The aim of this study was to determine the predictive value of computed tomography (CT) i.e., its sensitivity and specificity in detecting metastatic lymph nodes of head and neck tumors. We also studied the capacity of CT in correct nodal lymph staging.

Patients and methods: A CT was performed on 95 patients diagnosed with neoplastic disease of the pharynx and/or larynx. All patients subsequently underwent cervical lymph node dissections. In the imaging study, the following parameters were considered for suspected radiological nodal involvement: lymph node diameter greater than 10 mm, lesion margins poorly defined, capsule enhancement after contrast administration and lymph nodes that, despite their size, had signs of central necrosis.

Results: In the dissections, 70.53% resulted N+ in the histological study. The sensitivity of CT was 82.09% and the specificity, 85.71%. The CT detected positivity in 55 of the 67 histologically pathological dissections, while the CT detected negativity in 24 of the 28 dissections histologically negative. The weighted kappa index value was 0.6408, indicating limited capacity for appropriate staging of the lymph nodes.

Conclusions: While the ability of CT to detect metastatic lymph nodes in head and neck tumors is quite acceptable, it is less so for correctly staging them. It is therefore necessary to look for other imaging tests that provide greater accuracy to avoid unnecessary elective neck dissections and to reduce morbidity and mortality from them. We must now pay attention to new imaging techniques such as PET and PET/CT.

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Introduction

The detection of cervical metastases in head and neck carcinoma entails a significantly poorer prognosis of the disease and increases the rate of morbidity, mortality, recurrences and complications after treatment. There is consensus among most authors that, within local extension being equal, the appearance of lymph node metastasis decreases the chance of survival by approximately 50%. It is for this reason that the detection and treatment of cervical lymphadenopathy in these patients are essential. At present, we do not have a preoperative, non-invasive diagnostic method that offers diagnostic certainty, and clinical N0 neck (N0) remains an unresolved problem.

Palpation is still the most basic method of exploration and offers an acceptable capacity to identify cervical disease progression. However, its rate of false negatives is high because it does not detect lymphadenopathies in deep spaces, medial to the carotid-jugular area or simply of small size. On the other hand, palpation can be impaired in obese and short necks, as well as in those which have been previously irradiated or operated on. It also has other limitations such as with retropharyngeal adenopathies or very deep adenopathies that may go unnoticed.

Different techniques have used to help improve reliability in the diagnosis of regional disease. Among these are: computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), ultrasound, fine-needle aspiration (FNA) cytology and sentinel node examination.

For all these reasons, imaging tests are used in patients with head and neck tumors to stage the neck as accurately as possible and to plan the most appropriate treatment. In general, CT and MRI, alone or in combination, do not appear to have optimized the number of true positives or cancelled false negatives. Under these circumstances, the proposal of centers with PET is clear about its systematic implementation.

The most interesting point when exploring a neck, either by palpation or by imaging methods, is knowing whether a clinical N0 neck (cN0) is really a healthy neck (pN0), and should therefore not be treated, or if a clinical N+ neck (cN+) is really a diseased neck (pN+), and should therefore be treated.

The present study aimed to examine the predictive value of CT, that is, its sensitivity and specificity in detecting metastatic lymphadenopathies in head and neck tumors, as well as to determine the capacity of CT to correctly stage nodal involvement.

Material and Method

We carried out a retrospective study in which we examined cases belonging to patients undergoing surgery for cervical lymph node dissection due to head and neck neoplasm between 1998 and 2009.

Inclusion criteria were: having a CT scan prior to histology, no treatment prior to surgery and having a histological result.
All patients were studied using a Siemens Somatom Sensation multidetector CT (MDCT) scanner, with a collimation of 5 mm (5 mm sections) and a reconstruction interval of 3 mm. We injected 80 cm$^3$ of intravenous contrast unless this was contraindicated.

In accordance with Shah et al.,$^5$ in the CT scans we considered as positive lymphadenopathies those larger than 1 cm in diameter in any area (I–VII) and those that, regardless of size, showed signs of central necrosis.

The surgical specimens were sent to the Anatomical Pathology Service for their histopathological classification. We considered the final report of the specimen as the diagnostic reference to assess sensitivity and specificity indexes, as well as the predictive and efficiency values of the imaging tests in their ability to detect malignancy.

Statistical Analysis

Firstly, we calculated frequencies and percentages for qualitative variables (patients with CT+, etc.), as well as the mean and standard deviation for the age of patients.

To assess the association between results and staging according to anatomopathological and radiological findings, we used the Fisher exact test and Chi-square test, respectively. In both cases, we calculated the sensitivity and specificity values. Lastly, we calculated the weighted kappa coefficient with a 95% confidence interval to evaluate the correlation between the staging and the radiological and anatomopathological findings.

All calculations were performed using the statistical package SAS System v9.2. We assumed statistical significance with a value of $P<.05$.

Results

The study included 100 patients, of whom 5 were excluded as they had received prior treatment with RT. During the period studied (1998–2009), 95 patients were included in the study, of whom 89 were male and 6 were female, aged between 42–89 years and with a mean age of 65.81±8.6 years. Of these patients, 95 had undergone unilateral or bilateral neck dissections.

The location of the primary tumor is shown in Table 1. It is possible to observe that the most frequent location was the larynx, with 45 cases.

The 95 patients included in the study were explored in the ENT consultation, where in addition to an exploration of the primary tumor, lymph node chains were palpated and CT scans were requested.

<table>
<thead>
<tr>
<th>Location</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larynx</td>
<td>45 (47.3)</td>
</tr>
<tr>
<td>Oropharynx</td>
<td>11 (11.5)</td>
</tr>
<tr>
<td>Hypopharynx</td>
<td>18 (18.9)</td>
</tr>
<tr>
<td>Oral cavity</td>
<td>6 (6.3)</td>
</tr>
<tr>
<td>Unknown</td>
<td>14 (14.7)</td>
</tr>
<tr>
<td>Other location</td>
<td>1 (1.05)</td>
</tr>
</tbody>
</table>

The histopathological study of the 95 specimens detected metastatic lymphadenopathies in 67 dissections (70.53%).

Of the 67 histologically pathological dissections, CT detected positivity in 55, while in the 28 histologically negative dissections, CT detected 24 as negative. This association was statistically significant ($P<.001$) (Table 2). This association allowed us to calculate a sensitivity and specificity for CT findings of 82.09% and 85.71%, respectively. The positive predictive value (PPV) was 93.22% and the negative predictive value (NPV) was 66.67%. The diagnostic efficiency or ability of CT to identify only true positives and negatives was 83.16%.

The CT study offered 4 laterocervical regions with false positives and 12 with false negatives.

To determine the capacity of CT for nodal staging, we studied the weighted Kappa index. Its result was 0.6408 (0.52, 0.77), with this association being statistically significant ($P<.001$) (Table 3). The result obtained in our study led us to the conclusion that the capacity of CT to make a correct staging is limited.

Discussion

Regional involvement in head and neck tumors modifies their definitive treatment and conditions the prognosis of the patient notably. There are currently no safe diagnostic tools to detect cervical metastases. This lack of preoperative diagnostic certainty conditions the need for lymph node dissection in head and neck tumors. The concept of prophylactic neck dissection would become obsolete if it were possible to obtain a certain diagnosis of lymphadenopathies before surgery.

Clinical examination, CT and MRI are the non-invasive staging techniques used most frequently to study the presence or absence of metastatic lymphadenopathies. The
criteria used by CT and MRI in the staging of lymph node metastases are the size of the lymph nodes, presence of central necrosis, irregular edges of the nodes, enhancement of the capsule, etc.

The literature mentions different radiological criteria that have been used in the assessment of neck lymph node metastases. Mancuso et al.6 considered as metastases those lymph nodes over 15 mm, while Som et al.7 considered different values depending on the location of the lymph nodes. According to the latter, the lower limits of the submandibular and cervical lymph nodes, to be accepted as metastasis, were 15 mm and 10 mm, respectively. In our study, we considered lymph nodes over 10 mm as metastatic.

In this study, the sensitivity of CT for the study of lymph node involvement was 82.09%, given that it detected 55 of the 67 pathological dissections. In addition, the specificity of CT was 85.71%; that is, out of the 28 histologically negative necks, it detected negativity in 24 of them.

With regard to the correlation between CT staging and histological staging, the capacity of CT to correctly stage nodal involvement was limited in our study (weighted Kappa index value <0.7).

The correlation between CT staging and histological staging was better for stages N0 and N2. However, the capacity of CT to stage N1 decreased. Of the 50 necks histologically classified as N2, CT detected 37 as N2 (74%). Meanwhile, out of the 28 necks histologically classified as N0, CT detected 24 as N0 (85.7%).

The overall sensitivity and specificity results obtained in our study were similar to those from other series, such as that by Merritt et al.,8 who obtained sensitivity and specificity results of 81% and 86%, respectively, or that by Friedman et al.,9 with results of 87% and 86%, respectively. Other series, such as that by Mancuso et al.,10 reported somewhat different results from those in our study, with sensitivity and specificity values of 100% and 75%, respectively. Another review, by Altuna Mariezurrunaga et al.,11 found sensitivity and specificity values of 65% and 87%, respectively, for the ability of CT to detect regional extension. These results clearly show a lower sensitivity than that obtained in our series. The differences observed between series are surely due to the heterogeneity of the groups studied and the criteria employed.

Consequently, the ability of CT to detect disease when it is truly present, or to detect the absence of disease when it is truly absent, can be considered acceptable but not entirely safe. Furthermore, the ability of CT to stage nodal involvement correctly is limited. Therefore, it is necessary to search for other diagnostic tests that provide us with greater accuracy when performing the staging of lymph node metastasis.

It is precisely for this reason that other methods such as sentinel node biopsy, already well-established in the case of melanomas or breast cancer, are being tested in head and neck carcinomas. Nevertheless, this is an aggressive test that depends on the location of the primary tumor and which has varying results according to different authors.11

Another method which is currently in vogue is PET. The clinical implications of PET for the staging of head and neck carcinomas may be important in patients staged as N0 by palpation, CT or MRI. A PET exam has its own limitations because it provides little anatomical information and location of the viscera. On the other hand, both CT and MRI provide abundant morphological information, so the combination of CT or MRI with PET could solve this problem.

PET has generally been the diagnostic procedure of choice in numerous studies evaluating patients with positive N necks, with sensitivity (67%-100%) and specificity (64%-100%) values higher than those of CT or MRI.12,13 The clinical introduction of PET/CT has improved accuracy in the interpretation of PET images. However, several studies that have evaluated the efficiency of PET/CT have yielded conflicting results. Shoder Heiko et al.14 obtained sensitivity and specificity results for PET/CT of 67% and 95%, respectively, while Nahmias et al.15 obtained results of 95% and 25%, respectively.

According to a study carried out by Piao et al.16 on the effectiveness of PET/CT in the diagnosis of cervical lymph node metastasis, PET/CT enables early detection of cervical metastasis in oral and oropharynx cancers; however, the diagnosis of metastasis is not precise in metastases with a maximum diameter below 10 mm. Furthermore, the combination of PET/CT is able to accurately detect metastatic lymph node involvement levels. This information is of great aid to the surgeon in deciding the nodal level to be treated.

Conclusion

In this study we found that, although the capacity of CT to detect metastatic lymphadenopathies in head and neck tumors is quite acceptable (with a sensitivity of 82.09% and a specificity of 85.71%), it is not adequate to stage them correctly. Consequently, it is necessary to find other imaging tests that provide greater accuracy to avoid unnecessary elective neck dissections, and to reduce their morbidity and mortality. At present, we should pay close attention to new imaging techniques such as PET and PET/CT.

References


