Anatomy of the head and neck: background information

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Clinical

Head and neck cancer is relatively uncommon. They constitute approximately 3% of all cancers, with nearly 7000 new cases annually in the UK, giving an incidence of 12 per 100 000 (larynx, 4.5; oral cavity, 3.5; pharynx, 2.5; others, 1.5). The importance of head and neck cancer lies in the heterogeneity of its constituent parts, the potential for cure and the need to minimize functional impairment.

The major risk factors for developing neck cancer are smoking and alcohol consumption. Diet lacking in certain elements, particularly vitamins A and C, may predispose an individual to develop oral cancer.

In many head and neck sites of cancer there is no consensus about 'optimum' treatment, thus highlighting the necessity for multidisciplinary assessment and management of these patients. The treatment options are surgery (conventional, laser and reconstructive), radiotherapy (brachytherapy and teletherapy), chemotherapy, combined modality and palliative care.

Objectives

Nasopharynx and oral cavity

(1) Staging of proven malignant tumours
    Local extent of the primary tumour (T)
    Nodal involvement (N)
    Metastases (M)
(2) Detection of occult primary tumours
(3) Identification of an appropriate biopsy site
(4) Post-treatment assessment
    Tumour recurrence
    Complications of treatment

Hypopharynx and larynx

(1) Staging the primary tumour (TNM)
(2) Post-treatment assessment
    Tumour recurrence
    Complications of treatment

Salivary glands

(1) To evaluate mass lesions
    Differentiate between benign and malignant tumours
    Surgical treatment planning
    Differentiate between an extrinsic parapharyngeal space mass and an intrinsic parotid mass

Paranasal sinuses

(1) Staging the primary tumour
(2) Detection of lymphadenopathy
(3) Post-treatment assessment
    Tumour recurrence
    Complications of treatments

Indications

Choice of modality

Nasopharynx

In head and neck cancer the principle role of any imaging modality is to identify the deep infiltration of tumour, and the presence of metastases, particularly lymphadenopathy. Mucosal changes can often be evaluated by direct inspection.

Whilst Magnetic Resonance Imaging (MRI) is recognized as having greater tissue discrimination than other imaging modalities, there is still a significant problem with image degradation due to motion artefact; despite the availability of fast imaging sequences.

In the pharynx the nasopharynx is subject to the least motion, and in assessing tumours of the nasopharynx MRI is accepted as the imaging modality of choice; the better tissue contrast and multiplanar facility combining to improve the accuracy of staging compared with computed tomography (CT).

Oral cavity/oropharynx

In assessing tumours of the oral cavity and oropharynx, motion is a problem, and CT and MRI are considered complementary investigations. However, with appropriate patient selection the staging of oral cavity and oropharyngeal tumours can be achieved by MRI alone, and in patients with tumours at certain sites, for example, the posterior third of the tongue, it is more accurate than CT, enabling more precise radiotherapy and surgical treatment planning.

These statements also apply to the patient with recurrent tumour, who is potentially suitable for salvage surgery.

Patients with large oral cavity tumours, and excessive salivation are usually best imaged by CT. Chronic

obstructive pulmonary disease often co-exists in these patients.

Salivary glands

Parotid gland. Whilst at present CT is the mainstay for evaluation of glandular and peri-glandular masses, MRI can readily distinguish between lesions in the deep lobe of the parotid gland and those in the parapharyngeal space, but more significantly, the facial nerve is often seen distal to the stylomastoid foramen, thereby allowing a more accurate assessment of its relationship to a mass lesion. A disadvantage of MRI is the relatively poor detection of intra-glandular calcification or calculi within the salivary ducts. CT is, therefore, preferred to MRI when a mass is thought to be inflammatory.

Submandibular/sublingual glands. Mass lesions can be assessed by MRI with the multiplanar facility providing information about the relationship with the mass to the floor of the mouth and the parapharyngeal and masticator spaces.

Submental and submandibular lymphadenopathy is readily identified.

Paranasal sinuses/larynx/hypopharynx

CT and MRI are complementary investigations. The choice of imaging modality will often depend on the patient's status and ability to co-operate.

The advantage of CT is that it is quicker and more readily available than MRI. It is also more sensitive to cortical bone invasion.

Currently, CT is used for radiotherapy treatment planning.

Technique

MRI of the extracranial head and neck structures requires good patient co-operation. A high proportion of the patients have poor oral hygiene and are often alcohol abusers. The tumour itself often results in increased secretions and salivation and there is often associated airways disease. Coughing, swallowing and dyspnoea all predispose to image degradation due to motion artefact.

All patients should have an explanation of the procedure given to them by the radiographer together with reminders during the procedure not to cough or swallow. Data are acquired during quiet respiration.

An appropriate coil should be chosen to cover the area of interest and imaging should be undertaken in at least two orthogonal planes. Spin echo (SE) sequences are less sensitive than gradient echo (GE) to motion and susceptibility artefacts. Pre-contrast T1-weighted sequences are necessary for the assessment of medullary bone involvement.

With fast spin echo sequences tumour and brain can have similar signal intensity and i.v. contrast medium is usually required to distinguish tumour from normal brain. Contrast medium is also required for the detection of perincural/intracranial extension.

Lymph nodes can be assessed with: (a) T1-weighted; (b) fat-suppressed T2-weighted or Gd-enhanced T1-weighted; or (c) STIR sequences.

Flow-sensitive sequences and/or MR angiography are important complementary studies to assess the relationship of tumour to the carotid sheath, or to identify the vessels in the skull base.

There are some key points to remember in interpreting the MR images and these are:

(1) Retained fluid secretions in the paranasal sinuses have a higher signal than tumour on T2-weighted scans and do not enhance
(2) Inflamed mucosa enhances more than tumour
(3) Highly cellular tumour is generally of low/intermediate signal intensity on T1–T2-weighted sequences
(4) Serous/myxoid tumour elements produce increased signal on T2-weighted sequences, e.g. in adenocystic carcinoma, necrosis in squamous cell carcinoma
(5) Loss of the low signal intensity cortical line and low marrow signal intensity on T1-weighted sequences implies bone invasion
(6) Normal mucosa, lymphoid tissue and vessels enhance and can mask tumour, and limit tumour boundary definition

Reassessment

Patients will usually have a reassessment scan to: (a) assess the response to the treatment; (b) to identify tumour recurrence; or (c) to assess the complications of treatment.

Ideally, patients should be scanned in a similar fashion to the original study and i.v. contrast medium is required, particularly when differentiating between treatment effect and tumour recurrence. The distinction between the two is often difficult.

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