Chapter 17: Cancer of the neck

David Wright and Guy Kenyon

The management of neck cancer has undergone a succession of changes, but no treatment yet devised guarantees the patient the chance of a certain cure. Various combinations of treatment have been, and are still being, evaluated to improve both the cure rate and the rehabilitation of the patient. The control of regional metastatic disease constitutes a significant part of the process of treating head and neck cancer. When surgery is employed, either as the selected method of treatment or when other treatment has failed, a decision usually needs to be made on whether a neck dissection will have to be performed in addition to removing the primary cancer. The former may be necessary if lymph nodes are clinically positive; however, the type of neck dissection and the indications for bilateral neck dissection remain far from clear. In contemplating a surgical approach, ablation of the tumour by radical neck dissection is not acceptable if, as a consequence, the social and emotional well-being of the patient is destroyed. As Conley (1983) stated:

'Every surgeon engaged in this type of work recognises that a large percentage of his attempts to cure or palliate are associated with some degree of mutilation that will interfere with physiological function and aesthetics. The true evaluation of this mutilation can only be measured by the patient and his family. The physician's estimate, at best, is technical, remote and at times compassionate. The new physician often separates the disease from the patient, and the patient from his doctor. He must, however, be sensitive from the earliest moment of his involvement to all of the facilities that can be applied to ameliorate the inherent psychology and physical stresses of ablation'.

Ever since Crile (1906) described the radical neck dissection, it has been known that this operation does not always control cervical metastasis. Massive and fixed nodes that extend into surrounding tissues, or involve the skin or skull base, as well as the relatively inaccessible nodes of the superior mediastinum or lower neck, are not resectable. Even in the clinically negative neck, the rate of recurrence is between 7.5 and 24% (De Santo et al, 1982), depending on the site and control rate of the primary lesion.

A primary carcinoma arising in most sites in the head will ultimately drain into the lymph nodes of the neck. These lymph nodes usually form an efficient barrier to the further spread of cancer with the effect that distant metastasis may not occur or, if it does, only as a late event.

Organization of lymphatic drainage

Normal anatomy

The lymph nodes of the head and neck form one interlinked continuum. Although minor and confusing differences are found in the nomenclature given in different descriptions of lymph nodes in the neck, there is common agreement that, anatomically and functionally, the nodes form two main and distinct groupings. These are best thought of as one terminal or deep cervical group which is related to the internal jugular vein, and two groups of intermediary or outlying nodes which drain into the deep cervical chain. Ultimately, therefore,
the lymph from the head and neck drains into the deep cervical group either by direct passage from the adjacent tissues or indirectly from one of the outlying groups. In turn, the afferent lymphatics from the deep cervical chain on each side coalesce to form a jugular trunk which on the right side drains to the junction of the internal jugular and subclavian veins, and on the left usually terminates in the thoracic duct.

By using this arrangement, named groups of nodes can be described. The most widely quoted system in current anatomic text considers lymph drainage in the following groups:

1. deep cervical nodes including 'jugular chain' (named nodes - retropharyngeal, jugulodigastric and jugulo-omohyoid)
2. anterior cervical nodes (named nodes - infrahyoid, prelaryngeal and tracheal)
3. superficial nodes of scalp and face
   - occipital
   - retroauricular (mastoid)
   - parotid and superficial cervical
   - facial
   - submandibular
   - submental.

It is important to appreciate that the peripheral nodes associated with the scalp and face, together with the retropharyngeal and submental groups, represent a continuous ring surrounding the cervical structures like a collar. The anterior and lateral cervical nodes form separate chains lying inside this shield.

**Deep cervical nodes**

Most pathological processes are encountered in the deep or lateral cervical chain of nodes, as this group is the common route of drainage from all major regional structures - from the nasopharynx superiorly to the thyroid gland inferiorly. These nodes extend from the base of the skull to the root of the neck along the length of the great vessels. Most of them are concealed by the overlying sternomastoid muscle, but the lower end is uncovered and is, therefore, palpable in the lower part of the posterior triangle of the neck. The omohyoid muscle divides this group of nodes into superior and inferior parts. The majority of the superior group lie beneath the upper end of the sternomastoid muscle, but some of the nodes are evident in the anterior triangle of the neck with the most frequently palpable of these, the jugulodigastric, lying below the angle of the jaw. This node is associated particularly with drainage of the tongue and tonsil. Efferent lymphatics from the superior group pass to the lower cervical group and hence to the jugular lymph trunks. The inferior deep cervical nodes are closely related to the brachial plexus and subclavian vessels. The jugulo-omohyoid node in this group lies on, or above, the intermediate tendon of the omohyoid muscle, and receives lymph from both the submental group and the tongue.
**Group of nodes draining deeper structures**

The deeper structures of the head and neck all drain to the deep cervical nodes through one or other of the local regional groups; these include the retropharyngeal as well as the paratracheal and retrotracheal groups, and the prelaryngeal and infrahyoid nodes. The retropharyngeal nodes are further split into two subgroups, a median and a lateral, which lie on the front of the atlas along the lateral border of longus capitis, and which receive afferent lymphatics from the nasopharynx, the auditory tube and the adjacent cervical vertebrae. The paratracheal glands lie alongside the trachea and oesophagus and the pretracheal nodes are a group lying anterior to the trachea in intimate relationship with the inferior thyroid veins. The prelaryngeal nodes are also included in this group, and lie on the conus elasticus of the larynx. The main infrahyoid group, which completes the nodes draining the deeper structures, is found on the thyrohyoid membrane.

**The superficial ring of nodes**

The superficial ring of nodes drain the skin of the scalp and face. The occipital nodes lie at the apex of the posterior triangle and are contiguous with the retroauricular and mastoid groups which lie over the mastoid process in the superficial fascia. Parotid nodes lie on and in the parotid gland, and some extend down into the neck along the external jugular vein as part of the superficial group. The facial and buccal nodes are also grouped together; a small node often lies on the buccinator muscle and another on the lower border of the mandible at the anterior border of the masseter near the mandibular branch of the facial nerve. The submental nodes comprise three or four nodes lying on the surface of the mylohyoid between the two bellies of the digastric muscle; these nodes receive afferent lymphatics from both sides of the median plane, and some of the lymph channels in this region decussate over the symphysis of the mandible to drain into the submandibular and jugulo-omohyoid nodes. The final group, the submandibular nodes, lies on the surface of the submandibular gland and receives lymph from a wide area of the centre of the forehead, the nose and adjacent cheek, the upper lip, the floor of the mouth, the gums and from the major part of the tongue.

**Lymphatic drainage of the neck**

Following the definition and classification of specific lymph node groups within the neck, the topographical distribution of lymph node metastases can be described. Such patterns have been investigated in block dissection specimens by first staining and then, after clearing in cedar wood oil, by transilluminating the specimen (McKelvie, 1976). Subsequent superimposition on a Rouvier's diagram allows the accurate plotting of metastatic disease.

A study of 1155 cancer patients (Lindberg, 1972) documented tumour spread from the principal primary sites. This study found that tumours of the tongue and the floor of the mouth metastasize most frequently to nodes in the upper deep cervical chain and to nodes in the submandibular group. Tumours of the oropharynx also commonly drain to the upper deep cervical group; lesions of the retromolar trigone, anterior faical pillar and soft palate are particularly likely to involve the jugulodigastric node. However, the incidence of metastases to the midpart of the jugular chain and to the submandibular group is also high, and with tumours of the soft palate, the incidence of bilateral metastases to the upper deep cervical groups is appreciable. In the case of tumours of the tonsil, the jugulodigastric node is almost
always the first to be involved, but in this study the incidence of involvement of the mid- and lower cervical chain was also significant, as was the involvement of nodes in the posterior triangle on both the ipsilateral and contralateral sides. A survey of the location of cervical metastatic lymph nodes in relation to the possible primary sites may be of diagnostic value.

Bilateral metastases were also found with tumours of the base of the tongue and lateral and posterior oropharyngeal walls, and the most commonly involved nodes at presentation were the upper and midcervical groups.

Tumours of the hypopharynx were found to drain most commonly to the upper, the mid- and then finally the lower deep cervical chain in a decreasing order of frequency. Ipsilateral posterior triangle nodes were only occasionally seen. In contrast, carcinomata of the nasopharynx were found not only to have a very high incidence of spread to the posterior triangle, but also the highest incidence of bilateral spread. There was also a high predilection for the supraclavicular lymph nodes.

The lymphatic drainage from the larynx is divided, with the watershed lying at the level of the vocal cord. Most of the drainage is in a lateral direction above and below this level, but there is also some anastomosis on the posterior laryngeal wall. Above the vocal cords, the lymphatics pierce the thyrohyoid membrane and run with the superior laryngeal vessels to the upper deep cervical nodes. The drainage inferiorly is to the lower deep cervical chain, and the lymph passes either between the cricoid and the first tracheal ring or between the pretracheal and paratracheal nodes.

Hence, nodal involvement with metastasis within the neck originating from these primary sites is principally to the jugular chain, with the superior nodes being most commonly involved followed by the mid-jugular nodes. There is some variation between the different studies but it would seem that the submandibular nodes are rarely involved and then only in cases where there is extensive spread to deep nodes.

**The role of cervical nodes**

The function of the lymphatic drainage is to carry macromolecules, such as protein and particulate matter including effete cells, away from the tissues. A small amount of interstitial fluid also traverses the lymph vessels, but the removal of the bulk of tissue fluid remains a function of the blood capillaries. It is by way of the lymphatic flow that tumour cells drain to the regional lymph nodes.

The function of regional lymphatics is far from clear and is made more complicated by the evidence in favor of their playing a significant role in tumour immunity in the cancer-bearing patient. The work of some authors has suggested that the removal of nodes which are not involved with the tumour could promote the development of residual micrometastases (Fisher and Fisher, 1972). Other work has shown sinus histiocytosis in nodes involved with the draining of a primary malignancy (Black, Speer and Opler, 1958), and has considered this change and the degree of lymphocytic infiltration to be an indication of the strength of an antitumour immune reaction which will influence the prognosis. Furthermore, it has been shown that as the antigen load from a tumour increases, the effector reaction of the node is

The existence of an enlarged node does not, therefore, necessarily indicate the presence of metastatic spread and, especially if the node is soft, may represent no more than a response to coincidental infection or the mounting of an immunological reaction. However, it has been estimated that a node smaller than 1.0 cm is impalpable and yet may contain between \(10^6\) and \(10^7\) tumour cells. The principal problem for the clinician is how to decide whether a node which is palpably enlarged is involved with micrometastases. At present, such a decision remains purely clinical.

**TNM classification of cervical nodes**

A carcinoma arising in the head and neck is staged according to the extent of the tumour and the presence or absence of spread to the regional nodes and to distant sites. In practice, the latter event is a rare occurrence, and staging is feasible by clinical assessment of the primary site and examination of the neck. The staging system in most common usage in the UK at the present time is that proposed by the International Union against cancer (UIICC, 1978), which is based on data developed by the American Joint Committee (AJC) for Cancer Staging. This system is shown in Table 17.1.

**Table 17.1 Regional lymph nodes**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N0</td>
<td>Regional lymph nodes not palpable</td>
</tr>
<tr>
<td>N1</td>
<td>Movable homolateral nodes</td>
</tr>
<tr>
<td>N1a</td>
<td>Nodes not considered to contain growth</td>
</tr>
<tr>
<td>N2a</td>
<td>Nodes considered to contain growth</td>
</tr>
<tr>
<td>N2</td>
<td>Movable contralateral or bilateral nodes</td>
</tr>
<tr>
<td>N2a</td>
<td>Nodes not considered to contain growth</td>
</tr>
<tr>
<td>N2b</td>
<td>Nodes considered to contain growth</td>
</tr>
<tr>
<td>N3</td>
<td>Fixed nodes.</td>
</tr>
</tbody>
</table>

Although such a system is useful, many remain critical of its application. It has been shown that different observers will fail to agree on the presence of a palpable lymph node in as many as 30% of cases (Sako et al, 1964). This in turn makes even more questionable the validity of a clinical opinion as to whether a palpable node contains tumour and also the feasibility of clinically subdividing N1 and N2 regional nodes into subsets (a) and (b). The subjective nature of such an assessment is emphasized by one study in which it was demonstrated that only 60% of palpable nodes contained tumour at the time of their removal (Nichols and Greenfeld, 1968).

In addition, the present classification implies that there is a worsening of the prognosis with different stages from N1 to N3. However, this is certainly not the case, as the prognosis for bilateral nodes, N2, is usually much worse than for unilateral fixed nodes, N3. In view of these failings, a move towards the more cumbersome but possibly more realistic system, as used at the M. D. Anderson Hospital, Texas, would probably be appropriate (Table 17.2), and it seems likely that the UIICC will adopt such a system in the future.
Table 17.2 Nodal staging system

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N0</td>
<td>No clinically positive node</td>
</tr>
<tr>
<td>N1</td>
<td>Single clinically positive node &lt; 3 cm in diameter</td>
</tr>
<tr>
<td>N2a</td>
<td>Single clinically positive node &gt; 3 cm in diameter</td>
</tr>
<tr>
<td>N2b</td>
<td>Multiple clinically positive ipsilateral nodes</td>
</tr>
<tr>
<td>N3a</td>
<td>Unilateral fixed node(s), clinically positive</td>
</tr>
<tr>
<td>N3b</td>
<td>Clinically positive bilateral nodes, fixed or not fixed</td>
</tr>
</tbody>
</table>

Recent evidence has suggested that it is not so much the presence of a node which is of importance with regard to the assessment of prognosis, but rather the anatomical level of the tumour within the neck. Barrie, Knapper and Strong (1970) have suggested five levels of possible involvement (submandibular, upper, middle and lower cervical, and posterior triangle), and have shown that the 5-year survival for patients with a variety of different primary tumours dropped from 45% for those presenting with a node at level 12 (submandibular) to only 18% for those who had lymph node involvement at level 4 (lower cervical). Furthermore, no patient with involvement of a supraclavicular lymph node survived for 5 years (Spiro et al. 1974). Similar findings have been reported more recently by workers in the UK (Stell, Morton and Singh, 1983). In fairness, the failure of the present system to take node level into account has been acknowledged by the UICC which has recommended that such information should be recorded. It seems clear that the present system of staging is likely to be revised to take account of such information in the future.

Finally, the prognostic significance of extracapsular spread has recently been recognized. If patients are reassessed on the basis of a pathological examination of their block dissection specimens, it becomes apparent that spread outside the confines of the lymph nodes heralds statistically significant reduction in survival when compared with patients with either no nodes or with disease confined within nodes (Johnson et al, 1985). Furthermore, the disease-free interval between treatment and recurrence is shorter for patients with extracapsular spread.

It is true to say that no one clinical system is infallible. Nevertheless, with the advent of superior techniques - such as the possibility of delineating tumour metastases in the neck by using computerized tomography or, in the future, by means of monoclonal antibodies - it does seem likely that clinical staging preceding treatment will become more sophisticated. In this event, the drawbacks mentioned above will clearly recede; and when a partially subjective clinical impression can be objectively confirmed or refuted without recourse to the examination of a surgical specimen, a new clinical staging system will emerge. In the meantime, the present system with its inherent drawbacks will remain the one most commonly used for treatment planning and for communication between individuals and institutions.

**Differential diagnosis of a suspected malignant cervical node**

On account of the diversity of lesions, the neck is of special interest to several disciplines, including those of general surgery, otolaryngology plastic surgery, maxillofacial surgery and neurology. It is important, therefore, that a basic concept of the clinical significance of the cervical mass is fully appreciated, and that a general classification,
acceptable to all specialities, is made available. Most cervical masses fall into the following three groups:

1. congenital and developmental
2. inflammatory
3. neoplastic of either primary or metastatic origin.

**Incidence**

Primary thyroid disease represents 50% of cervical masses. Within the other half, neoplastic disease accounts for roughly 70%, inflammatory disease for 6% and congenital abnormalities for 24%. Eighty-five per cent of the malignant group is composed of metastatic spread to cervical lymph nodes arising from primary epithelial cancers above the clavicle, from the skin, the salivary glands, the thyroid gland, the lower lip and from the mucous membrane areas of the upper air and food passages.

**Differential diagnosis**

A complete history and a full examination must be undertaken, with the appropriate blood films, tuberculin test and serology to help differentiate between the three major classifications. Common congenital lesions are thyroglossal vestiges and branchial and dermoid cysts, including cystic hygromata; while inflammatory lesions present as cervical lymphadenitis, tuberculous cervical adenitis, actinomycosis, sarcoidosis, non-specific inflammatory nodes of the acquired immune deficiency syndrome (AIDS) and salivary gland inflammation.

**Neoplastic lesions**

**Primary thyroid tumours**

Primary thyroid tumours are usually midline lesions which are identifiable within the thyroid gland. Parathyroid tumours are evident only from symptoms produced by metabolic disturbances.

**Salivary gland tumours**

Salivary gland tumours appear in the neck as an extension of either the tail of the parotid or of the submandibular glands.

**Tumours of neurogenous origin**

Neuroblastoma, neurofibromata, neurilemmomata and other tumours of neurogenous origin occur in the neck. These types of tumour are difficult to diagnose preoperatively, the exception being the multiple neurofibroma of von Recklinghausen's disease and its associated café-au-lait spots. Other primary mesenchymal tumours, such as lipomata, haemangiomata or
sarcomata may also be present in the neck and may be found in the anterior or posterior triangles.

**Carotid body tumour**

The paraganglioma or carotid body tumour is uncommon, but may appear at any age from 12 to 50 years, and is always associated with the carotid vessels. These tumours possess mobility in the lateral but not the vertical plane.

**Branchiogenic carcinoma**

A branchiogenic carcinoma is exceedingly rare. It is believed to arise from remnants of the branchiogenic apparatus, but its diagnosis is always in doubt and many cases represents a metastatic epithelial cancer arising from an occult primary.

**Metastatic spread**

A suspected metastatic node in the neck warrants a systemic search to locate a primary source, preceding the biopsy of the cervical mass. A small number of metastases involving supraclavicular or scalene nodes may emanate from a primary arising in the abdomen or lungs. Fine needle aspiration biopsy and incisional biopsy are discussed elsewhere in this chapter.

**Lymphomata**

The presence of a lymphoma in the neck is often only one clinical manifestation of a more wide-spread systemic disorder. Such a finding may represent either primary or secondary disease, and as most reports of lymphomata in the head and neck have failed to use modern methods for detection of occult disease below the diaphragm, the number of patients who fall into each of these categories remains obscure. In practical terms, the distinction is important because adequate management of the patient presenting with a lymphoma in the neck depends on establishing the degree of prior systemic spread so that the disease is accurately staged and the appropriate treatment given.

**Classification of lymphomata**

All lymphomata are malignant. Unfortunately, much disarray has existed in respect of the nomenclature to be adopted in the classification of these diseases; in particular, the classification of the heterogeneous group, which comprises the non-Hodgkin's lymphomata, remains unsatisfactory. Opinion is unanimous that Hodgkin's disease, in view of its distinctive histological features, should be separated from the other diseases. At present, the remaining lymphomata are classified as 'non-Hodgkin's' on the basis of the predominant cell type involved, and subdivided according to whether the neoplastic cells are arranged in nodules or in a diffuse manner, as nodular disposition is associated with a better prognosis.
Hodgkin's disease

The diagnosis of Hodgkin's disease can be made with certainty only when Reed-Sternberg cells are seen in lymph node biopsy material. Histologically, the disease is classified into four subtypes:

1. lymphocyte predominant
2. nodular sclerosing
3. mixed cellularity
4. lymphocyte depleted.

These subtypes also give an indication of prognosis, with lymphocyte predominant and nodular sclerosing types having a better prognosis than the other two categories. However, the prognostic significance of the histological subtype is of less relevance than the clinical stage of the disease which must, therefore, be accurately assessed.

Non-Hodgkin's lymphomata

The diagnosis for non-Hodgkin's lymphomata is usually made from biopsy material taken from the lymph nodes, but occasionally an extranodal site or a bone marrow examination will reveal the nature of the disease. Although histological type is currently the basis for classification of these lymphomata, immunological characterization is increasing in importance. Unlike Hodgkin's disease, the histological characteristics of a non-Hodgkin's lymphoma are of paramount importance to prognosis, and this aspect outweighs the significance of anatomical staging. The original Rappaport classification of these diseases described the basic cell type as lymphocytic or histiocytic, but it is now realized that the latter term is a misnomer and that these cells do in fact represent proliferating lymphocytes.

Since the 1960s, several new classifications have been developed on the basis of the functional and immunological characteristics of the basic cell type. One of the most recent is as follows.

Low grade

1. Malignant lymphoma, small lymphocytic
2. Malignant lymphoma, follicular, small cleaved cell
3. Malignant lymphoma, follicular, mixed small cleaved and large cell.

Intermediate grade

1. Malignant lymphoma, follicular, large cell
2. Malignant lymphoma, diffuse, small cleaved cell
3. Malignant lymphoma, diffuse, mixed small and large cell
4. Malignant lymphoma, diffuse, large cell.
**High grade**

1. Malignant lymphoma, large cell, immunoblastic
2. Malignant lymphoma, lymphoblastic
3. Malignant lymphoma, small non-cleaved cell.

**Miscellaneous**

1. Composite malignant lymphoma
2. Mycosis fungoides
3. Extramedullary plasmacytoma
4. Unclassifiable.

Whichever classification of non-Hodgkin's lymphoma is used, the important prognostic factors are the subdivisions into low and high grade tumours. Features which favour a low grade rather than a high grade tumour are:

1. a nodular rather than a diffuse histological pattern
2. a lymphocytic rather than a histiocytic morphology
3. well-differentiated rather than poorly differentiated cells.

**Clinical features**

**Hodgkin's disease**

Hodgkin's disease usually presents with a painless lymph node enlargement in either the neck, axillae or inguinal regions. The question of whether such a presentation is accompanied by systemic symptoms, such as sweating, weight loss and fever, is of importance. A chest X-ray commonly shows either hilar or mediastinal lymphadenopathy. Bone marrow invasion may lead to signs of pancytopenia, although in most instances a trephine biopsy to establish involvement will be necessary. Very occasionally, the enlarged nodes will give rise to complications resulting from pressure, such as obstructive jaundice or spinal cord compression. Central nervous system involvement is rare.

**Non-Hodgkin's lymphomata**

The presentation of non-Hodgkin's lymphomata is similar to Hodgkin's disease, but the pattern of the disease is dissimilar, with the extranodal sites being involved much more frequently. Such sites include the central nervous system, the gastrointestinal tract, the nasopharynx, bone, soft tissues and the thyroid gland. True localized disease is therefore much less common than in Hodgkin's disease, and it has been estimated that over 50% of these patients have extranodal involvement at presentation.

**Staging**

Staging follows the Ann Arbor classification *(Table 17.3)* and this is now universally applied for both non-Hodgkin's and Hodgkin's lymphomata; clinical as well as pathological criteria are used. The staging is then further subdivided into cases without systemic symptoms
(substage A), and those cases with a weight loss greater than 10% during the 6 months preceding presentation, or with unexplained fever or sweating (substage B). Pruritus is no longer regarded as a B symptom.

Table 17.3 Ann Arbor classification of lymphoma

**Stage I**

Disease limited to one lymph node region (I) or to a single extralymphatic organ or site (IE)

**Stage II**

Disease in more than two anatomical regions on one side of the diaphragm (II) or localized involvement of extralymphatic organs or sites, and in one or more lymph node regions on the same side of the diaphragm (IIE)

**Stage III**

Disease on both sides of the diaphragm (III) with or without involvement of the spleen (IIIS) or localized extralymphatic organ or site (IIIE)

**Stage IV**

Diffuse or disseminated disease involving one or more extralymphatic organs or tissue (for example, liver, marrow, pleura, lung, bone and skin). Involvement of extranodal sites (for example, bone marrow, liver or skin).

**Investigation**

The investigation of patients with lymphoma requires a full history and clinical examination, together with a lymph node biopsy to establish the nature of the disease. Additional investigations should include a blood differential count, sedimentation rate, and liver function tests. The serum uric acid should also be estimated as hyperuricaemia may result from the early stages of treatment. Chest X-rays to demonstrate hilar involvement, mediastinal disease and parenchymal lung disease are important because such features carry a poor prognosis. Bone marrow trephine and an examination of a bone marrow smear are necessary for staging. Additional tests may include excretion urography, bone X-rays and ultrasonography. In addition, lymphangiography or computerized tomographic scanning have allowed a more comprehensive and non-invasive assessment of patients. However, in some cases with Hodgkin's disease, in spite of an acknowledged morbidity and finite but small mortality, staging laparotomies are still required in order to establish whether the spleen is involved. This procedure also allows an accurate sampling of lymph node sites along the iliac vessels and aorta, as well as wedge biopsy of the liver. In female patients, positioning of the ovaries behind the uterus is also necessary to protect them from subsequent irradiation.
In the investigation of a patient with non-Hodgkin's disease (where prognosis is less dependent on stage), the investigations are less comprehensive and staging laparotomy is not required.

Treatment

Hodgkin's disease

The treatment of Hodgkin's disease comprises radiotherapy for the treatment of localized disease and chemotherapy for a more extensive spread. Pathological stages I and II are usually treated by means of radiotherapy.

Because adjacent nodes are often involved, the treatment is usually extended to include related lymph node regions. For disease above the diaphragm, a 'mantle area' covering the cervical, clavicular, axillary, mediastinal and hilar lymph node areas is used. In contrast, stages I and II disease below the diaphragm is treated using an 'inverted-Y' to cover the para-aortic nodes from the level of the diaphragm to the bifurcation of the aorta, together with the pelvic and inguinal regions. After treatment with radiotherapy for stages I and II disease, over 80% of patients are alive and free of disease after 10 years. The only patients in this group who do badly on this regimen are those with large mediastinal masses at presentation; because the relapse rate in these patients is high, some centres now use chemotherapy for this subgroup.

The treatment of stage III disease has not yet been satisfactorily defined. A number of centres have reported good results using 'mantle' and 'inverted-Y' radiation (total nodal irradiation), but others have reported relapse rates as high as 50%; therefore, some workers combine radiotherapy with chemotherapy during the initial phase of treatment. As an alternative, chemotherapy may be given at the time of relapse.

The treatment of stage IV disease is now by means of combination chemotherapy. Various combinations have been used, including the original schedule of MOPP (nitrogen mustard, vincristine, procarbazine and prednisolone) and MVPP (nitrogen mustard, vinblastine, procarbazine and prednisolone). Other combinations have also been tested in an attempt to reduce toxicity and increase efficiency, but none has proved to be inherently better than the original treatment protocol. It is an unfortunate fact that even with the use of such agents, the death rate among patients with advanced Hodgkin's disease remains as high as 50%; and although some who suffer a relapse after one year will achieve a second remission with further treatment, those who have a relapse early on, or who fail to achieve a remission, have a poor prognosis.

Non-Hodgkin's lymphomata

There is little agreement about the treatment of non-Hodgkin's lymphomata. Most patients have widespread disease at presentation and are therefore unsuitable for radiotherapy. However, as these tumours are highly radiosensitive, those patients who have low-grade malignancies of clinical stages I and II are usually treated with radiotherapy alone. The results of such treatment are not as good as in comparable patients with Hodgkin's disease but, nevertheless, 50% of appropriately selected patients will be alive and disease-free at 5 years.
Chemotherapy in combination with radiotherapy has also been used in the treatment of low-grade tumours but its role remains unclear. In the more widespread diseases (stages III and IV), the treatment depends on histological classification. Patients with low-grade tumours often follow a protracted course with few symptoms. There is little evidence to suggest that cytotoxic agents improve the chance of survival and their use therefore seems unjustified. If, however, symptoms should intervene, low-dose alkylating agents will induce a response in most cases. In contrast, the prognosis pertaining to high-grade malignancies has been dramatically improved using aggressive combination chemotherapy, and the most commonly used regimens include cyclophosphamide, doxorubicin, vincristine and prednisolone. Treatment with these agents leads to remission in almost 100% of patients with stage III disease, and in just under 50% of those with stage IV disease.

The occult primary

A patient presenting with a metastatic cervical malignancy from an unknown primary source is said to have an occult primary. It is not uncommon for a metastatic node to produce minimal symptoms and to have an indefinite pattern of development which is not accompanied by any significant history. One-third of these patients have additional symptoms including pain, weight loss, malaise and fatigue, but because of the lack of significance attached to these symptoms, less than 20% of patients with a cervical mass present in the early stage of the disease. In a series of patients reported by Winegar and Griffen (1973), the average time from the first sign of a mass presenting in the neck to the time of the patient's initial evaluation was 5.1 months.

This interval is comparable with those reported by other authors. The incidence of tumour types is listed in Table 17.4.

Table 17.4 Incidence of tumour types

<table>
<thead>
<tr>
<th>Tissue type</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squamous cell carcinoma</td>
<td>41</td>
</tr>
<tr>
<td>Undifferentiated</td>
<td>36</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>17</td>
</tr>
<tr>
<td>Lymphoepithelioma</td>
<td>6</td>
</tr>
<tr>
<td>Melanoma</td>
<td>3</td>
</tr>
<tr>
<td>Leiomyosarcoma</td>
<td>1</td>
</tr>
<tr>
<td>Lymphosarcoma</td>
<td>1</td>
</tr>
<tr>
<td>Chondrosarcoma</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>106</strong></td>
</tr>
</tbody>
</table>

Current methods of investigation are unable to detect tumours in the body until about 1 g of tumour, consisting of approximately $10^9$ cells, is present. Generally speaking, as a patient is likely to die when the total tumour burden reaches between $10^{12}$ and $10^{13}$ cells (that is 1-10 kg tumour weight), it follows that the tumour will already be at least two-thirds of the way through its life span before it is detected. Using this criterion, most tumours in man must be late or at an advanced stage at the time of initial presentation.
Three points should always be kept in mind when examining a neck mass. First, most persistent lumps in the neck in the adult are the result of malignant disease. Second, most malignant tumours in the neck are metastatic and if the presence of a goitre is excluded, the frequency of occult carcinoma in patients presenting with a metastatic node is about 5%. Third, most metastases in the neck originate from primary sites in the head and neck.

Martin and Romieu (1952) reported the following primary sites which should always be under suspicion as a source for a metastatic node in the cervical region:

- nasopharynx
- tonsil
- base of tongue
- thyroid
- hypopharynx.

It is unfortunate that the three most common sites which give rise to occult cervical metastases - the nasopharynx, the tonsil and the base of the tongue - cannot be examined easily by the general physician using a simple tongue depressor. It is important that attention to the cervical mass does not distract from the search for the primary tumour, for any delay in its discovery may allow it to advance to an incurable stage.

**Premature biopsy**

Premature biopsy of a suspicious cervical mass is a common and usually serious error of management, especially if the metastatic node exhibits extracapsular rupture. It is an excellent principle that any surgeon who violates the skin of the neck to obtain a histological diagnosis by either an incisional or an excisional biopsy should be prepared to proceed with a radical neck dissection if this is indicated. Injudicious removal of a metastatic node causes surgical scarring which may prevent or preclude subsequent surgical dissection of the lymph node bearing area. Above all, this procedure may delay the proper treatment of the primary tumour.

**Search for the primary tumour**

When a patient presents with a cervical mass which is considered to be a metastatic node, the search for the primary tumor should follow an established sequence of investigation, although the order of investigations may have to be tailored to the individual. Following the taking of a careful history and a general physical examination, the buccal cavity, the base of tongue, the hypopharynx and the nasopharynx should be carefully inspected. Examination is further facilitated by palpation, particularly in areas where this can be carried out bimanually. Palpation is an important part of the examination and Conley (1971) has emphasized that palpation should be performed during examination of the head and neck wherever a finer may reach, likening its value to that of having the added facility of a third eye.
**Investigations**

Investigations should include the following:

(1) sinus and chest X-rays, contrast studies of the upper and lower gastrointestinal tract if the metastatic tumor is an adenocarcinoma

(2) triple endoscopy: this includes laryngoscopy, bronchoscopy and oesophagoscopy

(3) in some instances blind biopsies of the lymphoid tissue from Waldeyer's ring - in particular, the postnasal space, the tonsils and also the lymphoid tissue of the posterior third of the tongue

(4) The use of specialized techniques to aid identification of an undiagnosed mass in the neck (see below):

   - CT scanning
   - radiolabelled antibodies
   - fine needle aspiration cytology.

Only if, following of a full diagnostic evaluation, still no evidence of a primary tumour has been found does the patient fall into the occult primary tumour category.

**Management**

The survival time for a patient presenting with an occult tumour, in whom no primary is ever found in spite of full investigation, varies considerably with different reports. Jesse and Neff (1966) reported a 34% survival (absolute) in 127 patients, but Winegar and Griffen (1973) found only 15% (16 out of 106 patients) who survived a 5-year period. It must be postulated in such cases that the primary cancer is either so small that it cannot be discovered or that it has regressed spontaneously. Alternatively, if radiation therapy has been used for the treatment of the neck metastases, it is possible that the primary tumour has been sterilized by the irradiation. Although it is an established principle of radical neck dissection that the operation should not be performed unless the primary tumour has been controlled, it is impractical to follow this edict where the primary site is unknown. However, a radical neck dissection will still be necessary to control the metastatic disease, and the patient is more likely to die from the secondary disease than from the occult primary tumour even if it subsequently becomes clinically evident.

The options open for treatment of a patient with an occult tumour will have to be carefully considered. Surgery alone should give about a 40% 5-year cure rate. Combination therapy of surgery and radiotherapy may be more effective than irradiation alone, but it is probably wiser to employ surgery initially and to save irradiation therapy until later for proven residual or recurrent disease.

Jesse and Fletcher (1977) showed in their series that surgery alone gave the patient with a single node in the upper part of the neck a 50% chance of a cure. It is preferable, therefore, that surgery should be employed as the treatment of choice in the case of an occult
primary if the lesion appears resectable. However, for patients with multiple enlarged unilateral nodes, radical neck dissection combined with irradiation therapy is probably warranted, for without adjunctive radiotherapy this group is more liable to incur a recurrence.

Follow-up

Careful and regular follow-up after a patient has been treated for an occult primary is mandatory. The histology of a metastatic node may or may not be helpful in deciding the areas to be closely examined. In the case of metastasis from squamous cell carcinoma, examination of the ears, nasal fossae, postnasal space and pharynx should be carried out at regular intervals of 3-4 months. Periodic endoscopy with selected biopsies of the nasopharynx, base of tongue and tonsil area should also be performed. If the histology of the node shows a glandular origin, investigations should be carried out at 6-monthly intervals to screen the upper and lower gastrointestinal tract, and should include mammography in women, CT scanning of the thyroid and salivary glands and occasionally examination of the prostatic fluid in men.

Computerized tomography of the soft tissues of the neck

Computerized tomographic (CT) scanning has been used in the preoperative examination of patients with head and neck cancer. Mancuso, Maceri and Rice (1981) were the first to report on the use of CT scanning in the evaluation of cervical node metastasis. They found CT scanning to be accurate in 21 out of 23 patients when correlated with pathological specimens. Such early reports on the use of CT scanning for cervical lymphadenopathy were encouraging, and the accuracy of CT scanning in the detection of nodal metastasis has been further established by Friedman et al (1984) who compared 50 consecutive patients who had undergone radical neck dissection and preoperative CT scanning. The clinical staging of the neck, the CT scanning diagnosis and the pathological findings were correlated and the findings showed that the overall accuracy of CT scanning diagnosis was 90%. Through this comparison, the CT scan was shown to be superior to clinical examination and particularly effective in detecting occult metastasis. As the technique has proved to be diagnostically accurate, CT scans can provide important clinical information for treatment and prognosis.

At present, nodal disease is routinely staged by clinical examination and reports of the accuracy of such examination vary widely. Beahrs and Barber (1962) found a 30% false positive rate and a 39.9% false negative rate following clinical examination, which underlines the potential benefits of developing highly accurate CT scanning for cervical lymphadenopathy.

Tomographic studies of patients with clinically palpable nodes can also reveal the integrity of the vasculature. Thrombosis of the jugular vein has been diagnosed but involvement of the carotid artery is more difficult to assess accurately, although the findings by CT scanning in respect of a normal carotid artery rule out arterial involvement by nodal disease.
The use of radiolabelled antibodies in the detection of squamous cell tumours

The radioimmune detection of tumours by external emission scanning has attracted interest recently with the introduction of subtraction scanning techniques. Head and neck squamous cell carcinomata are not associated with tumour-specific antigens, but the serum carcinoembryonic antigen (CEA) levels are frequently elevated and CEA has been demonstrated on the tumour cell surfaces (Toto, 1979). Tranter et al (1984) successfully used a radiolabelled scanning technique to locate accurately several areas of tumour tissue arising from head and neck squamous cell carcinoma. The resolution is probably comparable with other antibody scans, but as the neck is a good area for radionucleotide imaging, considerable improvement was anticipated with new detection systems. In this study, masses greater than 2.0 cm were detected in several parts of the body. The technique was thought to be suitable for the detection of occult primary lesions and in the assessment of lymph node spread in metastatic sites, and at the same time in determining whether an enlarged lymph node containing tumour or was merely exhibiting reactive changes. Two advantages of this type of scan over other scanning techniques are that tumour is positively identified and, provided that the facilities are available, the procedure is simple to undertake.

Fine needle aspiration cytology of cervical lymph nodes

The examination of cells for diagnostic purposes originated in the nineteenth century and was initially applied in haematological diseases. Since then it has become accepted practice to use this technique in the assessment of haematological diseases, including the diagnosis of primary and secondary malignancies of the bone marrow and in the analysis of effusions.

The use of aspiration cytology in the diagnosis of solid tumours has remained controversial, although evidence in support of this method was published as long ago as the 1930s. A real stimulus to its further development was provided by Papanicolau, who demonstrated that malignant changes were present on smears obtained from secretions and who is remembered for the development of the Pap smear test used for the detection of uterine malignancy (Papanicolau and Trant, 1943). More recently, needle aspiration cytology has developed a wider application and the cytological features associated with a variety of different malignancies have now been catalogued.

The technique of aspiration cytology is simple, quick and virtually painless. Infiltration of the skin with a simple short-acting anaesthetic (such as lignocaine 1%) may be used before insertion of the needle for tumour aspiration, but it is not mandatory and may 'blur' the outline of a small lesion. The target is then precisely defined and the area punctured with a 24-gauge needle attached to a 10 or 20 mL syringe; if a local anaesthetic has been used, it is preferable to ensure a separate track for the aspiration in order to avoid any artefact which may have been induced. Negative pressure is then applied to the plunger of the syringe and the needle tip passed to and fro in the lesion to be sampled. The cells and tissue fluid thus obtained are then expelled and smeared on the surface of a glass slide; the smear is then air dried before staining and subsequent examination under the microscope. Variations in the technique described are common, but for a more comprehensive discussion the reader is referred to a recent review (Friedman et al, 1983).
Lymph nodes and neck masses were among the first targets selected for demonstrating the use of the technique of aspiration cytology. Multiple nodes can be sampled during the same session and an accuracy rate of around 95% has been claimed for epithelial tumours.

Cervical lymph node biopsy

It is a widely accepted principle that to take a biopsy of a metastatic cervical node mass instead of searching for a primary neoplastic source is totally incorrect. The information obtained is, at best, only the cell of origin and its degree of differentiation and, at worst, reveals the existence of an anaplastic lesion. In neither case does the result indicate the site and/or extent of the primary tumour. In addition, the incidence of wound sepsis and fungation of the tumour through the skin of the neck is higher in patients who have undergone such a biopsy, and McGuirt and McCabe (1980) reported an increase in the incidence of distant metastases in patients who had undergone a cervical node biopsy before definitive treatment.

The significance of a neck node to radical neck dissection

The effect of metastatic node on prognosis

In 50% of cases where one lymph node is positive on palpation there will be several other nodes which will be microscopically positive.

Whenever evidence of cervical metastasis is lacking, the general prognosis for a specific primary tumour is obviously more favourable. However, cancers of the nasopharynx and tonsil, as well as malignant melanoma, show a particularly poor prognosis when a node is involved. Regardless of the site of the primary tumour, only 33-40% of patients will survive longer than the 5-year period if cervical metastases are present at the time of dissection.

Chronological appearance of significant lymph nodes

If positive lymph nodes in the neck become apparent soon after the presentation of the primary tumour, an attempt to control the metastatic disease through a radical neck dissection will be less effective than in those cases where there is a delay in the spread of the metastatic tumour after the appearance of the primary. In the former cases, the 5-year survival rate falls below 40% (Pack and Ariel, 1964).

The operative techniques of neck dissection

The classical radical neck dissection

In many cases, a primary head and neck tumour will respond to treatment with radiotherapy, but lymph nodes invaded by squamous carcinoma are less likely to do so and must be treated surgically. Operation may be required to remove the nodes alone or can be performed in continuity with removal of the primary tumour; without doubt, this is best achieved by a classical radical neck dissection. The only indication for the local removal of palpable carcinomatous cervical nodes is in the treatment of papillary carcinoma of the thyroid which, during its long natural history, is slow to break out of the capsule of the
thyroid gland and does not follow the anticipated lymphatic channels taken by other head and neck carcinomata.

The surgical removal of metastatic lymph nodes by block dissection of the neck does not appear to increase the risk of general metastasis. An extended dissection into the mediastinum does not greatly increase the cure rate. It is therefore fair to say that the classical radical neck dissection of involved lymph nodes continues to offer the best possible means of control. The failure to remove all involved lymph nodes together with the primary tumour must decrease the survival rate; and, as such, a partial neck dissection can have only a limited role.

When a radical neck dissection is carried out as part of a combined procedure, it is most important that as much tissue continuity as possible is retained between the primary site and the lymphatic field. Therefore in a total laryngectomy, the neck dissection can be left attached along the whole length of the larynx to include the superior and inferior pedicles, whereas when a laryngopharyngectomy is performed, the pedicle consists of the whole length of the pharynx. In oral cancers, the specimen should be left attached along the lower border of the mandible and should include the inner layer of the periosteum. Tumours of the oropharynx drain through a pedicle to the upper deep cervical nodes, so the specimen should remain attached near the tail of the parotid.

**Incisions**

The factors which influence the planning of incisions in the neck can be divided into two main groups:

1. the site of metastatic cancer, the nature and position of the primary, and the size, mobility and anatomical level of the metastases

2. whether or not the patient has had preoperative irradiation, with consideration being given to the size of the port and the dosage given. It must be remembered that any patient who has received over 6.000 cGy of radiation will have suffered marked damage to the skin and subcutaneous structures which means that any flap will not be as viable or heal as quickly as in a non-irradiated neck.

The first approach was described by Crile in 1906. The Y-type of incision which he used remains an excellent incision, having proved its value over an 80-year period. MacFee's double horizontal incision (MacFee, 1960) which is perhaps the most aesthetic, and which is especially suitable following irradiation, does not give such good exposure. The Martin approach is also useful and was designed to produce smaller flaps in order to prevent necrosis associated with radiotherapy (Marin, 1941). The flap described by Schobinger was placed below the horizontal ramus of the mandible and extended to the top of the mastoid and over the border of the trapezius muscle to the clavicle, giving a large single lateral cervical neck flap with excellent exposure; however, it had the disadvantage that its upper part was subject to necrosis. Conley added an additional incision at the posterior curve of the Schobinger flap, to include the parotid gland and the nape of the neck. Other flaps based either anteriorly or posteriorly have not proved as reliable, and consequently have been discarded. Single flaps are not acceptable in patients who have had severe preoperative irradiation resulting in
extensive fibrosis, atrophy and telangiectasia of the skin, as all of these factors delay healing. This has been known to occur with the Martin flap and, as such, represents a serious disadvantage of the approach. The horizontal T-incision, which produces large superior and inferior flaps, is satisfactory when a combined neck dissection with the contralateral side is contemplated, but though should always be given to the question of whether an anteriorly developed flap will survive if a preoperative tracheostomy has been performed, for the blood supply will have been diminished by the tracheostomy incision. If there is any doubt about the viability of irradiated skin, or if the superficial layers have been invaded by cancer, the area of skin affected should be sacrificed and the deficit compensated for by a transposition flap.

Rogers and Freeland (1976) when investigating the arterial vasculature of cervical skin flaps by perfusion experiments in cadaveric flaps concluded that: (1) the platysma muscle should be included in the flap to conserve the vascular network; (2) the horizontal limb of an incision should lie in the watershed between the carotid and subclavian arterial systems; and (30 the upper flap should be larger than the lower flap.

Superficial dissection

In a routine approach using a modified Y-shaped Crile incision, the platysma muscle should be included in the flap. Following the raising of the superior skin flap, the great auricular nerve and the superior part of the sternomastoid muscle will be identified. In the anterior part of the neck there is an absence of platysma muscle separating the skin from the deeper structures in the submandibular triangle, and care must therefore be taken to preserve the mandibular branch of the facial nerve when raising the superior flap.

Lower end of the jugular vein

In the lower part of the neck, the supraclavicular nerves and vessels will be seen and a tunnel superficial to the anterior belly of the omohyoid will lead directly under the sternomastoid muscle to the carotid sheath. The manubrial and clavicular heads of the sternomastoid will have to be divided to expose the inferior segment of the internal jugular vein. When handling any of the large veins of the neck, care has to be taken to prevent an air embolus. In addition, the lower end of the jugular vein must be ligated at the earliest opportunity to reduce the incidence of systemic metastases caused by tumour embolus.

The jugular lymph trunks

On the left side, the thoracic duct ascends medially to the internal jugular vein and passes posteriorly and laterally to the vein before descending to enter the junction of the internal jugular and subclavian veins. Its position as well as the number of its tributaries may vary. In 50% of cases, the thoracic duct will be identified on the right side.

Supraclavicular dissection

By following the superior border of the clavicle laterally to the trapezius muscle, and after ligating the external jugular vein above, access will be gained to the posterior belly of the omohyoid muscle which can be cut and allowed to retract into the specimen. The brachial
plexus can now be identified with the phrenic nerve arising from anterior primary rami between the levels of C3 and C5. It runs under a fibrofatty pad on the scalenus anterior muscle. The three branches of the thyrocervical trunk will also be identified.

**Spinal accessory nerve and posterior dissection**

The splenius capitis muscle is identified by following the anterior border of the trapezius. The anterior and posterior branches of the transverse cervical artery, including the veins from the nape of the neck, will need to be ligated in the supraclavicular fossa.

The branches of the third cervical nerve may join the accessory nerve as it crosses the posterior triangle before its insertion into the trapezius muscle; these branches from the cervical plexus are now considered to contribute as motor nerves to the trapezius muscle and, if they can be preserved, they will help to prevent shoulder drop when the main spinal accessory nerve is divided. A shoulder drop nearly always occurs following a classical radical neck dissection, but whether this is an impediment or a serious handicap varies in different patients. By the earlier identification of the brachial plexus, the correct layer for preservation of the phrenic nerve is identified and then, by following the nerve pedicles of C2, C3 and C4 in turn, access to the posterior surface of the carotid sheath is ensured. This posterior approach gives access to the whole length of the carotid and deep jugular system.

The vagus nerve is identified lying between the internal jugular vein and the common carotid artery, and the descending branch of the ansa hypoglossi nerve, supplying the strap muscles, will be seen lying on the superior surface of the carotid sheath. The hypoglossal nerve is identified crossing the carotid artery above the bifurcation and the dissection is continued to expose the region of the axis and mastoid process as far as the digastric groove. The fibrous origin of the sternomastoid muscle is separated from the mastoid process, and the posterior belly of the digastric arising from the digastric groove is identified; a tunnel is developed along the muscle to the hyoid bone. The hypoglossal nerve will once again come into view between the internal carotid artery and vagus nerve; behind this lies the superior cervical ganglion.

**Anterior dissection and submandibular triangle**

The anterior part of the dissection is continued, to the hyoid bone, by dividing or ligating the ansa hypoglossi and the plexus of veins coming from the pharynx. Dissection exposes the anterior belly of the digastric and the lateral border of the mylohyoid muscle. Between 1.0 and 2.0 cm below the lower border of the mandible, the mandibular branch of the facial nerve is again identified, together with the facial vessels and related facial lymph nodes. The nerve should be preserved provided that there is no cancer in the anterior and posterior nodes associated with the facial artery. By retracting the posterior border of the mylohyoid, the lingual nerve is demonstrated. On elevation of the nerve, the lingual extension of the submandibular gland and duct is found so that the duct can be ligated as far forward as possible to prevent infection developing in any duct remnant. The deep part of the facial artery should be identified and ligated where it emerges above the posterior belly of the digastric muscle.
Parotid gland

If there is any tumour involvement of the parotid gland, the entire gland should be removed in conjunction with the facial nerve; usually only the most inferior part of the gland needs to be removed. The posterior facial or retromandibular vein will need to be ligated where it lies in relation to the posterior belly of the digastric muscle. At this stage, it is important that the subdigastic area is examined for metastatic spread. The stylohyoid muscle can be identified immediately above the digastric tendon as it passes to be inserted into the lesser cornu of the hyoid bone. Both muscles should be included in the specimen if there is metastatic disease in this area. The occipital artery will require ligation once the posterior belly of the digastric has been divided. It must be remembered that the facial nerve lies adjacent to the anterosuperior border of the posterior belly of the digastric muscle.

Carotid artery protection

The levator scapulae muscle, or part of the trapezius muscle, can be used if there is concern about cover for the carotid artery or bulb in heavily irradiated neck. These muscles can also be used to provide cover for a pharyngeal fistula.

The upper end of the internal jugular vein

The upper end of the internal jugular vein is identified and divided as it lies deep to the posterior belly of the digastric muscle. The specimen can then be removed along with the metastatic nodes which remain attached to the deep surface of the sternomastoid muscle and the internal jugular vein. The wound should be drained through two continuous suction drains. Healing is normally complete in 7-10 days.

Bilateral neck dissection

The presence of stage N3 bilateral neck glands is a serious and poor prognostic sign and, in such instances, the survival rate falls to around 5%. For example, the 5-year survival rate in cases of carcinoma of the mouth with bilateral neck glands is only 9% (Spiro et al, 1974), and in other sites, such as the oropharynx and hypopharynx, it may be as low as 4% (Lederman, 1967).

More than 90% of patients who have bilateral lymph nodes have primary cancers situated in midline structures such as the mouth, the oropharynx and the hypopharynx, and all these sites have an extremely poor prognosis. In most cases, surgery probably does not influence the natural history of the disease, but Stell (1978) indicated that patients with a supraglottic carcinoma and bilateral glands are an exception and can still have a reasonable prognosis.

In spite of this low survival rate there are many reports in the literature of synchronous bilateral neck dissection, the first being by Le Clerc and Roy in France in 1932. In the main, patients presenting for treatment who have advanced cancer of the head and neck with evidence of bilateral node involvement are felt to be beyond hope. Palliative irradiation may be offered to the patient, but there is little hope of success in respect of prolongation of life.
The same is true of those patients with advanced disease who have been treated by a neck dissection on one side, combined with an attempt to control the other side using radiation.

The procedure of bilateral synchronous radical neck dissection carries a significant morbidity, and a mortality rate of 3.4% (Ballantyne and Jackson, 1982). Many of the complications of bilateral radical neck dissection can be reduced by staging the two sides with an interval of 6 weeks or longer, but a tracheostomy is occasionally required at the time of performing the second stage of the procedure.

When a bilateral synchronous neck dissection is carried out, it should be appreciated that the operations on each side of the neck are not usually identical, and that a modified neck dissection is nearly always required on the opposite side to preserve the internal jugular vein.

If both internal jugular veins are to be ligated, it is important to understand the effect on the venous drainage of the head and neck. The anatomy of the venous circulation of the cranial cavity must be considered. In addition to the internal and external jugular veins, the alternative drainage systems in order of importance are:

1. the external and internal vertebral plexus with their communicating veins
2. the occipital vein
3. the posterior jugular vein
4. the deep cervical vein
5. the collecting veins of the posterior cervical region and pharyngo-oesophageal and pterygoid plexus.

The total cross-section of the vertebral venous system alone probably exceeds that of the jugular veins. A rich communication also exists between intracranial and extracranial structures of the head via emissary veins. In these, the flow is mainly towards the extracranial areas, thus reducing venous congestion in the brain when the jugular circulation is blocked.

Nevertheless, the most serious complication after bilateral radical neck dissection is that of increased intracranial pressure. Although cerebrospinal fluid pressure is to some extent influenced by the position of the head, the tying of one internal jugular vein in a radical neck dissection produces a threefold increase in intracranial pressure, and when the second side is tied a fivefold increase in pressure results.

De Vries, Balm and Tiwari (1986) published details of a case where a patient developed prolonged papilloedema as a result of increased cerebrospinal fluid pressure following a staged bilateral radical neck dissection. The prognosis for vision is usually good in such patients, but permanent visual impairment remains a serious complication.

The critical period for a patient with regard to the development of a raised cerebrospinal fluid pressure following a synchronous bilateral neck dissection is during the first 12 hours. During the 8-10 days after the operation, the intracranial pressure tends to fall, although it does not revert to a normal level.

The performance of a bilateral neck dissection undoubtedly increases the incidence of oropharyngeal fistula, particularly in those patients who have had previous irradiation; in
addition, there is the increased risk of postoperative wound complications resulting from sepsis and slough of skin flaps. As the survival rate is around 5% for patients presenting with bilateral neck metastasis, the indications for bilateral staged or synchronous neck dissections are obviously limited, but this should not be confused with the treatment of and the prognosis for a patient presenting with a metastatic node on the second side at a later stage. The prognosis here is totally different from that of a patient who presents with bilateral synchronous neck glands, and surgical treatment may be warranted in the case of the former group.

**Radical neck dissection combined with superior mediastinum dissection**

The majority of head and neck tumours metastasize to the jugular chain, but there are some tumours, notably those of the cervical oesophagus, the subglottic space and the thyroid gland, which are known to metastasize preferentially to lymph nodes in the mediastinum. Sissons, Edison and Bytell (1975) described an operation for dissecting the superior mediastinum based on a method given by Grillo (1966). This operation was developed to deal with recurrences affecting the stoma following a laryngectomy, and requires the development of two bipedicled upper chest flaps. These flaps are designed to protect the structures in the upper mediastinum which are exposed when the manubrium and the medial end of both clavicles are removed. According to Sissons' description of the operation, the first stage is to delay a myocutaneous flap of the pectoral muscle which, in the second stage of the operation, is then laid over the mediastinum to protect the great vessels. Although the operation has not been performed a sufficient number of times for it to be evaluated, there have been reports of success using this technique.

**Functional neck dissection**

In a 1979 report of a large series of 788 consecutive cases of radical neck dissection, nearly one-fifth of the patients experienced a major complication, with an overall morbidity rate of 50.8% (McGuirt and McCabe, 1980). As 20.4% of these patients had regional recurrences, it is not surprising that consideration has been given to the technique of 'functional neck dissection'.

The elegant technique of functional neck dissection was described by Bocca and Pignataro (1967) who removed a 'package' of lymph nodes and their vessels, but retained the internal jugular vein, accessory nerve and sternomastoid muscle. On the basis of the anatomical and surgical contributions of Suarez (1963), Bocca (1966) modified the traditional neck dissection by radically revising the historical concepts identified with the surgical treatment of regional metastasis. As a staunch opponent of conservative nodal stripping, Bocca set out to show the effectiveness of the surgical technique which he called 'the functional neck dissection'. The arguments he put forward to support his technique were as follows:

1. functional neck dissection avoids the unjustified consequences of the traditional neck dissection, including dropped shoulder, skeletal pain, the limitations of neck and limb motion and widespread cutaneous anaesthesia

2. bilateral dissection may be performed simultaneously without danger of intracranial venous congestion
(3) When the preferred treatment of the primary tumour requires combined surgery and radiation, the functional neck dissection may alter the decision for neck irradiation in patients with disease staged as N0, and may provide a reasonable alternative to radical radiotherapy of the neck. It was accepted that the presence of stage N3 fixed nodes represents an absolute contraindication to functional neck dissection.

A weakness of this operation has been exposed by McKelvie (1974) who, in his cedar wood cleared neck specimens, demonstrated that microscopically involved nodes could be identified invading the adventitia of the jugular vein. It is clear that these nodes would not have been removed in a functional neck operation.

Therefore, in spite of the elegant nature of a functional neck dissection in experienced hands, the operation has not been universally adopted and, where it might most reasonably be used, most surgeons still prefer to use radiotherapy as an alternative.

**Prophylactic/elective neck dissection**

A prophylactic radical neck dissection may be defined as a radical neck dissection performed on a neck evaluated by clinical examination as negative for metastatic cancer. The term elective radical neck dissection extends this concept to embrace neck dissection in a clinically negative neck combined with excision of the primary tumour and, as such, places emphasis on the value of the removal of clinically undetected metastatic nodes. Such an approach has the advantage of avoiding the possibility of future surgery under less favourable conditions. It should be emphasized that a prophylactic operation will not benefit patients with advanced primary disease or those with a primary that has metastasized across the midline to give contralateral cervical nodes.

**Conservation neck dissection**

Numerous attempts have been made in the past to modify the classical radical neck dissection by conserving structures that are thought not to be involved in the malignant process or the removal of which would significantly increase the morbidity of the patient after radical operation. The structures which have consistently come under review have been the internal jugular vein, the spinal accessory nerve and the sternomastoid muscle. This adaptation of the classical operation has been defined as a conservation neck dissection, but it is fraught with risk.

Skolnik and Deutsch (1983) found no statistically significant difference in the rate of neck recurrence between a group of 422 patients who underwent radical neck dissection and the 269 patients who underwent conservation surgery. These findings have been confirmed by other authors, notably Lingeman et al (1977), Molinara et al (1980), Deutsch et al (1985), all of whom have suggested that tumour recurrence in the neck in patients with N0 and N1 disease is the same regardless of whether radical or conservative neck dissection has been employed.

Some surgeons also think that it is logical to conserve the spinal accessory nerve, since the vagus, hypoglossal and lingual nerves are routinely spared in neck dissection without any increased risk of tumour recurrence. Skolnik et al (1976) showed that the inferior spinal
accessory nodes were free of metastatic tumour in 51 dissected necks in which the nerve had been preserved. However, they had studied only those nodes along the portion of the spinal accessory nerve distal to the sternomastoid muscle, whereas Schuller et al (1983), in carrying out a prospective study, found that 90% of metastases in the spinal accessory chain were located along the proximal portion of the nerve, that is, that part superior to the point of entrance of the spinal accessory nerve to the sternomastoid muscle.

If a conservation neck dissection is to be performed, a careful selection of patients is paramount, for the partial operations should be undertaken only where there is limited disease and where the natural history of the tumour is well understood. For example, the spinal accessory nerve may be preserved in the case of low-grade tumours of the thyroid, but it must be remembered that when less of the potential specimen is removed, there is more likelihood of residual disease remaining in the neck.

**Limitations and failure of radical neck dissection**

**Complications**

The incidence of major complications after radical neck dissection can be as high as 20% (Yarrington, Yonkers and Beddoe, 1973), and between 1 and 20% of patients die as a result of the various complications arising from this operation. The major and potentially lethal complications of radical neck dissection are wound infection, necrosis of the skin flaps and rupture of the carotid arteries. It is well known that the effects of these major complications are increased by prior radiotherapy.

**Infection**

Infection of the neck following surgery is almost always secondary to an infected haematoma, and is more likely to occur in heavily irradiated patients in whom large flaps with compromised blood supply are overwhelmed by Pseudomonas or other Gram-negative organisms. These infections rarely spread to the deep neck spaces as the spaces have usually been obliterated during the procedure. In addition to haematomata, other contributing causes may be excessive blood loss without replacement, diabetes or other debilitating diseases.

Infections with abscess formation usually take several days to develop and more frequently occur in patients in whom the oral and pharyngeal cavities have been opened. The presence of fullness under the skin flaps requires immediate action. Failure to incise or re-open the wound and to drain the serum or infected haematoma may result in the further undermining and elevation of the flaps, with flap necrosis, spread of infection, exposure of major vessels and possibly carotid artery rupture. The spread of infection into prevertebral, retropharyngeal or pretracheal spaces can lead to fulminating mediastinitis or septicaemia, and this can produce life-threatening complications, such as bacterial endocarditis, meningitis, brain abscess, or microabcesses in various other organs of the body. A local wound breakdown may also produce an oral, pharyngeal or oesophagocutaneous fistula.

In patients who have had a heavy dose of irradiation, the use of pre-, intra- and postoperative antibiotics, whenever the oral cavity, pharynx, larynx or oesophagus has been opened, is important in preventing the spread of infection.
**Carotid artery rupture**

Carotid artery rupture is a disastrous emergency which results in fatality unless someone close to the patient responds immediately. The gradual destruction of the vessel wall usually takes 6-10 days, with erosion most commonly occurring at the site of the carotid bulb in the region of the bifurcation. Such an event is more likely to occur if radiotherapy has been used preoperatively, as this affected the vasa vasorum of the adventitia. Immediate pressure must be applied locally over the artery to control the haemorrhage during urgent transfer of the patient to the operating theatre, where the wound can be explored and the bleeding vessel ligated. Hemiparesis remains a strong possibility after carotid artery rupture, but prevention of shock with the maintenance of adequate perfusion of the brain through the opposite internal carotid artery can diminish the risk. There are occasions in cases of advanced cancer of the neck when rupture of the carotid artery can be anticipated as the cause of death.

The incidence of carotid artery rupture can be reduced with careful planning of the neck incisions and this is an advantage of the double horizontal incision described by MacFee (1960). The carotid sheath of a patient should be protected if previous heavy irradiation has been given, particularly in cases where, because the primary carcinoma originated in the mouth, pharynx or larynx, the formation of a fistula is likely. Muscle flaps used to cover the artery were described by Schweitzer (1962) and free grafts of dermis by Corso (1963). More recently, Gardiner, Ariyan and Pillsbury (1983) have described the successful cover of an exposed infected carotid artery using an ipsilateral trapezius myocutaneous flap. In the absence of the transverse cervical artery, the flap is nourished by the occipital artery alone.

It is an ominous prognostic sign when the carotid artery is found to have been invaded by tumour. Kennedy and Krause (1977) showed that invasion occurred in 5.4% of 508 radical neck dissections. In most cases where invasion of the carotid artery by tumour is suspected before the operation, carotid angiography should be carried out with compression of the affected side in order to evaluate the collateral circulation and the likely tolerance to surgical interruption. Although numerous methods have been described, both preoperative and intraoperative, none is absolutely reliable. Serious neurological complications have been described in at least 5% of patients following ligation of the carotid artery despite a normal test (Suarez et al, 1981). The most effective tests are the use of EEG in conjunction with intraoperative clamping of the carotid artery and measurement of the resultant luminal pressure. Because of the unforeseeable sequelae which can occur as a result of occlusion of the carotid artery, it is preferable to excise and replace the vessel whenever possible. This is particularly true if the tests show tolerance to ligation and there is little risk of fistula formation. However, in adverse circumstances, for example after heavy irradiation, it is preferable to carry out a palliative excision rather than a graft because of the risk of infection with associated rupture of the graft. If the tests show tolerance in an irradiated patient, the decision to insert a graft needs to be taken carefully, although successful cases of arterial substitution in patients who have previously been irradiated have been described. It has to be said that, overall, the prognosis for these patients is discouraging whichever technique is adopted. For example, in the small series of Suarez et al (1981), only two of the 16 patients (13%) survived.
**Fistula**

Radical neck dissection combined with laryngectomy or partial laryngopharyngectomy dramatically increases the incidence of fistula formation. This in itself depends to some degree on the nature of the tumour, the dosage of preoperative irradiation, the presence of systemic disease and the operative technique used. T3 or T4 tumours of the pyriform fossa are associated with a high incidence of postoperative fistula when combined with radical neck dissection. Fistula formation is also high in patients who have received preoperative radiotherapy greater than 3,000 cGy. In general, patients with systemic disease, such as diabetes mellitus, are more likely to run a complicated clinical course and produce a fistula. In most instances, a fistula will develop within 3 weeks of surgery and it should then be exteriorized in order to prevent secretions transversing the carotid artery and elevating the skin flap. By exteriorizing the fistula medial to the carotid artery, rupture of the vessel will be prevented provided that the wound has not broken down. However, satisfactory closure of a fistula may ultimately require a myocutaneous flap for repair.

**Chylous fistula**

Chylous fistula is a rare complication of radical neck dissection (1-2%). It occurs predominantly on the left side of the neck; only 25% of fistulae appear on the right side. If the mediastinal pleura is intact, two or more days may elapse during which chyle will fill the mediastinum before rupturing into the pleural cavity. Once established, a chylothorax becomes a serious matter, because as much as 3 litres of fluid may quickly be lost, with an attendant electrolyte, protein and fat depletion.

The commonest presentation of a chylous fistula after an operation is the presence of milky fluid in the suction drainage. Chyle can be differentiated from standard wound effusions by its appearance, by an analysis of the fat content, and by the presence of fat droplets with the separation of a fat layer on standing. In addition, the specific gravity is higher and the protein content lower than effusion fluid. As chyle accumulates in the wound, it causes redness and bulging of the flap with marked induration of the tissues. Chylothorax, if it occurs, presents as either an acute or a gradual onset of dyspnoea, usually several days after the operation.

Conservative treatment is based on continuous suction drainage and rigorous substitution of lost nutritional elements.

The duration of conservative treatment depends on the general condition of the patient, as most chylous fistulae will eventually dry up over a 2-3 week period. The surgical management of a chylous fistula requires re-exploration of the neck and the identification and ligation of the leaking lymph vessel after the patient has been allowed to drink a small quantity of cream containing a colourant.

**Palliation in neck cancer**

About 60% of patients who present with cancer of the head and neck will not be cured, but will, nevertheless, require alleviation of their symptoms. Once such a policy is accepted, the choice of options for further therapy is wide, and much interdisciplinary
expertise must be available. The expansion of ablative and reparative treatment for the cure of head and neck cancer during the last 30 years has been accompanied by a substantial improvement in the scope of palliative techniques, perhaps over a broader field than for curative therapy. For example, if radiotherapy is used as a primary treatment, the problem arises of retreatment of tissues that have been previously irradiated. Sometimes it is possible for irradiation to be given through non-irradiated skin flaps which have been used to replace previously treated skin. Unfortunately, in cases of squamous cell cancer, palliative doses of radiotherapy need to be high, that is in the range of 6,000-6,500 cGy over 6-7 weeks. Inoperable neck metastases in previously irradiated areas are probably best palliated by means of either a permanent implant of radioactive gold grains or a temporary wire implant of radioactive iridium-192 and, wherever possible, by direct surgical exposure. It is prudent in such cases to remove all damaged irradiated skin at the time of placing the implant and to cover the defect with a non-irradiated well-vascularized myocutaneous flap. In the previously untreated neck, implants may be supplemented by teleradiation therapy (Shaw, 1985).

Advanced cancer of the neck

A gland in the neck is unlikely to be fixed until it becomes larger than 6.0 cm or more in diameter (Spiro et al, 1974). The presence of fixed glands is in itself an uncommon event, for it occurs in only 5% of all patients with head and neck cancer. Whether a neck is operable in the presence of a fixed gland or glands is a decision that must be made by the surgeon, but the presence of fixed glands does not totally preclude the possibility of surgery. If the tumour ruptures through its capsule and becomes fixed to other structures in the neck, the patient is almost certainly incurable and is likely to die from either a local recurrence or distant metastasis. Capsular rupture must, therefore, be seen as a contraindication to attempting further, be seen as a contraindication to attempting further curative treatment of the patient and, instead, thoughts must be turned towards palliation. Surgery is also contraindicated if the tumour involves either the base of the skull or the brachial plexus, but it is possible to resect a tumour involving a large area of overlying skin and replacing it with a myocutaneous flap. In some selected cases, this procedure has been shown to offer the chance of long-term survival and is helpful in palliation. Most patients are unlikely to be cured following the treatment of fixed nodes with a combination of preoperative radiotherapy and surgery, and Santos et al (1975), who analysed a small series of patients with fixed nodes, showed that the survivors were those in whom the tumour had been sterilized by radiotherapy.

If the tumour invades the carotid system, a decision has to be made as to whether resection of the common carotid artery and its replacement with a vein graft is warranted. A high operative mortality must be expected. Conley (1952) described the results in the case of 31 patients who underwent resection of the common carotid artery: in spite of an operative mortality of five out of the 15 patients, a few did survive to live a useful life for periods of up to 2 years. This is a technique that has not been generally accepted and represents an area where there is a need for further advancement and technical development.

Terminal cases

Almost all patients with advanced cancer in the neck will experience distressing symptoms during the weeks preceding death. These symptoms usually include a combination of physical, mental, social and spiritual ills which contribute to the concept of 'total pain' in
the dying, and were described by Cecily Saunders (1978) as a 'continuing situation, rather than a sharply demarcated event: it often has no foreseeable end and often no remembered beginning'. The principles underlying the methods adopted for the relief of the physical symptoms of advanced cancer should be in the repertoire of every otolaryngologist treating head and neck cancer, and they have been well-documented, notably by Saunders (1978).