A STUDY OF NECK SECONDARIES IN PHARYNGEAL AND LARYNGEAL MALIGNANCIES

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CERTIFICATE

Certified that this dissertation entitled "**A STUDY OF NECK SECONDARIES IN PHARYNGEAL AND LARYNGEAL MALIGNANCIES"** Submitted for M.S. BRANCH IV (OTORHINO LARYNGOLOGY), The Tamil Nadu Dr. M.G.R. Medical University, Chennai, March 2007, is the bonafide work done by **Dr. V. Sundararaman** under the direct supervision and guidance in the Department of ENT diseases, Government Rajaji Hospital and Madurai Medical College, Madurai during his course of study from may 2005 to march 2007.

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DECLARATION

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This is submitted to the TamilNadu Dr. MGR Medical University, Chennai in partial fulfilment of the requirement for the award of M.S. Degree, Branch IV (OTORHINOLARYNGOLOGY) degree examination to be held in March 2007.

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CONTENTS

INTRODUCTION

Lymphatic metastasis is the most important mechanism in the spread of head and neck malignancies. The rate of metastasis probably reflects the aggressiveness of the primary tumour and is an important prognosticator. Not only the presence, but also the number of nodal metastases, the level in the neck, the size of the nodes and the presence of extracapsular spread are important prognostic factors.

The single most important factor affecting prognosis for patients with secondaries of the upper aerodigestive tract is the stage of disease at the time of initial diagnosis and treatment. Patients who presented with tumours localised at the primary site without dissemination to regional lymph nodes enjoy an excellent prognosis. On the other hand, once dissemination to regional lymph nodes takes place, the probability of 5 years survival, regardless of the treatment rendered, reduces to nearly half of that seen in early staged patients [Shah 2003]. Clearly therefore, the single most important prognostic factor in the treatment of patients with secondaries of head and neck is the status of cervical lymph nodes.

The development of metastatic nodal disease represents a firm statement, by the tumour, of its aggressive malignant nature.

Selective groups of regional lymph nodes are initially at risk for each primary site in the head and neck region. Understanding the sequential patterns of neck metastases therefore greatly facilitates the management of regional lymph nodes.

AIMS & OBJECTIVES

1. To determine the incidence of cervical node metastasis by the site of primary.
2. To describe the distribution of neck node secondaries by the site of primary.
3. To correlate the site of secondary neck node with primary in a particular region.
4. To correlate individually the size of tumour with the incidence of cervical node metastasis and the time of initial presentation.

SURGICAL ANATOMY

Definitions

The Nasopharynx

It represents the nasal portion of the pharynx behind the nasal cavity and above the free border of the soft palate. It is a transitional zone between the nasal cavity and the oropharynx and has also been called the post nasal space or epipharynx.

The average dimensions of the nasopharynx in the adult are 4cm high, 4cm wide and 3cm in an anteroposterior dimension. The posterior wall is about 8cm from the pyriform aperture along the nasal floor.

The anterior wall is formed by the choanal orifice and posterior margin of the nasal septum.

'The floor' is formed by the upper surface of the soft palate which occupies the anterior two-thirds and by the nasopharyngeal isthmus.

'The roof and posterior wall' form a continuous sloping surface bounded by the body of the sphenoid, the basi occiput and the first two cervical vertebrae to the level of the soft palate. The upper portion of the posterior wall lies in front of the anterior arch of the atlas with a mass of lymphoid tissue embedded in the mucosal membrane (nasopharyngeal tonsil

or adenoid). The prevertebral fascia and muscles separate the adenoid from the vertebrae.

'The lateral wall' is dominated by the pharyngeal orifice of the eustachian tube. Located in the middle of the wall, it is about 1.5 cm equidistant from the roof, posterior wall, choana and the floor. The torus tubaris or tubal elevation created by the elastic cartilage of the tube, is particularly prominent in its upper and posterior lips. Behind the posterior margin of the torus, between it and the posterior wall, lies the lateral pharyngeal recess or the fossa of Rosenmuller. Aggregates of lymphoid tissue of variable size around the tubal orifice and part of the recess are collectively called the tubal tonsil.

'The fossa of Rosenmuller' is situated in the corner between the lateral and dorsal walls. Although not obvious in infants, the recess can measure upto 2.5 cms in depth in adults. More often than not it appears as a cleft, trabeculated at times, and recedes posterolaterally to an apex near to the edge of the carotid canal opening. It opens into the nasopharynx at a point below the foramen lacerum.

The oropharynx

The oropharynx extends from the soft palate to the epiglottis. It is continuous with the mouth through the oropharyngeal isthmus formed by the palatoglossal muscles on each side.

The anterior wall of the oropharynx is formed by the posterior third of the tongue. The mucous membrane of the tongue is continuous onto the epiglottis and creates three glossoepiglottic folds – one in the midline and two placed laterally. The space on either side of the median glossoepiglottic fold is the vallecula.

The lateral wall of the orpharynx has two folds of mucous membrane, the palatoglossal and palatopharyngeal folds created by the muscles of the same names. The palatine tonsil, lies in the triangular recess between these two folds.

Additional lymphoid tissue, the lingual tonsil, is located under the mucous membrane of the posterior third of the tongue.

The superior wall of the oropharynx is formed by the inferior surface of soft palate and uvula.

For practical considerations, the oropharynx is divided into the palatine arch and the oropharynx proper.

The palatine arch comprises of the soft palate and uvula and anterior faucial pillars.

The oropharynx proper comprises lateral and posterior walls of oropharynx including pharyngoepiglottic fold, base of the tongue, glosso-palatine sulcus, tonsillar fossa, vallecula and posterior faucial pillars.

The hypopharynx

The hypopharynx lies below and behind the base of the tongue, and behind and on each side of the larynx. It extends from the level of hyoid bone superiorly to the lower border of cricoid inferiorly. The three anatomical substies are the pyriform fossa, the postcricoid area and the posterior pharyngeal wall.

The pyriform fossae are channels formed on either side of the larynx and are open posteriorly. The lateral walls are continuous with the posterior pharyngeal wall, and the medial wall on each side contributes to the aryepiglottic fold and merges posteriorly with the postcricoid mucosa.

The upper part of the fossa is bounded laterally by the thyrohyoid membrane, and medially by the aryepiglottic fold. The deepest (most inferior) portion of the fossa is known as the apex. The apex is related laterally to the thyroid cartilage, medially to the cricoid cartilage and inferiorly to the paraglottic space, which is the potential space bounded by the thyroid ala laterally and the conus elasticus and the quadrangular membrane medially. Tumours involving the medial wall and apex of the pyriform fossa easily gain

entrance to the paraglottic space and then pass inferiorly lateral to the vocal cord.

The postcricoid area lies behind the larynx and extends from the level of the aryteroid cartilages to the inferior border of the cricoid cartilage. It is continuous below with the upper end of the oesophagus.

The posterior pharyngeal wall is less well defined. It can be regarded as that part of the hypopharynx lying between two lines projected posteriorly from the vocal cords as they lie in the cadaveric position. It begins superiorly at the level of the hyoid bone and ends inferiorly at the level of the aryternoids. It is separated from the prevertebral muscles by a fascial space.

The larynx

The larynx extends from the epiglottis and the aryepiglottic folds to the cricoid cartilage. It communicates with the laryngopharynx above through the laryngeal aditus and with the trachea below.

The lateral walls of the larynx have two infoldings of mucous membrane, the vestibular folds above and the vocal folds below. The space between the two vestibular folds is called the rima vestibuli and the space between the two vocal folds is called the rima glottidis.

The part of the larynx that extends from the aditus to the rima vestibuli is called the vestibule of the larynx. The part that lies between the rima

vestibuli and the rima glottidis is called the ventricle of the larynx. The ventricle has a lateral extension, the saccule, between the vestibular fold and the thyroid cartilage. The larynx is made of cartilages and ligaments that are essential to its role in phonation.

For practical considerations, the larynx is divided into the supraglottis, the glottis and the subglottis.

Each site is further sub-divided into sub-sites as follows:

I. Supraglottis
    a. Epilarynx (including marginal zone)
        i. Suprahyoid epiglottis (including the tip)
        ii. Aryepiglottic fold
        iii. Arytenoid
    b. Supraglottis excluding epilarynx
        i. Infrahyoid epiglottis
        ii. Ventricular bands (false cords)
        iii. Ventricular cavities

II. Glottis
        i. Vocal cords
        ii. Anterior commissure
        iii. Posterior commissure

III. Subglottis

Anatomical divisions of neck

The neck is divided by the sternocleidomastoid muscle into triangles, which by convention, are known as the anterior and posterior triangles of the neck. Each triangle is further sub-divided into smaller triangles by the omohyoid and digastric muscles. These triangles are three-dimensional in shape and change with the position of the neck.

The posterior triangle

The posterior triangle is bounded by the sternocleidomastoid muscle in front, the trapezius muscle behind, and the clavicle below. It is divided by the omohyoid muscle into an occipital triangle and a supraclavicular triangle. Although this is an anatomical division, a more important division is that made by the accessory nerve which travels in the roof of the triangle from 1 cm above Erb's point (where the greater auricular nerve curves around the sternomastoid muscle) down to entering trapezius in its lower third. Everything that is important in the posterior triangle lies below and inferior to this nerve.

1. Occipital triangle

The occipital triangle has a muscular floor formed from above downwards by the semispinalis capitis, splenius capitis, levator scapulae and scalenus medius muscles. After emerging from behind the sternomastoid

muscle, the spinal accessory nerve courses across the muscular floor of the posterior triangle to pass deep to the trapezius muscle. In addition, the cutaneous nerves of the neck, course through the deep fascia of the neck that covers the posterior triangle.

2. Supraclavicular triangle

The supraclavicular triangle lies above the middle of the clavicle. It contains the terminal portion of the subclavian artery, the roots, trunks and divisions of the brachial plexus, branches of the thyrocervical trunk and cutaneous tributaries of the external jugular vein. The copula of the pleural cavity extends above the level of the clavicle and is found deep to the contents of the supraclavicular triangle.

The Anterior Triangle

The anterior triangle is bounded by the sternocleidomastoid behind, the midline of the neck in front and the mandible above. It is sub-divided into submental, digastric, carotid and muscular triangles.

1. Submental triangle

The submental triangle is bounded by the anterior belly of the digastric muscle, the midline of the neck and the hyoid bone. The mylohyoid muscle forms its floor.

2. Digastric triangle

The digastric triangle is bounded by the mandible above and the two bellies of the digastric muscle. In addition, the stylohyoid muscle lies with the posterior belly of the digastric muscle. The mylohyoid and hyoglossus muscles form the floor of this triangle. The submandibular salivary gland is a prominent feature of this area, which is also referred to as the submandibular triangle. The hypoglossal nerve runs along with the stylohyoid muscle and posterior belly of the digastric muscle, between the hyoglosssus muscle and the submandibular gland, on its course into the tongue. The facial vessels course across the triangle, with the facial artery passing deep to the submandibular gland while the facial vein passes superficial to it.

3. Carotid triangle

The carotid triangle is bounded by the sternocleidomastoid muscle behind, the posterior belly of the digastric muscle above and the omohyoid muscle below. Its floor is formed by the constrictor muscles of the pharynx. It contains the structures of the carotid sheath-namely, the common carotid artery as it divides into its external and internal carotid branches, the internal jugular vein and its tributaries and the vagus nerve with its branches.

4. Muscular triangle

The muscular triangle is bounded by the omohyoid muscle above, the sternomastoid muscle below and the midline of the neck in front. It contains the infrahyoid muscles in its floor. Deep to these muscles are the thyroid and parathyroid glands, the larynx, which leads to the trachea, and the oesophagus. The hyoid bone forms the superior attachment for the infrahyoid muscles and the prominent thyroid cartilage and cricoid cartilage are also contained in this region.

Cervical Fascial Spaces

The neck contains superficial cervical fascia and deep cervical fascia.

The superficial fascia of the neck is a single layer of fibrofatty tissue which lies superficial to the platysma muscle.

The deep cervical fascia is more extensive and a much more important layer than the superficial fascia and lies deep to platysma and occupies important spaces between muscles, blood vessels, lymph nodes and the viscera in the neck. In areas it may be very thin whilst in others it can be thick.

The deep cervical fascia of the neck is thickened into several well defined layers that are of clinical significance. They are the investing or outer layer, the visceral or middle layer and the inner layer.

The investing layer

The investing layer of fascia invests the whole of the neck and splits to surround the trapezius muscle posteriorly and the sternomastoid muscle laterally. Above, it is attached to the superior nuchal line, the mastoid process and the mandible and below, it is attached to the spine of the seventh cervical vertebra, the spine of the acromion, the clavicle and the manubrium. It forms the roof of the posterior and anterior triangles.

It also splits to provide fascial sheaths for the parotid and submandibular glands and forms the carotid sheath which surrounds both the internal and external carotid arteries and the common carotid artery, along with the internal jugular vein and vagus nerve. Such a fascial envelope allows movement of these structures upon each other. Other cranial nerves are also surrounded by this fascia and these include the glossopharyngeal, the accessory and the hypoglossal nerves, along with the ansa hypoglossi.

The visceral layer

The visceral or middle layer of fascia surrounds the middle compartment of the neck to include the pharynx, larynx, oesophagus and trachea, and allows these structures to move upon each other. It extends from its attachment to the thyroid cartilage above, to the pericardium below and is fused with the carotid sheath and the investing layer of fascia. Included here is

the pretracheal fascia which surrounds and envelops the thyroid gland and the parathyroid glands, by convention, lies outside this layer although sometimes it may contain them.

The internal layer

The internal layer of the deep fascia is known as the prevertebral fascia. The prevertebral fascia surrounds the deep muscles of the neck, i.e., the erector spinae, the levator scapula, the three scaleni muscles, the longus capitis and longus colli. It is attached to the ligamentum nuchae in the back, the base of the skull above and extends down into the mediastinum below. There is a potential space, called the retropharyngeal space, between this fascial layer and the pharynx and oesophagus, allowing for the free movement of those structures against the vertebral column.

The prevertebral fascia provides the floor to the posterior triangle and has important relations with some important nerves in the neck. The cervical sympathetic trunk lies superficial to the prevertebral fascia under the carotid sheath. The branches of the cervical plexus lie deep to the fascia but pierce it as they become more superficial to enter the posterior triangle, and both the phrenic nerve and brachial plexus lie deep to this layer.

The Lymphatic System of The Head And Neck

There are 500 lymph nodes in the body and of these 200 are in the head and neck. The lymph nodes of the head and neck consist of two main groups, an outlying group and a terminal group. The terminal group are the deep cervical nodes which lie along the internal jugular vein and which receive all the lymphatic drainage of the head and neck. The lymph may drain directly into the deep cervical group or may first pass through nodes of the outlying group.

The lymphatic drainage of the head and neck is conventionally divided into three systems. They are:

i. Waldeyer's internal ring

ii. Waldeyer's external ring and

iii. Cervical lymph nodes proper – deep nodal system

Waldeyer's internal ring

Within the pharynx at the skull base, there is a circular collection of lymphoid tissue aggregates which plays an important part in early immunological development. They consist of a collection of lymphoid tissue and were described by Waldeyer in 1884. The ring includes the adenoid, the tubal tonsil, the lingual tonsil, the palatine tonsils and aggregates of lymphoid

tissue on the posterior pharyngeal wall. Tumours arising in this area have a high propensity for lymphatic spread.

Waldeyer's external ring

Waldeyer's external ring, also known as the superficial nodal system, drains the superficial tissue of the head and neck. It consists of two circles of nodes, one in the head and the other in the neck. In the head, the nodes are situated around the skull base and are known as the occipital, post auricular, parotid or pre auricular, and buccal or facial nodes. They are in continuity with the superficial nodes in the upper neck consisting of the superficial cervical, submandibular and submental nodes, along with the anterior cervical nodes. These latter nodes are situated along the external jugular vein and the anterior jugular veins respectively.

This superficial system receives drainage from the skin and underlying tissues of the scalp, eyelids and face, along with Waldeyer's internal ring, nasal sinuses and oral cavity.

Cervical lymph nodes proper

The deeper fascial structures of the head and neck drain either directly into the deep cervical lymph nodes or through the superficial system first and then into the deep system.

The deep cervical nodes are divided into upper and lower groups, and within these groups two more prominent either single nodes or groups of nodes can be identified. These are the jugulo-digastric nodes and the jugulo-omohyoid nodes.

The jugulo-digastric nodes consist of one large and several smaller nodes situated in the triangle formed by the internal jugular vein, the facial vein and the posterior belly of digastric muscle. They receive lymphatic vessels from the submandibular region, the tonsil, the tongue and from the floor of the mouth.

The jugulo-omohyoid nodes are situated low in the neck close to the point where the omohyoid muscle crosses the internal jugular vein. This group of nodes receives lymphatic vessels from the anterior floor of the mouth and from the tongue.

The efferent vessels from the deep cervical nodes form into a jugular trunk which, on the right side ends at the junction of the internal jugular vein and subclavian vein or joins the right lymphatic duct. On the left side, the jugular trunk usually joins the thoracic duct or may enter the junction of the internal jugular vein and subclavian vein separately.

Levels of Lymph Nodes In The Neck

It is possible to predict the site of a primary tumour based on the distribution of cervical metastases, and this was done by Lindberg in a classic study in 1972 where by he was able to identify the likely sites of metastases related to the site of the primary tumour. It is the accepted rule that patterns of subclinical microscopic metastases follow a similar distribution. Following Lindberg's work, the Memorial Sloan – Kettering Hospital published in 1981, a number of levels or regions within the neck which contain groups of lymph nodes that represent the first echelon sites for metastases from head and neck primary sites. These are described below:

Level I: Submental and submandibular groups

This consists of the submental group of lymph nodes within the triangle bounded by the anterior belly of digastric and the hyoid bone, and the submandibular group of nodes bounded by the posterior belly of digastric and the body of the mandible.

Level II: Upper jugular group

This consists of the lymph nodes located around the upper third of the internal jugular vein and adjacent spinal accessory nodes extending from the skull base down to the level of the carotid bifurcation where the digastric

muscle crosses the internal jugular vein. This point relates to level of the hyoid bone on a computed tomographic (CT) scan. It contains the junctional and sometimes the jugulo-digastric nodes.

Level III: Middle jugular group

This consists of lymph nodes located around the middle third of the internal jugular vein extending from the carotid bifurcation superiorly (bottom of level II) down to the upper part of the cricoid cartilage (seen on a CT scan) and represents the level where the omohyoid muscle crosses the internal jugular vein. It usually contains the jugulo-omohyoid nodes and may contain the jugulo-digastric node.

Level IV: Lower jugular group

This consists of lymph nodes located around the lower third of the internal jugular vein extending from the cricoid cartilage down to the clavicle inferiorly. It may contain some jugulo-omohyoid nodes.

Level V: Posterior triangle group

These nodes are located along the lower half of the spinal accessory nerve and the transverse cervical artery. Supraclavicular nodes are also included in this group. The posterior boundary is the anterior border of the trapezius and the anterior boundary is the posterior border of the sternomastoid muscle.

Level VI: Anterior compartment group (visceral group)

This consists of lymph nodes surrounding the middle visceral structures of the neck extending from the hyoid bone superiorly to the suprasternal notch inferiorly. The lateral border on each side is the medial border of the sternomastoid muscle. It contains the parathyroid, the paratracheal and pretracheal, the perilaryngeal and precricoid lymph nodes.

Level VII

These are the lymph nodes in the upper anterior mediastinum.

The factors which affect the pattern of spread of malignant disease to the neck depend on both tumour and patient factors. The site of the primary tumour is important, with some sites having a high incidence of metastases, both palpable and otherwise, at presentation.

It is important to note that the above drainage patterns apply in the non-violated neck. Once the natural history of the disease is changed, lymph-node metastases can occur anywhere. This explains why the operation of selective neck dissection is usually only suitable in the previously untreated neck.

SURGICAL PATHOLOGY

Although the presence or absence of cervical metastases is the single most important factor in determining prognosis in head and neck cancer [Norris, 1963; Spiro et al 1974, Schuller et al 1980] the extent of the cervical metastases is also important. Thus staging of the metastasis is important both from the point of view of reporting disease and also in terms of management and prognosis in a particular patient. Fortunately the most recent classifications suggested by the AJC and UICC are identical. These classifications apply to nodes from an unknown primary and from all primary tumours in the head and neck apart from the nasopharynx and thyroid. The classification is shown below:

TNM classification of regional lymph nodes

N_x Regional lymph nodes cannot be assessed

N_0 No regional lymph node metastasis

N_1 Metastasis in a single ipsilateral lymph node 3 cm or less in its greatest dimension.

N_2 Metastasis in a single ipsilateral lymph node, more than 3cm but not more than 6cm in its greatest dimension, or in multiple

ipsilateral lymph nodes none more than 6cm in greatest dimension, or in bilateral or contralateral lymph nodes none more than 6cm in greatest dimension.

N_{2a} Metastasis in a single ipsilateral lymph node, more than 3 cm but not more than 6cm in greatest dimension.

N_{2b} Metastasis in multiple ipsilateral lymph nodes, none more than 6cm in greatest dimension.

N_{2c} Metastasis in bilateral or contralateral lymph nodes, none more than 6cm in greatest dimension.

N_3 Metastasis in a lymph node more than 6cm in greatest dimension.

Nodal Classification for nasopharyngeal carcinoma (UICC 1997)

N_x Regional lymph nodes cannot be assessed

N_0 No regional lymph node metastasis

N_1 Unilateral metastasis in lymph node(s), 6 cm or less in greatest dimension, above supraclavicular fossa.

N_2 Bilateral metastasis in lymph node(s), 6 cm or less in greatest dimension, above supraclavicular fossa.

N_3 Metastasis in lymph node(s)

a. Greater than 6 cm in dimension

b. In the supraclavicular fossa

Behaviour of disease within cervical lymph nodes

The spread of disease from the primary tumour to the regional lymph node occurs by passive transport within lymph. Metastatic involvement of various lymph node regions usually progresses from superior to inferior in an orderly fashion but it has been shown that in some situations lymph node groups can be bypassed even in the normal lymphogram. Once tumour cells arrive at a draining lymph node, they can proliferate, die, remain dormant or enter the blood circulation through blood vessels in the node. The process of metastasis is not a random phenomenon, although random events may be important. Paget's seed and soil hypothesis was an attractive one and, although largely disproved, a number of important properties have recently been assigned to tumour cells or metastatic seeds and these include cell growth, chemotaxis, immunological, metabolic and hormonal factors. Similar host environment (soil) factors include the tissue and stromal environment, hormones, inflammatory and immunological responses and the presence and absence of vital nutrients.

There are several stages of metastasis via lymphatic pathways. Premetastatic invasion of the epithelial basal lamina of the primary tumour is followed by subsequent encroachment, penetration and translocation of cells through a lymphatic. This is followed by intranodal settling, proliferation and

destruction of the lymph node. Secondary metastases to other lymph nodes soon develop, although their occurrence is not always accompanied by the destruction by the primary echelon node. Metastatic squamous cell carcinoma within a cervical lymph node can stimulate the storma in a variety of ways and a number of histological and immunological patterns have been described.

There are four distinct growth patterns of squamous cell carcinoma within cervical lymph nodes.

1. Following original cancerous deposits in the sub-capsular sinus, growth within the affected node proceeds to a considerable extent before extranodal spread occurs. Ultimately extranodal extension occurs by the direct penetration and destruction of the capsule, or by the arrest of further underlying capsular or juxta capsular lymphatics.
2. Extranodal spread occurs at an early stage in the genesis of the tumour growth within the node.
3. A less common pattern involves the deposition of a malignant embolus within the subcapsular sinus together with the simultaneous arrest of tumour within capsule or juxta capsular lymphatics. This results in the coincident and equivalent proliferation of cancer both within and outside the node.

4. The least common growth patterns shows capsular or juxta capsular emboli with no intranodal cancer. This is important to realize since, in some instances, extranodal spread can occur much earlier in the natural history of the disease process and, as such, may be important when undertaking conservative neck surgery.

REVIEW OF LITERATURE

Approximately 30% of patients with early stage carcinoma of the head and neck with a clinically negative node have nodal metastasis on histo-pathologic analysis. Efforts have been made to improve the diagnosis of occult nodal metastasis and this improves instituting early treatment of the neck.

Some studies have failed to show a survival advantage of elective neck dissection over a 'wait and watch' policy.

Assessment of cervical lymph nodes

In the first place, palpation by the experienced head and neck surgeon remains the standard assessment.

The clinician stands behind the patient and flexes his or her head slightly. The index fingers are placed on both mastoid processes and the clinician works down the trapezius muscle until the fingers meet at the clavicle. The under surface of the anterior border of trapezius should also be palpated. When the clavicle is reached, the posterior triangle (Level V) is palpated. Here the nodes lie between the skin and muscles of the floor of the triangle and therefore can be rolled between these two surfaces. By gentle lateral movement of the head to the examining side, the sternomastoid is palpated with the fingers placed in front of and medial to the sternomastoid with the thumb behind it, thus forming a 'C' around the muscle. The

examination progresses down the muscle carefully because 80% of the nodes lie under the muscle within the jugular chain (Levels II-IV) of the deep cervical lymph nodes. The smallest node which can be easily palpated in the jugular chain is probably 1 cm.

Most clinically positive nodes occur in the upper jugular chain (Levels II and III) but the most superior jugular nodes (Level II), including the junctional nodes, are difficult to palpate, particularly in men, and positive lymph nodes in the lower jugular area (Level IV) may be difficult to feel since they are often small, deep and mobile.

Attention should be paid to the suprasternal notch and the space within it (The Space of Burns), to check for positive cricothyroid and pretracheal nodes. Then the trachea is palpated and the size of the thyroid gland is assessed. The mobility of the larynx and pharynx on the prevertebral fascia is then assessed. The submandibular gland and nodes, submental nodes and the preauricular nodes are then examined. These are easier to feel and nodes down to 0.5cm can usually be palpated.

Difficulties in assessment of lymph nodes

1. The retropharyngeal and parapharyngeal nodes are impossible to detect unless very large.
2. The nodes in the supraclavicular fossa are difficult to feel.
3. Patients with short and thick necks.

4. Structures in the neck which may be mistaken for enlarged lymph nodes – transverse process of atlas, the carotid bifurcation, parotid tail, the superior horn of thyroid cartilage, irradiated and obstructed submandibular salivary gland.

It should also be remembered that a neck lump in a patient with a tumour of the piriform sinus or tonsil may not be a secondary in a lymph node, but a direct extension of the tumour through either the thyrohyoid membrane or the pharynx. This should be assessed by asking the patient to swallow, upon which a lump due to direct extension will move up and down. In addition, such lumps are often painful.

Radiology

The role of computerised tomography (CT) becomes the next logical step in evaluating the regional spread of head and neck cancer. CT is accurate for nodes larger than 10mm and with central lucency, but is less accurate for smaller nodes (<10mm).

CT findings suggestive of metastatic node

- Spherical rather than oval
- >10mm size
- Peripheral enhancement with i.v. contrast
- Central necrosis (lucency)

The comparative results of CT, Magnetic Resonance Imaging (MRI), Ultrasound (US) and Ultrasound Guided Fine Needle Aspiration Cytology (USGFNA) have been compared [Van den Brekel et al, 1993] showing that USGFNA was the most accurate way of diagnosing neck node metastases overall and in N_0 patients (USGFNA 86%, CT 66%, MRI 75% accuracy), palpation alone being the least accurate. This has confirmed the previous work by Baatenburg de Jong et al 1991 – Netherlands, and other workers.

Currently research is being done in the field of Nuclear medicine with Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) with Thallium – 201 [Gregor et al 1996] in an attempt to improve the detection of nodal metastases.

FNAC is an important step in the assessment of nodes from an unknown primary in the process of diagnosis and treatment, and usually follows the clinical examination. However, open biopsy of the node is contraindicated, as it adversely affects survival. Experienced cytologists today have a high degree of success in the diagnosis of different tumours including lymphoma and salivary gland tumours [Roland 1993; Shah 1993]. It is simpler and less traumatic, provides equally accurate sampling and has a smaller chance of seeding.

Clinical Presentation

Patients with cervical nodal enlargement suspected to be metastatic should undergo a thorough general examination and ENT examination with particular reference to the common primary sites viz., the nasopharynx, oropharynx, hypopharynx and larynx.

Epidemiology of suspicious neck node swelling

1. Painless, often slowly growing mass in level II/ III.
2. Adult male population.
3. Asian or Mediterranean descent.
4. Alcohol abuse and heavy smoking.
5. Radiation exposure in the past.
6. Curative treatment in the past for other malignancy.

Nasopharynx

Patients with primary tumour in the nasopharynx may present with

i. Painless cervical lymphadenopathy
ii. Epistaxis and naso-respiratory symptoms
iii. Audiological symptoms-tinnitus, otalgia and deafness
iv. Neurological symptoms – headache, cranial nerve palsies and Horner's syndrome.

Particular attention to be made, during the examination, to the postnasal space, fossa of Rosenmuller and the eustachian tube orifice. This is further guided by the use of rigid Hopkin's telescope.

Oropharynx

Patients with primary in the oropharynx may present with

i. Soreness or discomfort in the throat
ii. Pain on swallowing
iii. Referred otalgia
iv. Ulcer in oropharyngeal region
v. Large tumours may cause change in voice of the patient.

Clinical examination should focus on the soft palate, the tonsillar fossae and pillars, the tonsillo-lingual sulcus. The posterior one-third of the tongue is examined by digital palpation and visualised on indirect laryngoscopy.

Hypopharynx

Patients with primary in the hypopharynx may present with

i. Pain – usually latralised, often radiating to, or most noticeable in the ipsilateral ear
ii. Dysphagia – usually constant and progressive

iii. Hemoptysis – an unusual but important symptom of pyriform fossa tumours
iv. Hoarseness of voice – if laryngeal extension is present
v. A neck mass – possibly nodal metastasis
vi. Weight loss – suggests a serious disease in the absence of an attempt to lose weight.

Clinical examination to be focussed on the presence of any mass lesion, pooling of saliva in the pyriform fossae (Chevalier – Jackson sign). Presence of laryngeal crepitus to be ascertained (Boca's sign).

Larynx

Patients with primary tumour in the larynx may present with

i. Progressive and unremitting dysphonia
ii. Dyspnoea and stridor
iii. Pain – relatively uncommon and late symptom
iv. Referred otalgia
v. Dysphagia
vi. Swelling of the neck or larynx – either direct penetration of tumour or secondary metastasis
vii. Cough and irritation in the throat
viii. Hemoptysis, anorexia, cachexia or fetor – rare and late

Special note to be made of any lesion in the epiglottis, aryepiglottic fold, arytenoids, vocal folds and any extensions into the adjoining hypopharynx. The mobility of the vocal cords and the arytenoids are also ascertained. This can be done on indirect laryngoscopy or with a probe during direct laryngeal examination under GA. Videolaryngoscopy with 70° Hopkin's telescopes provides a convenient method of assessing the hypopharynx and larynx, as an outpatient procedure.

Nodal factors affecting prognosis

- Presence or absence of clinically palpable cervical lymph node metastasis.
- The size of the metastatic lymph node.
- The number of lymph nodes involved.
- The location of the metastatic lymph node.

Involvement of lower cervical lymph nodes (level IV) and lower posterior triangle lymph nodes (level V) by metastatic cancer usually implies ominous prognosis. Thus involvement of lymph nodes in the lateral neck below the level of the cricoid is of serious prognostic significance.

In addition, the presence of extra nodal spread of metastatic disease by capsular rupture of the lymph node with invasion of the soft tissues adversely impacts upon the prognosis.

Perivascular and perineural infiltration by tumour, as well as the presence of tumour emboli in regional lymphatics, also have an adverse impact on prognosis.

Therefore, these factors must be considered in developing a treatment strategy for patients in whom regional lymph nodes are involved by metastatic disease, particularly for planning adjuvant therapy and for assessment of prognosis.

Risk of nodal metastasis

Involvement of regional lymphatics by primary squamous cell carcinomas of the upper aerodigestive tract is dependent on various factors – site, size, T stage and location of the primary tumour.

In addition, histomorphologic features also influence nodal metastasis, endophytic tumours more inclined to metastasize compared to exophytic ones.

Poorly differentiated tumours have an increased risk compared to well-differentiated tumours.

The risk of nodal metastasis increases as one goes from anterior to posterior aspect of the upper aerodigestive tract i.e., lips, oral cavity, oropharynx and hypopharynx.

For tumours of the larynx and pharynx, the risk of nodal metastasis increases as one progresses from the centre (vocal cords) to the periphery (pyriform fossa and lateral pharyngeal wall).

This means the risk increases as one progresses from the vocal cords to the vestibular folds, AE folds, pyriform sinus and pharyngeal wall. Nearly two-thirds of patients with primary carcinomas of the hypopharynx present with clinically palpable regional lymph node metastasis.

Patterns of Neck Metastasis

Dissemination of metastatic cancer to regional lymph nodes from primary sites in the upper aerodigestive tract occurs in a predictable and sequential fashion.

Thus, all regional lymph node groups are not usually at risk of metastasis initially from any primary site. Understanding the sequential patterns of neck metastasis therefore greatly facilitates surgical management of regional lymph nodes in the clinically negative neck, where the nodes are at risk of harbouring micrometastasis.

The nasopharynx, nasal cavities and sinuses drain via junctional nodes into the upper deep cervical nodes (level II and III) having passed through retropharyngeal or submandibular lymph nodes.

For primary tumours in the oral cavity, the regional lymph nodes at highest risk for early dissemination by metastatic cancer are limited to levels I, II and III (supra omohyoid triangle of the neck). Skip metastasis to levels IV and V in the absence of metastatic disease at levels I, II or III is exceedingly rare, with one exception being primary squamous cell carcinoma of the middle-third of lateral border of the tongue where skip metastsis to level IV has been reported.

For tumours on the lateral aspect of the oropharynx and larynx, the first echelon lymph nodes at highest risk of harbouring micro-metastasis in the clinically negative neck are in levels II, III and IV on the ipsilateral side. The lymph node groups in the deep jugular chain are the jugulo digastric, highest spinal accessory chain of lymph nodes, mid jugular lymph nodes, jugulo-omohyoid nodes and supraclavicular nodes deep to the sternomastoid muscle. Contiguous lymph nodes lateral to the internal jugular vein overlying the cutaneous roots of the cervical plexus are considered components of levels II, III and IV. In primary carcinomas of the oropharynx, hypopharynx and larynx, skip metastasis to levels I and V in the absence of disease at levels II, III or IV is usually not seen.

Primary tumours which involve both sides of the midline have the potential of microscopic dissemination of metastatic disease of jugular lymph nodes on both sides of the neck. Similarly, tumours of the medial wall of the pyriform sinus are reported to have an increased risk of contralateral neck metastases.

Regional metastasis from primary thyroid carcinomas occurs in a high proportion of patients with differentiated carcinoma with the first echelon nodes at highest risk are the perithyroidal lymph nodes and those in the tracheo-oesophageal groove and superior mediastinum. Sequential progression then goes to levels IV, III, V and to upper jugular nodes. Metastasis to level I from primary thyroid carcinoma is exceedingly rare and seldom seen.

Only 20 - 25% of parotid tumours develop regional lymph node metastasis. The first echelon nodes here are those in the preauricular, peri and intra parotid region as well as levels II, III and upper accessory chain.

Initial dissemination from primary malignant tumours of submandibular salivary gland occurs in the supraomohyoid triangle (levels I,II and III).

MATERIALS AND METHODS

Between June 2005 and May 2006, a total of 152 patients were admitted with cervical nodal metastases. Among these, 120 patients were taken up for study. 32 patients were eliminated from study due to various reasons such as inability to fully evaluate or confirm their diagnosis by histology.

Most of the patients presented to the hospital for swelling in the neck as one of their major complaints. A detailed history was obtained including information as to whether they had ENT, gastrointestinal, respiratory or urinary complaints.

A complete physical examination carried out including post nasal examination, IDL for characteristics of primary in terms of site, extent, size, macroscopic appearance, degree of local infiltration, presence of synchronous lesion and the T stage.

The palpable nodes were considered significant if they were >1cm in size, firm to hard in consistency, spherical rather than ovoid and those in the site of drainage of the primary [Lindberg 1972].

The important features noted regarding the nodes during palpation include the location, the level of the node, size, consistency, number of nodes and the group to which they belong, as well as signs of extracapsular spread

such as invasion of overlying skin, fixation to deeper tissues or paralysis of cranial nerves or sympathetics.

The presence of contralateral nodes and the N staging was also determined.

The clinical impression of the first observer was confirmed by atleast one other observer.

Laryngoscopy, bronchoscopy and oesophago-duodenoscopy was done to rule out synchronous primary tumours as there is a 10% chance of synchronous primary in the upper aerodigestive tract.

Fine Needle Aspiration Cytology (FNAC) was then done.

Biopsy from the primary site was done in all cases to know the nature and degree of differentiation of the primary.

OBSERVATIONS AND RESULTS

Period of study :

June 2005 to May 2006

Total number of patients with cervical metastases included in the study

120

Sex distribution

Among the patients, there were 102 males and 18 females in the ratio of 5.7:1.

Age incidence

An age range of 26-82 years was noted. Of those, 75.3% of patients were in the age group of 41-65 years. Highest incidence was noted in the fifth decade.

Duration of symptoms

Majority of patients presented within the first year of developing symptoms (84%). There were 2% of patients with positive family history. Most of the patients had tobacco or alcohol abuse, men in the form of beedies or cigarettes and women in the form of tobacco chewing. Most of the patients belonged to lower socio-economic status.

Distribution of nodal secondaries with primary

Carcinoma of nasopharynx tops the list, followed by hypopharynx, oropharynx and larynx. The incidence of nodal secondaries with primary is shown below:

Site	Node positive (%)
Nasopharynx	100
Hypopharynx	87
Oropharynx	83
Larynx	57

Risk of lymph node metastasis in patients according to demographic profile

Variable	Categories	% of patients
Age (years)	26-40	10.3
	41-65	75.3
	>65	14.4
Sex	Male	85
	Female	15

Risk of lymph nodal metastasis in patients according to clinical variables

Variable	Category	% of patients
Duration of symptoms	1-6 months	38%
	7-12 months	46%
	13-60 months	16%
Family H/o Cancer	No	98%
	Yes	2%
Tobacco abuse	No	10%
	Yes	90%
Alcohol intake	No	83%
	Yes	17%

Distribution of patients according to nodal status

About 25% of patients presented in N_0 stage. The remaining 75% were node positive. The frequency of each stage category is as follows:

Nodal Status	N_0	N_1	N_{2a}	N_{2b}	N_{2c}	N_3
Number of patients	30	11	32	31	10	6

Distribution of patients according to level of nodes

Majority of patients had involvement of level II nodes, followed by those with levels III, IV, VI, V and I in order of decreasing frequency. Shown in diagram are the absolute number of involved nodes and since more than one level is involved in many patients, the numbers add upto >100%.

Histopathological distribution

Almost all patients presented with squamous cell carcinoma. Two had adenocarcinoma and one had mucoepidermoid carcinoma that occurred in the hypopharynx.

Most of the squamous cell carcinoma were of well-differentiated type.

Nodal secondaries by the size of primary

Most of the patients presented with T_3 disease, followed by T_2, T_1 and T_4 in decreasing order of frequency. The incidence is shown below.

Size of primary	No. of patients	% of patients
T_3	51	43
T_2	42	35
T_1	17	14
T_4	10	8

Individual correlation of primary site with secondaries

Carcinoma of nasopharynx

Among the 120 patients, 5 patients presented with carcinoma nasopharynx. All of them presented with secondary neck nodes. Of these, one had T_2 lesion, 2 had T_3 lesion and 2 had T_4 lesion. The N stage of these lesions is tabulated below:

N stage	N_0	N_1	N_2	N_3	Total
T_1	-	-	-	-	-
T_2	-	-	1	-	1
T_3	-	-	1	1	2
T_4	-	-	1	1	2
Total	-	-	3	2	5

Of these, all had level II and 3 had level V involvement.

Node level	I	II	III	IV	V	VI
T_1	-	-	-	-	-	-
T_2	-	1	-	-	-	-
T_3	-	2	-	-	1	-
T_4	-	2	-	-	2	-
Total	-	5	-	-	3	-

Carcinoma oropharynx

12 patients presented with carcinoma oropharynx. Out of them, 2 presented in N_0 stage and the rest had nodal involvement. Of these, 2 had T_1

lesion, 5 had T_2 lesion, 4 had T_3 lesion and 1 had T_4 lesion. the 'N' stage of these lesions is tabulated below:

N stage	N_0	N_1	N_{2a}	N_{2b}	N_{2c}	N_3	Total
T_1	1	1	-	-	-	-	2
T_2	1	1	2	1	-	-	5
T_3	-	-	-	2	2	-	4
T_4	-	-	-	-	-	1	1
Total	2	2	2	3	2	1	12

Among these, 8 had level II involvement, 6 had level III and 1 had level I involvement.

Node level	I	II	III	IV	V	VI
T_1	1	-	-	-	-	-
T_2	-	4	1	-	-	-
T_3	-	3	4	-	-	-
T_4	-	1	1	-	-	-
Total	1	8	6	-	-	-

According to the subsite of the primary, base of the tongue tumours are common (72%), followed by tumours of the tonsillar fossa (21%) and tumours of soft palate (2%) in decreasing order of frequency.

Western literature shows 50% of tonsillar tumours show lymph nodal metastsis. Only 40% of tongue base tumours and almost 100% of soft palate tumours show lymph nodal metastases.

Base of the tongue tumours have propensity to bilateral nodal metastases.

Subsite	No. of cases	% of patients	Lymph nodal metastasis
Posterior 1/3 of tongue	9	72	70%
Tonsil	2	21	66%
Soft palate	1	7	100%

Carcinoma hypopharynx

54 patients presented with carcinoma hypopharynx. Out of them, 7 presented in N_0 stage and the rest had nodal involvement. Of these, 7 had T_1 lesion, 16 had T_2 lesion, 26 had T_3 lesion and 5 had T_4 lesion. The 'N' stage of these lesions is tabulated below:

N stage	N_0	N_1	N_{2a}	N_{2b}	N_{2c}	N_3	Total
T_1	4	2	1	-	-	-	7
T_2	3	2	6	5	-	-	16
T_3	-	-	8	14	4	-	26
T_4	-	-	-	-	4	1	5
Total	7	4	15	19	8	1	54

Among these, 37 had level II involvement, 37 had level III, 12 had level IV and 5 had level VI involvement.

Node level	I	II	III	IV	V	VI
T_1	-	3	-	-	-	-
T_2	-	11	9	1	-	-
T_3	-	19	24	8	-	1
T_4	-	4	4	3	-	4
Total	-	37	37	12	-	5

According to the subsite, pyriform fossa tumours are the most common followed by post cricoid tumours and tumours of posterior pharyngeal wall.

Carcinoma Larynx

49 patients presented with carcinoma larynx. Out of them 28 patients had clinically positive nodes while 21 patients had no nodes. Of these, 8 had T_1 lesion, 20 had T_2 lesion, 19 had T_3 lesion, and 2 had T_4 lesion. The 'N' stage of these lesions is tabulated below:

N stage	N_0	N_1	N_{2a}	N_{2b}	N_{2c}	N_3	Total
T_1	6	2	-	-	-	-	8
T_2	8	3	7	2	-	-	20
T_3	7	-	7	5	-	-	19
T_4	-	-	-	-	-	2	2
Total	21	5	14	7	-	2	49

Among these, 27 patients had level II involvement, 9 had level III and 3 had level IV involvement.

Node level	I	II	III	IV	V	VI
T_1	-	2	-	-	-	-
T_2	-	12	2	-	-	-
T_3	-	12	5	1	-	-
T_4	-	1	2	2	-	-
Total	-	27	9	3	-	-

Tumours of the supraglottis are the commonest to present with cervical nodes.

Correlation of site of primary with levels of nodal involvement

Site	No. of patients	Level I	Level II	Level III	Level IV	Level V	Level VI
Nasopharynx	5	-	5	-	-	3	-
Oropharynx	12	1	8	6	-	-	-
Hypopharynx	54	-	37	37	12	-	5
Larynx	49	-	27	9	3	-	-

DISCUSSION

Out of the 120 patients selected for the study, males predominate over females with a ratio of 5.7:1.

The age incidence is identical to that seen in the west with maximum incidence in the 5^{th} and 6^{th} decade.

Our patients presented late in the course of their disease and this is reflected in the high incidence of N_2 (60%) among those with cervical metastasis.

As in the Lindberg series (1972), the overall highest incidence of metastasis was in the upper deep cervical node.

Sites of predilection for metastasis from different primary sites

The commonest level of nodes involved, irrespective of the primary site is level II in both our series and Lindberg's series.

Also there is a higher incidence of nodal involvement in T_3 than T_2 lesions as was the case in Lindberg's series.

There is a overall higher incidence of N_2 in our series rather thanN_3 as in Lindberg series.

Nasopharynx

	Lindberg's series	**Our study**
N_1	12%	-
N_2	25%	60%
N_3	60%	40%

Levels II and V are the most commonly involved, in both our series and in Lindberg's series.

Oropharynx

	Lindberg's series	**Our study**
N_1	20%	17%
N_2	30%	58%
N_3	50%	8%

Level II is most commonly involved in both our series and Lindberg's series. Also there is a higher incidence of nodal involvement with T_3 lesions than T_2 lesions.

Hypopharynx

	Lindberg's series	**Our study**
N_1	25%	7%
N_2	36%	78%
N_3	39%	2%

The commonest level of nodes involved is level II in Lindberg's series. But our study shows almost equal involvement of levels II and III followed by level IV.

Larynx

	Lindberg's series	**Our study**
N_1	12%	10%
N_2	43%	43%
N_3	3%	4%

The commonest level of nodes involved are levels II and III in both our series and Lindberg's series.

SUMMARY AND CONCLUSION

- **Majority of the cervical metastases were due to squamous cell carcinoma of the head and neck.**
- **Certain primary sites had a predilection for certain group of nodes.**
- **Thus in this study, the incidence of cervical nodal metastasis is highest for**
    i. **Nasopharyngeal tumours (100%) followed by**
    ii. **Hypopharyngeal tumours (87%)**
    iii. **Oropharyngeal tumours (83%) and**
    iv. **Laryngeal tumours (57%)**
- **Lesions of nasopharynx metastasise to levels II and V.**
- **Lesions of oropharynx metastasise to levels II, III and I.**
- **Lesions of hypopharynx metastasise to II, III and IV and a small proportion to level VI.**
- **Lesions of larynx metastasise to levels II and III and a small proportion to levels IV and VI.**
- **Most of the patients presented with positive nodes belonged to N_2 stage followed by patients in N_1 stage.**
- **Jugulodigastric nodes (level II) are involved more often than other groups or other levels of nodes.**
- **In most of the cases, increasing size of the primary had increasing number of nodes as well as an increasing 'N' stage.**

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