



Imaging of Cervical Lymph Nodes

Keerthana KM¹ Jyoti Kumar¹

¹Department of Radiodiagnosis, Maulana Azad Medical College, New Delhi, India

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Address for correspondence Dr. Jyoti Kumar, MD, MNAMS, FICR, Director Professor, Department of Radiodiagnosis, Maulana Azad Medical College, New Delhi, India 110002 (e-mail: drjyotikumar@gmail.com).

Abstract

Keywords

- ▶ cervical lymph nodes
- ▶ drainage pathways
- ▶ nodal levels
- ▶ nodal metastases
- ▶ skip metastases

The occurrence of cervical lymph node metastases is the single most important prognostic factor for head and neck malignancy. It directly influences the staging of tumors, selection of treatment plan, and patient prognosis. Various head and neck cancers have the propensity to spread to different nodal stations in the neck. CT/MRI is routinely used to evaluate the patient of head and neck malignancy. Knowledge of various cervical nodal levels, as well as the preferential drainage pattern of various sites of head and neck malignancies, can aid in accurate imaging interpretation.

Introduction

Cervical nodal assessment is essential in patients with head and neck malignancy as it is a significant marker of patient prognosis and aids in planning appropriate treatment. In patients with proven head and neck carcinoma, the presence of a unilateral metastatic node reduces the 5-year survival rate by 50%, while bilateral metastatic nodes reduce it by a further 25%.¹ Number, size, and extracapsular spread of nodes also have a bearing on prognosis and correlate with distant metastases. Thorough knowledge of cervical nodal levels is essential for accurate reporting of imaging scans in these patients.

Imaging-Based Cervical Nodal Levels

Describing a node by its specific location aids in planning targeted treatment, which could be either neck dissection or radiotherapy. The simplified level system advocated by Shah et al² at Memorial Sloan-Kettering Cancer Center, New York, is widely used by surgeons. A correlative imaging-based standardized classification was proposed by Som et al³ in 1999. These classifications are widely accepted.

The neck nodes are divided into seven stations as depicted in ►Fig. 1. Levels I, VI, and VII are located in the central neck

compartment, while the rest are seen on either side of the neck. If a lymph node is seen at the junction of two levels, the final nodal level is determined by the level that contains the major part of the node when it is transected by the line dividing these levels.

Level I: consists of submental and submandibular nodes and extends from below the level of the mylohyoid muscle to the lower border of the hyoid bone. It lies anterior to the posterior border of the submandibular gland. It is further divided into levels IA and IB by the medial margin of the anterior belly of the digastric muscle (►Fig. 2).

- *Level IA:* constitutes the nodes situated between the medial margins of the anterior belly of digastric muscles on either side.
- *Level IB:* includes the nodes lying posterolateral to level IA.

Level II: nodes are the most commonly involved nodes in head and neck cancer⁴ and were previously called the upper internal jugular nodes. Level II represents all the nodes from the skull base to the lower body of the hyoid bone, lying behind the posterior margin of the submandibular gland but anterior to the posterior border of the sternocleidomastoid muscle as seen in ►Fig. 3. Within 2 cm of the skull base, level II consists of nodes anterior, posterior, and lateral to the internal carotid artery (ICA), while the nodes medial to ICA are considered retropharyngeal nodes. Below 2 cm from the

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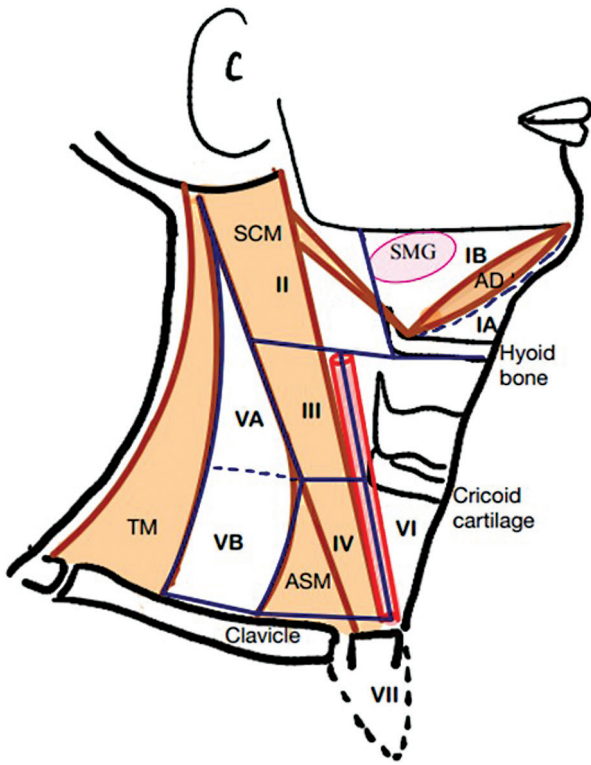


Fig. 1 Graphical representation of neck showing anatomy relevant to nodal classification. Level I and II are divided by the posterior margin of submandibular gland (SMG). Level II and III are divided by the inferior margin of hyoid bone. Level III and IV are divided by the inferior margin of cricoid cartilage. Posterior edge of sternocleidomastoid muscle separates level II and III from level V. Level IV and V are divided by an oblique line joining posterior border of sternocleidomastoid muscle and posterolateral border of anterior scalene muscles. Medial margins of carotid arteries separate levels III and IV from level VI. Superior margin of Manubrium separates levels VI and VII.

skull base, even the nodes medial to ICA are categorized as level II.

- **Level IIIA:** consists of the nodes that lie anterior, medial, or lateral to the internal jugular vein (IJV) and the nodes posterior to IJV that are in close contact with the vein.
- **Level IIIB:** consists of the nodes that lie posterior to the IJV with a definite fat plane between the node and the vein.

Level III: includes the middle internal jugular nodes. Level III extends from the lower body of the hyoid bone to the lower border of the cricoid cartilage, lateral to the medial margin of the common carotid artery/ICA. These nodes lie anterior to the posterior border of the sternocleidomastoid muscle (→ **Fig. 4**).

Level IV: are the lower internal jugular nodes and represent all the jugular chain nodes below the lower border of cricoid cartilage up to the clavicle, which lies lateral to the medial margin of the common carotid artery and anteromedial to the oblique line joining the posterior border of the sternocleidomastoid muscle and posterolateral border of anterior scalene muscle (→ **Fig. 5**).

Level V: are the posterior triangle nodes. Level V is divided by the lower border of the cricoid cartilage into level VA superiorly and level VB inferiorly.

- **Level VA:** extends from the skull base superiorly to the lower border of the cricoid cartilage inferiorly. These nodes lie posterior to the posterior border of the sternocleidomastoid muscle and anterior to the anterior border of the trapezius muscle as depicted in → **Fig. 6**.
- **Level VB:** extends from the lower border of the cricoid cartilage to the clavicle and lies posterior to the oblique line joining the posterior border of the sternocleidomastoid

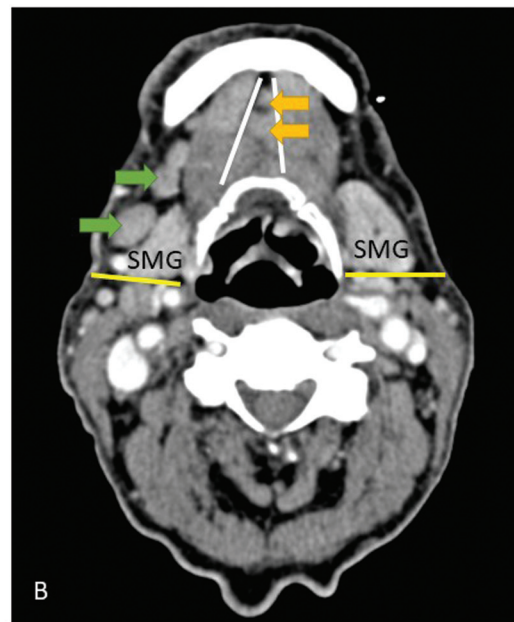
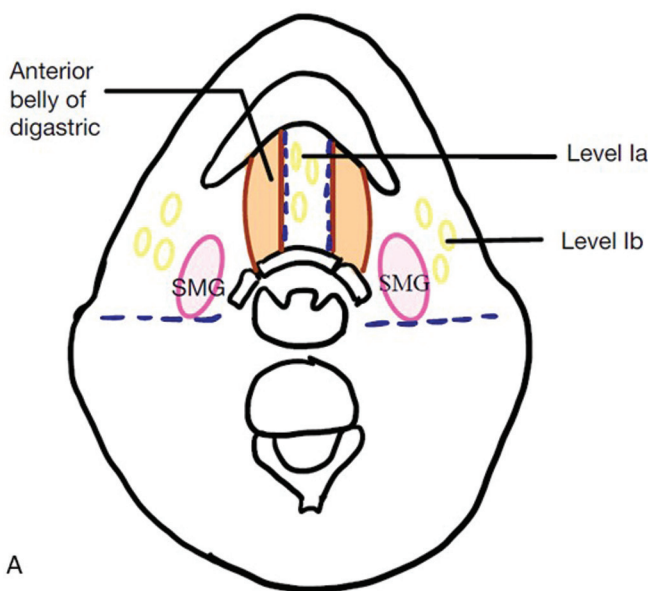


Fig. 2 Image A: Graphical representation of level I cervical lymph nodes. Image B: Axial contrast-enhanced CT scan of neck at the level of hyoid bone shows level Ia nodes (yellow arrows) lying between the medial margins of anterior belly of digastric muscles (white lines). Level Ib nodes (green arrows) are seen lying posterolateral to level Ia but anterior to posterior border of submandibular gland (SMG; yellow line).

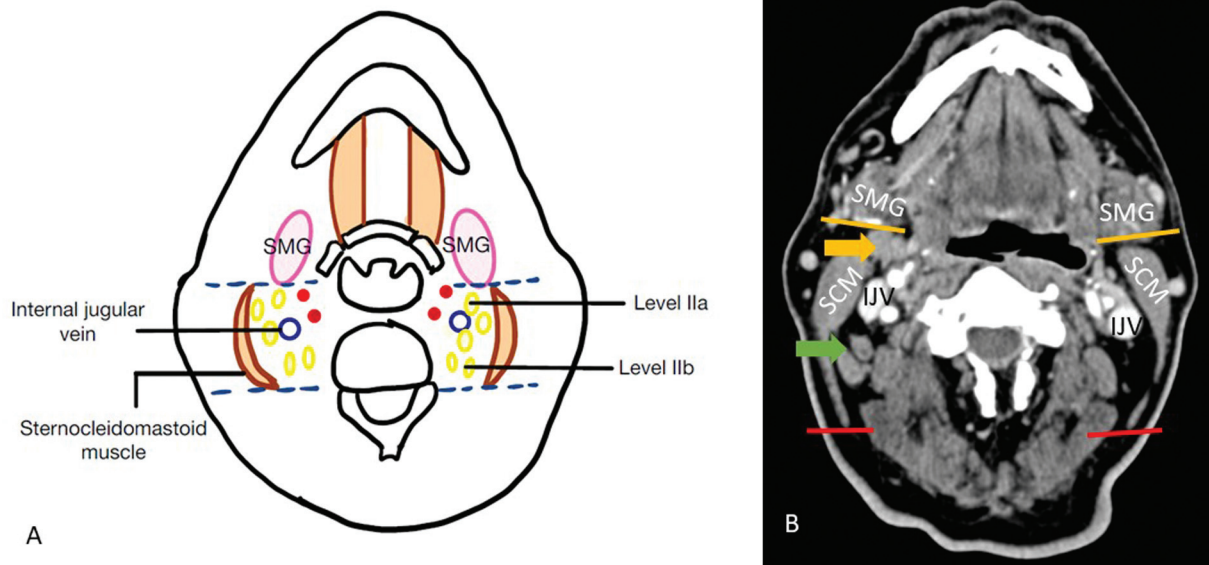


Fig. 3 Image A: Graphical representation of level II cervical lymph nodes. Image B: Axial contrast-enhanced CT scan of neck above the level of hyoid bone shows level II nodes lying posterior to posterior margin of submandibular gland (SMG; yellow line), but anterior to posterior edge of sternocleidomastoid muscles (SCM; red lines). Level II nodes, either anterior to the internal jugular vein or posterior to it but touching it, are subclassified as level IIA nodes (yellow arrows). Nodes posterior to internal jugular vein and not touching it are subclassified as level IIB nodes (green arrows).

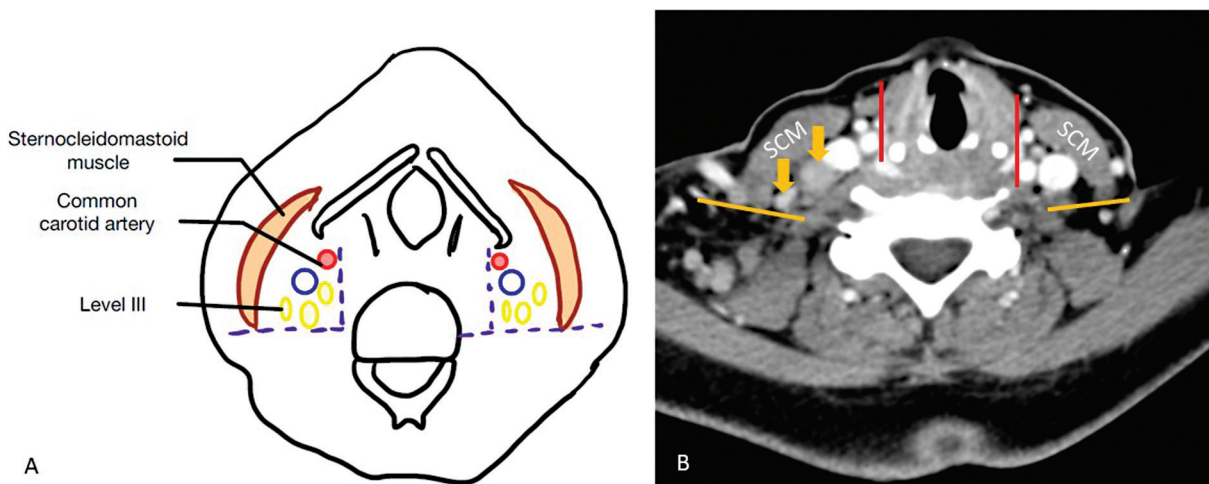


Fig. 4 Image A: Graphical representation of level III cervical lymph nodes. Image B: Axial contrast-enhanced CT scan of neck at the level of thyroid cartilage shows level III nodes (yellow arrows) lying anterior to posterior margin of sternocleidomastoid muscle (SCM; yellow lines) and lateral to medial margins of common carotid artery (red lines).

muscle and posterolateral border of the anterior scalene muscle. The posterior boundary is formed by the anterior margin of the trapezius muscle as seen in ►Fig. 7.

Level VI: are the visceral nodes. These are central nodes that are bounded laterally by the medial margins of bilateral common and internal carotid arteries (►Fig. 8). Level VI extends superiorly from the lower border of the hyoid bone to the superior border of the manubrium sterni inferiorly.

Level VII: includes the superior mediastinal nodes. These are also central nodes that lie between the medial margins of bilateral common carotid arteries (►Fig. 9). However, this level extends from the superior margin of the manubrium superiorly to the level of the innominate vein inferiorly.

Named Cervical Lymph Nodal Groups

Few nodal groups such as the retropharyngeal nodes and the superficial nodal groups are not included in these levels and are addressed by their anatomical names⁵ (►Fig. 10). This is because the level system was introduced as seen during neck dissection, and these nodes are not normally included in surgical procedures⁶:

- **Retropharyngeal nodes:** These nodes are seen within 2 cm of the skull base and lie medial to ICA. They are divided into lateral and medial groups. The lateral retropharyngeal nodes lie just medial to the ICA and anterior to the lateral margin of the prevertebral muscles, namely the

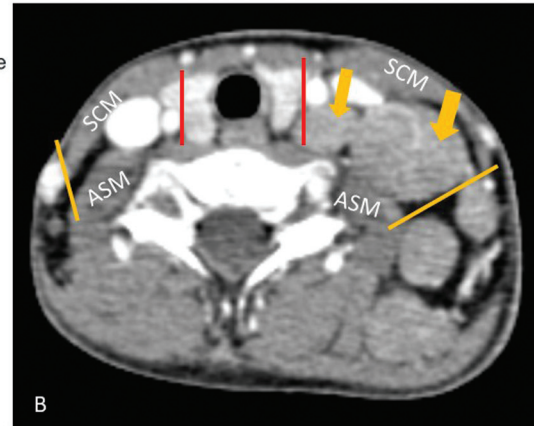
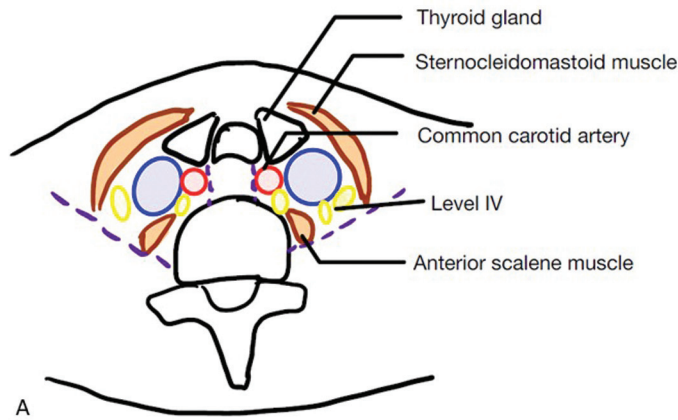


Fig. 5 Image A: Graphical representation of level IV cervical lymph nodes. Image B: Axial contrast-enhanced CT scan of neck at the level of thyroid gland shows level IV lymph nodes (yellow arrows) lying lateral to medial margins of common carotid artery (red lines) and anterior to the line joining posterior border of sternocleidomastoid muscle (SCM) and posterolateral margin of anterior scalene muscle (ASM; yellow lines).

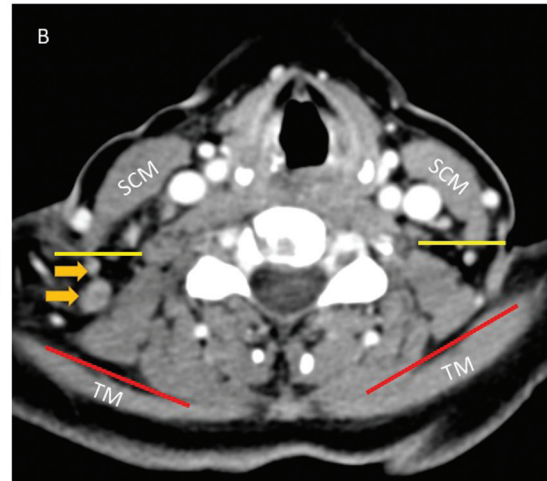
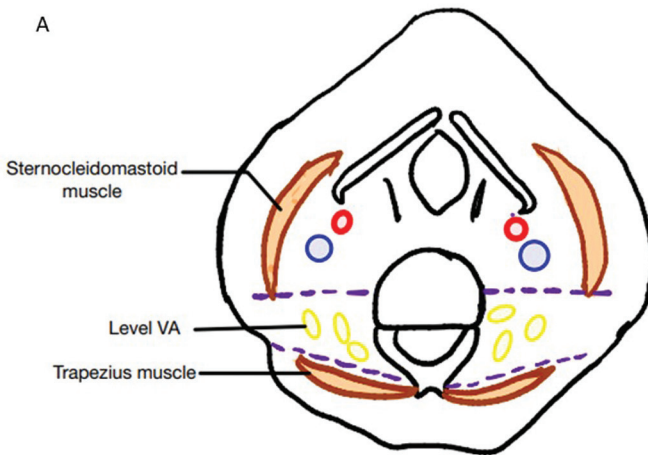


Fig. 6 Image A: Graphical representation of level VA cervical lymph nodes. Image B: Axial contrast-enhanced CT scan of neck at the level of thyroid cartilage shows level VA lymph nodes (yellow arrow) lying between posterior margin of sternocleidomastoid muscle (SCM; yellow lines) and anterior margin of trapezius muscle (TM; red lines).

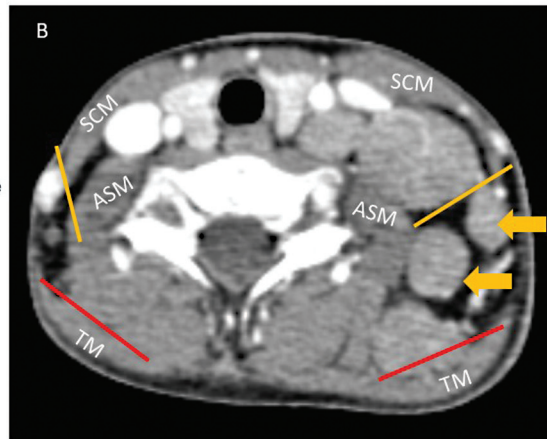
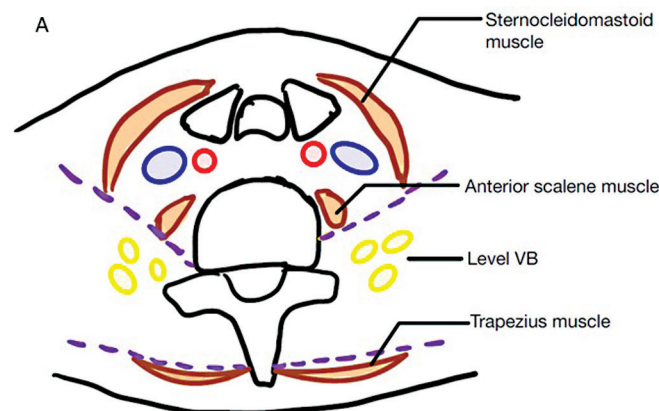


Fig. 7 Image A: Graphical representation of level VB cervical lymph nodes. Image B: Axial contrast-enhanced CT scan of neck at the level of thyroid gland shows level VB lymph node (yellow arrow) lying posterior to the line joining posterior border of sternocleidomastoid muscle (SCM) and posterolateral margin of anterior scalene muscle (ASM; yellow lines) but anterior to anterior margin of trapezius muscle (TM; red lines).

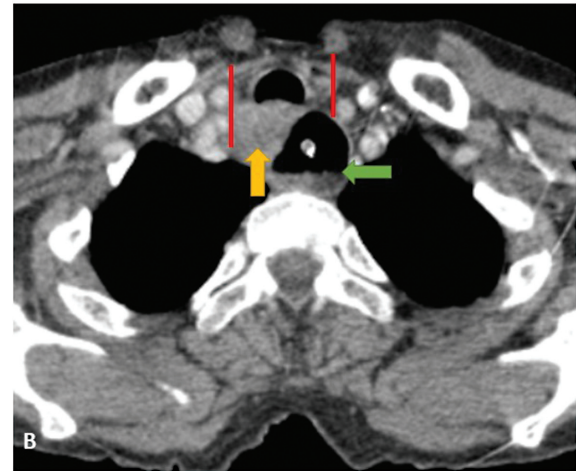
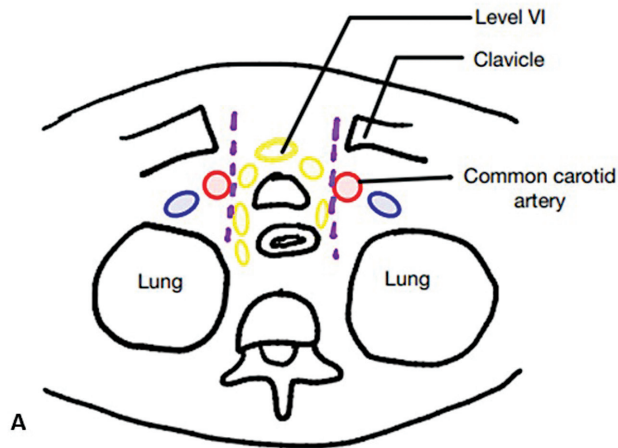


Fig. 8 Image A: Graphical representation of level VI cervical lymph nodes. Image B: Axial contrast-enhanced CT scan of neck above the level of manubrium in a case of lower esophageal carcinoma shows level VI lymph nodes (*yellow arrow*) between the medial margins of bilateral common carotid arteries (*red lines*). Dilated esophagus showing air-fluid level with Ryle's tube in-situ is also seen (*green arrow*).

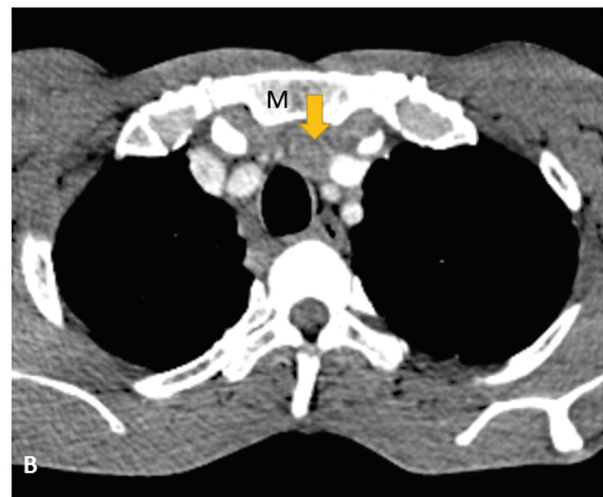
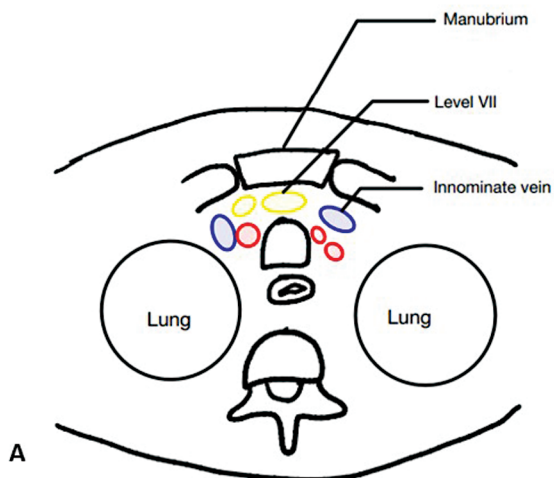


Fig. 9 Image A: Graphical representation of level VII cervical lymph nodes. Image B: Axial contrast-enhanced CT scan just below the level of superior margin of manubrium(M) shows level VII lymph nodes (*yellow arrow*) in superior mediastinum.

longus colli and longus capitus. The medial retropharyngeal nodes are seen near the midline anterior to the prevertebral muscles.⁷

- **Facial nodes:** They lie inferior to the orbit and above the inferior margin of the mandible. The facial nodes include mandibular, buccinator, infraorbital, and malar nodes.
- **Occipital nodes:** These nodes lie in occipital subcutaneous tissue near the lateral insertion of the trapezius muscle.
- **Parotid nodes:** These nodes lie within and surrounding the parotid gland. Parotid nodes include preauricular, intraglandular, and subparotid nodes.
- **Mastoid nodes:** These are seen in the retro-auricular region and superficial to the sternocleidomastoid attachment.
- **Superficial cervical nodes:** Along the superficial anterior and external jugular veins in the anterior and lateral neck.

The Virchow node is the left supraclavicular lymph node situated near the junction of the thoracic duct and the left

subclavian vein. Thyroid, thoracic, or abdominal malignancy should be suspected if isolated Virchow lymphadenopathy is seen during neck imaging.⁸

Cervical Nodal Metastases from Various Head and Neck Malignancies

Metastases to cervical lymph nodes commonly occur from squamous cell carcinoma of the aerodigestive tract, salivary gland, thyroid, and skin malignancies.⁹ Familiarity with the primary drainage sites of the lymph nodes helps in meticulous assessment. Primary tumor sites that drain into various levels of cervical lymph nodes are depicted in ►Table 1^{4,8}:

Cervical Lymphatic Drainage Patterns

The lymph from the various head and neck regions often follows an expected course. Most of the lymph node groups finally drain into the internal jugular nodes (level II, III, and

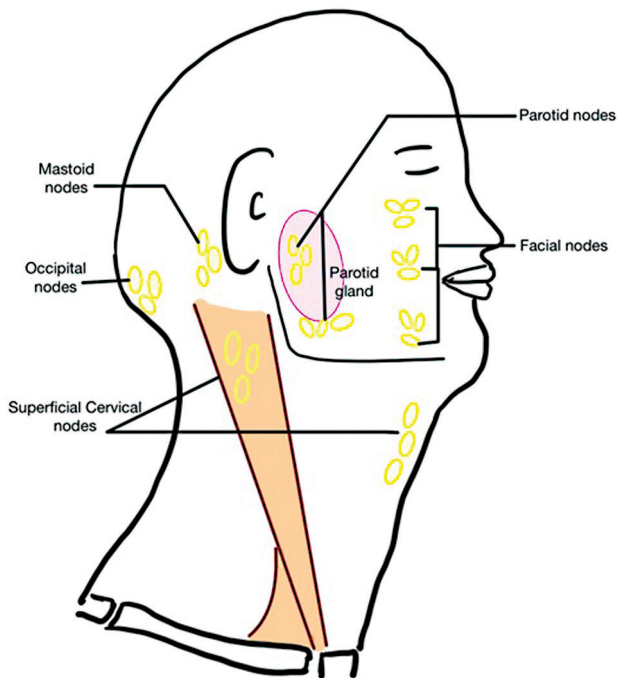


Fig. 10 Graphical representation of the neck showing superficial cervical lymph nodal groups. Facial nodes are seen extending from the inferior orbital margin to lower border of mandible. Occipital nodes are seen in occipital subcutaneous tissue. Parotid nodes are seen in and around the parotid gland. Mastoid nodes are seen in retroauricular region. Superficial cervical nodes lie in anterolateral neck along anterior and external jugular veins.

Table 1 Primary drainage sites of various cervical nodal levels

Cervical nodal level	Primary drainage site
Level I	Anterior oral cavity, lip and sinonasal region
Level II	Posterior oral cavity, oropharynx, supraglottic larynx, and parotid gland
Level III	Larynx (glottic and subglottic) and hypopharynx
Level IV	Subglottis, thyroid, and cervical esophagus
Level V	<ul style="list-style-type: none"> Nasopharynx and skin over the occipital scalp and neck May also be involved in other advanced head and neck malignancies.
Level VI	Pharynx, thyroid, subglottis, and cervical esophagus
Level VII	Thyroid, subglottis, and cervical esophagus

IV). The lymphatic drainage pathways of the head and neck are functionally divided into the main lymphatic pathway, the posterior pathway, the anterior pathway, and the superficial-lateral pathway.¹⁰

- The main lymphatic drainage pathway: Level IA and IB receives afferents from the oral cavity, nasal mucosa, and facial and parotid nodes. Level IA subsequently drains into level IB which further drains into the upper jugular chain

at level IIA, which is the major convergence point for various pathways. The lymph in the jugular chain then passes along level III and IV nodes and finally drains into the major lymphatic ducts.

- The posterior pathway: The lymph from the oropharynx, nasopharynx, root of tongue as well as posterior auricular region, and posterior scalp drains into level IIB which further drains posteriorly into level VA and VB nodes.
- The anterior pathway: The level IA receives afferents from the anterior oral cavity, tip of the tongue, floor of the mouth, median part of lower lip, anterior buccal and gingival mucosa, and skin over the chin. The lymphatic pathway bypasses the level IB and drains directly to the level III or less commonly level IV lymph nodes.
- The superficial-lateral pathway: This pathway is similar to the posterior accessory pathway. Lymph from the posterior scalp drains into the mastoid and occipital nodes which further drains into the superficial cervical nodes along the external jugular veins. Further, they drain into the main lymphatic pathway through the internal jugular nodes.

Skip Metastases

Most lymph nodal metastases occur in a predictable fashion based on the drainage of the primary tumor location; however, sometimes this orderly involvement is not seen, resulting in skip metastases. These are most commonly seen in tongue and floor of mouth cancer with metastases to inferior cervical nodes that are levels IV and V in the absence of involvement of levels I to III. This is due to tongue massage during normal mastication, which results in early and rapid lymphatic drainage into lower neck levels.¹¹ However, it is believed that advanced oral tongue cancers more often result in skip metastases than early cancers.¹² Other factors that alter the predictable drainage pattern include extensive tumor growth within lymph nodes, prior surgical treatment/radiation, and inflammation.¹³

Conclusion

It is imperative that radiologists be familiar with the simplified level classification system of cervical nodes used by surgeons and correlative imaging-based nodal distribution. The common classification system facilitates communication between radiologists, surgeons, and pathologists and aids in prognostication as well as management decisions.

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Conflict of Interest

None declared.

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