Head and Neck Lymph Node Anatomy

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Cancers of the head and neck—including cancers of the buccal cavity, head and neck subset, larynx, pharynx, thyroid, salivary glands, and nose/nasal passages—account for approximately 6% of all malignancies in the United States and accounted for approximately 3% of new malignancy cases in 2020 [1]. Careful analysis of nodes in the neck and knowledge of the various compartments are critical in the assessment and staging of primary head and neck malignancies. Regardless of the site of the primary tumor, the presence of a single metastatic lymph node in either the ipsilateral or the contralateral side of the neck reduces the 5-year survival rate by about 50%. The risk of cervical metastasis depends on the site of origin of the primary tumor [2].

1.1 Classification

The classification of cervical lymph nodes is complicated by the use of several different systems and the rather loose intermixing of specific names for a particular node from one system to another [3]. Of the approximately 800 lymph nodes in the body, about 300 are located in the neck. Thus, between one-fifth and one-sixth of all the nodes in the body are located in either side of the neck, making development of a classification system very complex [4].

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For nearly four decades, the most commonly used classification for the cervical lymph nodes was that developed by Rouvière in 1938 who described the "collar" (including occipital, mastoid, parotid, facial, retropharyngeal, submaxillary, submental, and sublingual nodes), anterior, and lateral cervical groups. The direction of nodal classification changed from that of a pure anatomic study to a nodal mapping guide for selecting the most appropriate surgical procedure among the various types of neck dissections [5].

In 1981, Shah et al. [6] suggested that the anatomically based terminology be replaced with a simpler classification based on levels. Since then, a number of classifications have been proposed that use such level, region, or zone terminology. In the past few decades, the simple level-wise classification (see Tables 1.1 and 1.2; Figs. 1.1 and 1.2) has been in use widely [7]. This system of division of neck nodes was supported by American Head and Neck Society and neck classification project [2]. However, it did not recommend adding additional levels and stated that the nodes involving regions outside the VI levels should be referred to by the name of their specific nodal group (e.g., retropharyngeal/periparotid nodes).

The ad hoc committee of the neck classification project introduced the concept of sublevels in the neck nodes, as the nodes in a particular zone in a level had different risk of metastatic involvement compared to the other zones in the same level [2].

Table 1.1 Numeric classification system of cervical nodes

Level	Location
I	Submandibular and submental nodes (all nodes in floor of mouth)
II	Internal jugular chain (or deep cervical chain) nodes; nodes about internal jugular vein from skull base to hyoid bone (same level as carotid bifurcation)
III	Nodes about internal jugular vein from hyoid bone to cricoid cartilage (same level that omohyoid muscle crosses internal jugular chain)
IV	Infraomohyoid nodes about internal jugular vein between cricoid cartilage and supradavicular fossa
V	Posterior triangle nodes (deep to sternocleidomastoid muscle)
VI	Nodes related to thyroid gland
VII	Nodes in tracheoesophageal groove, about esophagus extending down to superior mediastinum.

Table 1.2 Levels and sublevels of cervical lymph nodes with their anatomical boundaries

Level	Superior	Inferior	Anterior (medial)	Posterior (lateral)
IA	Symphysis of mandible	Body of hyoid	Anterior belly of contralateral digastric muscle	Anterior belly of ipsilateral digastric muscle
IB	Body of mandible	Posterior belly of muscle	Anterior belly of digastric muscle	Stylohyoid muscle
IIA	Skull base	Horizontal plane defined by the inferior body of the hyoid bone	Stylohyoid muscle	Vertical plane defined by the spinal accessory nerve

Table 1.2 (continued)

Level	Superior	Inferior	Anterior (medial)	Posterior (lateral)
IIB	Skull base	Horizontal plane defined by the inferior body of the hyoid bone	Vertical plane defined by the spinal accessory nerve	Lateral border of the sternocleidomastoid muscle
III	Horizontal plane defined by inferior body of hyoid	Horizontal plane defined by the inferior border of the cricoid cartilage	Lateral border of the sternohyoid muscle	Lateral border of the sternocleidomastoid or sensory branches of cervical plexus
IV	Horizontal plane defined by the inferior border of the cricoid cartilage	Clavicle	Lateral border of the sternohyoid muscle	Lateral border of the sternocleidomastoid or sensory branches of cervical plexus
VA	Apex of the convergence of the sternocleidomastoid and trapezius muscles	Horizontal plane defined by the lower border of the cricoid cartilage	Posterior border of the sternocleidomastoid muscle or sensory branches of cervical plexus	Anterior border of the trapezius muscle
VB	Horizontal plane defined by the lower border of the cricoid cartilage	Clavicle	Posterior border of the sternocleidomastoid muscle or sensory branches of cervical plexus	Anterior border of the trapezius muscle
VI	Hyoid bone	Suprasternal	Common carotid artery	Common carotid artery

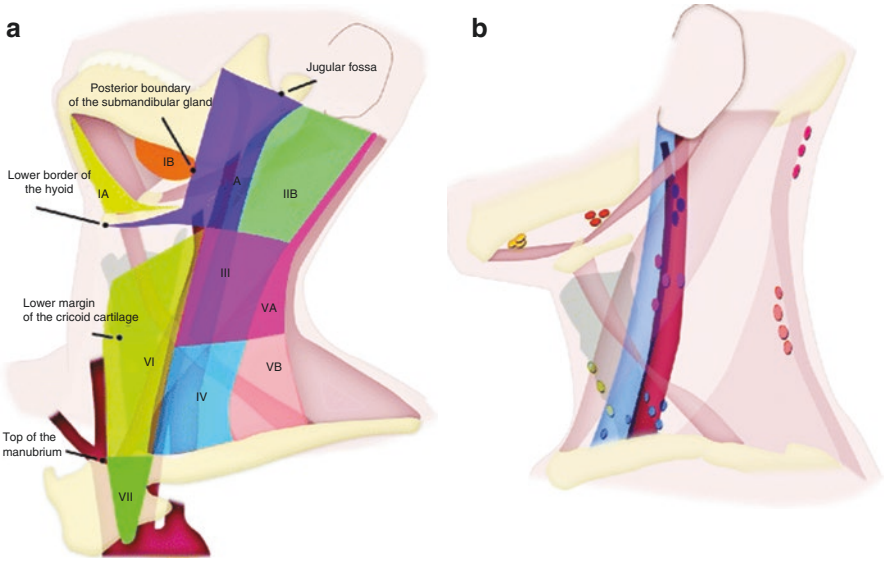

Fig. 1.1 (**a**) Important anatomical landmarks in the neck dividing the region into nodal levels. (**b**) Individual nodal groups are depicted (refer to color scheme)

Fig. 1.2 Level IB submandibular (left) and level IA submental group of nodes (right)

1.2 Criteria for Enlargement

The size criteria for the cervical lymph nodes has been proposed as short axis diameter greater than 11 mm in jugulodigastric and greater than 10 mm in all other cervical nodes [8]. At the time of this writing, the criteria to define cervical lymphadenopathy are (1) a discrete mass greater than 1.0–1.5 cm; (2) an ill-defined mass in a lymph node area; (3) multiple nodes of 6–15 mm; and (4) obliteration of tissue planes around vessels in a nonirradiated neck. A nodal mass with central low density is specifically indicative of tumor necrosis [7, 9–11].

1.2.1 Level I: Submental (IA) and Submandibular (IB)

1.2.1.1 Metastatic Involvement

These nodes contain metastatic disease when the primary site is lip, buccal mucosa, anterior nasal cavity, and soft tissue of cheek (see Table 1.3; Figs. 1.3 and 1.4). It is important to distinguish between level IA and IB, as IA is likely to contain metastatic disease associated with floor of mouth, lower lip, ventral tongue, and anterior nasal cavity tumors [12], whereas lesions from oral cavity subsite are likely to spread to level IB, II, and III. In the 1990 study by Candela et al. [13], level I metastases were frequent in oral cavity tumors, with a mean prevalence of 30.1%. The corresponding figure for oropharyngeal cancer was 10.3% largely because of the high prevalence in N+ disease [13].

Table 1.3 Summary of cervical lymph node involvement in various primaries

Site of primary carcinoma	Lymph nodes commonly involved	Not so commonly involved
Oral portion of tongue	I, II, III	
Floor of mouth	I, II	
Anterior faucial pillar-retromolar trigone	I, II, III	
Soft palate	II	
Nasopharynx	II, III, IV	V
Oropharynx	II,III	V
Tonsillar fossa	I, II, III, IV	V
Hypopharynx	II, III, IV	V
Base of tongue	II, III, IV	V
Supraglottic larynx	II, III, IV	
Thyroid	VI	II–V if V is clinically +
Stomach and testis		IV

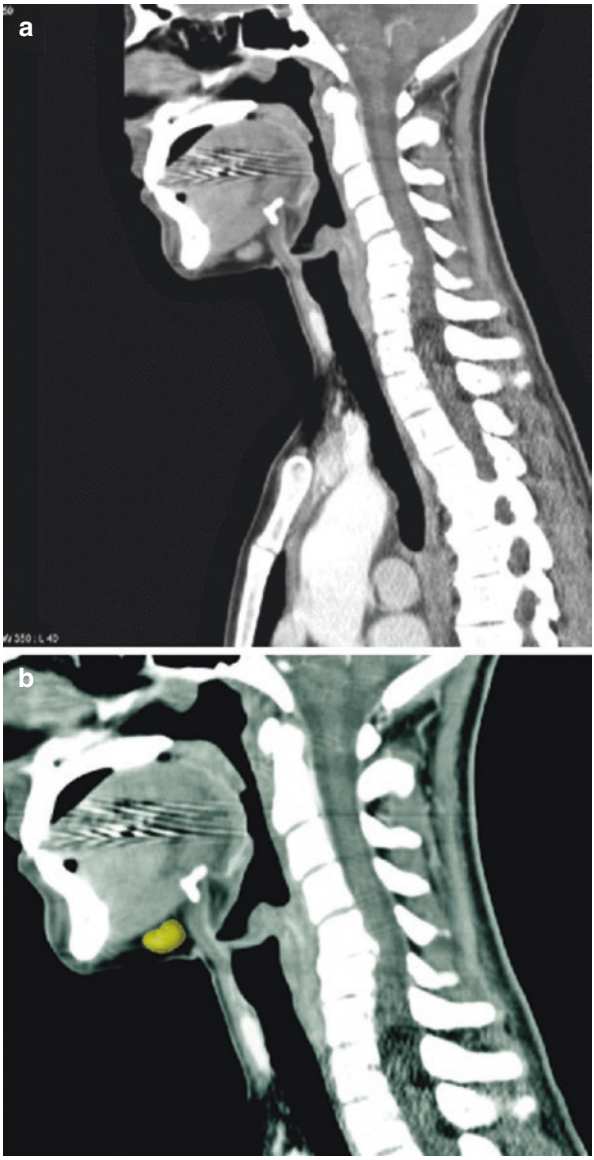

Fig. 1.3 (**a**) Sagittal CECT scans showing an enlarged level IA (submental) node in this patient with lymphoma. The node is outlined in (**b**)

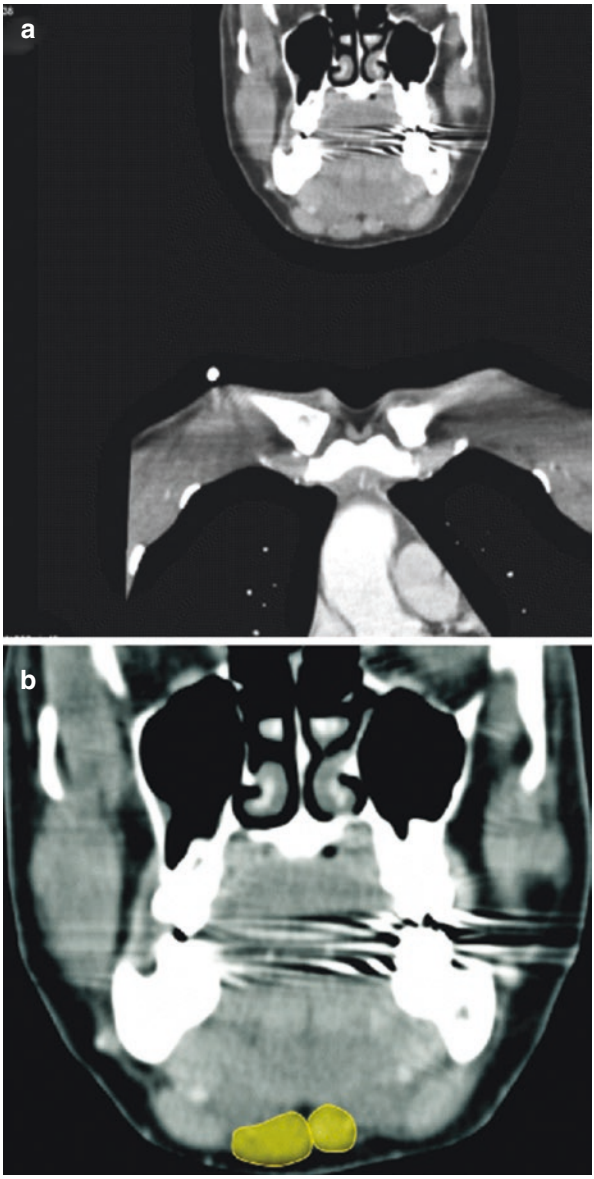

Fig. 1.4 (**a**) Coronal CECT scans showing an enlarged Level IB (submandibular) node in this patient with lymphoma. The node is outlined in (**b**)

1.2.1.2 Unusual Site of Metastasis

They do not form part of the primary drainage pathway of nasopharyngeal carcinomas but may be the sole site of tumor recurrence after radiotherapy. This is thought to be due to fibrosis of the lymphatic vessels in the irradiated regions resulting in diversion of lymph drainage to the submental nodes [14].

1.2.2 Level II

Internal jugular chain lymph nodes (see Fig. 1.5) are frequently divided into IIA (see Fig. 1.6) and IIB by spinal accessory nerve [2]. As the nerve cannot be identified on the CT scan, the Brussels guidelines used a criteria from radiological point of view proposed by Som et al. [15], which takes the posterior edge of the internal jugular vein (IJV) for subdivisions between levels IIA and IIB (see Figs. 1.7 and 1.8).

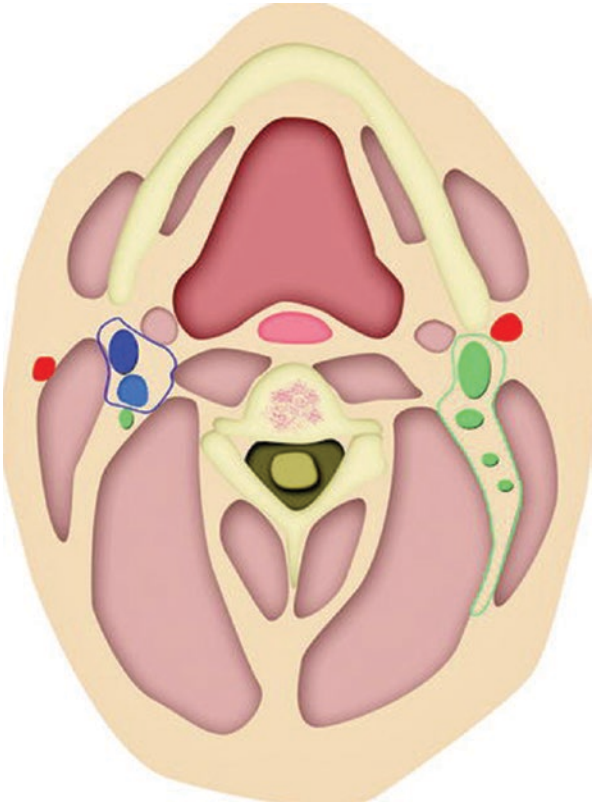

Fig. 1.5 Internal jugular chain of lymph nodes (level II). These nodes can be further divided into IIA and IIB by spinal accessory nerve. The red color represents branches of external carotid artery

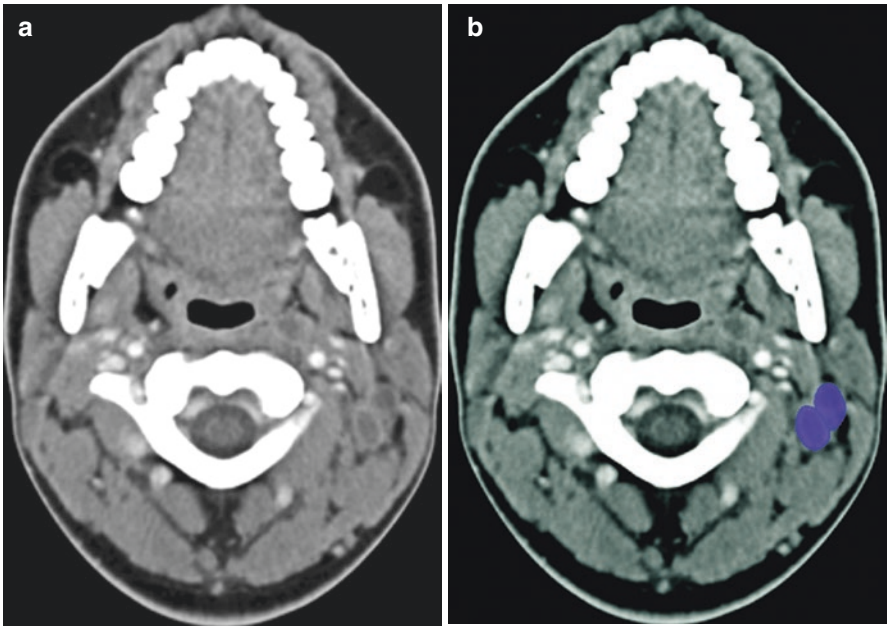

Fig. 1.6 (**a**) Axial CECT showing enlarged IIA level nodes. Note central hypodensity in these nodes which represent necrosis. The node is outlined in (**b**)

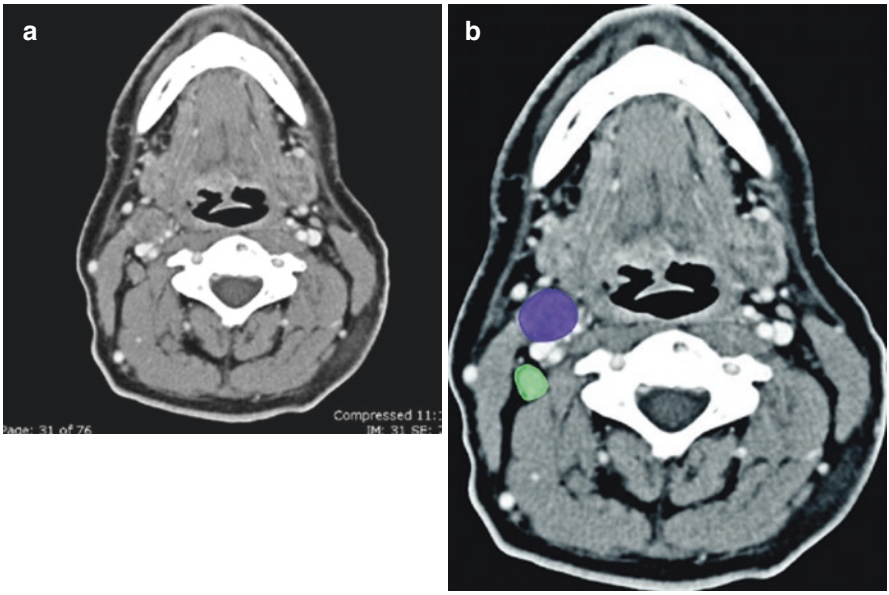

Fig. 1.7 (**a**) Axial CECT showing enlarged level II nodes. These are further divided into IIA and IIB based on the posterior edge of internal jugular vein. The nodes are outlined in (**b**)

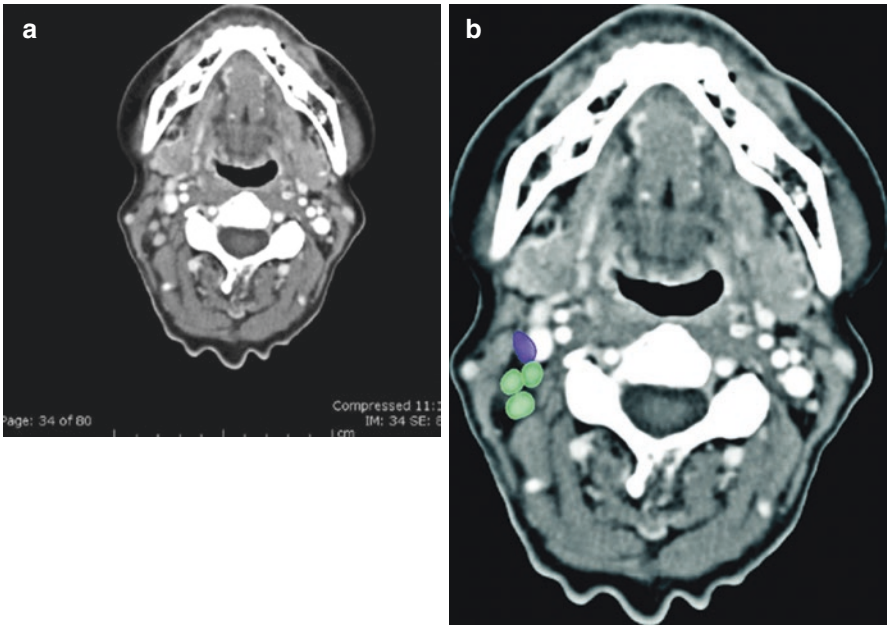

Fig. 1.8 (**a**) Axial CECT showing single level IIA and multiple level IIB nodes. The nodes are outlined in (**b**)

1.2.2.1 Metastatic Involvement

Level II is arbitrarily divided into IIA and IIB by spinal accessory nerve. They drain lymph from oral cavity, nasal cavity, nasopharynx, oropharynx, hypopharynx, larynx, and parotid gland (see Figs. 1.9 and 1.10).

The first draining lymph node station of supraglottic carcinomas is located in level IIA. Metastatic nodal involvement in papillary thyroid carcinoma is not uncommon especially of level IIB nodes. Neck dissection should include the level IIB lymph node whenever level IIA lymph node metastasis is found. Level IIB dissection is probably unnecessary when level IIA lymph nodes are uninvolved because the incidence of metastasis to level IIB is low if level IIA is not involved [16].

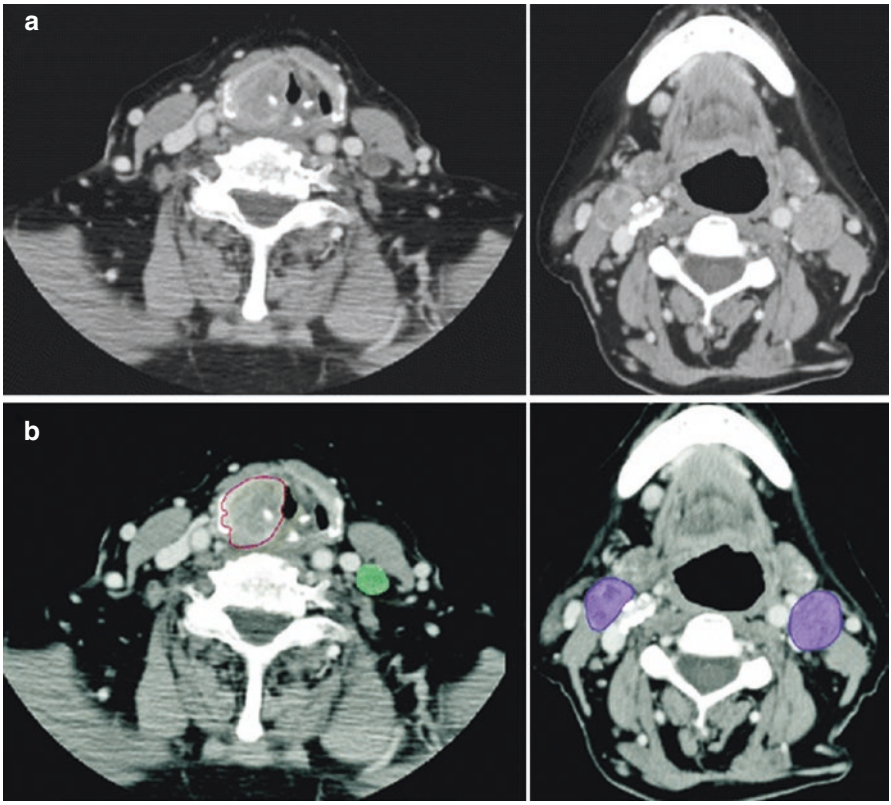

Fig. 1.9 (**a**) Axial CECT showing bilateral enlarged level II nodes in this patient with poorly differentiated right pyriform sinus carcinoma. The tumor and the nodes are outlined in (**b**)

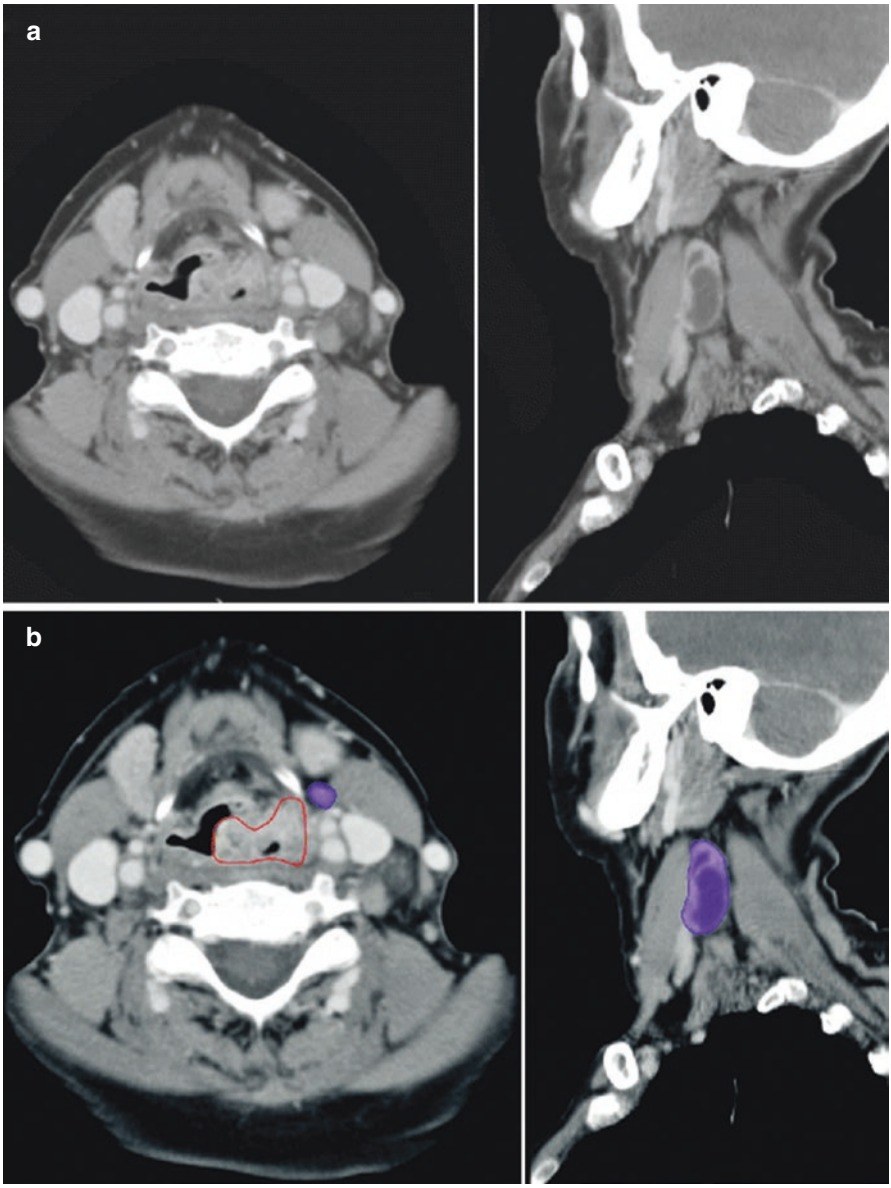

Fig. 1.10 (**a**) Axial CECT showing bilateral enlarged level II nodes in this patient with squamous cell carcinoma of the supraglottic larynx and enlarged level II nodes. Sagittal image shows necrotic level IIA node. The tumor and the nodes are outlined in (**b**)

1.2.2.2 Unusual Site of Metastasis

Intraparotid lymph nodes may be involved by lymphoma or metastatic spread from tumors of the scalp and face region [17].

1.2.3 Level III

Level III nodes drain lymph from the oral cavity, nasopharynx, oropharynx, hypopharynx, and larynx and can harbor metastatic spread from primaries located at these locations [2] (see Figs. 1.11, 1.12, and 1.13). Skip metastasis from carcinoma of the tongue is not unusual in this group [18].

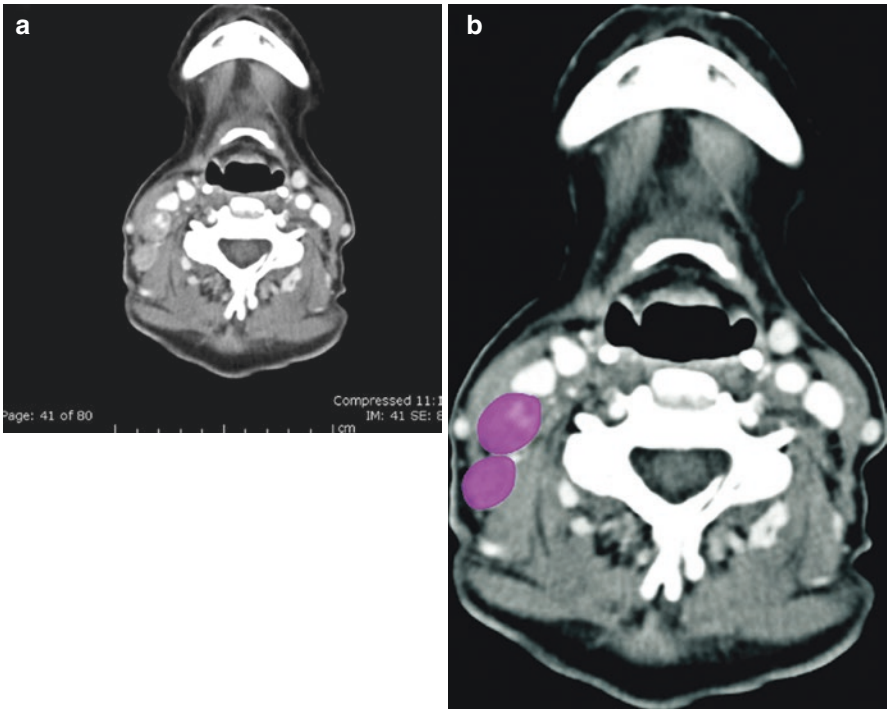

Fig. 1.11 (**a**) Enlarged right-sided level III nodes seen on axial CECT. The nodes are outlined in (**b**)

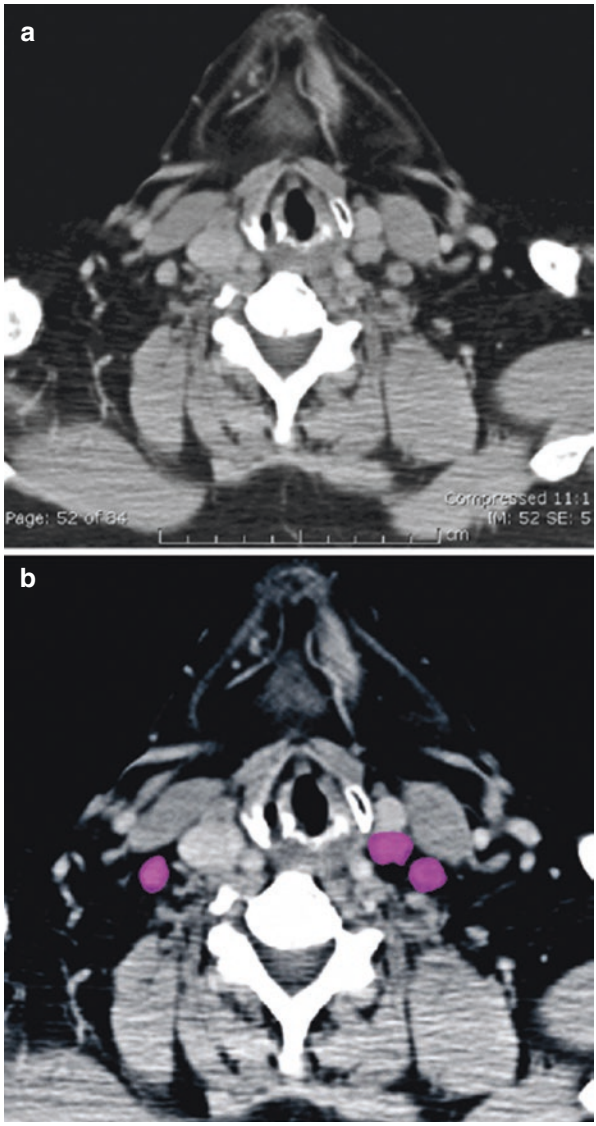

Fig. 1.12 (**a**) Enlarged bilateral level III nodes seen on axial CECT. The nodes are outlined in (**b**)

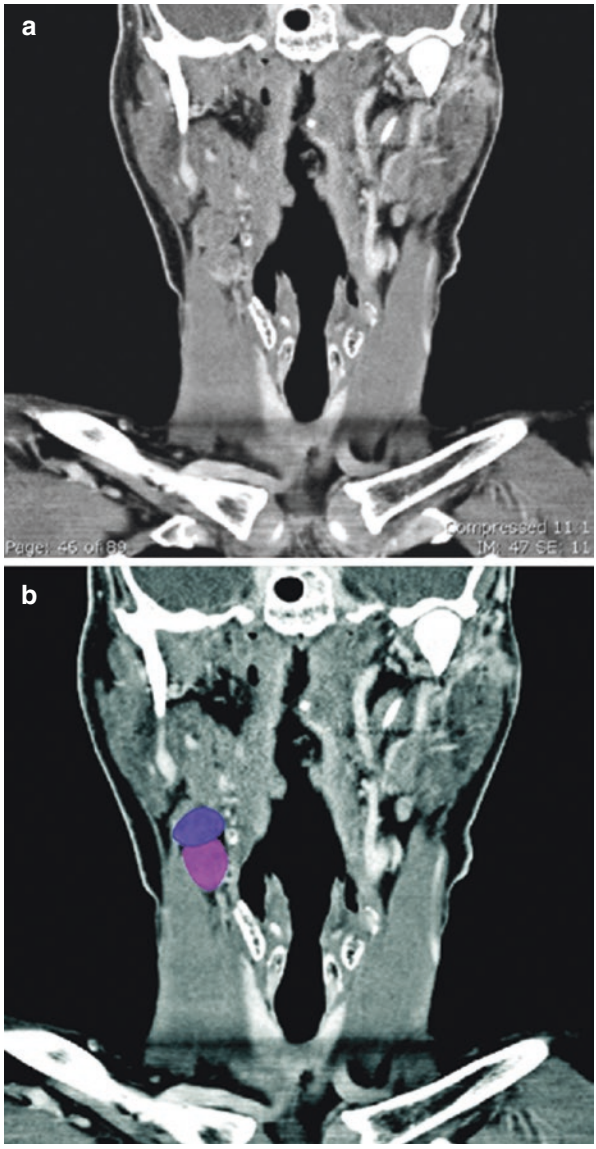

Fig. 1.13 (**a**) Hyoid bone as anatomical landmark separating enlarged level IIA node (superiorly) and level III node (inferiorly) on this coronal CECT. Part of the inferior body of hyoid bone is seen medial to these nodes. The nodes are outlined in (**b**)

1.2.4 Level IV

These groups of lymph nodes drain the following sites: hypopharynx, thyroid, cervical esophagus, and larynx. The classical Virchow node hails from this group. Involvement of level V nodes precedes their involvement in thyroid malignancies (see Figs. 1.14, 1.15, 1.16, and 1.17) [2, 19]. These nodes accompany level III nodes in skip metastasis from carcinoma of the tongue [18]. Involvement of Virchow node in carcinoma of the stomach is attributed to the predominant drainage by thoracic duct and partial filtration by Virchow node. This is considered as an ominous sign and changes the staging of carcinoma stomach to stage IV/M1b [20]. Level IV can be an unusual site of testicular metastasis [21].

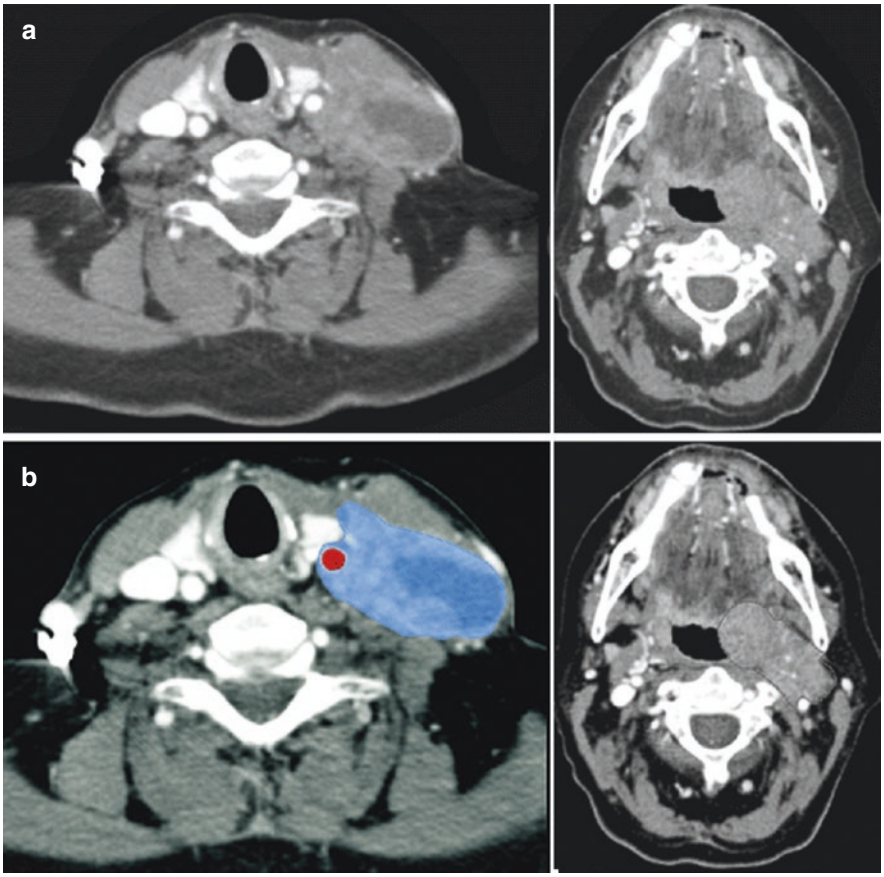

Fig. 1.14 (**a**) Axial CECT demonstrates an enlarged necrotic level IV node abutting the internal carotid artery in this patient with oropharyngeal carcinoma. The tumor and the node are outlined in (**b**)

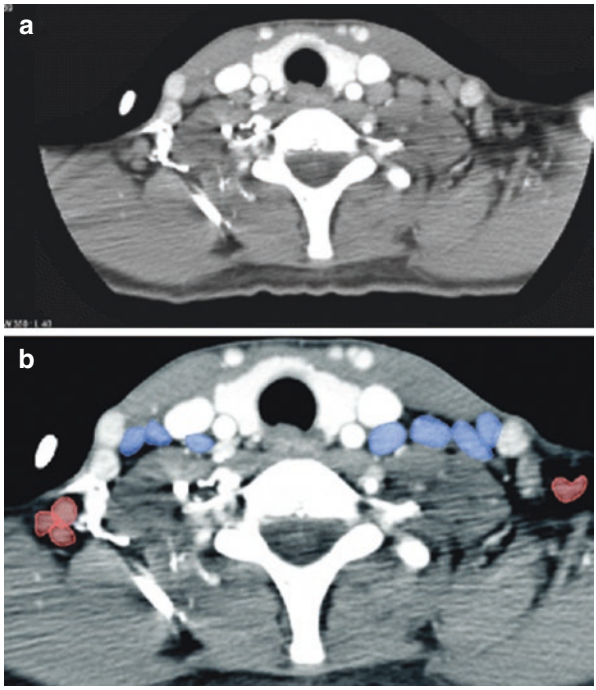

Fig. 1.15 (**a**) Multiple bilateral enlarged level IV and VB nodes noted on this axial CECT in this patient with lymphoma. The nodes are outlined in (**b**)

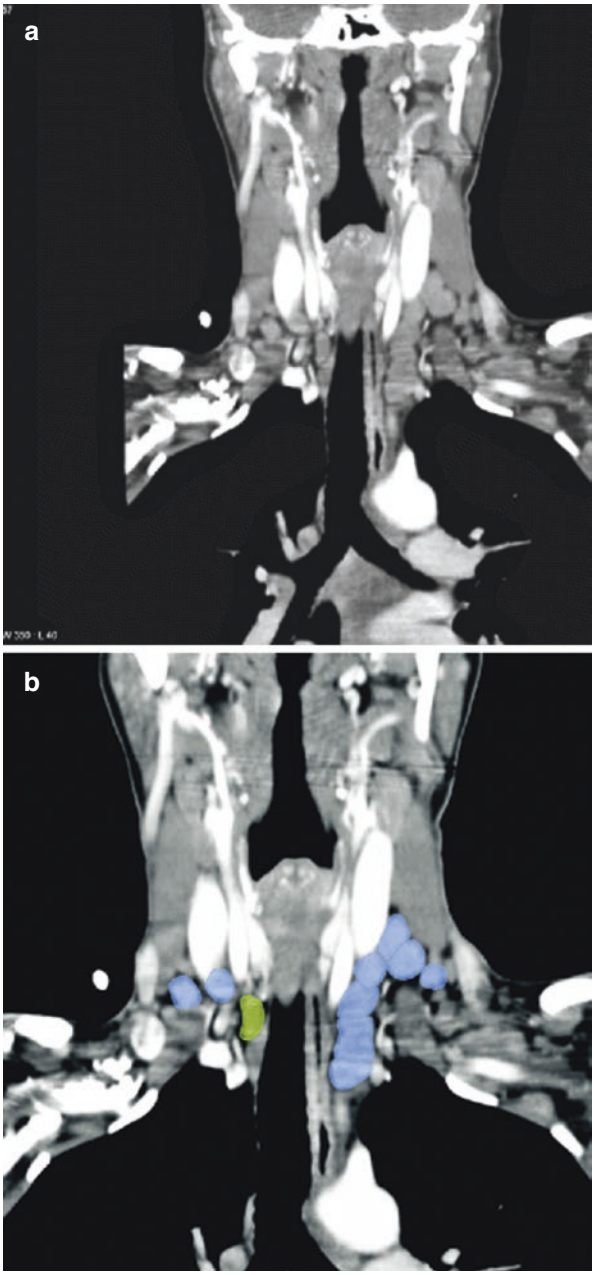

Fig. 1.16 (**a**) Coronal CECT image showing enlarged bilateral level IV and level VI nodes, which are outlined in (**b**)

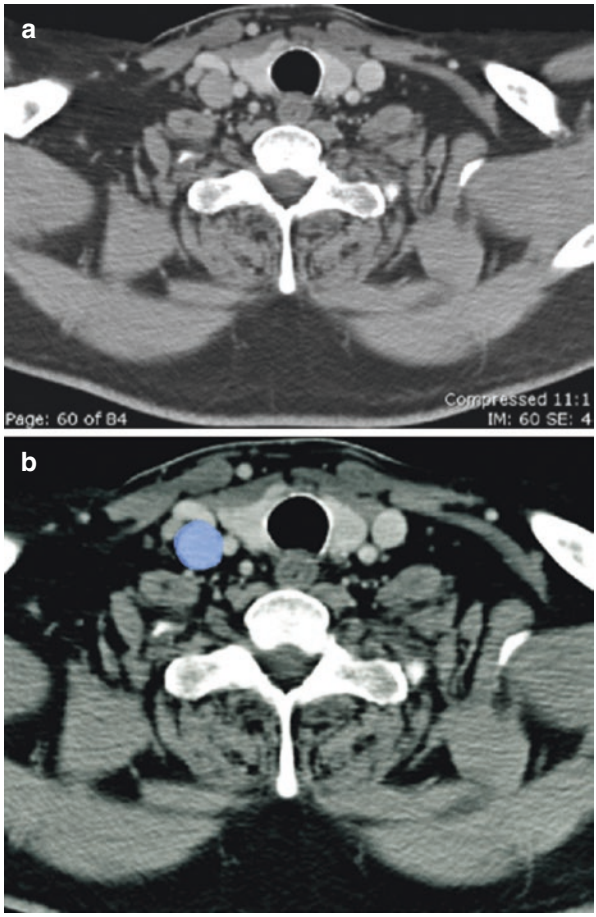

Fig. 1.17 (**a**) Axial CECT in this patient with lymphoma showing enlarged right-sided level IV node, which is outlined in (**b**)

1.2.5 Level V (A + B)

Lymphatics from nasopharynx and cutaneous tissue of posterior scalp and neck drain in to group V. Level VA (see Fig. 1.18) primarily contains nodes along the spinal accessory nerve, and level VB contains transverse cervical and supraclavicular nodes (see Fig. 1.19).

Metastatic involvement of this group alone is seen in a small subset of patients but occurs commonly if groups I to IV harbor the tumor spread. Level VB (see Fig. 1.20) is known to be associated with primary tumor located in the thyroid gland [5]. Involvement of level VB is an ominous sign in aerodigestive tract malignancies. Level VB nodes should be carefully identified and differentiated from Virchow nodes [2].

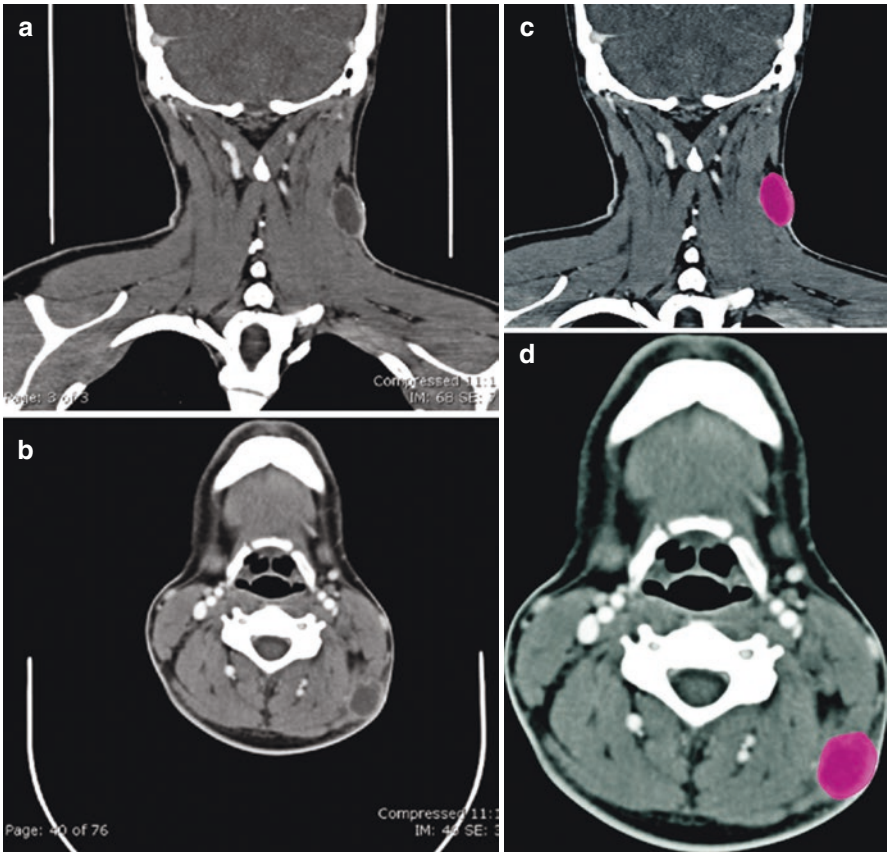

Fig. 1.18 Coronal (**a**) and axial (**b**) CECT image showing an enlarged necrotic level VA node noted at the convergence of trapezius and sternocleidomastoid muscles, which forms superior margin for this group. The nodes are outlined on (**c**, **d**)

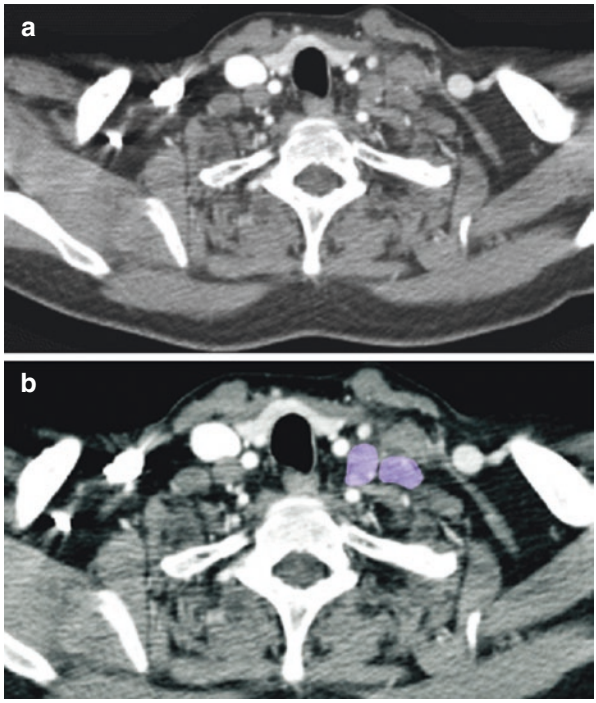

Fig. 1.19 (**a**) Enlarged supraclavicular nodes noted on this axial CECT image. Involvement of these nodes is considered as a bad prognostic sign in aerodigestive tract malignancies. The nodes are depicted in (**b**)

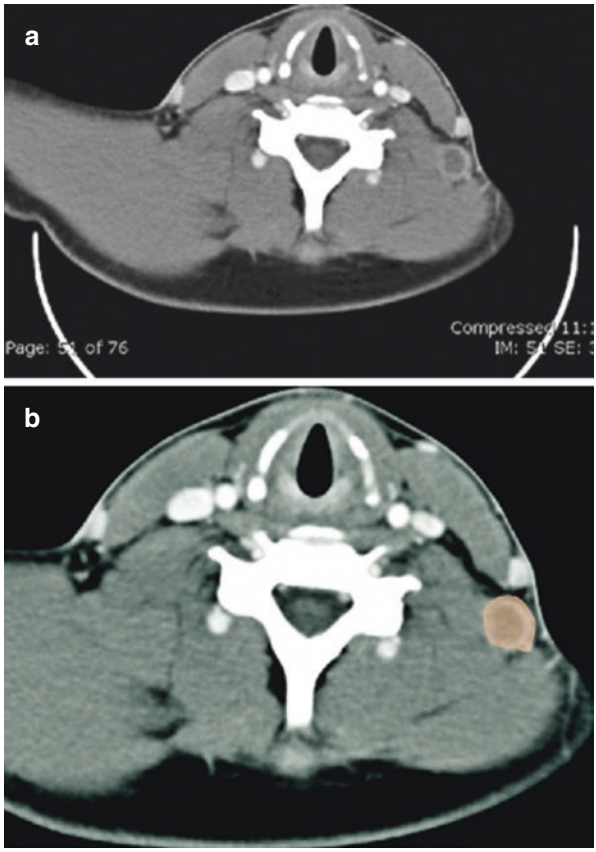

Fig. 1.20 (**a**) Axial CECT image showing an enlarged level VB node with central necrosis and peripheral enhancement. The node is depicted in (**b**)

1.2.6 Level VI

Pre- and paratracheal (see Fig. 1.21), precricoid, and perithyroid lymph nodes constitute this group and drain lymph from thyroid gland, glottic/subglottic larynx, apex of pyriform sinus, and cervical esophagus [13].

The facial, mastoid occipital, and retropharyngeal nodes (see Fig. 1.22) are not included in the level system and are designated by their names if they are enlarged. The American Academy Otolaryngology–Head and Neck Surgery (AAO-HNS) believes that level VII (see Table 1.1) should be included in mediastinal nodal groups instead of cervical nodes. Facial nodal group is a blanket term applied for nodes at mandibular, buccinators, infraorbital, retrozygomatic, and malar nodes. These nodes are rarely identified, and their metastatic involvement is seen in nasopharyngeal and epidermal malignancies [17].

Medial and lateral retropharyngeal nodes may be involved in pharyngeal and sinonasal, thyroid and cervical, esophageal primaries and are considered abnormal if larger than 5 mm [22, 23].

Occipital, facial, and mastoid groups of nodes are not included in the level system (Fig. 1.23).

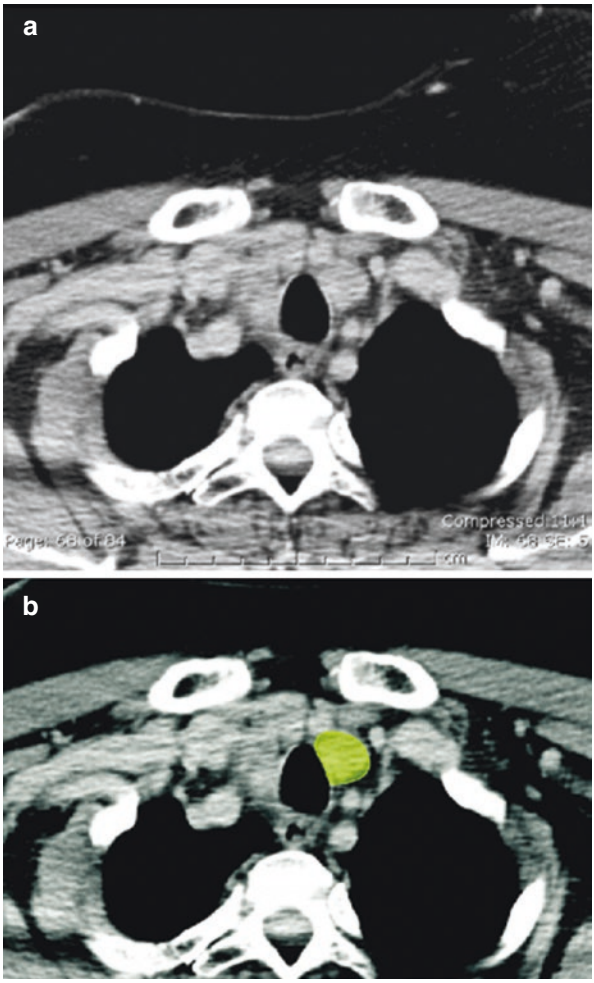

Fig. 1.21 (**a**) Axial CECT showing an enlarged level VI node in left paratracheal location, which is outlined in (**b**)

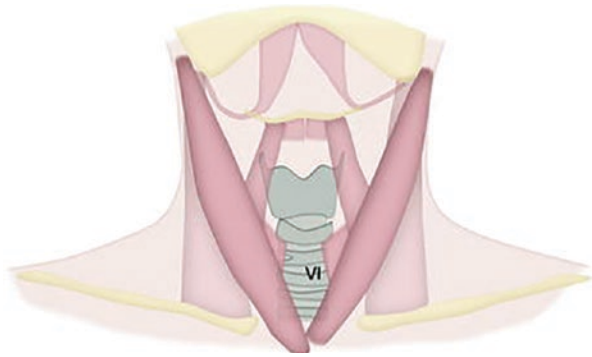

Fig. 1.22 Anatomical location of level VI nodes

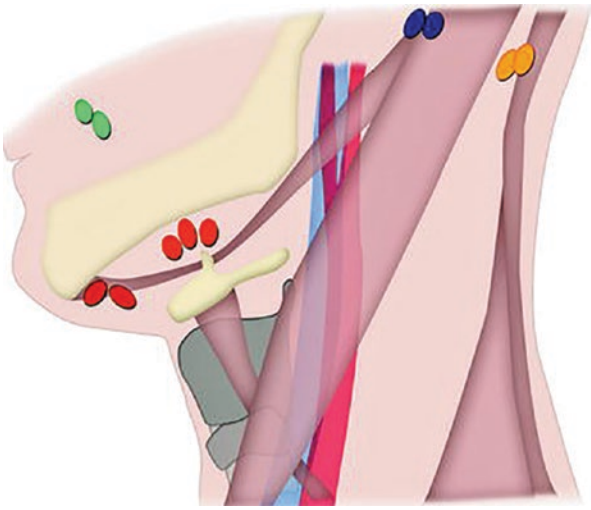

Fig. 1.23 Occipital, facial, and mastoid groups of nodes are depicted. These nodes are not included in the level system

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