# Head and Neck Lymph Node Anatomy

<div align="right">**1**</div>

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 [1]. Careful analysis of nodes in the neck and knowledge of the various compartments is 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 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].

## 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].

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).

**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. |

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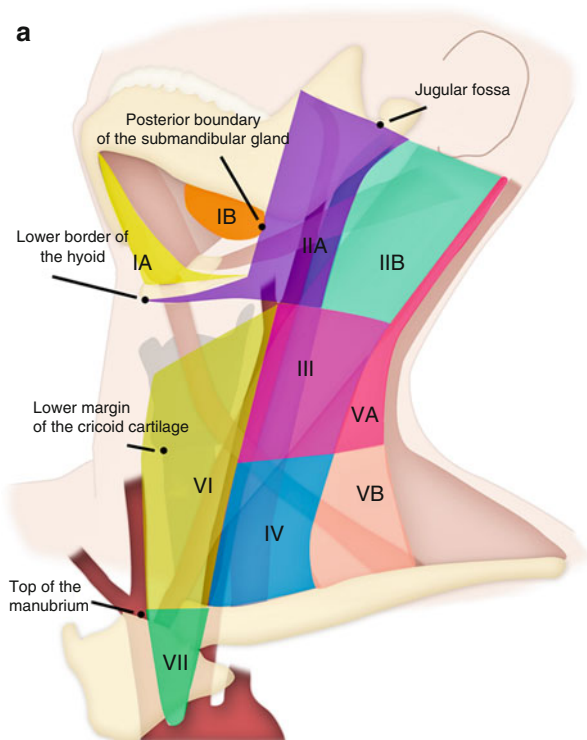


**Fig. 1.1**  (**a**) Important anatomical landmarks in the neck dividing the region into nodal levels. (**b**) Individual nodal groups are depicted (refer to color scheme)
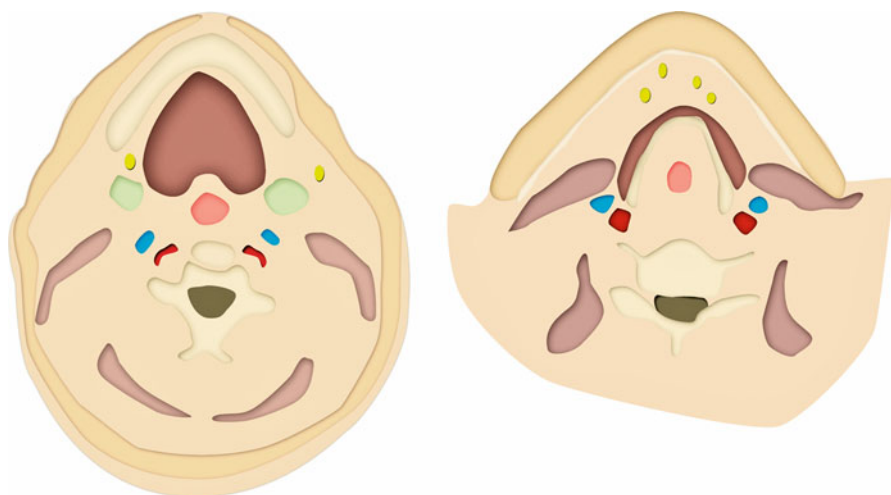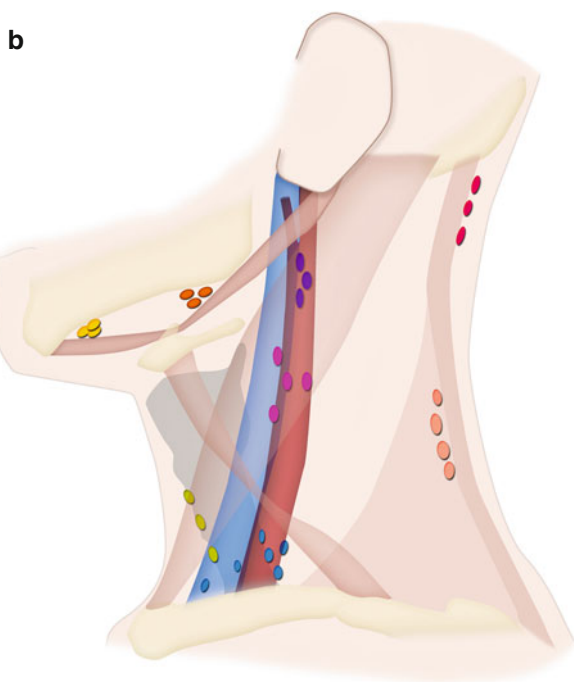
**Fig. 1.1** (continued)





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

**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 |
| 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 |

**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 |

## 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 great 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].

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

## 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). Of course 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].

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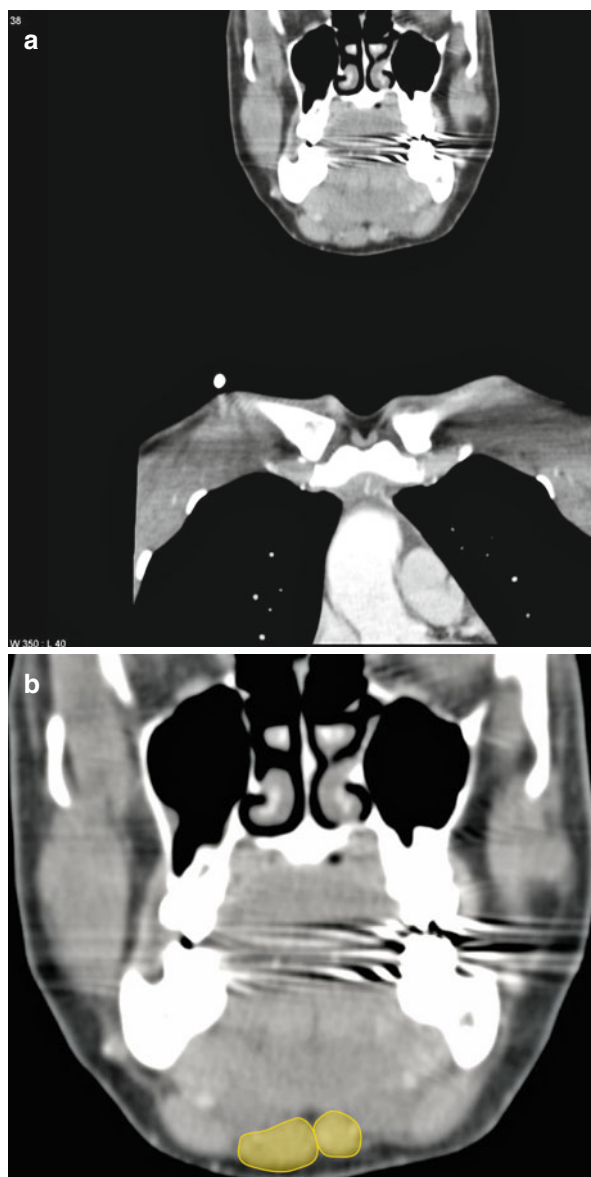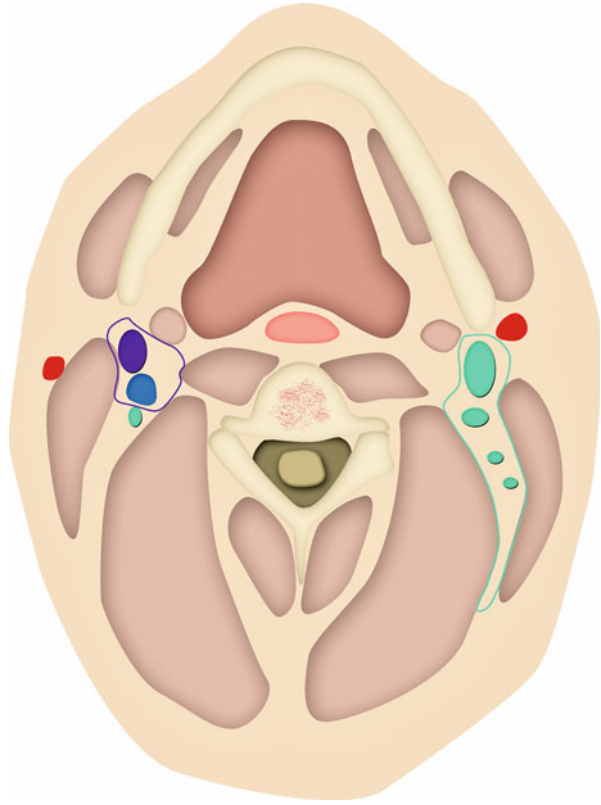
**Fig. 1.5** Internal jugular chain of lymph nodes (level II). These nodes can be further divided into IIA and IIB by spinal accessory nerve The red colors represent branches of external carotid artery

## Unusual Site of Metastasis

They do not form part of the primary drainage pathway of nasopharyngeal carcinomas but may be the sole site of tumour 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].

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



a
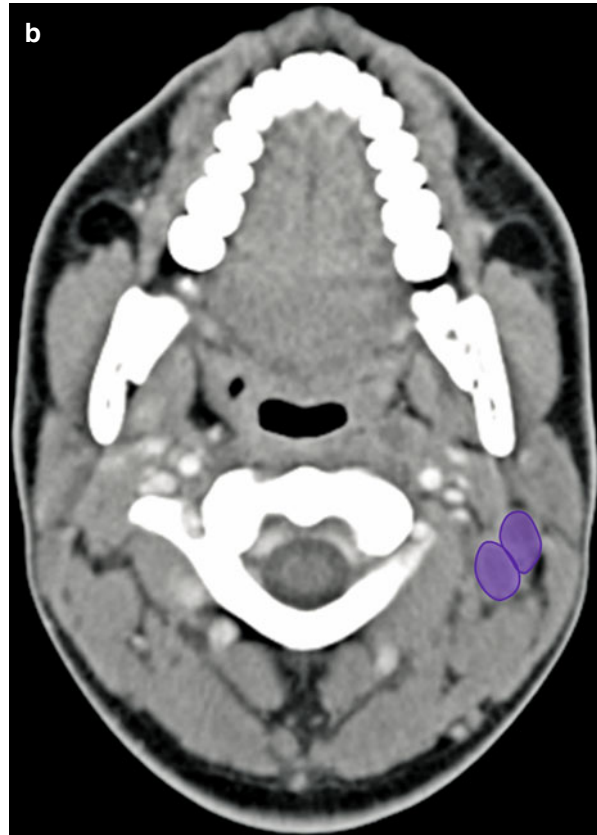
**Fig. 1.6** (continued)



**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**)
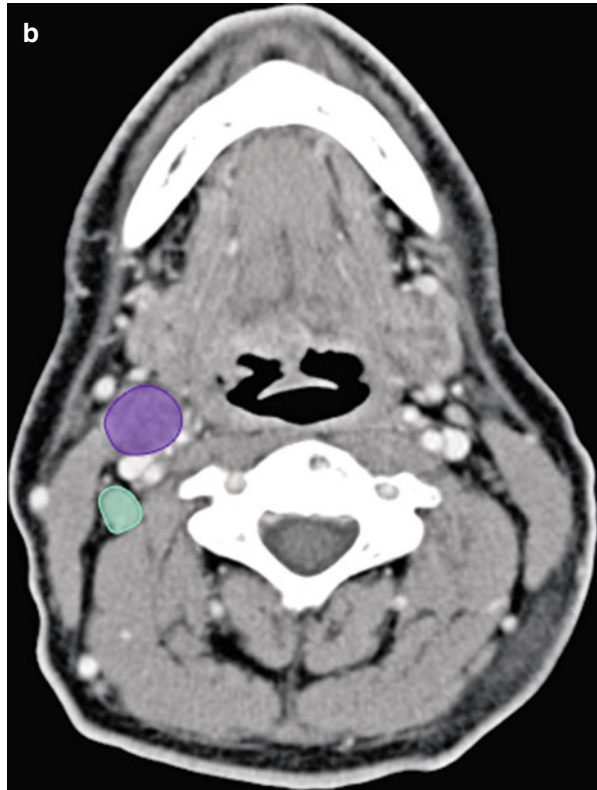
**Fig. 1.7** (continued)



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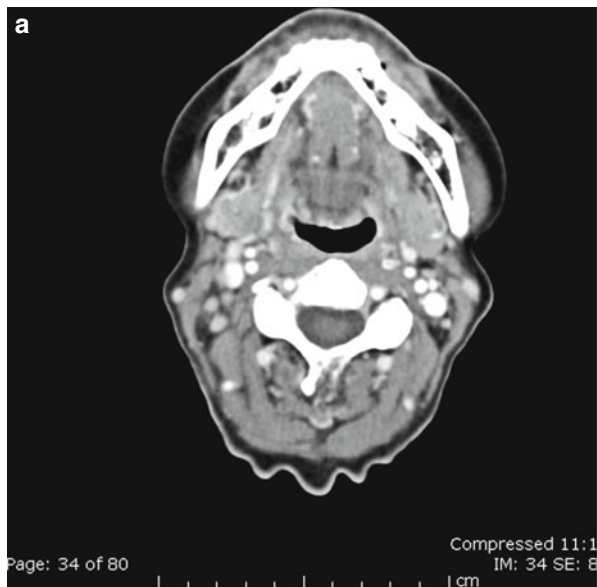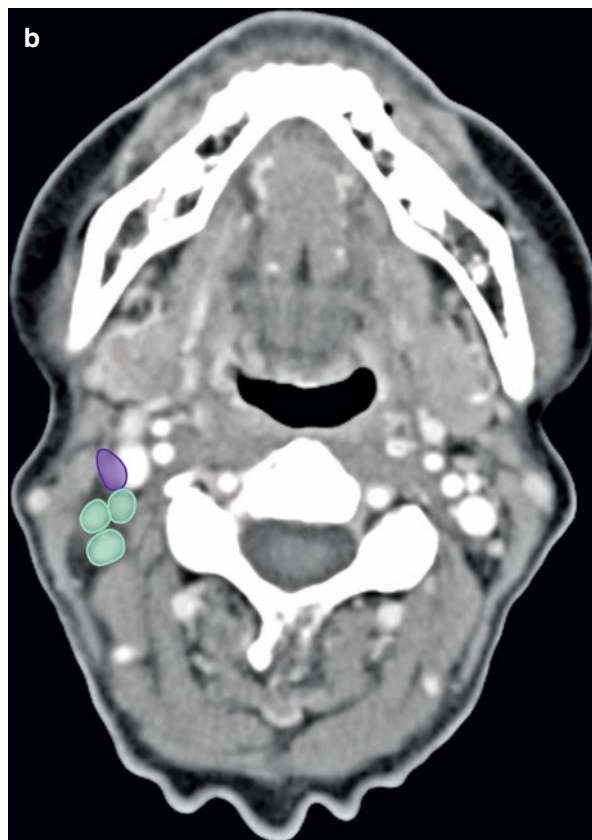
## Metastatic Involvement

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. 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].

## Unusual Site of Metastasis

Intraparotid lymph nodes may be involved by lymphoma or metastatic spread from tumors of the scalp and face region [17].
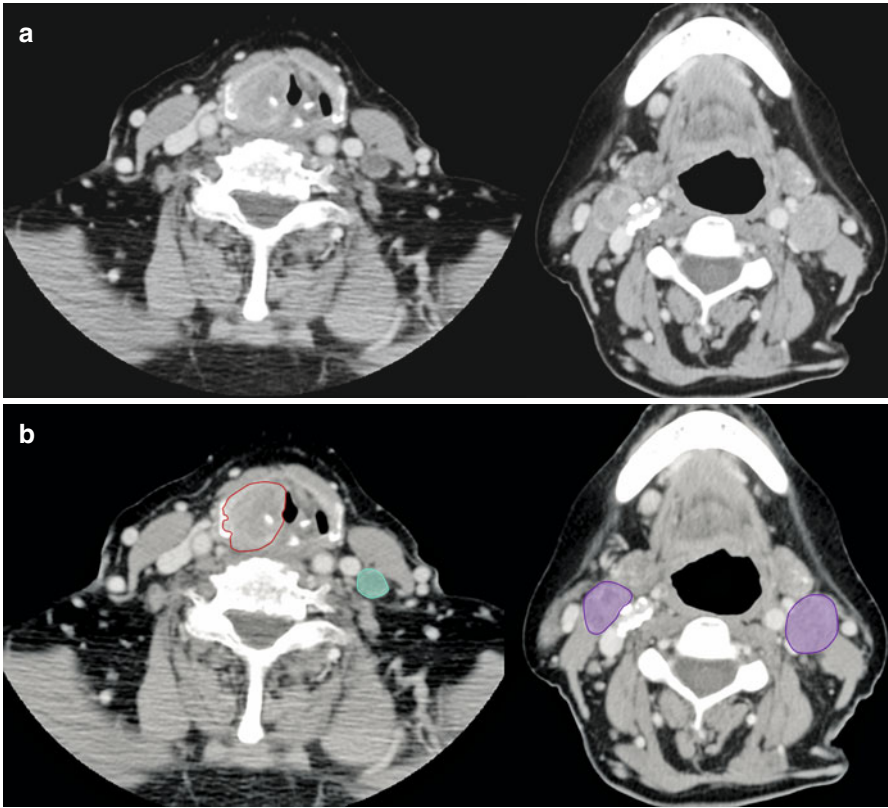
**Fig. 1.9** (**a**) Axial CECT showing bilateral enlarged level II nodes in this patient with poorly differentiated right pyriform sinus carcinoma. The tumor and the nodes are outlined in (**b**)
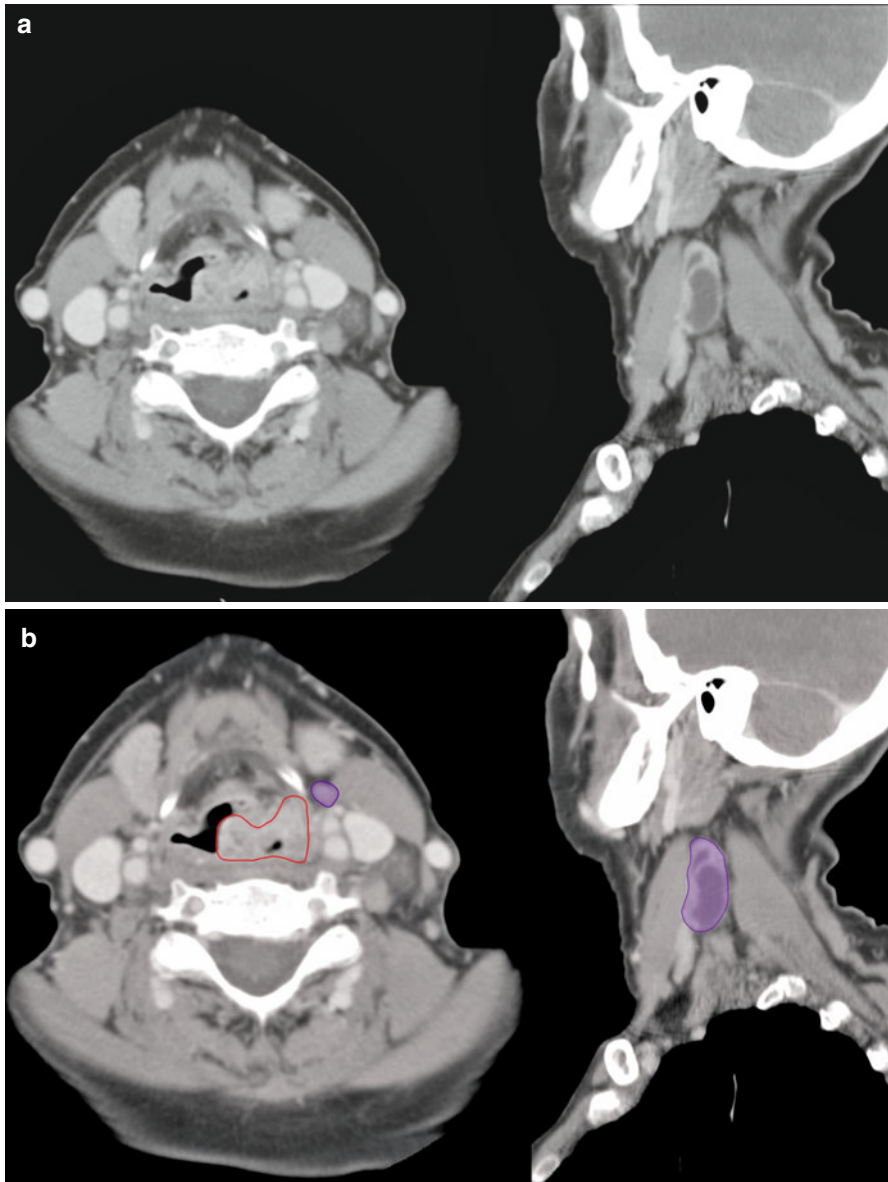
**Fig. 1.10** (**a**) Axial CECT showing bilateral enlarged level II nodes in this patient with squamous cell carcinoma of the supraglottic larynx and enlarged level II nodes. Sagittal image shows necrotic level IIA node. The tumor and the nodes are outlined in (**b**)

## 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 tongue is not unusual in this group [18].
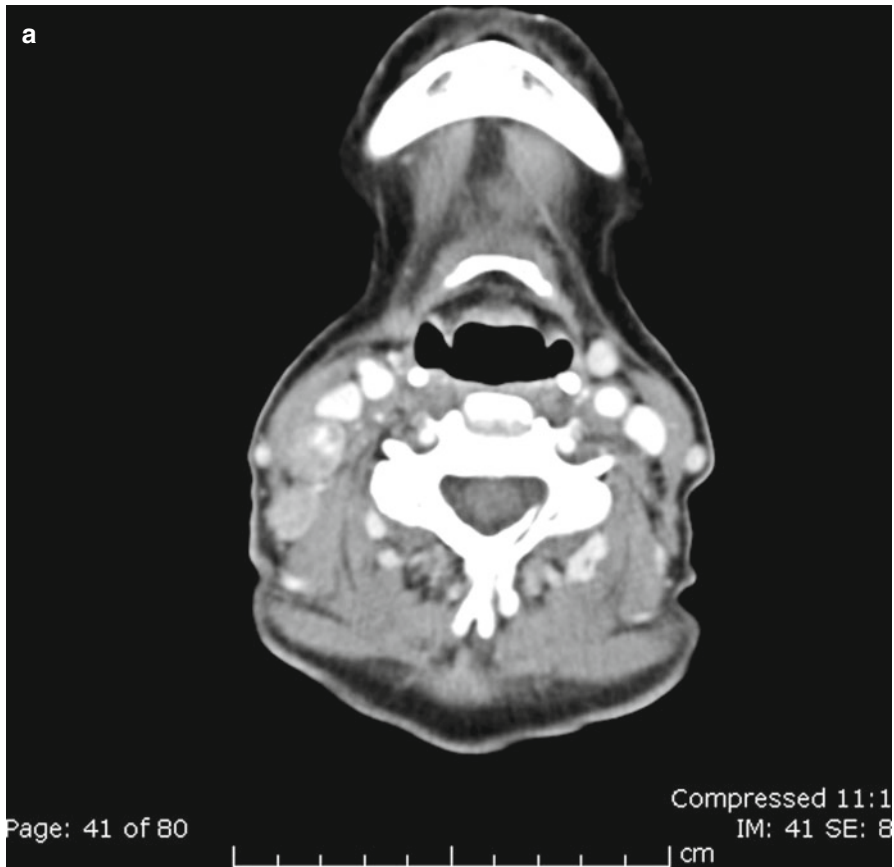
**Fig. 1.11** (**a**) Enlarged right-sided level III nodes seen on axial CECT. The nodes are outlined in (**b**)

**Fig. 1.12** (**a**) Enlarged
bilateral level III nodes seen
on axial CECT. The nodes
are outlined in (**b**)
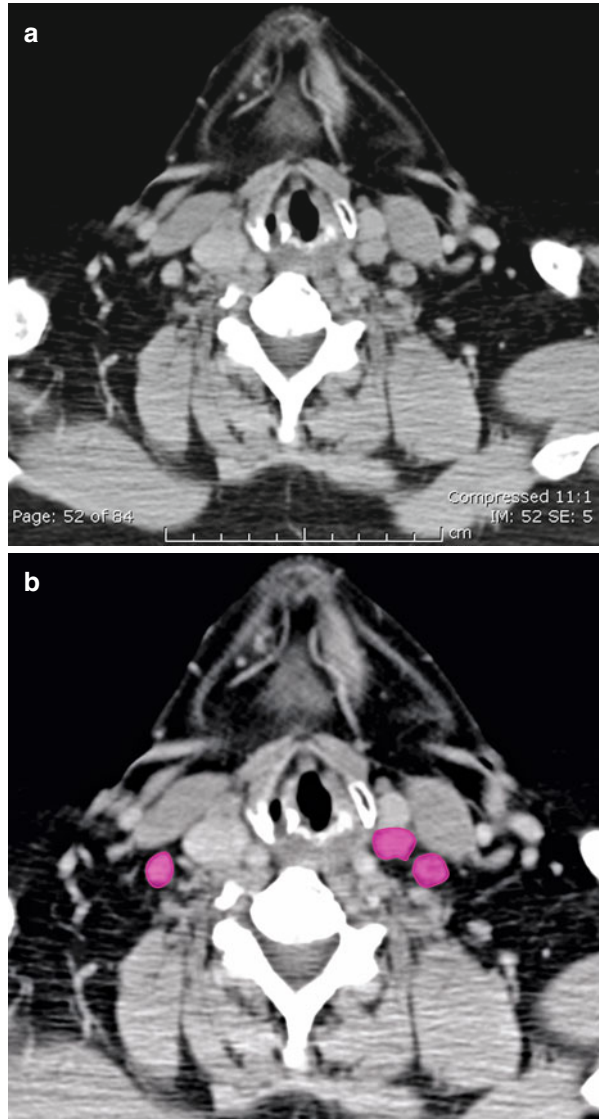
**Fig. 1.13** (**a**) Hyoid bone as anatomical landmark separating enlarged level IIA node (superiorly) and level III node (inferiorly) on this coronal CECT. Part of the inferior body of hyoid bone is seen medial to these nodes. The nodes are outlined in (**b**)
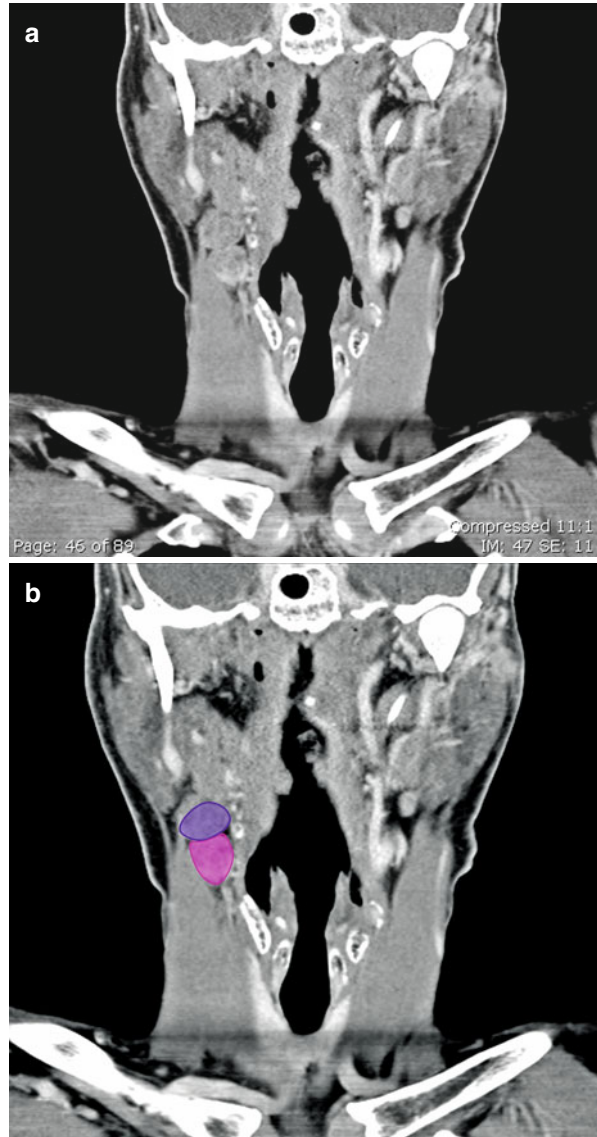
## Level IV

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 tongue [18]. Involvement of Virchow node in carcinoma 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].
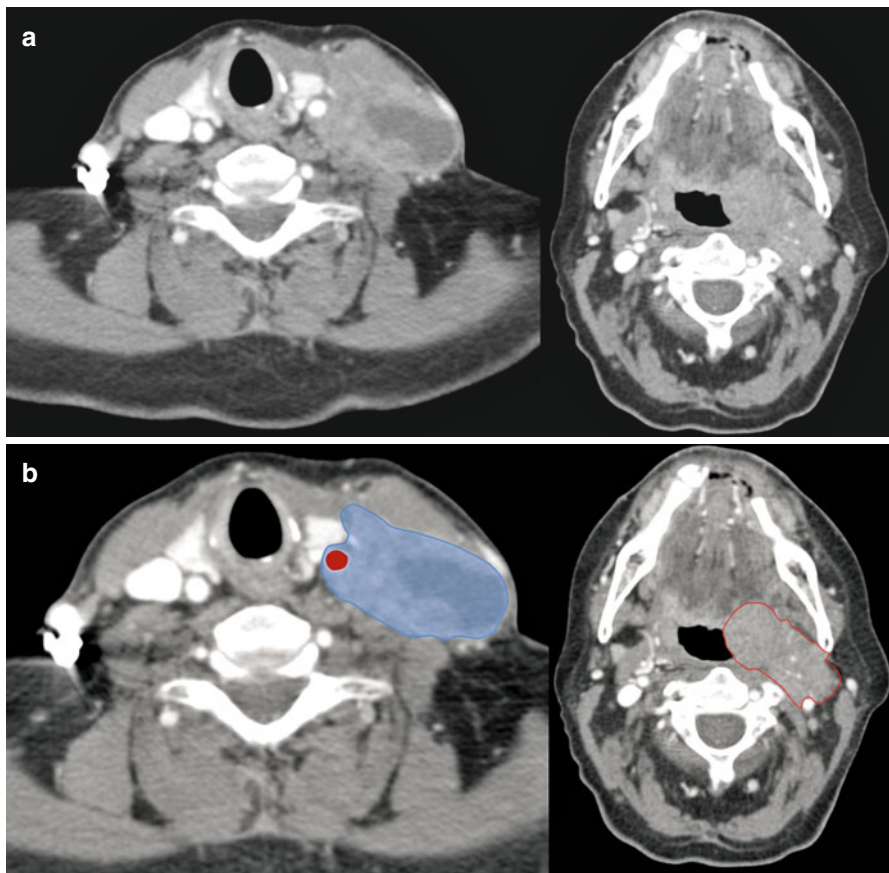


**Fig. 1.14** (**a**) Axial CECT demonstrates an enlarged necrotic level IV node abutting the internal carotid artery in this patient with oropharyngeal carcinoma. The tumor and the node are outlined in (**b**)

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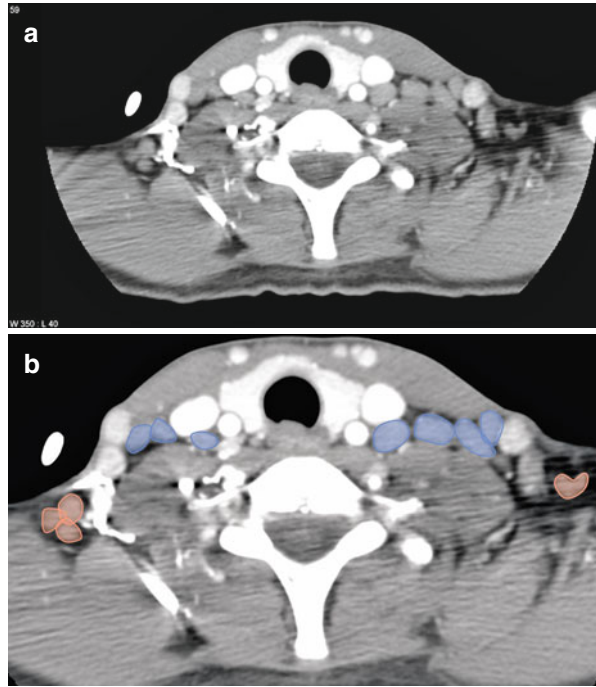
**Fig. 1.16** (**a**) Coronal
CECT image showing
enlarged bilateral level IV
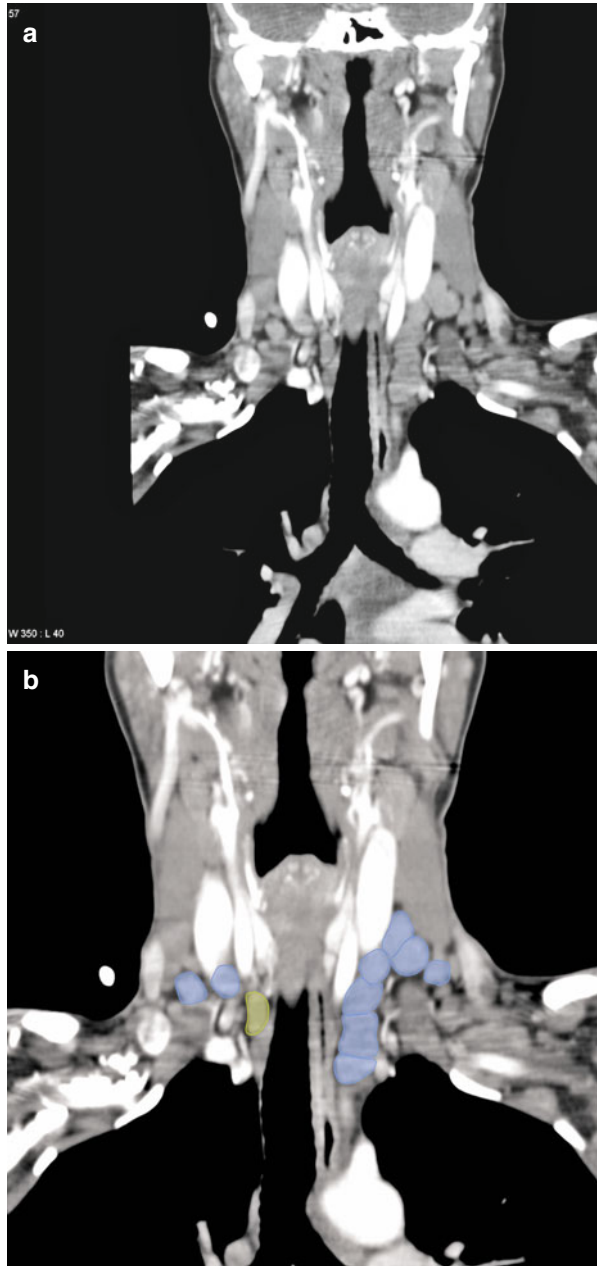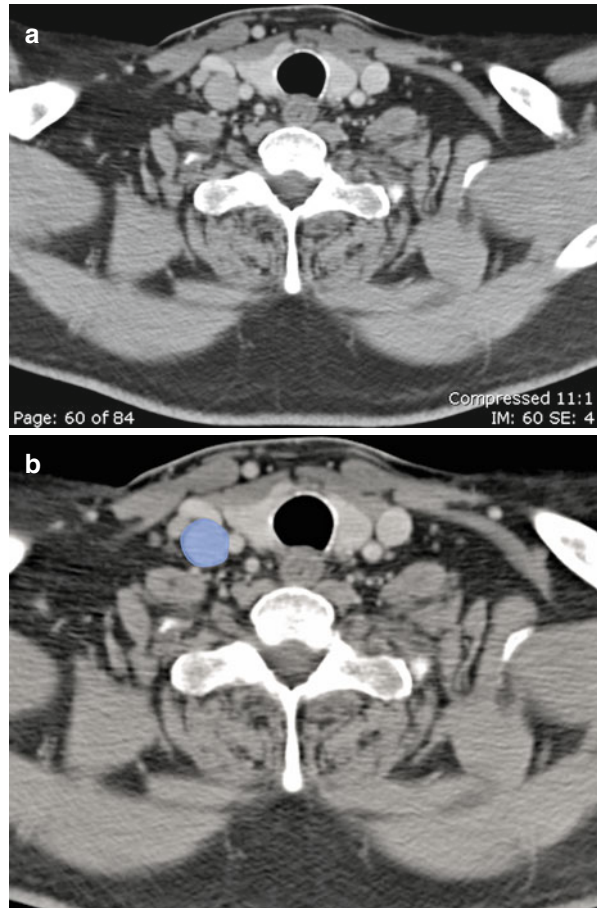and level VI nodes, which are
outlined in (**b**)

## 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 supraclavicu-
lar nodes (*see* Fig. 1.19).

Metastatic involvement of this group alone is seen in a small subset of patients
but occurs commonly if group 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**)
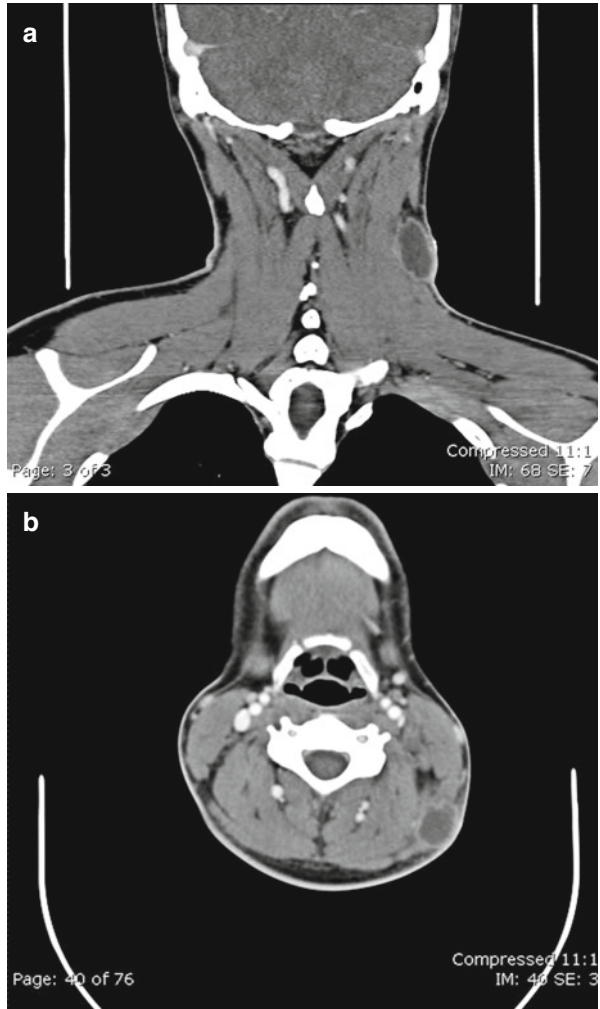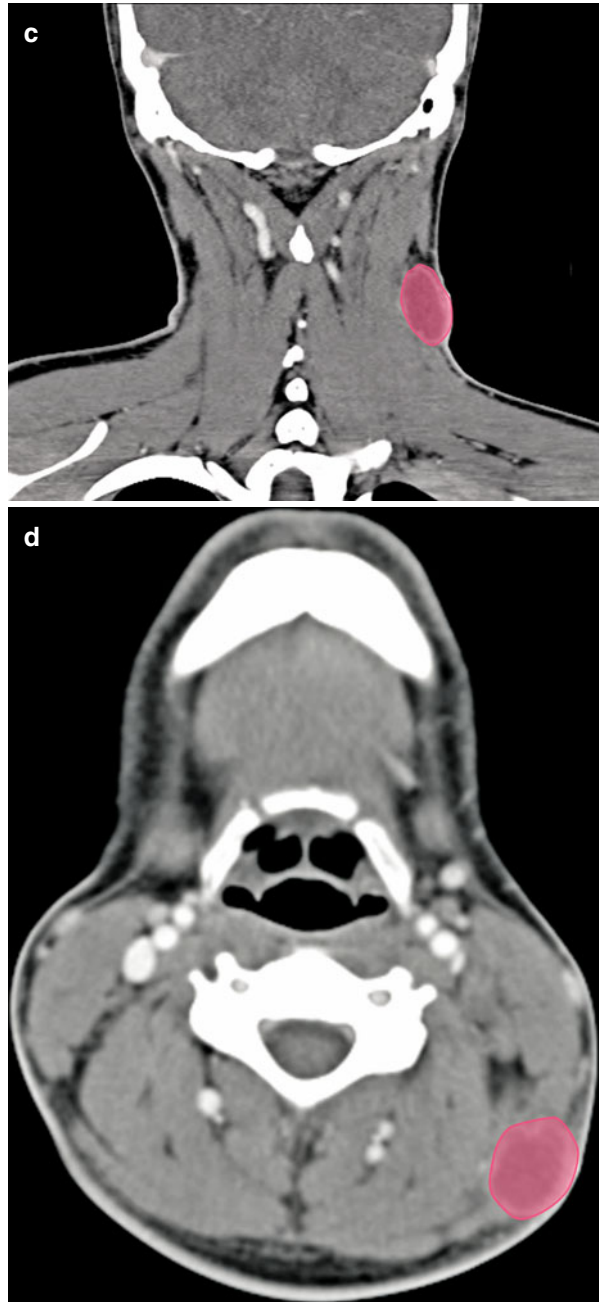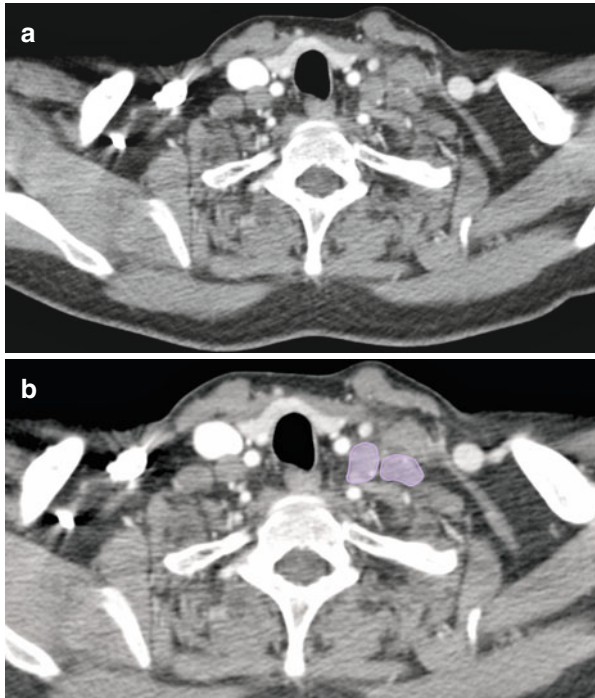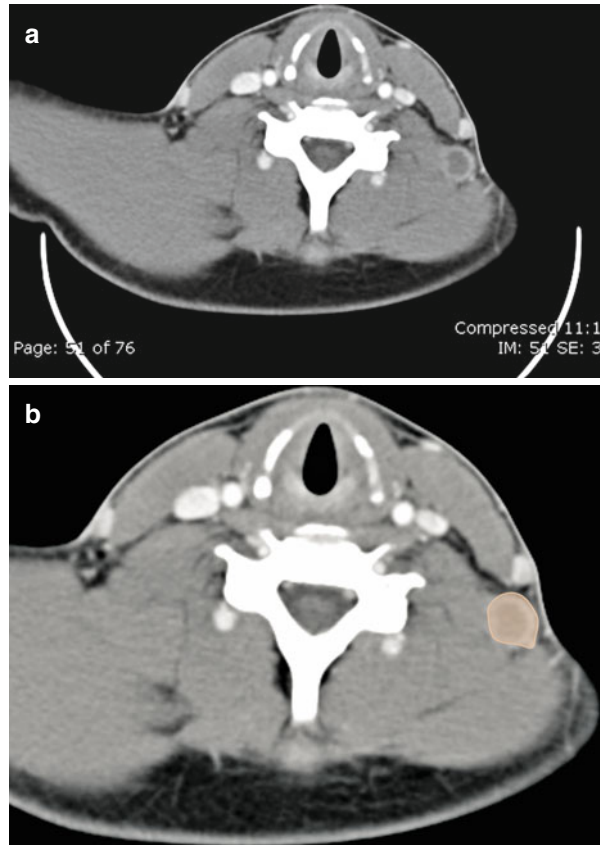
**Fig. 1.20** (**a**) Axial CECT image showing an enlarged level VB node with central necrosis and peripheral enhancement. The node is depicted in (**b**)

## Level VI

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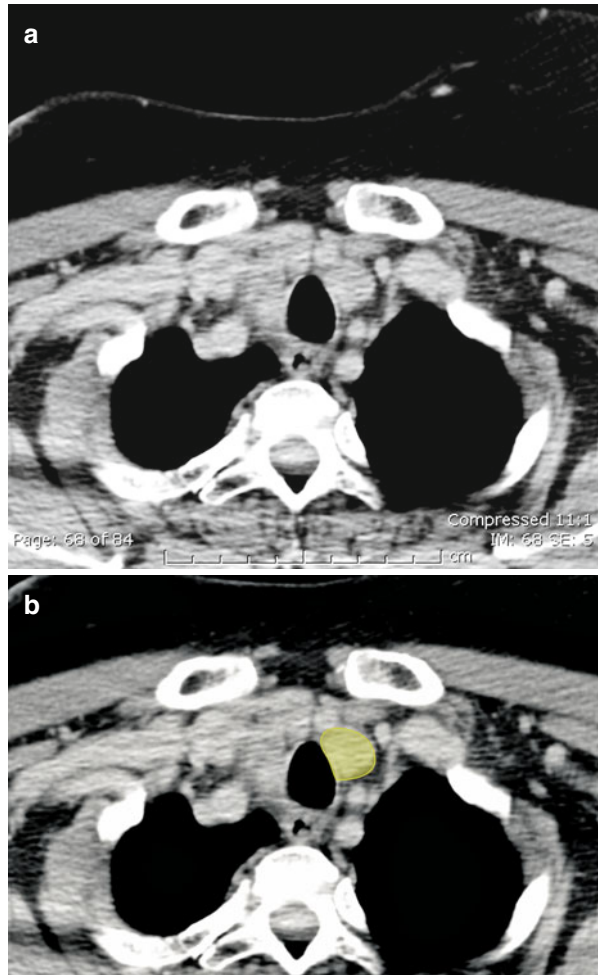


**Fig. 1.21** (**a**) Axial CECT showing an enlarged level VI node in left paratracheal location, which is outlined in (**b**)

Fig. 1.22 Anatomical
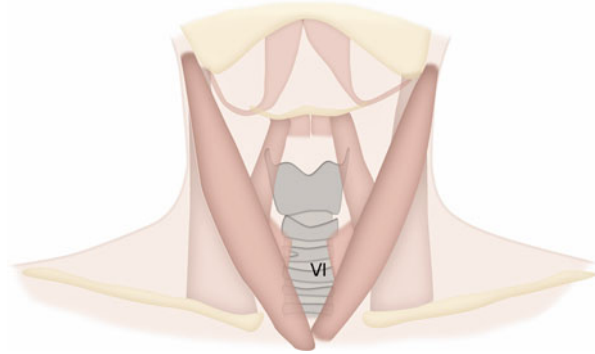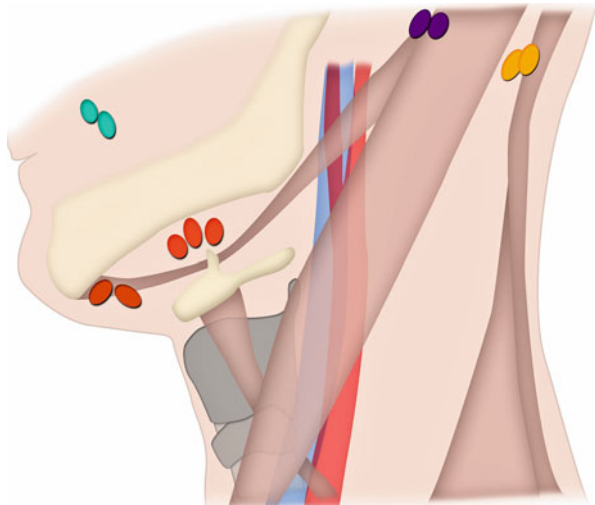location of level *VI* nodes



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

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).

# References

1. Altekruse SF KC, Krapcho M, Neyman N, Aminou R, Waldron W, Ruhl J, Howlader N, Tatalovich Z, Cho H, Mariotto A, Eisner MP, Lewis DR, Cronin K, Chen HS, Feuer EJ, Stinchcomb DG, Edwards BK, editors. SEER Cancer Statistics Review. 1975–2007. Bethesda: National Cancer Institute. Accessible at: http://seer.cancer.gov/csr/1975_2007/, based on November 2009 SEER data submission, posted to the SEER web site, 2010. Accessed 17 May 2012.

2. Robbins KT, Clayman G, Levine PA, et al. Neck dissection classification update: revisions proposed by the American Head and Neck Society and the American Academy of Otolaryngology-Head and Neck Surgery. Arch Otolaryngol Head Neck Surg. 2002;128:751–8.

3. Paff GH. Anatomy of the head and neck. Philadelphia: Saunders; 1973.

4. Schuller DE. Management of cervical metastasis in head and neck cancer. Washington, D.C.: American Academy of Otolaryngology, Head and Neck Surgery Foundation; 1982.

5. Robbins KT. Classification of neck dissection: current concepts and future considerations. Otolaryngol Clin North Am. 1998;31:639–55.

6. Shah JP, Strong E, Spiro RH, Vikram B. Surgical grand rounds. Neck dissection: current status and future possibilities. Clin Bull. 1981;11:25–33.

7. Som PM. Detection of metastasis in cervical lymph nodes: CT and MR criteria and differential diagnosis. AJR Am J Roentgenol. 1992;158:961–9.

8. van den Brekel MW, Stel HV, Castelijns JA, et al. Cervical lymph node metastasis: assessment of radiologic criteria. Radiology. 1990;177:379–84.

9. Rouviere H. Lymphatic system of the head and neck. Ann Arbor: Edwards Brothers; 1938.

10. Suojanen JN, Mukherji SK, Dupuy DE, et al. Spiral CT in evaluation of head and neck lesions: work in progress. Radiology. 1992;183:281–3.

11. van den Brekel MW, Castelijns JA, Snow GB. Detection of lymph node metastases in the neck: radiologic criteria. Radiology. 1994;192:617–8.

12. van den Brekel MW, Castelijns JA. Imaging of lymph nodes in the neck. Semin Roentgenol. 2000;35:42–53.

13. Buckley JG, Feber T. Surgical treatment of cervical node metastases from squamous carcinoma of the upper aerodigestive tract: evaluation of the evidence for modifications of neck dissection. Head Neck. 2001;23:907–15.

14. Ahuja AT, Leung SF, Teo P, et al. Submental metastases from nasopharyngeal carcinoma. Clin Radiol. 1999;54:25–8.

15. Som PM, Curtin HD, Mancuso AA. An imaging-based classification for the cervical nodes designed as an adjunct to recent clinically based nodal classifications. Arch Otolaryngol Head Neck Surg. 1999;125:388–96.

16. Lee BJ, Wang SG, Lee JC, et al. Level IIb lymph node metastasis in neck dissection for papillary thyroid carcinoma. Arch Otolaryngol Head Neck Surg. 2007;133:1028–30.

17. Moulding FJ, Roach SC, Carrington BM. Unusual sites of lymph node metastases and pitfalls in their detection. Clin Radiol. 2004;59:558–72.

18. Byers RM, Weber RS, Andrews T, et al. Frequency and therapeutic implications of "skip metastases" in the neck from squamous carcinoma of the oral tongue. Head Neck. 1997;19:14–9.

19. Seethala RR. Current state of neck dissection in the United States. Head Neck Pathol. 2009;3:238–45.

20. Bhatia KS, Griffith JF, Ahuja AT. Stomach cancer: prevalence and significance of neck nodal metastases on sonography. Eur Radiol. 2009;19:1968–72.

21. van Vledder MG, van der Hage JA, Kirkels WJ, et al. Cervical lymph node dissection for metastatic testicular cancer. Ann Surg Oncol. 2010;17:1682–7.

22. Ozlugedik S, Ibrahim Acar H, Apaydin N, et al. Retropharyngeal space and lymph nodes: an anatomical guide for surgical dissection. Acta Otolaryngol. 2005;125:1111–5.

23. Mancuso AA, Harnsberger HR, Muraki AS, Stevens MH. Computed tomography of cervical and retropharyngeal lymph nodes: normal anatomy, variants of normal, and applications in staging head and neck cancer. Part II: pathology. Radiology. 1983;148:715–23.