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HEAD AND NECK IMAGING

PICTORIAL ESSAY

# Approach to intensely enhancing neck nodes

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**ABSTRACT**

Cervical node evaluation is one of the most common problems encountered by a radiologist. Here, we present a pictorial review of intensely enhancing neck nodes. While enhancement in a cervical node is a common radiologic finding on contrast-enhanced computed tomography scan, only few conditions cause intense enhancement in cervical nodes. We discuss the common causes of intensely enhancing neck nodes along with pertinent radiologic features and key differentiating points that aid radiologists in reaching a diagnosis. In addition, we discuss certain potential non-nodal mimics, which need to be excluded.

Enlarged cervical lymph node is one of the most common causes of a mass lesion in the neck. Although ultrasonography can be used as an initial investigative tool to assess neck nodes, computed tomography (CT) and magnetic resonance imaging (MRI) have an advantage in assessing disease extent and evaluating any primary head and neck pathology. MRI has a very high contrast sensitivity compared with CT and hence most lymph nodal diseases show postcontrast enhancement, making it difficult to appreciate differential nodal enhancement. In addition, absence of direct measurement of signal intensity makes interpretation subjective. In contrast, CT scan can differentiate varying degrees of enhancement based on Hounsfield unit (HU) values rendering higher objectivity. To reduce radiation exposure, a contrast-enhanced CT scan is performed directly in most cases. In pediatric patients, however, Doppler ultrasonography and MRI may take preference as investigative tools.

Almost all conditions affecting cervical nodes cause postcontrast enhancement. Of these, only few conditions cause intense enhancement in cervical nodes. We define intense contrast enhancement as above 120 HU (Fig. 1). The sternomastoid muscle shows a CT value of 60–80 HU on postcontrast scan for comparison. In this pictorial essay, we discuss the various causes of intensely enhancing solid neck nodes and important features that may help differentiate these conditions. The images given below were obtained on two CT machines: Siemens Somatom Definition AS (128 slice, 120 Kv, 250 mAs, slice thickness 1 mm, scan interval 0.8 mm, pitch 0.8) and Spiral CT systems CT/I GE Medical systems (single slice spiral CT, slice thickness 5 mm, no overlap).

Common causes of intensely enhancing neck nodes are as follows: metastases from hypervascular primaries, most commonly papillary thyroid carcinoma; Castleman disease; Kikuchi disease; Kimura disease; and rarely, angioimmunoblastic lymphadenopathy (1).

## Metastatic neck nodes from hypervascular primary malignancy

Metastatic neck nodes from hypervascular primaries show intense enhancement due to increased vascularity. The primary hypervascular malignancies that metastasize to neck nodes include papillary and medullary carcinoma of thyroid, renal cell carcinoma, Kaposi sarcoma, and neuroendocrine tumors. Most common cause of hypervascular metastases from a head and neck primary is the papillary thyroid cancer.

1) Thyroid cancer: Papillary thyroid cancer has a high propensity to metastasize to nodes (30%–90%); other thyroid cancers with frequent node metastasis are medullary carcinoma (50%) and anaplastic carcinoma (40%) (Figs. 2, 3) (2). Besides intense enhancement, nodal calcification (50%–69%) and cystic change (20%) may also be noted. In larger tumors, CT scan may show a thyroid mass invading adjacent structures (trachea, esophagus). A heterogeneous thy-

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roid mass along with enhancing nodes (with cystic/calcific foci) helps the diagnosis.

2) Neuroendocrine tumors: These are rare hypervascular submucosal masses in the head and neck region and behave in similar manner here as in the rest of the body (3, 4). Nodal metastases are known to occur (Fig. 4).

3) Renal cell carcinoma: Neck nodal metastasis is a late manifestation, usually preceded by involvement of the abdomen and lungs.

4) Kaposi sarcoma: It is seen in immunocompromised patients and presents as cutaneous, mucosal, or nodal forms. Tumor deposits are nodular protrusions in pharynx or larynx, associated with enhancing cervical nodes (5).

## Castleman disease

Castleman disease is an uncommon benign lymphoproliferative disorder that is characterized by hypervascular lymphoid hyperplasia. The most common site of involvement is chest (70%), followed by neck, abdomen, and pelvis (15% each), involving primarily lymphatic tissues. They can be classified histologically into the hyaline vascular type (90%), plasma cell type (<10%) and human herpesvirus 8-associated Castleman disease (extremely rare) (6). The disease can either be unicentric or multicentric in involvement.

The hyaline vascular type makes up about 90% of the cases and usually presents as an asymptomatic solitary mass in young adults (between the third and fourth decades of life) with a benign course (Fig. 5). Treatment is generally surgical resection, with a good prognosis.

The plasma cell type is commonly multicentric (Fig. 6) and presents in the sixth de-

**Main points**

- Although all nodal pathologies show enhancement, only few conditions cause intensely enhancing neck nodes. We define intense nodal contrast enhancement as more than 120 HU.
- CT scan is widely available and offers objectivity to enhancement values as opposed to MRI which has high contrast sensitivity.
- Diseases presenting with intensely enhancing neck nodes have varied radiologic and clinical presentations and their salient points can help us further narrow the differentials and avoid unnecessary interventions and treatment, especially in self-limiting conditions.
- Certain pitfalls are known to occur and have to be excluded.

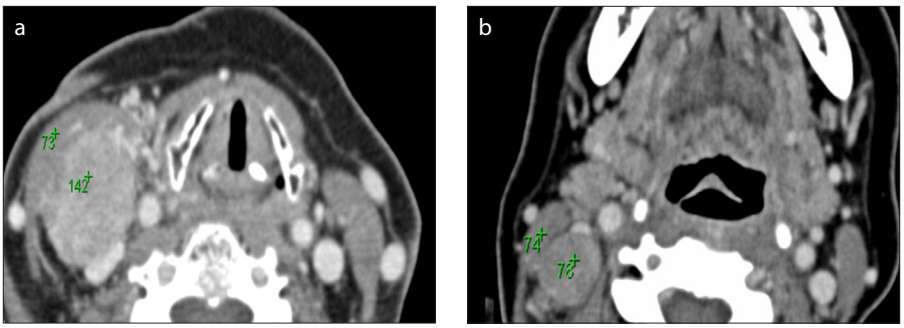



**Figure 1. a, b.** Axial contrast-enhanced CT images show **(a)** an intensely enhancing right level 3 node (metastatic papillary thyroid cancer) with a CT value above 142 HU and **(b)** a heterogeneously but not intensely enhancing right level 2 node (metastatic nasopharyngeal cancer). Note that the sternomastoid muscle has a postcontrast CT value of about 78 HU.

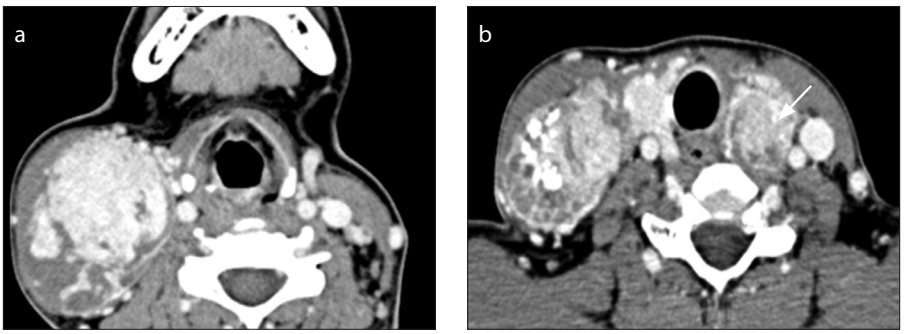



**Figure 2. a, b.** Axial contrast-enhanced CT images show **(a)** intensely enhancing bilateral level 3 nodes and **(b)** a primary left lobe thyroid mass (*arrow,* histologically proven papillary thyroid cancer). Interestingly, the nodal burden is more on the contralateral side. Note that the presence of cystic changes and calcifications in the nodes can aid in further differentiation.

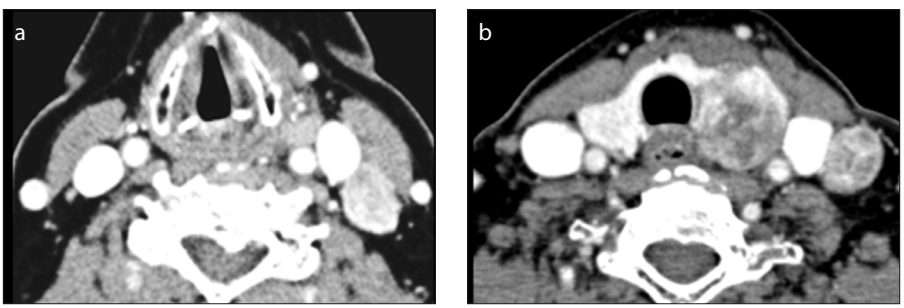



**Figure 3. a, b.** Axial contrast-enhanced CT images show **(a)** left metastatic nodal disease in medullary thyroid cancer and **(b)** a primary left thyroid mass. Note that the nodal mass is significantly hyperdense compared with the sternomastoid muscles.

**Figure 4.** Axial contrast-enhanced CT reveals left level 1B nodal metastasis from a primary neuroendocrine tumor (latter not shown) in the nasal cavity.

**Figure5.** Hyaline vascular type Castleman disease presenting with a dominant solitary intensely enhancing left nodal mass. Note that non-nodal neck masses such as glomus tumors remain close differentials.

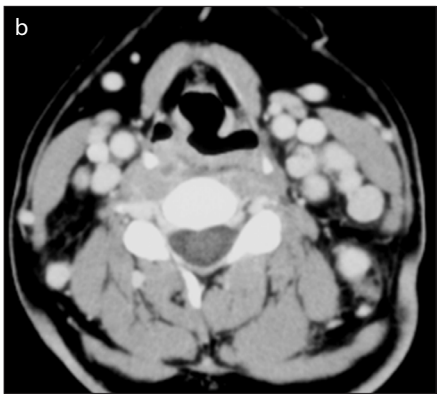
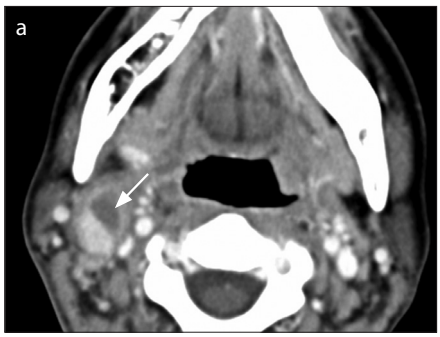




**Figure 6. a, b.** Axial contrast-enhanced CT of a patient with plasma cell variant Castleman disease shows multiple intensely enhancing left neck nodes. This type is multicentric as opposed to the solitary hyaline vascular type.

**Figure 9.** Axial contrast-enhanced CT image shows an intensely enhancing intraparotid node in a patient with Kikuchi disease.



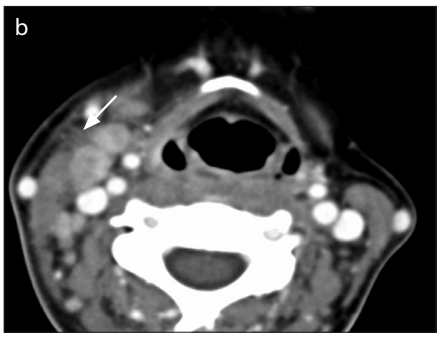




**Figure 7. a, b.** Axial contrast enhanced CT image of enhancing nodes due to Kikuchi disease. Associated features such as nodal necrosis (**a,** *arrow*) and perinodal fat infiltration (**b,** *arrow*) if present, may act as differentiating tools.

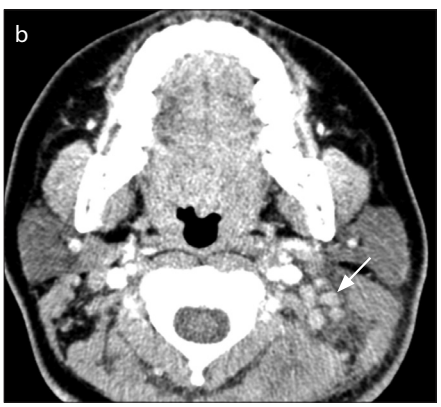




**Figure 8. a, b.** Axial contrast-enhanced CT images **(a, b)** show intensely enhancing nodes *(arrows)* in Kikuchi disease with perinodal fat infiltration. The degree of nodal enhancement and perinodal fat infiltration can be variable.

cade of life. It is frequently associated with systemic manifestations such as fever, night sweats, and splenomegaly. It has a worse prognosis than the hyaline type.

On CT scans, Castleman disease of the neck has been described as a well-circumscribed homogeneous nodal mass lesion with moderate to intense enhancement (6–8), with the hyaline vascular type having a tendency to enhance more than the plasma cell type due to the greater vascularity of the former. Nodal calcification is uncommon, unlike its pelvic counterpart (50% incidence in pelvic involvement) (7).

## Kikuchi disease

Kikuchi disease, also known as Kikuchi-Fujimoto disease or histiocytic necrotizing lymphadenitis, is a self-limiting cause of cervical lymphadenopathy. It generally affects young adults (about 30 years of age) with a slight female preponderance (9). There is a higher incidence in the Asian population, particularly the Japanese.

Clinical features are variable, including cervical lymphadenopathy (nontender or tender), fever, and leucopenia (10). Laboratory results are nonspecific. It is a benign self-limiting condition with spontaneous resolution of the cervical lymphadenopathy usually occurring within 1–4 months without treatment. Adequate knowledge of this entity is important as proper diagnosis may avoid unnecessary interventions and treatment. On contrast CT, unilateral or bilateral enhancing nodes are seen. If bilateral, the disease is usually asymmetric. The nodes may be homogeneously enhancing or may show areas of necrosis (9–11) (Fig. 7). The enhancement is variable in intensity, ranging from intense to mild.

Perinodal infiltration is seen in most cases (9). The degree of perinodal infiltration may differ from case to case, from mere obliteration of the adjacent fat plane to widespread increased attenuation involving nearly the entire cervical space (Figs. 7b, 8). Involvement of intraparotid nodes is known to occur (Fig. 9).

## Kimura disease

Kimura disease is a rare idiopathic chronic lymphoproliferative disorder of unknown etiology. It usually occurs in young (second to fourth decades of life) Asian population with a male predominance (male-female ratio varying from 3:1 to 10:1). The typical triad of presentation includes painless subcutaneous masses (predilection for the head and neck region, especially the postauricular and parotid areas), regional lymph node enlargement, and involvement of salivary glands. Increased IgE levels and eosinophilia in the

peripheral blood are known associations (12).

Lesions can be solitary or multiple (localized or disseminated). The lesions can be classified into two types (13):

1) Well-defined, nodular masses with homogenous enhancement (Fig. 10);

2) Ill-defined, plaque like, heterogeneous appearance with variable enhancement (Fig. 11).

Associated lymphadenopathy is frequent with an incidence of about 42%–100%. Although surgery is the preferred method for initial treatment, recurrence is common (14).

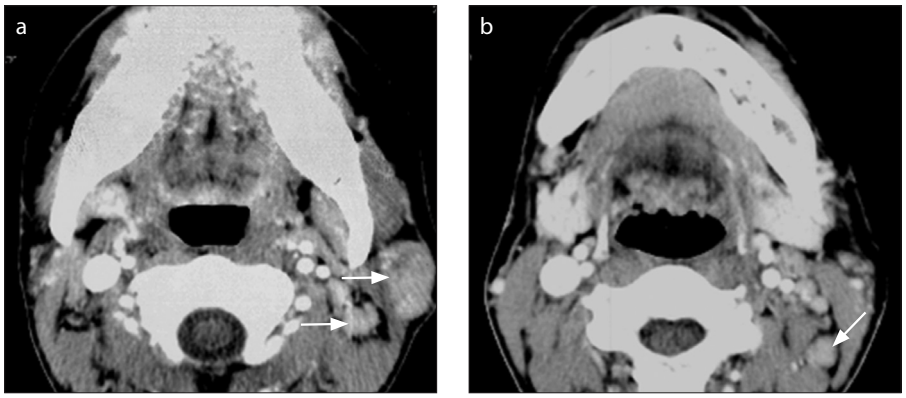



**Figure 10. a, b.** Axial contrast-enhanced CT. Images **(a, b)** show enhancing left neck nodes *(thin arrows)* due to Kimura disease. An associated subcutaneous hyperdense mass *(thick arrow)* is also seen **(a)**.

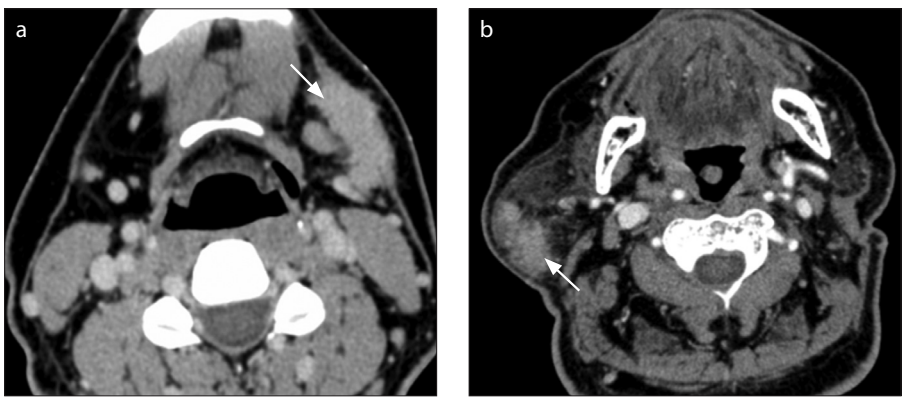



**Figure 11. a, b.** Axial contrast-enhanced CT. Image **(a)** shows ill-defined plaque-like soft tissue enhancement in the left submandibular region *(arrow)* of a patient with Kimura disease. Image **(b)** shows similar enhancement in the right parotid region *(arrow)* of a different patient. Presence of soft tissues plaques and subcutaneous lesions may aid further differentiation.

## Uncommon causes of intensely enhancing neck nodes

Apart from these commonly discussed causes of intensely enhancing solid neck nodes, we have come across conditions like hyperplastic nodes (Fig. 12a), infections like tuberculosis (especially in immunocompromised patients) and, rarely, metastases from squamous cell cancers showing intense nodal enhancement. But infections like tuberculosis (Fig. 12b) and metastases from squamous cell cancers are also associated with significant necrosis (Fig. 12c).

## Approach to intensely enhancing neck nodes

Here, we present an approach to evaluate cases presenting with intensely enhancing solid neck nodes. Although this article focuses on the intensely enhancing solid neck nodes, we acknowledge the fact that the above-described diseases have variable associated radiologic presentations. These associated presentations and features can be used to distinguish various conditions.

The important distinguishing features in intensely enhancing solid neck nodes are as follows:

1) Thyroid metastases and Kikuchi disease is slightly predominant in females, while Kimura disease has a distinct male predilection. Kikuchi and Kimura disease present mostly in the Asian population.

2) Kikuchi disease typically presents as painful cervical lymphadenopathy.

3) Hyaline variety of Castleman disease presents as a solitary mass, while the rest have multiplicity.

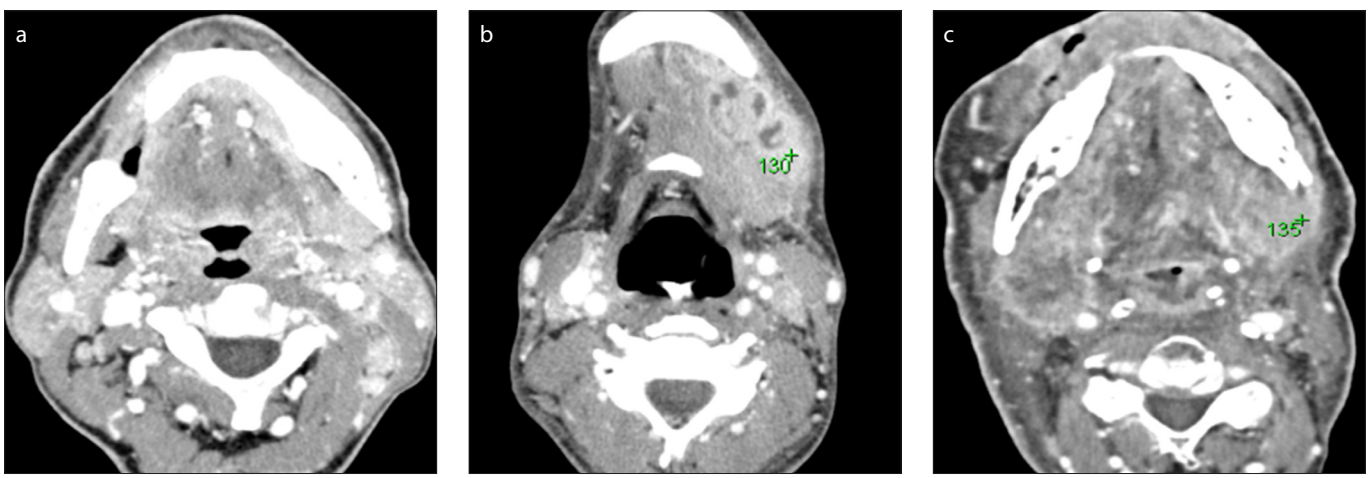



**Figure 12. a–c.** Axial contrast-enhanced CT images of different patients. Images show **(a)** hyperplastic nodes (immunocompromised), **(b)** tuberculosis (immunocompromised), **(c)** metastatic squamous cell carcinoma (primary aggressive mass involving the hard and soft palate, not shown). Note the intense enhancement in left neck nodes for all patients. Images **(b)** and **(c)** show associated necrosis.

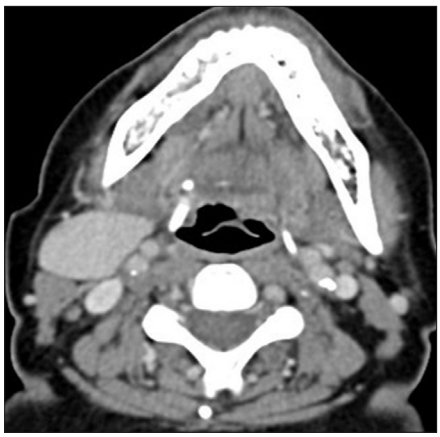


**Figure 13.** Surgically proven epidermoid cyst with high keratin content mimics an intensely enhancing nodal mass (like hyaline vascular variant of Castleman disease). The lack of mass effect by the lesion and beak-like deformity of the anterior aspect of the lesion suggests soft consistency of the lesion and should prompt a non-nodal entity in the differentials. A delayed or plain CT scan can clinch the diagnosis.

4) Variegated features such as associated nodal necrosis/cystic change and calcifications may be helpful. Nodal necrosis/cystic change is known in thyroid metastases and Kikuchi disease, while nodal calcifications are known in thyroid metastases.

5) Intraparotid nodal involvement may be seen in Kikuchi disease, while extranodal parotid gland involvement and subcutaneous masses are seen in Kimura disease.

6) Perinodal stranding is common in Kikuchi disease.

## Pitfalls

Hyperdense mass lesions in the neck may mimic intensely enhancing neck node on a contrast-enhanced CT scan and may be mistaken for one of the above diseases (Fig. 13).

In solitary intensely enhancing nodal masses (e.g., hyaline vascular type), non-nodal intensely enhancing masses like Glomus tumors or parathyroid adenoma should always be excluded (15, 16). Typical location at carotid bifurcation and pulsatile tinnitus are valuable tips to diagnose glomus tumor. However, differentiation based only on radiologic features may sometimes be difficult and reliance on clinical and laboratory findings and correlation with histology (fine-needle aspiration or excision biopsy) may also be needed.

## Conclusion

There are few differential diagnoses for intensely enhancing solid neck nodes. CT offers higher objectivity over MRI in diagnosing intense enhancement. We discuss the necessary radiologic findings along with relevant clinical features, which aid in further differentiation. In some conditions, an accurate diagnosis may help avoid unnecessary interventions and treatment, especially in self-limiting conditions.

### Conflict of interest disclosure

The authors declared no conflicts of interest.

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