American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Neck Mass/Adenopathy**

Variant 1: **Adult presenting with a nonpulsatile solitary neck mass (afebrile).**

Radiologic Procedure	Rating	Comments	RRL*
CT neck with contrast	9		☢☢☢
MRI neck without and with contrast	8	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI neck without contrast	7		O
CT neck without contrast	6	May be appropriate initially if mass relationship to thyroid gland is uncertain.	☢☢☢
CT neck without and with contrast	5	For selected cases if sialolith is suspected.	☢☢☢
US neck	4		O
MRA neck without and with contrast	3		O
CTA neck with contrast	3		☢☢☢
FDG-PET/CT neck	2	Not for primary diagnosis.	☢☢☢☢
MRA neck without contrast	1		O
Arteriography cervicocerebral	1		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 2: **Adult presenting with a solitary neck mass (febrile).**

Radiologic Procedure	Rating	Comments	RRL*
CT neck with contrast	9		☢☢☢
MRI neck without and with contrast	8	See statement regarding contrast in text under "Anticipated Exceptions."	O
CT neck without contrast	6	May be appropriate initially if mass relationship to thyroid gland is uncertain.	☢☢☢
MRI neck without contrast	5		O
US neck	4		O
MRA neck without and with contrast	3		O
CTA neck with contrast	3		☢☢☢
CT neck without and with contrast	2		☢☢☢
FDG-PET/CT neck	2	Not for primary diagnosis.	☢☢☢☢
MRA neck without contrast	1		O
Arteriography cervicocerebral	1		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Clinical Condition: **Neck Mass/Adenopathy**

Variant 3: **Adult presenting with a pulsatile neck mass.**

Radiologic Procedure	Rating	Comments	RRL*
CT neck with contrast	9		☢☢☢
CTA neck with contrast	9	May be done at same time as CT of neck.	☢☢☢
MRI neck without and with contrast	8	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRA neck without and with contrast	8	May be done at same time as MRI of neck. See statement regarding contrast in text under "Anticipated Exceptions."	O
US neck	6		O
MRI neck without contrast	5		O
CT neck without contrast	4		☢☢☢
Arteriography cervicocerebral	4	Useful if preoperative embolization of glomus tumor is planned.	☢☢☢
MRA neck without contrast	3		O
CT neck without and with contrast	2		☢☢☢
FDG-PET/CT neck	2		☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 4: **Adult presenting with multiple neck masses.**

Radiologic Procedure	Rating	Comments	RRL*
CT neck with contrast	9		☢☢☢
MRI neck without and with contrast	8	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI neck without contrast	7		O
CT neck without contrast	6		☢☢☢
FDG-PET/CT neck	4		☢☢☢☢
US neck	4	To further characterize nodes in anticipation of biopsy.	O
CTA neck with contrast	3		☢☢☢
MRA neck without and with contrast	3		O
MRA neck without contrast	2		O
CT neck without and with contrast	2		☢☢☢
Arteriography cervicocerebral	1		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Clinical Condition: **Neck Mass/Adenopathy**

Variant 5: **Adult with a history of treatment for cancer presenting with a neck mass.**

Radiologic Procedure	Rating	Comments	RRL*
CT neck with contrast	9	Complementary with FDG-PET.	☢☢☢
FDG-PET/CT neck	9	Complementary with CT of neck with contrast.	☢☢☢☢
MRI neck without and with contrast	8	See statement regarding contrast in text under "Anticipated Exceptions."	O
CT neck without contrast	6		☢☢☢
MRI neck without contrast	5		O
US neck	4	Used for localization for biopsy.	O
CTA neck with contrast	3		☢☢☢
MRA neck without and with contrast	3		O
MRA neck without contrast	2		O
CT neck without and with contrast	2		☢☢☢
Arteriography cervicocerebral	1		☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 6: **Child (up to age 14) presenting with a solitary neck mass or multiple neck masses (afebrile).**

Radiologic Procedure	Rating	Comments	RRL*
US neck	9		O
CT neck with contrast	8		☢☢☢
MRI neck without and with contrast	7	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI neck without contrast	6		O
CT neck without contrast	5		☢☢☢
CT neck without and with contrast	2		☢☢☢☢
CTA neck with contrast	2		☢☢☢
MRA neck without and with contrast	2		O
MRA neck without contrast	2		O
Arteriography cervicocerebral	1		☢☢☢☢
FDG-PET/CT neck	1		☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Clinical Condition: **Neck Mass/Adenopathy**

Variant 7: **Child (up to age 14) presenting with a solitary neck mass (febrile).**

Radiologic Procedure	Rating	Comments	RRL*
US neck	9	For palpable neck mass, except retropharyngeal, where CT would be preferred.	O
CT neck with contrast	8		☢☢☢
MRI neck without and with contrast	7	See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI neck without contrast	6		O
CT neck without contrast	5		☢☢☢
CT neck without and with contrast	2		☢☢☢☢
CTA neck with contrast	2		☢☢☢
MRA neck without and with contrast	2		O
MRA neck without contrast	2		O
Arteriography cervicocerebral	1		☢☢☢☢
FDG-PET/CT neck	1		☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

NECK MASS/ADENOPATHY

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Summary of Literature Review

Initial Diagnosis

Imaging may be requested in a patient who presents with a palpable neck mass. The clinical presentation may vary. For example, the patient may be an adult or a child, the mass may be painful or nontender, or the patient may be febrile or afebrile. Recommendations for initial imaging studies have changed in past decades with the development and maturation of new imaging modalities.

Magnetic Resonance Imaging and Computed Tomography

In adults, a neck mass is likely to be either neoplastic or inflammatory [1-5]. In patients up to 20 years of age, neck masses are usually benign, including late presentations of congenital lesions. In patients 20 to 40 years of age, masses are usually malignant. In patients over 40 years of age, especially with a smoking history, the diagnosis overwhelmingly favors a malignancy [6]. Moreover, with the rise of human papillomavirus (HPV)-related oropharyngeal carcinomas in nonsmoking adults, vigilance for carcinoma is now warranted for all adult age-groups [7]. In adults who present with a fever, the etiology is often inflammation [8-10].

Both computed tomography (CT) and magnetic resonance imaging (MRI) can accurately diagnose tumors and inflammation, and therefore CT and MRI should be considered complementary studies [11-13]. Multidetector CT (MDCT) now appears to be the preferred initial modality for evaluating a patient with a palpable neck mass [14]. Both modalities can be used for initial diagnosis of a primary head and neck malignancy and for staging of cervical lymph nodes [15-19]. The rapid image acquisition of MDCT reduces physiologic motion and produces a higher consistent image quality compared with MRI [20-22]. On the other hand, MRI is superior to CT for soft-tissue characterization. MRI is also superior to CT for detecting perineural spread, which is important for initial staging for a variety of skull base tumors. Addition of sequences such as short tau inversion recovery (STIR) may further increase sensitivity of MRI to lymphadenopathy [23]. Advanced CT and MRI techniques, such as perfusion and diffusion imaging are being investigated for possible applications such as differentiating benign from malignant lymph nodes and tumor response [24-29].

Use of Contrast

Intravenous contrast is recommended for routine cross-sectional imaging in adults or children presenting with a neck mass and who have no contraindications to selected contrast agents [30]. Contrast is helpful for assessing tumor margins and is essential for detecting neck abscesses, especially those that are intramuscular [31-33]. Moreover, contrast enhancement may reveal malignant nodes that are not pathologically enlarged. Intravenous contrast is also helpful for distinguishing vessels from lymph nodes and determining if the mass is hypervascular, as many pulsatile neck masses (especially those in level 2 or 3) are lymph nodes overlying the carotid rather than true vascular masses. Contrast may obscure visualization of sialoliths, and therefore noncontrast CT is recommended in patients presenting with a neck mass suspected of being a swollen major salivary gland due to an obstructing sialolith. MRI may be helpful in patients with nonmineralized sialoliths. Iodine-based contrast may be avoided in patients with thyroid cancer history or when metastatic thyroid cancer is suspected.

Positron Emission Tomography

The role of positron emission tomography (PET) and now PET combined with CT for assessing neck masses continues to evolve [34-49]. Some investigators feel that PET/CT is superior to CT alone for evaluating primary site tumor margins and preoperative staging [50-52]. PET/CT may also be superior to CT alone for staging cervical lymph nodes [53]. However, it cannot detect lymph node micrometastases [54-56]. Moreover, some

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investigators have been more cautious in endorsing PET/CT for such applications as evaluating cystic or necrotic neck masses or treated necks, citing pitfalls with the combined modality [57-59]. PET/CT should also be considered for patients with stage III/IV disease or with occult primaries, and selectively for other patients [60]. Most recently PET combined with MRI has been introduced; however, this new technique is not yet widely available [61].

Ultrasound

The use of ultrasound (US) for the initial diagnosis of neck masses in adults and children continues to increase. In fact, the overall use of neck US in the United States has generally lagged its use in Europe and Southeast Asia, due in part to the greater accessibility of cross-sectional modalities such as CT and MRI here [62,63]. US is useful in differentiating solid from cystic neck lesions in both adults and children, in recording the size of nodes (at least in the upper neck), and in discriminating high-flow from low-flow vascular malformations [64-67]. US is also very helpful for image-guided biopsies of nonpalpable or small lesions that are relatively superficial and for biopsies of indeterminate soft tissue in the treated neck. Studies have shown that US-guided fine-needle aspiration of lymph nodes can be useful in staging the N0 neck [68,69]. The positive predictive value of this technique is high; however, its negative predictive value and its inability to exclude micrometastases remain problematic issues. Some studies have suggested that color Doppler US can distinguish between metastatic and inflammatory neck nodes [70-72]. Although these results are promising, the results appear to be user dependent. Also, novel techniques such as US elastography are being explored for possible future clinical applications [73].

Angiography

The role of conventional angiography for initial diagnosis is very limited. The initial imaging modality for evaluating a pulsatile neck mass (glomus tumor, aneurysm) is CT angiography, which now appears to be preferred to MR angiography for these indications [74]. Conventional angiography is used for planning endovascular treatment (tumor embolization, balloon test occlusion, etc) or for further characterization of vascular neck lesions.

Neck Masses in Children

In children who present with neck masses, congenital etiologies should be added to differential diagnostic considerations [75]. Any recommended imaging study in a child with a neck mass must consider the risk of sedation and radiation dose. In children suspected of having a congenital abnormality, US is usually sufficient for distinguishing a cystic from a solid mass. Color-flow Doppler US is also helpful for characterizing flow in solid lesions [71,76]. Either CT or MRI can be performed in children suspected of a having a malignancy or a deep neck abscess that may require surgical drainage. MDCT tends to be preferred over MRI because of the lower sedation requirements for a shorter examination time.

Post-treatment

CT and MRI are beneficial in patients previously treated for head and neck squamous cell carcinoma (HNSCCA) [27,77-81]. Both modalities can assess the extent of locoregional recurrence and look for synchronous lesions in the neck [82,83]. MRI is superior to CT for characterizing soft-tissue and detecting perineural spread. However, due to the length of the examination, MRI is prone to motion artifact in patients treated for advanced disease, in whom severe post-treatment mucositis has caused difficulty with pooled secretions. New physiologic techniques such as diffusion-weighted MRI, MR spectroscopy, and MR and CT perfusion have shown promise in attempting to differentiate recurrent tumor from post-treatment changes [84-89]. However, the results are preliminary, and further investigations are required.

The current literature suggests that PET/CT may be superior to CT or MRI for detecting recurrent tumor [90-95]. It has the advantage of detecting recurrent HNSCCA based on correlation of anatomic distortion with physiologic abnormality [96]. The sensitivity and specificity of PET/CT for detecting recurrent HNSCCA are in the range of 70%-100%. However, one must be aware of the range of physiologic activity following treatment to avoid false-positive results [97]. Although PET/CT is commonly used to evaluate post-treatment HNSCCA patients, there is no consensus regarding the proper timing of serial post-treatment surveillance studies. A new modality, PET/MRI, is currently being launched in several centers, but no clinical data regarding its efficacy in recurrent HNSCCA are yet available. The imaging study that is ordered should depend on the clinical indication of the patient and an understanding of the information that the imaging study can provide.

Summary

- CT and MRI are complementary methods for evaluating a patient with a palpable neck mass.
- MDCT is emerging as the preferred modality for the initial diagnostic imaging workup.

- US is increasingly demonstrating usefulness in differentiating solid and cystic neoplasms, in assessing vascular lesions, and in facilitating biopsies.
- CT, MRI, and PET/CT are useful in evaluating the post-treatment cancer patient.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (ie, <30 mL/min/1.73m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73m^2. For more information, please see the ACR *Manual on Contrast Media* [98].

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document.

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢ ☢	0.1-1 mSv	0.03-0.3 mSv
☢ ☢ ☢	1-10 mSv	0.3-3 mSv
☢ ☢ ☢ ☢	10-30 mSv	3-10 mSv
☢ ☢ ☢ ☢ ☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies".

Supporting Documents

- ACR Appropriateness Criteria® Overview
- Procedure Information
- Evidence Table

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