PICTORIAL REVIEW Head and neck imaging

# Unusual lesions in the retropharyngeal space – a pictorial review

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## ABSTRACT

The concept of neck spaces has been widely described to assist radiologists in approaching pathology and establishing a differential diagnosis. One of these spaces, the retropharyngeal space (RPS), spans both the suprahyoid and infrahyoid neck, extending from the skull base to the superior mediastinum, and contains only fat and lymph nodes, thus limiting the number of possible differential diagnoses. Despite this, pathologies affecting this space can produce significant morbidity and the RPS is clinically difficult to assess by direct inspection or physical examination. Fortunately, imaging can readily examine the RPS and consequently plays a crucial role in not only determining the extent, but also the character, of any abnormality as well as any associated complications. In this pictorial review, we present a range of unusual conditions that can affect this space and provide some key imaging concepts to aid diagnosis and help guide patient management.

KEY WORDS

Retropharyngeal space, longus colli calcific tendonitis, retropharyngeal emphysema, retropharyngeal abscess, CT, MRI

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## *Introduction*

The retropharyngeal space (RPS) is a potential space that extends from the skull base to the upper mediastinum [1-4] which typically contains fat, medial and lateral lymph nodes. Pathologies of this space are uncommon and limited in number but, when they do occur, can have significant morbidity. Unfortunately, clinical inspection and examination is difficult, and thus cross-sectional imaging plays a key role in the assessment of the RPS. Furthermore, certain pathologies have a propensity to involve this space. These include malignancy, either from direct invasion or nodal metastasis; inflammation; infection; or congenital/developmental lesions. This pictorial essay will outline the anatomy and delineate an approach to evaluating RPS abnormalities using imaging features and clues in order to provide a clinically relevant differential diagnosis.

### Anatomy

Understanding the anatomy is crucial not only in the diagnosis, but also further management, of abnormalities within the RPS (Figure 1). This potential space lies posterior to the pharynx and oesophagus. It is bounded by the buccopharyngeal fascia anteriorly; the prevertebral muscles and prevertebral fascia lies posteriorly; laterally, the space is bounded by the carotid sheaths – thus a tortuous carotid artery projecting medially into the lateral RPS can present as a pseudomass [3]. The very thin alar fascia extends from the medial border of the carotid spaces and fuses to the middle layer of the deep cervical fascia at a variable level between T1 to T6 [4]. This separates the true RPS from the immediately posterior danger space, which extends into the posterior mediastinum and to the diaphragm. The fusion of the alar fascia and visceral fascia obliterates the true RPS; however, the RPS and danger space cannot be separated with imaging. The RPS has a bowtie configuration because it is divided by a median raphe – this allows pathology to present either symmetrically or asymmetrically. The lateral fascia is tough [5] and the anteroposterior borders are thin, so RPS masses tend to enlarge in the craniocaudal direction and allow infections and malignancy to spread from the neck to the mediastinum.

The RPS can be further divided into the suprahyoid and infrahyoid portions. The suprahyoid segment is predominantly composed of fat and lymph nodes. The lymph nodes are divided into medial and lateral groups based on their location relative to the longus colli muscles – the medial group are inconsistently present and lie anterior to the medial aspect of the longus colli muscles, whereas the lateral (nodes of Rouviere) group lie anterior to the longus colli muscles [3]. The infrahyoid segment consists of fat only.

### Interpretative approach to a RPS mass

Firstly, masses arising from outside the RPS can mimic a true RPS lesion by extension or invasion. Prevertebral lesions can compress the RPS but can be identified by locating any prevertebral fat and the position of the longus colli muscles, which would be elevated anteriorly. As previously mentioned, tortuous internal carotid arteries may extend into the lateral RPS through deficiencies in the alar fascia. Conversely, lateral RPS nodal masses may mimic carotid space lesions as they both displace the parapharyngeal fat anteriorly, however, the RPS lesions will displace the carotid space structures posterolaterally. Another pitfall is that the lesion may have secondarily invaded the RPS by crossing fascial boundaries, and the most notable offenders are malignancies, such as nasopharyngeal carcinoma invading the posterior pharyngeal wall, or chordoma or other spinal malignancies extending anteriorly into the RPS [5].

The attenuation and signal characteristics will help to differentiate the abnormality, but care should be taken with interpretation – fluid in the RPS may represent an abscess, oedema, or suppurative adenitis; the presence of fat will raise suspicion of lipomas or liposarcomas; gas should prompt a search for a perforating injury from surgery or trauma, or may suggest the presence of gas forming organisms.

The configuration and any enhancement pattern will assist with further differentiation of any irregularity, as retropharyngeal abscess will have a round or ovoid configuration and have an enhancing wall, whereas oedema will not [2].

Associated features to suggest a source or cause for the abnormality will help narrow the differential diagnosis, for example infection in an adjacent neck space, foreign bodies, calcification; as well as search for possible complications such as internal jugular vein throm-

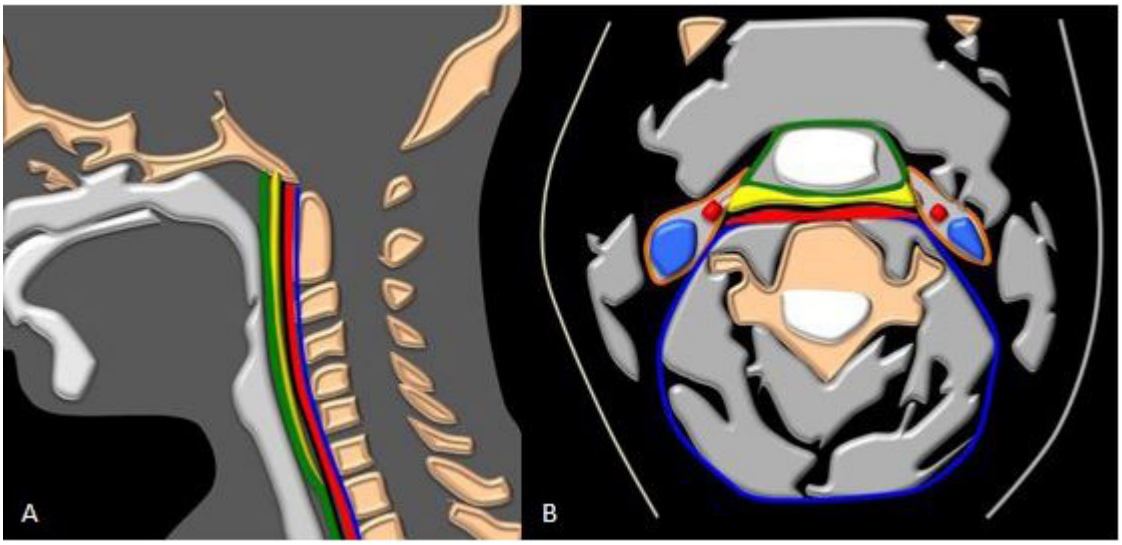


***Figure 1.***
*The RPS is bounded by the buccopharyngeal fascia (green) anteriorly, the prevertebral fascia (blue) posteriorly, and the carotid sheaths (brown) laterally. The alar fascia (black) separates the true RPS (yellow) from the danger space (red).*

bosis.

The effect of the abnormality/mass on the adjacent structures is also vital, as the location relative to the airway and great vessels will be important for the surgeon to know, and the anaesthetist would want to be aware of any airway embarrassment [6].

**Air**

CT is the ideal modality to identify gas within the RPS as it demonstrates the low attenuation within soft tissues, quickly assists in the identification of complications and the time taken to acquire images is short. It is typically associated with pneumomediastinum and common causes include trauma, surgery, bronchial asthma, infection such as tuberculosis, dental surgery, or any behaviour reproducing the Valsalva manoeuvre [7-10]. The clinical history is obviously important, and the associated findings will depend on this – for example, signs of traumatic injury will include cartilage discontinuity, mucosal or transmural defects and intralaryngeal/paralaryngeal haemorrhage [11]. Rarely, spontaneous retropharyngeal emphysema can arise without a clear precipitant and not be accompanied by pneumomediastinum (Figure 2). The history will be atypical and vague, impeding its diagnosis. The most common presenting features are odynophagia, dysphagia and neck pain. The clinical course is usually benign, and the patient can be managed conservatively with oxygen, analgesia and bronchodilators [7]. Very infrequently, patients may worsen and deteriorate - patients can develop acute airway obstruction requiring intubation, but this is rare and generally patients recover with no long term complications [8,9].

**Fluid**

Fluid within the RPS can be identified by its density and signal characteristics. Fluid tends to cause mild distension of the RPS but its normal bow-tie configuration is maintained and there is no peripheral contrast enhancement. Fluid within the RPS is most frequently associated with cellulitis, abscess or suppurative retropharyngeal nodes. However, these are not the only causes of fluid in the RPS. Radiation therapy is commonly used, to great effect, to treat many head and neck malignancies. Fluid collections as a result of radiation therapy may appear four to six weeks after radiation therapy, and resolve in eight to twelve weeks [3].

A further differential is calcific tendinitis of the longus colli muscles (Figure 3), a condition first described by Hartley in 1964 [12]. The longus colli muscles are paired thin flexor muscles spanning the anterior surface of the vertebral bodies from C1 to T3. The superior oblique fi-

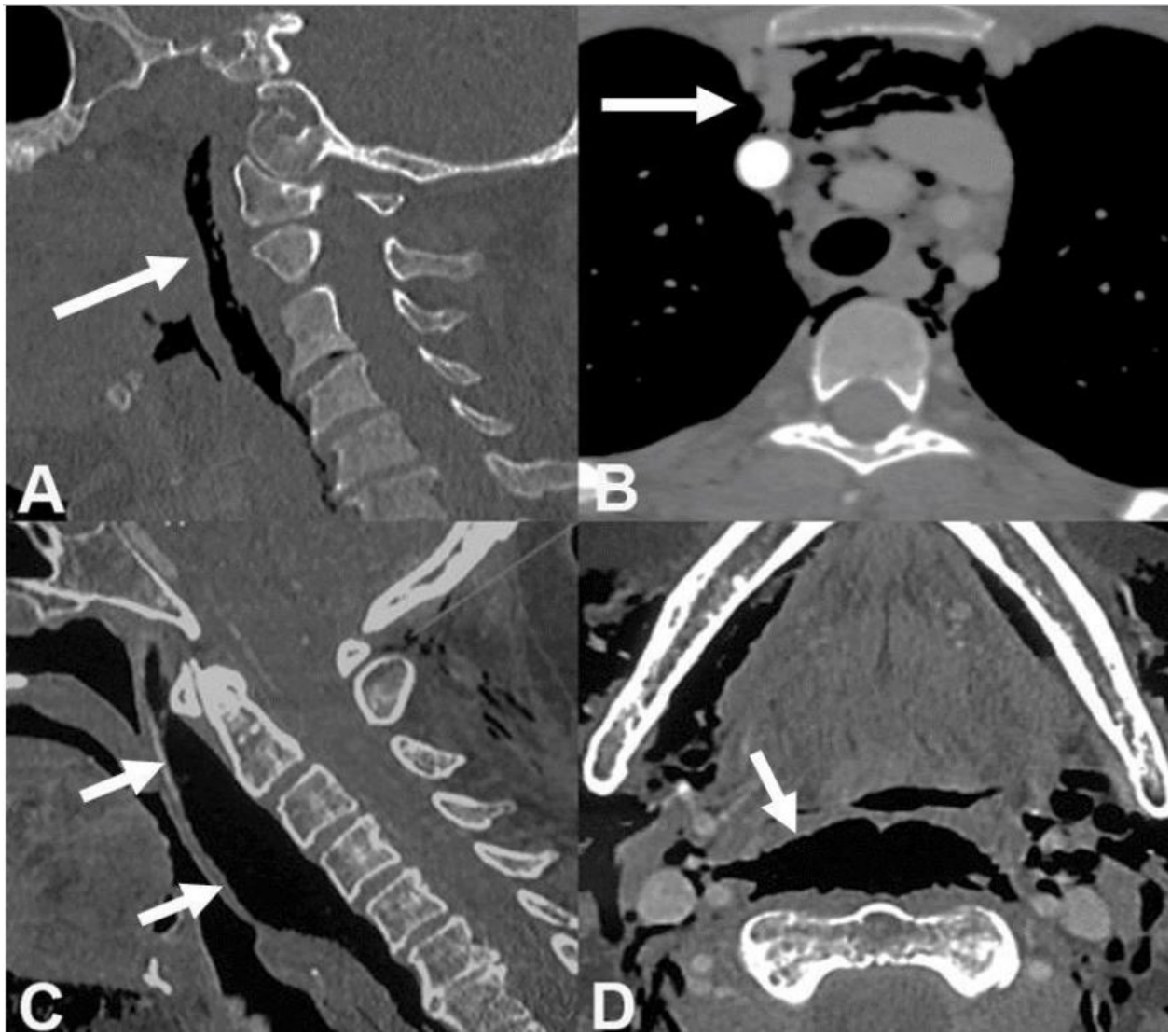


***Figure 2.***

*Spontaneous retropharyngeal (A) and mediastinal (B) emphysema is an uncommon, self-limiting disorder that occurs without any apparent precipitating factor or disease. In contrast, air in the RPS (C&D) can be part of diffuse involvement of the neck & chest and is usually secondary to trauma or surgery.*

bres [13] are vulnerable to calcium hydroxyapatite crystal deposits that are presumed to be the precipitant for a non-infectious inflammatory response [14, 15]. The typical demographic for a patient to experience acute calcific longus colli tendinitis is in their third to sixth decade of life, with both sexes equally affected [16]. Patients present with symptoms of reduced range of motion, odynophagia, dysphagia and throat swelling, thus mimicking clinically serious disease but there is usually no preceding illness. The patient may have mild leukocariosis and erthryocyte sedimentation rate. Although the pathognomonic amorphous calcification anterior to the C1-2 vertebral bodies can be demonstrated on plain radiographs, these are often unreliable. These findings are better demonstrated on CT, which can also easily differentiate this condition from an avulsion fracture and identify reactive lymph nodes [17]. In addition to the calcification, inflammatory changes typically smoothly expand the RPS in all directions without peripheral enhancement or loculation, thus distinguishing it from

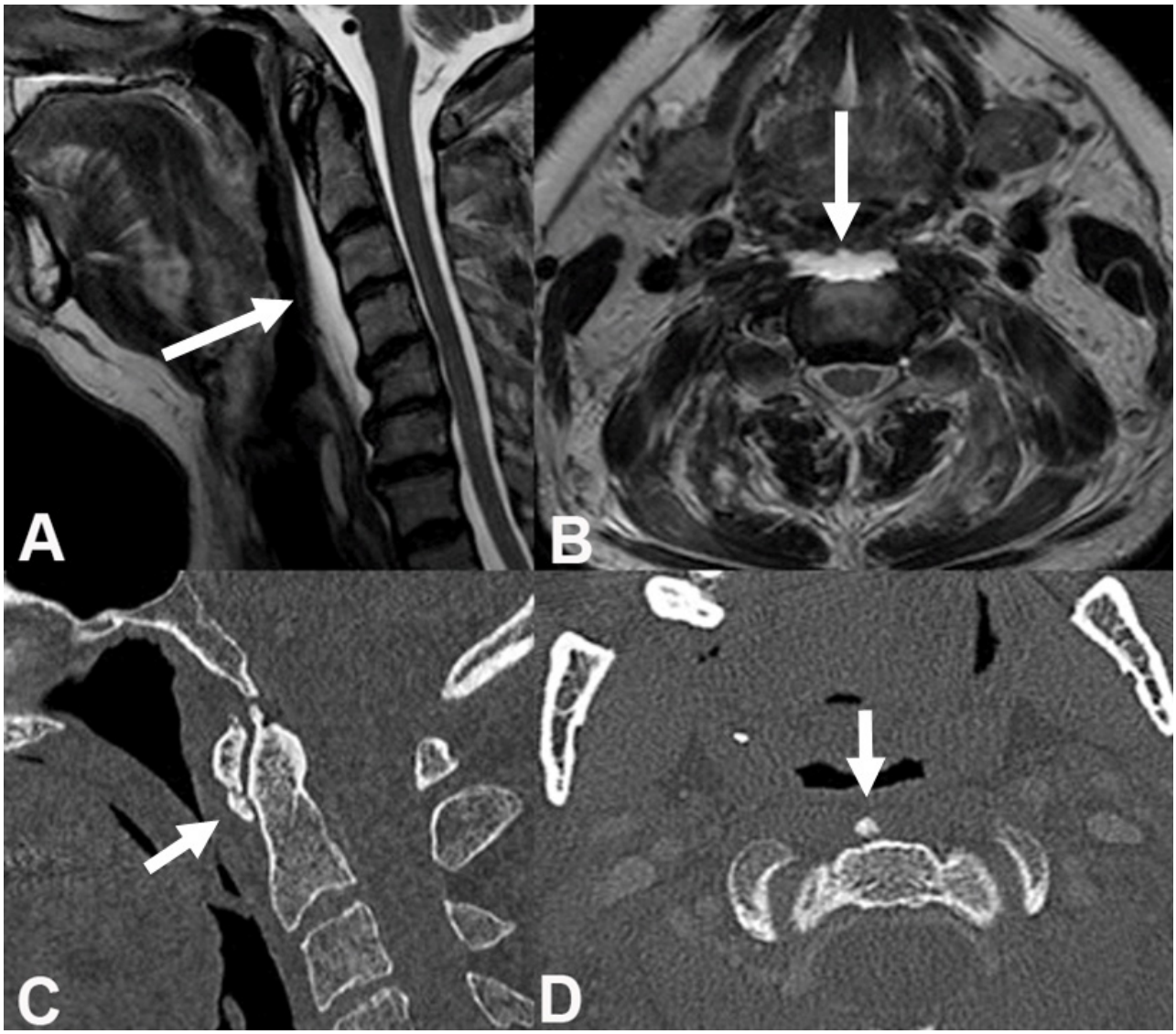


***Figure 3.***

*Calcific tendinitis of the longus colli secondary to calcium hydroxyapatite deposition results in RPS oedema (A&B) and is caused by the rupture of crystal deposits provoking an inflammatory response. CT (C&D) demonstrates the calcification better than MRI.*

the main differential of an abscess. Retropharyngeal abscess must be differentiated from acute calcific longus colli calcification as the treatment is drastically different. MRI is usually not required to make this diagnosis but can be helpful to demonstrate the normal striations in the T2 hyperintense [17], contrast enhancing, oedematous and enlarged non-calcified muscle. These appearances could imitate a neoplastic pathology; however, this can be excluded by the retention of the normal striations within the muscles [18, 19]. The condition usually improves over the course of a few weeks with non-steroidal anti-inflammatories, and follow up imaging is not required [13].

**Infection**

RPS infections in adults are usually secondary to penetrating trauma, iatrogenic injury from endoscopy, intubation or nasogastric tube insertion, with Gram positive cocci [20] the usual culprit. Cervical spine infections can also serve as a nidus due to direct spread of adjacent dis-

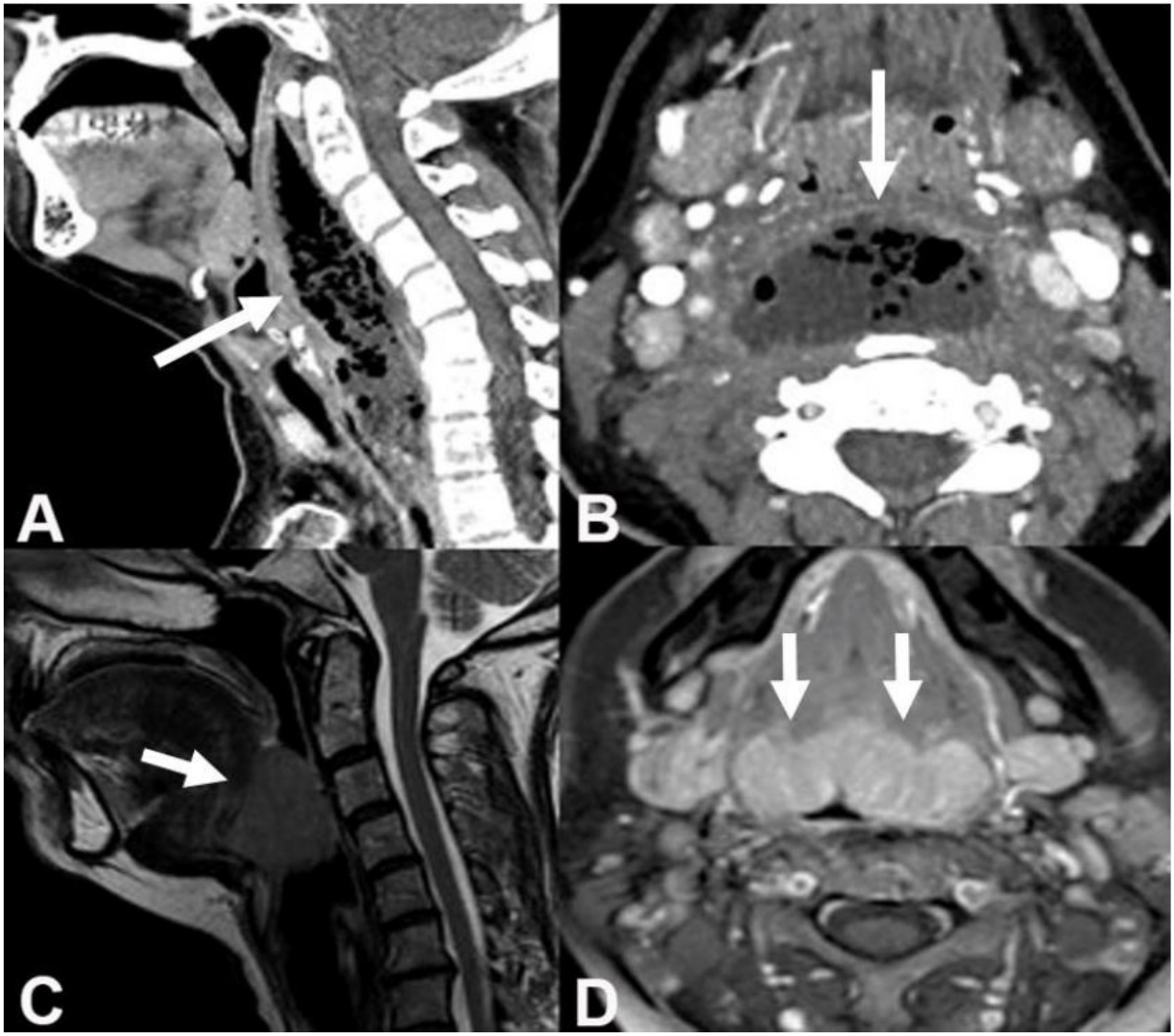


***Figure 4.***

*Retropharyngeal abscess (A&B) following tonsillectomy is rare and thought to occur secondary to perforation of the posterior pharyngeal wall during the procedure. This patient developed a large abscess one week following tonsillectomy performed for suspected lymphoma (C&D). Staph. Aureus was isolated at culture.*

citis or osteomyelitis [21]. However, infection in the RPS is more common in children and the origins are slightly different, typically from upper respiratory tract infections spreading from the pharyngeal mucosal space via lymphatic channels to the upper RPS, with Haemophilus influenzae the most common pathogen responsible [20, 21]. These channels are often fibrosed and the medial lymph nodes often atrophied by adulthood, explaining the difference in age distribution. Infection in the RPS can come in several forms: cellulitis, suppurative adenitis, and abscess. Cellulitis can be identified on CT as a symmetric focus of low attenuation, atypical for fluid but higher than fat in density, mildly displacing the posterior wall of the pharynx anteriorly (but not more than a few millimetres). The RPS lymph nodes are responsible for draining the middle ears, paranasal sinuses and upper pharyngeal soft tissues in young children and enlarged lymph nodes can result from any inflammatory process in the upper airway [22]. However, prolonged or severe infections encourage bacterial seeding, leading to in-

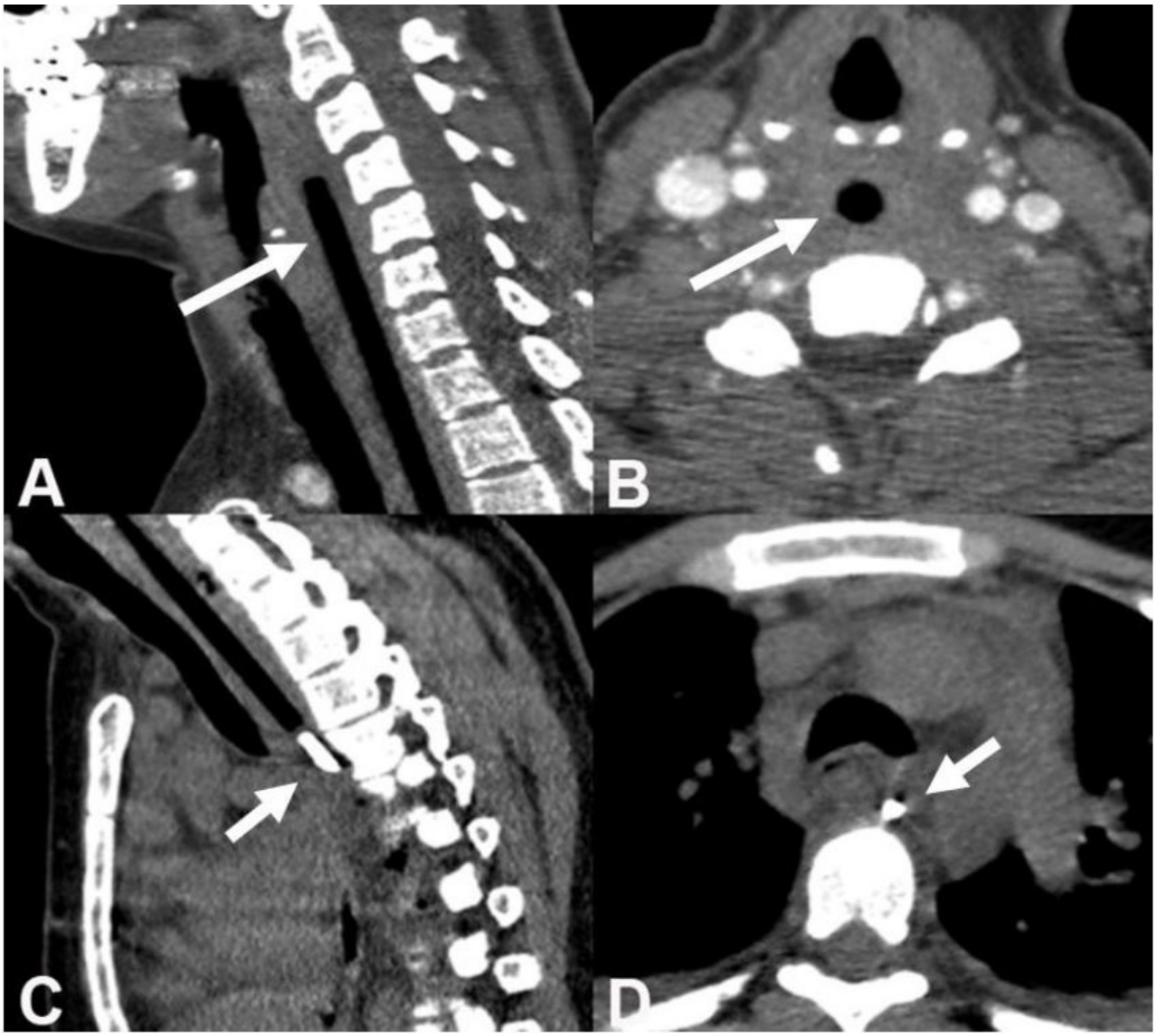


***Figure 5.***

*Young patient with known psychiatric illness forced a biro pen down their throat. It penetrated the posterior pharyngeal wall and was stuck in the RPS (A&B). The metallic clip of the pen can be seen in the posterior mediastinum (C&D). The patient was clinically well & at surgery the pen was removed 'in toto'.*

tranodal abscesses (suppuration) [23]. These suppurative lymph nodes can be localised as off midline, posterolateral to the pharyngeal mucosal space, round or ovoid in morphology with central hypoattenuation on CT. When these rupture, an abscess forms and again CT is often performed first-line because it provides information rapidly, with sufficient spatial resolution to inform the surgeon of the extent of disease and any involvement of adjacent tissues (Figure 4). In contrast to cellulitis, abscess will appear as a convex bordered/oval shaped collection, with rim enhancement and flattening of the prevertebral muscles. Similarly, on MRI, there will be peripheral enhancement and diffusion sequences will show restricted diffusion [23]. Cross-sectional imaging can assess for vascular complications (such as IJV thrombosis or carotid space involvement) and determine the complete extent of the disease, such as into the spine or epidural space [2, 21, 22]. Although the abscess will initially be unilateral,

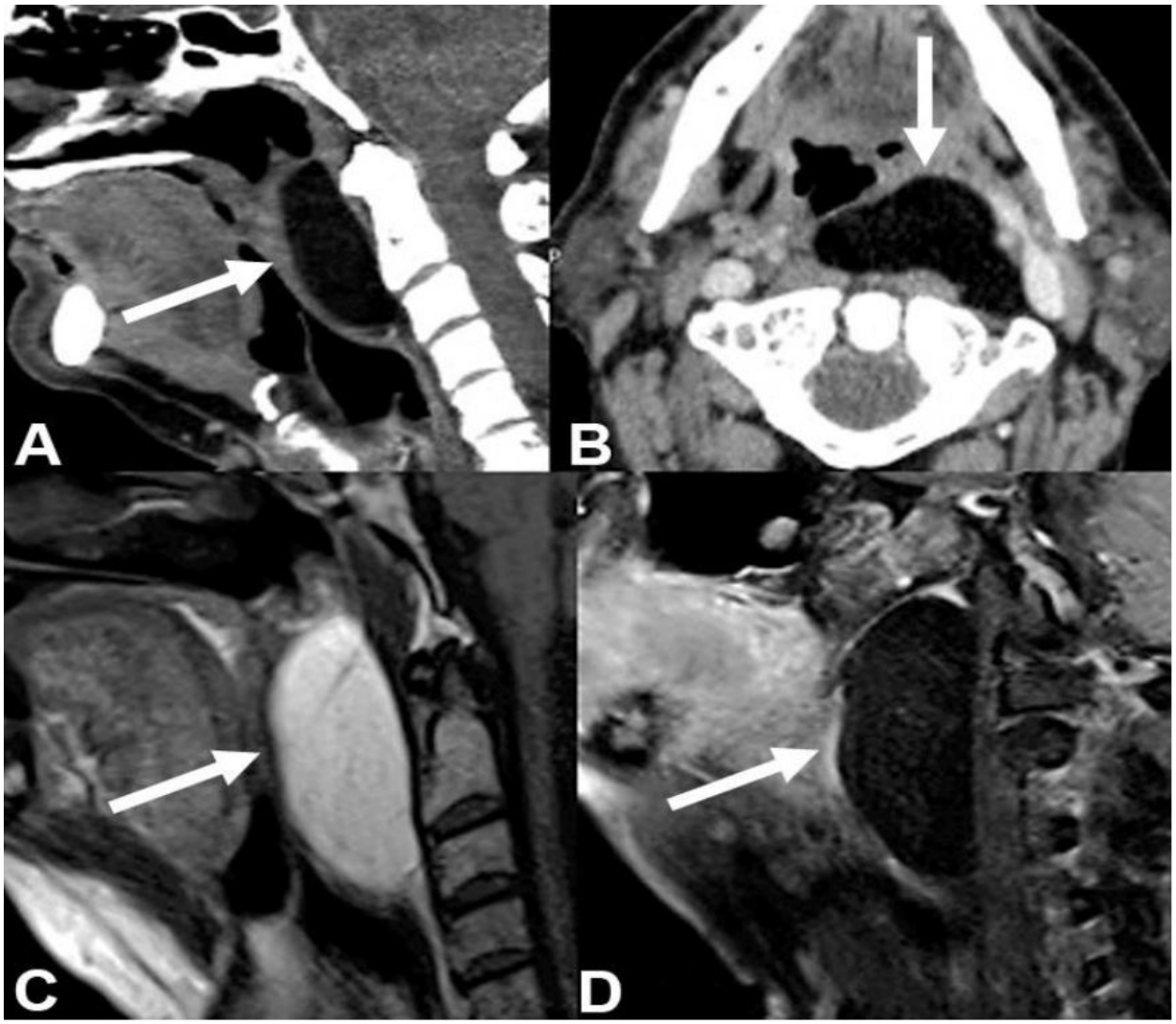


***Figure 6.***

*Primary lipoma of the RPS is extremely uncommon. They do not cause symptoms until they reach a large size. They show homogeneous fat density/signal intensity on CT (A&B) and MRI (C&D). However, it is difficult to differentiate lipoma from a liposarcoma as they can have overlapping features.*

the infection may cross the alar fascia to the contralateral side and also into the danger space, thus inspection of the mediastinum is critical because descending necrotising mediastinitis has a mortality rate ranging from 25-40% [21]. Imaging facilitates an early diagnosis and treatment with intravenous antibiotics and, if necessary, airway management; but surgical drainage may be required for large or complex abscesses.

**Foreign body**

Foreign bodies in the aerodigestive tract are most commonly encountered in children between the ages of 6 months and 6 years [24]. Generally, foreign body ingestion is rare in adults, except for the elderly, those with developmental delay, psychiatric disorders (Figure 5), or they are intoxicated [3, 20]. The foreign body is mostly of food origin and 80-90% passes spontaneously [24]. The main sites where foreign bodies lodge are of normal anatomical narrowing, such as the cricopharyngeus region, aortic arch or distal oesophagus [24]. These may cause airway compromise indirectly by secondary aspiration. In addition, sharp objects may perforate and

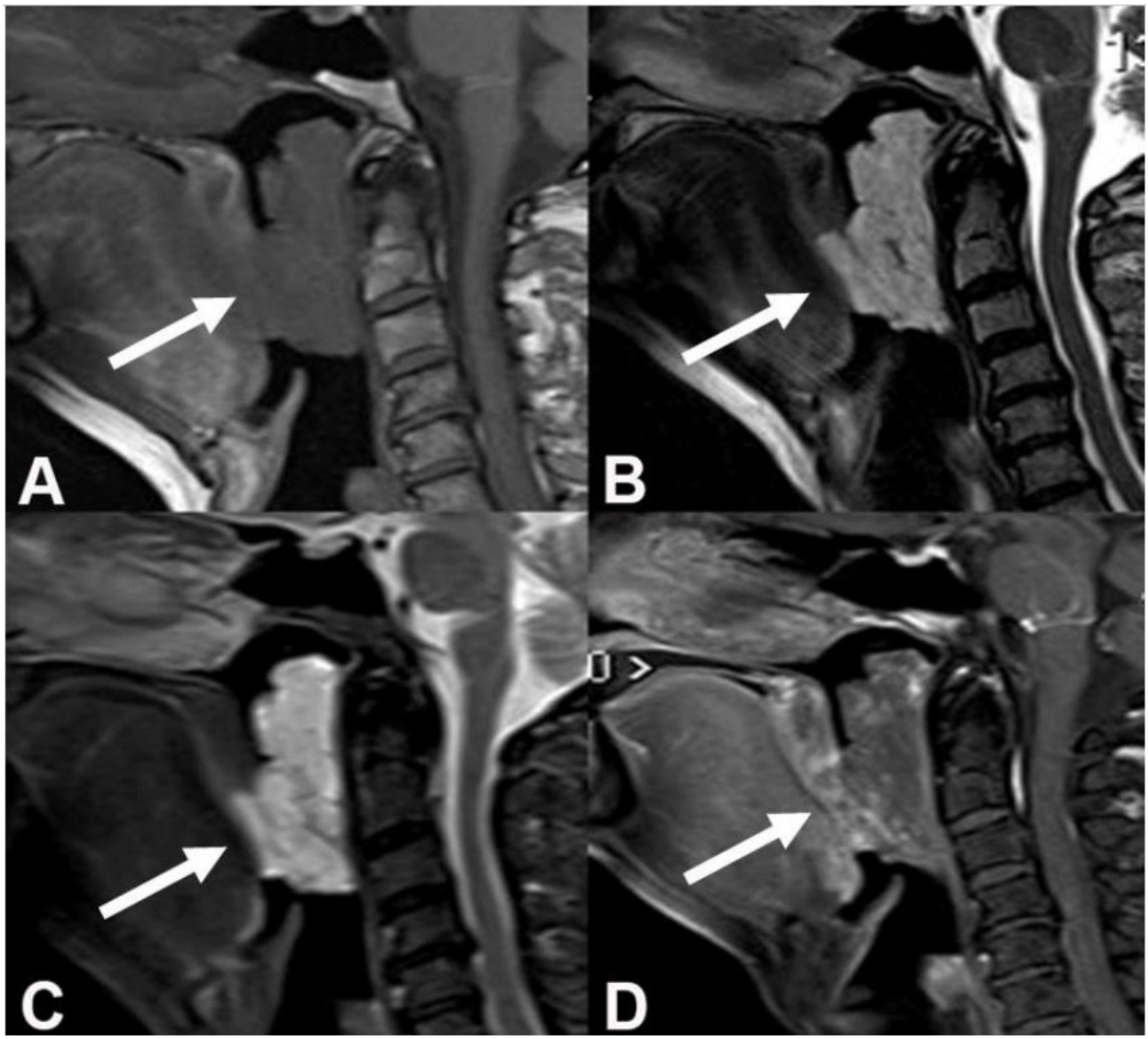


***Figure 7.***

*RPS is an unusual location for low flow venous malformation. They are well circumscribed, mildly lobulated mass, isointense to muscle on T1 (A) and markedly T2 hyperintense (B&C) on MR imaging. They can demonstrate progressive contrast pooling on routine delayed post contrast imaging (D), although this is not seen in this patient.*

lead to abscess formation. The main objectives of initial evaluation involve confirming the presence of a foreign body and excluding complications such as airway compromise, perforation and migration to adjacent vasculature. Plain radiographs are frequently the first line of investigation, but this is reliant on the radio-opacity of the foreign body. If there is continued high suspicion or perforation/abscess, CT is mandated [25]. Multi-detector CT is superior to plain radiography for pharyngo-oesophageal foreign bodies, with sensitivity of 100% and specificity of 93.7-100% [24].

**Lipoma**

Although lipomas are one of the most common soft tissue tumours in the body, with 15% in the head and neck region, these are usually found in the posterior triangle of the neck. Primary tumours and lipomas in the RPS are rare - only 30 cases of RPS lipoma have been

described in the literature since 1877 [26]. Lipomas are slow growing, benign mesenchymal tumours, and may reach a large size and present late because patients often become accustomed to the symptoms until they cause obstruction of adjacent structures. The symptoms vary depending on the level of the aerodigestive tract affected, with progressive dysphagia, obstructive sleep apnea [26-29] with snoring the most commonly reported. Lipomas are classically described as of homogeneous fat density and signal on CT and MRI respectively (Figure 6), with an elliptical shape conforming to the RPS [26]. However, imaging cannot entirely exclude liposarcoma, and unfortunately, there is a large degree of overlap of the imaging features – 9 to 31% of lipomas have non-adipose areas due to fat necrosis and associated calcification [5]. Features that may help distinguish liposarcomas include moderate/marked enhancement of thick septae and nodules, high percentage of non-adipose tissue (25 %) [1, 5], an irregular margin, increased age and large size. Similarly, fine needle aspiration of lipomas requires adequate sampling to avoid false negative results, so surgical excision is usually recommended [27]. However, the incidence of malignant transformation of lipomas is low, and there have been two reported cases of RPS lipomas managed with serial imaging. In particular, this method may be preferred if the patient has multiple comorbidities and the risk of surgery is high, with the caveat that rapid changes in symptomatology or radiological increase in size may herald neoplastic change [27].

**Vascular malformation**

Vascular lesions in the RPS are extremely rare (Figure 7) and, as with most other lesions, the commonest presenting symptoms are of mass sensation, dysphagia, oral bleeding and snoring [30, 31]. However, most adult patients with a vascular lesion are asymptomatic. Vascular lesions of the head and neck include vascular neoplasms and malformations, with malformations further subdivided into low and high flow. Whilst high flow lesions include arteriovenous malformations, low flow vascular malformations include lymphatic, venous and venolymphatic malformations. Malformations are present in 1% of births, but are hardly ever treated [30]. Typically, MRI and CT are employed in the evaluation of the lesion to determine the size, relationship to adjacent structures, lesion appearance and content. Lymphatic malformations (LM) are slow growing and have pathognomonic imaging features, typically well circumscribed, sharply marginated, masses with high T2 signal. Hemorrhage and infection may alter the signal characteristics, with layering of blood products due to different densities [31]. Venous malformations contain abnormally dilated and tortuous veins and again demonstrate T2 hyperintensity, with small signal voids suggestive of calcifications, but CT is very helpful in demonstrating these phleboliths [31]. Imaging findings of mixed malformations may be indistinguishable from venous malformations. Most cases are managed conservatively, but malformations may be treated with propranolol, topical or intralesional therapy (corticosteroid injection, embolization, sclerotherapy), radiation, or surgery (excision, laser or cryotherapy) if symptomatic [30-35].

## *Conclusion*

Primary RPS lesions are uncommon, but identifying whether the mass is a primary lesion or secondarily invading the RPS; determining the tissue characteristics of the mass and ancillary findings and complications will help narrow the differential diagnosis for the referring clinician as well as guide management. **R**

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