Retropharyngeal, Danger, and Paraspinal Spaces

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• Although diseases affecting these spaces are relatively uncommon, they can result in significant morbidity.
• Because of the deep location of these spaces within the neck, lesions arising from these locations are often inaccessible to clinical examination but they are readily demonstrated on CT and MRI.
• Therefore, cross-sectional imaging plays an important role in the evaluation of these spaces.

Retropharyngeal Space (RPS)

• It is seen as a thin line of fat between the pharyngeal constrictor muscles anteriorly and the prevertebral muscles posteriorly.

Retropharyngeal Space (RPS)

• It is bounded anteriorly by the MLDCF (buccopharyngeal fascia), posteriorly by the DLDCF (prevertebral fascia), and laterally by sagittal oriented slips of DLDCF (cloison sagittale).
Alar fascia (AF)
- Coronally oriented slip of DLDCF (alar fascia) extends from the medial border of the carotid space on either side and divides the RPS into 2 compartments.

Retropharyngeal Space
- The anterior compartment is true or proper RPS and the posterior compartment is danger space.

Retropharyngeal Space
- The true RPS extends from the clivus inferiorly to a variable level between the T1 and T6 vertebrae where the alar fascia fuses with the visceral fascia to obliterate the true RPS.
- The danger space extends further inferiorly into the posterior mediastinum just above the diaphragm.
- Danger space is named as such because it provides a conduit for spread of infection from the pharynx to the mediastinum.

Medial Raphe
- In suprathyoid RPS a median raphe which is a weak midline fascia may sometimes be seen (~50%) separating the true RPS into two lateral compartments (spaces of Gillette), preventing spread of disease from crossing midline.

Contents of the RPS and DS
- The normal contents of the suprathyoid RPS include adipose tissue, fibroareolar tissue, small vessels, and lymph nodes, whereas the infrahyoid RPS contains only adipose tissue, thus, can be involved only by non-nodal disease.
- Only areolar connective tissue is present between the alar and prevertebral fasciae (danger space).
Retropharyngeal nodes
- The suprathyroid retropharyngeal nodes are divided into medial and lateral groups.
- The medial group of nodes is not consistently present and is situated close to the midline.
- The lateral group, also known as the nodes of Rouvière, lies ventral to the longus colli muscles between the carotid sheath.

Retropharyngeal lymphadenopathy
- Retropharyngeal lymphadenopathy is a radiological diagnosis as these nodes cannot be palpated.
- The retropharyngeal nodes drain the nasopharynx, oropharynx, nasal cavity, paranasal sinuses, middle ears, and prevertebral space.

Retropharyngeal lymphadenopathy
- The most common primary malignancy that spreads to the RPN is nasopharyngeal carcinoma.
- The RPN are first echelon nodes of the nasopharynx, however, in one third of patients, lymphatic drainage of the nasopharynx bypasses the first echelon nodes to drain directly into the internal jugular chain.

Retropharyngeal lymphadenopathy
- Primary squamous cell carcinoma arising from the nasopharynx, oropharynx and hypopharynx may metastasize to the RPN.
- According to Ballantyne, retropharyngeal metastasis indicates a poor prognosis in patients with primary lesions arising from outside the nasopharynx.
- In a subsequent study, Tart demonstrated that RPN involvement was associated with decreased neck control, increased distant metastasis and decreased survival.
- Both Tart and Chua et al. confirmed Ballantyne’s observation that retropharyngeal metastasis is of no prognostic significance in nasopharyngeal carcinoma.

Suppurative Retropharyngeal Node
- A suppurative retropharyngeal node is a reactive lymph node that has undergone liquefactive necrosis but is contained by the nodal capsule (also known as retropharyngeal adenitis or intranodal abscess).
The process begins as a bacterial infection in the pharynx, paranasal sinuses, middle ear, or the prevertebral space.

Such infections are most commonly seen in early childhood before the retropharyngeal nodes atrophy.

Suppurative retropharyngeal node, or adenitis, is regarded as a more accurate description for infection contained by the nodal capsule.

Suppurative Retropharyngeal Node

Nodally necrosis Vs suppurative adenitis

Occasionally, nodal necrosis may be confused with abscess or suppurative lymphadenitis.

Necrotic nodes often maintain a clear nodal margin with no signs of surrounding inflammation.

RPS and DS: Differential Diagnosis

Edema

Infectious/inflammatory (reactive or suppurative nodes, osteomyelitis, diskitis, calcific tendonitis)

Primary tumors (Lipoma, liposarcoma, synovial sarcoma, lymphoma, ectopic parathyroid adenoma, Nerve sheath tumors, leiomyoma)

Direct spread of tumors from adjacent spaces (NPC, Thyroid ca, goiter, chordoma)

Metastasis

Pseudo-masses (tortuous, medial carotids)

Vascular (vertebral aneurysms/dissection)

Congenital lesions (vascular malformations, branchial cleft cyst, foregut duplication cysts, dermoid)

Iatrogenic

RPS and DS: Differential Diagnosis

Retropharyngeal edema

It fills the retropharyngeal space from side to side.

It has a smooth ovoid, rectangular, or “bow-tie” configuration on axial imaging and a diffuse cranio-caudal distribution on sagittal images, with tapered inferior and superior margins; there is only mild mass effect.

Retropharyngeal edema

There is no wall thickening or enhancement.

Ancillary findings (Radiotherapy, Lymphatic or venous obstruction, IJV thrombosis, IJV thrombophlebitis (Lemierre’s syndrome), adjacent neck infection (infection in spaces surrounding the retropharyngeal space or suppurative retropharyngeal node, or adenitis), Prior surgery, iatrogenic, Calcific tendinitis, trauma)

Retropharyngeal edema does not require surgical drainage. Most cases resolve as the cause of edema is treated.
Suppurative retropharyngeal nodes
- Such nodes are usually laterally located, rarely midline.
- They have a rounded or oval configuration, and the mass effect varies depending on the degree of nodal enlargement.

Suppurative retropharyngeal nodes
- A thin hyperdense or enhancing rim may be found around this low-density node; an edematous node in the presuppurative phase can also be low density.
- Ancillary findings include evidence of the primary infectious source, such as otitis media or tonsillitis.
- Retropharyngeal edema is a common associated finding.

Suppurative retropharyngeal nodes
- The current treatment for suppurative retropharyngeal nodes is a trial of IV antibiotics if the patient’s condition is stable.
- Surgical drainage is considered if there is progression after medical therapy or if the suppurative node is large at presentation.
- The typical clinical presentation of retropharyngeal abscess is acute to subacute onset of neck pain, dysphagia or odynophagia, and a low-grade fever.
- In an adult, the prevertebral space is the most common source of infection, compared with the pharynx in children.

Retropharyngeal abscess
- Ancillary findings include evidence of primary infection or presence of a foreign body in traumatic causes.
- Retropharyngeal abscess is most commonly due to rupture of a suppurative retropharyngeal node into the retropharyngeal space and and is contained only by the fascia surrounding the retropharyngeal space.
- Before infection evolves into a walled abscess, it is known as retropharyngeal cellulitis or phlegmon.
- This condition can be difficult to differentiate from retropharyngeal edema.

Retropharyngeal abscess
- It usually fills the RPS from side to side.
- May have an oval or rounded configuration; moderate-to-marked mass effect can produce anterior displacement of the pharynx and flattening of prevertebral muscles.
- Usually has a thick enhancing wall.

Retropharyngeal abscess
- Ancillary findings include evidence of primary infection or presence of a foreign body in traumatic causes.
- The most urgent complication is airway compression from mass effect on the larynx and pharynx.
- Infection can spread inferiorly via the danger space to the mediastinum, where it can result in mediastinitis, pericarditis, pleuritis, and empyema.
Infection can also break through the surrounding fascial planes and cause infection in the airway, spine, or carotid space. Vascular complications of carotid space infection include IJV thrombosis, carotid artery rupture, and pseudoaneurysm.

Finally, the infection itself can evolve into necrotizing fasciitis and sepsis.

Because these complications are associated with significant morbidity and mortality, a true retropharyngeal abscess usually requires prompt surgical drainage.

In children, both the tonsils and adenoids are common sites of infection. From these primary sites, microorganisms can spread to the RPN and result in suppurative lymphadenopathy. Subsequent cellulitis and abscess formation in the RPS may take place.

Pyogenic or tuberculous spondylitis may spread anteriorly through the anterior longitudinal ligament causing retropharyngeal cellulitis or abscess.

Primary tumors of the RPS are extremely uncommon. Lipoma is the most common primary neoplasm. Malignant neoplasms, such as liposarcoma and synovial sarcoma, are even rarer than lipomas in the RPS. Well-differentiated liposarcomas may have homogeneous adipose tissue, characterized by T1 signal hyperintensity, with only several thin septa. Features more suggestive of malignancy include greater than 25% non-adipose tissue, irregular margins, moderate to marked enhancement of thickened septa and nodules, large lesion size, and increased patient age.

Ectopic parathyroid adenoma

Nerve sheath tumor
Pharyngeal masses, such as nasopharyngeal carcinoma (NPC) and squamous cell carcinoma of the oropharyngeal wall, can spread directly and invade the RPS.

Superior spread in the RPS is impeded by the attachment of the buccopharyngeal fascia to the skull base, and disease spread may result in extensive erosion of the clivus.

Supraglottic, oropharyngeal, or sinonasal tumors may also grow into the RPS and can extend in a craniocaudal direction after gaining access because there are no fascial barriers within the RPS.

Lesions of the thyroid, including goiters, can extend posteriorly and medially into the RPS.

Primary lesions of the spine and chordoma can invade the PVS and then the RPS from a posterior direction.

Chordomas are midline lesions arising from the clivus, have variable enhancement, and are hyperintense on T2-weighted images.

A tortuous carotid artery may mimic a RPS mass. In this condition, the vessel is not contained within the RPS but instead bows the alar fascia medially and projects into the RPS.
### Foregut duplication cyst

- Cylindrical space around spine in supra- & infrahyoid neck.
- Craniocaudal extent: Skull base to T4 (mediastinum)

### Nerve sheath tumor

- The deep layer of the deep cervical fascia encloses the perivertebral space.
- When disease (infection or tumor) begins within the PVS, it will usually remain confined by this fascia. This is why PVS disease so frequently ends up into the epidural area.

### Vascular malformation

### Hematoma

### Perivertebral Space

- Cylindrical space around spine in supra- & infrahyoid neck.
- Craniocaudal extent: Skull base to T4 (mediastinum)
Because the DLDCF attaches to the transverse process of the cervical vertebrae, it separates the perivertebral space into two compartments:

- Pre-vertebral space (PVS) (anterior)
- Paravertebral (Paraspinal) in IHN (posterior)

**Perivertebral Space**

The PVS describes the region between the carotid sheaths laterally, the prevertebral fascia anteriorly, and the vertebral bodies posteriorly, extents from skull base to coccyx and is contiguous with the psoas muscle sheath.

**Prevertebral Space (PVS)**

- Only the roots of the brachial plexus pierce this fascia, as they leave the PVS to enter the posterior cervical space on their way to the axillary apex.

**Perivertebral space**

- Prevertebral muscles (Longus colli & Capitis)
- Fat
- Vertebral, artery, vein
- Scalene muscles (infrahyoid)
- Phrenic nerve (infrahyoid)
- Brachial plexus (infrahyoid)
- Connective tissue
- Perivertebral muscles
- Posterior vertebral elements

**Phrenic nerve**

Proximal portion of each phrenic nerve lies deep to the prevertebral fascia on the anterior face of each anterior scalene muscle.

**DDx of Perivertebral space**

- **Vascular:**
  - Vertebral artery dissection, aneurysm, or pseudoaneurysm
- **Inflammatory:**
  - Osteomyelitis, TB spondylitis
- **Benign tumor:**
  - Schwannoma, neurofibroma
  - Vertebral body benign bony tumors
  - Lipoma
DDx of Perivertebral space

- Malignant tumor:
  - Sarcoma
  - Chordoma
  - Metastases
  - Lymphoma
  - SCCA
  - Vertebral body primary malignant tumor
  - Direct invasion
  - NHL

DDx of Perivertebral space

- Vertebral body osteophyte
- Anterior disc herniation
- Large or asymmetric transverse process
- Cervical rib
- Hypertrophic facet joint

DDx of Perivertebral space

- Dilated nerve root sleeves
- Hypertrophied levator scapulae muscle
- Cervical ribs
- Enlarged transverse processes

Dilated nerve root sleeves/Lateral meningocele

- It results from herniation of the meninges through a foramina or a defect in the vertebral column.
- They are typically associated with neurofibromatosis type I but can rarely occur in isolation.

Hypertrophic Levator Scapulae

- Spinal accessory nerve injury leading to atrophy of SCM and trapezius muscle with compensatory hypertrophy of levator scapulae muscle

Differentiating PVS vs RPS lesions

- Displaces prevertebral muscles anteriorly
- Epidural extension
Where do most PVS pathology arise?
- Vertebral body (e.g. infection or neoplasm)

PVS- Infection
- Discitis/osteomyelitis
- T2 hyperintensity, T1 hypointensity, enhancement along endplates and within disc space

Perivertebral space infection
- Septic facet arthropathy with paraspinous abscess

Perivertebral space metastases
- Vertebral body destruction
- Disc spared

Perivertebral space chondrosarcoma
- Rapid growth, new pain, growth of cartilage cap > 1.5 cm (after skeletal maturity)

Brachial Plexus (Prevertebral IHN)
- The ventral rami of C5, C6, C7, C8 and T1 form the brachial plexus.
- Ventral rami exit the neural foramina and enter the interscalene triangle between the anterior and middle scalene muscles.

NF2, Bilateral neurofibroma
**Plexiform Neurofibroma**
- Congenital, with approx. 50% occurring in head, neck, face, and larynx.
- Growth and plateau phases in early childhood
- Cosmetic deformities and functional deficits

**Prevertebral calcific tendinitis**
- Inflammatory condition caused by deposition of calcium hydroxyapatite in the superior oblique tendon fibers of the longus colli muscles.

**Prevertebral calcific tendinitis**
- There is a fluid collection and soft tissue swelling in the RPS.
- It is important to distinguish this process from an infectious cause.

**DIRECT SPREAD OF TUMOR TO THE PVS**
- NPC involves the mucosal surface of the nasopharynx and its spread is initially limited by the pharyngobasilar fascia. Once this fascia is breached, NPC may extend posteriorly and inferiorly into the PVS.

**OTHER LESIONS**
- Other lesions that may affect the PVS include nerve sheath tumors, vascular malformations, lymphatic malformations, hemangioma, and leiomyoma.