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Pediatric Pulmonology

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Preface

Respiratory diseases are a common cause of morbidity and mortality in children. Significant advances have occurred leading to better understanding of pediatric respiratory illnesses. Diagnostic tests have improved and with better treatment, outcome of acute as well as chronic illnesses has improved.

Basic principles of clinical medicine include, making a provisional diagnosis from history and clinical examination and confirming diagnosis by using available investigations judiciously.

In the first edition of this multi-author book, we have included cases of common respiratory illnesses and discussed them based on clinical findings to reach a diagnosis by using available investigations, where indicated. We have also discussed the principles of management and outcome of patients. The cases were selected considering the local epidemiological situation, sociodemographic background of patients, and available resources.

The basic aim of the book is to equip practicing pediatricians with necessary knowledge to consider and confirm various respiratory illnesses in children. We hope the book will achieve its objective.

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Plate 1

Figure 1: Throat examination showing small ulcers around the edges of faucial pillars (Chapter 4).

Figure 2: Posterior pharyngeal wall showing cobblestone appearance (Chapter 2).

IT, inferior turbinate; S, septum; A, adenoids.

Figure 1: Nasal endoscopic images showing adenoid obstructing choana almost completely (Chapter 6).

Figure 1: Bilateral tonsillar enlargement (Chapter 7).

Figure 2: Scarlatiniform rash after partial improvement (Chapter 4).

Figure 1: Influenza virus (Chapter 18).
CASE 1
- A 2-year-old boy with no significant illness in the past, presented to the emergency with swelling on left side of the neck for 2 days. There was associated fever and redness over the swelling. He had coryza and cough for 3 days prior to the onset of swelling. There was also history of drooling of saliva, noisy breathing, and refusal to feed.
- On examination, the child was irritable but vitals were stable. His neck was deviated to the left side and there was a reddish, tender, fluctuant swelling 3 cm × 3 cm palpable in the left anterolateral part of the neck. Multiple enlarged cervical lymph nodes were also palpable. On oral cavity examination, there was drooling of saliva with congested posterior pharynx and anterior displacement of the posterior and left lateral pharyngeal wall. Tonsils were normal. Respiratory system examination revealed only mild suprasternal retractions. Air entry was bilateral and there were no added sounds. Rest of the systemic examination was normal. He was shifted to the pediatric intensive care unit (PICU) for monitoring of airway and post of care for surgical intervention.
- During the PICU stay course, the child’s respiratory distress worsened with increased suprasternal and substernal retractions and falling oxygen saturation. He was intubated and mechanically ventilated as there was evidence of bronchopneumonia bilaterally. An urgent contrast enhanced computed tomography (CT) of the head, neck, and chest was ordered to delineate the extent of the abscess.

Q. What are the likely differentials we could think of in this case?

This child had fever, swelling, and redness of the posterior pharyngeal wall and features suggestive of upper aerodigestive tract infection. The main differentials to be considered are:
- Acute epiglottitis: Epiglottitis is a life-threatening infection characterized by rapidly progressive inflammation of the epiglottis. It usually manifests with high fever, toxic appearance, stridor, muffled voice, dysphagia, and difficulty in handling oral secretions. It can be rapidly progressive and life-threatening. Oral examination should be done in an environment where there is facility for emergent establishment of artificial airway if needed, i.e., in the operation theater. Oral examination may be unremarkable other than pooling of secretions. There will be evidence of edema and inflammation of supraglottic structures.
- The CT scan of the head, neck, and chest showed a large retropharyngeal abscess (RPA) measuring 3.7 cm × 3.1 cm × 2.6 cm with inflammatory and phlegmonous changes extending into the left parapharyngeal space and the mediastinum (Fig. 1). Thus, a diagnosis of retropharyngeal wall abscess was confirmed in this case.
Chapter 5: Retropharyngeal Abscess

- Acute infectious pharyngitis: Pharyngitis due to viral and bacterial infections can present with sore throat, dysphagia, drooling of saliva, and respiratory distress. The presence of edema and cellulitis of the posterior pharyngeal wall mucosa can cause features of upper airway obstruction.

- Acute tonsillitis: Acute viral or bacterial tonsillitis can present with the above mentioned complaints. On examination, there will be evidence of enlarged and inflamed tonsils with exudates or membrane covering them.

- Peritonsillar cellulitis and abscess (quinsy): Peritonsillar cellulitis is an inflammation of the tissue between the capsule of the palatine tonsils and the pharyngeal muscles, and when there is collection of pus it is called quinsy or peritonsillar abscess. Trismus may limit a complete oral examination. Extremely swollen tonsils with fluctuations and deviation of tonsils to opposite side may be seen along with erythema and exudates over the tonsils.

- Retropharyngeal abscess: Usually presents in children less than 4 years with a preceding history of upper respiratory infections. Fever, features of upper airway obstruction, torticollis, and limitation of neck movements may be common presentation. The posterior location of the abscess makes it difficult to visualize on oral examination, but sometimes a bulging posterior pharyngeal wall may be seen.

- Lateral pharyngeal abscess: The clinical presentation may be similar to RPA, but the condition is rare. Trismus and swelling below the mandible is more common.

- Diphtheria: A life-threatening infectious bacterial pharyngitis should always be kept in mind in children presenting with upper airway obstruction and dysphagia, especially when immunization status is incomplete. Thick pharyngeal membrane and cervical adenopathy (bull neck) are characteristic features.

Q. What are the boundaries of retropharyngeal space?

The retropharyngeal space is also known as retropharyngeal space of Gillette or the posterior space of Grodinsky or the Holoyoke's space. It lies behind the pharynx with the middle layer of deep cervical fascia (buccopharyngeal fascia) forming the anterior boundary abutting the posterior pharyngeal wall. The posterior boundary is the deep layer of deep cervical fascia (prevertebral fascia). These fasciae fuse inferiorly at the level of the first and second thoracic vertebrae. It extends from the base of the skull to the level of tracheal bifurcation. It communicates laterally with the lateral pharyngeal space (Fig. 2).
Retropharyngeal abscess is most commonly seen in children between ages 2–4 years, although it can occur in children of any age group including infants. With increasing age, there is progressive regression of the retropharyngeal lymph nodes and hence lesser incidence of RPA. It is more common during the winter months and in males.

Q. What are the findings in history and examinations to be elicited in a suspected case of retropharyngeal infection?

The presenting features of RPA are highly variable because of which they present a diagnostic challenge to emergency physicians, pediatricians, and otorhinolaryngologists. The features may be subtle and nonspecific early in the course of illness, while life-threatening symptoms related to inflammation and obstruction of upper respiratory tract may be seen with progression of illness.

The commonly reported symptoms of RPA are:

- Fever
- Neck pain
- Dysphagia/odynophagia
- Sore throat
- Refusal to feed
- Torticollis
- Swelling in the neck
- Drooling
- Respiratory difficulty/stridor.

The initial step in examining a child with suspected deep neck infection is a rapid assessment of the degree of upper airway obstruction. Anxious ill appearing children with drooling, abnormal neck posture, and stridor should be monitored continuously in a setting where emergent artificial airway can be established if necessary such as in an operating room.

The common signs one should look for while examining a patient with RPA are cervical lymphadenopathy, limitation of neck movements, oropharyngeal swelling, torticollis, drooling, and stridor. There should be a high index of suspicion of RPA in a child who cannot fully extend his neck to look up. This is known as “Bolte's sign.”
Q. What are the challenges in making a diagnosis of retropharyngeal abscess?

The diagnosis of RPA remains challenging as many patients present with nonspecific symptoms such as fever and neck stiffness. Even though some studies have reported that limitation of neck movements and torticollis are more specific for RPA, diagnosis based solely on history and examination remains a challenge. Hence, a contrast-enhanced CT neck showing evidence of fluid collection with rim enhancement and specific location is used to diagnose RPA in conjunction with the clinical findings.

CASE 2

- A 15-month-old boy, premorbidly normal, presented with an episode of choking with food and was taken to the local emergency department. On clinical examination, there was no evidence of foreign body and the child was sent home. Three days later, the child returned to the emergency department with high grade fever and respiratory distress. Physical examination revealed right cervical swelling and restriction in neck movements. Oral cavity examination revealed a bulging posterior pharyngeal wall and drooling of saliva.
- The child underwent blood investigations followed by contrast imaging of the neck. Cervical CT scan revealed a retropharyngeal collection or abscess with ‘air bubbles’ extending from the oropharynx to the cervical-thoracic transition measuring 4 cm × 5 cm. The child was started on intravenous fluid and antibiotics and kept under observation in the PICU.

Q. What is the etiopathogenesis of retropharyngeal infection?

In children and infants, acute retropharyngeal infection is usually nontraumatic caused by suppuration of the retropharyngeal lymph nodes which drain from oropharynx, nasopharynx, nose, paranasal sinuses, adenoids, and tonsils. Rarely, RPA in children can also result from mastoid infection. Retropharyngeal abscess is associated with antecedent upper respiratory infection in one half of the cases. Regional trauma, foreign body ingestion, as a complication of procedure in the oropharyngeal region or immunosuppression, are rare causes in children but common in adults. Retropharyngeal infections progress from cellulitis to organized phlegmon to mature abscess. Early institution of antimicrobial therapy may halt the progression to mature abscess.

Q. What findings do you expect in his blood investigations?

The initial laboratory evaluation in a patient with suspected RPA includes getting a complete blood count with differentials, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), blood culture for both aerobes and anaerobes, and throat swab for group A streptococcus. Patients with RPA usually have an elevated total count with a predominance of neutrophils and bands and elevated CRP and ESR levels. Blood cultures are rarely positive, but may help in identifying the pathogen. Whenever surgical drainage is done, both aerobic and anaerobic cultures have to be sent immediately to isolate the causative agent.

Q. What are the various imaging modalities available for the diagnosis of retropharyngeal abscess and their findings?

The radiographic evaluation for RPA includes lateral neck radiographs, CT scan of the neck with contrast, and magnetic resonance scan. The imaging strategy depends on the clinical condition of the child and the level of suspicion of RPA. If the patient’s condition is stable and the level of suspicion of RPA is low, then a lateral radiograph of the neck may suffice. If suspicion is high, then a CT neck with contrast would be the preferred modality as it gives preoperative insights. Magnetic resonance imaging scan would be helpful during follow-up to identify any residual collection after treatment.

The retropharyngeal space is considered pathologically widened if it is >7 mm at C2 level and >14 mm at C6 level, or if the retropharyngeal
space is >50% of the width of the corresponding cervical vertebrae (Fig. 3). Plain lateral neck radiographs showing prevertebral soft tissue thickening, straightening of cervical lordosis due to muscle spasm, presence of gas, or fluid level in the retropharyngeal space are suggestive of the presence of a RPA (Fig. 4).

Contrast-enhanced CT is the radiological modality of choice for evaluating RPA and is highly sensitive but not very specific. It can demonstrate the extension of the abscess to contiguous areas of the neck and chest, identify a nonopaque foreign body if any, may be able to differentiate between cellulitis and abscess in most cases, and identify loculations and position of the carotid artery and internal jugular vein in relation to the abscess for planning a surgical approach.

The CT findings suggestive of an abscess include areas of low attenuation, rim enhancement of the abscess wall, scalloping of the wall margin, tissue edema surrounding the abscess, and a cystic or multiloculated appearance (Fig. 5).

In this child, blood investigations showed only a slight increase in CRP. He was started on ciprofloxacin and amikacin intravenous. On day 2, the child developed worsening of respiratory distress for which he was intubated and had to be put on mechanical ventilation. His antibiotics were changed to amoxicillin-clavulanic acid and clindamycin at this time.
Q. Was the initial antibiotic coverage in this child appropriate? What are the common organisms causing retropharyngeal abscess?

The initial antibiotic coverage in this child was not appropriate as there is no coverage for Gram-positive or anaerobic organism. Retropharyngeal abscess is usually a polymicrobial infection, including aerobes, microaerophiles, and anaerobes. The most common organisms are aerobic Streptococcus pyogenes [group A β-hemolytic streptococci (GABS)], viridans streptococci, Staphylococcus aureus [methicillin-resistant Staphylococcus aureus (MRSA)], Klebsiella pneumoniae, Peptostreptococcus, and anaerobic bacteroides such as Fusobacterium, Prevotella, and Veillonella species. There has been an increasing incidence of RPA and has coincided with the emergence of GABS and MRSA infections. It has been seen that community acquired MRSA infections may be associated with a more complicated clinical course including mediastinitis, especially in children <2 years with prolongation of hospital stay and duration of antibiotics. Several virulence factors, especially the presence of pore forming Panton-Valentine leukocidin have been attributed to the invasiveness of MRSA.

Q. What would be the appropriate antibiotics to be started in a case of suspected retropharyngeal abscess?

The antibiotic treatment of RPA should be directed against the likely organisms. Early initiation of appropriate antibiotics may prevent the progression from cellulitis to abscess stage. These infections are often mixed and β-lactamase organisms are frequently isolated. The recent emergence of GABS and community acquired MRSA as RPA pathogen makes the antibiotic choice more challenging.

In areas where the incidence of community acquired MRSA is less, the empiric therapy should include high dose of parenteral amoxicillin-clavulanic acid along with an anti-anaerobic such as metronidazole or clindamycin. Alternatively second- or third-generation cephalosporins may be used as second-line therapy in case of penicillin allergy or severe infections. Clindamycin is preferred as it may be effective against community acquired MRSA. In areas where there is clindamycin resistant MRSA, vancomycin or linezolid should be added to clindamycin. Vancomycin may be considered empirically in critically ill children and in those with mediastinal extension while awaiting culture reports. Parenteral therapy is continued until the patient is afebrile and clinically stable after which oral therapy should be continued to complete a 14 days course. The empiric therapy should be amended based on the culture reports if a drainage procedure has been done.

Q. What is the optimal management of retropharyngeal abscess—medical or surgical?

The optimal management of RPA has been the subject of debate between conservative (medical) versus surgical drainage. The surgical drainage of the abscess has been the treatment of choice for decades. However, recent studies have shown successful conservative treatment of RPA without surgery. The initial modality of treatment should depend on the stage of inflammation, presence of associated respiratory compromise, the presence of drainable fluid, and associated complications. In the early state of the disease, appropriate antimicrobial therapy alone may prevent progression and preclude the need for surgery. Surgical drainage may be required as a first line therapy if there is associated respiratory compromise.
compromise or severe septic shock. Surgical drainage may also be considered in cases of large mature abscess >2 cm thickness with rim enhancement in CT scan. In all other cases, a trial of conservative antibiotic therapy should be considered first, and surgical drainage is to be considered in the absence of favorable clinical evolution after 48 hours of intravenous antimicrobial therapy.

Q. What are the different surgical approaches for draining retropharyngeal abscess?

Traditionally, external cervical approach has been advocated. But presently, transoral drainage is the preferred modality if the abscess is medial to the great vessels and limited to the retropharyngeal space. With the availability of modern anesthetic technique and better airway management, transoral approach has been found to be relatively safe and effective. Currently, external cervical approach is reserved for abscess extending laterally to the great vessels or to the mediastinum.

Q. What should be the practical approach to the management of a case of suspected retropharyngeal abscess?

A practical approach to the management of a case of RPA is summarized below (Flowchart 1).

CT, computed tomography; CECT, contrast-enhanced computed tomography.

Flowchart 1: Approach to a child with retropharyngeal abscess
Chapter 5: Retropharyngeal Abscess

Postoperatively, the child improved, inotropes were stopped and he was weaned off from mechanical ventilation to nasal prongs. The oral drain was removed after 2 days. The pus culture grew K. pneumoniae and S. aureus sensitive to the prescribed antibiotics. Intravenous antibiotics were continued for 7 days and then switched over to oral antibiotics for a total of 14 days. On follow-up, the child was doing well and there were no complications related to the illness or the procedure. An magnetic resonance imaging of the neck showed complete resolution of the abscess.

Q. What are the anticipated complications of retropharyngeal abscess?

Although RPA is a life-threatening condition, complications have become rare because of early detection, timely antibiotic therapy, and early surgical intervention. The most common complications of RPA are:

- Airway obstruction
- Septicemia
- Aspiration pneumonia (rupture of abscess into airway)
- Internal jugular vein thrombosis or thrombophlebitis (Lemierre’s syndrome)
- Carotid artery rupture
- Mediastinitis
- Atlantoaxial dislocation.

Q. What is the outcome and prognosis of retropharyngeal abscess?

When detected early and appropriately managed, RPA seldom leads to any long-term consequences. One-fourth of the patients may be managed by antimicrobial therapy alone while others may require surgical intervention. Some children may even require recurrent surgical intervention for persistent fever, recollection of pus, or development of complications. Hence, the duration of illness is highly variable and individualized. These children require follow-up evaluation and imaging to document complete resolution of illness.

LEARNING POINTS

- Retropharyngeal infection in children is a rare aerobic or anaerobic polymicrobial infection.
- The incidence of retropharyngeal abscesses has been increasing recently in parallel with emerging group A (β-hemolytic) streptococcus infection and methicillin-resistant Staphylococcus aureus infections.
- Early diagnosis and initiation of appropriate broad-spectrum antibiotics can prevent progression and preclude the need for surgery.
- Imaging plays a key role in timely diagnosis of retropharyngeal abscess.
- Inappropriate and/or delayed treatment may lead to life-threatening complications and even death.

SUGGESTED READINGS