Radiographic Evaluation of Stridor in Children

*Focusing on Infectious Causes*

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Overview

- Clinical Basics
- Radiographic Anatomy
- Patient Cases
Clinical Basics

- **Stertor:** inspiratory snoring
  - nose, nasopharynx, oropharynx

- **Stridor:** low to medium pitch sound
  - Inspiratory = extrathoracic airway obstruction
  - Expiratory = intrathoracic obstruction
Sites of Obstruction

- Nasopharynx
- Oropharynx and Hypopharynx
- Supraglottic
- Glottic
- Subglottic
- Tracheobronchial

Differential Diagnosis

- Congenital Anomalies
- Trauma or Intubation
- Foreign Body
- *Infection and Inflammation*
- Neoplasm

“CT FIN”
Examining the Upper Airway Radiologically

- Neck “soft tissue” Plain Films
- 4 views
  - Inspiratory and expiratory
  - AP and Lateral
- Extension of neck if possible for best view
- If patient is in severe respiratory distress, need to intubate and transfer to ICU
- CT / MRI for better visualization
Normal Radiographic Anatomy - Lateral

Approach to Films: Survey the Entire Airway

- Tongue
- Nasopharynx
- Uvula
- Tonsils/ “Adenoids”
- Oropharynx
- Hypopharynx
- Retropharynx
- Larynx Region
- Trachea
- Esophagus


Stram, E. “Bacterial Tracheitis.” Boston Children’s Hospital Teaching File Case 6-291
Normal Radiographic Anatomy – Lateral
Coned down view of larynx

- Tongue
- Hyoid Bone
- Vallecula
- Epiglottis
- Aryepiglottic folds
- Vestibule of Larynx
- Vocal Fold
- Vestibular Fold
- Sinus/Ventricle of Larynx

Normal Radiographic Anatomy - Frontal

- Epiglottis
- Aryepiglottic Folds
- Arytenoid Cartilage
- Vallecula
- Vestibular Cord
- Vocal Cord
- Ventricle
- Glottis
- Subglottis


Gray's Anatomy
Patient HP

- 6 mo old female presents with fever and respiratory distress x 1 day
- On exam
  - Stable vital signs
  - Nontoxic appearing
  - ? Inspiratory stridor, + subcostal retractions
- Elevated WBC (18.49)
- Differential includes viral URI, bronchiolitis, PNA, croup
- Chest and neck films were ordered
- Chest film shows no evidence for PNA
Patient HP – Lateral film

Normal retropharyngeal soft tissue width

Anatomy:
- Posterior Tongue
- Vallecula
- Epiglottis
- Aryepiglottic fold
- Glottis / Vocal Cords

Subglottic region hazy with suggestion of narrowing

Courtesy of Dr. Maryellen Sun
Patient HP – Frontal Film

Subglottic Stenosis

Tracheal Deviation
Normal in infants

Diagnosis?
Croup

Courtesy of Dr. Maryellen Sun
Normal vs Croup

Kandarpa, K. “Normal vs Croup” Boston Children’s Hospital Teaching File Case 5-273

Normal

“shoulder”

Croup

“Steeple” sign
Radiographic Differential Diagnosis

Subglottic Tracheal Narrowing

### Circumferential
- Croup
- Subglottic stenosis
- Paradoxic collapse with other glottic obstruction

### Assymetric
- Subglottic hemangioma
- Posttracheostomy fibrosis
- Intratracheal thyroid
- Subglottic mucocele
- Histiocytoma
- Papilloma
- Intratracheal thymus

Patient JW

- 4 y/o boy presented to ED with 6 day hx of headache and 5 day hx of bilateral swollen and sore neck and fever to 103.6.
- Poor PO intake, trouble turning head, new cough, mild stridor, snoring at night.
- Exam showed bilateral cervical LAD
- WBC 27.04
Patient JW – CT scan

See any hypodense areas that could represent edema or inflammation?

Retro-pharyngeal abscess

Tracheal deviation and compression

Courtesy of Raymond Mak, HMS IV
Plain Film Diagnosis of Retropharyngeal Abscess

Normally there is a “step off” from the hypopharynx to the larynx. This is due to the soft tissue density of the undistended esophagus posterior to the tracheal air column.

In a retropharyngeal abscess there is obliteration of the step off, due to the swelling of the posterior space into the hypopharynx.

Retropharyngeal abscess?

Patient was crying!

Beware the fakeout: Crying, expiration, and swallowing can look like a retropharyngeal soft tissue swelling.

Courtesy of Dr. Maryellen Sun
## Radiographic Differential Diagnosis

<table>
<thead>
<tr>
<th>Retropharyngeal Soft Tissue Thickening</th>
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</thead>
<tbody>
<tr>
<td>Buckling of airway (pseudothickening)</td>
</tr>
<tr>
<td>Inflammation (adenopathy)</td>
</tr>
<tr>
<td>Retropharyngeal abscess</td>
</tr>
<tr>
<td>Common</td>
</tr>
<tr>
<td>Edema with C-spine injury</td>
</tr>
<tr>
<td>Retropharyngeal tumor</td>
</tr>
<tr>
<td>Moderately common</td>
</tr>
<tr>
<td>Noninflammatory adenopathy</td>
</tr>
<tr>
<td>Osteomyelitis of C-spine</td>
</tr>
<tr>
<td>Tumors of C-spine</td>
</tr>
<tr>
<td>Uncommon</td>
</tr>
<tr>
<td>Myxedematous thickening</td>
</tr>
<tr>
<td>Edema with obstructed superior vena cava</td>
</tr>
<tr>
<td>Rare</td>
</tr>
<tr>
<td>Vein of Galen aneurysms</td>
</tr>
<tr>
<td>Enteric cyst</td>
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<tr>
<td>Goiter</td>
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</tbody>
</table>

Patient JF

- 4 y/o boy who had a 1 wk history of URI.
- 1 day prior to admission he had: fever to 105 F, cough, stridor, drooling, and vomiting.
- Let us compare JF’s normal follow up film from next year to JF’s film from today.
Patient JF

Hankins, Carol. Boston Children’s Hospital Teaching File Case 5-272

Diagnosis?
Epiglottitis

Retropharynx

Hypopharynx

Epiglottis and Aryepiglottic Folds

Dilation

Thickening

Normal

Subglottic trachea

C-spine

Normal

Normal lordosis

Straightened, leaning forward

JF next year (normal film)

JF today
Patient S

- 2 ½ year old boy
- 2 week history of URI
- 1 day history of dysphagia and temperature to 104°F.
- He arrives at 6:30 am and neck films are taken.
6:30 am
There is a suggestion of epiglottic thickening and the rest of the film appears normal
11:30 am  
Just 5 hours later…  

Our patient S is now in significant distress, extending his neck in a struggle to breathe.

The epiglottis and aryepiglottic folds are markedly thickened.

The glottic region is hazy and inflamed.

The subglottic trachea and retropharyngeal space appear normal.

Diagnosis?  
Epiglottitis  
He needs immediate intubation!

Hankins, Carol. Boston Children’s Hospital Teaching File Case 5-272
Epiglottitis Fakeouts

Buckling on poor inspiration

“Omega” Epiglottis
Normal variant
Note thin aryepiglottic fold

### Epiglottic and Aryepiglottic Fold Enlargement

<table>
<thead>
<tr>
<th>Condition</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epiglottitis</td>
<td>Common</td>
</tr>
<tr>
<td>Angioneurotic edema</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Corrosive burns</td>
<td></td>
</tr>
<tr>
<td>Face and neck edema</td>
<td></td>
</tr>
<tr>
<td>Tumor</td>
<td></td>
</tr>
<tr>
<td>Aryepiglottic fold cyst</td>
<td>Rare</td>
</tr>
<tr>
<td>Sarcoidosis</td>
<td></td>
</tr>
<tr>
<td>Hemorrhage (hemophilia)</td>
<td></td>
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<tr>
<td>Radiation</td>
<td></td>
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</tbody>
</table>

Patient JO

- 6 year old girl with a 2 day history of fever to 102 F and sore throat
- Physical exam appears normal
- Neck films are obtained
Patient JO – Frontal Film

Subglottic stenosis

Tracheal narrowing

Stram, E. “Boston Children’s Hospital Teaching File Case 6-291”
JO- Lateral Neck Soft Tissue Film

Normal appearing epiglottis; thickening of aryepiglottic fold

Subglottis dense and hazy

Tracheal “Pseudomembrane” – Strand of exudate

Diagnosis?
Bacterial Tracheitis

Stram, E. Boston Children’s Hospital Teaching File Case 6-291
# Summary of Infectious Causes of Stridor

<table>
<thead>
<tr>
<th></th>
<th>Croup</th>
<th>Bacterial Tracheitis</th>
<th>Epiglottitis</th>
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<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Infants to preschool</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prodrome URI</strong></td>
<td>+</td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td><strong>Toxicity</strong></td>
<td>+</td>
<td></td>
<td>+++</td>
</tr>
<tr>
<td><strong>Microbiology</strong></td>
<td>Viral</td>
<td>S. aureus</td>
<td>H. influenza</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C. diphtheria</td>
<td>S. aureus</td>
</tr>
<tr>
<td><strong>Radiographic Findings</strong></td>
<td>“Steeple” on AP = Subglottic narrowing Dilated hypopharynx</td>
<td>Subglottic narrowing Irregular tracheal margin Pseudomembranes</td>
<td>“Thumb sign” = Thickened epiglottic and aryepiglottic folds</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Mist Epinephrine Steroids</td>
<td>Artificial Airway Antibiotics</td>
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Acknowledgments

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- Raymond Mak, HMS
- Shreya Kangovi, HMS
References

- Kandarpa, K. “Normal vs Croup” Boston Children’s Hospital Teaching File Case 5-273.
- Stram, E. “Bacterial Tracheitis.” Boston Children’s Hospital Teaching File Case 6-291.