

DIAGNOSIS AND TREATMENT OF RESPIRATORY CONDITIONS IN CHILDREN WITH NEUROLOGICAL IMPAIRMENT

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Disclosure

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- I do not intend to discuss an unapproved/investigative use of a commercial product/device in this presentation.

Question

Why do children with Neurological Impairment (NI) have frequent respiratory problems?

What are the pathophysiologic mechanisms?

Aspiration

Oropharyngeal
Motor Dysfunction
(from above)

Aspiration of
oral feeds

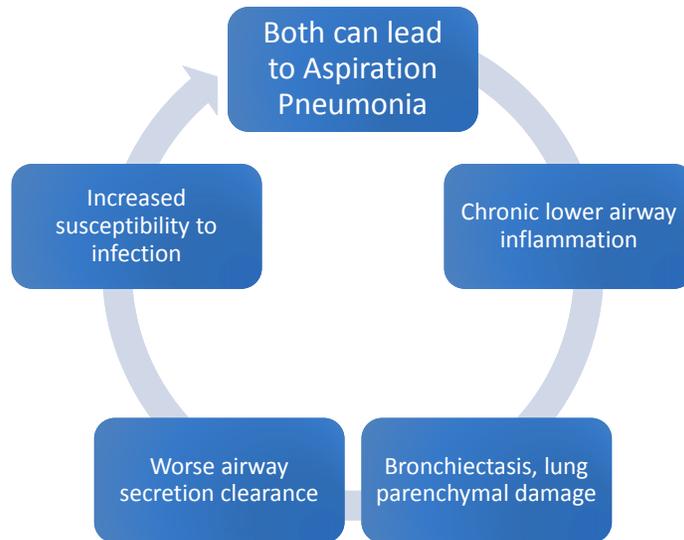
Aspiration of
oral or upper
respiratory
secretions

Gastroesophageal
Reflux
(from below)

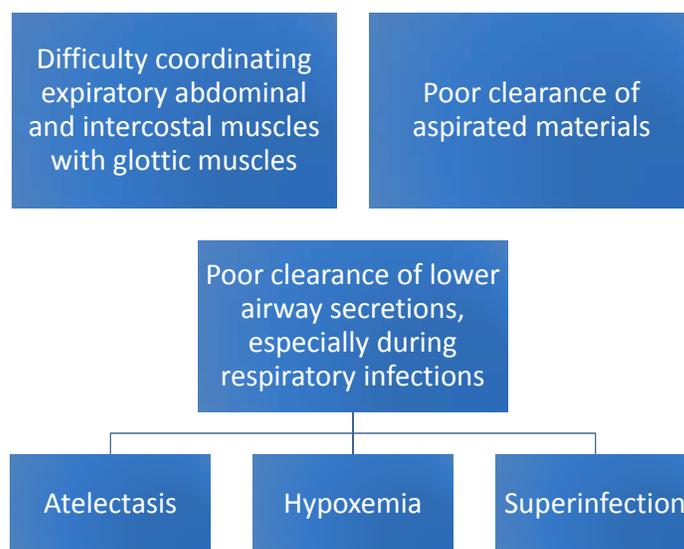
Food
Acidic/Non-
acidic secretions

May cause
apnea, laryngeal
spasm,
inflammation

Aspiration

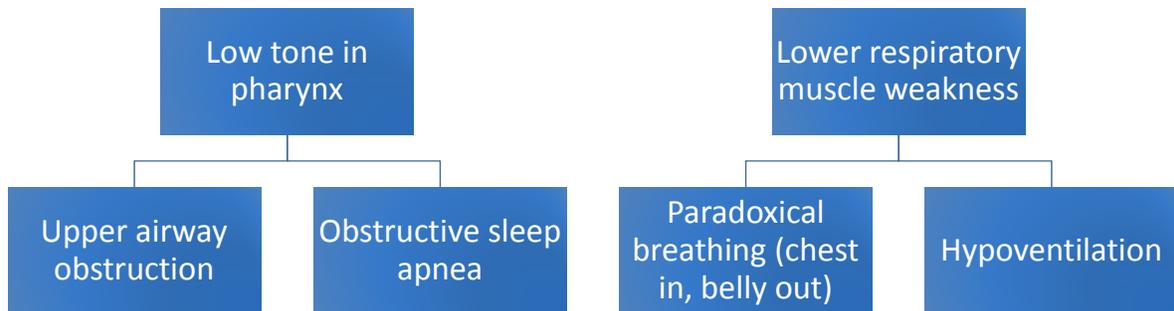


Poor Cough and Airway Clearance



Respiratory Muscle Weakness

Contributes to poor cough and airway clearance



Kyphoscoliosis

Restrictive Lung Disease

V/Q mismatch

- atelectasis on one side
- overexpansion on the other

If occurs early in life, can limit lung growth

Brainstem Control of Breathing

Of particular concern in Chiari malformation and acute hydrocephalus

Central Sleep Apnea

Other factors

Asthma is common in all populations including kids with NI

- Reflux and Aspiration worsens

Some causes of NI also cause respiratory problems

- Prematurity → IVH & BPD

Oromotor dysfunction

- Malnutrition → Respiratory weakness → Increased infections

Autonomic Dysfunction

- Respiratory distress

Tonsil and Adenoid hypertrophy

- Watch for Stertor

Case 1

5-year-old with cerebral palsy, seizure disorder, and G-tube presents with fever, tachypnea, hypoxia, and right sided crackles

- RVP is positive for rhino/entero
- CXR shows a RML infiltrate
- This is the 3rd such episode in the last year
- The patient is noted to have a weak cough

What else would you want to know?

How would you approach this patient's treatment?

Symptoms of Aspiration

Gagging, choking, apnea, stridor, cyanosis during feeding

“Wet breathing” or “rattling” suggests laryngeal penetration

Repeated aspiration can cause recurrent wheezing, hoarseness of voice

Coughing may or may not be present

- Cough reflex blunted in kids with NI, leading to silent aspiration

Aspiration Pneumonia – Risk Factors

Seizure

Anesthesia, or other episode of reduced level of consciousness

Neurologic disease

Dysphagia

Gastroesophageal reflux

Alcohol or substance abuse

Use of a nasogastric tube

Foreign body aspiration

Aspiration Pneumonia

May be caused by anaerobic oral flora

- Anaerobic *streptococci* (eg *Peptostreptococcus*)
- *Fusobacterium* spp
- *Bacteroides* spp
- *Prevotella melaninogenica*

Diagnosis

Swallow Study

CXR

- Early PNA or silent aspiration may be negative
- Infiltrate in dependent lung segments, such as the superior or posterior basal segments of a lower lobe or the posterior segment of an upper lobe

Nuclear Medicine

- Salivagram
- Gastroesophageal scintigraphy

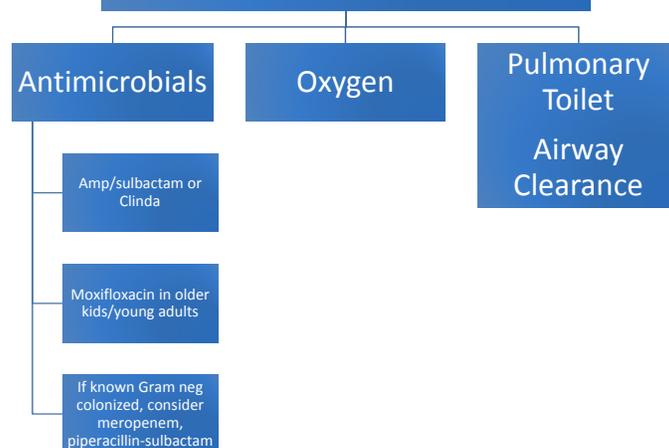
Scopes

- Laryngoscopy, Esophagoscopy, Bronchoscopy
- Bronchial-Alveolar lavage looking for Lipid-laden macrophages

pH/impedance probes

Aspiration Management

Acute Pneumonia



Treatments for Poor Airway Clearance

Chest physiotherapy

- Vibes in younger children

Bronchodilators

Secretion management:
anticholinergics,
suctioning

Vest Therapy

Cough Assist

May be used at baseline and increased during acute exacerbations

Chronic/Preventive Management

Reduction of GE reflux

- Positioning
- H2 blockers, PPI, low dose, pro-motility erythromycin
- Adjustment of enteral feeds
 - Smaller boluses/continuous feeds
 - Jejunal feeds vs. Nissen

Reduction of oral secretions

- Tastes of foods → increased swallowing
- Anticholinergics – glycopyrrolate, scopolamine
- Botox
- Salivary Gland removal
- Laryngo-Tracheal Separation

Case 2

3 year old with Trisomy 21 is admitted for gastroenteritis and dehydration. The patient is noted to have periods of apnea and desaturations during sleep on the monitor. Patient has some noisy breathing that is horse with sleep, but lungs otherwise sound clear. The patient had a normal echo during infancy.

What else would you want to know?

How would you approach this patient's treatment?

Obstructive Sleep Apnea

Risk factors

- Adenoid/tonsillar hypertrophy
- Obesity
- Medical, neurological, or dental conditions that:
 - Reduce upper airway size
 - Affect the neural control of the upper airway
 - Impact the collapsibility of the upper airway

Consequences

- Behavioral problems
- Growth delay
- Pulmonary hypertension, right heart failure

OSA - Diagnosis

Diagnostic criteria from the American Academy of Sleep Medicine (AASM)

Both A and B criteria should be present

A criteria

The presence of one or more of the following clinical symptoms:

Snoring

Labored, paradoxical, or obstructed breathing during the child's sleep

Sleepiness, hyperactivity, behavioral problems, or learning problems

B criteria

The polysomnogram (PSG) demonstrates one or both of the following:

One or more obstructive apneas, mixed apneas, or hypopneas, per hour of sleep. These respiratory events are defined according to the AASM Manual for the Scoring of Sleep and Associated Events.

A pattern of obstructive hypoventilation, defined as at least 25 percent of total sleep time with hypercapnia ($\text{PaCO}_2 > 50 \text{ mmHg}$) in association with one or more of the following: snoring, flattening of the nasal pressure waveform, or paradoxical thoracoabdominal motion

Management Options

Surgical reduction of airway obstruction

- Tonsillectomy,
- Adenoidectomy
- Other airway surgeries

Supplemental O₂

Noninvasive Ventilation

- CPAP
- BiPAP

Tracheostomy +/- ventilation

Children with NI may have intrinsic lung diseases and/or central sleep apnea, too, influencing management

Case 3

A 2-year-old ex-24-week infant with mild CP, BPD, and tracheostomy presents with increased secretions from the trach.

- Patient is afebrile, and desaturating during sleep to the low 80s
- Chest X-ray has baseline chronic changes, but no acute changes

What else would you want to know?

How would you approach this patient's treatment?

Artificial Airway-Associated Tracheobronchitis Pathogens

Staphylococcus aureus

Streptococcus pneumoniae

Haemophilus influenzae

Moraxella catarrhalis

Acinetobacter species

Pseudomonas aeruginosa

Klebsiella pneumoniae

Escherichia coli

Serratia marcescens

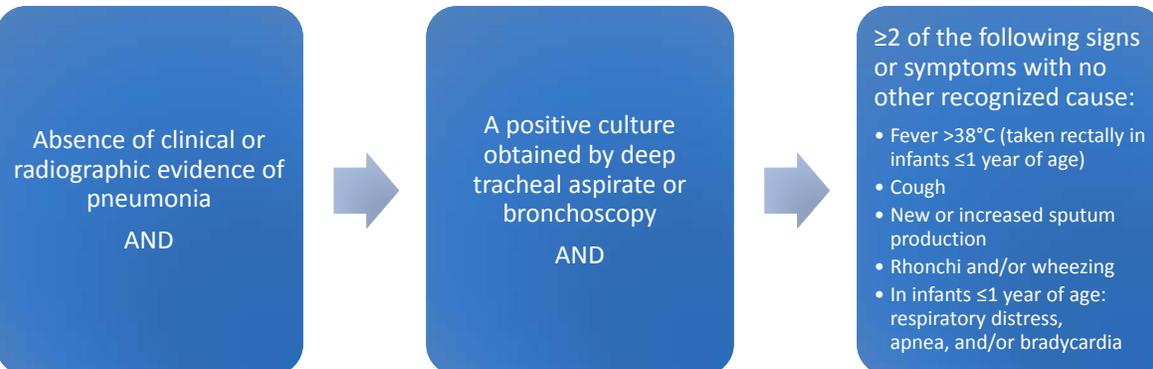
Enterobacter species

Stenotrophomonas maltophilia

Other gram-negative enteric organisms

Diagnosis

Centers for Disease Control and Prevention (CDC)/National Healthcare Safety Network (NHSN) surveillance definition



Management

To choose antibiotic, consider

- The severity of illness
- Gram stain of the tracheal aspirate
- Susceptibilities of pathogens previously identified in the patient (most useful if recent)
- Likelihood of having multidrug-resistant flora (children with recent hospitalizations or residing in long-term care facilities)

Other Key Points

Be careful about using anticholinergics during acute infections, which can thicken secretions and increase plugging

Change trach
Plugs can be hiding in them

Pulmonary Toilet regimen may need to be increased

Home vs. hospital depends on both disease severity and home care capabilities

Some Take-Home Messages

NI increases risk for respiratory disease from a variety of mechanisms

Aspiration in children with NI can come from both above and below, cause both acute and insidious disease

Don't forget about airway clearance regimen both acutely and chronically

Children with NI are at higher risk for OSA and needing more invasive treatments for OSA

Trach cultures should not be treated in a vacuum

Resources

P C Seddon, Y Khan. Respiratory problems in children with neurological impairment. Arch Dis Child 2003;88:75-78 doi:10.1136/adc.88.1.75
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1719284/pdf/v088p00075.pdf>
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Fiona Healy, Howard B Panitch. Pulmonary Complications of Pediatric Neurological Diseases. Pediatric Annals 2010;39/4:216-224. DOI: 10.3928/00904481-20100318-06

UptoDate articles on Aspiration, Obstructive Sleep Apnea, and Tracheitis are well-done