Approach to Stridor in a Neonate

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Introduction-

- Stridor is an abnormal, high-pitched sound produced by turbulent airflow through a partially obstructed airway at the level of the supraglottis, glottis, subglottis, or trachea.
- Stertor is a flapping or snoring sound generated by redundant soft tissue or secretions in the nasal passages, nasopharynx, oral cavity, or oropharynx.

Table. 1. Definitions of respiratory sounds-

Stridor	Musical, high pitch sound produced by rapid, turbulent flow of air through a narrowed segment of the large airways (Supraglottic region, larynx, subglottic region & trachea). Often inspiratory Almost always heard with stethoscope
Stertor/Snoring	Low pitch inspiratory noise caused by nasal or nasopharyngeal obstruction
Wheezing	Expiratory sound produced turbulent airflow through constricted small airways

Stridor is a symptom, not a diagnosis or a disease, and the underlying cause must be determined. Stridor results from partial obstruction of an airway with turbulent flow characteristics. The obstruction can be fixed or variable.

Types of stridor based on the anatomy of of obstruction and its timing in respiratory cycle:

- **Inspiratory stridor-**
- Variable extrathoracic obstructions are primarily associated with inspiratory stridor.
- This is because, during inspiration, extrathoracic intraluminal airway pressure is negative relative to atmospheric pressure, leading to collapse of supraglottic structures.
- **Expiratory stridor-**
- During expiration, intrathoracic pressure is positive and tends to collapse the airway. Thus, stridor caused by intrathoracic obstructions tends to be more prominent upon expiration.
- **Biphasic stridor-**
- Stridor heard during both phases of respiration is usually due to either a fixed airway obstruction or to 2 areas of obstruction (ie, intrathoracic and extrathoracic).

Approach to a neonate with stridor:

History-

- The most common presentation for congenital stridor is chronic noisy breathing since birth. Most patients come to attention by the first 4-6 weeks as the baby gains strength and airflow velocity increases during that time.
- Characteristics of stridor that should be elicited include the following:
  - Association with position
  - Association with feeding
  - Persistent versus intermittent
  - Abnormal phonation
  - Presence of other congenital abnormalities

<u>Perinatal history-</u>

- Type of delivery (including shoulder dystocia),
- Endotracheal intubationand duration, and
- Presence of congenital anomalies.

- Surgical history-neck or cardiothoracic procedures, puts the recurrent laryngeal nerve at risk for injury.

Time of initial onset-

- In most cases, stridor in a newborn will be due to a congenital anomaly and therefore presents ***at birth*** (Table. 1).
- Even laryngomalacia, which may be reported as manifesting in the ***first week or 2 after birth***, is usually present to some degree soon after delivery.
- In rare cases, masses or vascular compression of the airway, brainstem abnormalities, or perinatal iatrogenic injury to the recurrent laryngeal nerve may result in stridor in the newborn that ***presents postnatally***.
    - Examples include masses within the airway, mediastinal masses, vascular compression of the trachea, Chiari malformation, and recurrent nerve injury during congenital heart surgery or ligation of a patent ductus.

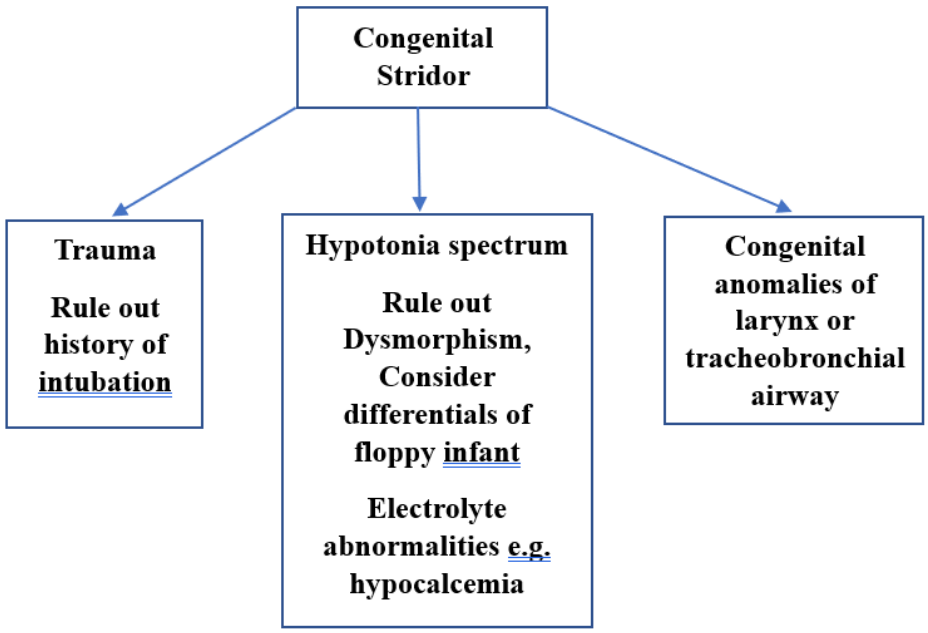

Fig. 1. Differential diagnosis of congenital stridor

Progression of the stridor-

- **Progressively increasing stridor**- evolving pathologic condition, such as compression from growing mass (most commonly subglottic infantile hemangiomasor

cysts), progressive stenosis following endolaryngeal or endotracheal injury, or increasing vascular compression of the airway.

- **Improving stridor** - likely due to inflammation, or to laryngomalacia that is spontaneously resolving.

Changes with position (prone vs supine) or state (sleep vs awake)-

- **Stridor changing with position** : Increasing stridor in supine position – Likely laryngomalacia or supraglottic pathologic condition.
- **Stridor worsens on awakening** – Likely due to dynamic disorders e.g. laryngomalacia, tracheomalacia.

Changes in voice-

- Dysphonia, manifested as a hoarse cry, is associated almost exclusively with glottic pathologic conditions, such as vocal fold paralysis or laryngeal web.

Cough:

- Common with lesions that narrow the subglottis or trachea.
- *Cough with feeding* is often suggestive of abnormalities of vocal fold mobility or dyscoordination between swallowing and breathing as is seen in laryngomalacia, but may also suggest a cleft of the larynx or tracheoesophageal fistula.
- Gastroesophageal reflux has been implicated as both a cause and a sequela of airway pathologic condition and is commonly associated with laryngomalacia.

The presence of sternal retractions, progression, feeding difficulty or failure to thrive, and/or acute life-threatening episodes often suggests a need for further intervention. Birth history, intubation history, medical and surgical history, and family history are also helpful in determining possible causes.

Physical examination-

Should focus on-

- Characteristics of the patient's stridor
  Effect of position
  Effect of feeding
  Inspiratory versus expiratory

Pitch and loudness

- Respiratory examination

  Lower respiratory tract sounds (eg, wheezes, crackles)

  Retractions

  Quality of voice or crying

- Other physical findings

  Dysmorphism, skin lesions (eg, hemangiomas)&neurologic examination

Summarising clinical approach of a neonate with stridor:

- A complete neonatal examination - may provide important additional information regarding possible cause of the stridor.
- Assessment of the child's growth will provide further information about the child's overall functioning and ability to balance feeding with respiratory effort and caloric consumption.
- On initial evaluation, pulse oximetry may be useful to determine the extent and severity of the stridor and respiratory compromise.
- For moderate-to-severe cases, arterial blood gas evaluation may be needed. Generally, no investigations are required for mild stridor.

Table. 2. SPECSR Algorithm for evaluation of stridor-

S	Severity	Retractions, respiratory efforts
P	Progression	Changes in quality & severity over time
E	Eating difficulties	Prolonged feeding time, aspiration, failure to thrive, gastroesophageal reflux
C	Cyanosis or apneic events	Acute life threatening episodes
S	Sleep disturbances	Changes in stridor during sleep, note position during sleep
R	Radiology	Specific radiologic abnormalities

Table. 3. Causes based on anatomic localisation

Anatomic subsite	Pathologic condition	Notes
Supraglottic larynx	Laryngomalacia	Most common cause Mild cases self-limiting & don't require surgical consultation

	Vallecular cysts Saccular cysts Masses	 Lymphatic malformations common
Glottic Larynx	Webs Clefts Vocal folds immobility	Hoarseness & stridor Stridor present only when associated significant redundancy of mucosa May be associated with Chiari malformations
Subglottic larynx	Subglottic stenosis or cysts Masses	Congenital or Acquired (prolonged intubation) Hemangiomas- usually present at 3-4 months of age
Trachea	Tracheomalacia Primary Secondary Stenosis	Because of abnormal ratio of membranous to cartilaginous tracheal wall Extrinsic compression from vascular anomalies (anomalous innominate, double aortic arch, pulmonary sling) Collapse due to presence of tracheoesophageal fistula Congenital complete cartilaginous tracheal rings Intubation injury

Imaging –

Imaging is rarely necessary in the assessment of newborn stridor, with the exception of those cases in which intrathoracic pathologic condition is suspected.

- ***Chest radiography***may be helpful in diagnosing a vascular ring if a right-sided aortic arch is observed in patients with congenital stridor.
- ***Barium esophagraphy***can be helpful in diagnosing vascular rings if an indentation in the esophagus is present. The pattern of indentation may also be helpful in indicating what type of vascular anomaly may be present. However, the lesion of anomalous innominate artery does not yield abnormal findings on esophagraphy.
- ***Computed tomography (CT)***scans with contrast can be used in the assessment of suspected masses of the airway, neck, or mediastinum, and CT angiography is diagnostic in cases of vascular compression of the airway.
- ***MRI***is particularly helpful in the assessment of vascular anomalies, or if there is concern for Chiari malformation in the case of bilateral vocal fold paralysis.
- ***Laryngeal ultrasound (LUS)***can demonstrate arytenoid adduction during inspiration to provisionally diagnose laryngomalacia. [9]

Other Tests-

- ***A multichannel sleep study***that measures airflow, chest wall excursion, oxygen saturation, and heart rate can provide useful information about the severity of obstruction.
- ***ABG***can reveal the presence of carbon dioxide retention or chronic hypoxemia.
- For gastroesophageal reflux (GER), ***24-hour mid esophageal pH monitoring***may be helpful in establishing the diagnosis.

Endoscopic Assessment –

Fiberoptic laryngoscopy and bronchoscopy are valuable diagnostic tools for the evaluation of congenital stridor, offer several important advantages:

- Lesions can be directly visualized. Evidence of inflammation or bleeding can be observed. Characteristics of the lesion, such as vascularity, can be determined.
- Biopsies and bronchoalveolar lavage samples can be taken if necessary.
- The examination is conducted while the patient is actively breathing, allowing assessment of dynamic events.

  Fiberoptic direct laryngoscopy can be performed in the office.

Summary:

- Based upon history and clinical examination, a differential diagnosis of the most likely causes of stridor can be made.
- In most instances, the patient must be referred to an ENT surgeon for a flexible upper airway endoscopy and direct laryngoscopy during anesthesia.
- Laryngomalacia is the most common cause of congenital stridor and has a spontaneous resolution without need for intervention in about 80% of the patients.

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