Approach to a Term Newborn with Respiratory distress

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Introduction

Respiratory distress occurs among 4-7% of all neonates and is the reason for 30-40% of admissions in the NICU. It is more common among preterm (30%) and post term (21%) than among term neonates (4.2%).

Respiratory distress is defined by presence of at least 2 of the following three features-

- Tachypnea (respiratory rate >60 per minute),
- Retractions (intercostal, subcostal, sternal or suprasternal) and
- Noisy respiration (grunt, stridor or wheeze).

The distress may or may not be associated with cyanosis or desaturation on pulse oximetry.

Etiology-

Among term inborn neonates born at various hospitals under the NNPD network, respiratory distress was noted in 4.4% of all live births and the etiologies were: TTN (46.7%), meconium aspiration syndrome (MAS, 29%), RDS (3.7%), pneumothorax (3.4%) and pneumonia (2.1%).

Table 1 Differential diagnosis of respiratory distress in term-born infants.

Common Causes	Less Common Causes	Rare Causes
Transient tachypnoea of Newborn	Pulmonary Hemorrhage	Surfactant Protein Deficiency
Respiratory distress syndrome	Pleural Effusion (Chylothorax)	Alveolar Capillary Dysplasia
Meconium Aspiration syndrome	Neuromuscular disorders (e.g., Congenital myotonic dystrophy)	Chest wall deformity
Pneumonia	Metabolic disorders (Hypoglycemia,IEM)	Skeletal dysplasia
Pneumothorax		**Other causes**
Persistent Pulmonary Hypertension (PPHN)	Congenital or Surgical conditions-	Sepsis
Cardiac Failure due to CHD	Diaphragmatic Hernia	Hypo/Hyperthermia
Hypoxic Ischemic Encephalopathy	Tracheo-esophageal Fistula	Anaemia
Aspiration of milk or blood	Choanal Atresia	Polycythemia
	Cystic congenital adenomatoid malformations	Drug withdrawal
	Lobar Emphysema	Hydrops Fetalis
	Pulmonary Sequestration	
	Pulmonary Hypoplasia	
	Laryngotraceomalacia	
	Vocal cord paralysis	

Initial assessment –

- Rule out life threatening conditionssuch as inadequate respiratory efforts or obstructed airway (gasping, choking, stridor) or circulatory collapse (bradycardia, hypotension, poor perfusion).
- Assess the need for oxygen administration, bag and mask ventilation or intubation should be carried out as necessary.

Table 2. Danger signals in newborn with respiratory distress-

Obstructive airway- Gasping Choaking Stridor
Insufficient breathing- Apnea Poor respiratory effort
Circulatory collapse- Bradycardia Hypotension Poor perfusion
Poor oxygenation- Cyanosis

History-

Detailed maternal history –

Table 3 – Important maternal history and risk in the newborn

Maternal history	Probable risks in the newborn
Diabetes	TTNB, RDS, Hypoglycemia
PIH	IUGR, Polycythemia, Hypoglycemia
Fever, UTI	Sepsis
Asthma	TTNB
Polyhydramnios	GI obstruction, Neuromuscular disorders
Oligohydramnios	Pulmonary Hypoplasia
Rh iso immunization	Anemia, Hydrops fetalis
Antenatal steroid status	Risk of RDS
Meconium stained amniotic fluid	Meconium aspiration syndrome
Chorioamnionitis	Congenital pneumonia
Fetal distress	Asphyxia

Table. 4. Probable etiologies related to symptom onset and relation to feeds-

Onset at birth	TTNB, RDS, Pneumothorax, MAS, Congenital malformations
Onset hours or days after birth	CHD, Sepsis
History of coughing and choking during feeding	Both functional aspiration and structural (eg, tracheoesophageal fistula, cleft palate) should be considered.
History of coughing and choking following feeding	gastroesophageal reflux with aspiration should be suspected.

Probable etiology based on the course of the disease-

- Gradual improvement- TTNB
- Gradual deterioration- Pneumonia
- Sudden deterioration- Air leak

General Examination-

- Examine for dysmorphism, cranio facial anomalies, stigmatas of congenital infections, pooling of secretions (TEF).
- Pallor, Icterus, Clubbing, Lymphadenopathy, Edema.

Assessment of respiratory distress-

Inspection:

- Infants who exhibit apnea, poor respiratory effort, marked retractions, cyanosis, or poor perfusion require urgent attention.
- Inspiratory stridor- Upper airway obstruction.

  Subglottic stenosis (h/o endotracheal intubation)
- Asymmetric chest movement with severe distress- sign for tension pneumothorax.
- Scaphoid abdomen- congenital diaphragmatic hernia.
- Rounded chest with increased A-P diameter- Hyperinflation
- Cyanosis- Do pulse oximetry

Signs of respiratory distress-

- Tachypnea- deep sighing kussmaul breathing- metabolic acidosis
- Apnea or gasping- severe respiratory failure, encephalopathy
- Nasal flaring- to reduce upper airway resistance
- Grunting-
    - Expiratory noise due to partial closure of glottis during expiration to maintain functional residual capacity by increasing positive end-expiratory pressure (PEEP).
    - Disappearing grunt usually means improvement but at times it may be an ominous sign of severe respiratory disease and must be assessed along with other parameters like pulse oximetry.
- Retractions- Intercostal- parenchymal lung disease

  Suprasternal- upper airway obstruction
- Stridor- Inspiratory/expiratory/biphasic. Laryngomalacia, Pierre Robin sequence, Subglottic narrowing due to edema or stenosis, vocal cord palsy.
- Wheezing- BPD, Pulmonary edema, bronchopulmonary malformation or foreign body in case of asymmetric wheezing

Palpation and percussion: are done sparingly in neonates,

Palpation-

Feel the tracheal position,
Locate the apex beat,
Palpating for crepitus or murmurs

Percussion-

Dullnessover areas of consolidation or collapse. Stony dullness over pleural effusion and hyper-resonance over pneumothorax.

Auscultation-

- Assess whether breath sounds are equal on both sides, listen for presence of crepitations, wheeze or stridor.

- Transillumination test- in a neonate with suspected tension pneumothorax, it would be wise to do a trans-illumination of thorax and proceed with treatment rather than wait for a chest x ray.

CVS Examination-

- CVS examination is a must in cases of respiratory distress.
- Cardiac diseases usually manifest with tachypnea but less signs of respiratory distress like retractions.
- Assess for poor perfusion, cyanosis. Auscultation may reveal abnormal heart sounds or murmur.
- Monitor pulse rate, capillary refill & blood pressure.

Pulse oximetry-

- Oxygen saturation monitoring is an important tool in the management of neonates with respiratory distress. Oxygen saturation below 90% indicates hypoxia. Difference of more than 5-10% saturation between preductal (Right upper limb) and lower limb indicates possibility of persistent pulmonary hypertension (PPHN).

Other systems-

- Abdomen: Contour (Scaphoid, distended)
- Palpate liver and spleen (hyperinflation, CCF, IEM)
- Miscellaneous: Fontanel, sutures separation (IVH)
- Skin - color (pallor, plethora), mottling, meconium staining
- CNS-tone, pupils, alertnes

Respiratory distress scoring-Table 5.Downe's score is used for assessing severity of respiratory distress in term neonates.

Parameter	0	1	2
Respiratory rate (/min)	<60	60-80	>80 or apnea
Cyanosis	Absent	In room air	In 40% oxygen
Grunt	Absent	Audible with stethoscope	Audible with naked ear
Retractions	Absent	Mild	Moderate to severe

Air entry	Good	Diminish	Barely audible

Mild- <5, Moderate- 5-7, Severe- >7

Serial scoring helps in understanding the progression of the disease & to initiate treatment.

Investigations-

1) Arterial blood gas (ABG) analysis: (1,2)
   Normal & abnormal values:
   PaO2 : Pre-ductal PaO2 50–70 mmHg with an O2 saturation of 87-93%. PaO2 up to 80 mmHg is acceptable in term infants
   Hypoxemia- PaO2 < 50 mmHg
   Hyperoxemia: PaO2 >80 mmHg in preterm and >90 in term.
   PaCO2 : Normal PaCO2 is 35-45 mmHg
   Acceptable upper limit:
   Acute stage – 45-50mmHg,
   Chronic (>72 hours of ventilation) – 55mmHg (with pH of >7.2)
   Respiratory failure is present when there is hypoxemia (PaO2< 50), hypercarbia (PaCO2>60) in the presence of falling pH <7.20. Hypoxemia may result from both cardiac and respiratory causes. Hypercarbia is a better indicator of respiratory failure.

Assessment of gas exchange-

Though the blood gas parameters indicate oxygenation and ventilation at a single point of time, these parameters alone would not be sufficient to evaluate gas exchange. Interpretation of PaO2 without FiO2 is misleading. Hence the gas exchange should be assessed using various parameters like

1) Alveolar-arterial Oxygen gradient (A-aDO2)
2) a/A ratio
3) Oxygenation Index (OI).

Calculation and interpretation:

A) A-aDO2 (alveolar arterial oxygen diffusion gradient):

This is to be calculated as shown below.

A-a DO2 = PAO2 – PaO2 (PAlveolar – Parterial oxygen)

= [PiO2 – PACO2] – PaO2

=[(PB -PW) × FiO2 – PaCO2] – PaO2

= [(760-47) × FiO2 – PaCO2] – PaO2

[PiO2= Partial inspired oxygen pressure PB = Baromatric pressure, PW = water vapor pressure, FiO2 = Fractional inspired oxygen concentration]

Normally it ranges between 5-15, if breathing room air.

A-aDO2 is considered to be abnormal if more than 40.

B) a /A ratio: Ratio of PaO2 to PAO2 .A better indicator of gas exchange as the ratio is usually not affected by changes in FiO2 Interpretation:

a) Greater than 0.8: Normal

b) Less than 0.6: indicates need for O2 therapy

c) Less than 0.15: severe hypoxemia

C) **Oxygenation Index (OI):**

OI = (MAP × FiO2) / PaO2

Interpretation:

a) OI 25 – 40: severe respiratory failure; mortality risk is 50 – 60%

b) OI > 40: Mortality risk is >80%

4) X ray Chest-

Most important diagnostic tool in respiratory distress. X ray chest findings in some common disorders causing respiratory distress in term neonates are tabulated below-

Table 6.Characteristic X ray findings in various neonatal respiratory conditions

Neonatal respiratory condition	Characteristic X ray findings
TTNB	Normal/hyperinflation Prominent minor interlobar fissure Mild cardiomegaly Prominent hilar & pulmonary vascular markings
MAS	Generalised/localised hyperinflation Areas of patchy atelectasis
Congenital pneumonia	Low to normal volume lungs Patchy atelectasis
PPHN	Pulmonary oligemia

	Features of underlying lung disease
RDS	Low lung volumes, reticulo-granular pattern, air bronchogram, ground glass opacities, white out lungs

5) Point of care Lung Ultrasound:

To evaluate pleural and pericardial effusions ,
To detect pneumothorax,
For evaluation of mediastinal and thoracic masses,
To assess the position and movement of diaphragm as in eventration and diaphragmatic palsy, and
To confirm the position of intravascular catheters.

6) Gastric aspirate for polymorphs- The gastric fluid should be aspirated preferably within one hour after birth and mixed with one drop of heparin. A drop of this is placed on a glass slide and a thick smear is made and stained with Leishman's stain. More than 5 polymorphonuclear leucocytes/HPF is suggestive of infected amniotic fluid or chorioamniotis. The test is not useful if the aspirate is contaminated with blood or meconium.

7) Other investigations:
Sepsis screen and blood cultures are indicated when infection is suspected.
Blood sugars and electrolytes should be monitored.
Cranial USG to diagnose IVH.Echocardiography should be done to rule out congenital heart disease and to evaluate PPHN.

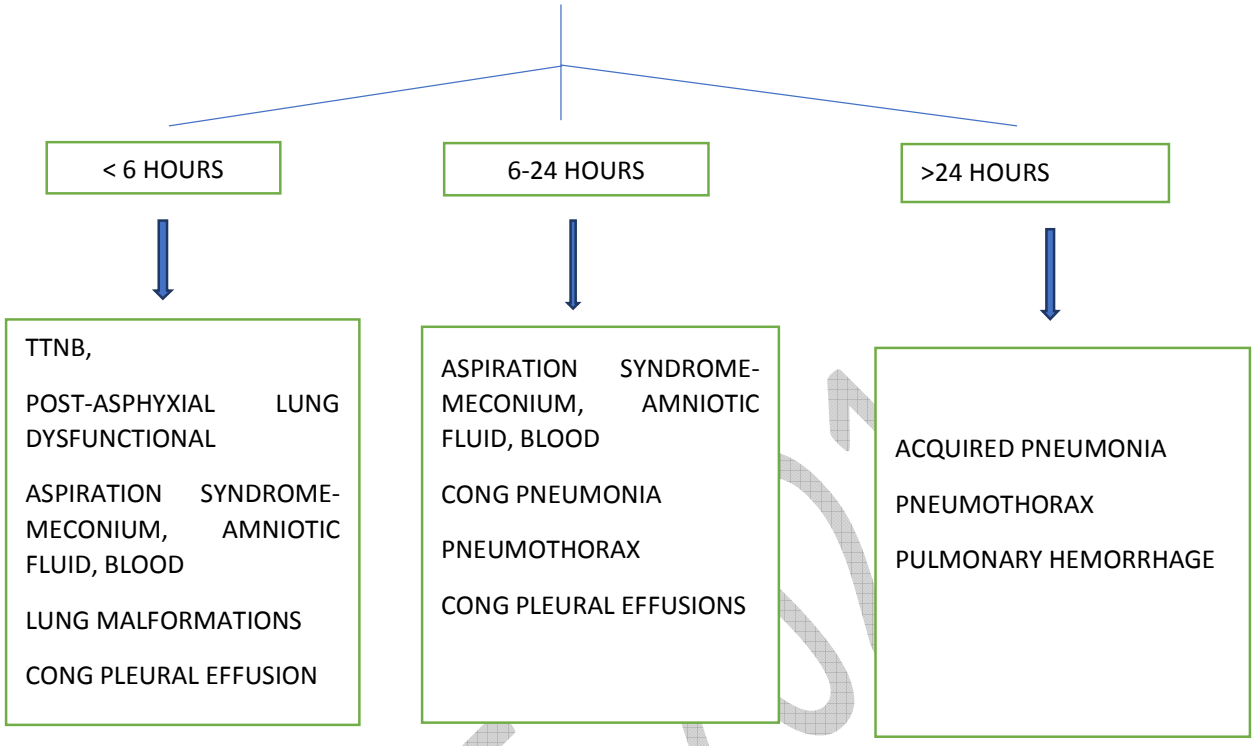

Fig. 1 Summary of causes based on the time of onset of respiratory distress

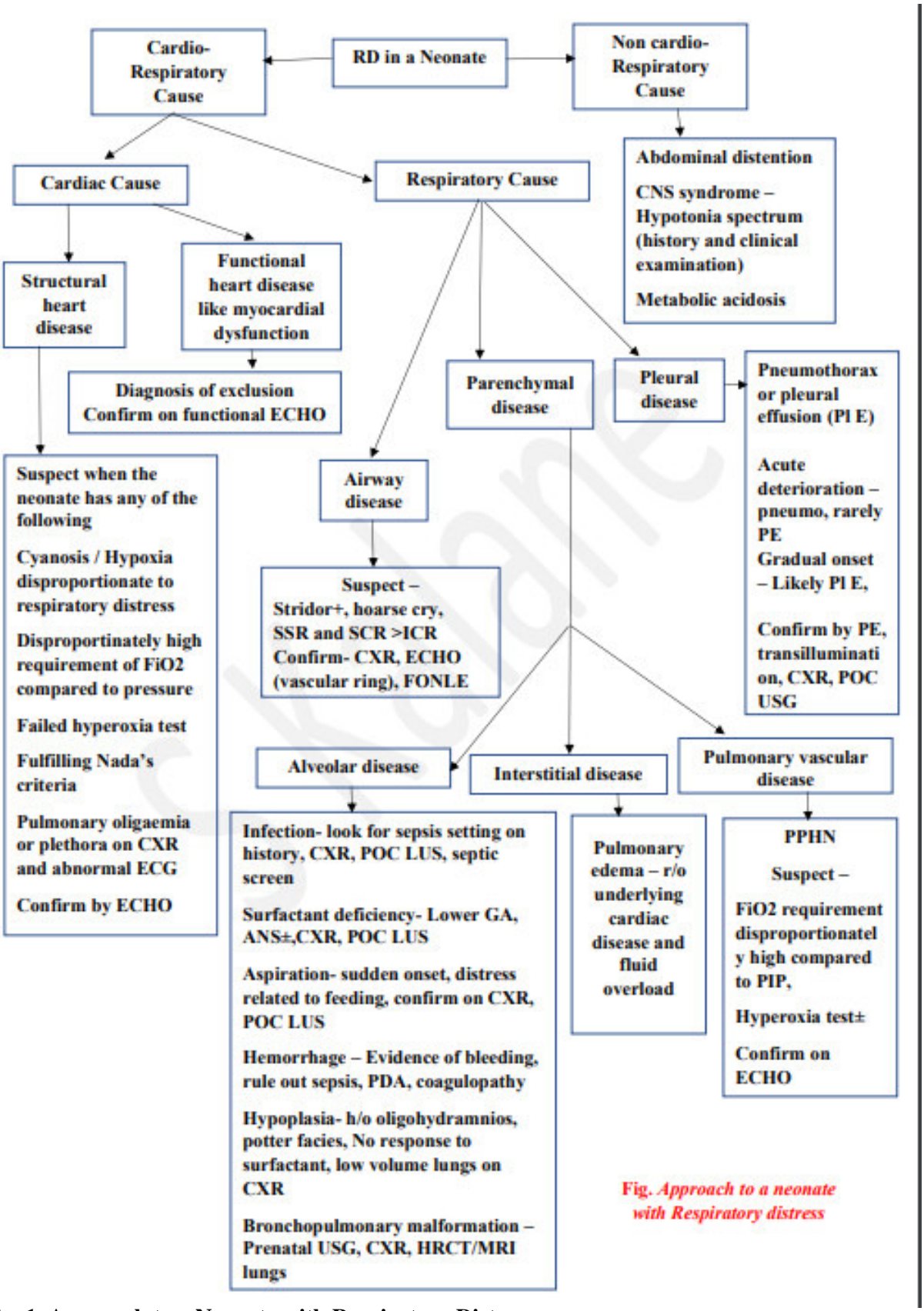

Fig. 1. Approach to a Neonate with Respiratory Distress

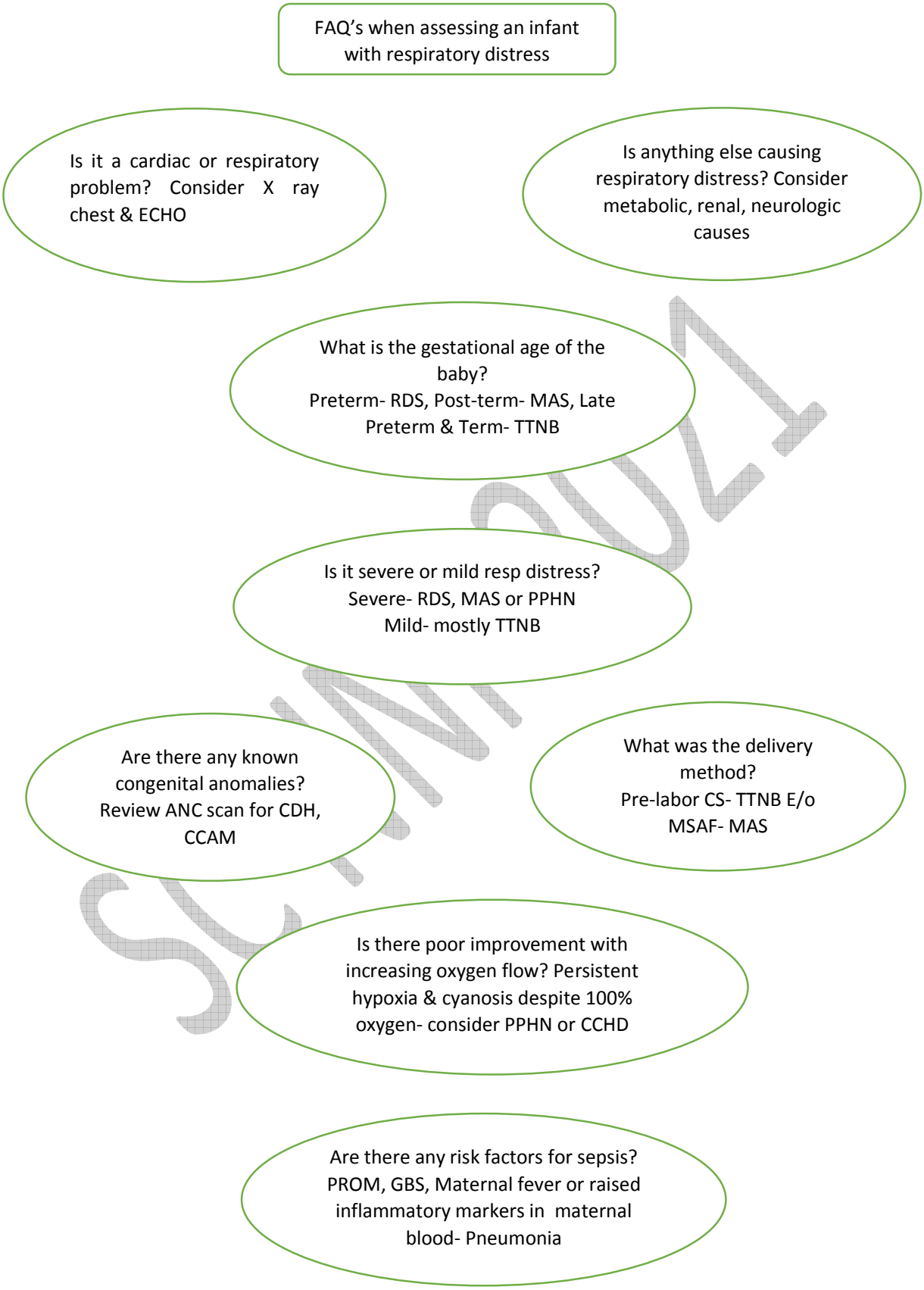

Fig. 2 Approach for diagnosis of respiratory distress in termnewborn

Table 7. Differentiation of Cyanotic heart disease from Pulmonary disease in Term newborn with respiratory distress

Criteria	Cyanotic heart disease	Pulmonary disease
History	Previous sibling with CHD Diagnosis if CHD by prenatal USG	Maternal fever Meconium-stained amniotic fluid Preterm delivery
Physical findings	Cyanosis Gallop Single second heart sound Large liver Mild respiratory distress	Cyanosis Severe retractions Split second heart sound Fever
Chest radiograph	Increased heart size Decreased pulmonary vascularity (except TGA &TAPVC)	Normal heart size Abnormal pulmonary parenchyma- 1- Total whiteout or patches of consolidation in pneumonia 2- Fluid in the fissure in TTN 3- Ground glass appearance in HMD
Arterial blood gases	Normal or decreased Pco2 Decreased pO2	Increased Pco2 Decreased Po2
Hyperoxygenation test	PaO2 < 150 mm Hg	PaO2 > 150 mm Hg (except PPHN)
Echocardiography	Abnormal heart or vessel	Normal heart or vessels

Summary

- Respiratory distress could be a clinical presentation of both pulmonary and non-pulmonary causes.
- Respiratory distress presents with varying degrees of tachypnea, grunting, chest retractions, nasal flaring, and/or cyanosis.
- Initial stabilization is utmost important.
- Probable diagnosis can be made by history taking and physical examination, which can be supported by doing appropriate investigations like chest radiograph, a blood gas and bedside POC LUS.
- A systematic approach is mandatory to confirm the diagnosis of respiratory distress.

Suggested reading:

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5. Respiratory Disorders in the Newborn: Identification and Diagnosis-Hany Aly Pediatrics in Review 2004;25;201,DOI: 10.1542/pir.25-6-201
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