

# Air Leak Syndrome in Infant on Mechanical Ventilation

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Radiology 3030

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# Clinical History

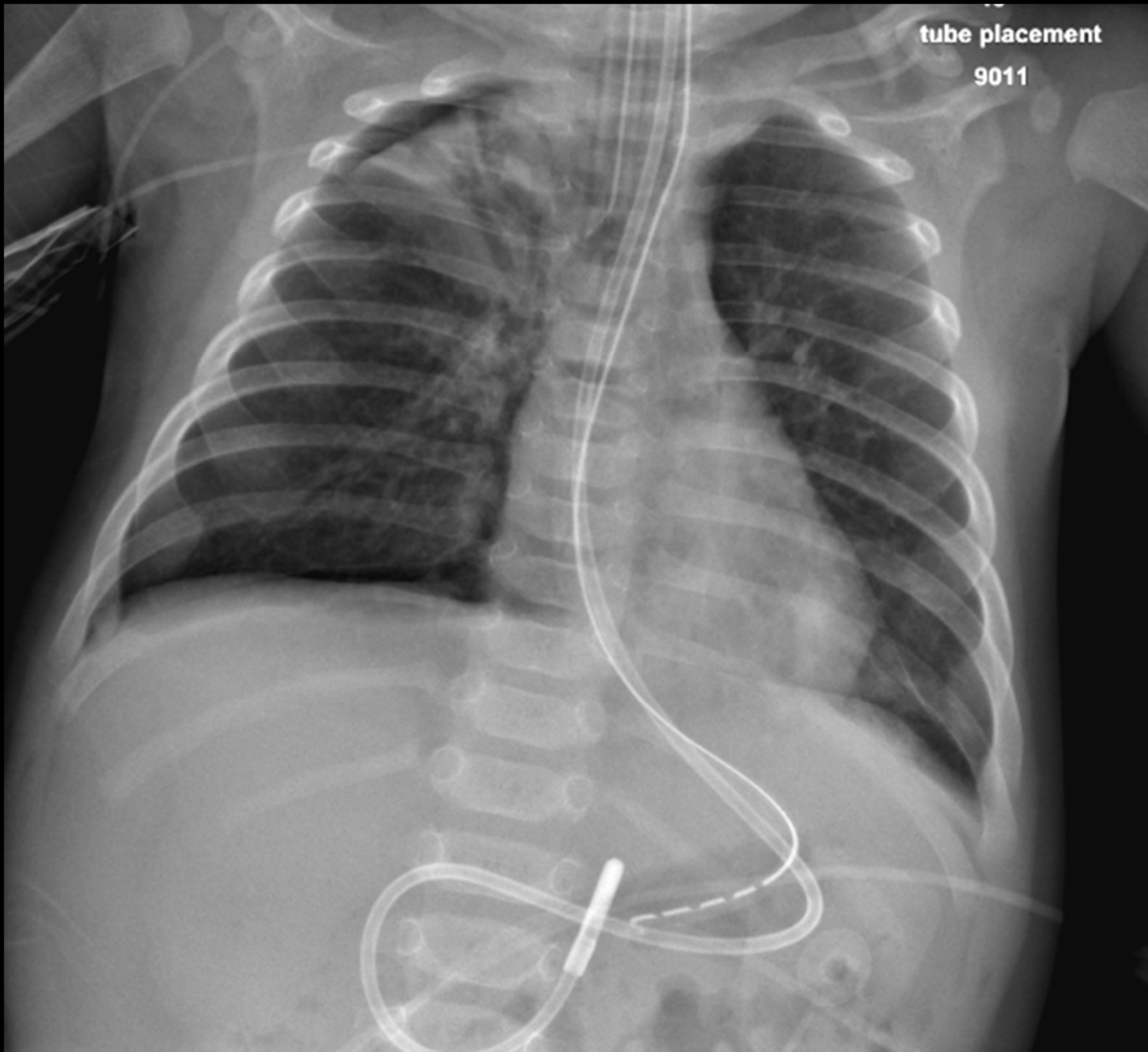
4 month old former 34 weeker who presents after one day of fever, cough, and increased work of breathing.

## Physical Exam Findings:

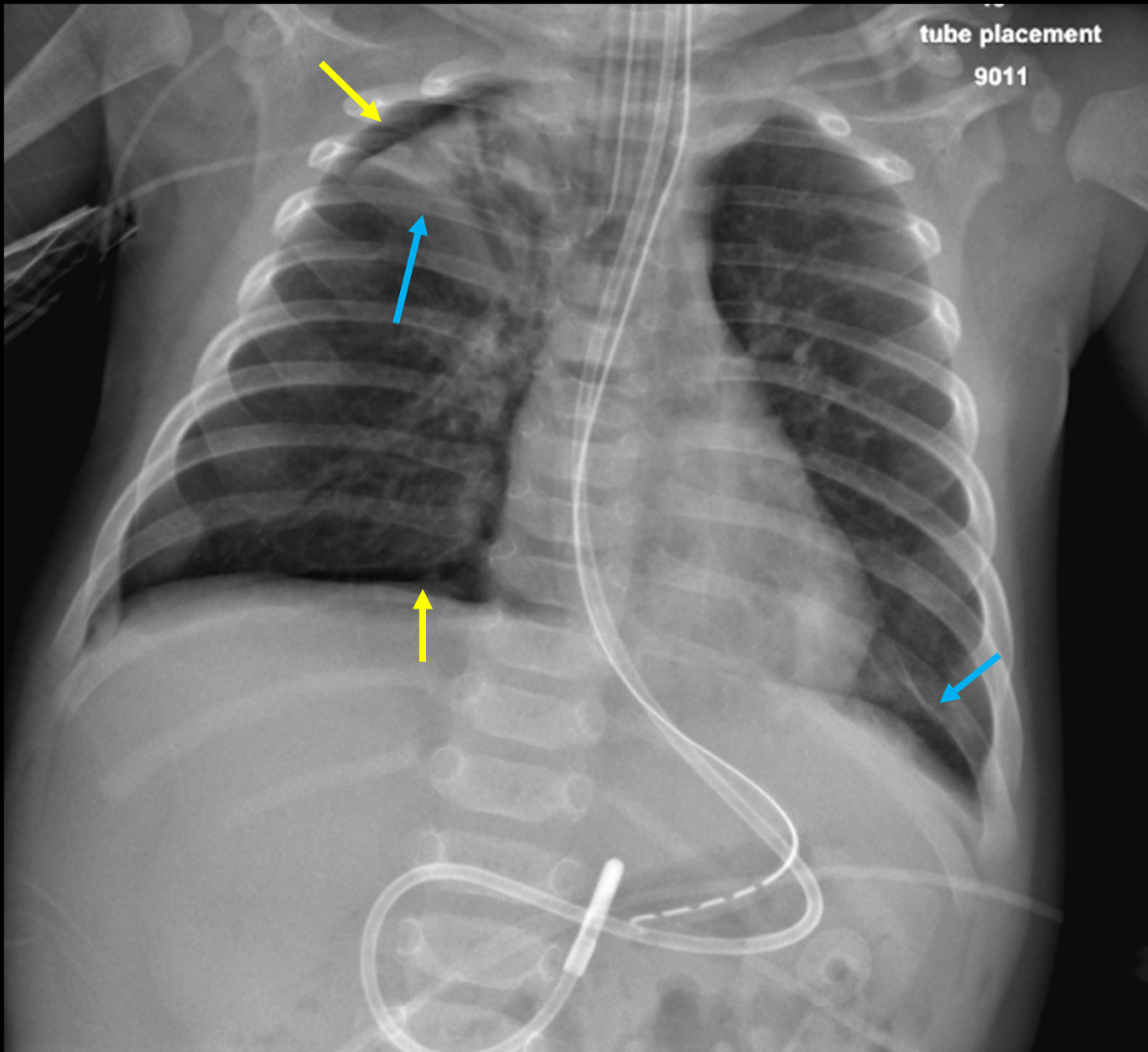
- Tmax 100.4 F, HR 159, RR: 71, BP: 113/69
- Subcostal and substernal retractions, diffuse crackles

## Initial Work Up:

- Tested positive for RSV at OSH
- Blood gas: pH 7.53 / CO<sub>2</sub> 29 / HCO<sub>3</sub> 24
- CBC – WBC 7.7 / BMP within normal limits
- CXR – lungs unremarkable with no consolidation. No acute cardiopulmonary findings.



**Day 10 11:09 PM: CXR AP infant**

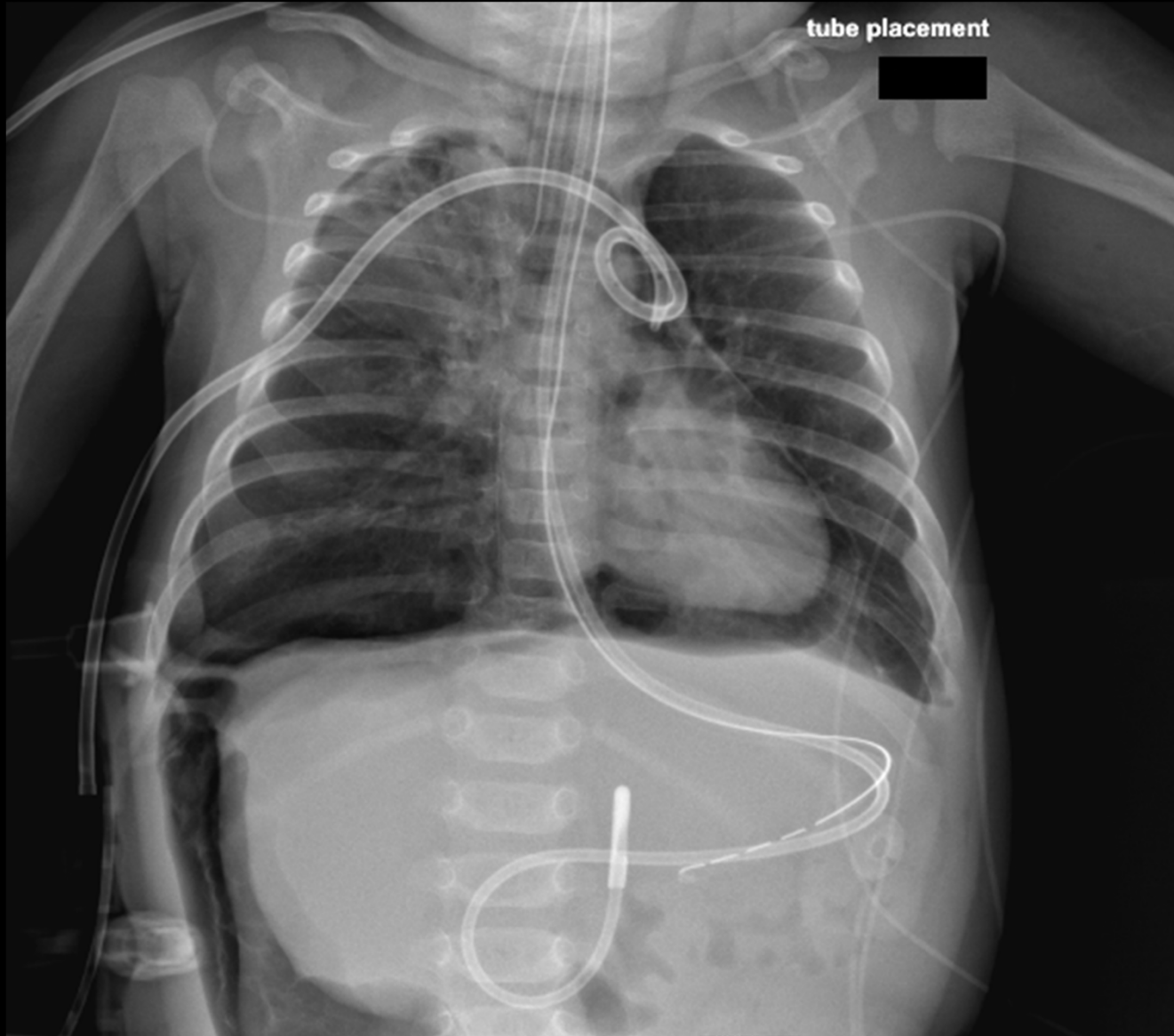


## Day 10 11:09 PM: CXR AP infant

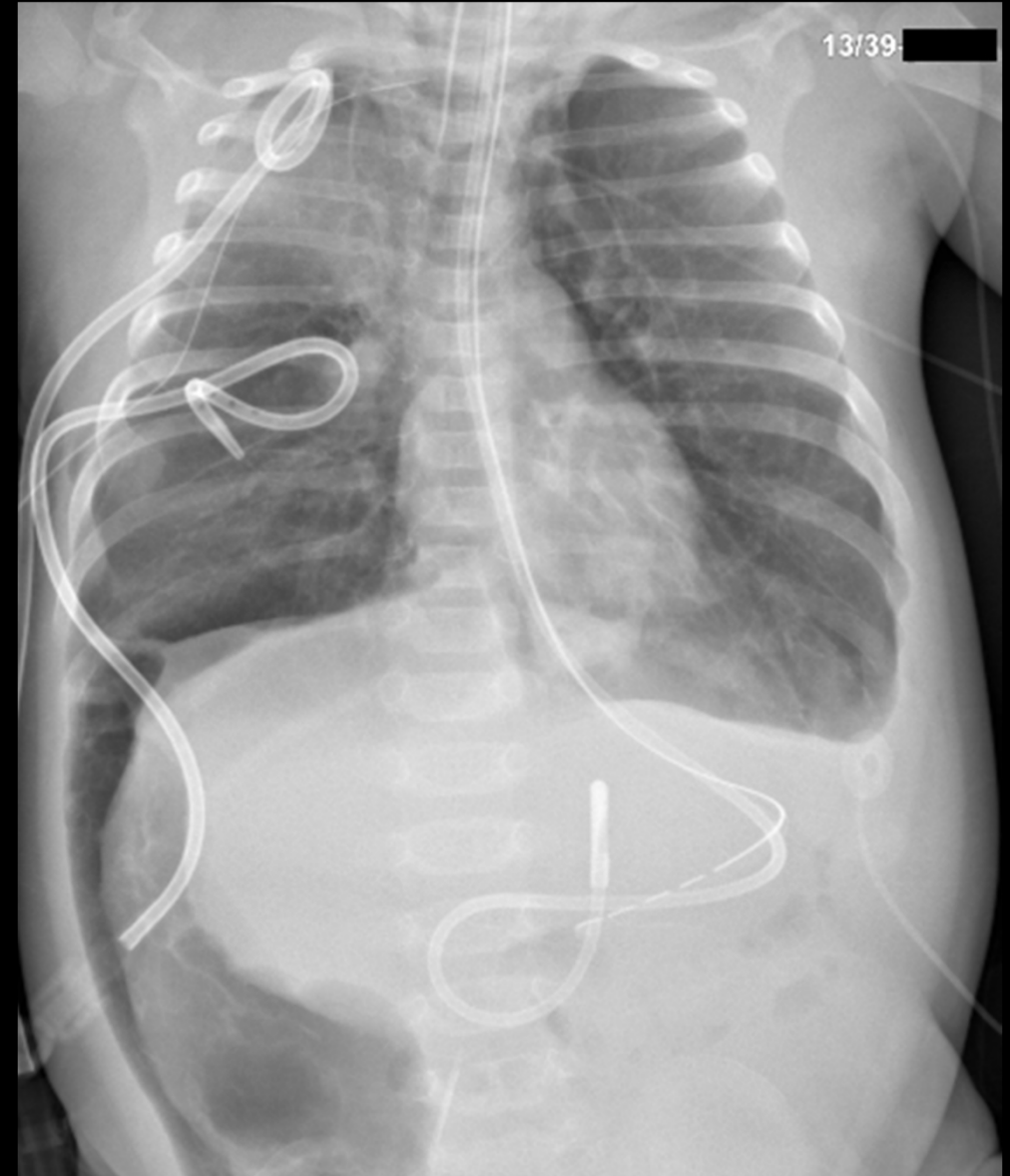
Yellow: pneumothorax

Blue: atelectasis

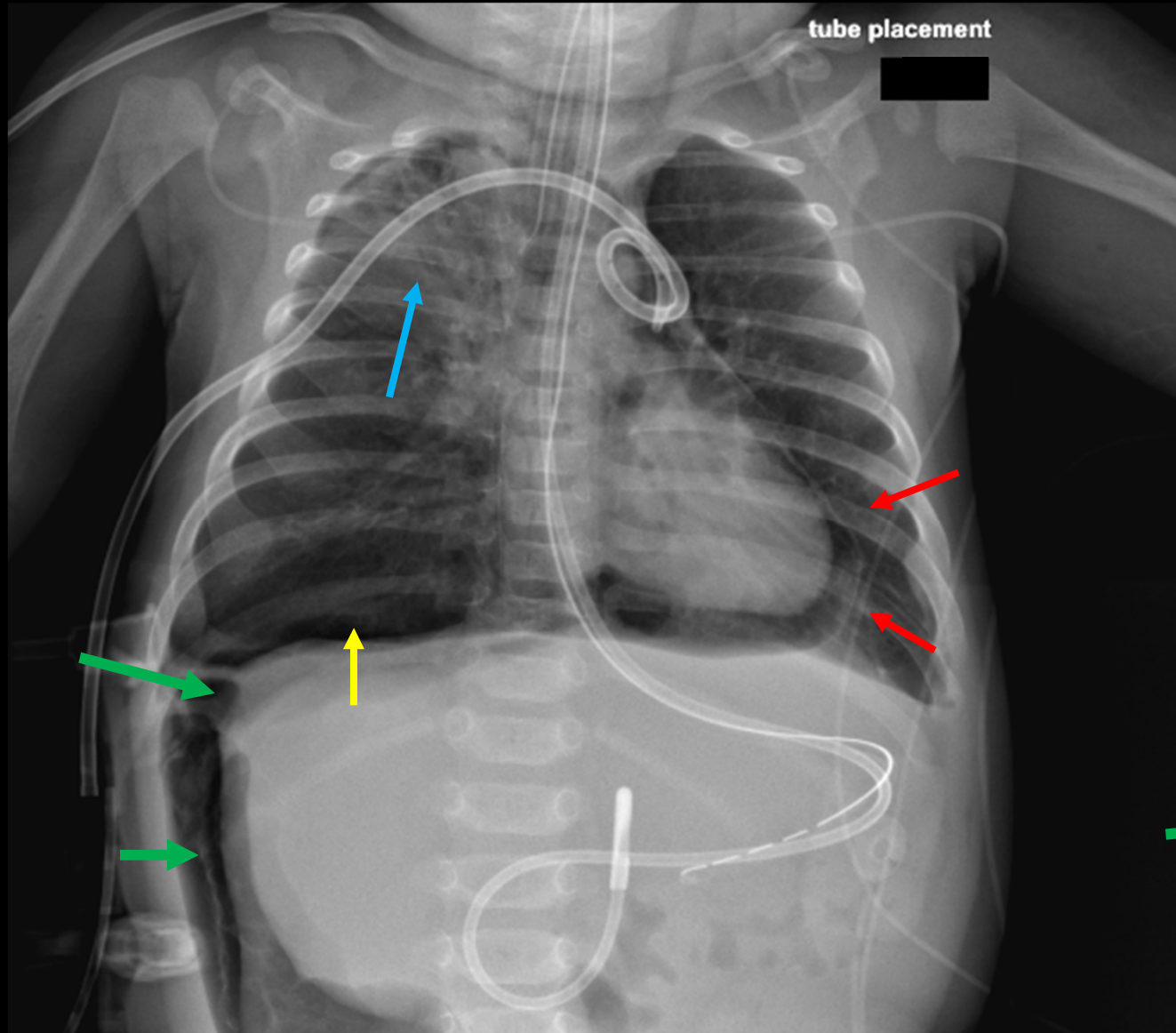
Day 11 12:23 AM: CXR AP infant



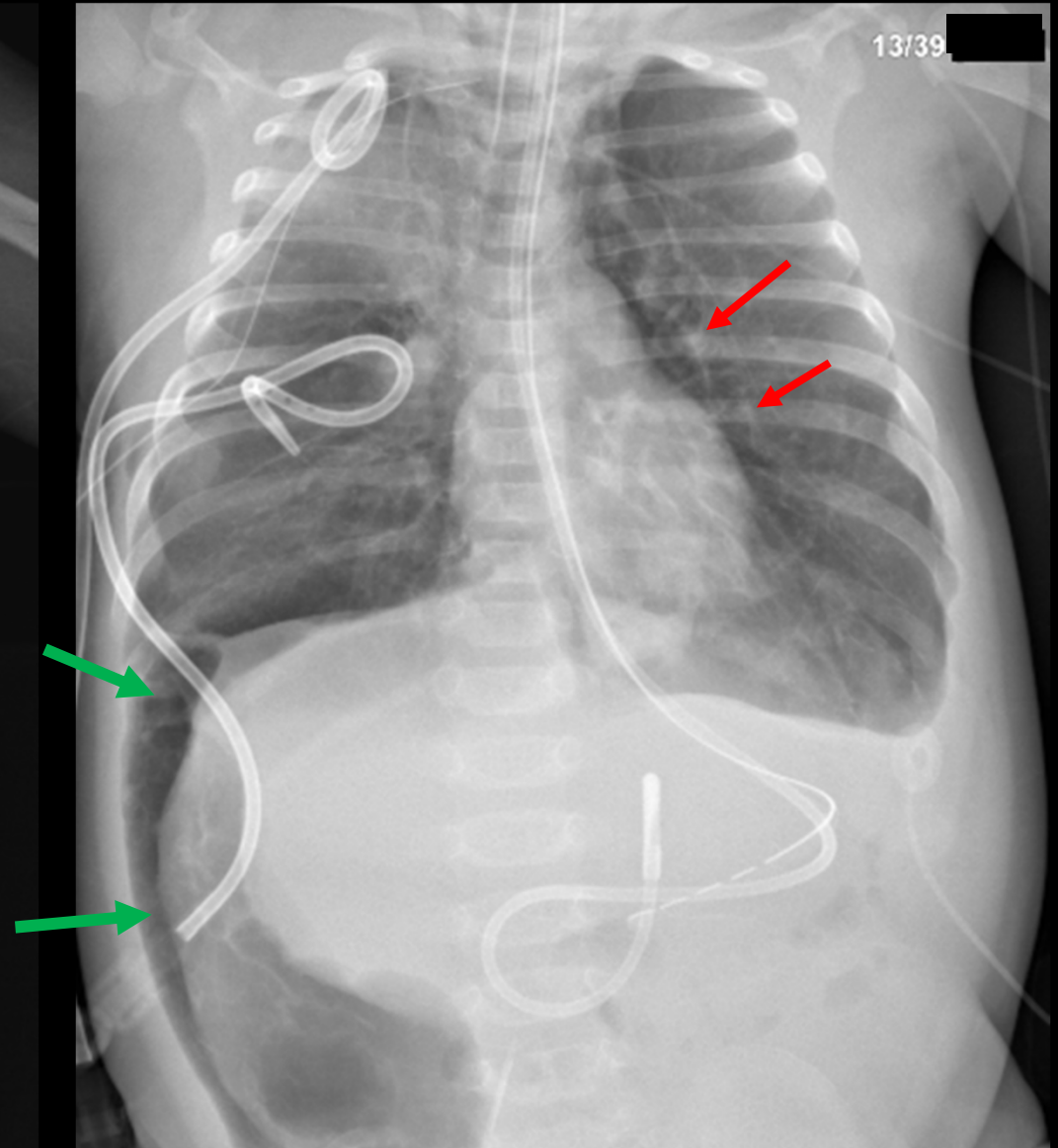
Day 11 4:26 PM: XR chest abdomen



Day 11 12:23 AM: CXR AP infant



Day 11 4:26 PM: XR chest abdomen



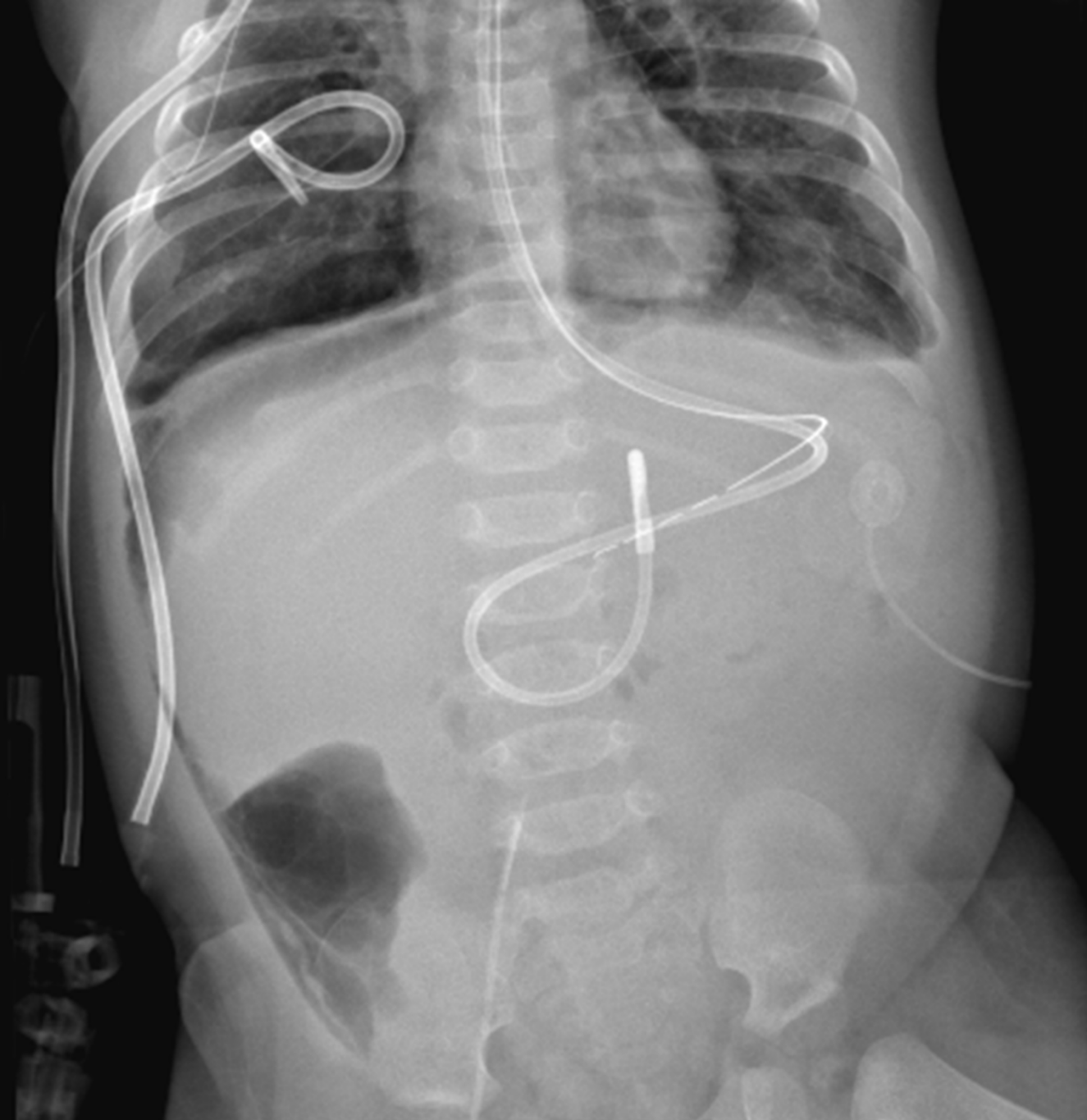
Yellow: pneumothorax

Blue: atelectasis

Green: pneumoperitoneum

Red: pneumomediastinum

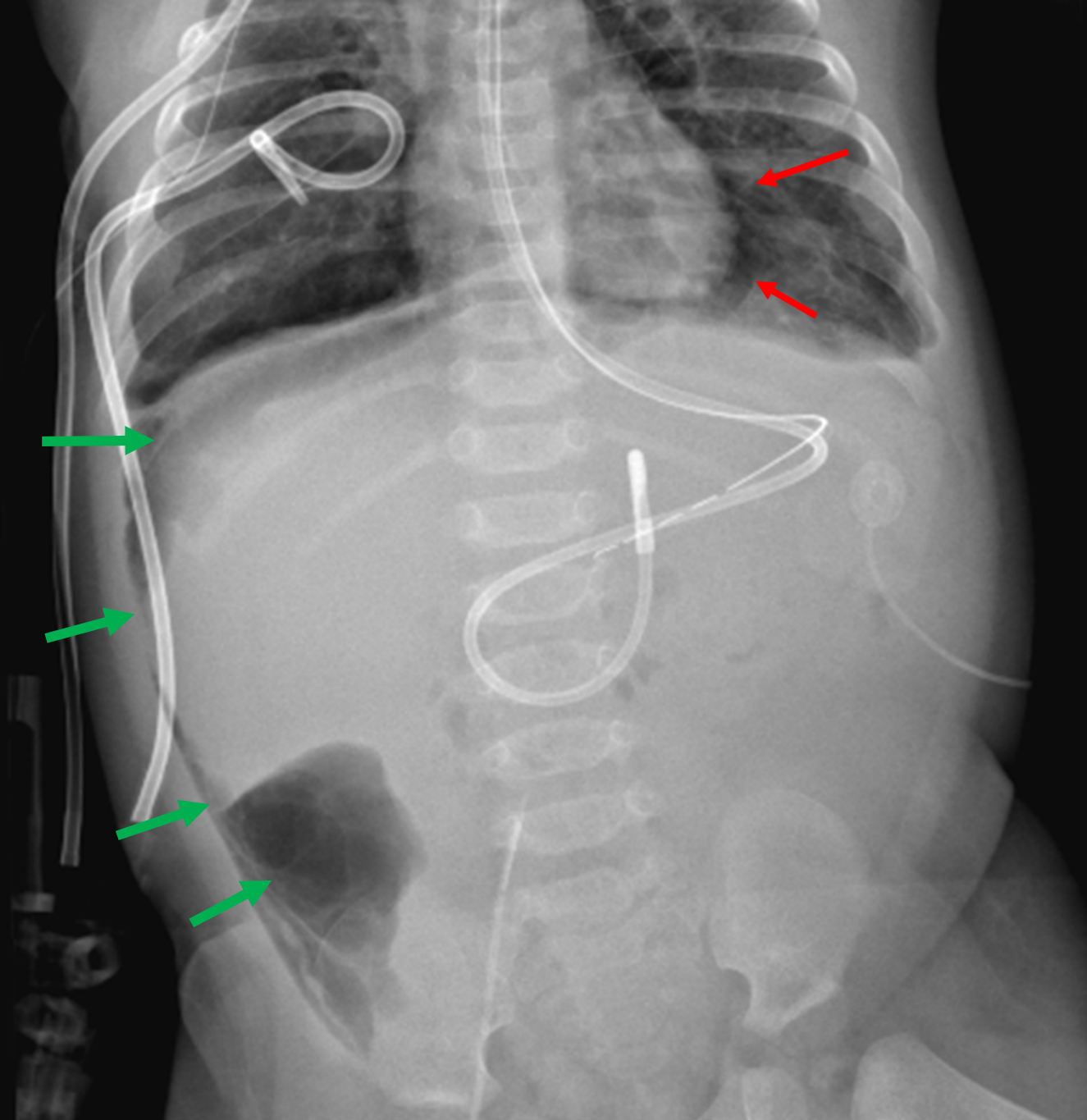
**Day 11 9:54 PM: XRAY Chest Abdomen**



# Day 11 9:54 PM: XRAY Chest Abdomen

Green: Pneumoperitoneum

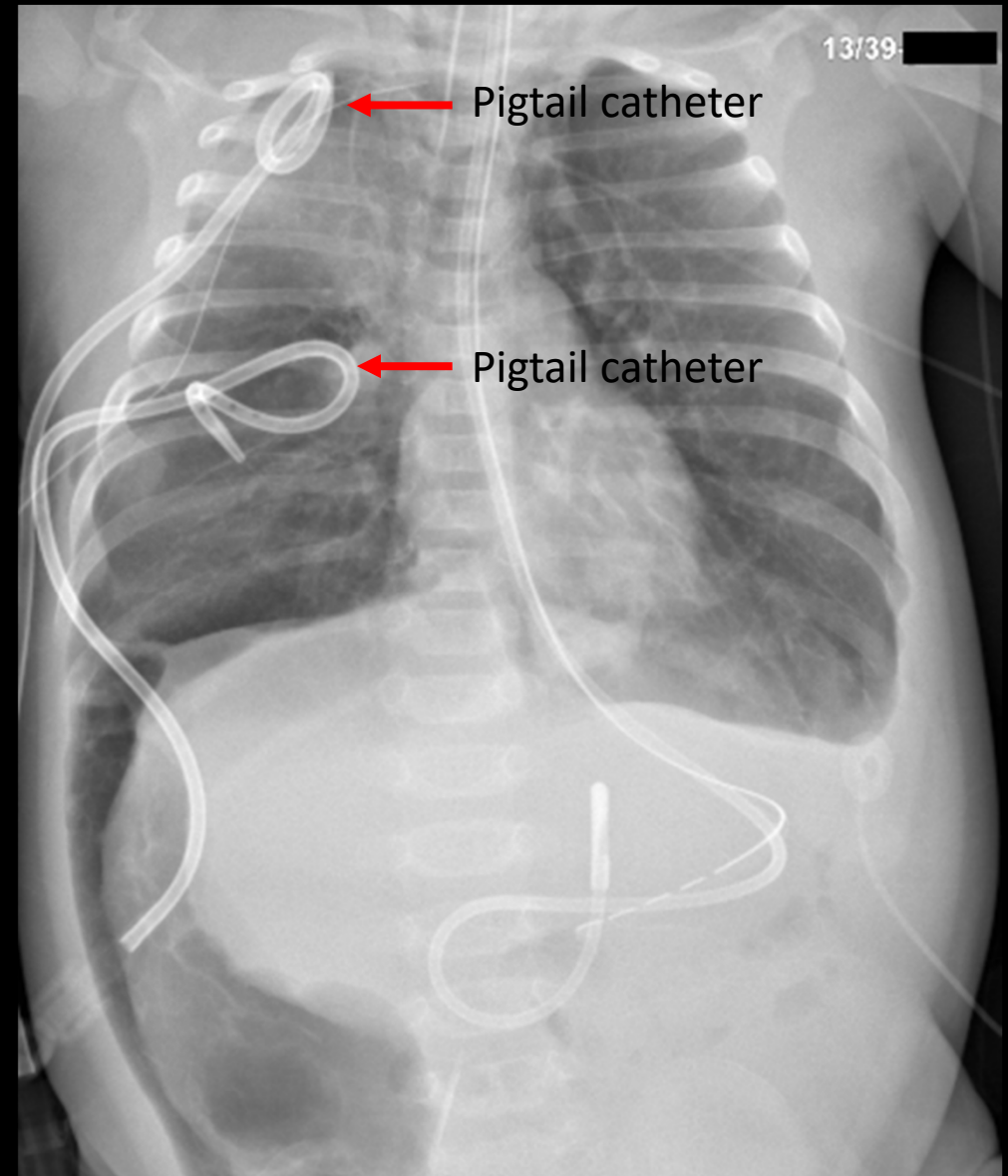
Red: Pneumomediastinum





# Chest Tubes

- **Two pigtail catheters were inserted to treat pneumothorax**
- **A third chest tube with a larger bore was placed in the anterior chest wall due to persistence of right pneumothorax**



# Key imaging findings

- 1) Right-sided pneumothorax
- 2) Pneumomediastinum with possible pneumopericardium
- 3) Air tracking along the abdomen concerning for pneumoperitoneum

# Differential Diagnosis – Pneumoperitoneum in Neonate

- 1) Perforation in GI tract – spontaneous or iatrogenic
- 2) Air Leak Syndrome
- 3) Necrotizing enterocolitis
- 4) Congenital malformations – ano-rectal malformations, ileal atresia, Hirschsprung's disease

# Discussion: Air Leak Syndrome

- Pathophysiology: air escapes from alveoli and tracks to other parts of the body leading to...
  - Pneumothorax (most common)
  - Pulmonary interstitial emphysema
  - Pneumomediastinum
  - Pneumopericardium
  - Pneumoperitoneum
  - Subcutaneous emphysema
- Risk factors: prematurity, low birth weight, RDS on mechanical ventilation, meconium aspiration

# Discussion: Air Leak Syndrome

## Prevention:

- Avoid high tidal volume, high peak inspiratory pressure, and long inspiratory duration
- High Flow Oscillatory Ventilation does not decrease incidence of pulmonary air leak in preterm infants
- Surfactant in preterm infants with RDS reduces incidence of air leak syndrome

# Final Diagnosis

- 1) RSV with acute hypoxemic respiratory failure
- 2) Air leak syndrome with spontaneous pneumothorax, pneumomediastinum and pneumoperitoneum

# Management for Air Leak Syndrome

## Pneumothorax in child:

- Small pneumothorax in stable: observation in hospital w/ CXR every 6-12 hours
- Large pneumothorax in stable patient: needle aspiration
- Unstable patients (dyspnea, hypoxemia, pain): pigtail catheter or thoracostomy tube insertion

## Pneumopericardium :

- Asymptomatic: frequent monitoring of vital signs (pulse pressure)
- Symptomatic: pericardiocentesis

Pneumoperitoneum and pneumomediastinum typically resolve spontaneously

# Management of the Patient in PICU

- Three chest tubes placed: two pigtail catheters and one 10 French chest tube
- Intubation
- CXR every 8 hr
- Frequent monitoring of vital signs to assess for cardiac tamponade. Arterial line was placed for frequent measurement of blood pressure and ABG.



# ACR Appropriateness Criteria

**Variant 4:**

**Infant or child aged 1 to 36 months with FWS with any of the following: respiratory signs or symptoms, fever  $\geq 39^{\circ}\text{C}$ , or white blood cell count  $\geq 20,000/\text{mm}^3$ .**

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		⊗
<b><u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate</b>			<b>*Relative Radiation Level</b>

# Cost of Imaging

16 Chest XRAYs 1 view = \$12,294

2 Chest XRAYs 2 view = \$1,520

3 chest/abdomen XRAY = \$2,010

**TOTAL COST: \$15,824**

Prices from Memorial Hermann charge description master:

<https://www.memorialhermann.org/patients-caregivers/pricing-estimates-and-information/>

# Take Home Points

- Air leak syndrome can present as pneumothorax, pneumomediastinum, pneumopericardium, and, rarely, pneumoperitoneum
- It is important to differentiate air leak syndrome from other causes of pneumoperitoneum
- Treatment for air leak syndrome is based largely on patient's clinical presentation and location of air leak

# References

- (1) ACR Appropriateness Criteria, Acute Respiratory Illness in Immunocompetent Patients. Website URL: <https://acsearch.acr.org/docs/69446/Narrative/>
- (2) ACR Appropriateness Criteria, Fever Without Source or Unknown Origin in Child. Website URL: <https://acsearch.acr.org/docs/69438/Narrative/>
- (3) Baumann MH, Strange C, Heffner JE, Light R, Kirby TJ, Klein J, Luketich JD, Panacek EA, Sahn SA, AACP Pneumothorax Consensus Group. Chest. 2001;119(2):590
- (4) F. Cools, L.M. Askie, M. Offringa, J.M. Asselin, S.A. Calvert, S.E. Courtney, *et al.* **Elective high-frequency oscillatory versus conventional ventilation in preterm infants: a systematic review and meta-analysis of individual patients' data.** Lancet, 375 (2010), pp. 2082-2091
- (5) Jeng, Mei-Jy, et al. "Neonatal Air Leak Syndrome and the Role of High-Frequency Ventilation in Its Prevention." *Journal of the Chinese Medical Association*, vol. 75, no. 11, 2012, pp. 551–559., doi:10.1016/j.jcma.2012.08.001.
- (6) Soll RF, Morley CJ. Prophylactic versus selective use of surfactant in preventing morbidity and mortality in preterm infants. Cochrane Database Syst Rev 2001; :CD000510.
- (7) Varano LA, Maisels MJ. Pneumopericardium in the newborn: diagnosis and pathogenesis. Pediatrics. 1974;53(6):941



Questions?