**Academic Half Day: Acute Respiratory Failure**

Learner Guide

August 26, 2021

Case 1

Ms. Ersats is a 25-year-old female with past medical history of asthma and allergic rhinitis, who presents to the hospital with 1 hour of shortness of breath and wheezing. She was cleaning her new apartment prior to sudden onset of shortness of breath. She notes chest tightness as well. She used her home Albuterol inhaler with little improvement. She denies chest pain, fever, chills, and sputum production. She does not take any medications regularly but does take fexofenadine occasionally for seasonal allergies. She has never smoked or vaped but does drink alcohol on the weekends.

Vitals:   
T 98.6. HR 105. BP 130/70. RR 29. SpO2 92% on 2 L oxygen

Exam:  
General: Appears uncomfortable and tachypneic. She is awake, alert, and oriented to person, place, and time.  
HEENT: Normocephalic, atraumatic. Mucus membranes are moist. No cervical lymphadenopathy.  
Cardiac: Regular rhythm, slightly tachycardic. Well-perfused in extremities. No murmurs appreciated. No edema noted.  
Lungs: Diffuses wheezes throughout all lung fields. Decreased air movement throughout all lung fields.  
Abdomen: Soft, non-tender to palpation. Normoactive bowel sounds.   
Neuro: AAOx3. Moving all 4 extremities spontaneously with 5/5 motor strength. No sensory deficits. Answering questions appropriately.

Labs:  
CBC: WBC 7.3, Hgb 13.2, Plt: 320  
Renal: Na 137, K 4.1, Cl 101, HCO3 24, BUN 14, Cr 1.0 (baseline 0.9)  
ABG: pH 7.48, pCO2 32, pO2 72   
CXR: No cardiopulmonary abnormalities

1. **What is the diagnosis and what are the next steps in management?**

The patient was admitted to medicine. You get a page from the nurse for a diet order. Repeat labs resulted while you were opening the patient’s chart and repeat vitals were obtained:

Vitals:  
T 99.1. HR 112. BP 126/70. RR 26. SpO2 92% on 3L oxygen

VBG: 7.38, pCO2 44

You reassess the patient at bedside and the patient continues to appear uncomfortable. She has intercostal retractions. Her nasal cannula is in proper position. She is taking breaths every 3-4 words when answering questions.

1. **What is happening with this patient?**
2. **What are your next steps?**
3. **What are the indications for intubation?**
4. **What are contraindications to NIPPV?**
5. **Where will you treat this patient?**

Ms. Ersats is transferred to the ICU and intubated. Initial vent settings: AC/VC, FiO2 100%, PEEP 8, RR 16, Vt 6 cc/kg IBW.

Case 2

Mr. Proseva is a 66 year old male with past medical history of hypertension, hyperlipidemia, and CKD stage 1. He presented to the hospital 3 days ago for fever, cough, nausea, and vomiting. Initial evaluation was significant for hypoxia requiring 2L NC and otherwise normal vital signs. Workup revealed a positive PCR for Influenza A with a negative COVID test. He was started on Tamiflu and admitted to the wards due to his hypoxia. He was also placed on maintenance fluids due to his recent decreased PO intake. You are cross-covering overnight when a rapid response is called to his room for an SpO2 of 80% on 5L NC.

You arrive to find him in bed, lethargic but arousable. He says his breathing has been getting worse throughout the day.

Vitals: HR 110, BP 100/60, RR 28, SpO2 85% on 6L NC, T 38.5

Exam: General: Lethargic but arousable, tachypneic, middle aged male in mild distress.  
HEENT: Normocephalic, atraumatic. Mucus membranes are moist. No cervical lymphadenopathy.  
Cardiac: Regular rhythm, slightly tachycardic. Well-perfused in extremities. No murmurs appreciated.   
Lungs: Bibasilar crackling with coarse rhonchi R>L  
Abdomen: Soft, non-tender to palpation. Normoactive bowel sounds.   
Extremities: Pitting edema bilateral LE to mid-shin, edema appears worse on the right. No overt calf tenderness.  
Neuro: AAOx3. Moving all 4 extremities spontaneously with 5/5 motor strength. No sensory deficits. Answering questions appropriately.

Labs:   
CBC: WBC 19, Hb 13, Plt 330  
Renal: Na 136, K 4.8, Cl 103, HCO3 22, BUN 35, Cr 1.9, Glucose 188

Your intrepid co-intern looks up his admission labs and notes they are largely unchanged to now.

ABG: 7.49/32/59 on 5L NC (pH/pCO2/pO2)

1. **What are the five causes of hypoxemia?**

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| --- | --- | --- | --- |
| Cause of Hypoxemia | Examples | Effect on A-a gradient | Corrects with supplemental O2? |
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1. **What is the A-a gradient and how is it impacted by each cause of hypoxemia?**
2. **What is on your differential?**
3. **What do you want to order?**
4. **Where would you send this patient?**

Imaging:



Mr. Proseva is subsequently transferred to the ICU and intubated.

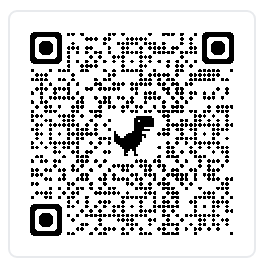
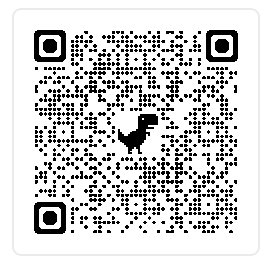
**Take a break and ask the ICU attending any questions while the other ICU attending, Dr. Strange, is helping the fellow intubate your patient.**

Initial vent settings: AC/VC, FiO2 100%, PEEP 8, RR 12, Vt 6 cc/kg IBW. Now that the multiverse has been unraveled by Dr. Strange, you find yourself in an alternate reality in which you are the ICU resident taking care of both Ms. Ersats and Mr. Proseva. Mr. Proseva’s ABG shortly after intubation results: 7.15/90/70.

1. **What changes to the vent settings do you want to make and why?**
2. **What is the pathophysiology of this patient’s lungs? What are the important aspects of oxygenating this patient?**
3. **After 30 minutes on the above settings with FiO2 at 1.0, his ABG is 7.28/60/95 (pH/CO2/O2). What adjustments should be made at this time?**

The respiratory therapist alerts you that both patients (conveniently located in adjacent beds) are having peak pressure alarms on their ventilators.

1. **Why do airway pressures change on volume control ventilation?**
2. **What components of respiratory mechanics comprise a peak airway pressure?**
3. **What maneuver on the ventilator can be done to help differentiate between the above changes?**

Case 1:  Case 2: 

1. **What is the differential for a high-pressure alarm with a wide delta?**
2. **What is the differential for a high-pressure alarm with a narrow delta?**
3. **Why does Case 1 have a different pattern than Case 2?**
4. **What adjustments do you want to make to Case 1?**
5. **What adjustments do you want to make for Case 2?**

You sign out and go home for the day.

Case 3

Mr. Gold is a 62 yo male with a history of COPD who presents to the ED with a 2-day history of gradually progressive dyspnea on exertion and increased frequency of his chronic cough which is productive for clear sputum. He denies fevers. He is adherent to prescribed albuterol MDI, salmeterol BID, and tiotropium QD. His albuterol helps his symptoms some. He has a 30-pack year smoking history and currently smokes 0.5 PPD. His apartment complex has been cleaning the AC vents recently.

Vitals:   
T 99.3. BP 156/87. HR105. RR 26, 91% on 2L (new requirement)

Gen - Uncomfortable, AAOx3  
HEENT- PERRL, moist mucous membranes, no oral cavity lesions   
CV - Heart sounds distant. Tachycardic, regular, no murmurs, no JVD   
Resp - Labored, no wheezing, +accessory muscle use. Able to speak in partial sentences   
Abd - soft/nontender/nondistended, +BS   
Ext - 2+ radial and DP pulses. No LE edema

**Labs**:   
WBC - 7.3 (normal diff); Hgb- 14.3;  Plt- 320

Na - 137, K- 4.1, Cl- 101, HCO3- 29, BUN- 14, Cr- 1.0

ABG - 7.23/60/62 on 2L  (pH/CO2/O2)  
CXR: No acute cardiopulmonary process

1. **What is the diagnosis and what are the next steps in management?**
2. **You start Mr. Gold on bilevel NIPPV. What are you trying to improve in this patient from a respiratory perspective? Return to physiology - where is the defect in the lungs, how do we use NIPPV to overcome this defect?**
3. **How soon after initiating this therapy should you check an ABG? What parameters are you hoping to see?**