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Incidence of Barotrauma in COVID-19 (+) Hospitalized Patients

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Incidence of Barotrauma in COVID-19 (+) Hospitalized Patients
Disclosure of Commercial Interest

Co-authorship Thoracic Imaging Textbooks

Lung Cancer Screening

Mark S Parker, Robert C. Groves, Joanna El Kusmirek, Leila Rezai Gharai, and Samira Shojaee; Thieme, New York; 2017

Chest Imaging Case Atlas, 2nd edition

Mark S Parker, Melissa L Rosado-de-Christenson, Gerald F Abbott; Thieme, New York; 2012

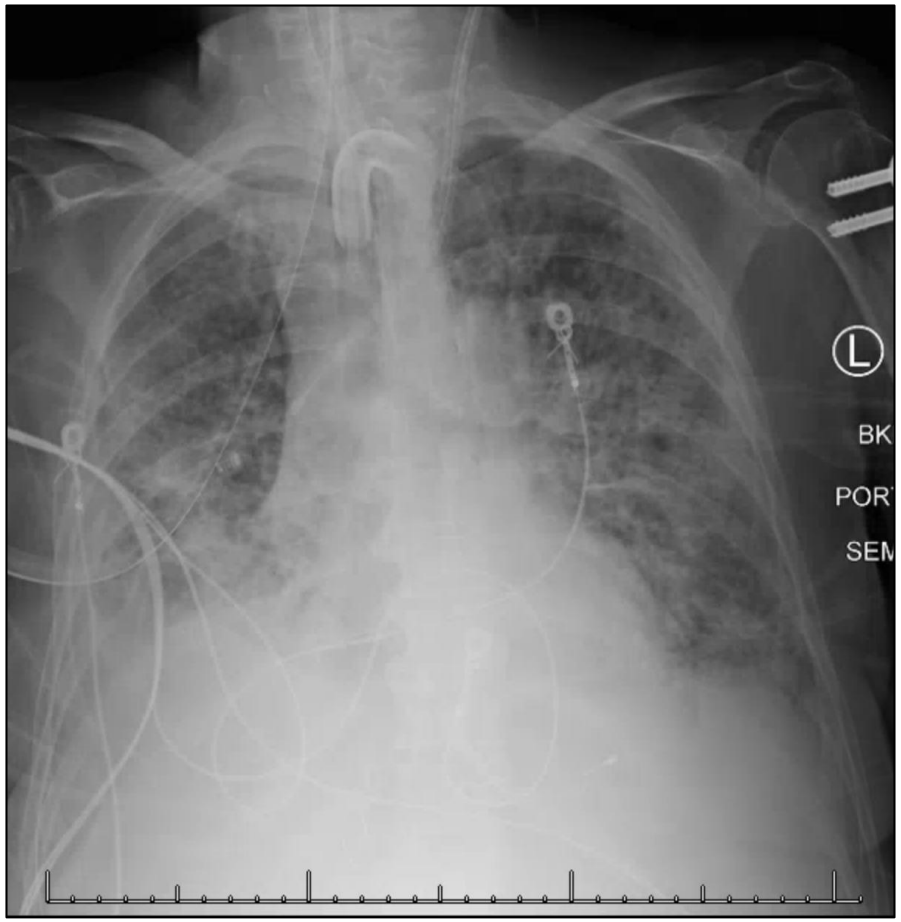
Incidence of Barotrauma in COVID-19 (+) Hospitalized Patients

BACKGROUND

- COVID-19 in the US as of Aug 2022 [1]:
  - ~ 90 million cases reported
  - ~ > 1 million deaths
  - ~ 1.2% case fatality rate

- Acute respiratory distress syndrome (ARDS) Noncardiogenic pulmonary edema resulting in impaired oxygenation at the alveolar capillary level [2-3]

- Pathophysiology of COVID-19 ARDS (CARDS) includes direct cytopathic effects, diffuse alveolar hemorrhage and hyaline membrane, cytokine storm via IL-6 and TNF [3]



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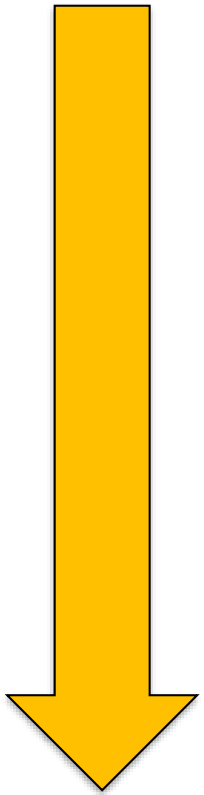
COVID-19 Respiratory Management Ladder



Low-flow O_2:

- Delivery through nasal cannula

High-flow nasal cannula (HFNC) [4-5]**:**

- O_2 delivery system
- 100% humidified and heated oxygen
- up to 60 L/min O_2 through large-bore nasal cannula

Invasive mechanical ventilation (IMV) [4-5]**:**

- Endotracheal intubation, highest level of respiratory / ventilatory support

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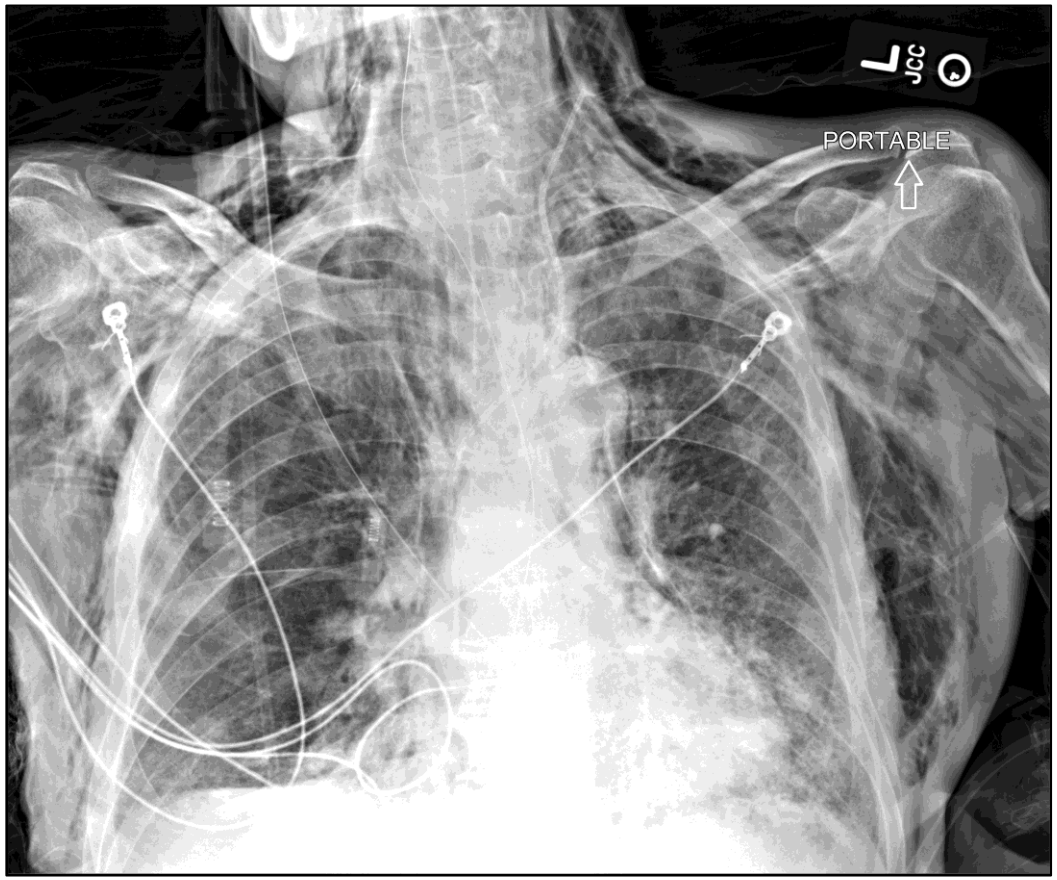
Ventilator-Induced Lung Injury (VILI) - Barotrauma

- **Alveolar injury:** overdistension of the lungs from mismatch between ventilatory parameters and alveolar tolerance → pneumothorax, pneumomediastinum, pneumopericardium, subcutaneous air, pneumoperitoneum [6]
- Ventilatory settings - respiratory rate, tidal volume, positive end expiratory pressure [6]
- Reported barotrauma for all cause hospitalized ARDS is 4.8-11% (with ARDSnet protocol) [7]



Incidence of Barotrauma in COVID-19 (+) Hospitalized Patients

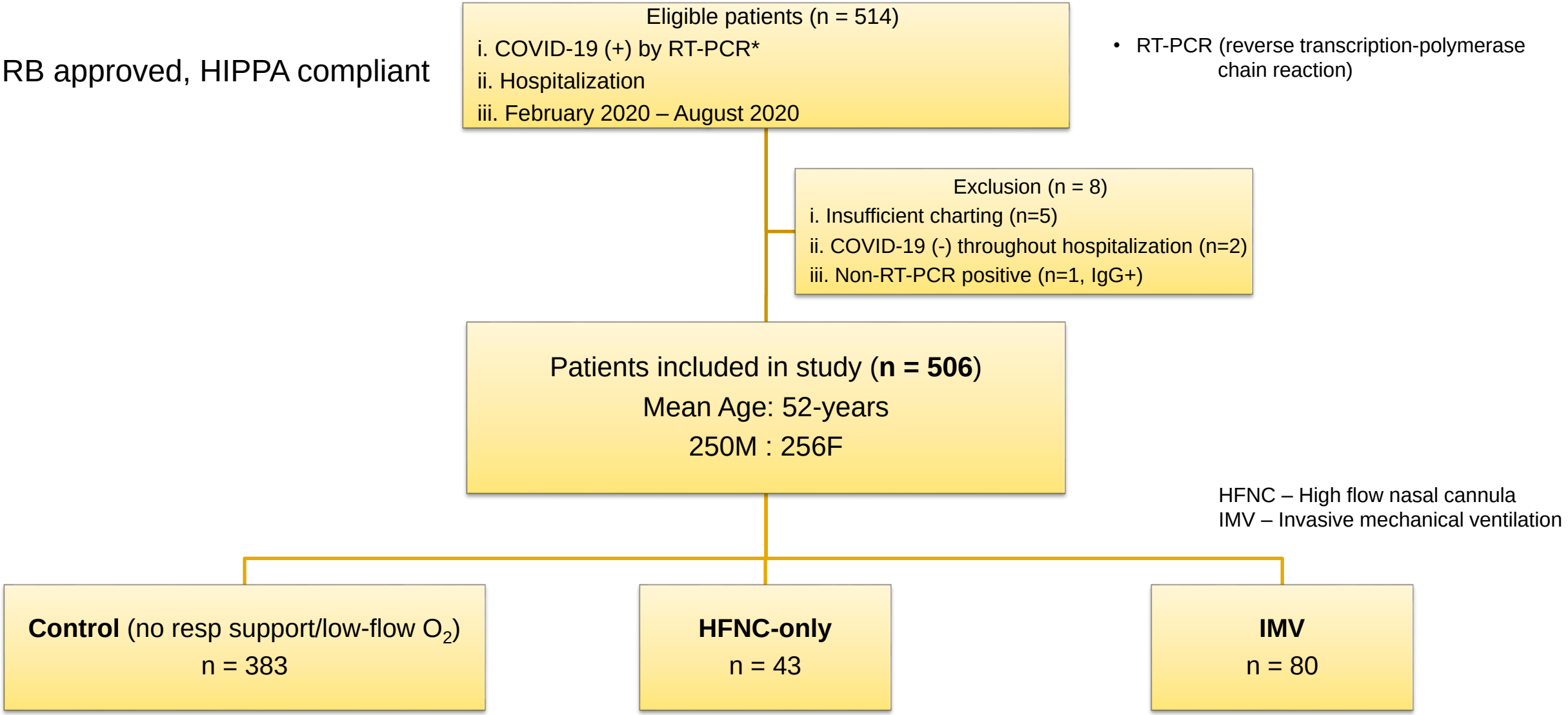
Purpose of Our Study

Investigate whether there is an increase in incidence of barotrauma in COVID-19 (+) patients requiring high flow nasal cannula (HFNC) or invasive mechanical ventilation (IMV).

Incidence of Barotrauma in COVID-19 (+) Hospitalized Patients

Patient Selection

IRB approved, HIPPA compliant



- RT-PCR (reverse transcription-polymerase chain reaction)

HFNC – High flow nasal cannula
IMV – Invasive mechanical ventilation

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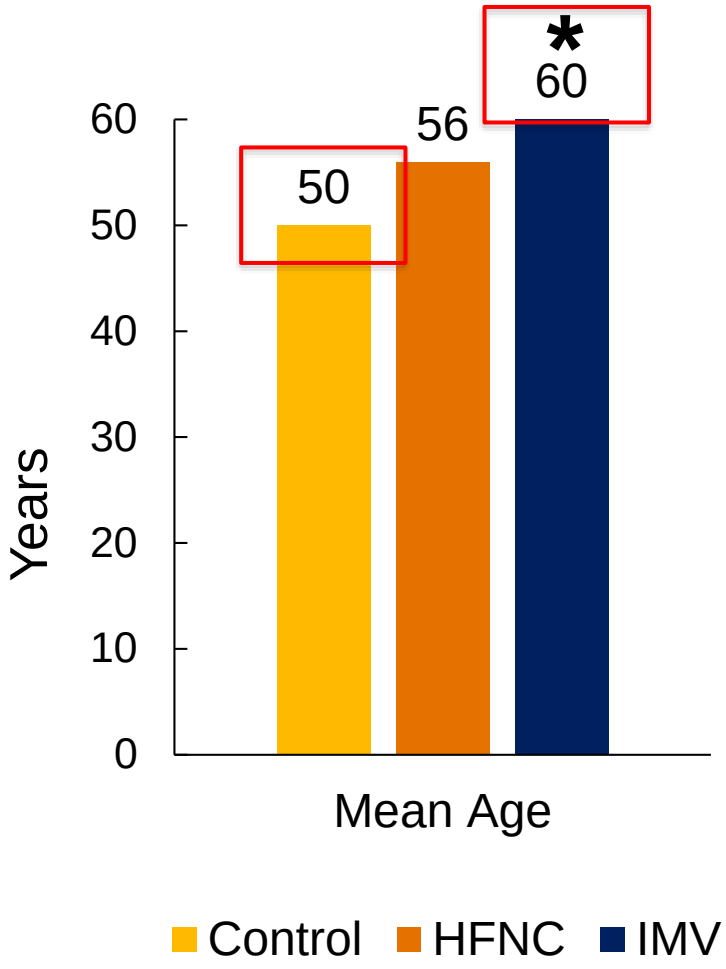
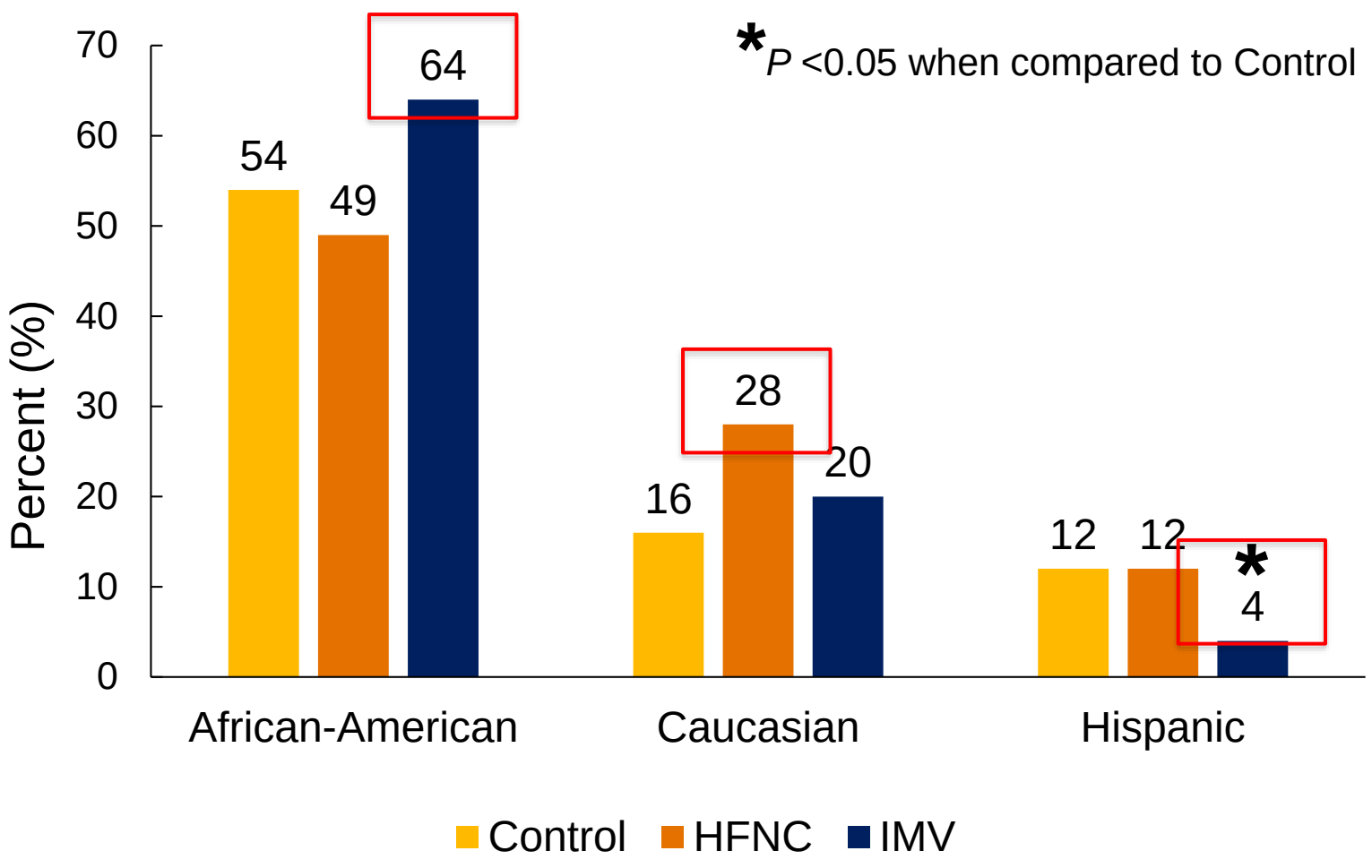
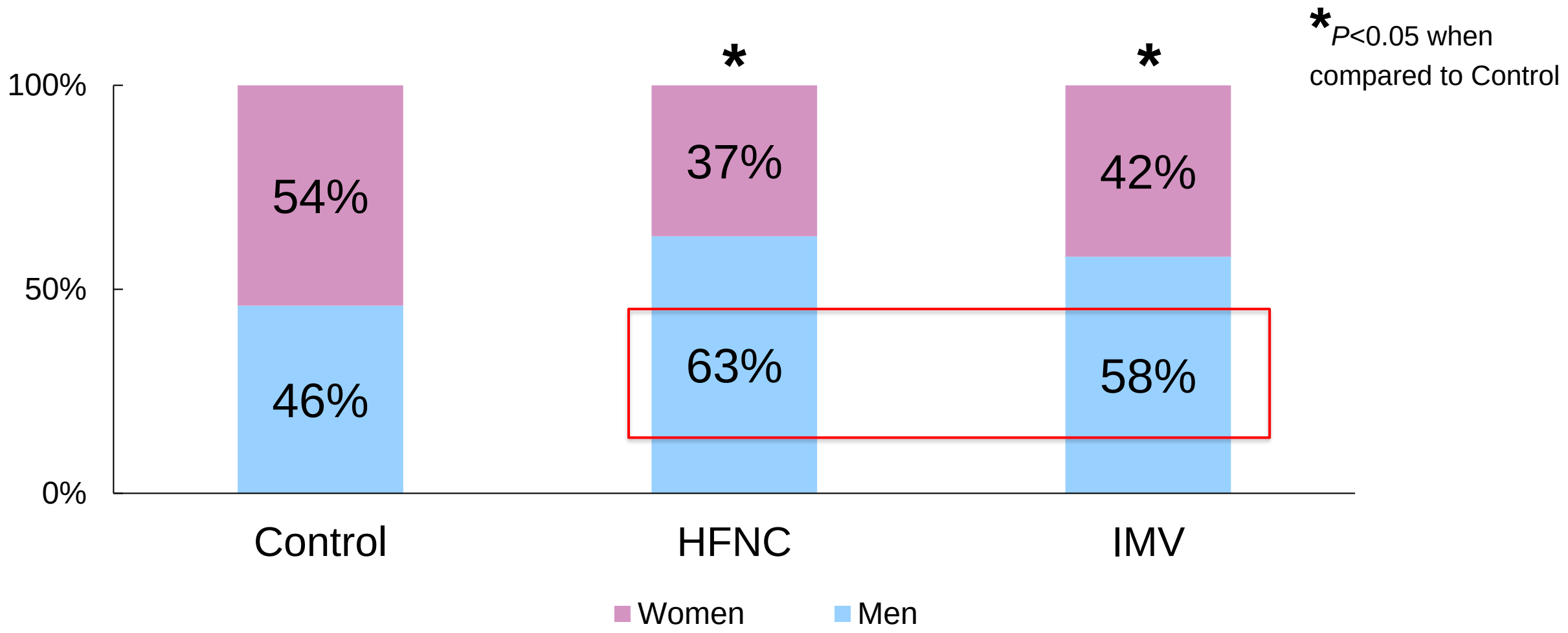
RESULTS - Age & Race Distribution





Incidence of Barotrauma in COVID-19 (+) Hospitalized Patients

RESULTS - Gender Distribution



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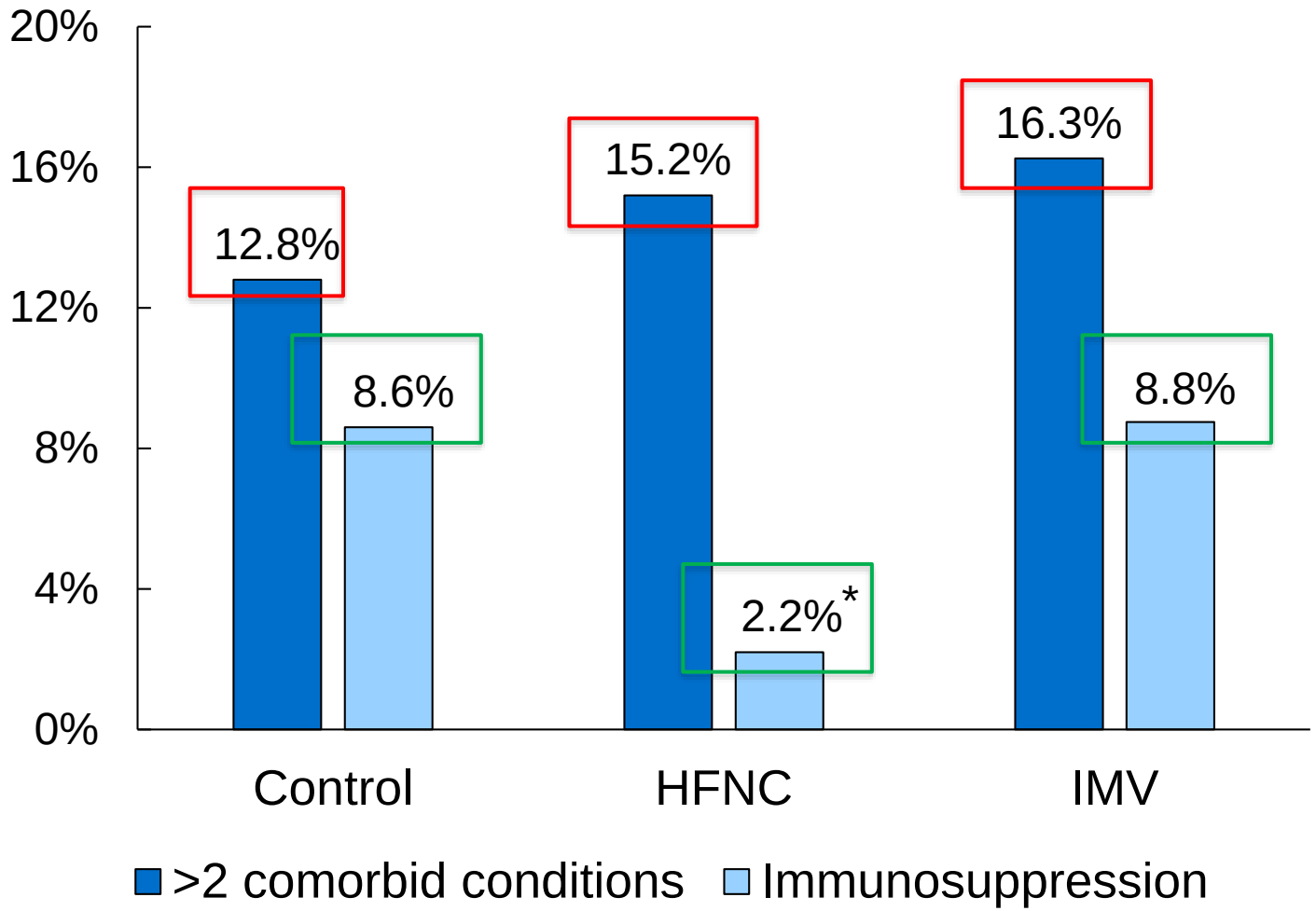
RESULTS – Comorbidities and Immunosuppression



Common comorbidities among all patients:

- **Hypertension**
- **Diabetes mellitus type 2**
- **Obesity**
- Hyperlipidemia
- Chronic kidney disease
- Coronary artery disease/Stroke

Immunosuppression:

- Medication-induced
- Pathological (ie. leukemia)

*** Only 1 immunosuppressed HFNC PATIENT**

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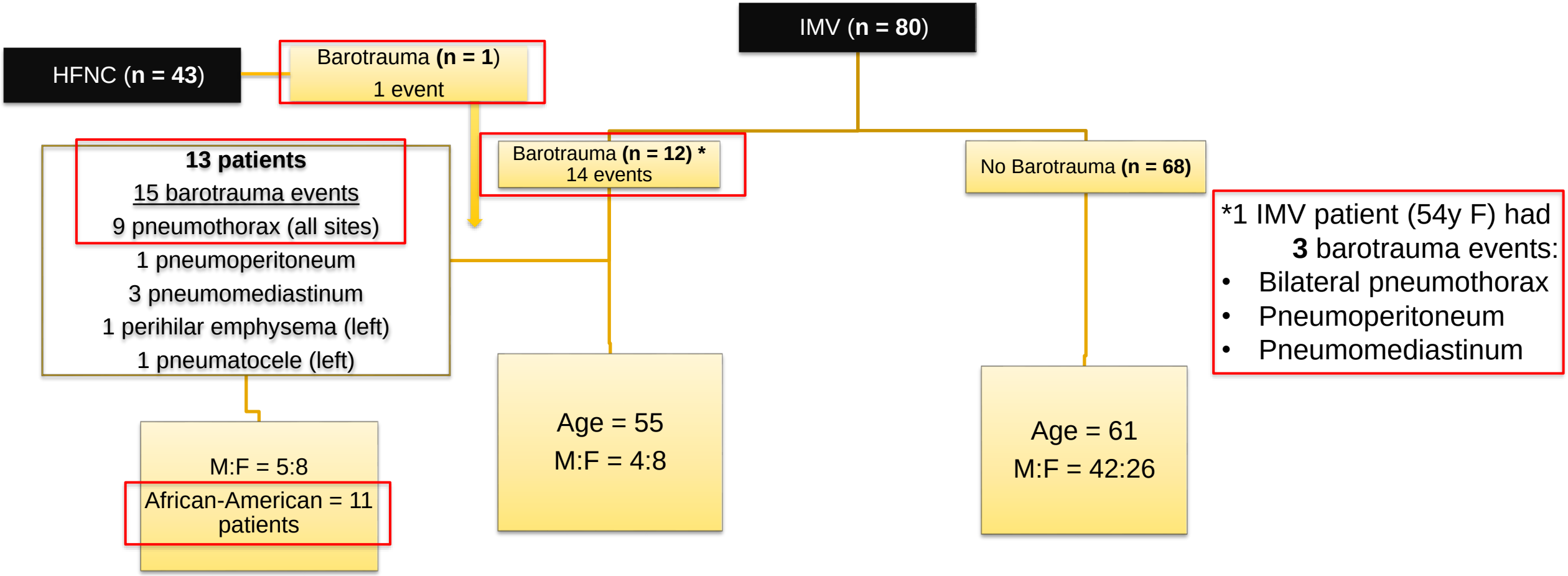
RESULTS - Barotrauma Events



n = # of patients

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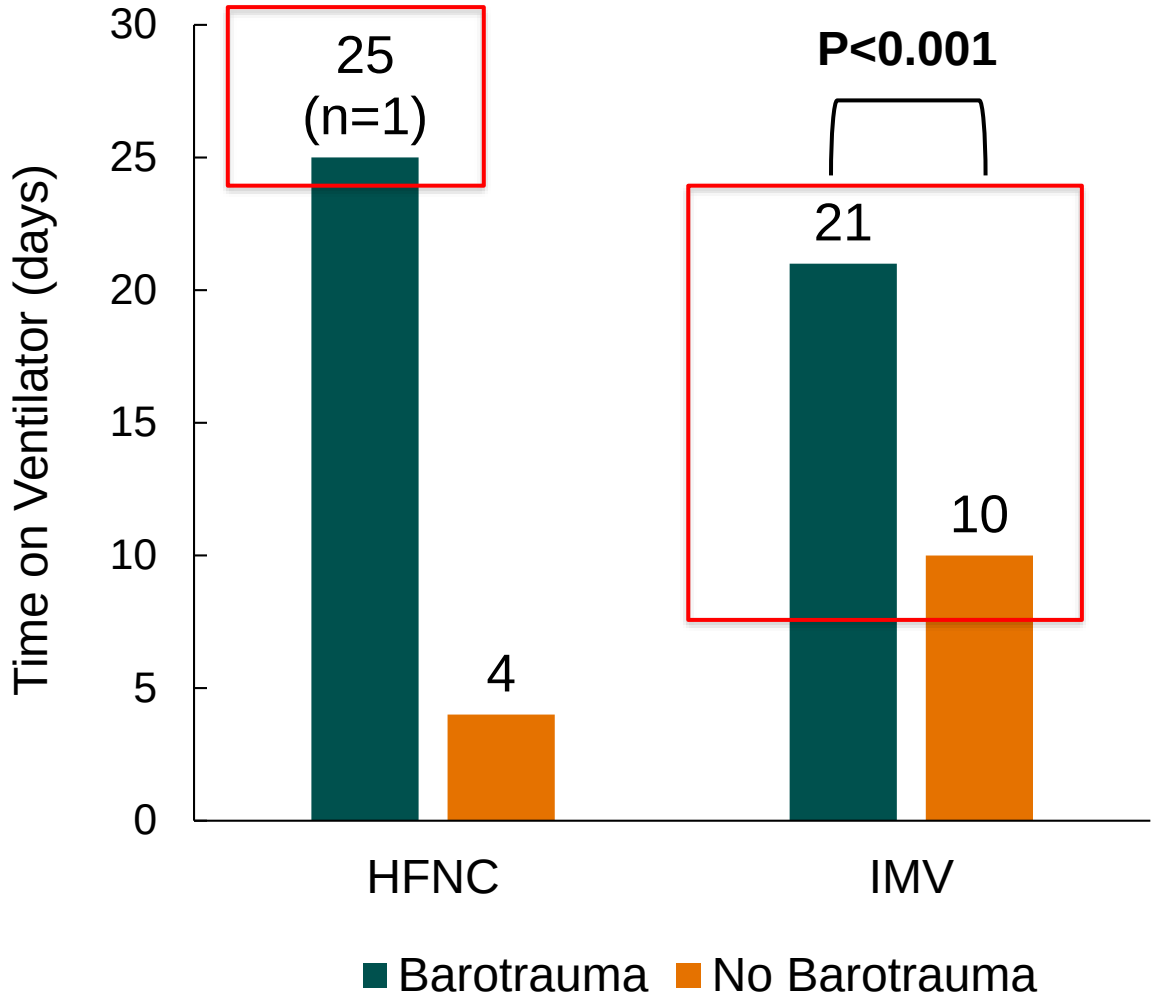
RESULTS – Barotrauma, Ventilator Settings and Time



	IMV group - Barotrauma	IMV group – No Barotrauma
PEEP (cm H_2O)	10	11
Tidal Volume (mL)	465	434
Respiratory Rate	**28**	**20** **P<0.05**

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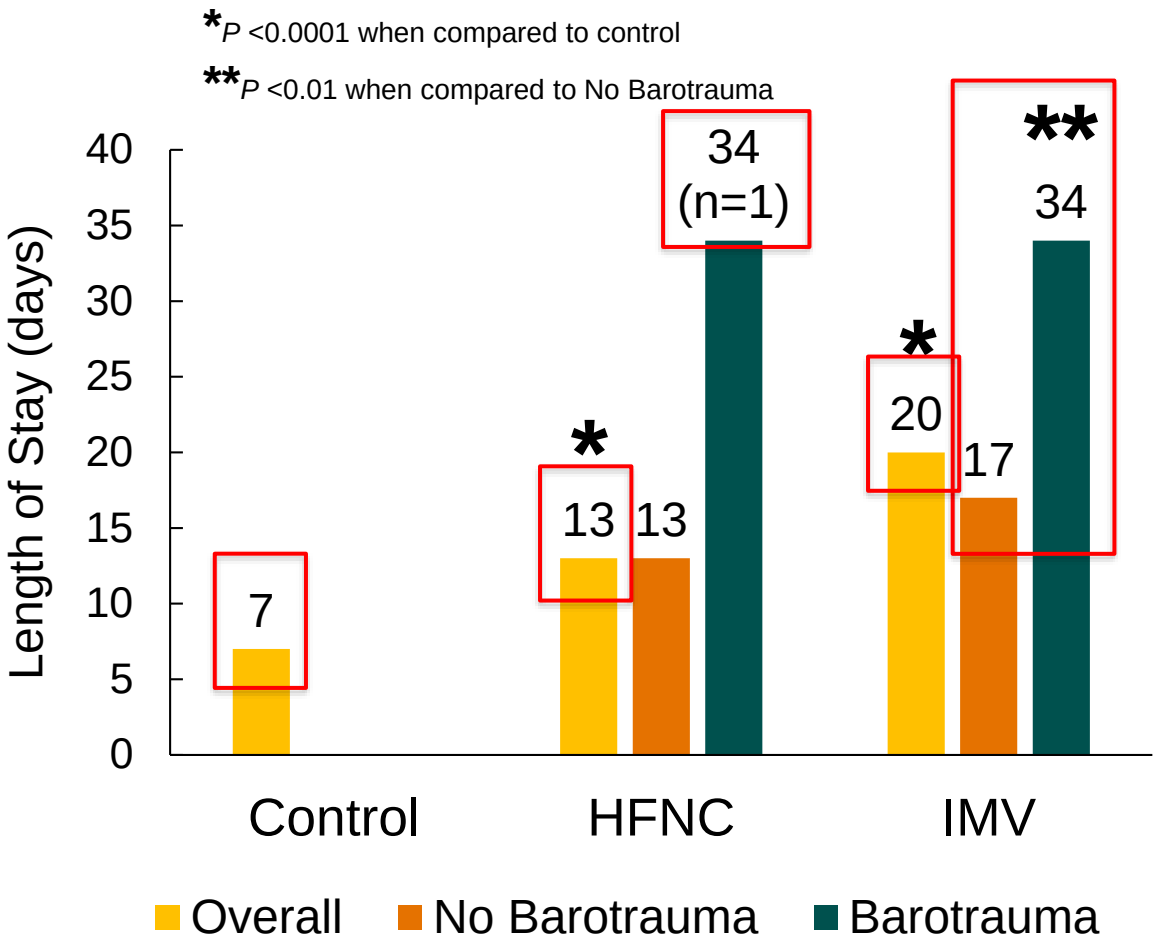
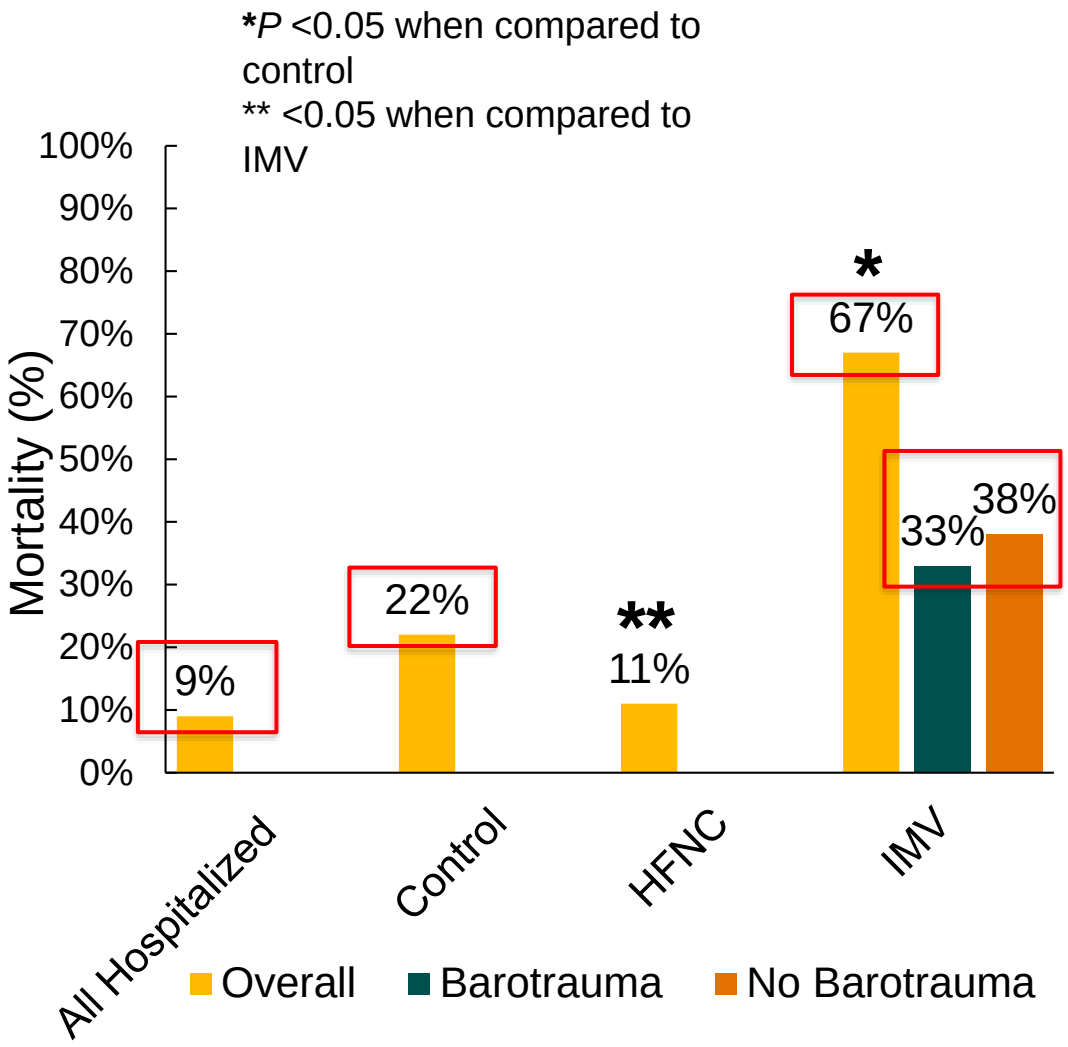
RESULTS - Barotrauma and Length of Stay (LOS)



IMV patient	Barotrauma LOS (days)	No Barotrauma LOS (days)	
African-American	31	17	P<0.01
Men	46	16	P<0.001
Women	27	19	

Incidence of Barotrauma in COVID-19 (+) Hospitalized Patients

RESULTS - Mortality for IMV & HFNC



9% (45/506) died during their COVID-19 hospitalization

- 62% (28/45) were Men
- 64% (29/45) were African American
- 20% (9/45) were Caucasian

IMV GROUP	Total Mortality (n=30)	Barotrauma Mortality (n=4)	No-Barotrauma Mortality (n=26)
African-American	19/30 (63%)	3/4 (75%)	16/26 (58%)
Men	21/30 (70%)	2/4 (50%)	19/26 (73%)
Female	9/30 (30%)	2/4 (50%)	7/26 (27%)
	P<0.05		**P<0.05**

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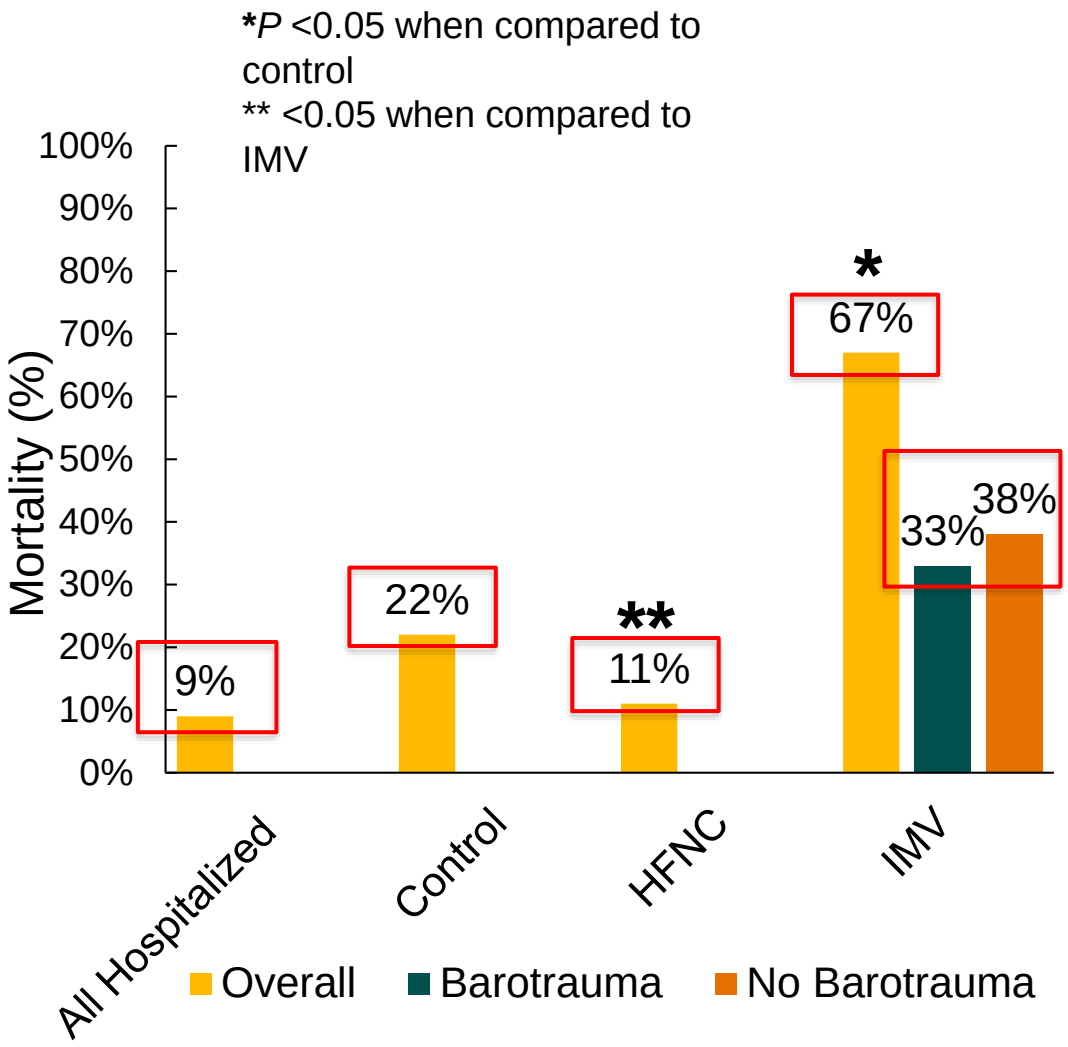
RESULTS - Mortality for IMV & HFNC



9% (45/506) died during their COVID-19 hospitalization

HFNC group	Total Mortality
African-American	3/5 (60%)
Men	1/5 (20%)
Female	4/5 (80%)

P<0.05

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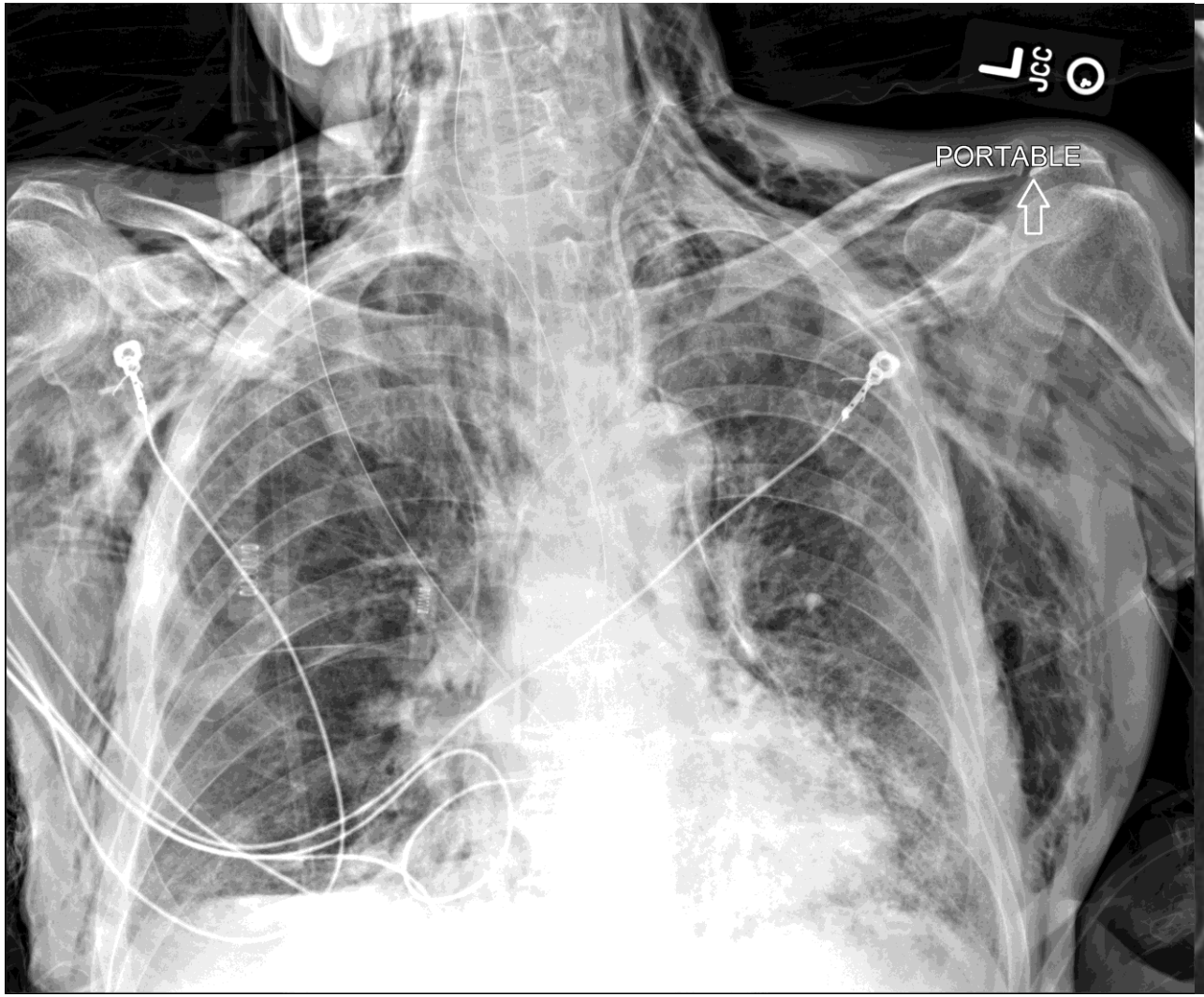
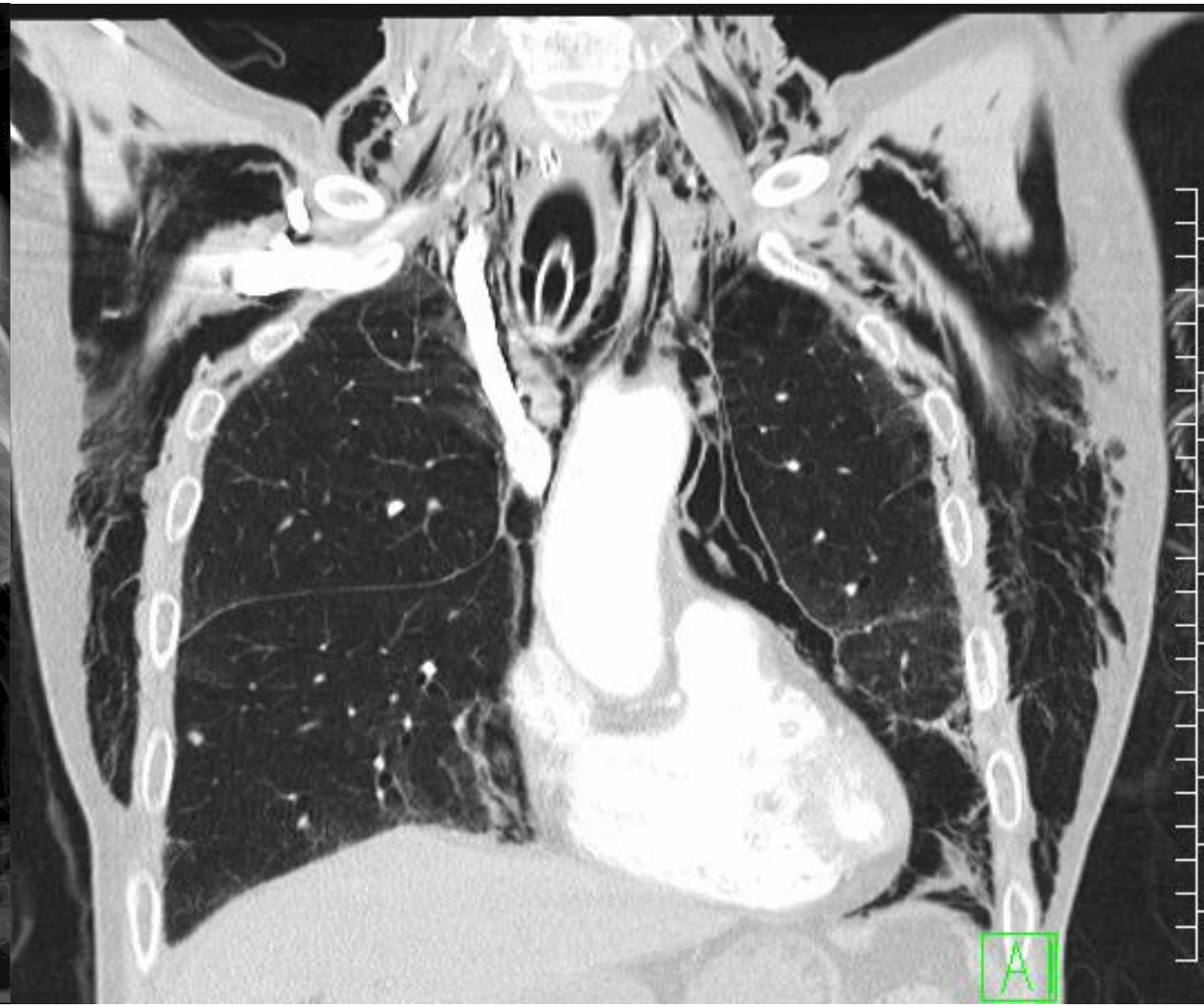
Case Example 1





78-year-old male on IMV

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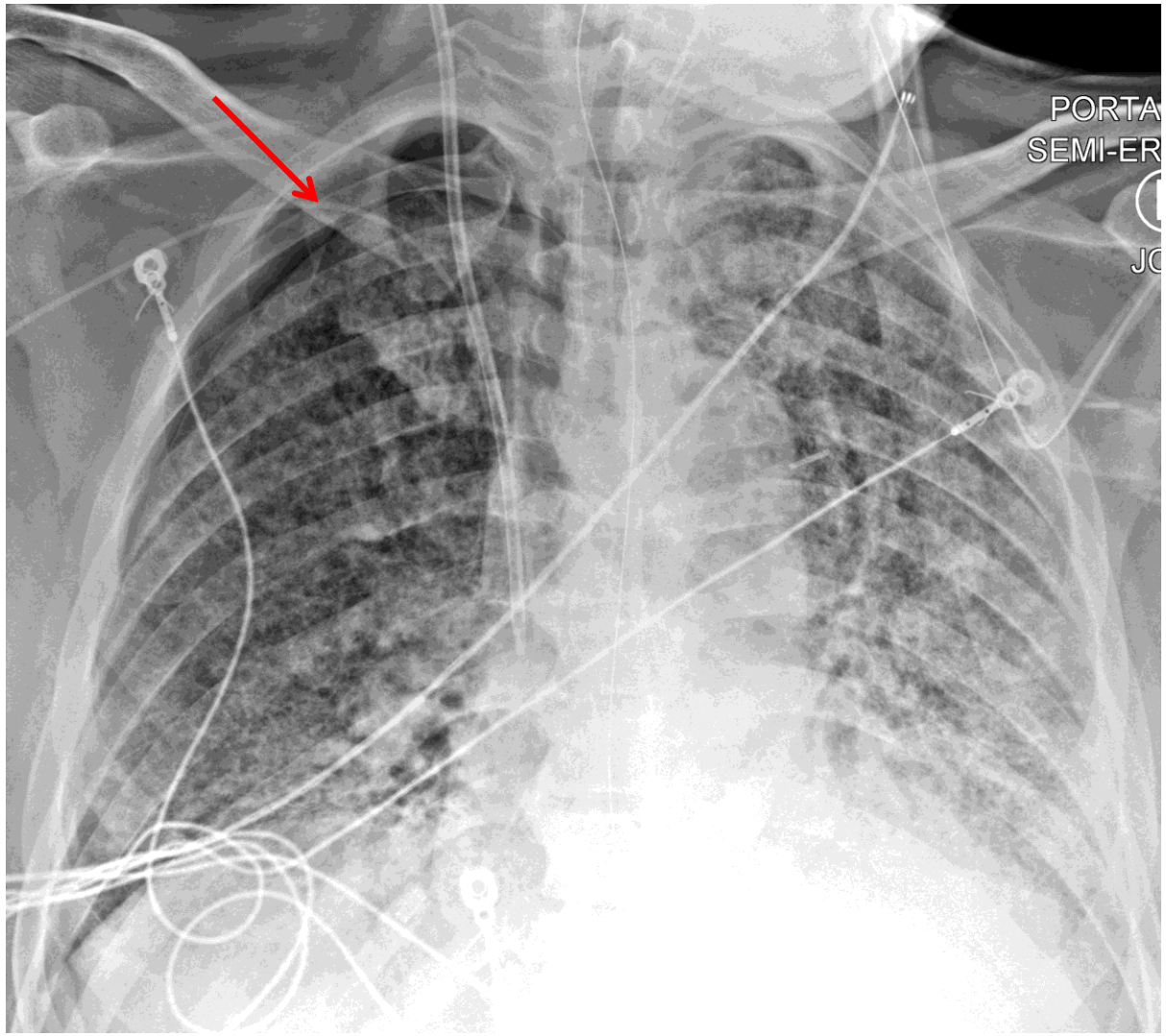
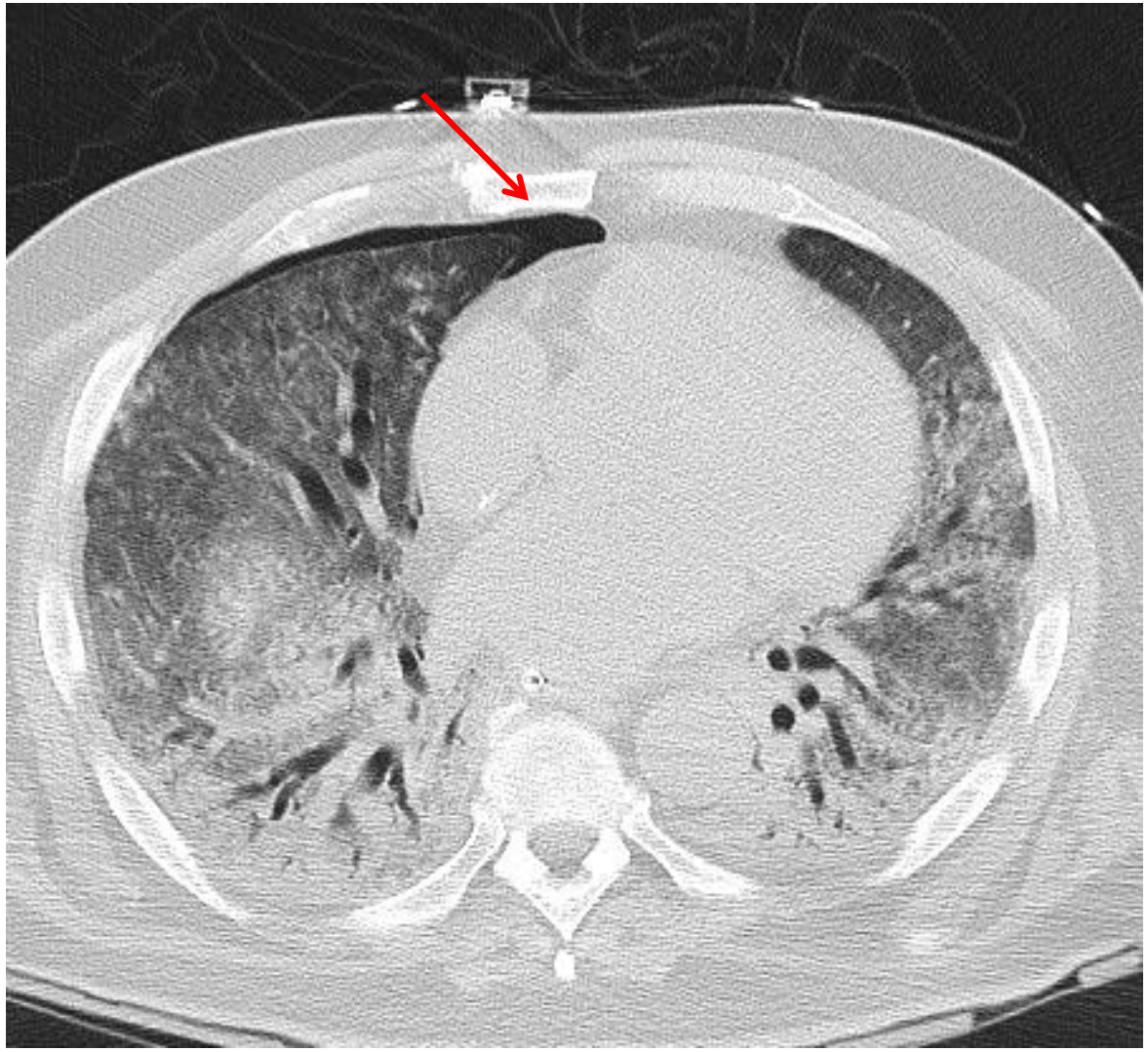
Case Example 2





57-year-old male on IMV

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Case Example 3

54-year-old female with on IMV

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Case Example 4

49-year-old male on HFNC

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Discussion – Barotrauma incidence

- IMV CARDS barotrauma:
  - McGuiness et al 2020 [7]: 15% (89/601 patients)
  - Rajdev et al. 2021 [6]: 17.3% (21/121 patients)
  - Steinberger et al 2022[8]: 12% (43/363 patients)
  - **Our study,** comparable at <u>15%</u> (12/80 patients)

  - <u>Non-COVID ARDS</u> barotrauma incidence (4.8-11%) [7]

- HFNC barotrauma:
  - Rajdev et al [6]: 4.7-8%
  - Our **study**, 1 case in 43 patients (2%)

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Discussion – Barotrauma types

- Shrestha et al. 2021 [9:] Pneumothorax 72% and Pneumomediastinum 52%
- Belletti et al. 2021 [10]: Pneumothorax 78.5% (chest tube needed in 18 patients; 1 required emergent thoracostomy)
- Steinberger et al 2021 [8]: Pneumothorax 40%
- **Our study**: Pneumothorax 60% and Pneumomediastinum 20%

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Discussion – Barotrauma and Mortality and Length of Stay

- Shrestha et al, meta-analysis of 13 studies [9]: average mortality of 58.7% for hospitalized patients with COVID barotrauma vs 40.6% mortality without barotrauma.
  - **Our study,** 33% mortality with barotrauma vs 38% mortality without barotrauma.

- McGuiness and Belletti et al [7,10]: Longer length of hospitalization and ICU admission associated with COVID-19 barotrauma
  - **Our study,** IMV barotrauma doubled length of hospital stay particularly in African Americans and men

- Men in the IMV group overall and African Americans in the IMV barotrauma group particularly face increased mortality.

Incidence of Barotrauma in COVID-19 (+) Hospitalized Patients
Conclusion

Increased barotrauma incidence and mortality associated with IMV management of CARDS should be taken into strong consideration particularly with males, African-Americans, and in the setting of prolonged ventilation with high respiratory rate ventilator settings.

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