

# MECHANICAL VENTILATION IN THE COVID ERA

ROBERT M. RODRIGUEZ, MD FAAEM

CLINICAL PROFESSOR OF MEDICINE AND  
EMERGENCY MEDICINE, UCSF



# OVERWHELMING NUMBER OF COVID PUBLICATIONS

- 40,000 MEDICAL PUBLICATIONS ABOUT COVID
- DIFFICULT TO SIFT THROUGH SO MUCH
- PREPRINT VS PEER-REVIEWED
- SEVERAL REPOSITORIES
  - [HTTPS://WWW.DIMENSIONS.AI/NEWS/DIMENSIONS-IS-FACILITATING-ACCESS-TO-COVID-19-RESEARCH/](https://www.dimensions.ai/news/dimensions-is-facilitating-access-to-covid-19-research/)
  - [HTTPS://PUBLONS.COM/PUBLON/COVID-19/?SORT\\_BY=DATE](https://publons.com/publon/covid-19/?sort_by=date)

# KEY MESSAGES

- 1) KEEP USING NIV
- 2) COVID VENTILATION – SIMILAR TO ARDS  
WITH SOME DIFFERENCES
- 3) FOCUS ON HYPOXIA
- 4) PRONING
- 5) COVID ICU COCKTAIL

# REVIEW - NON-INVASIVE MODES

CPAP (PEEP)

BIPAP

- GREAT FOR COPD AND CHF
- SEPARATE COMPONENTS
  - IPAP (INSPIRATORY SUPPORT)
  - EPAP (PEEP)

HI-FLOW

- GREAT FOR HYPOXIA
- SET FLOW AND FIO<sub>2</sub>
- BETTER FOR KIDS, AMS AND PALLIATIVE CARE

THAN BIPAP



# HOW TO MAKE NON-INVASIVE WORK

- FIRST 20 MINUTES
- ADJUST LEVELS OF IPAP, EPAP
- SEDATION
  - KETAMINE
  - FENTANYL



# DO NOT GIVE UP ON NIV IN COVID!

- MANY, IF NOT MOST, RESPIRATORY DISTRESS PATIENTS ARE NOT COVID
- EVEN FOR COVID, SHOULD STILL USE NIV
- NEGATIVE PRESSURE ROOMS
- PPE/PAPRS



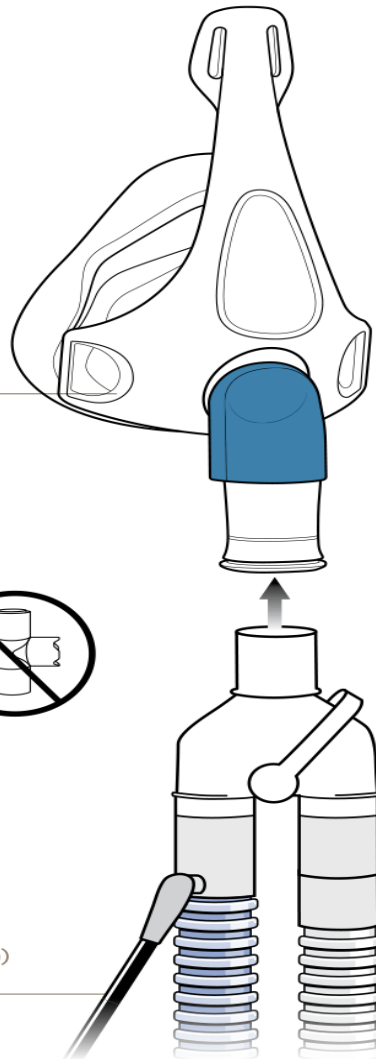
# NON-VENTED MASK SYSTEM



Non-vented  
mask with standard  
elbow



Circuit (dual limb)



# OTHER NIV COVID CHANGES

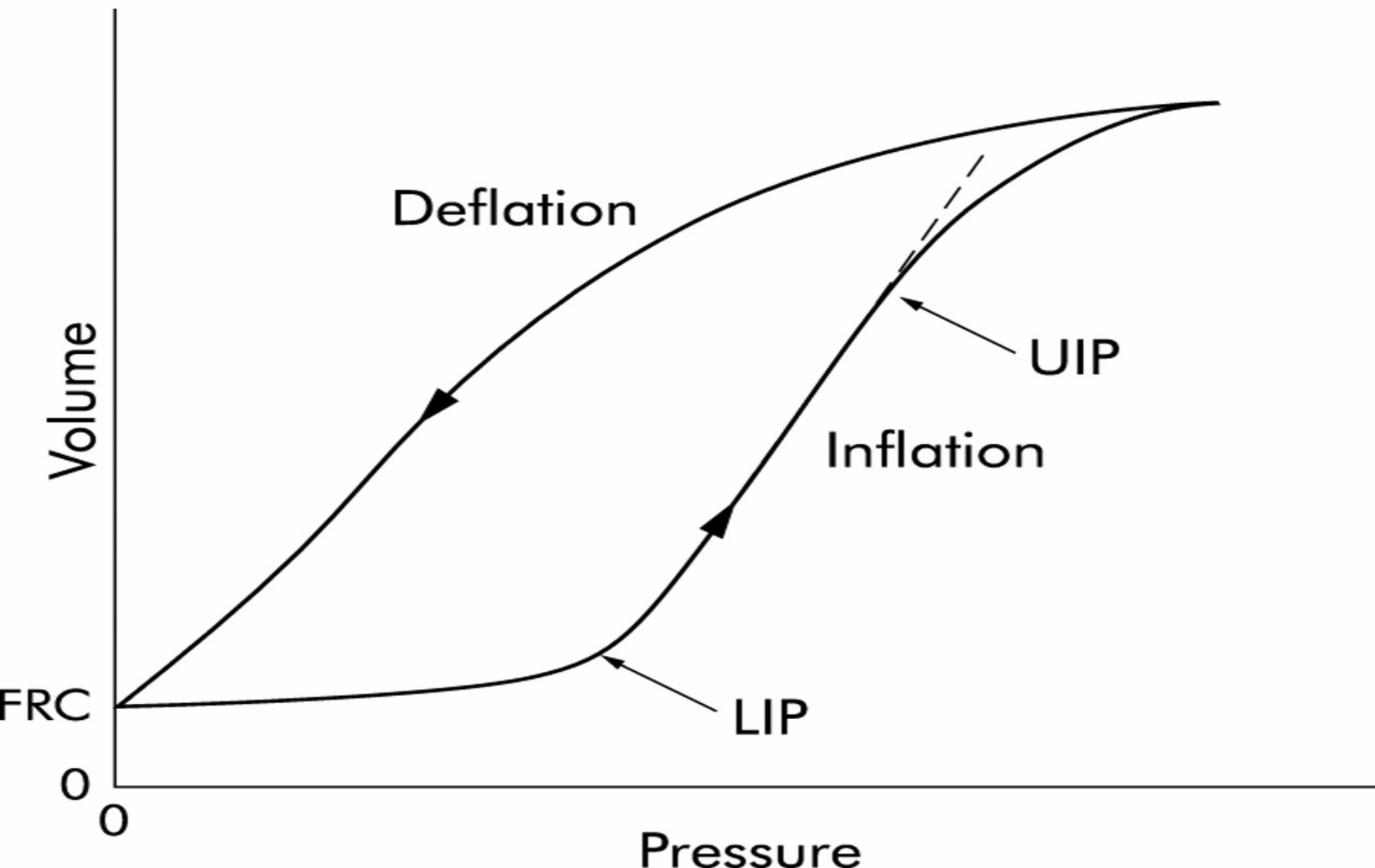
- PERHAPS FAVOR HI-FLOW OVER BIPAP
- LOWER PRESSURES IF USE BIPAP
- LOWER FLOW RATE FOR HI-FLOW: NO MORE THAN 20 L/MIN
- PERHAPS ABANDON IF NEED MORE THAN 70% FIO<sub>2</sub>
- LOWER THRESHOLD TO INTUBATE
- CONTINUE TO USE LOW DOSE KETAMINE



# PRIORITIES FOR INTUBATED MECHANICAL VENTILATION STAY THE SAME

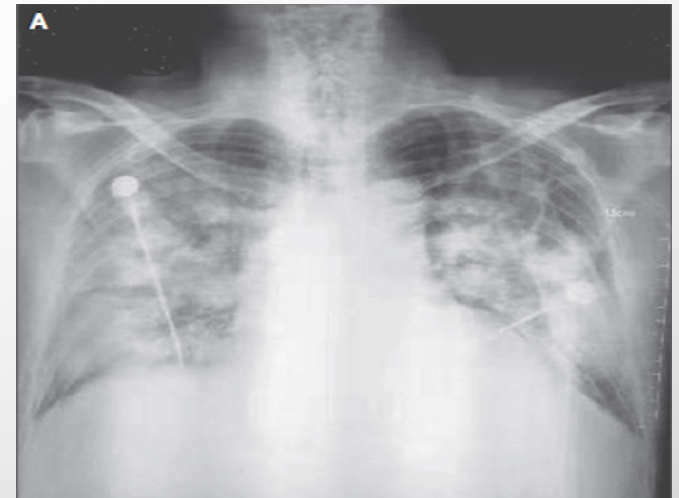
1. OXYGENATE
2. DON'T CAUSE CARDIOVASCULAR  
COMPROMISE
3. AVOID FURTHER LUNG INJURY
4. VENTILATE/ELIMINATE CO<sub>2</sub>

# ARDS - OPEN LUNG MODEL



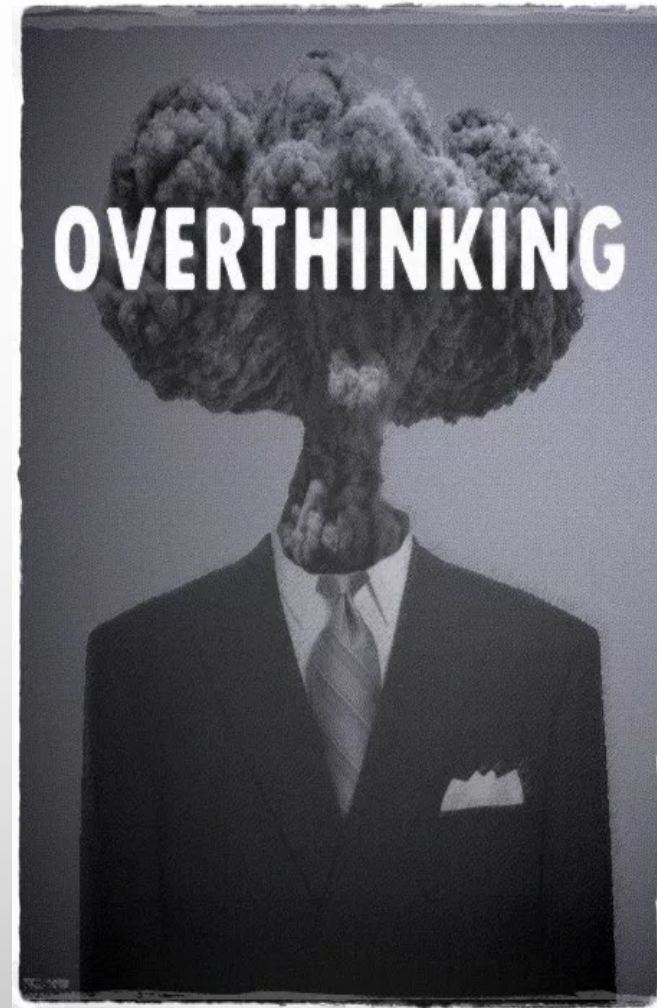
# COVID VS ARDS

- SIMILAR CXR BUT A BIT FLUFFIER
- SAME SEVERE HYPOXIA
- LUNGS NOT AS STIFF
- NOT AS MANY PROBLEMS WITH CO<sub>2</sub> ELIMINATION
- NOT AS MANY PROBLEMS WITH HIGH VENT PRESSURES



# COVID VENTILATION MODES— DON'T OVERTHINK!

- STICK TO PRESSURE CONTROL OR  
VOLUME CONTROL
- FOCUS ON SETTINGS!!!**



# COVID VENT SETTINGS: NOT ONE SIZE FITS ALL

## TIDAL VOLUME

- 6 – 8 CC/KG
- IDEAL BODY WEIGHT—HEIGHT
- CONSISTENTLY OVERESTIMATE TV FOR SHORT PEOPLE
- TAPE MEASURE

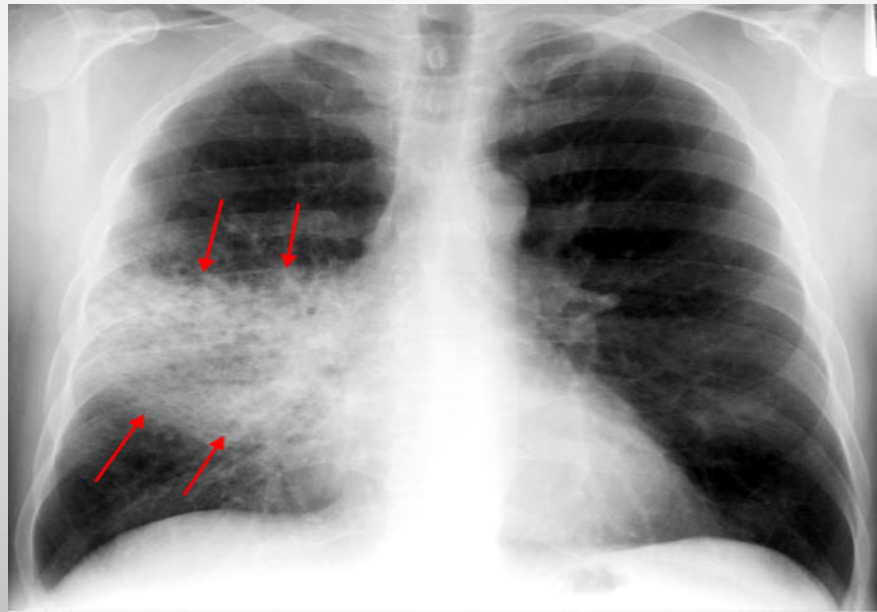


## PEEP

- HIGHER FOR HYPOXIA/ARDS
- COVID —PERHAPS A BIT LOWER PEEP THAN IN ARDS

# TAILORED PEEP

- PEEP BEST FOR DIFFUSE SYMMETRIC DISEASE (ARDS/CONTUSION)
- NOT SO GOOD FOR DIFFERENTIAL LUNG DISEASE (PATCHY ONE SIDED PNEUMONIA) – MAYBE LOWER PEEP IN THESE



# OTHER SETTINGS

**RATE** -- TYPICALLY NO NEED FOR HIGH RATES

-- 14 TO 24

## **FIO2**

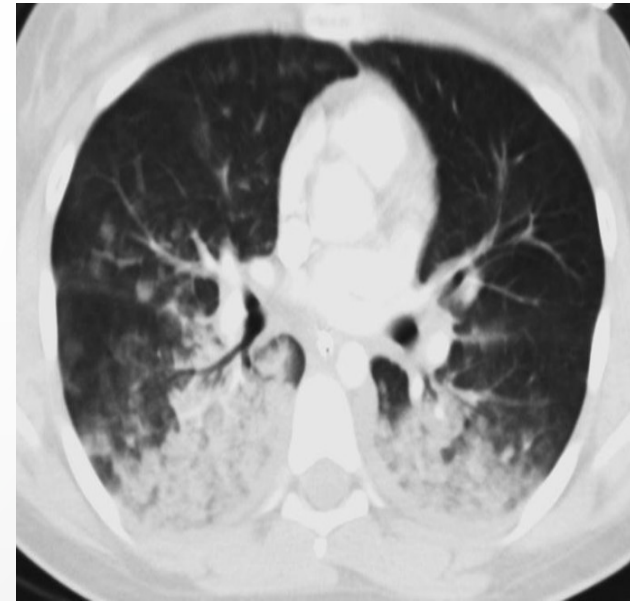
- AVOID SUPEROXIA**
- START LOW AND TITRATE UP**
- SAT 92-96%**



# INTUBATED - PRONING

## **ALL INTUBATED PATIENTS DEVELOP DEPENDENT ATELECTASIS**

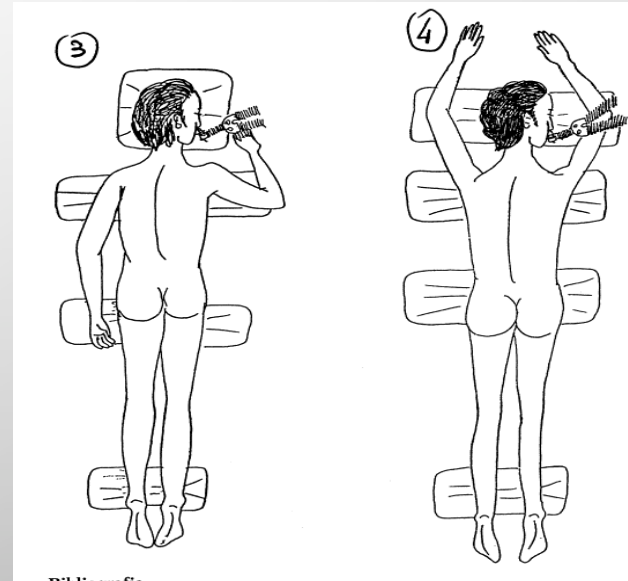
- PROSEVA 2013 TRIAL – IMPROVED MORTALITY IN ARDS
- PRONING
  - RECRUITS DEPENDENT ATELECTATIC ALVEOLI
  - IMPROVES FLOW TO VENTILATED AREAS
  - IMPROVES V/Q MISMATCH





# PRONING IN INTUBATED COVID

- PRONE EARLY AND OFTEN!
- PARALYZE
- PRONE AT NIGHT FOR 10 TO 14 HOURS
- WATCH TUBES

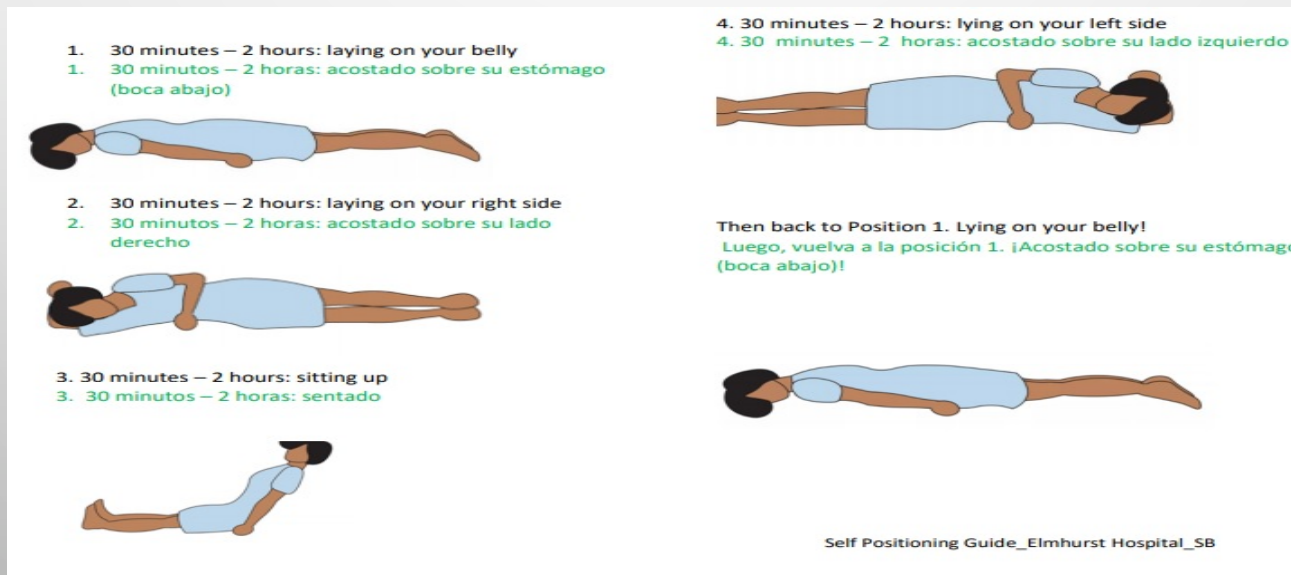


# NON-INTUBATED (SELF) PRONING

- SAME PRINCIPLE AS INTUBATED PATIENTS EXCEPT MORE **PREVENTATIVE FOR ATELECTASIS**
- SMALL TRIALS IN COVID SHOW PROMISE
  - MODEST IMPROVEMENTS IN OXYGENATION
  - MUST BE ABLE TO TOLERATE IT FOR AT LEAST 3 HOURS
  - DECREASED INTUBATION RATES IN THOSE WHO TOLERATE
- **BOTTOM LINE IS THAT IT IS VERY LOW RISK AND CAN IMPROVE THE SITUATION**

# HOW TO SELF-PRONE

- MOVE ECG AND OTHER MONITORS
- GIVE PADDING AND PILLOW
- TELL PATIENT TO ROLL OVER TO PRONE AND SELF-ADJUST
- MAKE SURE OXYGEN AND OTHER TUBES NOT BLOCKED
- OBS CLOSELY FOR FIRST 30 MINUTES FOR TOLERATION AND DESATURATION
- CYCLE 2 TO 4 HOURS
- CHECK FOR PRESSURE ULCERS/POINTS



## **Proning – Information Leaflet for Patients**

Try not to spend time lying flat on your back.  
Lying on your stomach and alternating positions will help get air into all areas of your lungs.

**Spend as much time as possible lying on your front as demonstrated below:**

### Lying on your front

Remove the head of the bed. Place pillows under chest and pillows on table at head of bed to support (Fig. 1 & 2); or supported with pillow between legs, head turned to side (Fig. 3)



Fig. 1



Fig. 2



Fig. 3

**\*\*If this becomes uncomfortable, please see below alternative positions; however remember to return to lying on your front when possible\*\***

### **1. Sitting up**



Fig. 4

### **2. Lying on right side**



Fig. 5

### **3. Lying on left side**



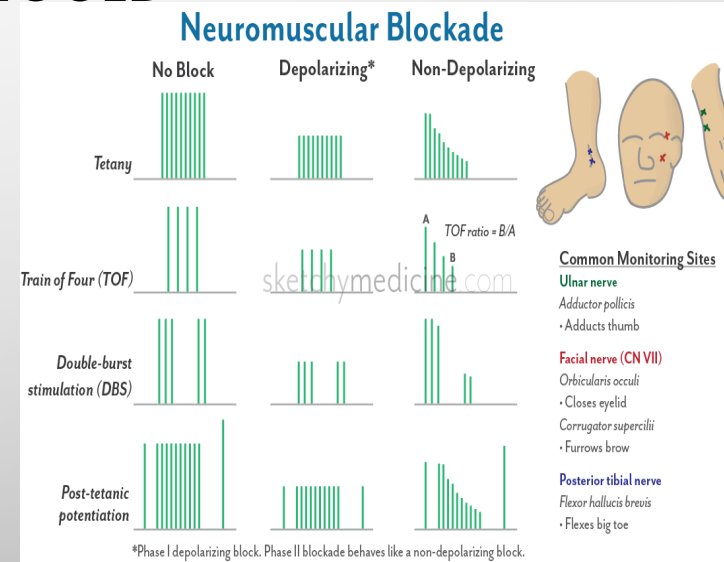
Fig. 6

# SELF-PRONING: EXCLUSIONS

- CHRONIC LUNG DISEASE OR CHF
- CHEST TUBES
- SPINAL INSTABILITY, VERTEBRAL COMPRESSION FRACTURES, OTHER SPINAL ISSUES
- GCS < 15/AMS/AGITATION
- HEMODYNAMIC INSTABILITY
- PREGNANCY
- MORBID OBESITY
- **MUST BE ABLE TO CALL FOR HELP**

# PARALYSIS – NMB BLOCKADE

- SAME INDICATIONS AS WITH ARDS
  - VENTILATOR SYNCHRONY
  - SEVERE HYPOXIA
  - TWITCH OR OTHER MONITORING
- SPECIAL CONSIDERATION OF PRONING PATIENTS-IF GOING TO PRONE THEM, SHOULD PARALYZE THEM



# INHALED AGENTS FOR HYPOXIA

- INHALED AGENTS THROUGH THE VENT OR EVEN VIA HI-FLO
  - EPOPROSTENOL
  - NITRIC OXIDE
- PULMONARY ARTERY VASODILATORS
- IMPROVE V/Q MISMATCH
- WATCH FOR CLOGGING



# ECMO



- LIMITED EXPERIENCE W COVID
- IMPROVED OUTCOMES IN FLU EPIDEMICS
- TREATMENT OPTION APPROVED BY FDA AND NIH
- GUIDELINES

[HTTPS://JOURNALS.LWW.COM/ASAIOJOURNAL/CITATION/ONLINEFIRST/INITIAL\\_ELSO\\_GUIDANCE\\_DOCUMENT\\_ECMO\\_FOR\\_COVID\\_19.98541.ASPX](https://journals.lww.com/asaiojournal/citation/onlinefirst/initial_elso_guidance_document_ecmo_for_covid_19.98541.aspx)

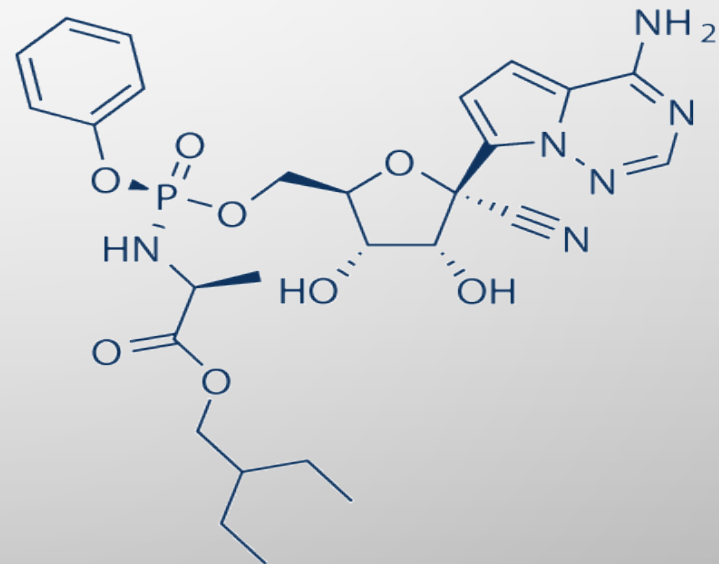


# COVID ICU COCKTAIL

- REMDESIVIR
- CONVALESCENT PLASMA
- ANTICOAGULATION
- DEXAMETHASONE

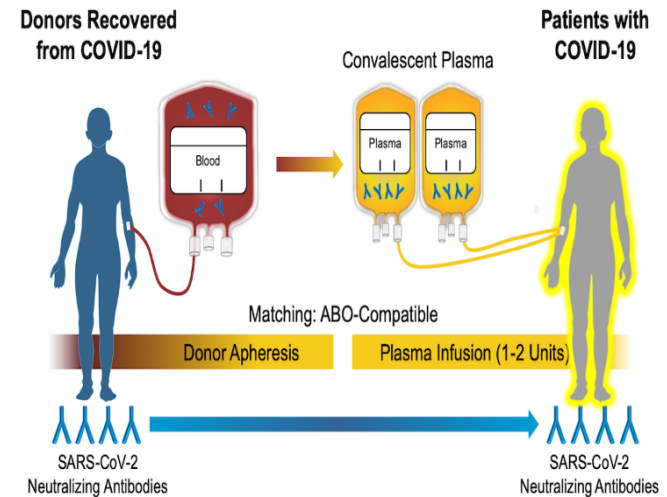
# REMEDESIVIR

- BROAD SPECTRUM ANTIVIRAL
- SHORTENS TIMES TO RECOVERY
  - 10 DAYS VS 5 DAYS
- TREND TOWARD IMPROVED MORTALITY
  - (7.1% VS 11.9%)



# CONVALESCENT PLASMA

- SINGLE DOSE (1-2 UNITS)
- FEW SIDE EFFECTS
- BEST EARLY ON
- [HTTPS://WWW.USCOVIDPLASMA.ORG/](https://www.uscovidplasma.org/)



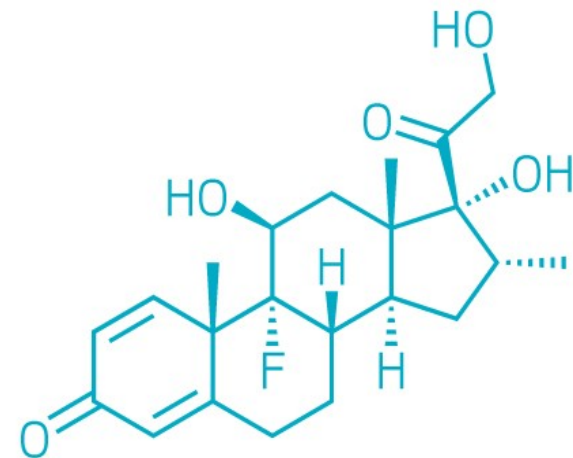
# ANTICOAGULATION IN COVID

- CLOTTING IS A MAJOR PATHOPHYSIOLOGIC MECHANISM
- BOTH MACRO AND MICROVASCULAR THROMBOSIS
- PULMONARY, CEREBRAL, EXTREMITIES
- ENOXAPARIN (30 – 40 BID)



# DEXAMETHASONE

- HYPERINFLAMMATORY STATE
- PREPRINT SO FAR
- APPROXIMATELY A THIRD LOWER MORTALITY
- ONLY FOR VENTILATED PATIENTS
- 6 MG Q DAY



**Dexamethasone**

# FINAL COVID MESSAGES

- DON'T GIVE UP ON THE ELDERLY
- ANXIETY IN HEALTH CARE PROVIDERS IS REAL  
*ACADEMIC EMERGENCY MEDICINE PHYSICIANS' ANXIETY LEVELS, STRESSORS AND POTENTIAL STRESS MITIGATION MEASURES DURING THE ACCELERATION PHASE OF THE COVID-19 PANDEMIC*
- GET HELP – CONSULT WITH FRIENDS AND COLLEAGUES