Acute Respiratory Distress Syndrome (ARDS): Lessons from the COVID Pandemic

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No disclosures

LEARNING OBJECTIVES

Objective #1: Understand the severity of COVID ICU illnesses

Objective #2: Understand the similarities & differences between other etiologies of ARDS vs. COVID

Objective #3: Understand post-ICU syndromes & possible rehab

SEVERE COVID-19

- Wu et al (2020)
  - Dyspnea
  - RR >=30
  - Oxygen saturation <= 93%
  - Pao_2:Fio_2 < 300 mm Hg, OR infiltrates > 50% of the lung field within 24 to 48 hours from the onset of symptoms
- ~5% with severe disease
  - Mortality ~25-50%

COVID ICU Group (2021)

- N=4643 (4244 w/90-day post ICU available)
- 138 hospitals in US
- February 25-May 4, 2020
- SAPS III 37
- 80% Ventilated
- Mortality 31%
  - Decreased from 42% to 25% over the time frame
- Mortality increased: older, DM, obese & severe ARDS

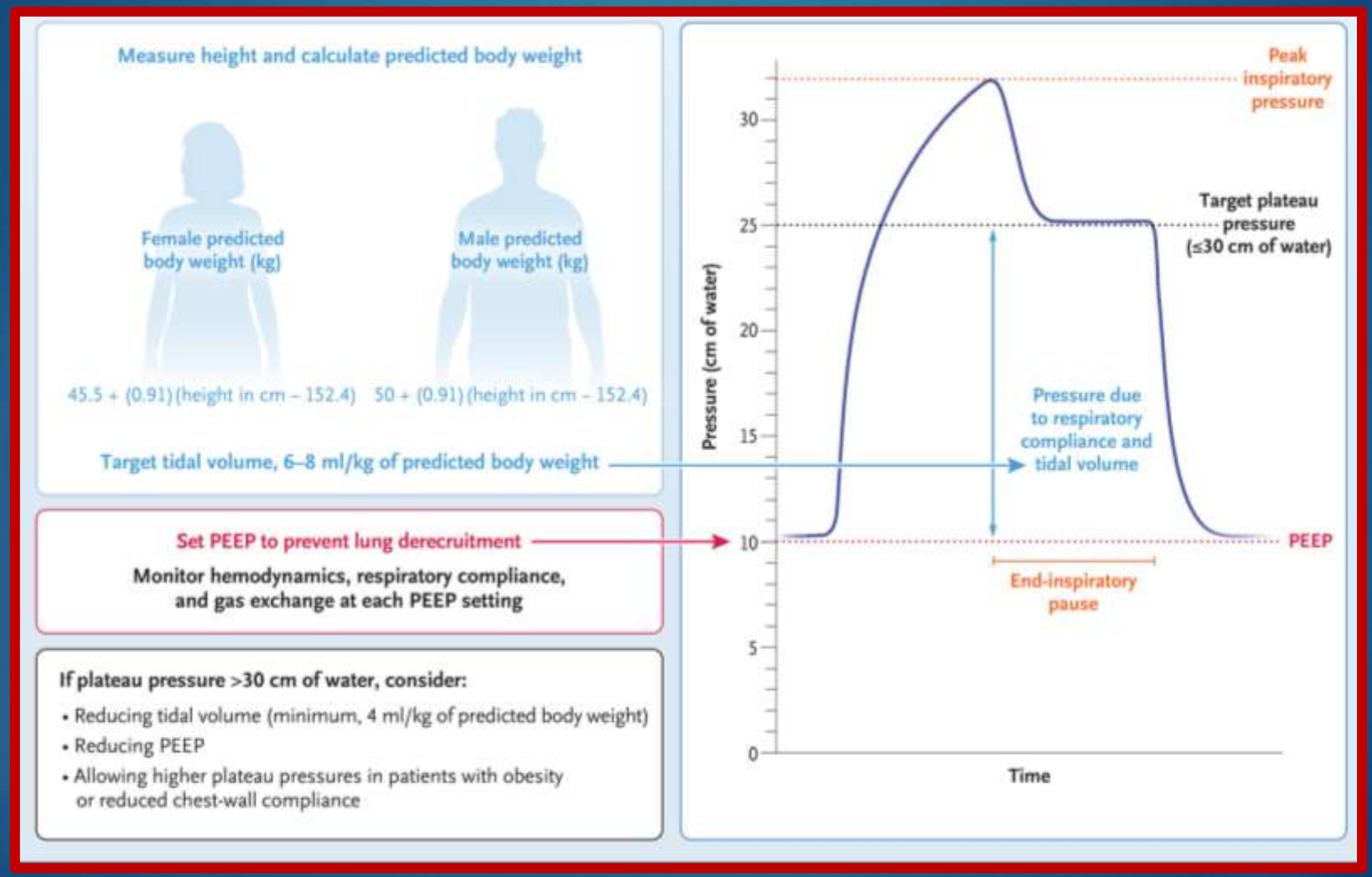
ORGAN INVOLVEMENT

- May be due to cytokine-release syndrome
- Pulmonary
  - ARDS, respiratory failure
- Hematology
  - Arterial & venous thromboses
- Renal
  - 5% require renal replacement

ORGAN INVOLVEMENT

- Cardiac
  - Myocarditis, CHF, arrhythmia, AMI
- Neurologic
  - CVA, encephalitis, polyneuropathy, anosmia, GBS
- Gastrointestinal
  - Diarrhea, nausea, transaminitis, ischemic bowel

VENTILATOR


Measure height and calculate predicted body weight
Female predicted body weight (kg)
Male predicted body weight (kg)
45.5 + (0.91) (height in cm – 152.4)
50 + (0.91) (height in cm – 152.4)
Target tidal volume, 6–8 ml/kg of predicted body weight
Set PEEP to prevent lung derecruitment
Monitor hemodynamics, respiratory compliance, and gas exchange at each PEEP setting
If plateau pressure >30 cm of water, consider:
• Reducing tidal volume (minimum, 4 ml/kg of predicted body weight)
• Reducing PEEP
• Allowing higher plateau pressures in patients with obesity or reduced chest-wall compliance
Peak inspiratory pressure
Target plateau pressure (≤30 cm of water)
Pressure due to respiratory compliance and tidal volume
PEEP
End-inspiratory pause
Pressure (cm of water)
30
25
20
15
10
5
0
Time

LONGTERM CHRONIC DX

- Some ARDS survivors have chronic dx
- Physical
  - Critical illness polyneuropathy (CIP)
  - Critical illness myopathy (CIM)
  - Mononeuritis multiplex
  - Chronic Fatigue

LONGTERM CHRONIC DX

- Pulmonary
  - Post intensive care syndrome
  - Fibrotic lung dx
- Neurologic
  - Cognitive dysfunction
  - Anxiety
  - Depression
  - PTSD

LONGTERM CHRONIC DX

- Pathology & course of severe COVID-19 similar to severe ARDS
  - Likely similar long term issues
- Improvements up to >=1 year post-ICU DC for ARDS survivors

CIP

- Critical Illness Polyneuropathy
- Symmetrical weakness
  - Proximal>distal
- Muscle atrophy
- Distal sensory loss

CIM

- Critical Illness Myopathy
- Associated w/exposure to
  - Steroids, paralytics, sepsis
- Symmetrical weakness
  - Proximal>distal
- Muscle atrophy
- Sensory preservation

MONONEURITIS MULTIPLEX

- Needham et al (2021)
- 11/69 patients w/severe ARDS
- Initially diagnosed as critical illness myopathy
- Focal neurologic deficits
  - Upper & lower extremities
- EMG not c/w diffuse myopathy

PHYSICAL IMPAIRMENTS

- Proning
  - Shoulder injuries (subluxation)
  - Brachial Plexus Injuries
- Prolonged intubation
  - Laryngeal injury
  - Dysphagia
  - Diaphragm dysfunction
- Long term fatigue

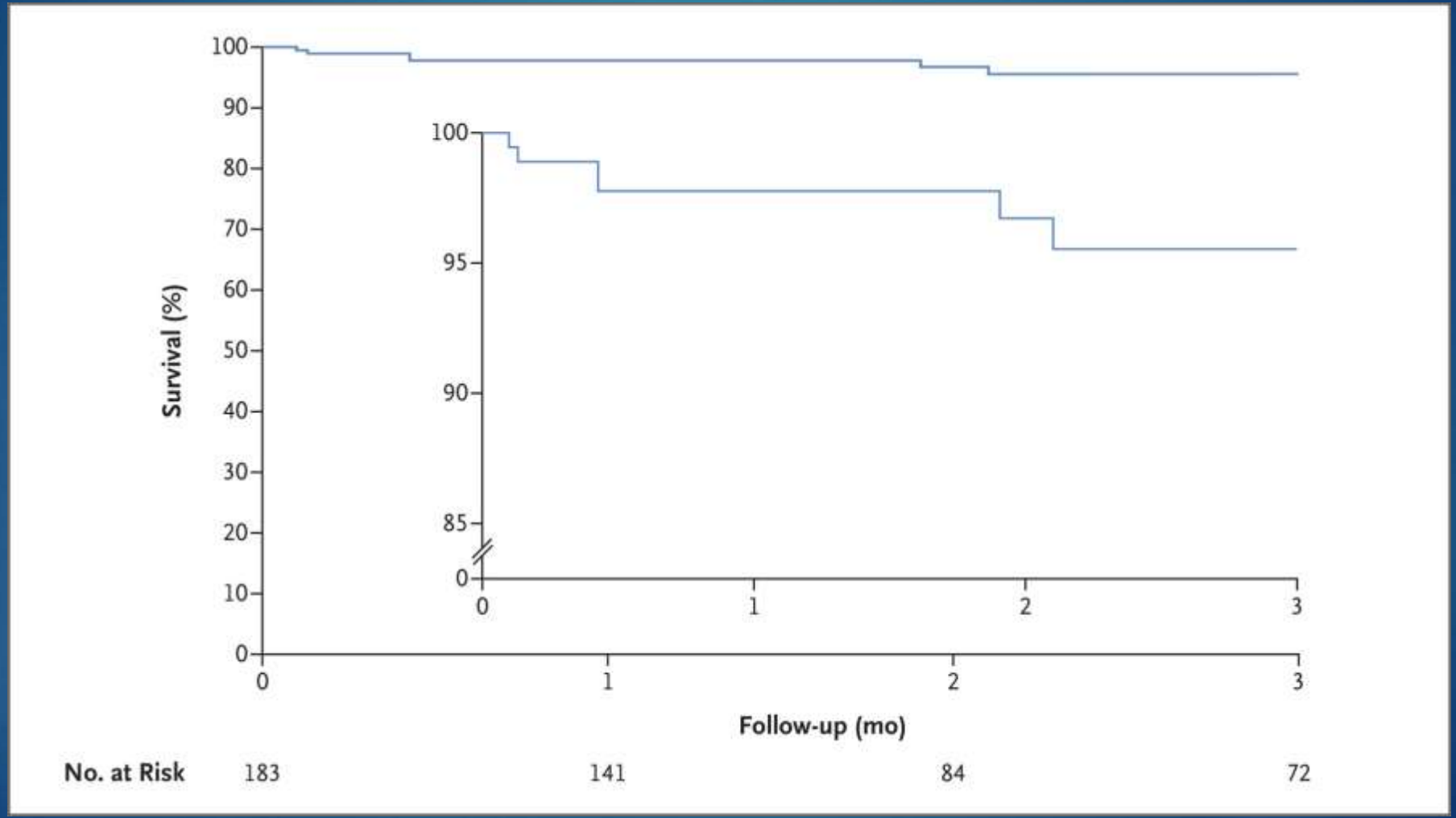
POSTINTENSIVE CARE SYNDROME

- Restrictive PFTs
- Reduced inspiratory muscle strength
- Poor upper extremity grip strength
- Low functional capacity

FIBROTIC LUNG DX

- Roach et al, NEJM Jan 26, 2022
- UNOS Data (August 2020-Sept. 2021)
- N=183, median age 52, COVID
- 7% of lung transplants for that period
- 3-month survival approached other transplant etiologies
- Complications: Death (9), stroke (6), rejection (11)

LUNG TRANSPLANTATION



COGNITIVE IMPAIRMENTS

- Prolonged ventilation = Prolonged delirium
- Most Prominent Deficits in
  - Memory
  - Executive Function
  - Attention Deficits

MENTAL IMPAIRMENTS

- ?Not related to severity of illness
- Isolation has >risk for mental disorders
- Disorders
  - Anxiety
  - Depression
  - PTSD
  - Survivor guilt

LONGTERM ORGAN DYSFUNCTION

Organ systems w/same & different involvement vs other etiologies of ARDS

- Cardiac-AMI, myocarditis
- Renal-AKI
- Pulmonary-higher risk for fibrosis
- Neuro-CVA in young patients
- Hematologic-thromboses, coagulopathy

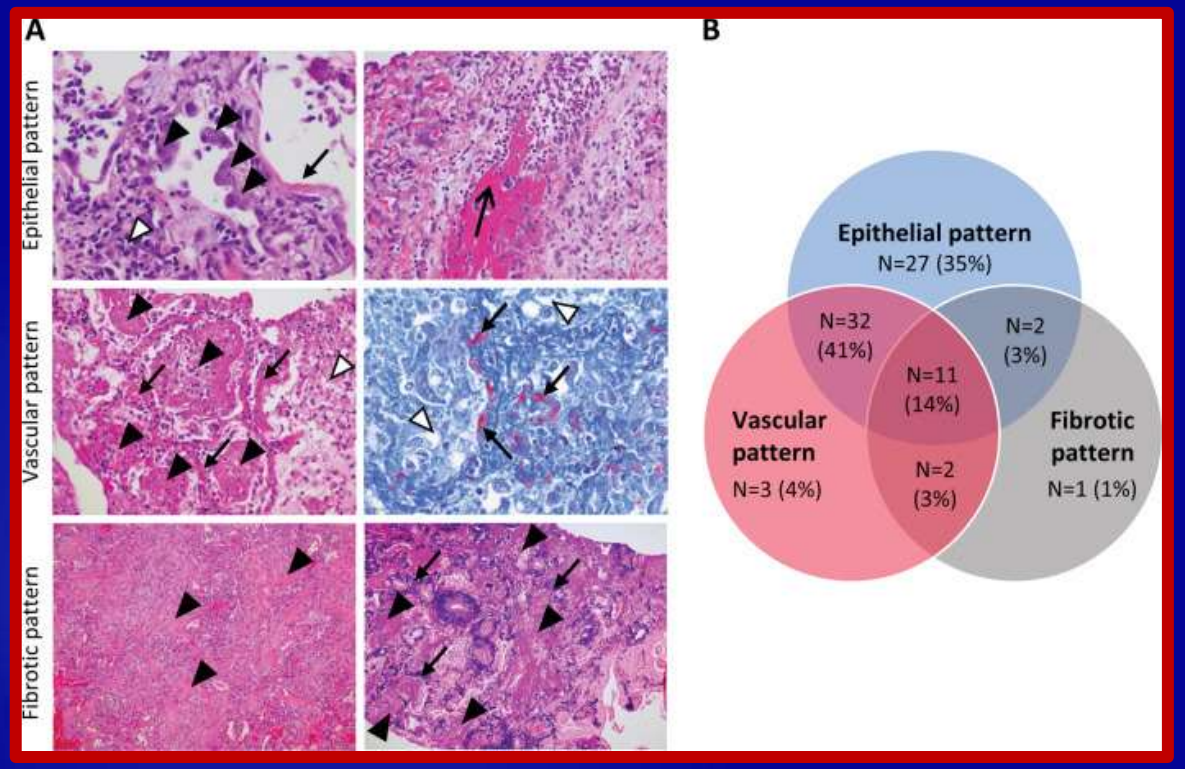
LONGTERM ORGAN DYSFUNCTION RISKS

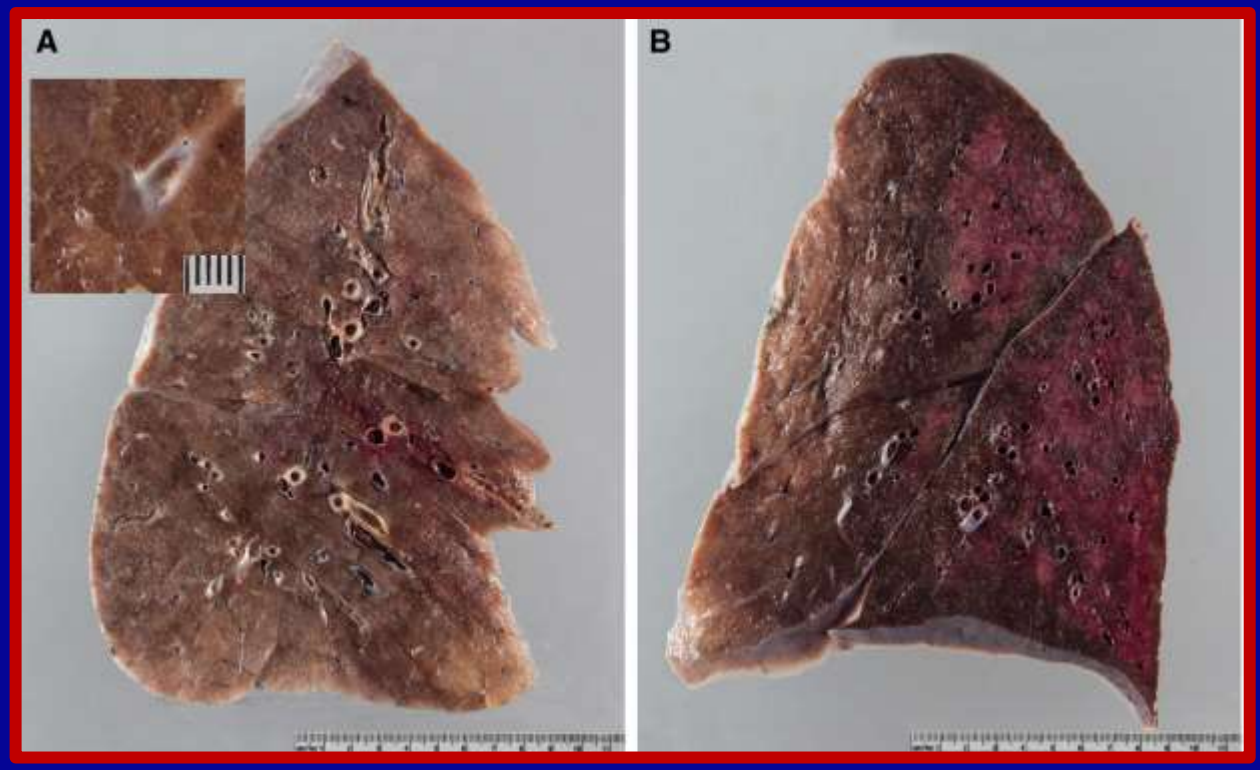
- Many patients have significant pre-existing co-morbidities
  - ?Interplay w/organ injury & failures
- Older patients w/significant frailty
  - ?Interplay w/mortality, morbidity, recovery

PULMONARY DYSFUNCTION

- Most frequent organ w/severe COVID-19
- Degree of improvement long term unknown
  - Severe ARDS survivors may have moderate/severe residual disease
  - Torres-Castro et al (2021)
    - Meta-analysis COVID survivors
    - N=380
    - Restrictive, obstructive and DLCO defects

PULMONARY PATHOLOGY





Severe injury seen in COVID-19 pathology: DAD, hemorrhage, fibrosis

CARDIAC DYSFUNCTION

- Persistent damage after recovery possible
  - CV dysfunction affects ~20-25% of patients admitted w/COVID-19
- CV dysfunction present
  - Increased risk for ventilatory support & death

CARDIAC DYSFUNCTION

- Xie et al (2022)
  - 12 months out from COVID
  - VA database (control vs COVID)
  - Increased risk
    - Dysrhythmias
    - Ischemic and non-ischemic heart disease
    - Pericarditis, myocarditis
    - Heart failure

RENAL DYSFUNCTION

- Gupta et al (2020)
  - N=3099
  - 67 hospitals in US
  - 21% w/AKI-RRT within 14 days of ICU admit
  - Mortality >60%
  - 39 (18%) RRT dependent 60 days after ICU admission

RENAL DYSFUNCTION

- Bowe et al (2021)
  - VA database (controls vs COVID)
  - 30-day survivors
  - Increased risk for
    - AKI
    - Decline in GFR
    - Major adverse kidney events (ESRD, Decrease in GFR>=50%, death from kidney disease)

ICU LESSONS

- Mortality has improved
- MV
  - Later if possible, use non invasive 1st
  - Same strategies as ARDS due to other etiologies
- Manage organ failures
- Long term disease is an issue

WHAT HAPPENS TO SURVIVORS?

Ahmed et al (2020)

- SARS and MERS patients
- Literature search
- 28 articles (26 SARS, 2 MERS)
- HRQoL
  - Measured using SF-36
  - Reduced at 6 months post admission
- Reduction in DLCO present in 11–45%
- ~30% w/ anxiety, depression, PTSD
- Did not distinguish between ICU & non-ICU survivors

Musheyev et al (2021)

- N=118
- Retrospective, United States
- Calculated Barthel Index, Modified Mental Status, ICU Mobility Scale
- Analysis at hospital DC

Musheyev et al (2021)

- Worse functional status associated w/
  - Longer MV
  - Older age
  - Male sex
  - Higher number of comorbidities
    - Htn, DM, COPD, immunosuppression

Medrinal et al (2021)

- N=23
- 2 ICU, 60 beds; France
- Retrospective; 30 days post DC
  - No standardized testing
- 69% limb muscle weakness
- 26% limb & respiratory weakness
- 44% unable to walk 100 m

Halpin et al (2021)

- N=100
- 32 ICUs; United States
- Prospective
- Screened 4-8 weeks post DC
- Fatigue, breathlessness, psychological distress ICU >> Ward
- EQ5D dropped significantly in 68% ICU vs 45% Ward

Taboada et al (2021)

- N=183 (32 in ICU)
- Prospective, 32 ICUs; Spain
- 6 month FU
- Functional status: post-COVID-19 functional status scale (PCFS)
- ICU patients had significant limitations in every day life compared w/non-ICU
- Female sex, age, LOS, MV, & ICU admit associated w/limitations in function (grade II-IV PCSF)

Puchner et al (2021)

- N=23
- Prospective observational study; Austria
- Individualized rehab
- High percent of patients upon admission w/
  - Post intensive care syndrome
  - Diminished PFTs
  - Cognitive issues
  - Decreased 6-minute walk time

Puchner et al (2021)

- At D/C from rehab
  - Residual diffusion deficits
  - Cognitive issues
  - Abnormal 6-minute walk time

Rousseau at el (2021)

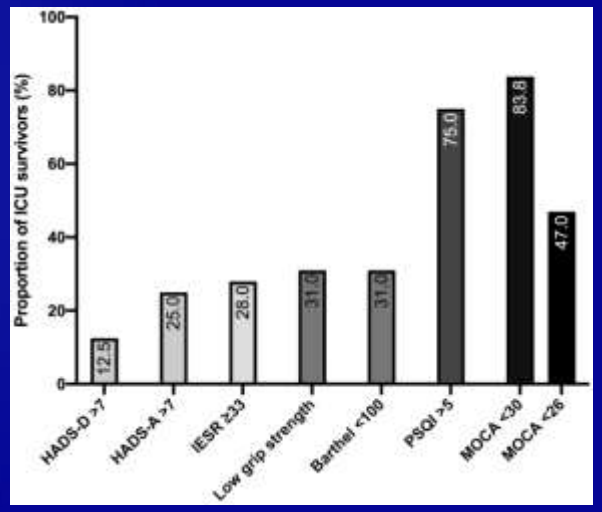
- N=32 (80% of survivors)
- Prospective, 3 month evaluation
- 60 bed ICU; March 2020-July 2020; Belgium

Rousseau at el (2021)

- Testing
  - Health-related quality of life (EQ-5D-3L)
  - Sleep disorders (PSQI)
  - Physical status (Barthel index, handgrip and quadriceps strength)
  - Mental health disorders (HADS and IES-R)
  - Cognitive impairment (MoCA)
  - Biological parameters
    - CRP, Cr

Rousseau at el (2021)

- Prolonged MV (ave. 21 days)
- 2/32 tested normal for all parameters
- ~50% went to rehab
- 20% still hospitalized/rehab at 3 months



Frithiof et al (2021)

- N=111
- Observational cohort
- EPS and EMG to diagnose CIN/CIM
- Compared COVID vs nonCOVID ICU patients who had positive studies

Frithiof et al (2021)

- Results
  - 11 COVID with CIN/CIM
  - Risks
    - LOS ICU
    - Thromboembolic events
    - Days MV
    - Vasoactive meds
    - Renal replacement therapy
  - COVID vs nonCOVID with CIN/CIM
    - COVID-CIN w/axonal sensorimotor polyneuropathy
    - nonCOVID-CIM

Xie et al (2021)

- VA database
- Compared COVID vs nonCOVID VA patients
- Hospital & non-hospitalized
- Results
  - Increased
    - Depression
    - Anxiety
    - PTSD
    - Use of Benzos, opioids, antidepressants
    - Neurocognitive decline

Hazarika et al (2021)

- N=145 (final N=74 due to lost to f/u, death)
- Groups: non-invasive vs MV
- Moderately severe ARDS
- Prospective, 3 month hospital DC, India
- Testing
  - PFTs
  - 6-minute walk
  - HRQOL (SF-12)

Hazarika et al (2021)

- MV group sicker (e.g. higher SOFA, lower PAO2/FIO2)
- Restrictive PFTs
  - MV >non-invasive
  - 82% w/abnormal PFTs
- Decreased 6-minute walk
  - MV worse vs non-invasive
- SF-12
  - Physical component decreased-MV much worse
  - Mental component decreased-no difference

Jacquet et al (2022)

- N=41
- Prospective, 3-6 month post ICU DC, France
- Testing
  - Montreal Cognitive Assessment score
  - Medical Research Council (weakness)
  - Hospital Anxiety and Depression score
  - Posttraumatic stress disorder checklist for Diagnostic and Statistical Manual of Mental Disorders 5

Jacquet et al (2022)

- Results
  - 60% had some disability
  - Mild cognitive impairment: 17/33 tested
  - Weakness: 6/37 tested
  - Depression or anxiety: 8/31 tested
  - PTSD 2/27: tested
- 74% required rehab
- Negative outcomes
  - ICU, hospital LOS
  - Tracheostomy
  - Corticosteroids

ICU SURVIVOR LESSONS

RECOVERY OF IADLS

RETURN TO WORK

FAMILY MEMBER RECOVERY

RECOVERY OF IADLs

- Hopkins et al (2017)
- ICU population systematic review
- 16 studies; 4,723 survivors
- IADLS–Shopping, Housekeeping, Accounting, Food preparation &Telephone/Transportation (SHAFT)
- 11 studies (69%): survivors of critical illness w/new or worsening IADL dependencies
- 3 of 4 longitudinal studies-IADL dependencies decreased over time, but did not disappear

RETURN TO WORK

- Kamdar et al (2020)
- ICU population systematic review
- 52 studies, 10,015 previously employed survivors
- ~2/3, 2/5 & 1/3 of previously employed ICU survivors are jobless up to 3, 12 & 60 mos. after hospital d/c
- Survivors returning to work often experience
  - Job loss
  - Occupation change
  - Worse employment status

FAMILY MEMBERS

- Johnson et al (2019)
- ICU population systematic review; 40 articles (>5000 w/FU)
- Caregiver experience during ICU STAY
  - Anxiety 0-73%
  - Severe depression 16-42%
  - PTSD 14-81%
- Caregiver experience post-ICU
- Anxiety 2-80%
- Depression 4-94%
- PTSD 3-62%
- Decreased or unchanged prevalence over time

Van Veenendaal et al (2021)

- 60 survivors/78 family members; Netherlands
- Prospective; questionnaires at 3 & 6 mos. post-ICU DC
- Physical functioning
  - MOS Short-Form General Health Survey
  - Clinical Frailty Scale
  - Spirometry (including DLCO)

Van Veenendaal et al (2021)

- Social functioning
  - McMaster Family Assessment Device
  - Return to work
- Psychological functioning
  - Hospital Anxiety and Depression Scale

Van Veenendaal et al (2021)

- Physical functioning impaired at 3 & 6 months
  - 33.3 (IQR 16.7-66.7) & 50 (IQR 16.7-83.3) (ttl 100)
  - 90% reported continued impairment > 6 mos.
- Social function impaired in 90%
- Psychological impairment patients < family
  - 63% of family w/ongoing impaired well-being
  - Family members also couldn't return to work

Heesaakers et al (2022)

- Prospective, March 1, and July 1, 2020
- Family members COVID-19 ICU survivors 3 &12 months post-ICU
- Prevalence of mental health symptoms
  - Hospital Anxiety and Depression Scale
  - Impact of Event Scale-6 (PTSD)
  - QoL (Short Form-12)
- N=197, 84% completed 12-month survey
- 46%, 38% had mental health symptoms @ 3, 12 months
  - Baseline prevalence 22%-predicted higher rate post ICU
  - 28% w/work related problems

HOW CAN YOU BE PRESENT FOR SEVERE COVID PATIENTS?

REHABILITATION

- Rehab w/multidisciplinary team
  - PT, OT, ST, PMR, Pulmonary, Cardiology
  - Demonstrated efficacy in patients w/ severe ARDS, other critical illness w/ prolonged ICU stays (Hopkins, Herridge, Needham)
  - Recommendations from Barker-Davies et al (UK) & Curci et al (Italy) are similar to those for ARDS patients

REHABILITATION ISSUES

- COVID may impede rehab, extend rehab times
- Increased frailty due to age, isolation
- More cardiac complications
- Chronic fatigue

REHABILITATION

- Early mobilization in ICU
- Cardiac rehab
- Early & long-term OT/PT/ST
  - Recognition of syndrome(s) to facilitate targeted therapy
- Cognitive testing with rehab, job retraining
- Screening for depression, PTSD, Anxiety
- Management of family during & post ICU

TAKE HOME MESSAGES

COVID IN ICU

- May have Severe ARDS
- Low Vt management, noninvasive management
- Multiorgan failure common
- Lung transplant has a role in fibrotic disease

ICU COVID survivors may

- Need extensive multi-team rehab
- Have persistent deficits w/long rehab
- Not achieve pre-COVID functional status

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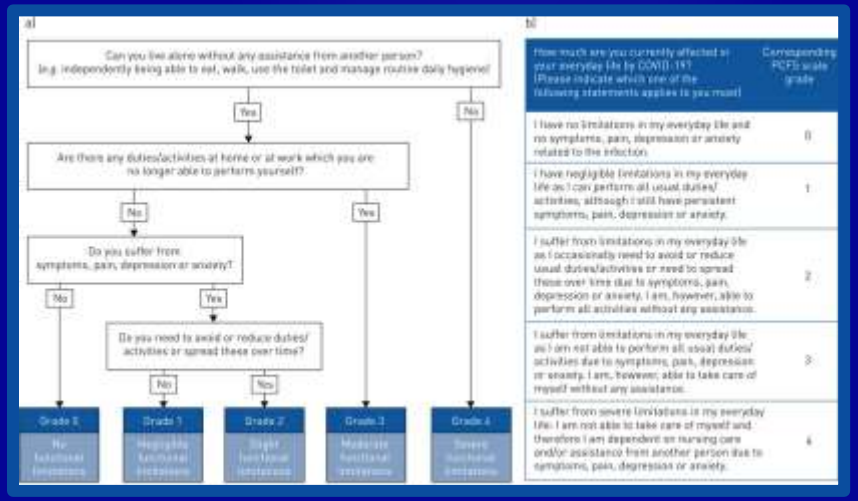
EVALUATION-IN OFFICE

- IHC Pulmonary, Yonter et al
- Walking pulse oxi/6-minute walk
- Questionnaires & screenings
  - Post Covid-19 Functional Status scale – https://bit.ly/3cofGaa
  - GAD-7 – anxiety
  - PHQ2/9 – depression
  - SBIRT – substance use
  - MOCA – cognition
  - PSS/IESR/SPTSS – PTSD
  - Labs – CBC, CMP, dimer, TSH, A1C, & EKG
    - Consider Vit D, Vit B12 in patients with profound fatigue



EVALUATION-F/U

- CT chest
  - 3 month follow up if abnormal imaging on diagnosis
- Consider follow up inflammatory markers
  - ferritin, CRP, trop, CPK, pro-BNP, procalcitonin for persist symptoms
- Ongoing pulmonary symptoms
  - Referral to pulmonary, PFT, chest CT/CTA, ECHO
- Ongoing chest symptoms or abnormal EKG
  - Referral to cardiology, ECHO, cardiac MRI, stress test, Holter monitor