POST-ICU COVID-19

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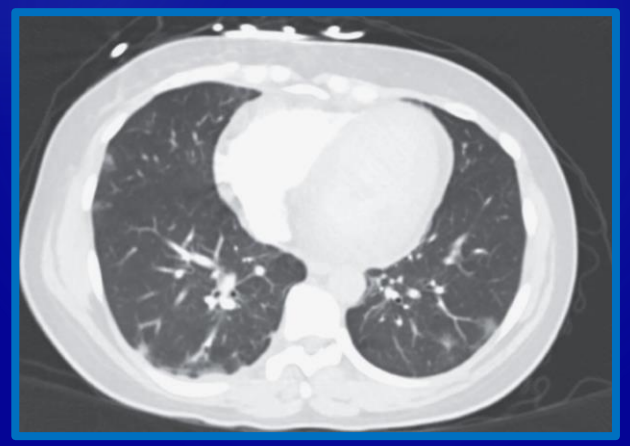


No disclosures

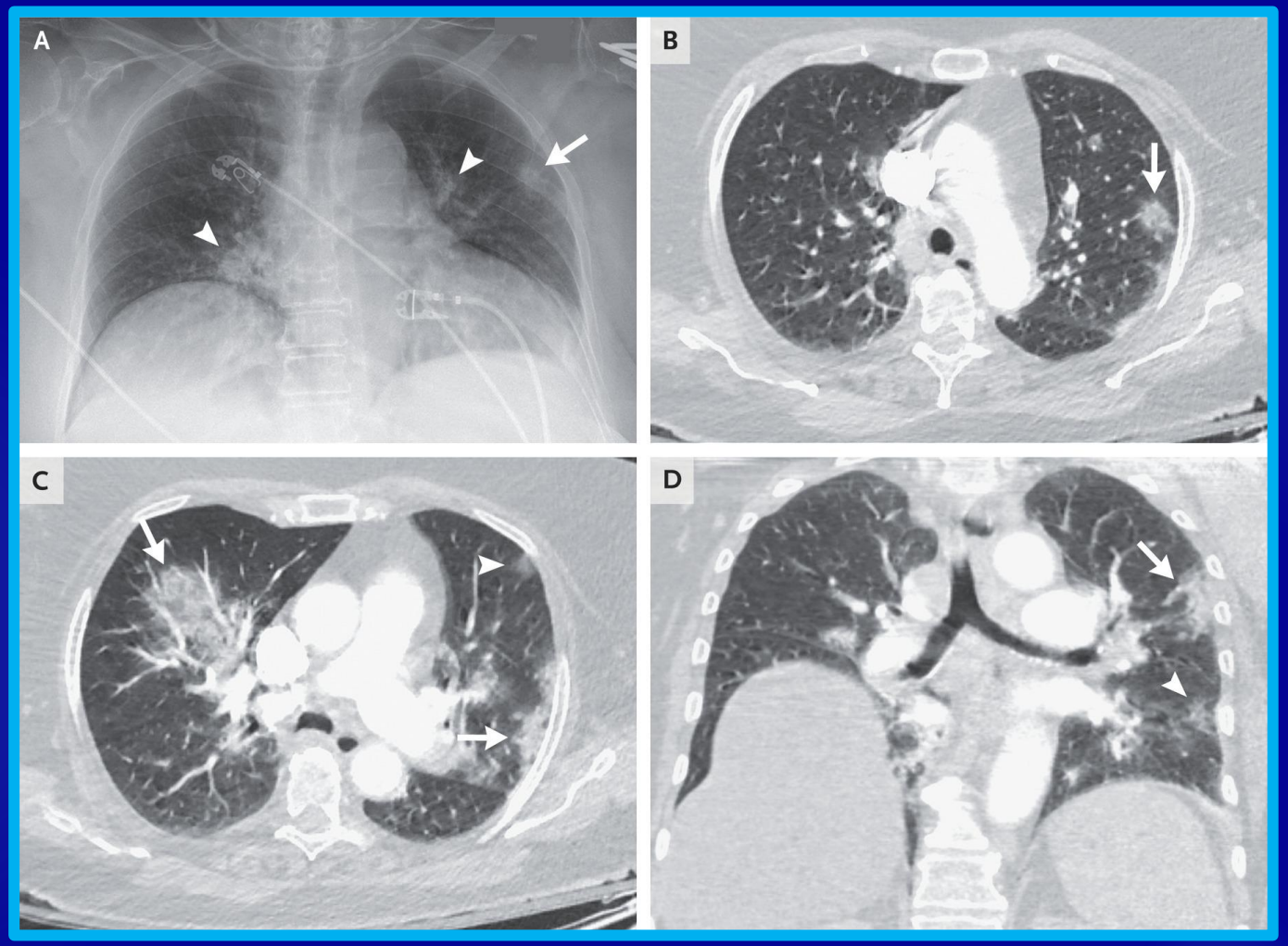
LEARNING OBJECTIVES

- Objective #1: Understand the severity of COVID ICU illnesses
- Objective #2: Understand that the majority of patients with COVID have ARDS & as such have a similar yet different course as other patients with ARDS
- Objective #3: Understand Post ICU syndromes & possible rehab for these patients

CASE PRESENTATION

A 45 year-old female presented to ER w/ SOB & cough. She had viral s/s for 7 days. Temperature 38˚C, HR 110, BP 102/70 & RR 26 w/saturation 85%. CXR w/ground glass opacities. Labs: CBC 4,500 w/lymphopenia, normal electrolytes. Oximetry improved to 95% on 4L/NC. IV fluids administered; she was admitted to the floor. PCR was positive for SARS-CoV-2. She required increasing oxygen & was transferred to the ICU.

IMAGING



CASE PRESENTATION

She spent 66 days in the ICU (30 days ventilated) & was admitted to acute rehabilitation for 6 weeks. She was discharged to home, but her family was distressed at her level of functioning.

WHAT HAPPENS TO COVID PATIENTS WITH EXTENDED ICU STAYS?

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%

SEVERE COVID-19

- Age > 65 yrs.
- Men > women
- Ethnicity: Hispanic, African American, Polynesian, Native American
- Underlying diseases: CVD, DM, Obesity, Htn, Chronic lung disease

ORGAN INVOLVEMENT

- Many of manifestations 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

LONGTERM CHRONIC DX

- Severe ARDS survivors may suffer from chronic disease
- Physical
  - Critical illness polyneuropathy (CIP)
  - Critical illness myopathy (CIM)
  - Mononeuritis multiplex
  - Chronic Fatigue & other

LONGTERM CHRONIC DX

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

LONGTERM CHRONIC DX

- Pathology & course of severe COVID-19 similar to severe ARDS
  - Likely similar issues
- Improvement up to >=1 year post ICU D/C 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

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
- Anxiety
- Depression
- PTSD
- Survivor guilt

LONGTERM ORGAN DYSFUNCTION

- Organ systems w/different involvement than other etiologies of ARDS
  - Cardiac-AMI, myocarditis
  - Renal-AKI
  - Pulmonary-risk for interstitial fibrosis
  - Neuro-CVA in young patients
  - Hematologic-thromboses, coagulopathy

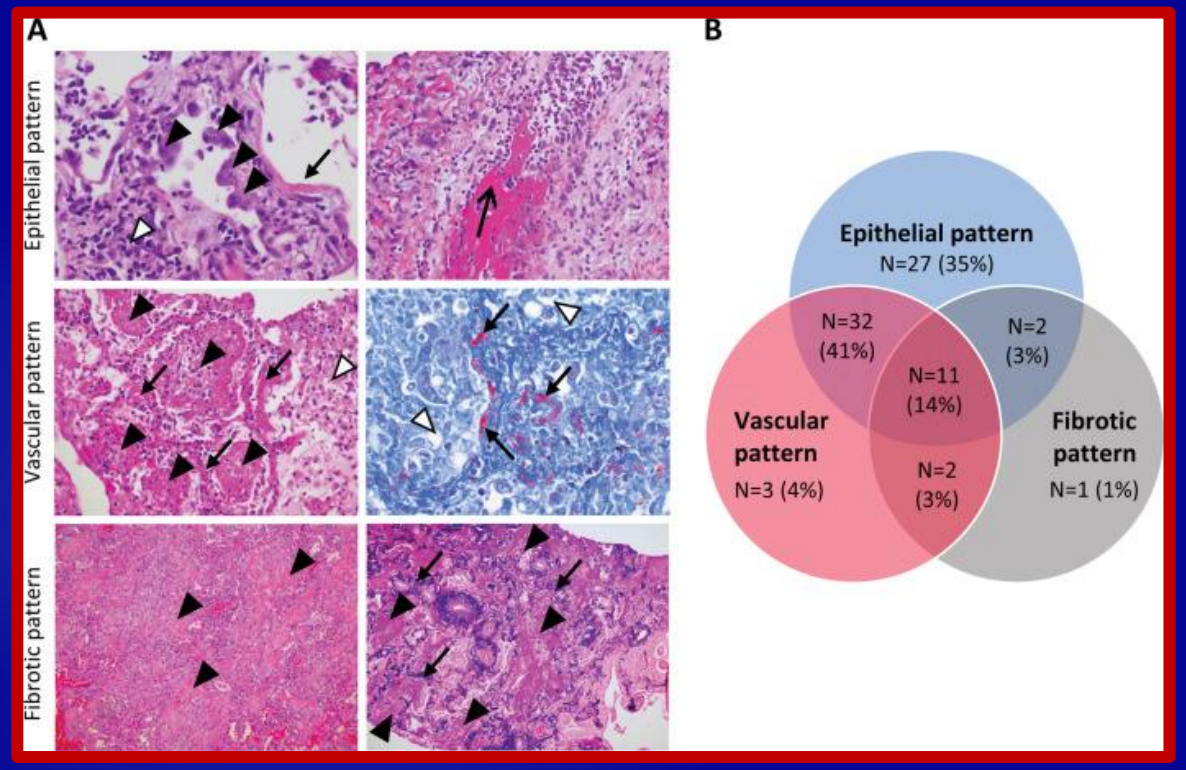
LONGTERM ORGAN DYSFUNCTION

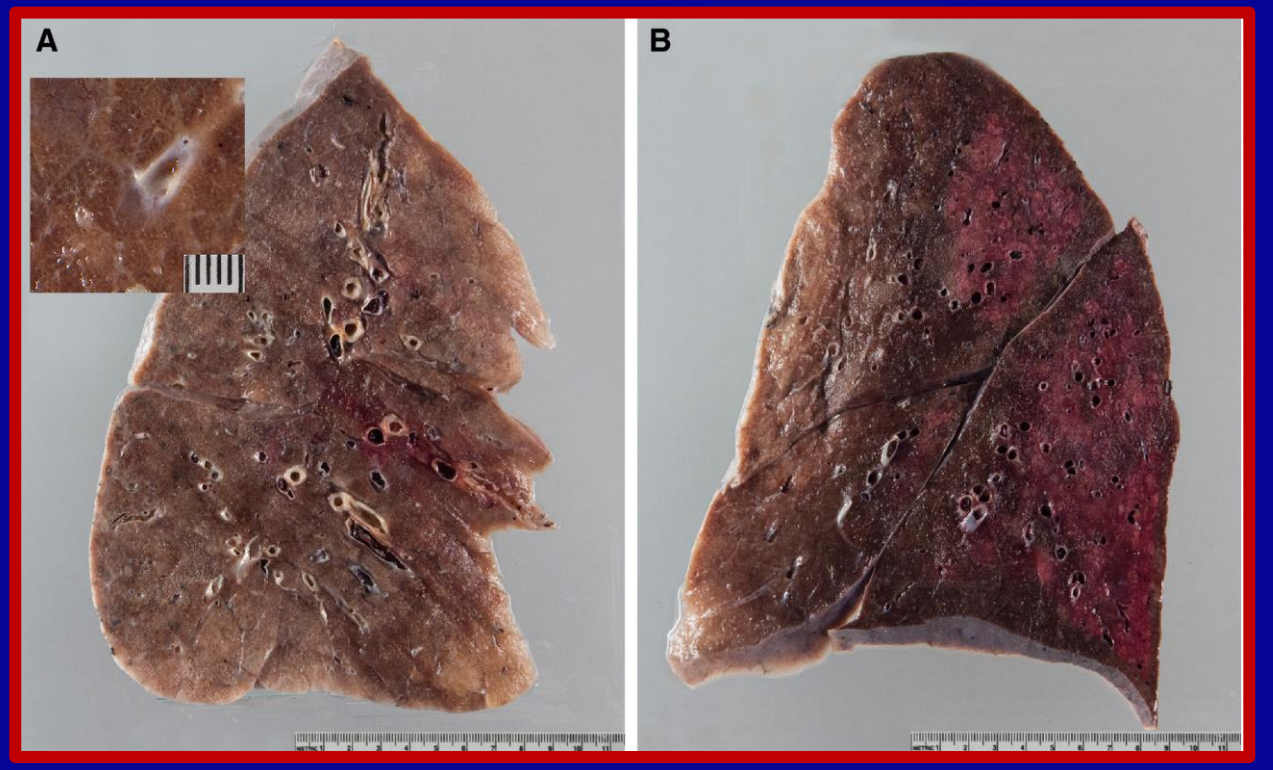
- Many patients have significant pre-existing co-morbidities
  - May interplay with organ injury & organ failures
- Older patients may have significant frailty
  - May interplay with mortality, morbidity, recovery

LONGTERM PULMONARY

- Lung is most frequently devastated organ in severe COVID-19
- Degree of lung improvement unknown
  - Severe ARDS survivors may have moderate to severe residual disease
    - Torres-Castro et al (2021)
      - Meta-analysis COVID survivors
      - N=380
      - Restrictive, obstructive and DLCO defects
- Severe injury seen in COVID-19 pathology
  - DAD, hemorrhage, fibrosis

PULMONARY PATHOLOGY





LONGTERM CARDIAC

- Cardiovascular damage that persists after recovery
  - CV dysfunction affects ~20% of patients admitted to the hospital w/COVID-19
- When heart damage present
  - Increased risk for ventilatory support
  - Increased risk of dying from COVID-19

CARDIAC DYSFUNCTION

- Kirk Knowlton MD (Journal of Molecular & Cellular Cardiology, August 2020)
  - Examined >100 published studies related to COVID-19 & its effects on the heart.
- Rajpal et al
  - 26 athletes at Ohio State (27% had s/s during COVID)
  - CMR imaging
  - 15% had myocarditis
  - 30% w/findings suggestive of prior myocardial injury

RENAL DYSFUNCTION

- Gupta et al (2020)
  - N=3099
  - 67 hospitals in US
  - 21% w/AKI-RRT within 14 days of ICU admission
  - Mortality >60%
  - 39 (18.1%) RRT dependent 60 days after ICU admission

PUBLISHED DATA

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 was higher in older, diabetic, obese & severe ARDS patients

Ahmed et al (2020)

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

Musheyev et al (2021)

- N=118
- Retrospective in US
- Calculated Barthel Index, modified Mental Status, ICU Mobility Scale
- Analysis at hospital DC

Musheyev et al (2021)

- Worse functional status at hospital discharge
  - Longer IMV duration
  - Older age
  - Male sex
  - Higher number of comorbidities
  - Hypertension, diabetes, COPD, immunosuppression

Medrinal et al (2021)

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

Halpin et al (2021)

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

Taboada et al (2021)

- N=183 (32 in ICU)
- Prospective, 32 ICUs
- 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, length of hospital stay, mechanical ventilation, and ICU admission were associated with limitations in the functional status (grade II-IV PCSF)

Puchner et al (2021)

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

Puchner et al (2021)

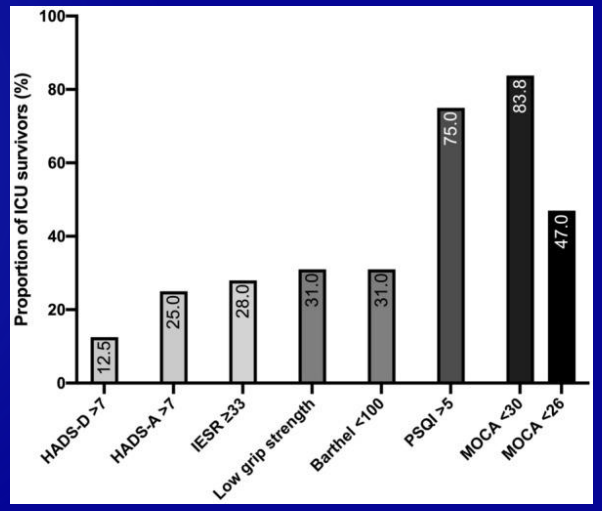
- At D/C from rehab
  - Residual diffusion deficits
  - Cognitive issues
  - Abnormal 6 minute walk time

Rousseau at el (2021)

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



Van Veenendaal et al (2021)

- 60 survivors/78 family members in Netherlands
- Prospective; questionnaires at 3 & 6 months post ICU D/C
- Physical functioning
  - MOS Short-Form General Health Survey
  - Clinical Frailty Scale
  - Spirometry (including DLCO)
- 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) out of 100
  - 90% reported continued impairment > 6 months
- Social function impaired in 90%
- Psychological function impairment patients < family
  - 63% of family w/ongoing impaired well-being
  - Family members also couldn't return to work

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%) found that survivors of critical illness had new or worsening IADL dependencies
- 3 of 4 longitudinal studies-IADL dependencies decreased over the follow-up period, 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

SO WHAT IS NEXT FOR SEVERE COVID SURVIVORS?

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

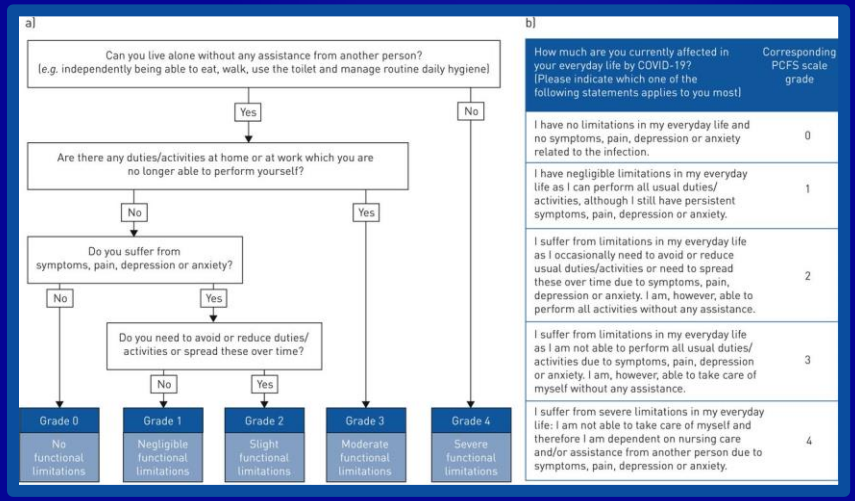
- COVID may impede rehab, extend rehab times
- Increased frailty due to age, isolation
- More cardiac complications
- Chronic fatigue

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

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-FU

- 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

TAKE HOME MESSAGE

Post ICU COVID survivors may need extensive multi team rehab, have remaining deficits & not achieve pre-COVID ICU functional status

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VENTILATOR

Measure height and calculate predicted body weight

Female predicted body weight (kg)

45.5 + (0.91) (height in cm – 152.4)

Male predicted body weight (kg)

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