

Introduction

- Patients with **COVID-19** and **severe respiratory disorder (SARS-CoV-2)** see complications involving the **liver, kidneys, and central nervous system (Figure 1)**
- May require **invasive mechanical ventilation**, meeting **acute respiratory distress syndrome (ARDS)** diagnostic criteria
- Hospitals utilizing **prolonged pronation positioning (PP)** 12 to 16 hours per day
 - Positioning: Typically upper extremities either at the patient's side or with the **elbow in a flexed position**

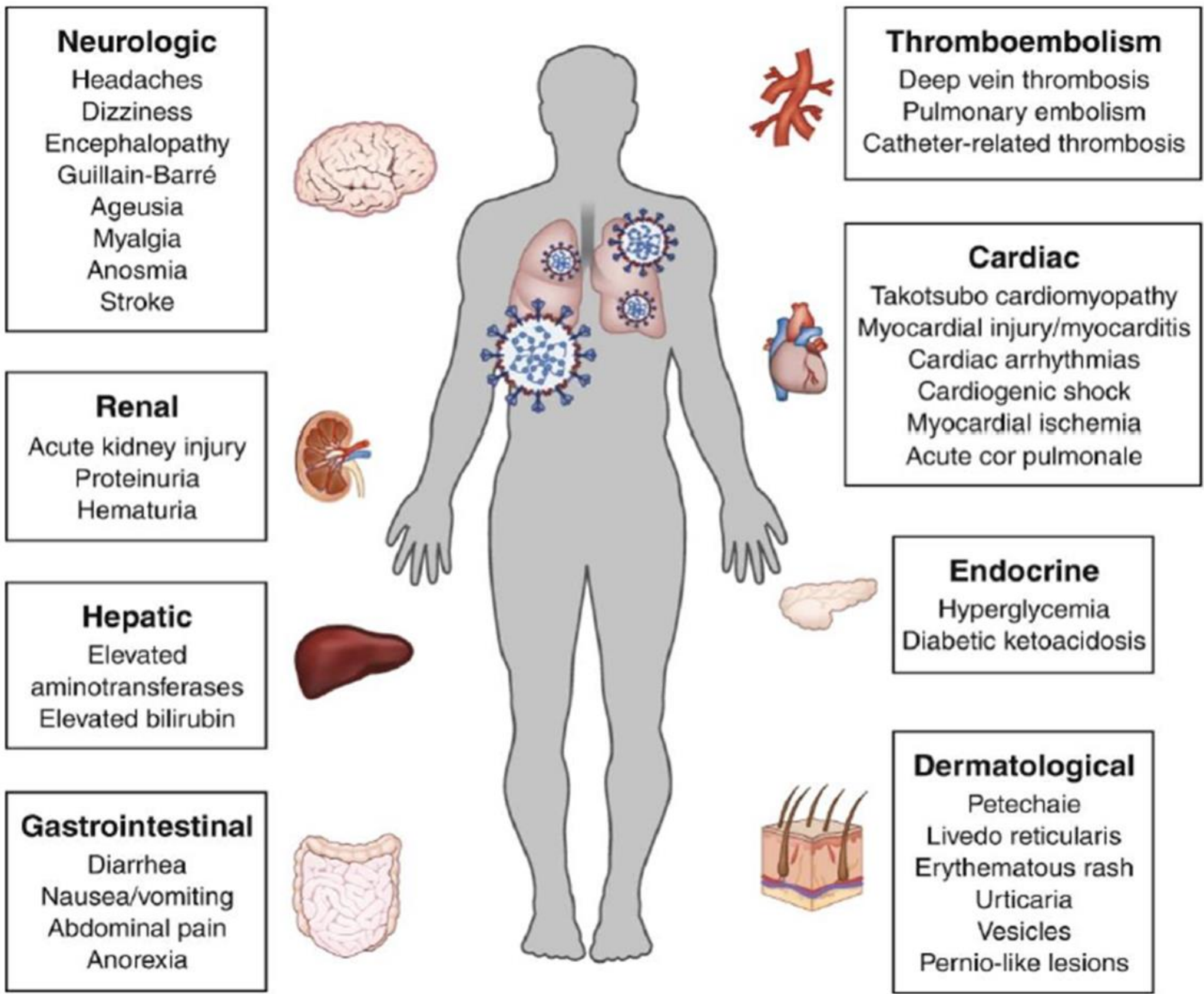


Figure 1: COVID complications (Gupta et al. 2020. *Science*).

Objectives

- To analyze the correlation between patients with **COVID-19 related ARDS** that underwent **PP** and **potential peripheral nerve injury**, including the **NCS/EMG findings**

Design

- Retrospective** cohort
- Patients admitted from various **tertiary care centers** to **Inpatient Rehabilitation Facility (IRF)** with primary diagnosis of **COVID 19**
- Nerve conduction studies (NCS)**, **electromyography studies (EMG)**, and imaging studies (**Musculoskeletal Ultrasound, MRI, MR Neurography**) were analyzed for these patients



Figure 2: Standard Prone positioning with bilateral shoulder abduction to 90° and elbows flexed 90°

https://www.ficm.ac.uk/sites/default/files/prone_position_in_adult_critical_care_2019.pdf

Results

- 22 patients** from **12 tertiary care centers**
- 12.9% of patients** admitted to IRF with primary COVID diagnosis were then diagnosed with PNI
- Thirty-seven PNIs** were diagnosed in 22 patients; 65% of PNIs located in **upper extremities**
- EMG: **91.6%** demonstrated predominately **axonal loss** (axonotmesis per Seddon)
- Critical Illness Myopathy (CIM):** 10 patients (45%); **Critical Illness Neuropathy (CIN):** 4 patients (18%)

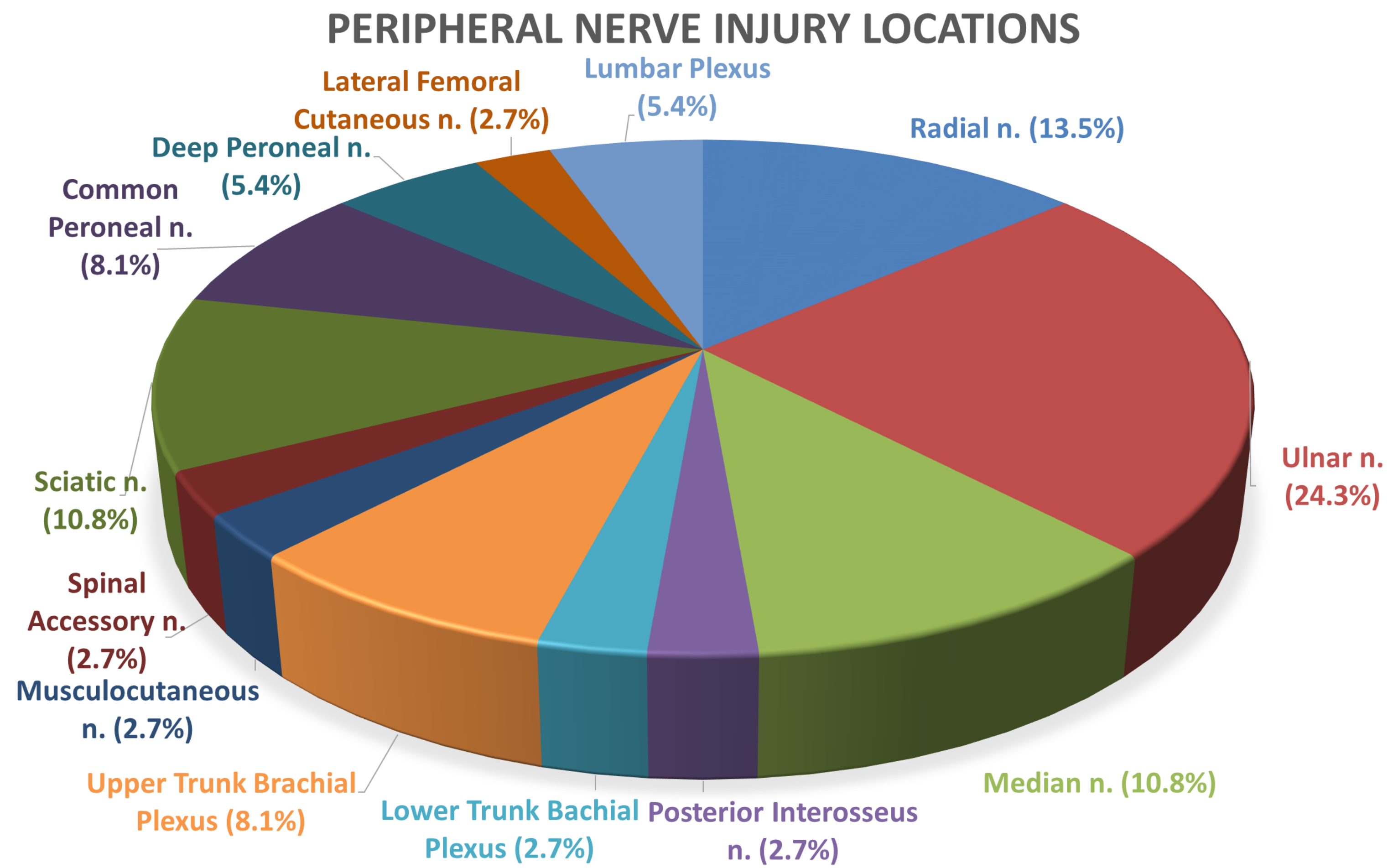
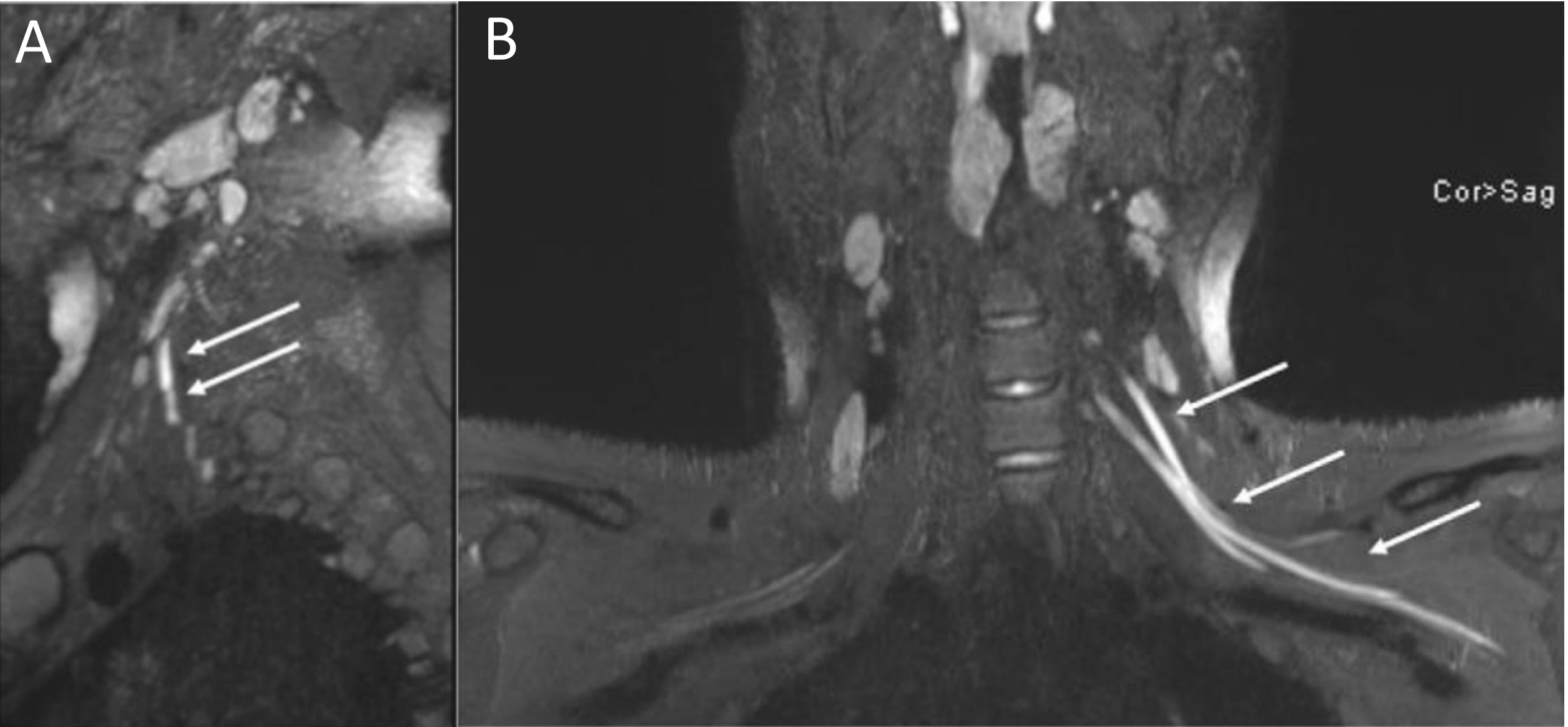


Figure 2: MR Neurography of 21 YO M male with left shoulder weakness with abduction. **A)** Sagittal T2 SPACE STIR post-contrast for vascular suppression image demonstrates signal hyperintensity of the C5 and C6 nerve roots (arrows). **B)** Coronal T2 SPACE STIR post-contrast for vascular suppression image demonstrates signal hyperintensity of both the lateral and posterior cords as well as the suprascapular nerve (arrows). MR neurography findings are compatible with neuropathy (axonotmesis)⁷.



Discussion

- Single largest description of new PNIs associated with PP** for management of ARDS and the first description specific to **COVID-19**
- Comorbidities such as diabetes mellitus, hypertension, and obesity** likely contribute to **severity of COVID-19-related ARDS** and PNIs
 - Likely associated with axonal neuropathies by a combination of **immune, inflammatory, and vascular** involvement
- Hospital specific approaches to PP cannot alone account for these PNIs (**12 different tertiary care centers**)
- Reduction in the mechanical loads on peripheral nerves, specifically through **position optimization, frequent repositioning, unloading and cushioning** susceptible nerve compression sites, as well as monitoring for early signs of focal injury

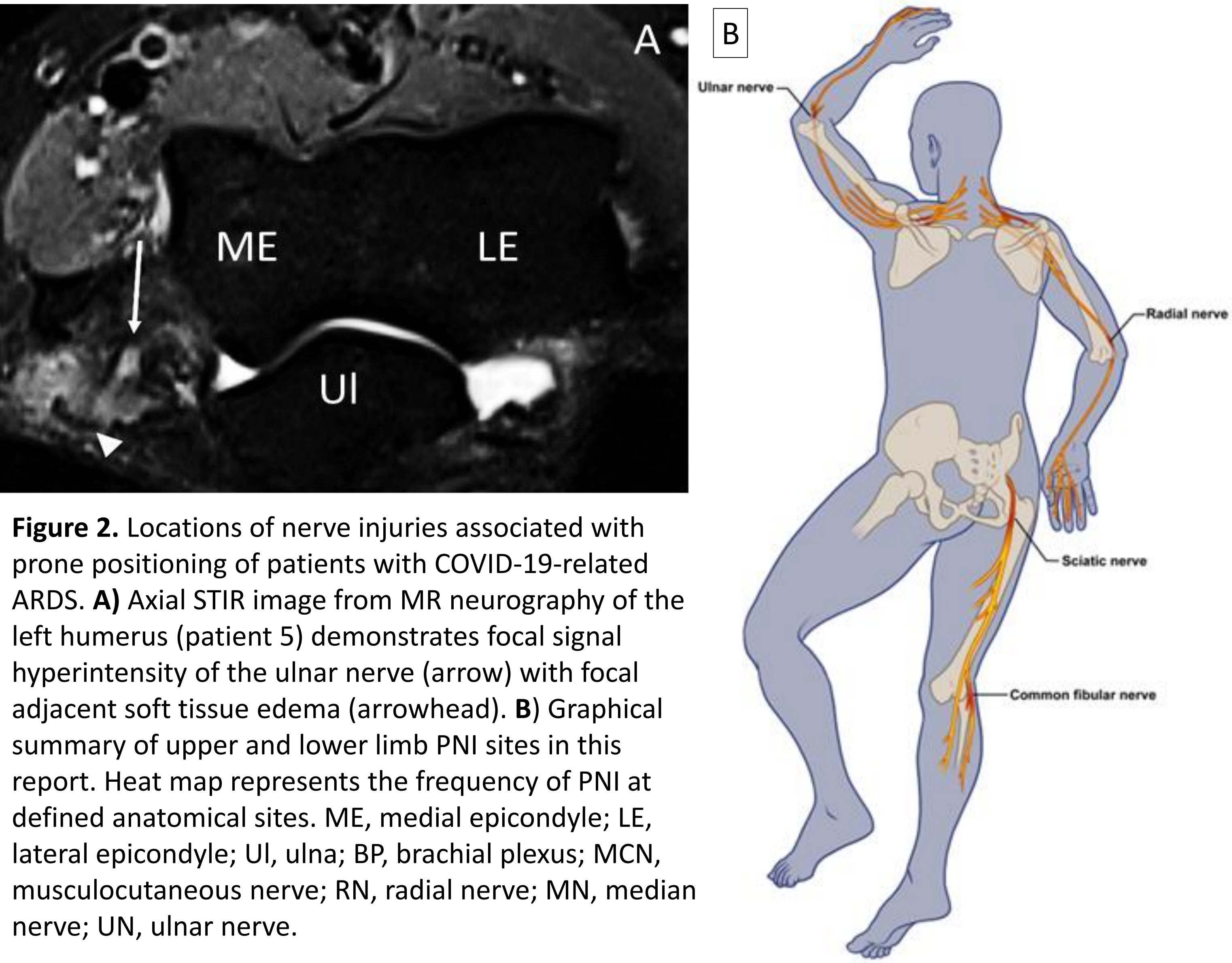


Figure 2. Locations of nerve injuries associated with prone positioning of patients with COVID-19-related ARDS. **A)** Axial STIR image from MR neurography of the left humerus (patient 5) demonstrates focal signal hyperintensity of the ulnar nerve (arrow) with focal adjacent soft tissue edema (arrowhead). **B)** Graphical summary of upper and lower limb PNI sites in this report. Heat map represents the frequency of PNI at defined anatomical sites. ME, medial epicondyle; LE, lateral epicondyle; UI, ulna; BP, brachial plexus; MCN, musculocutaneous nerve; RN, radial nerve; MN, median nerve; UN, ulnar nerve.

Conclusion

- Significant **PNIs are associated with PP** in the management of **COVID 19-related ARDS**, which leaves many patients with **long-term disability**
- With EMG, these PNIs exhibited compelling **axonal loss** that when combined with the **higher prevalence of CIM and CIN** can leave these patients debilitated
- Physicians must be aware of this **elevated susceptibility to PNI** in severe COVID-19 and **refine standard PP protocols** in order to reduce the risk

Acknowledgments

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