GLOBAL SCIENCE LIBRARY

CASE REPORT

Journal of Clinical Case Reports and Reviews

The role of magnetic resonance imaging in the diagnosis of brachial plexopathy in a COVID-19 patient

Su Yen Lam*, Brian Tsang, Sakib Moghul and Mohammad Aslam

Southend University Hospital NHS Foundation Trust, Essex, UK

Abstract

Severe COVID-19 infection can lead to acute respiratory distress syndrome (ARDS) requiring intensive care admission. Mechanically ventilated patients are commonly managed by being positioned in a prone 'swimmer's position'. However, this position can lead to a variety of potential complications not related to the illness, including stretching of the brachial plexus resulting in nerve damage. Brachial plexopathy is an important consideration in all patients stepped down from prolonged prone ventilation. This is to prevent possible long-term numbness and weakness in the affected arm which may require intensive physiotherapy. The role of magnetic resonance imaging is particularly useful in visualizing the brachial plexus and providing an accurate diagnosis. Early recognition and prompt imaging is recommended to reduce the incidence and severity of brachial plexopathy, particularly in the wake of a second COVID-19 wave.

We report a case of brachial plexopathy in a 54-year-old male following intensive care admission and the relevant MRI protocol and findings which highlight this pathology.

.

Keywords: *magnetic resonance neurography, STIR sequence, neuropathy, acute respiratory distress syndrome, prone position*

Introduction

The coronavirus disease 2019 (COVID-19) is an unprecedented global pandemic with over 60 million confirmed cases worldwide [1]. Severe infection can lead to acute respiratory distress syndrome (ARDS), which is the most critical complication of COVID-19 and a major cause of death [2-4]. Critically ill patients with ARDS are managed with intubation and ventilation in the intensive care unit (ICU).

The current practice of mechanical ventilation in ARDS is via the prone position to improve oxygenation [4-7], with higher survival rates if commenced early [4,7]. The current United Kingdom (UK) guidance [8] recommends adopting a 'swimmer's position' for prone positioning, as shown in Figure 1 below. This position stretches the brachial plexus and leaves it vulnerable to injury due to traction and compression forces [10]. Brachial plexopathy is therefore a recognized but uncommon complication of prolonged prone positioning10. Clinical evaluation of this condition with an understanding of the relevant investigations is paramount for a prompt diagnosis.

In this paper, we report a case of brachial plexopathy following ICU admission for COVID-19 and the role of magnetic resonance imaging (MRI) in diagnosis.

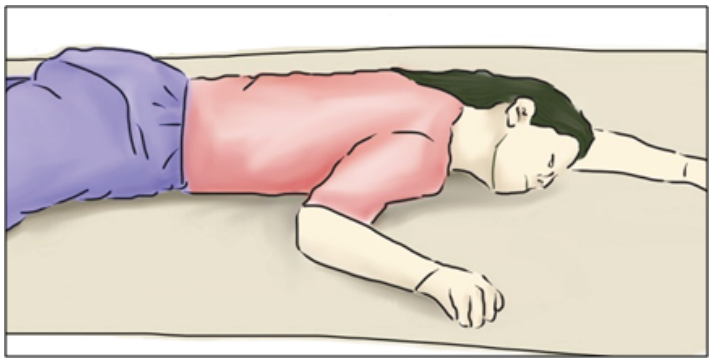

Figure 1: *Swimmer's position for ventilation in the prone position [9]. The head is turned to one side, the arm on the side where the head is facing is raised, and the other arm is placed down by the patient's side. The shoulder of the raised arm should be abducted to 80° and the elbow flexed to 90°.*

Case report

A 54-year-old male patient with a background history of type 2 diabetes and hypertension presented to hospital with a four-day history of progressively worsening shortness of breath, dry cough and fever. On examination he was tachypnoeic, tachycardic and febrile with pulse oximetry reading oxygen saturations of 70% on room air. Chest auscultation revealed non-specific bi-basal crackles. Given the history and current pandemic he was managed as a severe COVID-19 infection. A chest radiograph on admission (Figure 2) demonstrated patchy bilateral pulmonary infiltrates suggestive of classic/probable COVID-19 infection according to British Society of Thoracic Imaging (BSTI) criteria [11]. This was later confirmed with a positive RT-PCR result from a nasopharyngeal swab. Shortly after admission he was reviewed by the intensive care team due to worsening hypoxia and subsequently intubated, ventilated and transferred to the ICU.

Due to his high ventilatory and oxygenation requirements, the intensive care team started prone position ventilation from day two of admission. He had a prolonged ICU admission requiring prone position ventilation for 18 days. A tracheostomy was inserted during this period and following a long respiratory wean, this was decannulated on day 32. He was stepped down from ICU shortly after.

Post-sedation, the patient reported weakness in the left arm and shoulder with pain over the anterior glenohumeral joint and pain on passive movements. Acute fracture and dislocation were ruled out on X-ray and computed tomography (CT) scan of the shoulder.

Neurological examination showed globally reduced power and reduced sensation in the left upper limb. Specifically, he was noted to have reduced power in the left upper limb myotomes which were graded as follows using the Medical Research Council (MRC) muscle power scale [12]: C5-6 were 1/5, and C7-T1 were 5/5. Following a discussion with the neurology team, MRI of the brachial plexus was performed. This confirmed left-sided brachial plexopathy (Figure 3 and Figure 4) affecting the left C5-C7 nerves which correlated with his symptoms. He was subsequently referred for intensive physiotherapy and outpatient neurology follow-up with neurophysiology assessment.

Discussion

The brachial plexus [13-16] is formed at the base of the neck by C5 to T1 spinal nerves. This complex network of nerves innervates the upper limb to supply its motor and sensory functions, along with the diaphragm and pectoral muscles. Brachial plexopathy can therefore result in altered sensation to the upper limb and weakness (as in the case described); or more severely, paralysis of the limb (Figure 5).

Given the potential outcome of significant functional disability, protocols have been developed by specialist referral units to aid clinicians in managing patients with suspected brachial plexopathy10,17. There are recommendations that all patients should be screened for signs and symptoms of brachial plexopathy after regaining consciousness post-extubation using set criteria that assess pain, active movement of the upper limb and sensation (Figure 6) [10,17]. Due to the increased risk of long-term complications, early referrals to specialist units with peripheral nerve injury expertise are warranted for patients with neuropathic pain, or neuropraxia that has not resolved in three weeks [10,17]. In the UK, the recommended protocol from the Royal National Orthopaedic Hospital (RNOH) [10,17] is shown in Figure 7 below.

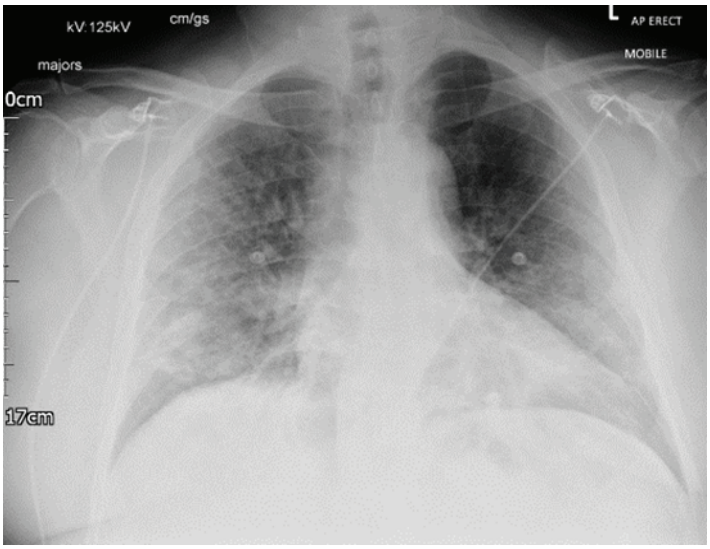

Figure2: *AP chest radiograph demonstrating bilateral, mid and lower zone predominant patchy parenchymal infiltrates in keeping with moderate/severe COVID-19 pulmonary infection. (AP – anteroposterior).*

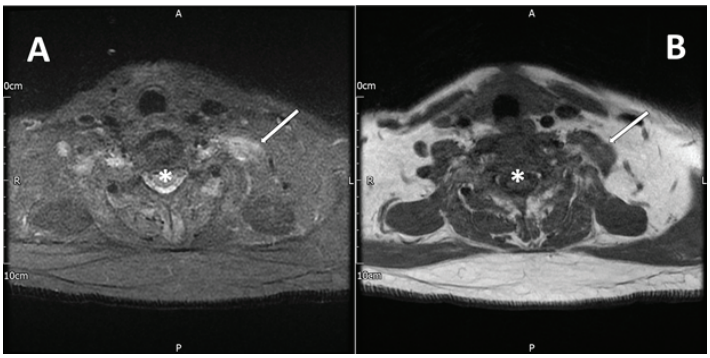

Figure 3: *MMRI axial STIR (A) and axial T1 (B) weighted images of the brachial plexus at the level of C6/7 intervertebral disc showing diffuse asymmetric high signal oedema involving the left brachial plexus with ill-defined thickening of the nerves at this level (white arrow). The cervical spinal canal is marked with the asterisk. (MRI – magnetic resonance imaging; STIR – short tau inversion recovery).short tau inversion recovery).*

Magnetic resonance imaging (MRI) is the preferred imaging modality for the diagnosis of brachial plexopathy [18]. In particular, magnetic resonance neurography (MRN) is increasingly performed as it is a dedicated study which improves diagnostic accuracy. The scan typically extends from the level of C3 to T3 [18]. Sagittal T1, T2 and short-tau inversion recovery (STIR) images of the cervical spine are performed to exclude any spinal canal or neural foramen pathology, specifically nerve root avulsion injuries which typically manifest as pseudomeningoceles [19]. The normal brachial plexus should appear smooth and well-defined, with a similar size to the adjacent arteries [18]. On T1-weighted sequences, the signal intensity of the nerves should be similar to the surrounding musculature [15,18]. On T2-weighted images, the normal plexus appears slightly hyperintense compared to the muscles [15,18]. In a traction injury of the brachial plexus, the affected nerves lose their well-delineated margins and become disproportionately thickened [14,15]. There is also increased signal intensity on STIR images and diffuse contrast enhancement on the affected side [14,15]. In the case described, the STIR images were sufficient to highlight an abnormality with the left brachial

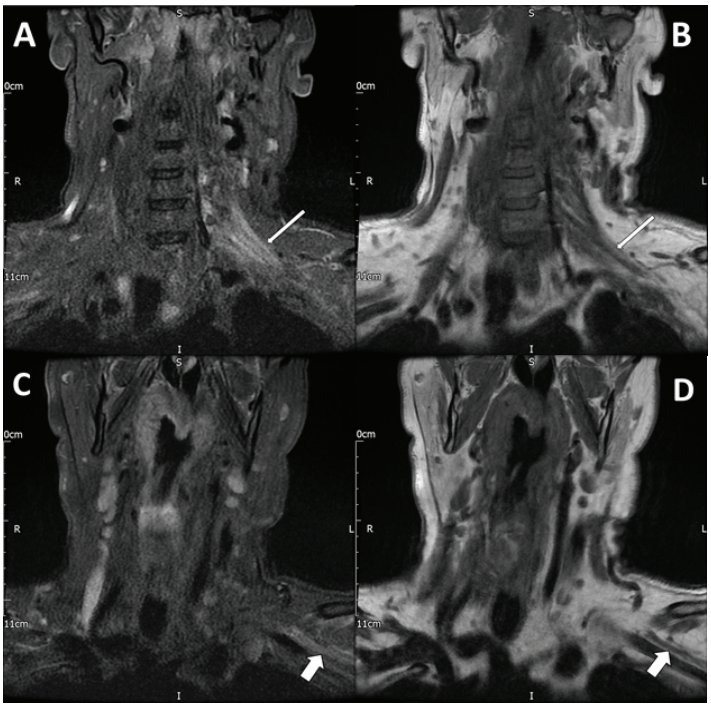

Figure 4: *Coronal oblique STIR (A and C) and corresponding coronal oblique T1 (B and D) weighted images from anterior to posterior confirm the involvement of left C5-C7 nerves with diffuse oedema in the region of the brachial plexus trunks (thin white arrow) and cords (thick white arrow).*

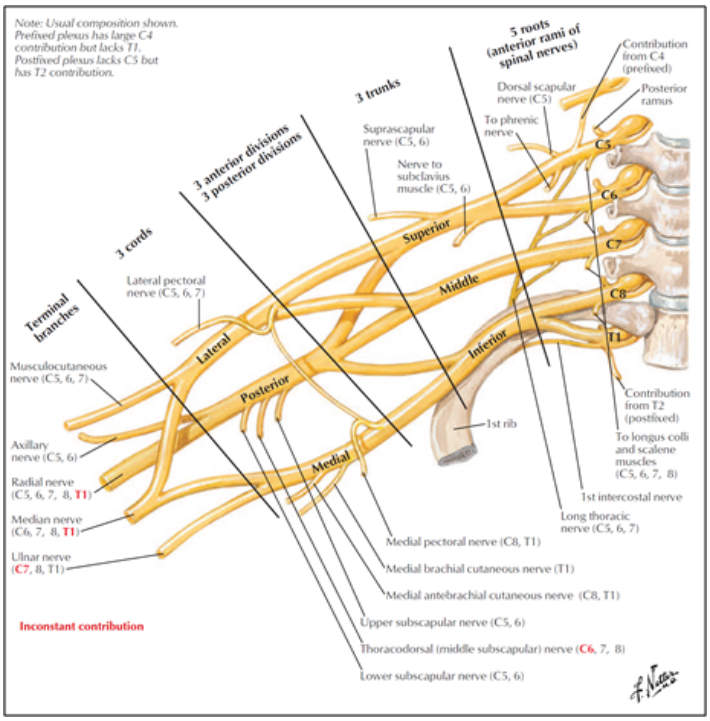

Figure 5: *Anatomy of the brachial plexus [16]. The roots consist of C5 to T1 spinal nerves, which form the superior, middle and inferior trunks. These are further split into six divisions, then three cords (lateral, posterior and medial), and finally five terminal branches. The terminal branches consist of the musculocutaneous, axillary, median, radial and ulnar nerves. Additionally, there are named nerves arising before the terminal branches..*

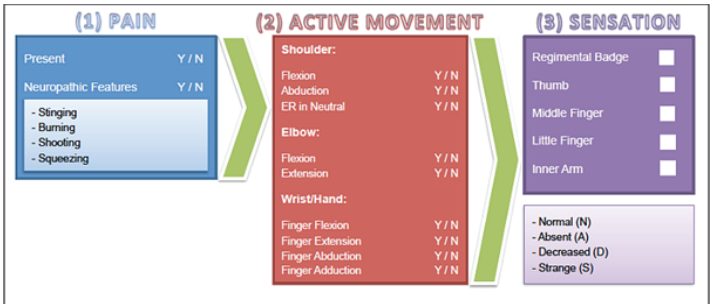

Figure 6: *Suggested screening tool for brachial plexopathy from the RNOH [10,17].*

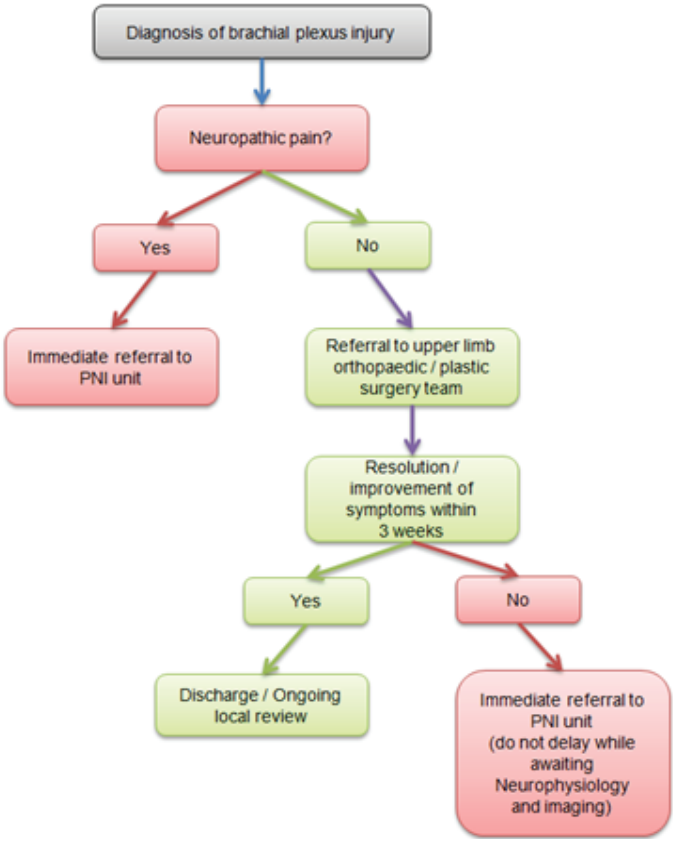

Figure 7: *The RNOH's suggested protocol for assessment and referral of brachial plexopathy [10,17].*

plexus and therefore intravenous gadolinium administration was not necessary. The radiological findings can be subtle, particularly in patients who are unable to tolerate MRI or if there is suboptimal image quality. For this reason, the interpretation and reporting of these scans should be reserved for experienced radiologists specialising in musculoskeletal and spinal imaging.

The limitations of MRI assessment of the brachial plexus tend to revolve around suboptimal image quality [20]. Patients recovering from severe COVID-19 infections may continue have a degree of residual respiratory symptoms increasing the chance of degraded images from breathing motion artefacts. Neurophysiology can be used to confirm the exact nerves affected once MRI suggests a brachial plexopathy in such cases. However, this may be used to assess symptom progression at a later stage following physiotherapy.

Measures to prevent brachial plexopathy in prone position ventilation have long been implemented in the intensive care setting. The Faculty of Intensive Care Medicine in the UK suggests changing the position of the head and arm every 2-4 hours [8]. They also have recommendations for the height and positioning of pillows. Pillows should be placed at a height where the neck is not hyperextended [8]. The pillows should be positioned such that the shoulders are slightly forward to the anterior capsule of the glenohumeral joint8. The RNOH additionally recommends reducing compression of the abdomen to prevent increased thoracic outlet pressure and maintaining the patient's shoulders in a slightly shrugged position to avoid shoulder girdle depression [10,17].

Conclusion

Brachial plexopathy is an uncommon but important complication of ventilation in the prone position, with the potential to cause a significant impact on a patient's functional ability and quality of life. In the wake of the second COVID-19 wave in the UK with hospitals seeing increased admissions again, it is all the more important that preventative measures for brachial plexopathy be emphasized in the intensive care setting. There needs to be a streamlined process in hospitals to actively monitor high-risk patients for brachial plexopathy with screening tools. All clinicians, in particular step-down medical teams, should be made aware of the value of early MRI and referral to local orthopaedic/neurology teams, or more preferably a dedicated peripheral nerve injuries unit if available. Even though there is no patient positioning that comes without complications, with active monitoring and prompt diagnosis, it is hoped that the incidence and severity of brachial plexopathy can be kept to a minimum.

References

1. World Health Organization. WHO Coronavirus Disease (COVID-19) Dashboard. 2020. Available from: https://covid19.who.int/
2. Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. J Autoimmun. 2020;109: 102433.
3. Huang C, Wang Y, Li X, Ren L, Zhao J, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020; 395: 497-506.
4. Meng L, Qiu H, Wan L, Ai Y, Xue Z, et al. Intubation and Ventilation amid the COVID-19 Outbreak: Wuhan's Experience. Anesthesiol. 2020; 132: 1317-1332.
5. Munshi L, Sorbo L Del, Adhikari NKJ, Hodgson CL, Wunsch H, et al. Prone Position for Acute Respiratory Distress Syndrome: A Systematic Review and Meta-Analysis. Ann Am Thorac Soc. 2017; 14: S280-S288.
6. Guérin C, Reignier J, Richard JC, Beuret P, Gacouin A, et al. Prone Positioning in Severe Acute Respiratory Distress Syndrome. N Engl J Med. 2013; 368: 2159-2168.
7. Rhodes A, Evans LE, Alhazzani W, Levy MM, Antonelli M, et al. Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016. Intensive Care Med. 2017; 43: 304-377.
8. The Faculty of Intensive Care Medicine. Guidance For: Prone Positioning in Adult Critical Care. 2019. Available from: https://www.ficm.ac.uk/sites/default/files/prone_position_in_adult_critical_care_2019.pdf
9. Bruen C. The Rise of Prone Positioning. Resus Review. 2015. Available from: https://resusreview.com/2015/prone-positioning-tips-checklist/
10. Simpson AI, Vaghela KR, Brown H, Adams K, Sinisi M, et al. Reducing the Risk and Impact of Brachial Plexus Injury Sustained From Prone Positioning-A Clinical Commentary. J Intensive Care Med. 2020; 22.
11. British Society of Thoracic Imaging. COVID-19 BSTI Reporting Templates and Codes. 2020. Available from: https://www.bsti.org.uk/covid-19-resources/covid-19-bsti-reporting-templates/
12. Medical Research Council. Aids to the examination of the peripheral nervous system. 1976.
13. Tharin BD, Kini JA, York GE, Ritter JL. Brachial Plexopathy: A Review of Traumatic and Nontraumatic Causes. Am J Roentgenol. 2014; 202: W67-W75.
14. Aralasmak A, Karaali K, Cevikol C, Uysal H, Senol U. MR Imaging Findings in Brachial Plexopathy with Thoracic Outlet Syndrome. Am J Neuroradiol. 2010; 31: 410-417.
15. Lutz AM, Gold G, Beaulieu C. MR Imaging of the Brachial Plexus. Neuroimaging Clin N Am. 2014; 24: 91-108.
16. Netter F. Atlas of Human Anatomy. (7th edn). Elsevier. 2019; Plate 420.
17. Quick T, Brown H. A commentary on Prone Position Plexopathy during the COVID-19 pandemic [Internet]. The Transient J. 2020.
18. Upadhyaya V, Upadhyaya DN. Current status of magnetic resonance neurography in evaluating patients with brachial plexopathy. Neurol India. 2019; 67: 118-124.
19. Shin AY, Spinner RJ, Steinmann SP, Bishop AT. Adult traumatic brachial plexus injuries [Internet]. Vol. 13, The Journal of the American Academy of Orthopaedic Surgeons. J Am Acad Orthop Surg. 2005: 382-396.
20. Yoshikawa T, Hayashi N, Yamamoto S, Tajiri Y, Yoshioka N, et al. Brachial plexus injury: clinical manifestations, conventional imaging findings, and the latest imaging techniques. Radiographics. 2006; 26: S133-S143.

*Correspondence: Su Yen Lam, Southend University Hospital NHS Foundation Trust, Essex, UK, Tel: +44 1702 435555; E-mail: sylam@doctors.org.uk

Rec: 02 Oct 2020; **Acc:** 16 Oct 2020; **Pub:** 19 Oct 2020

J Clin Case Rep Rev. 2020;3(4):159
DOI: 10.36879/JCCRR.2020.0000159