The Role of Diagnostic Testing in the Covid-19 Pandemic

By:
Mohini Rawat, PT DPT MS ECS OCS RMSK & John E. Lugo, PT DPT MS ECS

The profession of physical therapy has historically addressed the health care needs of the population of the United States. Physical therapists possess extensive erudition on diverse domains of human recuperation including, but not limited to neuromuscular, musculoskeletal, and cardiopulmonary rehabilitation. Physical therapists have directed their focus and attention to the most urgent conditions that were prevalent at that time. The first physical therapists, known as reconstruction aides under the leadership of Mary McMillan, provided treatment for the traumatic injuries sustained during World War I (Neil, 2010). This experience led to the advent of structured post-surgical programs prior to and during World War II (Shaik & Shemjaz, 2014). In the late 1940's and 1950's, physical therapists were instrumental in helping the nation address the physical limitations caused by the polio epidemic (Neil, 2010). Through the end of the 20th century and beginning of the 21st century, physical therapists achieved recognition as independent practitioners (Shaik & Shemjaz, 2014) with a vision to "transform society by optimizing movement to improve the human experience" (Gardner, 2013).

Today, our nation and the world are in the midst of another great pandemic. As of 4/25/20, there were 2,965,306 globally confirmed cases of covid-19 coronavirus with 970,352 in the USA (Worldometers, 2020). Fortunately, 81% of the closed cases of the virus with an outcome ended in recovery or discharge from the hospital (Worldometers, 2020). As people recover, physical therapists must answer the call again and address the needs of the population.

Tests and measurements including nerve conduction studies and needle electromyography are recognized as appropriate methods that physical therapists can use to evaluate the integrity of the peripheral nervous system (APTA HOD, 2018). Additionally, the American Institute of Ultrasound in Medicine (AIUM) recognizes physical therapists as a medical provider who can evaluate and interpret diagnostic musculoskeletal ultrasound examinations (AIUM, 2019). As people seek out treatment to address their functional limitations caused by covid-19 coronavirus, physical therapists need to use electrodiagnostic tests and musculoskeletal ultrasound appropriately to evaluate for impairments associated with this condition.

As new data and clinical presentations become published, the types of peripheral polyneuropathies associated with covid-19 coronavirus and its treatment are becoming established. Acute inflammatory demyelinating polyneuropathy (AIDP), also known as Guillan-Barre Syndrome is a rapidly progressing paralytic illness with motor greater than sensory involvement, is associated with hyporeflexia, and typically starts in the lower extremities (Kimura, 2013). Patients typically present with functional deficits including decreased ambulatory ability and impaired balance. A case series of 5 patients who developed AIDP after the onset of covid-19 coronavirus was recently presented (Toscano, et al 2020). EDX studies are paramount in the evaluation of a patient with suspected AIDP and typically present with reduced compound muscle action potential, temporal dispersion, prolonged late responses, and slow nerve conduction velocities (Kimura, 2013). In addition to AIDP, potential neuromuscular complications of covid-19 coronavirus include myositis and critical illness myopathy and/or

polyneuropathy (Guidon & Amato 2020). The needle EMG component of the EDX exam are one of the three crucial diagnostic tests used to confirm muscle tissue disease caused by inflammation or associated with critical illness (Kimura, 2013). Typical findings encountered in a myopathy are myotonic discharges at rest, small amplitude, polyphasic, short duration polyphasic motor units, and rapid recruitment with full interference pattern (Kimura, 2013).

Muscle weakness is a common occurrence related to critical illness(Hund, 1996; Vanhorebeek, Latronico, & Van den Berghe, 2020). Although, pathophysiology of the ICU-acquired weakness is not clearly understood, there is a plausible explanation for muscle atrophy due to critical illness related to hormonal changes. There is catabolic state during critical illness causing increased catabolic hormones and reduced anabolic effector hormones which gets pronounced with mechanical unloading of muscle due to immobilization during hospitalization(Vanhorebeek et al., 2020).

Ultrasound is an excellent, non-invasive tool in screening and studying muscle morphology in neuromuscular disease. When indicated it provides qualitative and quantitative data to study muscle morphology, understand the problem better and monitor disease progression to inform patient management.

Benefits of ultrasonography are its non-invasive nature, the comfortable experience of the patient, the patient is not required to participate in the exam, it is cost effective, readily available in the ICU or the patent's home, has good inter-rater reliability, and it can study the gross architecture of the muscle.

Muscle ultrasonography provides 1) quantitative data like muscle thickness, muscles cross-sectional area, echo-intensity and 2) qualitative data like details of muscle morphology which be seen in the images below (Figure 1 & 2). Figure 1 shows longitudinal view of a normal muscle showing muscles fascicles in longitudinal view. On ultrasound muscle tissue shows as darker signal and connective tissue like perimysium, epimysium appear as brighter signal. Figure 2 shows transverse view of the muscle where muscle tissue appears as darker signal and connective tissue as brighter signal.

There is loss of normal muscle morphological architecture in muscle diseases. In critical illness related muscles weakness, decreased thickness, decreased cross-sectional area of the muscle and loss of normal gross muscle architecture can be seen(Mayer et al., 2020; van Alfen, Gijsbertse, & de Korte, 2018). Abnormal muscle appears brighter as there is loss of healthy muscle tissue (darker signal). There are other highly specialized imaging techniques like elastography and speckle tracking using M mode, that can also be used in studying muscles tissue, however they require specialized ultrasound software and equipment with capability of these advanced techniques.

Muscle ultrasonography is valuable tool in the assessment of muscle weakness related to critical illness and has a promising future, as more advancement are being made in the field of ultrasonography to overcome the user or specific-system related dependency(van Alfen et al., 2018).

In conclusion, as patients transition back into office-based care from telehealth care, physical therapists need to incorporate diagnostic testing when appropriate to determine the specific impairments of the neuromuscular and musculoskeletal systems. Physical therapists have historically answered the call and served on the front-line in the acute care hospital inpatient setting as well as provided much needed after-care to return to prior functional levels. Today's physical therapists should incorporate all the tools at their disposal, including electrodiagnostic testing and musculoskeletal ultrasound to continue the precedent set by our profession's pioneers.

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Figure 1:

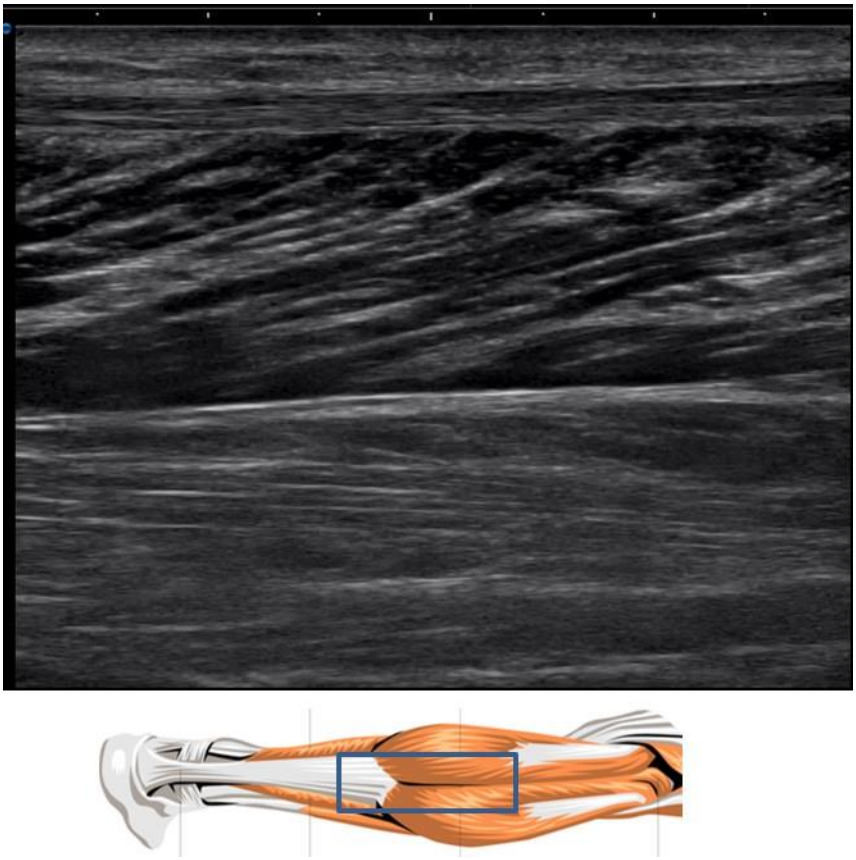

Figure 2: