OPINION

# Neuromuscular ultrasonography has clinical and research benefits in amyotrophic lateral sclerosis

Joseph Dore

**Wilson R. Neuromuscular ultrasonography has clinical and research benefits in amyotrophic lateral sclerosis. J Neurol Clin Neurosci 2022;6(1): 01-02.**

## ABSTRACT

Amyotrophic Lateral Sclerosis (ALS) is a terrible neurodegenerative disease that affects various levels of the nervous system. Without a formal diagnostic investigation, it remains a clinical diagnosis. Electrodiagnostic testing can help rule out mimicking illnesses when used in conjunction with imaging and biochemical markers. Neuromuscular ultrasonography is useful in the diagnosis and monitoring of ALS because it adds to clinical assessment and electrodiagnostic testing while also providing insight into the disease's underlying pathogenesis. This study summarises the evidence for using ultrasonography to assess bulbar, limb, and respiratory musculature, as well as peripheral nerves, in people with ALS. In this developing field, further research is needed.

**Key Words:** *Amyotrophic lateral sclerosis; Ultrasound; Clinical neurophysiology; Biomarker; Clinical trials*

## INTRODUCTION

Lmyotrophic Lateral Sclerosis (ALS) is a progressive neurodegenerative disease that affects both upper and lower motor neurons and is always deadly. The lack of a reliable biomarker and the variability of clinical symptoms, especially early in the course of the disease, may make diagnosing ALS difficult. Evidence of lower and upper motor neuron degeneration with gradual spread of symptoms or signs within or between body areas is required under the updated El Escorial criteria. As described in the Awaji criteria, electrodiagnostic testing can give supportive evidence, increasing the sensitivity of diagnosis without compromising specificity. This, as well as other types of diagnostic tests including neuroimaging, serology, and CSF analysis, is still necessary to rule out probable mimicking illnesses [1].

In the examination of patients with ALS, neuromuscular ultrasonography is becoming more often used. It is a noninvasive, easily accessible technology that can be employed across numerous body locations to offer crucial information to support an ALS diagnosis. It has the potential to play a role in the structural and dynamic evaluation of bulbar, limb, and respiratory musculature, as well as peripheral nerves, complementing current testing modalities. It's also well-suited to being used in a series to track illness progression without exposing patients to radiation. As a result, neuromuscular ultrasonography has a lot of potential for early diagnosis, excluding mimicking illnesses, and monitoring disease progression. Its application in a clinical trial context has the potential to boost confidence in the underlying diagnosis of "ALS" patients and track their response to new treatments [2].

### Ultrasound of the muscles

Muscle Ultrasonography (MUS) is the most well-known ultrasound application in ALS patients. It's especially beneficial for looking for anomalies in big muscle groups across many body segments, which can help in ALS diagnosis. Fasciculations, muscle atrophy, and structural alterations such as an increase in muscle echogenicity and other textural characteristics are among the things that can be seen.

### Fasciculations

Muscle Ultrasonography (MUS) is the most well-known ultrasound application in ALS patients. It's especially beneficial for looking for anomalies in big muscle groups across many body segments, which can help in ALS diagnosis. Fasciculations, muscle atrophy, and structural alterations such as an increase in muscle echogenicity and other textural characteristics are among the things that can be seen. In recognising fasciculations, MUS is more sensitive than EMG or visual inspection, boosting identification from 88% to 98%. MUS are a sensitive and repeatable screening technique for regional Lower Motor Neuron (LMN) impairment, which includes cranial muscles [3]. The ideal scan period for most muscles is 30 seconds, while for the first dorsal interosseous muscle, it's 60 seconds. When MUS and EMG are used together, the diagnostic sensitivity for ALS using the Awaji criteria increases by 25%, giving patients more diagnostic certainty. This is likely due to MUS' ability to examine a larger region of muscle, including deeper muscular layers, compared to EMG. It may also help guide muscle selection for EMG, minimising the number of muscles investigated and improving diagnostic output. This approach is especially beneficial for evaluating the tongue since it allows for the screening of broad areas of muscle and is unaffected by muscular relaxation in response to (or expectation of) unpleasant needle testing. Based on visual assessment of MUS, fasciculations may be clearly separated from artefacts, and the approach is simple to learn with good inter-rater agreement. MUS can detect a pattern of fasciculations in the upper limb and proximal muscle groups, which is specific for ALS diagnosis. Using computational analysis, they've also proven great accuracy in recognising fasciculations, which could be useful as an objective measure in clinical studies and to help less experienced sonographers. MUS can be used to define fasciculation potentials, estimate firing rate, and illustrate central impacts on fasciculation frequency when combined with assessments of cortical silent period. However, MUS may be inferior than EMG in measuring the intricacy of fasciculation potentials, which would add to the Awaji criteria's support for ALS diagnosis. Fasciculation analysis using MUS may also help to rule out other diagnosis in cases of probable ALS. MUS have a sensitivity of 96 percent and a specificity of 84 percent in distinguishing ALS from mimicking illnesses. However, mimics such Multifocal Motor Neuropathy (MMN) and Peripheral Nerve Hyperexcitability Syndromes (PNHS), which are difficult to distinguish from ALS, were left out of their prospective sample. Although the numbers of patients with each alternative diagnosis were small, these findings were confirmed and included relevant mimicking disorders, specifically axonal polyneuropathy, myasthenia gravis, cervical myelopathy, cramps, inclusion body myositis, Kennedy syndrome, spinal muscular atrophy, polymyositis, plexus neuritis, and MMN [4]. When it comes to distinguishing ALS from imitators, the pattern and distribution of fasciculations, as well as the number of muscles involved, are extremely sensitive and particular, and fasciculations are less evident in advanced disease. To make diagnosis easier, the MUS fasciculation score was created. Fasciculation intensity, or the number of fasciculations that occur in 60 seconds, might provide crucial predictive information on disease progression when used in conjunction with markers of cortical hyperexcitability. Due to the largely distal distribution of fasciculations in the latter illnesses, MUS can also help identify ALS from benign fasciculation syndromes. Fasciculations are more common and broad in ALS than in PNHS, according to MUS, which can be a useful diagnostic differentiator. There's some indication that fasciculations in ALS are caused by central factors (i.e. cortical hyperexcitability). Assessment and monitoring of fasciculation may be useful in treatment and prognosis. There was a link between fasciculation number

*Editorial Office, Journal of Neurology and Clinical Neuroscience, Windsor Berkshire, England*

*Correspondence: Rebecca Wilson, Editorial Office, Journal of Neurology and Clinical Neuroscience, Windsor Berkshire, England, E-mail neurosci@jneuropsychiatry.org*

*Received: 05-Jan-2022, Manuscript No. PULJNCN-22-4127; Editor assigned: 07-Jan-2022, PreQC No. PULJNCN-22-4127(PQ); Reviewed: 12-Jan-2022, QC No. PULJNCN-22-4127; Revised: 22-Jan-2022, Manuscript No. PULJNCN-22-4127(R); Published: 29-Jan-2022, DOI: 10.37532/2632-251X.2021.6(1).104*

and a Lower Body Mass Index (BMI), which is a poor prognostic indicator. As a result, treatment strategies that lower fasciculation frequency may improve prognosis. Higher serum riluzole levels do, in fact, correspond with less fasciculation intensity. The number of fasciculations inversely corresponds with disability, which is likely related to the attrition of hyperexcitable motor units as ALS advances. Quantification of fasciculations may be useful for disease monitoring.

**Muscle structural evaluation**

Muscle atrophy, which is a common symptom of ALS, can also be shown clearly with MUS. Muscle thickness has been shown to be reduced even in the early stages of the disease. However, it's vital to remember that compensatory reinnervation may, at least initially, make muscle size maintenance easier. Muscle thickness varies significantly among muscle groups, which is consistent with the patchwork pattern of ALS disease [5].

Depending on the location of ALS onset, appropriate muscles for monitoring could be chosen. Multiple potential technical difficulties with measuring muscle thickness have been identified, including minor transducer location or pressure on muscle discrepancies that can have a major impact on results. Furthermore, as ALS progresses, changes in muscle echogenicity and heterogeneity may make it difficult to see reference sites for transducer location. MUS can show quantitative changes in muscle Echo Intensity (EI), Echo Variation (EV), and Gray-Level Co-Occurrence Matrix (GLCM) characteristics, as well as morphological changes in muscle anatomy. Ultrasound waves reflected off surfaces between tissues with varied acoustical impedance provide the brightness of the ultrasound image. The EV parameter assesses the relationship between the intensity of adjacent pixels, which might be homogenous or heterogeneous, while the GLCM parameter assesses the range of brightness visible [6].

**The progression of the disease**

MUS have also been studied as a disease progression marker in ALS, with mixed findings. Some people have noticed consistent changes in several metrics as the condition progresses, whereas others haven't. More research with bigger longitudinal samples is needed. Multiple MUS characteristics have been established that can help with ALS diagnosis. MUS can be used to screen broad areas of muscle throughout the body and to guide electrodiagnostic examinations. Sonographic abnormalities in muscles with maintained strength may be visible, allowing for the identification of additional body regions subclinically engaged in the underlying disease process, which can help with ALS diagnosis in limited disease presentations. MUS characteristics could potentially be useful for tracking illness development [7]. As a result, real-time MUS in the neurophysiology clinic play a role in illness diagnosis and monitoring.

**Dysphagia and bulbar muscle dysfunction**

Due to bulbar motor neuron failure, dysphagia is a typical symptom of ALS. Accurate swallowing assessment is critical for determining aspiration risk and the necessity for tube feeding, as well as tracking progress and determining prognosis. Video Fluoroscopy (VFS) has long been used to assess dysphagia and is now considered the gold standard. Ultrasonographic swallowing examination, on the other hand, has significant advantages over VFS. It's a noninvasive, quick bedside test that doesn't use ionising radiation and may detect reflex swallowing in patients who aren't cooperating. It also reduces the danger of aspiration of barium contrast media, which has a twofold benefit: patients prefer water to barium-based treatments, and aspiration is associated with a high mortality rate in ALS patients. Electrodiagnostic procedures can also be employed; however, they are invasive, poorly tolerated, and difficult to perform due to insufficient tongue relaxation. VUS was found to be more sensitive than VFS in detecting anomalies in early dysphagia, such as bolus location, oral bolus transport, and dynamic tongue movements. Because it was consistently related with dynamic anomalies in the oral phase of deglutition, aberrant bolus position, a static measure, may offer a particularly valuable diagnostic of swallowing dysfunction. While VUS could not observe swallowed material stagnation in the oral cavity due to a lack of bone penetration, this was almost often linked with other swallowing disorders and hence did not represent a significant limiting element of VUS [8]. Tongue atrophy was also associated with indications of dynamic swallowing anomaly, implying a link between structural and dynamic bulbar muscle abnormalities, however this tends to emerge later in the ALS disease course. As a result, this study established the value of VUS as an alternative to VFS that allows for the early and sensitive detection of dynamic swallowing dysfunction in the oral phase [9]. The ALS cohort had a poorer thickness ratio in the mylohyoid-geniohyoid muscle complex than the controls. This was specifically the case in the bulbar-onset group, according to a sub-analysis. Clinical UMN scores were negatively linked with thickness ratio and maximal thickness during swallowing [10,11]. Thus, dynamic bulbar muscle ultrasonography is a sign of UMN failure in ALS, however its sensitivity was only 66.7%, and the method's repeatability has to be investigated further. These findings may represent stiffness and impaired bulbar muscle contractility in ALS patients due to UMN dysfunction. This approach has the potential to be developed as a noninvasive objective marker of bulbar UMN failure in ALS patients, which can be difficult to detect clinically in those with bulbar onset ALS.

## CONCLUSION

Overall, neuromuscular ultrasonography plays an essential role in the diagnosis and monitoring of individuals with ALS, as well as providing important insights into the disease's underlying pathogenesis. To complement clinical and electrodiagnostic assessment procedures, the validation of a composite sonographic marker of nerve and muscle dysfunction appears to be achievable in the near future. Additional uses of these techniques will be enabled by future technological advancements, such as the development of ultra-high-frequency transducers and novel techniques like ultrasound elastography. Neuromuscular ultrasonography has a wide range of uses in ALS and other neuromuscular illnesses, making it an essential piece of equipment in all clinical neurophysiology departments.

## REFERENCES

1. Brooks BR, Miller RG, Swash M, et al. Escorial revisited: revised criteria for the diagnosis of amyotrophic lateral sclerosis. Amyotroph Lateral Scler Other Mot Neuron Disord. 2000;1(5):293-299.
2. Ludolph A, Drory V, Hardiman O, et al. WFN research group on ALS/MND. A revision of the el escorial criteria-2015. Amy Lat Scler Front Degener. 2015;16(5-6):291-292.
3. Grimm A, Prell T, Décard BF, et al. Muscle ultrasonography as an additional diagnostic tool for the diagnosis of amyotrophic lateral sclerosis. Clin Neurophysiol. 2015;126(4):820-827.
4. Boekestein WA, Misawa S, Schelhaas HJ, et al. Ultrasonographic Detection of Fasciculations Markedly Increases Diagnostic Sensitivity of ALSAuthor Response. Neurology. 2012;77(16):370-371.
5. O'gorman CM, Weikamp JG, Baria M, et al. Detecting fasciculations in cranial nerve innervated muscles with ultrasound in amyotrophic lateral sclerosis. Muscle & nerve. 2017;56(6):1072-1076.
6. Misawa S, Noto Y, Shibuya K, et al. Ultrasonographic detection of fasciculations markedly increases diagnostic sensitivity of ALS. Neurology. 2011;77(16):1532-1537.
7. Eisen A, Vucic S. Fasciculation potentials: A diagnsotic biomarker of early ALS? J Neurol Neurosurg Psychiatry. 2013;84(9):948.
8. Hallett M. Volitional control of movement: the physiology of free will. Clin Neurophy. 2007; 118(6):1179-1192.
9. Shen J, Cartwright MS. Neuromuscular ultrasound in the assessment of polyneuropathies and motor neuron disease. J Clin Neurophysiol: official publication of the American Electroencephalographic Society. 2016;33(2):86.
10. Caress JB. Optimal muscle selection in amyotrophic lateral sclerosis and the end of the 4-limb EMG. Muscle & Nerve. 2017;56(1):4-6.
11. Gulberti A, Hamel W, Buhmann C, et al. Subthalamic deep brain stimulation improves auditory sensory gating deficit in Parkinson's disease. Clin Neurophysiol. 2015;126(3):565-574.