Published in final edited form as:
Lancet Neurol. 2009 March ; 8(3): 226–227. doi:10.1016/S1474-4422(09)70030-4.

Electrical impedance myography as a biomarker for ALS

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Turner and coauthors[1] are to be congratulated on a thoughtful and comprehensive review of biomarkers for amytrophic lateral sclerosis (ALS), a complex subject that spans the realm of medicine, from molecular biology to MRI. I would, however, like to highlight one potentially important biomarker that was not discussed in the review: electrical impedance myography (EIM). Although EIM is new to the field of neurophysiology, the technique holds the promise of being an important biomarker for ALS that might be used in clinical trials. The basis for EIM is the surface application and measurement of a high-frequency electrical current to localised areas of muscle. Underlying EIM is the concept that ALS-associated changes in the structure and composition of muscle, including denervation, atrophy, and reinnervation, will affect the impedance of the tissue, resulting in changes in its electrical signature. Unlike standard neurophysiological techniques, EIM does not assess the inherent electrical activity of muscle, but rather the distortion of the applied current by the tissue. Early studies showed that EIM values are altered in many neuromuscular disorders and that these alterations can often be seen in the mild stages of the disease.[2] Indeed, in the first patient with ALS we studied, we identified a decline in the phase angle—which is one of the main outcome measures of EIM—in the quadriceps, well before the onset of clinical weakness in that muscle.[2] Following on from this work, in a study of 15 patients with ALS who were followed up for a maximum of 18 months, we compared EIM with other accepted outcome markers.[3] We concluded that EIM could be a more powerful biomarker than standard indices, such as strength testing or the ALS functional rating scale. Our work on disease progression has mainly focused on the use of EIM at one frequency (50 kHz) of applied electrical current; however, the use of EIM at several frequencies potentially enables a much broader assessment.[4] Moreover, the application of the current at several angles across a muscle and during active muscle contraction might eventually provide an even more complete picture of the condition of a muscle.[5] Although our work has mainly focused on the application of EIM to study disease progression, EIM also has potential in the early diagnosis of ALS. Other advantages of EIM are: it is painless, it can be used at the bedside, and it is low cost. EIM also has limitations; for example, the changes it identifies might not be able to differentiate ALS from other neurogenic conditions. EIM has shown considerable promise during the early stages of its development. On the basis of this work, and with the support of the US ALS Assocation, we have launched a prospective multicentre study to assess the potential value of EIM as a biomarker for ALS.

References

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I have no conflicts of interest, but my employing institution has filed a patent application that covers aspects of EIM technology unrelated to those in this letter.

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