PROVA ORALE N. 1

1. Neurofisiologia delle neuropatie acquisite e ereditarie
2. Neurofisiologia della spasticità
3. IOM: Valutazione del nervo facciale

QUESITO DI INGLESE

Lettura e traduzione stralcio articolo scientifico:

Small Fiber Neuropathy

QUESITO DI INFORMATICA

In una pipeline di analisi dei segnali EMG, quale fase dovrebbe essere eseguita prima dell'estrazione delle feature?

A. Classificazione tramite machine learning

B. Preprocessing del segnale (filtraggio, normalizzazione)

C. Visualizzazione dei risultati

D. Riduzione della dimensionalità

PROVA NON ESTRATTA

ALLEGATO DI GRADO

Muscle & Nerve

WILEY

MUSCLE&NERVE

AANEM GUIDELINE

Diagnostic and Screening Laboratory Tests in the Assessment of Patients With Small Fiber Neuropathy: An Evidence-Based Review—Report of the American Association of Neuromuscular and Electrodiagnostic Medicine Small Fiber Neuropathy Task Force

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Keywords: diagnostic testing | laboratory screening | painful neuropathy | skin punch biopsy | small fiber neuropathy

ABSTRACT

Small fiber neuropathy (SFN) presents with neuropathic pain, dysesthesia, and autonomic symptoms in the context of normal nerve conduction studies, necessitating specialized diagnostic approaches. This evidence-based review by the AANEM SFN Task Force evaluates the diagnostic utility of ancillary tests and appropriate screening laboratory investigations in the assessment of SFN. A comprehensive literature review was conducted using OVID MEDLINE and EMBASE from 1966 to January 2023. Studies were selected based on prespecified inclusion criteria requiring clinical symptoms consistent with SFN and normal large fiber conduction studies. Articles were independently reviewed and graded for evidence quality by multiple raters. Thirteen diagnostic and two laboratory screening studies met criteria. Skin punch biopsy assessing intraepidermal nerve fiber density showed Class II evidence (sensitivity 74%–78%, specificity 65%–80%). Additional metrics included intraepidermal fiber length and inter-fiber distance. Corneal confocal microscopy (CCM) showed potential (Class III) but lacked validation in isolated SFN. Indirect tests (laser/contact heat evoked potentials, cutaneous silent period) had variable sensitivity and high specificity. Lab screening identified metabolic/immune etiologies in up to 64%, though most evidence was Class III. Skin biopsy is the most validated direct diagnostic tool for SFN, though CCM and indirect assessments can aid in diagnosis. No test offers enough sensitivity or specificity to serve as a stand-alone gold standard. Despite limited high-level evidence, screening for metabolic and immune conditions may help identify etiologies. Standardized methods and population studies are needed to improve accuracy.

1 | Introduction

Small caliber nerve fibers can be involved in polyneuropathies leading to symptoms of pain, temperature insensitivity, and autonomic dysfunction. In some cases, there is exclusive dysfunction of the small fibers, a condition characterized as a small fiber neuropathy (SFN).

The diagnosis of polyneuropathy is based on a clinical neurological examination and routine nerve conduction studies, but

PROVA ORALE N. 2

1. Neurofisiologia delle forme atassiche
2. Blefarospasmo
3. IOM Mappaggio aree del linguaggio

QUESITO DI INGLESE

Lettura e traduzione stralcio articolo scientifico:

Transcranial magnetic stimulation

QUESITO DI INFORMATICA

Nel contesto della neurofisiologia computazionale, cosa si intende per pipeline di analisi dei dati?

A. Un tipo di filtro digitale

B. Una sequenza automatizzata di passaggi di elaborazione dei dati

C. Un database clinico

D. Un algoritmo di machine learning

PROVA ESTRATTA

ATTESTO DI GRADO

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Review article

Transcranial magnetic stimulation outcomes as biomarkers of multiple sclerosis disease progression: A structured literature review

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ABSTRACT

Multiple sclerosis (MS) is an immune-mediated central nervous system (CNS) disease and a leading cause of disability in young adults. Chronic disability progression is an unmet challenge for persons with MS and an area of interest for the development of biomarkers. Transcranial magnetic stimulation (TMS) is a putative technique for the development of MS biomarkers. However, TMS outcomes have not been extensively reviewed as biomarkers of disability progression in MS to date. This structured literature review assessed longitudinal and cross-sectional studies of TMS and disability progression in MS. Of the TMS techniques reviewed, central motor conduction time (CMCT), motor evoked potential (MEP) onset latency, and MEP amplitude demonstrated the best clinical performance as markers of CNS demyelination and neuro-axonal damage. While studies showed notable cross-sectional differences in TMS outcomes between persons with progressive and relapsing MS, these findings were less well-supported by longitudinal studies. Across studies, effect sizes were variable, sensitivity and specificity were underreported, and correlations with disability outcomes were heterogeneous. Studies were limited by small sample sizes, short follow-up periods, lack of standardized disability progression definition and TMS methods, and low reporting of diagnostic accuracy. We found insufficient evidence to presently justify the use of TMS techniques as biomarkers of MS disease progression. Future studies should address current limitations.

1. Introduction

Multiple sclerosis (MS) is an immune-mediated central nervous system (CNS) disease and leading cause of disability in young adults (Jakimovski et al., 2024). MS is characterized by neurologic disability accumulation caused by blood-brain barrier breakdown, inflammatory demyelination, and axonal injury (Jakimovski et al., 2024; Krieger et al., 2024; Lublin et al., 2022). Alongside relapse-associated worsening (RAW) is chronic disability progression (smouldering-associated worsening [SAW]/progression independent of relapse activity [PIRA]) due to CNS-compartmentalized inflammation and loss of neurologic reserve (Krieger et al., 2024; Lublin et al., 2022; Scalfari et al., 2024).

Contemporary diagnostic criteria promote earlier disease detection, for rapid initiation of disease-modifying therapy (DMT) (Montalban et al., 2025) and reduced RAW (Filippi et al., 2022). Nevertheless, due to low CNS penetrance of most DMT, chronic disability progression remains an unmet need (Lublin et al., 2022; Scalfari et al., 2024). Similarly, a challenge in discerning long-term therapeutic goals is defining the threshold for transition from relapsing MS (RMS) to secondary-progressive MS (SPMS) (Bayas et al., 2022; Cree et al., 2021). There are no universally accepted defining criteria for SPMS and most are retrospective and based on progressive disability accumulation with absent RAW (Cree et al., 2021; Lublin et al., 2022; Scalfari et al., 2024). Biomarkers for MS progression—including novel magnetic resonance imaging (MRI) sequences, optical coherence tomography (OCT), and fluid biomarkers like serum glial fibrillary acidic protein (GFAP)—are hampered by high cost, requirements for specialized expertise, or inconsistent diagnostic accuracy (Bastos et al., 2024; Bsteh et al., 2025).

MS biomarkers may also be obtained by transcranial magnetic stimulation (TMS) (Simpson and Macdonell, 2015; Snow et al., 2024; Snow et al., 2019; Stampanoni Bassi et al., 2020; Sy et al., 2023; Vucic et al., 2023). TMS biomarkers are relatively cost-effective, time efficient, non-invasive, and reliable (Hofstadt-van Oy et al., 2015; Jacques et al., 2024; Simpson and Macdonell, 2015; Wassermann and Zimmermann, 2012). TMS uses a time-varying magnetic field to induce an electric current along the cortical surface of the precentral gyrus, leading to

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PROVA ORALE N. 3

1. Neurofisiologia del secondo motoneurone
2. Miotonia
3. IOM Potenziali evocati somatosensitivi in chirurgia spinale: monitoraggio e mappaggio

QUESITO DI INGLESE

Lettura e traduzione stralcio articolo scientifico:

Microsurgical Clipping

QUESITO DI INFORMATICA

Quando si analizzano segnali neurofisiologici con software scientifici, perché è importante salvare anche i metadati (frequenza di campionamento, filtri, parametri di acquisizione)?

A. Per ridurre la dimensione dei file

B. Per consentire la corretta interpretazione e riproduzione dell'analisi

C. Per velocizzare i calcoli

D. Per migliorare la risoluzione del segnale

PROVA NON ESTRATTA

ALLEGATO DI GRADO

REVIEW

Comparative Outcomes of Intraoperative Neurophysiological Monitoring Modalities in Microsurgical Clipping of Unruptured Intracranial Aneurysms: A Systematic Review and Meta-Analysis

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BACKGROUND AND OBJECTIVES: Intraoperative neurophysiological monitoring (IONM), including somatosensory evoked potentials (SSEPs) and motor evoked potentials (MEPs), aims to reduce ischemic complications during unruptured intracranial aneurysm clipping. This systematic review focuses on the clinical value of IONM.

METHODS: We systematically searched PubMed, Medline, and Embase up to January 2025 for studies reporting neurological outcomes after microsurgical clipping of unruptured intracranial aneurysms with IONM. Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, outcomes included new neurological deficits at discharge and at first follow-up. In addition to summarizing complication rates across IONM modalities, we conducted an individual patient data analysis to evaluate the predictive value of IONM signal changes. Receiver operating characteristic curve analysis was used to define optimal duration thresholds for reversible IONM changes associated with neurological outcomes.

RESULTS: Seventeen studies (3222 patients) were included, with consistent anesthetic protocols, typical demographic characteristics, and modality use aligned with aneurysm location. The individual patient data analysis of 129 cases demonstrated that timely intraoperative intervention in response to IONM signal changes significantly reduces the risk of postoperative neurological deficits. Patients without any IONM signal loss had a 6% deficit rate at discharge. When signal changes occurred, reversal within <18 minutes for MEP or <16 minutes for SSEP was associated with a 15% deficit rate, compared with 95% when signals were not reversed. Isolated changes in either SSEP or MEP also led to deficits, underscoring the added value of multimodal monitoring.

CONCLUSION: IONM signal duration and reversibility are critical predictors of neurological outcome in aneurysm surgery. Multimodal IONM not only improves ischemia detection but also offers actionable thresholds for intraoperative decision-making. Its routine use should be considered to reduce neurological morbidity in microsurgical clipping of unruptured aneurysms.

KEY WORDS: Intracranial aneurysm, Motor evoked potentials, Intraoperative neurophysiological monitoring, Unruptured aneurysm, Intraoperative monitoringSomatosensory evoked potentials

ABBREVIATIONS: EEG, electroencephalogram; GLMM, generalized linear mixed model; **IONM,** intraoperative neurophysiological monitoring; **IPD,** individual patient data.

Supplemental digital content is available for this article at operativeneurosurgery-online.com.