IMAGING E APPROCCI DIAGNOSTICI INTERVENTISTICI NELLE DERMATOPOLIMIOSITI

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CME

Polymyositis

An overdiagnosed entity

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Abstract—*Background:* According to widely used criteria (Bohan and Peter criteria, 1975), dermatomyositis (DM) is differentiated from polymyositis (PM) only by skin changes. More recent criteria also include histopathologic characteristics enabling the distinction between PM and DM and the differentiation of sporadic inclusion body myositis (s-IBM) from PM. The authors investigated the applicability of diagnostic features for diagnosing PM and DM. *Methods:* The authors performed a retrospective follow-up study of 165 patients with 1) a previous diagnosis of myositis; 2) subacute onset of symmetric, proximal weakness; and 3) an evaluation between 1977 and 1998 excluding other neuromuscular disorders. *Results:* The diagnoses at initial evaluation based on clinical, laboratory, and histopathologic criteria were PM, 9 (6%); DM, 59 (36%; 54 isolated, 3 with associated connective tissue disease [CTD], 2 with associated malignancy); unspecified myositis (perimysial/perivascular infiltrates, no PM or DM), 65 (39%; 38 isolated myositis, 26 with associated CTD, 1 with malignancy); and possible myositis (necrotizing myopathy, no inflammatory infiltrates), 32 (19%; 29 isolated myositis, 3 with associated CTD). At follow-up evaluation, five of the nine patients with PM had typical s-IBM features. None of the remaining four patients complied with the assumed typical signs of PM. Ten of the 38 patients with isolated unspecified myositis had been diagnosed with a CTD. *Conclusions:* Polymyositis is an overdiagnosed entity. At evaluation, more than half the patients with autoimmune myositis cannot be specifically diagnosed with polymyositis or dermatomyositis. A quarter of patients with isolated unspecified myositis subsequently developed connective tissue disease.

NEUROLOGY 2003;61:316–321

NEUROLOGY 2003;61:288–290

Editorial

Unicorns, dragons, polymyositis, and other mythological beasts

Anthony A. Amato, MD; and Robert C. Griggs, MD

PERGAMON

Neuromuscular Disorders 14 (2004) 337–345

www.elsevier.com/locate/nmd

Workshop report

119th ENMC international workshop: Trial design in adult idiopathic inflammatory myopathies, with the exception of inclusion body myositis, 10–12 October 2003, Naarden, The Netherlands

Jessica E. Hoogendijk[a,*], Anthony A. Amato[b], Bryan R. Lecky[c], Ernest H. Choy[d], Ingrid E. Lundberg[e], Michael R. Rose[f], Jiri Vencovsky[g], Marianne de Visser[h], Richard A. Hughes[i,1]

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Available online at www.sciencedirect.com

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Neuromuscular Disorders 25 (2015) 268–272

www.elsevier.com/locate/nmd

Workshop report

205th ENMC International Workshop: Pathology diagnosis of idiopathic inflammatory myopathies Part II 28–30 March 2014, Naarden, The Netherlands

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Current Opinion in Rheumatology:
November 2011 - Volume 23 - Issue 6 - p 595–604
doi: 10.1097/BOR.0b013e32834bab42
Myositis and myopathies: Edited by Lisa Christopher-Stine

Acquired immune and inflammatory myopathies: pathologic classification

Pestronk, Alan[a,b,c]

Abstract

Purpose of review: We discuss pathology-based characterization and classification of acquired immune and inflammatory myopathies (IIMs).

Recent findings: Several types of IIMs do not fit well into the typical IIM subclassifications: dermatomyositis, polymyositis and inclusion body myositis (IBM). Myopathologic features that can provide additional diagnostic clarification in IIM are types of muscle fiber pathology; immune changes (cellular and humoral); and tissues with distinctive involvement (connective tissue, vessels and muscle fibers). Pathologic classification categories include immune myopathies with perimysial pathology (IMPP), a group that can be associated with antisynthetase antibodies; myovasculopathies, including childhood dermatomyositis; immune polymyopathies, active myopathies with little inflammation such as the myopathy with signal recognition particle antibodies; immune myopathies with endomysial pathology (IM-EP), illustrated by brachio-cervical inflammatory myopathy (BCIM); histiocytic inflammatory myopathies, like sarcoid myopathy; and inflammatory myopathies with vacuoles, aggregates and mitochondrial pathology (IM-VAMP), which have inclusion body myositis as a pathologic subtype and are poorly treatable. Some myopathologic features, like B-cell foci and alkaline phosphatase staining of capillaries or perimysium, are more likely to be present in treatable categories of IIM.

Summary: Myopathology can be used to classify IIM. Identification of distinctive myopathologic changes in IIM can improve diagnostic and prognostic accuracy and focus treatment, therapeutic trials and studies of pathogenic factors.

biopsies

Boel De Paepe reported on the online scoring survey that preceded the workshop. In the survey, material was made available from 24 patients from the University Hospitals of Amsterdam, Berlin and Ghent (Supplementary Table S1). For all individual biopsies, H&E, NADH, SDH, and COX stains were provided. For most cases, Gomori trichrome, non-specific esterase and alkaline phosphatase were also available, and in a large selection, accompanied by immunostains for CD3, CD4, CD8, CD20, CD68, MHC I, MAC and p62. The material was available via an online digital platform (Slidepath, Leica), allowing the analysis of the entire biopsy. No clinical data were provided from the patients, not even age or gender. An expansive score sheet was drawn up based upon Delphi during the 193rd ENMC workshop and supplied to the scorers. An analysis was done on the score sheets from 12 respondents, all international experts in diagnostic reading of muscle biopsies.

There was strong disagreement on diagnostic criteria. In only one biopsy, the experts unanimously agreed on the pathological diagnosis, and scored it as representing a non-specific myositis. An animated discussion followed concerning the diagnostic criteria for PM and IBM. Variation in scoring the severity of myopathological changes pointed to the need for providing standards for quantitative scoring. There was also disagreement on the localization of inflammatory cell infiltrates and the invasion of non-necrotic muscle fibres. The quality of immunostaining was sometimes considered poor, which compromised interpretation. Requests for extra stains were frequent and consisted mainly of markers for blood vessels, fiber types, and inclusions.

4. Consensus building

4.1. List of stains and score sheet

On the second day, consensus building included itemized discussions of myopathological methods and scoring, led by **Eleonora Aronica**, and the re-analysis of previewed cases, led by **Marianne de Visser**.

Based upon the achievements of the first workshop and further discussion, recommendations for IM diagnostic criteria

Table 1
Recommended list of IM diagnostic stains.

Required stains for muscle biopsies	Additional stains for suspected IM	Optional stains for suspected IM
HE	AK	CD20/CD79a
ATPases/Myosin F/S	CD3, CD8, CD68	CD4
NADH	HLA-ABC/MHC-I	CD138
SDH	MAC (c5b-9)	BDCA1/BDCA2
COX or COX/SDH	p62	HLA-DR/MHC-II
Gomori	CD31	TDP43
PAS		CD56/NCAM
Oro/Sudan B.		Myosin-fetal
AP		
NE		
Congo red		

Abbreviations: alkaline phosphatase (AK), fast/slow (F/S), acid phosphatase (AP), cytochrome c oxidase (COX), hematoxylin–eosin (HE), membrane attack complex (MAC), non-specific esterase (NE), succinate dehydrogenase (SDH).

Workshop report

205th ENMC International Workshop:
Pathology diagnosis of idiopathic inflammatory myopathies Part II
28–30 March 2014, Naarden, The Netherlands

Jan L. De Bleecker [a,*], Boel De Paepe [a], Eleonora Aronica [b], Marianne de Visser [c], for the ENMC Myositis Muscle Biopsy Study Group

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Miopatie infiammatorie da causa nota

- Miositi infettive
  - Virali (es., AAV, EBV, CMV)
  - Batteriche (es., piomiositi stafilococciche, m. Whipple)
  - Parassitarie (es., trichinella, strongiloide)
- 'Miositi' da farmaci (es., statine)
- 'Miositi' in corso di altre malattie sistemiche (es., distiroidismi)

Miopatie infiammatorie idiopatiche

- Dermatomiositi (DM)
- Polimiositi (PM)
- Miositi a corpi inclusi (sIBM)
- Miopatie necrotizzanti immuno-mediate (IMNM)
- *Forme rare*: miositi focali, fasciti, “graft vs host”, miosite granulomatosa, miofascite macrofagica (da vaccino)

Miopatie infiammatorie “overlap”

- Polimositi, dermatomiositi, miopatie necrotizzanti in corso di collagenopatie note
  - LES
  - ARTRITE REUMATOIDE
  - CONNETTIVITI MISTE
  - CONNETTIVITI INDIFFERENZIATE
  - SCLERODERMIA
  - S. SJÖGREN
- L'interessamento muscolare può essere parcellare o subclinico

Biochimica et Biophysica Acta 1852 (2015) 622–632

Contents lists available at ScienceDirect

Biochimica et Biophysica Acta

journal homepage: www.elsevier.com/locate/bbadis

Review

Dermatomyositis, polymyositis and immune-mediated necrotising myopathies☆☆

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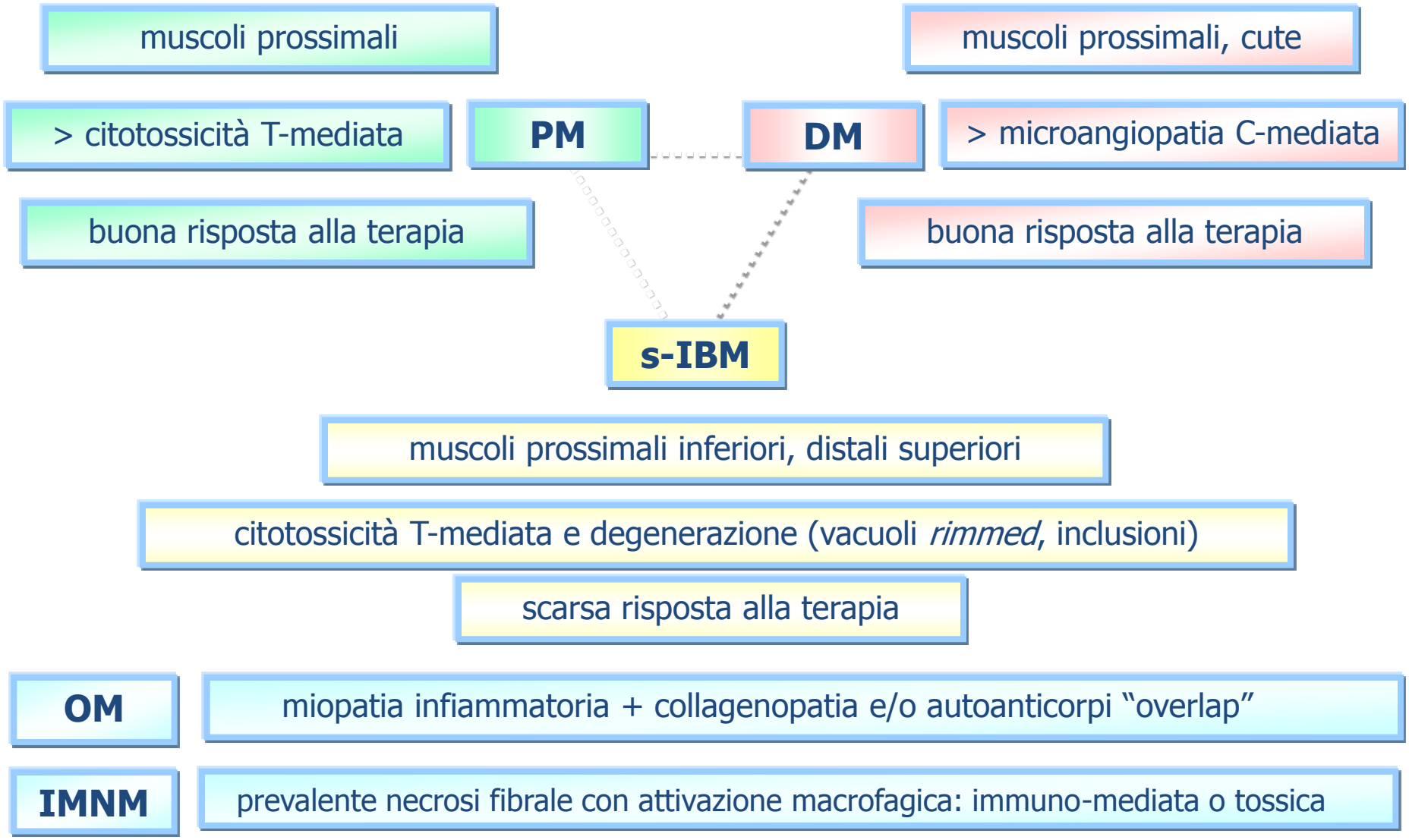
Table 1
Clinical, serological and pathological features of immune-mediated inflammatory myopathies.

	Dermatomyositis	Polymyositis	IMNM
Muscle weakness	Proximal predominant (UL > LL)	Proximal predominant	Proximal + distal
Skin involvement	+	−	−
Association with CTD	+	++	+
Association with malignancy	+	+	−
Association with viral infections (HIV, HTLV-1, hepatitis C)	+	+	+
Autoantibodies (target antigens)	Mi-2, MDA5, TIF-1, NXP-2	U1-snRNP, PM-Scl, Antisynthetase	SRP, HMGCR
Histopathology			
Myofibre necrosis	Fibre groups, perifascicular, microinfarcts	Single fibres	Single fibres
Perifascicular atrophy	+	−	−
Inflammatory infiltrates	CD4+ T cells, B cells, pDCs (BDCA2+)	CD8+ T cells, plasma cells (CD138+), mDCs (BDCA1+)	Macrophages (CD68+/CD163+)
MAC (C5b-9)	++	−	+/−
MHC-I/II	++	++	+/−
Capillary depletion	++	+/−	−

Miopatie infiammatorie idiopatiche



Miopatie infiammatorie idiopatiche: 'HOT SPOTS'

- Studio di algoritmi diagnostici per una diagnosi differenziale 'cost-effective'
- Ricerca di biomarcatori per sottoclassificare i pazienti in gruppi clinicamente e eziopatologicamente omogenei per i trials clinici
- Ricerca di biomarcatori o di outcome measures sensibili e standardizzabili per valutare la risposta terapeutica

Polimiosite/Dermatomiosite: caratteristiche cliniche

- Esordio subacuto, talvolta con rapida progressione o nell'arco di qualche mese
- Debolezza degli arti, simmetrica, prossimale > distale; muscoli posteriori del collo, mm. paravertebrali; risparmiati mm. oculomotori, mimici
- Interessamento cutaneo e capillare (dermatomiosite)
- Assenza di disturbi di sensibilità
- Mialgie (meno importanti della debolezza)
- Disfagia, disfonia, deficit muscoli respiratori

Altri sintomi/segni associati

- Fenomeno di Raynaud
- Sintomi polmonari persistenti (tosse, dispnea da sforzo)
- Dolori articolari (piccole o grandi articolazioni)
- Alterazioni cutanee (ispessimenti, prurito)
- Disturbi della lacrimazione e/o salivazione
- Disturbi del transito intestinale

Sindrome da anti-tRNA sintetasi

- (dermato)Miosite + interstiziopatia polmonare + fenomeno di Raynaud
- Presenza di anticorpi Anti Jo-1
- Prognosi discreta per la componente muscolare, meno favorevole per l'aspetto polmonare

Miopatie necrotizzanti immuno-mediate

- Clinicamente identiche alle polimiositi idiopatiche + ipostenia distale o generalizzata
- CK molto elevata
- Quadro istologico di necrosi delle fibre muscolari con scarsa componente linfocitaria, positività MAC;
- Forma con 'pipestem capillaries' (MAC + a livello capillare)
- Autoanticorpi: SRP, anti HMGCR
- Forma paraneoplastica: > maschi, bianchi, sopra 45 anni, entro 3 aa dalla diagnosi
- Tipo di neoplasia: polmone, ovaio, linfoma non-Hodgkin, pancreas, colon, altri
- Diagnosi differenziale con miopatie tossiche

Table 3
Potential triggers for immune-mediated necrotising myopathies.

Anti-signal recognition particle antibodies
Statin therapy (anti-HMGCR antibodies)
Antisynthetase antibodies
Malignancy
Connective tissue diseases
Viral infections (HIV, hepatitis C)

Diagnosi differenziale: il laboratorio

- CK significativamente elevata (5x →)
- Indici di infiammazione +/-
- Autoanticorpi antinucleo e miosite-specifici (antisintetasi, anti Mi2, Pm-scl, anti-SRP)
- EMG: reperto 'miopatico' con aspetti 'irritativi'

Diagnosi differenziale : caratterizzazione e quantificazione delle alterazioni ai fini terapeutici

- BIOPSIA MUSCOLARE
- RMN MUSCOLARE

La biopsia muscolare

- indispensabile in assenza di alterazioni cutanee diagnostiche o di autoanticorpi specifici
- diagnosi differenziale PM/DM e con altre miopatie genetiche ed acquisite (casi “non responder”)
- può dare informazioni prognostiche e terapeutiche (es, Indice CD4/CD8: ↑ nelle overlap, ↓ nelle PM/DM pure; vacuoli p62 + nelle IBM)

➡ va eseguita <u>prima</u> della terapia steroidea

➡ va eseguita su muscolo congelato

➡ Se disponibile, va eseguita dopo esecuzione della RMN per la scelta della sede migliore

Biopsia muscolare

Biopsia muscolare

Biopsia muscolare: altri aspetti

atrofia perifascicolare

deficit parziale di COX

Marcatori infiammatori: CD8, CD4, macrofagi

Marcatori infiammatori: MAC (C5b9), HLA I

Miosite a corpi inclusi

Miosite a corpi inclusi

p-tau

β-amiloide

αβ-cristallina

Altre patologie con quadri clinici e istologici simil-infiammatori

- Sindromi miasteniche
- Neuropatie motorie acute
- Malattie del secondo motoneurone (IBM)
- Miopatie secondarie (distiroidismo, altre disendocrinopatie, farmaci)
- Miopatie geneticamente determinate con componente infiammatoria (es., mutazioni della lamina A/C, disferlina; distrofia facio-scapolo-omerale, glicogenosi tipo 2 – m. di Pompe)

Table 2
Polymyositis mimics

Age ≤40	Age >40
Fibromyalgia	Inclusion body myositis
Dermatomyositis, necrotizing myopathy	Overlap syndrome: RA, SLE
Dystrophin, dysferlin, calpain-3, FSHD, Pompe disease, etc	Myotonic dystrophy 2
Myotonic dystrophy 2	Polymyalgia rheumatica
Overlap syndrome: RA, SLE, juvenile RA	Dermatomyositis, necrotizing myopathy
Inclusion body myositis	Fibromyalgia
Influenza A or B	Pompe disease

Imaging muscolare

- Ecografia muscolare: fasciti, miositi focali; ancora poco specifica; utile per la scelta della sede di biopsia
- RMN muscolare: introdotta a metà degli anni ottanta, sta acquistando un ruolo sempre maggiore con il progredire delle conoscenze; attualmente ha ancora un ruolo complementare

RMN nelle malattie neuromuscolari

- Rilevazione di alterazioni subcliniche (es., nelle iperCKemie paucisintomatiche)
- Rilevazione della distribuzione delle alterazioni (pattern) per la diagnosi differenziale
- Distinzione tra lesioni 'attive' con edema e aree di sostituzione fibro-adiposa per la diagnosi differenziale e per il monitoraggio dell'evoluzione
- Scelta della sede di biopsia
- Candidata come 'outcome measure' in trials terapeutici

Protocollo 'Muscle MRI'

JOURNAL OF MAGNETIC RESONANCE IMAGING

ISMRM ONE COMMUNITY FOR CLINICIANS AND SCIENTISTS

JOURNAL OF MAGNETIC RESONANCE IMAGING 25:433–440 (2007)

Invited Review

Muscle MRI in Inherited Neuromuscular Disorders: Past, Present, and Future

Eugenio Mercuri, MD,[1,2*] Anna Pichiecchio, MD,[3] Joanna Allsop, DCR,[4] Sonia Messina, MD,[1] Marika Pane, MD,[1] and Francesco Muntoni, MD[2]

Interest in muscle MRI has been largely stimulated in the last few years by the recognition of an increasing number of genetic defects in the field of inherited neuromuscular disorders. Muscle ultrasound (US) and computed tomography (CT) have been used to detect the presence of muscle involvement in patients affected by these disorders, but until recently the use of muscle MRI has been, with a few exceptions, limited to detecting inflammatory forms. The aim of this review is to illustrate how muscle MRI, in combination with clinical evaluation, can contribute to the selection of appropriate genetic tests and more generally in the differ-

muscle MRI in the diagnosis of inherited neuromuscular disorders, and to identify possible new applications of this technique in a research setting in an attempt to better understand the mechanisms of neuromuscular disorders.

PAST

In the early 1980s Heckmatt et al (1,2) reported the

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Neuromuscular Disorders 22 (2012) S54–S67

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Workshop report

Towards harmonization of protocols for MRI outcome measures in skeletal muscle studies: Consensus recommendations from two TREAT-NMD NMR workshops, 2 May 2010, Stockholm, Sweden, 1–2 October 2009, Paris, France

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Neuromuscular Disorders 22 (2012) S43–S53

www.elsevier.com/locate/nmd

Workshop report

TREAT-NMD workshop: Pattern recognition in genetic muscle diseases using muscle MRI 25–26 February 2011, Rome, Italy

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Available online at www.sciencedirect.com

SciVerse ScienceDirect

Neuromuscular Disorders 22 (2012) S68–S84

www.elsevier.com/locate/nmd

Whole body muscle MRI protocol: Pattern recognition in early onset NM disorders

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A paediatric and adult whole-body MRI (WB-MRI) protocol using a 1.5-T MRI system was used to examine 117 individuals (106 patients, 11 asymptomatic relatives). Genetic diagnosis was obtained in 38 subjects (*RYR1*, *LMNA*, *COL6*, *DNM2*, *GAA*, *TPM2*, *SGCA*, *MYH7*, *NEB*, *SMN*, *FKBP14*). T1-TSE WB-MRI sequences were abnormal in 67% of patients and 27% of asymptomatic relatives. Multiple striped signal abnormalities ('tiger-like') were very specific for COLVI-related myopathy. Distinct involvement of muscles in the head, neck, trunk, girdles and limbs was observed in patients with *RYR1*, *SEPN1*, *GAA*, *LMNA* or *TPM2* mutations. Abnormalities and pattern recognition were more frequent in patients studied due to rigid spine syndrome (80% abnormal, recognisable in 75% of cases), hyperlaxity syndrome (75%; 50%) or with confirmed myopathy but absence of these markers (71%; 40%). Pattern was consistent with the molecular diagnosis in 97%. Mild clinical involvement was revealed by muscle testing in three parents with abnormal WB-MRI. The Garches WB-MRI protocol is suitable for a large spectrum of adults and children with early-onset neuromuscular disorders and can be used as an effective screening test in relatives. Recognition of characteristic patterns of abnormalities is improved by whole-body scanning compared with sequential MRI and, therefore, diagnostic impact is greater.

Neuropediatrics 2014; 45(05): 278-288
DOI: 10.1055/s-0034-1381954

Original Article

Georg Thieme Verlag KG Stuttgart · New York

Muscle Magnetic Resonance Imaging of the Lower Limbs: Valuable Diagnostic Tool in the Investigation of Childhood Neuromuscular Disorders

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Children presenting with neuromuscular symptoms are subject to exhaustive investigations. As it is noninvasive, muscle magnetic resonance imaging (MRI) is an important diagnostic tool in children, yet its impact has so far been mainly studied in small groups of genetically defined diseases, where specific MRI patterns are known. To assess the contribution of muscle MRI of the lower limbs in a diverse cohort of patients, we reviewed the diagnostic findings in 39 patients with a suspected neuromuscular disorder that underwent muscle MRI (28/39), biopsy (26/39), or both (18/39). MRI was performed without sedation in 26 of 28 patients at a mean age of 10 years (range, 1–27 years). In 10 of 28 cases (35%), MRI significantly contributed to the final diagnosis, and in 7 of 28 cases (25%), muscle MRI directly instructed genetic testing. These cases included Bethlem myopathy, laminopathy, calpainopathy, and *RYR1*-related myopathies. Muscle MRI serves as a valuable additional tool to guide diagnosis in suspected neuromuscular disorders in children, especially in cases with nonspecific biopsy findings.

MRI Findings in Inflammatory Muscle Diseases and Their Noninflammatory Mimics

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OBJECTIVE. The purpose of this article is to provide a practical review of the spectrum of MRI findings in inflammatory muscle diseases and their noninflammatory mimics.

CONCLUSION. MRI is a highly sensitive tool for the diagnosis of muscle diseases. Although it has low specificity, awareness of the potential imaging findings in the various, sometimes rare, muscular disorders is helpful for accurate diagnosis.

COMBINING MRI AND MUSCLE BIOPSY IMPROVES DIAGNOSTIC ACCURACY IN SUBACUTE-ONSET IDIOPATHIC INFLAMMATORY MYOPATHY

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Accepted 29 May 2014

ABSTRACT: *Introduction*: In 10–20% of patients with subacute-onset idiopathic inflammatory myopathy (IIM), muscle biopsy is normal or shows nonspecific findings. MRI can be used as a triage test before muscle biopsy and as an add-on test if the biopsy is nondiagnostic. *Methods*: MRI scans of skeletal muscles and muscle biopsies were evaluated prospectively in 48 patients suspected to have IIM. The interpretations of MRI and muscle biopsy were compared with the definite diagnosis (based on European Neuromuscular Centre criteria and response to corticosteroids). *Results*: The false negative rate (FNR) of all muscle biopsies was 0.23. Biopsies of a muscle showing hyperintensity on MRI (as triage test) had an FNR of 0.19. The result of MRI as an add-on test in patients with a nondiagnostic muscle biopsy decreased the FNR from 0.23 to 0.06. *Conclusions*: We recommend both MRI and muscle biopsy in patients suspected of having IIM.

Muscle Nerve **51**: 253–258, 2015

Whole-body magnetic resonance imaging in the assessment of muscular involvement in juvenile dermatomyositis/polymyositis patients

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MYO-MRI

MRI & MRS IN NEUROMUSCULAR DISEASE

The COST Action BM1304, *"Applications of MR imaging and spectroscopy techniques in neuromuscular disease: collaboration on outcome measures and pattern recognition for diagnostics and therapy development"*, was approved by the COST Committee of Senior Officials on 15 May 2013.

It was formally launched on **2 December 2013.**

Objectives

- Improve diagnosis and understanding of muscle pathology: online atlas
- Develop multicentric imaging outcome measures: SOPs
- Explore new contrasts, targets and imaging techniques for NMD: clinical testing
- Explore strategies for muscle imaging texture analysis: validated algorithms

Proposer

Prof. Volker Straub, Newcastle University

Vice-proposer

Links

MRI & MRS @TREAT-NMD

Harmonised MR protocols – publication

Participate

If you are interested in participating in this COST action, please contact Olav

MYO-MRI

MRI & MRS IN NEUROMUSCULAR DISEASE

Improve diagnosis and understanding of muscle pathology

Working Group Leaders – Volker Straub Susana Quijano-Roy

Knowledge about the onset of muscle pathology detected by imaging, about the degree of progression, the spectrum of selective involvement across the whole body and about modifiers of these parameters is still very sparse for the majority of NMD. This lack of information might delay the diagnosis of patients with NMD and impede our understanding of disease mechanisms.

Specific objectives:

- Hold two WG meetings per year that coordinate the collection of an agreed number of standardized MR images for defined diseases.
- Establish and validate a secure Information Technology (IT) platform to share medical images between experts.
- Establish an online inventory of muscle MR images with associated standardised clinical and genetic data from NMD prioritized by the consortium (including a spectrum from pre-symptomatic to advanced, whole-body images, where appropriate cardiac images).
- Define regions of interest (ROI) for each disease, indicating the optimal muscle to biopsy or to be used for outcome measurements in a clinical trial setting (showing most reliable change over time).
- Develop a user friendly digital NMD atlas of muscle MR images with public access.

The working group involved with this consists of...

Develop multicentric imaging outcome measures

Working Group Leader – Pierre Carlier

The most important reason why quantitative muscle MRI and MRS is currently not applied routinely across trial sites in multicentric studies is because of the lack of standardized and validated MR protocols for both data acquisition and data analysis. Trial participants therefore either need to all travel to a single centre or there is a risk that data is not comparable across centres. Protocols may need to be tailored for specific diseases. There is also a global lack of young researchers, (MR physicists and radiographers) with expertise in this area, and given its rapid growth it is essential to encourage new researchers to specialise in this field.

Enabling STSMs for young researchers to gain expertise in different departments is crucial to catalyse development of expertise in the "next generation".

Specific objectives:

- Hold 2 expert WG meetings per year that serve to develop SOPs for imaging protocols relevant for quantitative muscle imaging in natural history studies and clinical trials.
- Publish optimised protocols for Dixon acquisition (Iterative Decomposition of water and fat with Echo Asymmetry and Least-squares estimation, IDEAL vs non-IDEAL, and fat spectrum simulation) and T2 acquisition using new approaches (partially Spoiled Steady State Free Precession, pSSFP, acquisitions) validated in a multicentric, cross-platform setting.
- Hold 1 training school per year for MR staff from different centres at a central location, coordinated by the Action's Dissemination and Training Committee (DTC).
- Offer up to 4 STSMs per year for ESRs to train in muscle imaging at centres of excellence. ESRs from Eastern Europe will be encouraged to make use of the offer as will those who are working in neuromuscular centres with an interest in clinical trials. Applicants are selected by the DTC.
- Provide expert site visits for onsite training on outcomes of WG1 and WG2 to ensure implementation of the relevant protocols. 2.6: One international conference on neuromuscular imaging as a show case for European translational research in rare diseases.

Explore new contrasts, targets and imaging techniques for NMD

Working Group Leader – Hermien Kan

New imaging techniques and contrast agents evolve with the development of improved MR technology and need to be tested against established protocols for their added value in the quantitative assessment of muscle pathology.

Specific objectives:

- Hold two expert consensus WG meetings per year to confidentially share pre-clinical and clinical data with the intention to develop joint protocols for new imaging techniques.
- Publish joint reports on experimental validation of new contrasts relevant for the diagnosis and/or assessment of NMD and recommendations for their application by non-experts.

This working group consists of…

Aristides Bakandritsos	Andrew Blamire
Jedrek Burakiewizc	Bruce Damon
Paulo de Sousa	Martijn Froeling
Melissa Hooijmans	Barbara Janssen
Hermien Kan	George Loudos
Marisa Garcia Martin	Aart Nederveen
Jos Oudeman	Paola Porcari
Oliver Scheidegger	Chris Sinclair
Gustav Strijkers	John Thornton

Explore strategies for muscle imaging texture analysis

Working Group Leader – Jacques de Certaines

Muscle architecture disorganization is a frequent end-stage feature of chronic NMD and particularly of muscular dystrophy. These structural changes translate into abnormal dispersion of the NMR signal distribution within muscles. The NMR signal heterogeneities result in increased standard deviation of muscle signal intensities. This very simple index has been shown to identify dystrophic muscle in animal models and to normalize when dystrophin expression is restored. However it does not take into account possible particular spatial distribution of muscle signal intensities. Texture analysis algorithms may reveal topographical patterns and improve diseased muscle characterization.

Specific Objectives:

- Hold Working Group meetings of experts to define strategies of muscle texture analysis and to define the best NMR contrast for these techniques to be applied.
- Compare results obtained with different approaches and determine their merits for moitoring disease evolution.
- Publish joint reports and manuscripts on the relative performances of all techniques tested.

This working group consists of...

Noura Azzabou
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Luis Escudero
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Ringraziamenti

AZIENDA OSPEDALIERO - UNIVERSITARIA
Città della Salute e della Scienza di Torino

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