



International Parkinson and
Movement Disorder Society
European Section



5th Congress of the European Academy of Neurology

Oslo, Norway, June 29 - July 2, 2019

Hands-on Course 11

**EAN/MDS-ES: Clinical neurophysiology for
assessment of patients with movement disorders
(Level 2)**

Jerky movements

Marina A. J. de Koning-Tijssen
Groningen, The Netherlands

Email: m.a.j.de.koning-tijssen@umcg.nl

Movement Disorder sessions at the 5th Congress of the European Academy of Neurology are done in collaboration between MDS-ES and the EAN.



#MDSatEAN

Jerky Movements



Marina AJ de Koning-Tijssen
Neurology, UMCG, Groningen
the Netherlands



Disclosures

European Fund for Regional Development (01492947)
ZONMW-TOP (91218013)
Dystonia Medical Research Foundation
Stichting Wetenschapsfonds Dystonie Vereniging
Fonds Psychische Gezondheid
The province of Friesland
Phelps Stichting
Actelion (Unrestricted grant)

30 juni 2019



Jerky Movement Disorders

DD

- Myoclonus
- Tics
- Functional jerks



30 juni 2019



Is it Myoclonus ?










Table 1 Mimics of myoclonus	
Hyperkinetic movement disorder	Clinical characteristics
Functional (psychogenic) jerks	Inconsistent Reduces with distraction Entrainment
Chorea	Dance-like movements Non-patterned Integrated with normal movement
Motor tics	Stereotypic or repetitive movements Onset in childhood Coexistence of other tics Can be voluntarily suppressed Premonitory sensations (urge) Relief after movement
Dystonic jerks	Jerks together with dystonia Sensory tricks (geste antagoniste) can alleviate
Tremor	Sinusoidal and rhythmic

REVIEWS

A novel diagnostic approach to patients with myoclonus

Paul Zulf, Margje E. van Egmond, Jan Willem Ebing, Pieter Jan van Laar, Oubek F. Elroway, Catherine A. Wood, Ruben van Pelt, Tom J. de Boer and Marina A. Tijssen



Is it Myoclonus ?









Table 1 Mimics of myoclonus	
Hyperkinetic movement disorder	Clinical characteristics
Functional (psychogenic) jerks	Inconsistent Reduces with distraction Entrainment
Chorea	Dance-like movements Non-patterned Integrated with normal movement
Motor tics	Stereotypic or repetitive movements Onset in childhood Coexistence of other tics Can be voluntarily suppressed Premonitory sensations (urge) Relief after movement
Dystonic jerks	Jerks together with dystonia Sensory tricks (geste antagoniste) can alleviate
Tremor	Sinusoidal and rhythmic


103 Patients

15% Others

- 12 tremor**
- 4 chorea**
- 2 dystonic jerks**

85% Myoclonus including

- 45 organic**
- 40 functional jerks**



Case 1



**CLINICAL DIAGNOSIS?
ELECTROPHYSIOLOGICAL TEST?**



TIC



Hyperkinetic movement disorder	Clinical characteristics
Motor tics	Stereotypic or repetitive movements Onset in childhood Coexistence of other tics Can be voluntarily suppressed Premonitory sensations (urge) Relief after movement



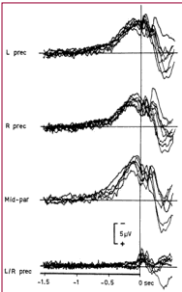
TIC

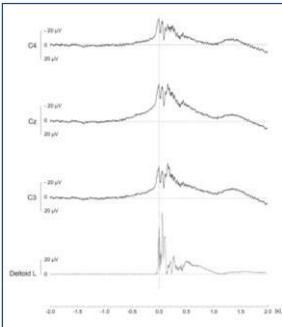



Hyperkinetic movement disorder	Clinical characteristics	Electrophysiological characteristics
Motor tics	Stereotypic or repetitive movements Onset in childhood Coexistence of other tics Can be voluntarily suppressed Premonitory sensations (urge) Relief after movement	Burst duration >100ms Pre-movement potential on back-averaging



Average of > 40 jerks







Movement disorders
GRONINGEN


Bereitschafts potential

	Total included	Spontaneous jerky movements				Intended wrist extension BP (%)
		BP (%)	Onset BP	Early BP (%)	Late BP (%)	
Psychogenic	29	25 (86)*	1195 * (700–2410)	22 (76)*	3 (10)	12 (41)*
Tourette	14	6 (43)	915 * (510–1700)	4 (29)	2 (14)	13 (93)
Myoclonus	5	0 (0)	*	0 (0)	0 (0)	5 (100)
Control subjects	25	—	—	—	—	25 (100)*


The total number of participants and BPs is reported per condition (spontaneous jerks or intended wrist extension task) with the percentage between brackets. Median is reported (range) for onset of BP (msec).
*Indicates significant differences.
BP, Bereitschaftspotential.


Salm et al, 2012 JNNP

Case 2



Movement disorders
GRONINGEN





CLINICAL DIAGNOSIS? ELECTROPHYSIOLOGICAL TEST?

30 juni 2019



FUNCTIONAL JERKS

Abnormal involuntary movements that are incongruent with a known neurologic cause and are significantly improved on neurological exam with distraction or non-physiologic maneuvers Edwards, 2013



Acute onset
Start after minor trauma Stone & Carson 2013
Paroxysmal features
Spontaneous remissions
Dissociation / panic attacks
Excessive tiredness
Multiple somatisations

Psychiatric co-morbidity ?
Raelofs, 2002, Sharpe, 2006, Stone, 2007, Kranick 2011

Inconsistency
Incongruence
Distraction and 'entrainment'
Suggestibility
Voluntary movements major effort
Excessive response to external stimuli
Discrepancy disability & clinical findings



Positive Signs

30 juni 2019



Hyperkinetic movement disorder	Clinical characteristics	Electrophysiological characteristics
Functional (psychogenic) jerks	Inconsistent Reduces with distraction Entrainment	Variation in muscle involvement Variation in muscle recruitment order Variation in burst duration and/or amplitude Pre-movement potential on back-averaging

Bereitschaftspotential (BP) Right I: 4 seconds of raw EEG and EMG data. long duration EMG bursts (+/- 500 ms), and the artefact in the EEG as the consequence of the myoclonus. After back-averaging of 63 epochs of myoclonus, a BP can be seen, which starts approximately 1 second before myoclonus onset. Note the centroparietal field distribution.

	Total included	Spontaneous jerky movements			Intended wrist extension BP (%)
		BP (%)	Onset BP	Early BP (%)	
Psychogenic	29	25 (86)*	1195 * (700–2410)	22 (76)*	3 (10)

30 juni 2019

Case 3

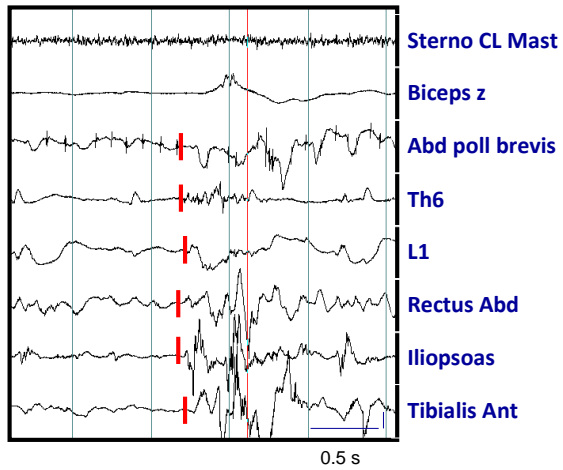
30 juni 2019

CLINICAL DIAGNOSIS? ELECTROPHYSIOLOGICAL TEST?

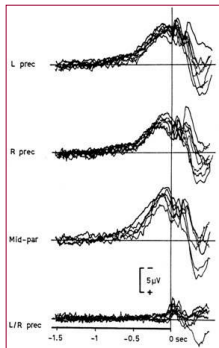
30 juni 2019




Polymyography



Bereitschafts potential



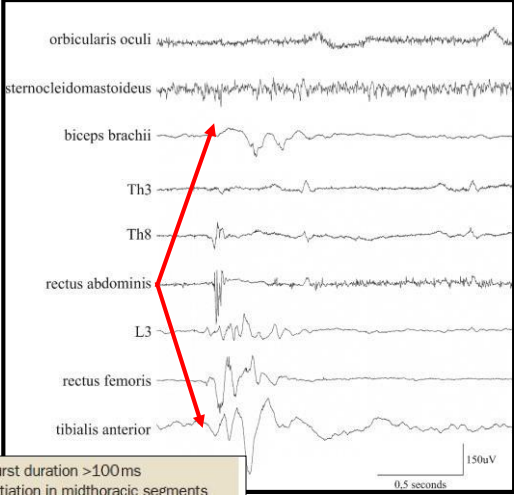
Propriospinal myoclonus



Movement disorders
GRONINGEN

Polymyography

- Burst duration
- Pattern activation
- Conduction time




150µV
0.5 seconds

Chokroverty, 1992 & Post, 2004

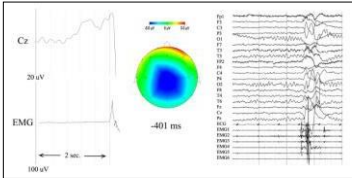
Propriospinal	Fixed pattern Affects axial muscles Spontaneous or stimulus-sensitive (lying down can be a provoking factor)	Burst duration >100ms Initiation in midthoracic segments followed by rostral and caudal activation Slow propagation velocity (5–10m/s)
----------------------	--	--

Propriospinal myoclonus



Movement disorders
GRONINGEN

Often Functional



Propriospinal myoclonus
Clinical reappraisal and review of literature

ABSTRACT

Objective: Propriospinal myoclonus (PSM) is a rare disorder with repetitive, usually flexor arrhythmic brief jerks of the trunk, hips, and knees in a fixed pattern. It has a presumed generation in the spinal cord and diagnosis depends on characteristic features at polymyography. Recently, a historical paradigm shift took place as PSM has been reported to be a functional (or psychogenic) movement disorder (FMD) in most patients. This review aims to characterize the clinical features, etiology, electrophysiologic features, and treatment outcomes of PSM.

Methods: Re-evaluation of all published PSM cases and systematic scoring of clinical and electrophysiologic characteristics in all published cases since 1993.

Results: Of the 179 identified patients with PSM (55% male), the mean age at onset was 4.3 years (range 6–88 years). FMD was diagnosed in 104 (58%) cases. In 12 cases (26% of reported secondary cases, 7% of total cases), a structural spinal cord lesion was found. Clonazepam and botulinum toxin may be effective in reducing jerks.

Conclusions: FMD is more frequent than previously assumed. Structural lesions reported to underlie PSM are scarce. Based on our clinical experience and the reviewed literature, we recommend polymyography to assess recruitment variability combined with a literature/epidemiological recording in all cases. *Neurology*® 2014;83:1862–1870

Content not available at this time

Parkinsonism and Related Disorders

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

Improving neurophysiological biomarkers for functional myoclonic movements

M. Brudek^{1,2}, R. Zan^{3,4,5}, A.M. Moppelink¹, S. Little¹, J.W. Ebing¹, B.M.L. Stetten¹, M. Edwards¹, M.A.J. Tijssen^{1,2,6}

Myoclonus subtypes



Retrospective study in 85 patients

- 34 % Cortical myoclonus
- 11% Subcortical myoclonus
- 6% Spinal myoclonus
- 2% Peripheral myoclonus

! 47% Functional (psychogenic) myoclonus

30 juni 2019



Case 4



CLINICAL DIAGNOSIS? ELECTROPHYSIOLOGICAL TEST?

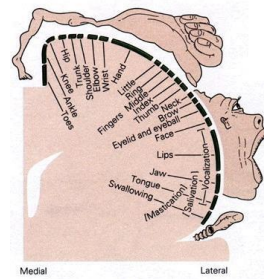
30 juni 2019



Cortical myoclonus

Clinical characteristics

(Multi)focal or generalized
Affects face, distal limbs
Spontaneous, action-induced or stimulus-sensitive
Negative myoclonus



BRAIN
"North Sea" progressive myoclonus epilepsy: phenotype of subjects with GOSR2 mutation



Movement disorders
GRONINGEN


Burst duration < 100 ms

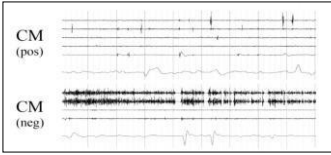
Polymyography

Movement disorders
GRONINGEN

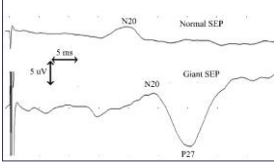
SEP

Polymyography





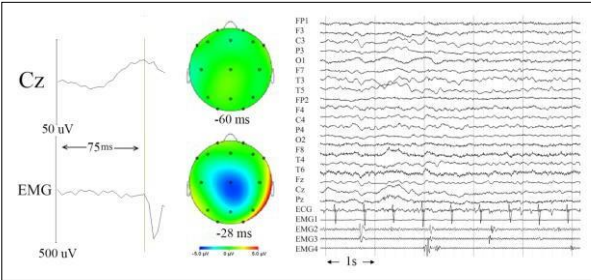
Polymyography




SEP

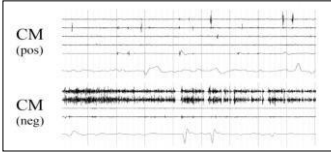
Electrophysiological characteristics

- Burst duration <100ms
- Positive back-averaging
- Positive coherence
- Giant somatosensory evoked potentials
- C reflex

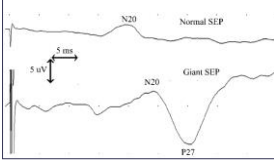


Backaveraging Backaveraging on 72 segments of myoclonus in the left tibialis anterior muscle. A negative going potential starts in the central region at about 35 ms before EMG onset, and is maximal at EMG onset.





Polymyography



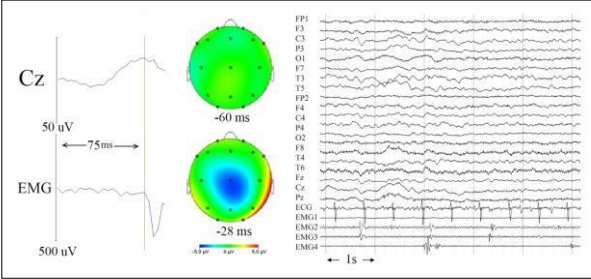
SEP

Electrophysiological characteristics

- Burst duration <100ms
- Positive back-averaging
- Positive coherence
- Giant somatosensory evoked potentials
- C reflex

Electrophysiologic testing aids diagnosis and subtyping of myoclonus

In cortical myoclonus the yield of back-averaging to confirm a cortical origin was 60% and of SEP 21%.



Backaveraging Backaveraging on 72 segments of myoclonus in the left tibialis anterior muscle. A negative going potential starts in the central region at about 35 ms before EMG onset, and is maximal at EMG onset.

Case 5



30 juni 2019



**CLINICAL DIAGNOSIS?
ELECTROPHYSIOLOGICAL TEST?**


30 juni 2019



EMG
burst 50 ms

SSEP
Giant potential

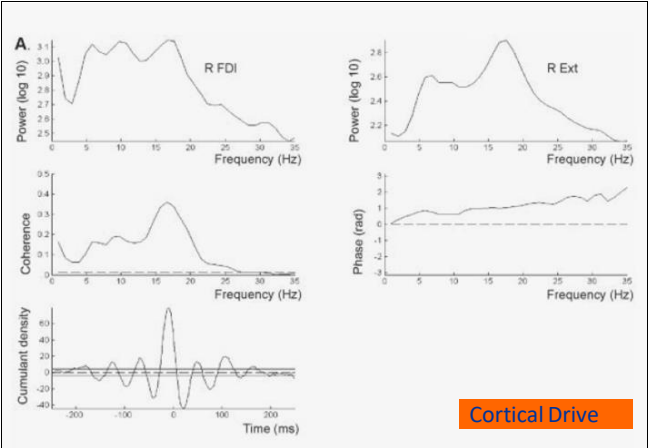
EMG-EEG
Coherence analysis



Movement disorders
GRONINGEN

Frequency spectra


Coherence spectrum




Van rootselaar et al., 2006

Familial cortical myoclonus/tremor with epilepsy FCMT


ADCME, BAFME, FAME, FCMT, FMEA, FEME, FCTE, THE




Case 6



Movement disorders
GRONINGEN



30 juni 2019



CLINICAL DIAGNOSIS? ELECTROPHYSIOLOGICAL TEST?

30 juni 2019

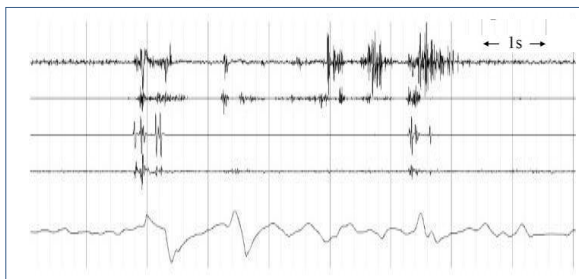


Sub-Cortical / Non-Cortical

34

Myoclonus dystonia	(Multi)focal Axial, affects proximal limbs Spontaneous or action-induced
-----------------------	--

Burst duration >100ms



30 juni 2019



Sub-Cortical / Non-Cortical

Myoclonus Dystonia (SGCE, DYT11)



Genetics:

Epsilon-sarcoglycan gene

Reduced penetrance

Maternal imprinting

M-D phenotype 50% DYT11

Genetic heterogeneity:

KCTD17, CACNA1B, RELN, ACDY5, TH

Major criteria

Myoclonus isolated or predominating over dystonia

Prominence of the motor manifestations in the upper body

Absence of truncal dystonia

Positive family history

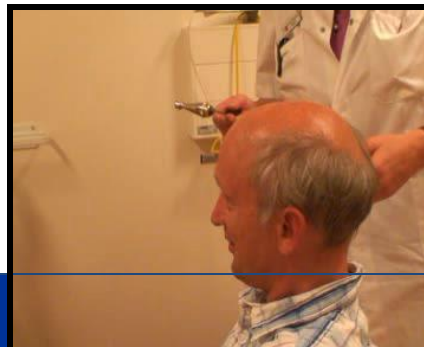
Onset before age 18 years

Minor criteria

Obsessive compulsive disorder, anxiety related disorder or alcohol dependence

Spontaneous remission of limb dystonia during childhood or adolescence

Alcohol responsiveness



Man , 55 years

Many falls since childhood

Falls forward 'as stiff as a stick'

Falls are frequently related to unexpected stimuli

He only falls during standing and walking

Past medical history : EEG's and analysis cardiology



CLINICAL DIAGNOSIS? ELECTROPHYSIOLOGICAL TEST?

30 juni 2019

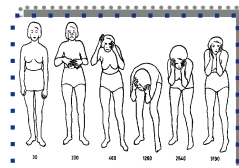


Brainstem, Hyperekplexia

Subcortical	
Brainstem	Generalized or synchronous Axial Affects proximal limbs Spontaneous or stimulus-sensitive

Excessive startle reflexes
Stiffness with startle
Stiffness in the first year of life

Head retraction reflex



Suhren & Bruyn, 1964

GLRA1 mutation and long-term follow-up of the first hyperekplexia family

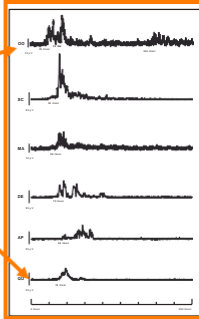
Willemsen et al. Brain 2014; 137: 1000-1010

30 juni 2019



Brainstem, Hyperekplexia

Subcortical		
Brainstem	Generalized or synchronous Axial Affects proximal limbs Spontaneous or stimulus-sensitive	Burst duration >100ms Simultaneous rostral and caudal muscle activation Habituation
Myoclonus dystonia	(Multi)focal Axial, affects proximal limbs Spontaneous or action-induced	Burst duration >100ms



The recruitment order of muscles is consistent with a bulbo-spinal origin
>>Medial bulbo-pontin reticular formation

Brown *et al*, Brain, 1991



How good can we classify myoclonus and how useful is Electrophysiological testing?

Electrophysiologic testing aids diagnosis and subtyping of myoclonus

Prospective 72 patients with myoclonus.

Initial clinical anatomical classification 25 cortical myoclonus

7 subcortical myoclonus

2 spinal myoclonus

15 functional myoclonic jerks

23 cases complex

Electrophysiologic testing in 66:

agreement of myoclonus in 60 (91%)

agreement of subtype in 28 (47%)

Subsequent clinical review by a movement disorder specialist agreed with the electrophysiologic findings in 52 of 60.



Table 4 Details of cases in which the clinical diagnosis changed after evaluation by the movement disorders specialist

no.	Age at onset, y ^a	Age at examination, y ^a	Clinical features	Electrophysiologic findings	Electrophysiologic diagnosis	Expert clinical diagnosis	final clinical diagnosis	Reasons for revising the electrophysiologic diagnosis
1	10	20	Distal limbs and face Provocation by action Stimulus sensitive	50-200 ms Back-averaging NP	SCM	CM	CM	Distal distribution Facial involvement Stimulus sensitivity No firm electrophysiologic results
2	0	10	Distal + proximal limbs Face Provocation by action Stimulus sensitive	Positive and negative 50-100 ms Back-averaging NP	SCM	CM	CM	Distal distribution Facial involvement Stimulus sensitivity No firm electrophysiologic results
3	68	69	Negative myoclonus Distal limbs Provocation by action	Negative 50-100 ms Back-averaging NP	SCM	CM	CM	Negative myoclonus Metabolic derangements No firm electrophysiologic results
4	6	7	Distal limbs Provocation by action Stimulus sensitive	50-200 ms Negative back-averaging	SCM	CM	CM	Distal distribution Stimulus sensitivity Co-occurrence of epilepsy
5	16	17	Epilepsy Acute onset Distal upper limbs Entrainment Alipical sensory problems	50-200 ms Negative back-averaging	SCM	F)	F)	No firm electrophysiologic results Acute onset Alipical sensory problems Entrainment No firm electrophysiologic results
6	18	18	Acute onset Distal limbs Stimulus sensitive Change with distraction	Variable duration Multifocal Back-averaging NP	SCM	F)	F)	Acute onset Stimulus sensitive Change with distraction No firm electrophysiologic results
7	20	20	Subacute onset Proximal and distal Provocation by rest Stimulus sensitive Change with distraction	50-200 ms Negative back-averaging	SCM	F)	F)	Provocation by rest Stimulus sensitive Change with distraction No firm electrophysiologic results
8	14	20	Myoclonus, dystonia, tremor Cognitive difficulties Proximal and distal	Positive and negative 50-100 ms Back-averaging NP	CM	SCM	SCM	Combined myoclonus and dystonia No firm electrophysiologic results

Abbreviations: CM = cortical myoclonus; F) = functional jerks; NP = not performed; SCM = subcortical myoclonus.
*Values are displayed as median.



Conclusion

Phenotyping of jerky movements is important
For diagnosis and treatment

Clinical phenotyping
Use Electrophysiology if needed

EMG-Polymyography most useful
>> Burst duration & Pattern
Back-averaging additional value

rijksuniversiteit groningen umcg bcn Research Institute BCN-BRAIN Movement disorders GRONINGEN 43

Thank you for your attention



m.a.j.de.koning-tijssen@umcg.nl

30 juni 2019

Movement disorders GRONINGEN
Healthy Ageing: moving to the next generation



Non-habituating excessive startling

- Vocalisations
- Echolalia
- Echopraxia
- Forced obedience
- Coprolalia

Psychiatric features

Anxiety & Depression

Treatment

Behavioral therapy?









Bakker, *et al.*, Movement Disorders, 2013

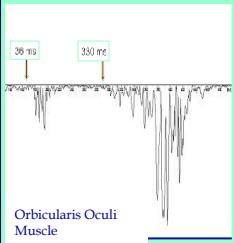
Startle reflex: Two phases



Initial phase

Brainstem mediated motor reflex

Roughly uniform



Secondary phase

'Orienting response' or 'what-is-it?' reflex

Variable, complex behaviors, influence of psychological factors

A shift of attention and perception

Bakker, *et al.*, Movement Disorders, 2013 Pavlov, 1927, Gogan, 1970, Wilkins, 1986