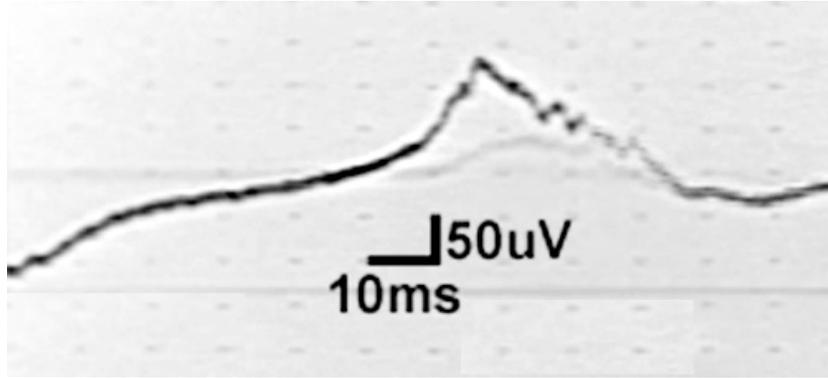


QUESTION 2. THESE POTENTIALS ARE RECORDED FROM

- a. FIBROTIC MUSCLE
- b. NEONATAL MUSCLE
- c. MUSCLE DISUSE
- d. NORMAL ADULT MUSCLE
- e. STEROID MYOPATHY



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WAVE FORM IDENTIFICATION

ID	INITIAL DEFLECTION	
DUR	DURATION	} MUSCLE FIBER vs MOTOR UNIT
AMP	AMPLITUDE	
RA	RATE	} SPONTANEOUS vs VOLITIONAL
RHY	RHYTHM	
O*	ORIGIN	
DS*	DIAGNOSTIC SIGNIFICANCE	

* In notes but will not be mentioned during presentation to allow time for adequate wave form identification

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MUSCLE FIBER & MOTOR UNIT POTENTIALS

POTENTIALS are MORE LIKELY MUSCLE FIBER POTENTIALS if they ARE:

< 5 ms
< 200 μ v
If the POTENTIAL DISAPPEARS
WITH MOVE NEEDLE MOVEMENT

POTENTIALS are MORE LIKELY MOTOR UNIT POTENTIALS if they ARE:

> 5 ms
> 1 mv
If the POTENTIAL IS UNCHANGED
WITH MOVE NEEDLE MOVEMENT

POTENTIALS ARE VOUNTARY if THEY ARE SLIGHTLY RANDOMLY IRREGULAR

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DETERMINING RATE = POTENTIALS/sec EXAMPLE

100 ms BETWEEN POTENTIALS (P) =
100 ms INTERPOTENTIAL INTERVAL =
100 ms INTERSPIKE INTERVAL

$$\frac{1P}{100ms} = \frac{X}{1000ms/sec}$$

$$X = \frac{1P \times 1000ms/sec}{100ms}$$

$$X = 10 P/sec$$

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DETERMINING RATE

TO DETERMINE RATE i.e. Hz i.e. POTENTIALS/sec

IDENTIFY ms BETWEEN POTENTIALS =
ONE POTENTIAL PER SO MANY ms =
INTERPOTENTIAL INTERVAL in ms =
INTERSPIKE INTERVAL in ms =
INTER-EVENT INTERVAL in ms

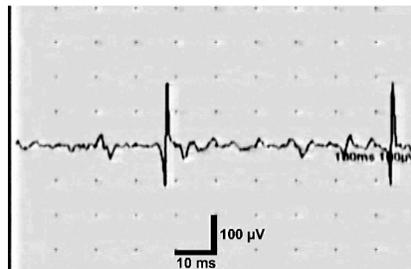
$$\text{POTENTIALS/sec} = \frac{1000}{\text{INTERPOTENTIAL INTERVAL in ms}}$$

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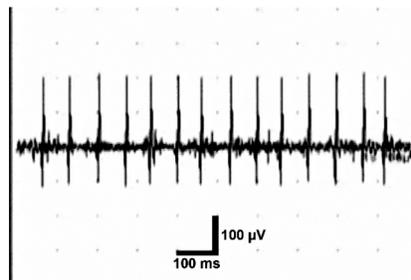
RHYTHM

Q3

a. Vol
MUP



b. FIB



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SPONTANEOUS POTENTIALS
MUSCLE FIBER POTENTIALS
NORMAL ENDPLATE ACTIVITY

NON-PROPAGATED: MEPP's
PROPAGATED ENDPLATE SPIKES

ABNORMAL POTENTIALS

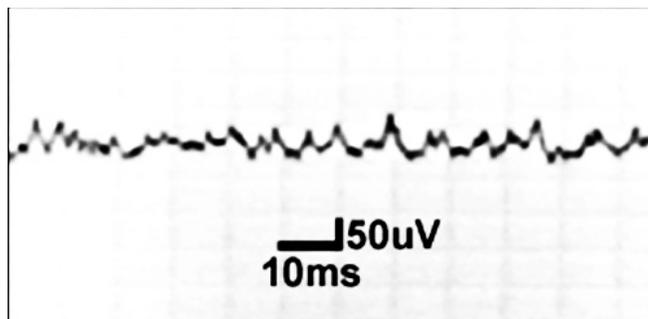


MOTOR UNIT POTENTIALS
MYOKYMIA
FASCICULATIONS

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MEPP

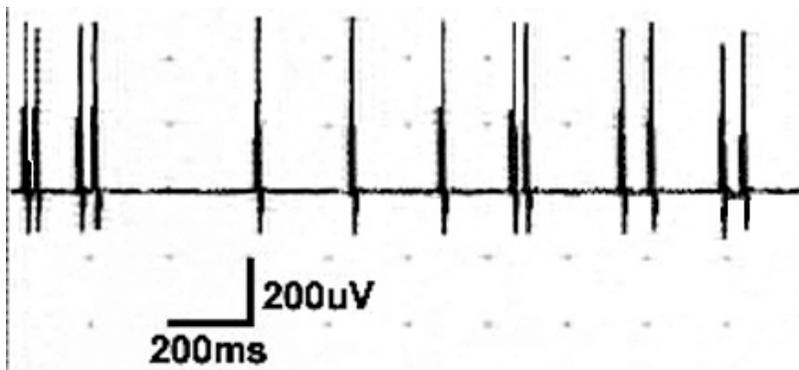
ID: NEGATIVE
DUR: 0.2 to 2 msec
AMP: 10 to 40 μ V
RA: 150 Hz
RHY: IRREGULAR
O: PREJUNCTIONAL
DS: NORMAL



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Q4: QUESTION 3. IDENTIFY POTENTIALS

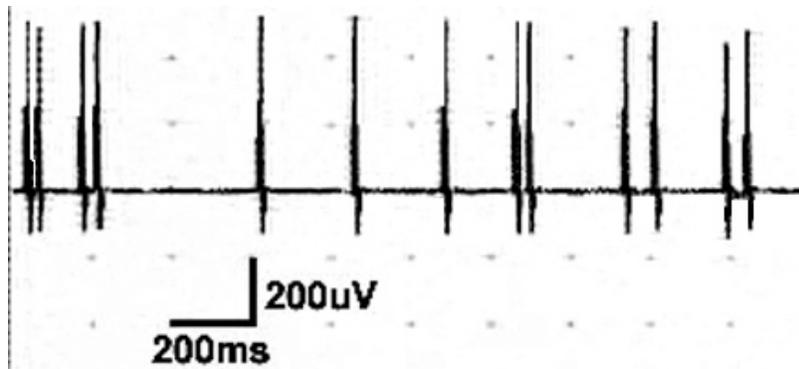
- a. FIBRILLATIONS
- b. MYOPATHIC MUP's
- c. MUP's from EYE MUSCLES
- d. NEONATAL MUP's
- e. ENDPLATE SPIKES (EPS's)



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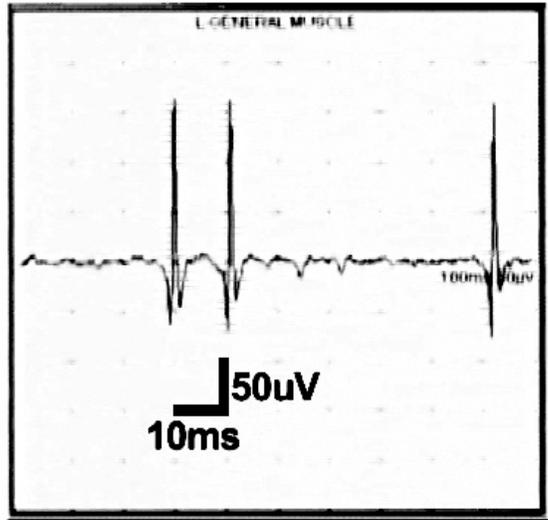
ENDPLATE SPIKES

ID:	USUALLY NEGATIVE
DUR:	< 5 msec
AMP:	< 1 mV
RA:	1 to 100 Hz
RHY:	"WILDLY" IRREGULAR
O:	PREJUNCTIONAL
DS:	NORMAL



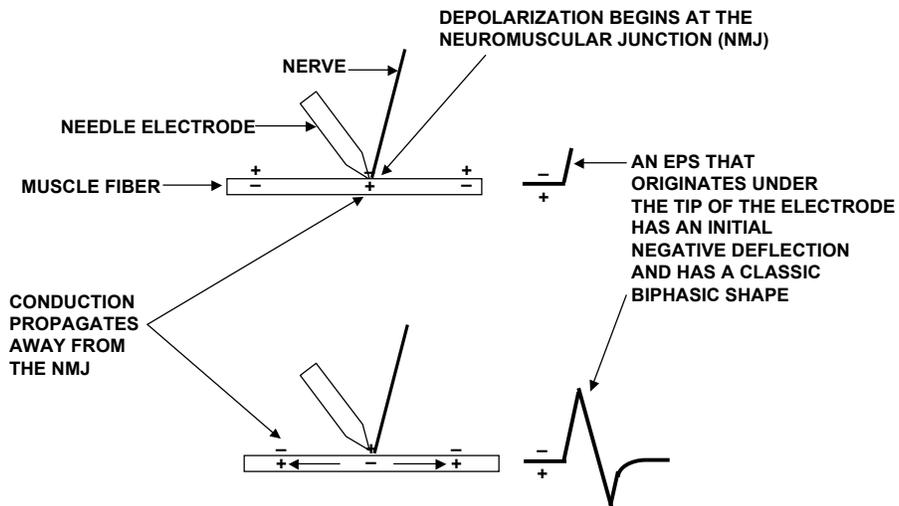
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- a. FIBRILLATIONS
- Q5 b. ENDPLATE SPIKES
- c. MUPs



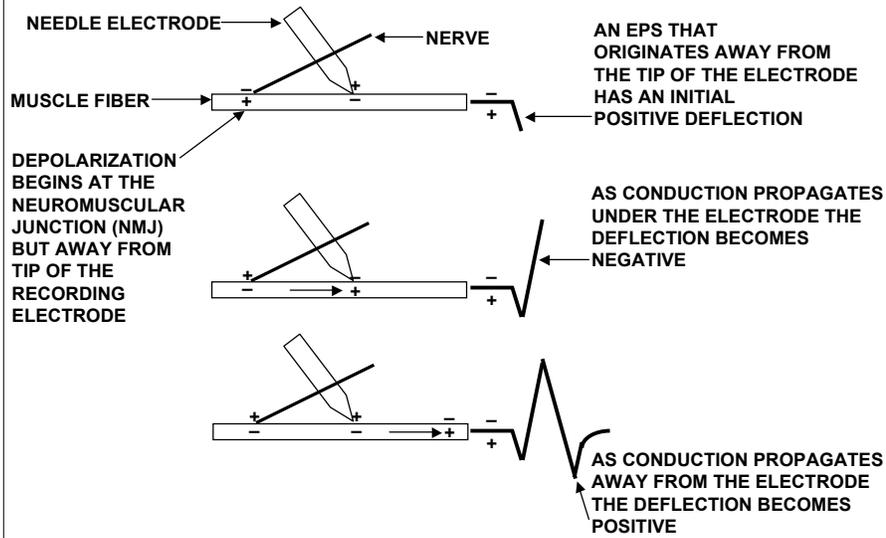
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CLASSIC ENDPLATE SPIKE (EPS) WITH AN INITIAL NEGATIVE DEFLECTION & BIPHASIC SHAPE



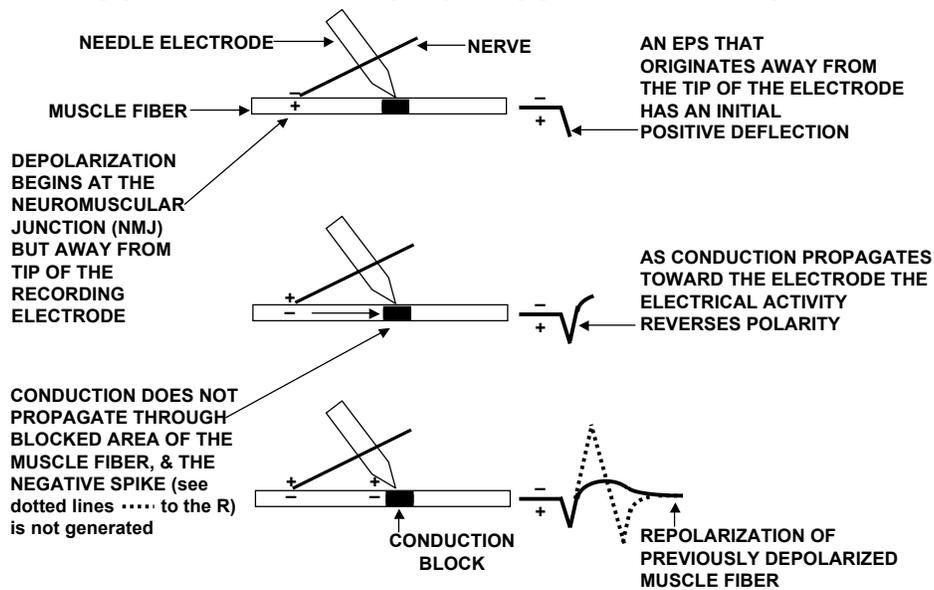
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ENDPLATE SPIKE (EPS) WITH AN INITIAL POSITIVE DEFLECTION & TRIPHASIC SHAPE



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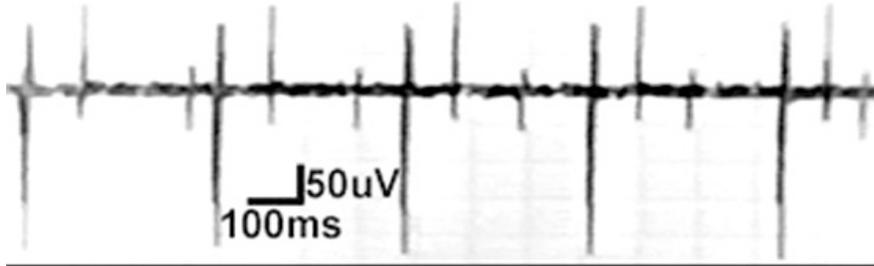
ENDPLATE SPIKE (EPS) WITH AN INITIAL POSITIVE DEFLECTION & "POSITIVE WAVE" SHAPE



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Q6. QUESTION 4. IDENTIFY POTENTIALS

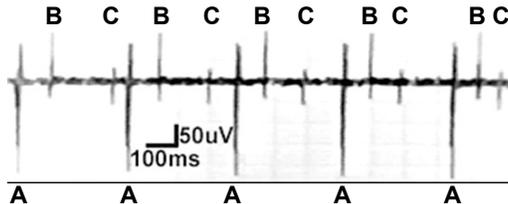
- a. ENDPLATE SPIKES
- b. FIBRILLATIONS
- c. NORMAL MUP's
- d. PACEMAKER POTENTIALS
- e. FASCICULATIONS



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FIBRILLATION POTENTIALS

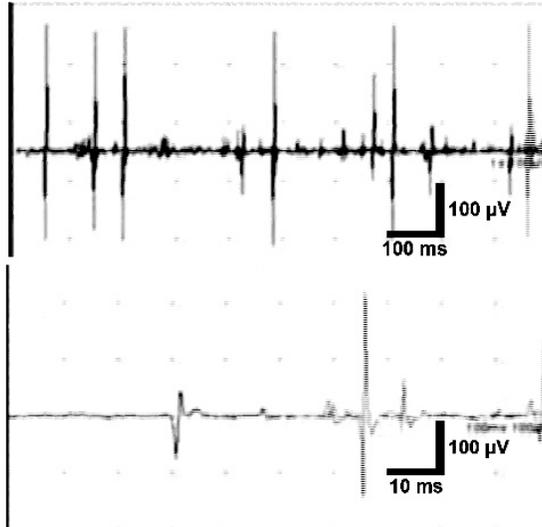
- ID USUALLY POSITIVE
- DUR < 5 msec
- AMP < 1 mV
 - early > 300 μ V
 - late < 25 μ V
- RA 0.5 to 20 Hz
- RHY VERY REGULAR but
 - DRIFT
 - SLOW to FASTER
 - SLOW to SLOWER
 - EARLY SLIGHTLY IRREGULAR
- O POSTJUNCTIONAL
- DS ABNORMAL



FIBRILLATIONS IDENTIFIED BY THE SAME LETTER REPRESENT REPEAT FIRING OF THE SAME FIBRILLATION. NOTE REGULARITY OF FIRING OF THE SAME FIBRILLATIONS

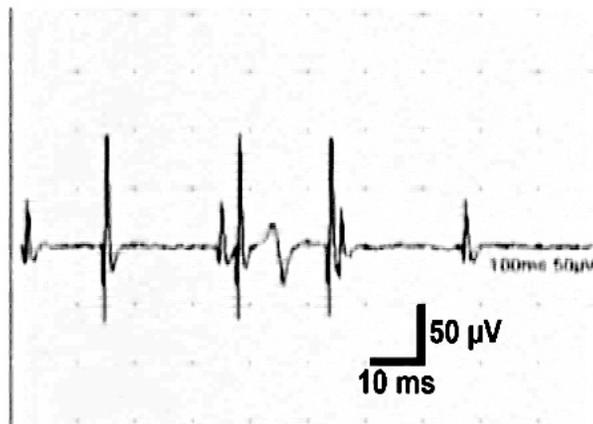
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IRREGULAR FIBRILLATION POTENTIALS



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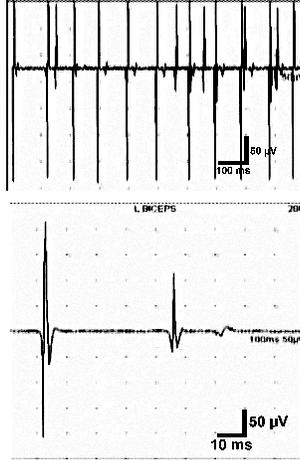
- Q7
- a. Voluntary MUPs
 - b. ENDPLATE SPIKES
 - c. FIBRILLATIONS



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Q8

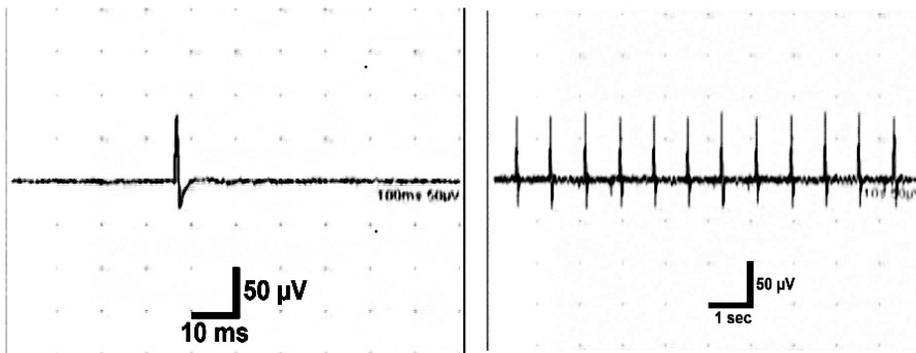
- a. FIBs**
- b. Vol MUPs**



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Q9

- a. END PLATE SPIKE**
- b. FIBRILLATION**
- c. PACEMAKER**
- d. Voluntary MUP**

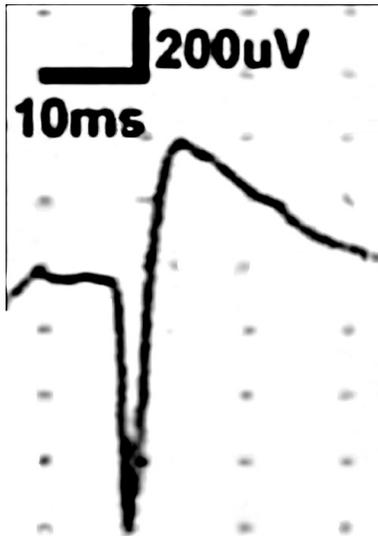


CLOSE CLIP

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**QUESTION 5.
IDENTIFY POTENTIALS**

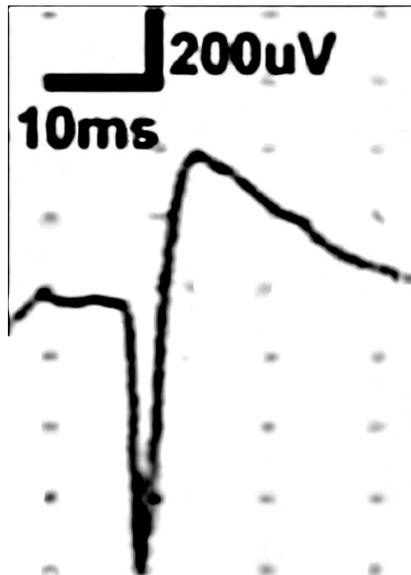
- a. DISTANT MUP's
- b. POTENTIALS from TENDONS
- c. POSITIVE WAVES
- d. ARTIFACTS from LIGHTS
- e. MYOTONIC POTENTIALS



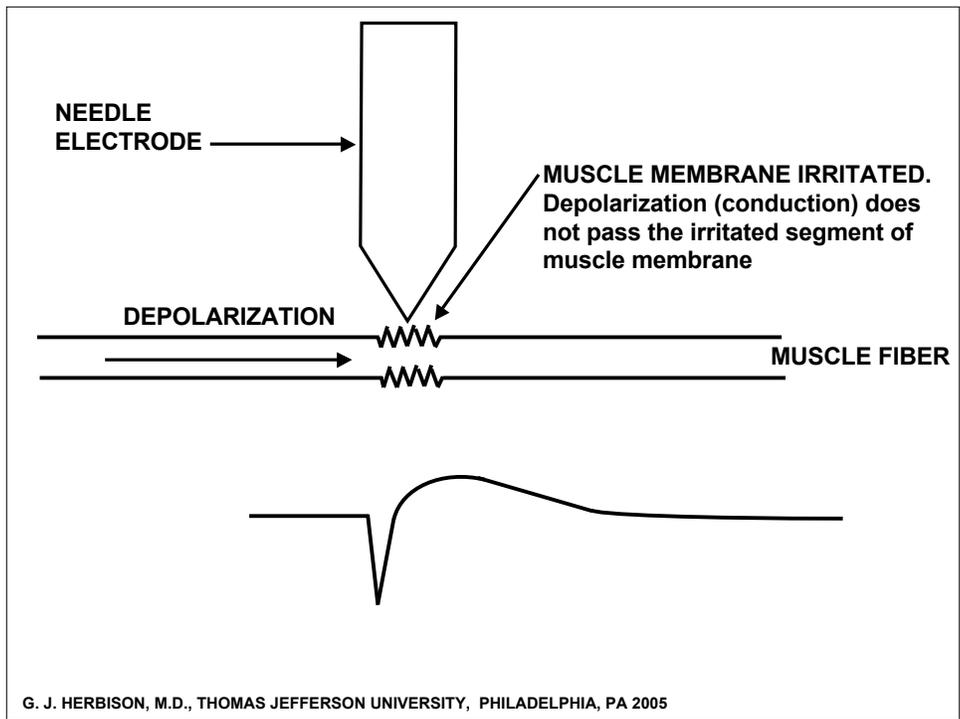
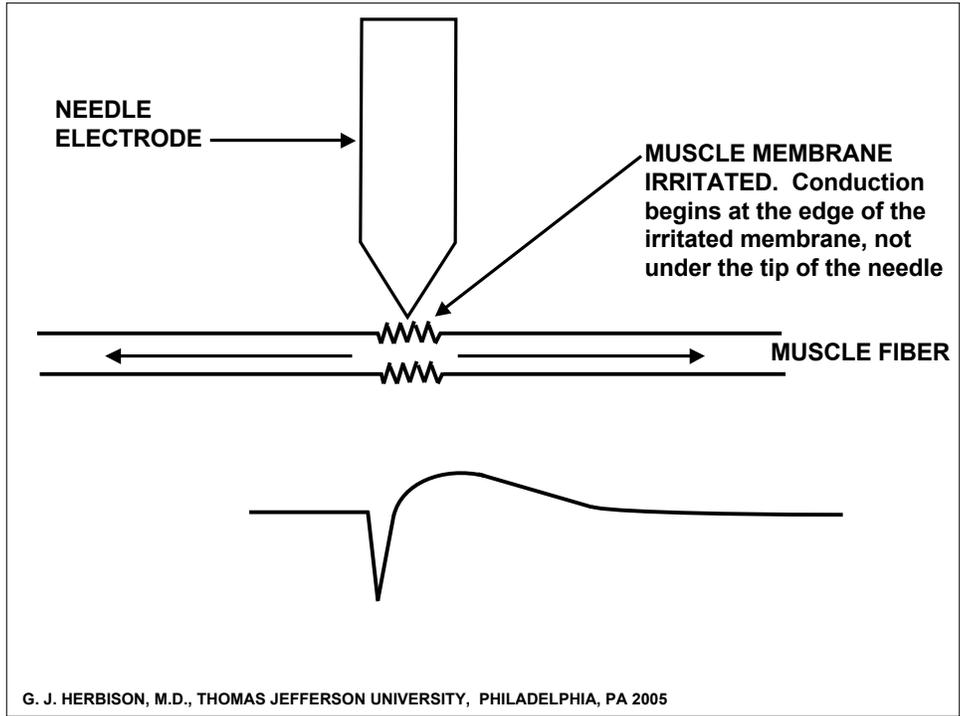
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POSITIVE WAVES

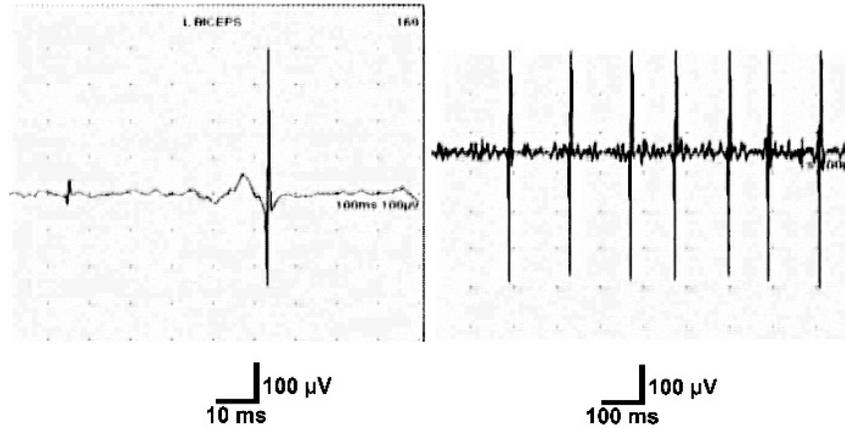
- ID: SHARP POSITIVE
DUR: 5 to 150 msec
AMP: < 1 mV
RA: 1 to 20 Hz
RHY: REGULAR but DRIFT
 SLOW to FASTER
 ALOW to SLOWER
O: POSTJUNCTIONAL
DS: ABNORMAL



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- Q13** a. VOLUNTARY MOTOR UNIT POTENTIAL
b. FIBRILLATION POTENTIALS
c. END PLATE SPIKES



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GRADING OF FIBRILLATIONS & POSITIVE WAVES

- 1+ PERSIST > 1sec in \geq 2 SITES
- 2+ PERSIST IN MODERATE NUMBER of SITES
- 3+ PERSIST IN MOST SITES
- 4+ PERSIST IN ALL SITE

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FIBRILLATIONS & POSITIVE WAVES

DENERVATION

MYOPATHIES

POLYMYOSITIS

DYSTROPHIES

MYOTUBULAR MYOPATHY

HYPERKALEMIA

ACID MALTASE DEFICIENCY

RHABDOMYOLYSIS

MUSCLE TRAUMA

UPPER MOTOR NEURON DISEASE

STROKE

BRAIN INJURY

SCI

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FIBRILLATIONS & POSITIVE WAVES UNUSUAL (MYOPATHIES)

HYPOKALEMIA

McARDLES

MYOTONIA CONGENITA

THYROID

HYPER

HYPO

HYPOPARATHYROID

MYASTHENIA

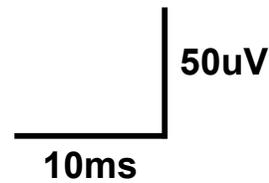
GRAVIS

SYNDROME

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**Q14: QUESTION 6. IDENTIFY CONDITION
of the MUSCLE**

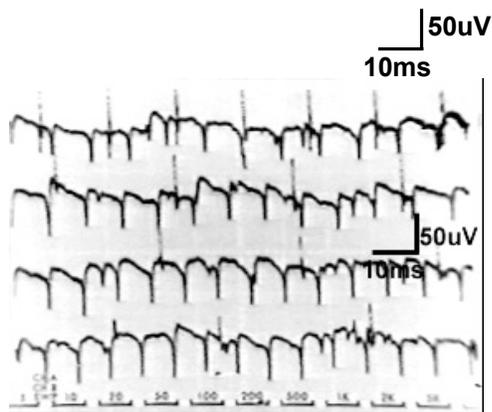
- a. FIBROTIC
- b. OLD DENERVATION
- c. DAY OLD DENERVATED
- d. FOUR WEEK OLD DENERVATION
- e. TWO WEEK OLD DENERVATION



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Q15: QUESTION 7. IDENTIFY POTENTIALS

- a. COMPLEX REPETITIVE DISCHARGES (CRD's)
- b. MYOTONIC POTENTIALS
- c. POSITIVE WAVES
- d. NEUROMYOTONIC DISCHARGES
- e. CRAMP POTENTIALS



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MYOTONIC DISCHARGES

CAN LOOK LIKE "CLASSIC":

EPS
FIB's
POS WAVES

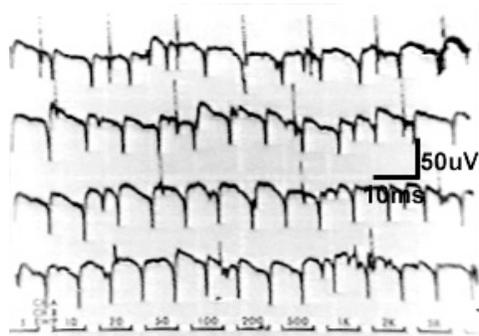
50uV
10ms

RA: 20 to 100 Hz

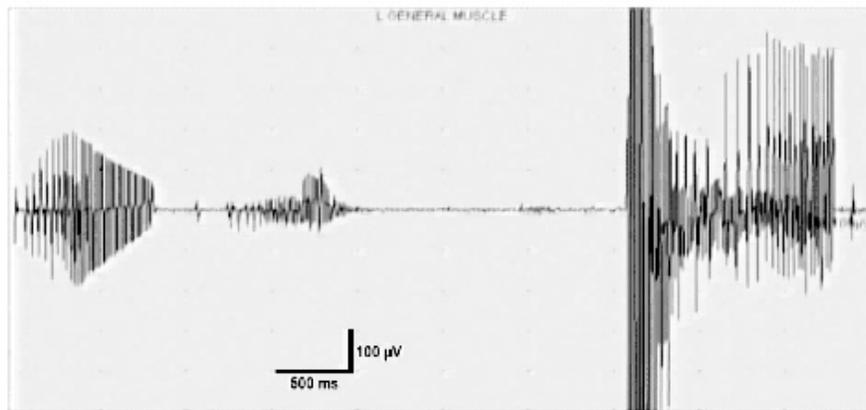
RHY: WAX & WANE SMOOTHLY
and SLOWLY in
RATE &
AMPLITUDE

O: POSTJUNCTIONAL

DS: ABNORMAL



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DS:MYOTONIC DISCHARGES

**MYOTONIA CONGENITA (THOMSON)
MYOTONIC DYSTROPHY (STEINERT)
BECKER MYOTONIA: AUTOSOMAL RECESSIVE
PARAMYOTONIA
DERMATOMYOSITIS
MUSCLE TRAUMA
HYPERKALEMIA
HYPERTHYROIDISM
ACID MALTASE DEFICIENCY
SCHWARTZ-JAMPEL**

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Q16: QUESTION 8. IDENTIFY POTENTIALS

- a MYOTONIC POTENTIALS**
- b. CRD's**
- c. NEUROMYOTONIC DISCHARGES**
- d. 4 + FIBRILLATIONS**
- e. NEEDLE ARTIFACTS**

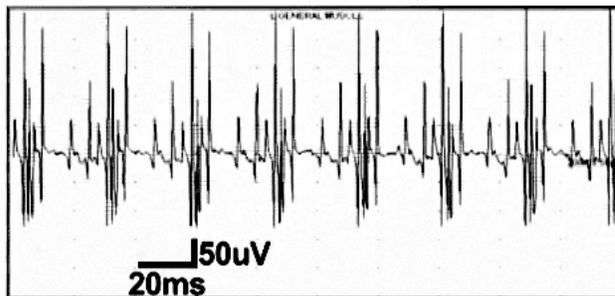
©THOMAS JEFFERSON UNIVERSITY, 2002. G. J. HERBISON, M.D.

NEUROMYOTONIC DISCHARGES

SOUND	HIGH PITCHED
RATE	150 TO 300 Hz
RHYTHM	WAX & WANE: RAPID CHANGE IN RATE & AMP

Q17: QUESTION 9. IDENTIFY POTENTIALS

- a. CRD's
- b. MUP's
- c. MYOTONIC POTENTIALS
- d. MYOKYMIC POTENTIALS
- e. CRAMP POTENTIALS



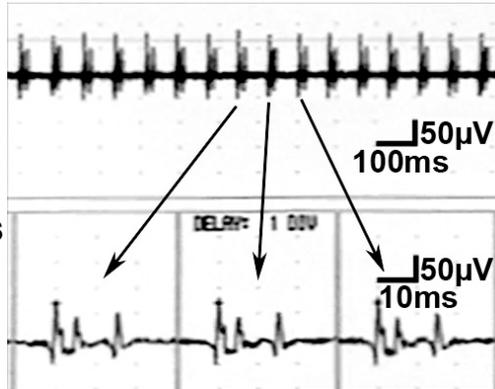
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PHILADELPHIA, PA 2009

COMPLEX REPETITIVE DISCHARGES (CRD'S)

MULTIPHASIC DISCHARGES

RA: 1 to 100 Hz

RHY: WITHIN DISCHARGES:
REGULAR but
CHANGE ABRUPTLY
BETWEEN DISCHARGES
REGULAR but DRIFT
SLOW to FASTER
SLOW to SLOWER
ABRUPT START & STOP

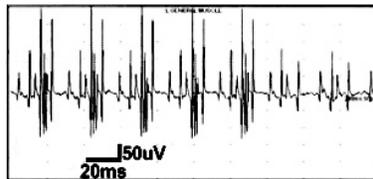
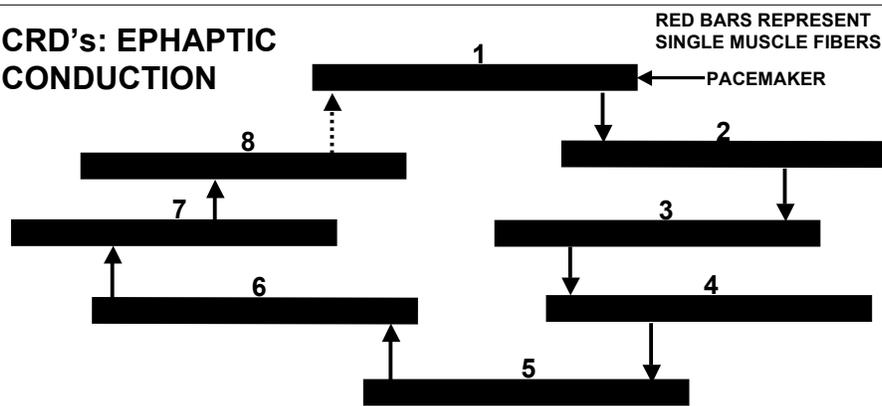


O: POSTJUNCTIONAL

DS: ABNORMAL

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CRD's: EPHAPTIC CONDUCTION

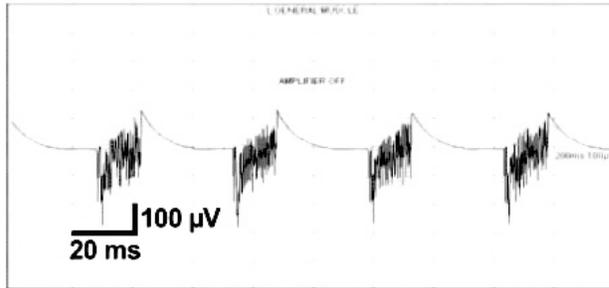


ADAPTED FROM BALL RD.
GENERATORS OF SPONTANEOUS
POTENTIALS. AAEM COURSE.
ROCHESTER MN. 2000; p27

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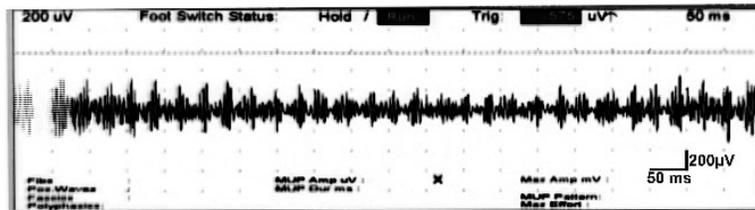
Q18

- a. CRD
- b. POLYPHASIC MUP
- c. ARTIFACT



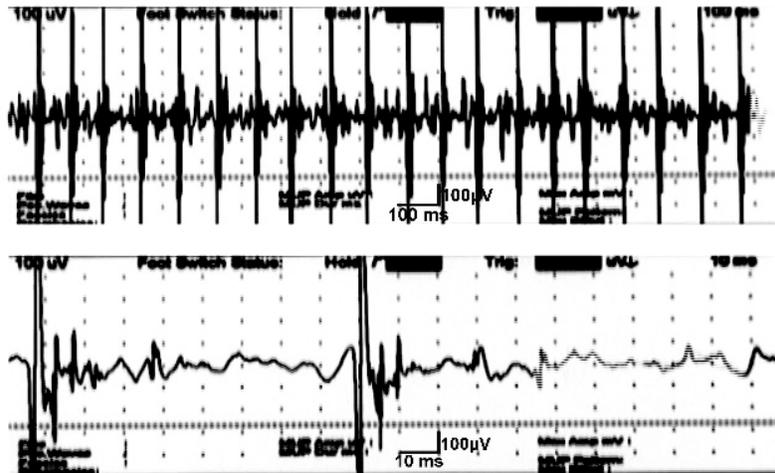
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- Q19**
- a. MYOTONIC DISCHARGE
 - b. CRD



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- Q20** a. **POLYPHASIC MUP**
 b. **CRD**



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DS: CRD's

NORMAL

ILIOPSOAS
URETHRAL SPHINCTER
ANY MUSCLE IN ISOLATION

ABNORMAL

CHRONIC

ANTERIOR HORN CELL DISEASE
RADICULOPATHIES
PERIPHERAL NEUROPATHIES

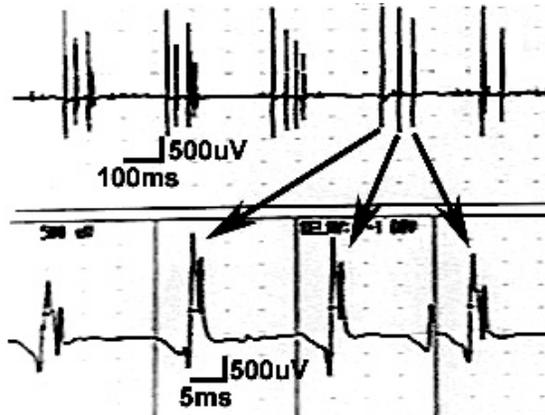
MYOPATHIES

POLYMYOSITIS
MD
MYXEDEMA
SCHWARTZ-JAMPEL

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Q21: QUESTION 10. IDENTIFY POTENTIALS

- a. FASCICULATIONS
- b. VOLUNTARY MUP's
- c. END PLATE SPIKES
- d. TREMOR POTENTIALS
- e. MYOKYMIC DISCHARGES



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MYOKYMIC DISCHARGES:

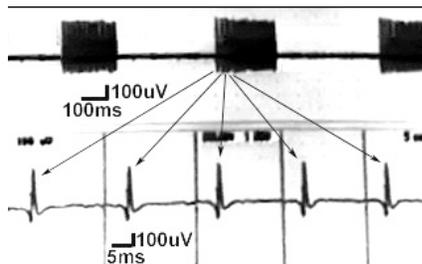
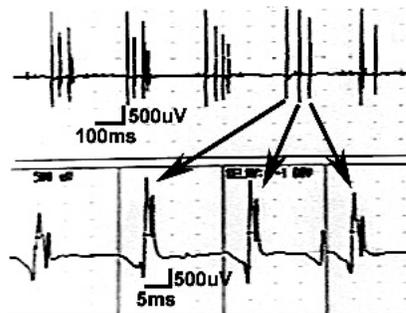
SINGLE or MULTIPLE MUP's make up each discharge or burst

RA: Within each discharge: 5-150Hz
Between each discharge: 0.1-10Hz

RHY: SEMI-REGULAR
Within each discharge
more irregular than
Between each discharge

O: PREJUNCTIONAL

DS: NORMAL / ABNORMAL



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DS: MYOKYMIC DISCHARGES

NORMAL

ABNORMAL

FACIAL

MS

BRAINSTEM TUMOR

BELL

GUILLAIN-BARRE (up to 15%)

EXTREMITY

RADIATION PLEXOPATHY (60% to 70%)

COMPRESSION (demyelination or remyelination)

ACUTE

CHRONIC

GENERALIZED

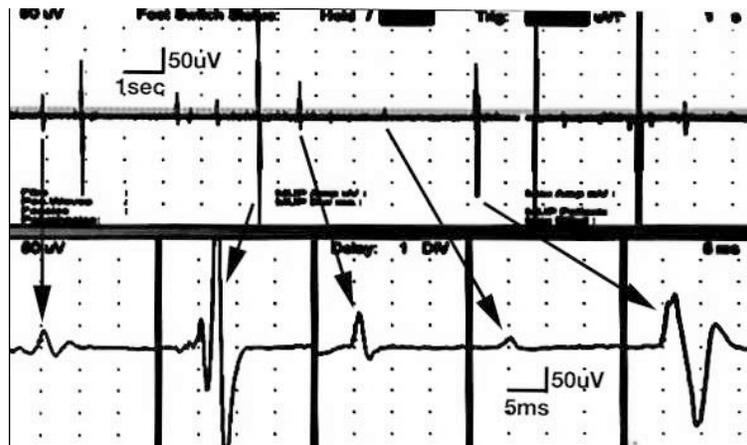
TIMBER RATTLESNAKE VENOM

CIDP

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Q22: QUESTION 11. IDENTIFY the MOST LIKELY CONDITION

- a. NORMAL MUSCLE
- b. POST-POLIO
- c. ISAAC SYNDROME
- d. ENDOCRINE MYOPATHY
- e. RHABDOMYOLYSIS



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FASCICULATION POTENTIALS

SPONTANEOUS SINGLE MUP's
(only 10% to 20% polys)

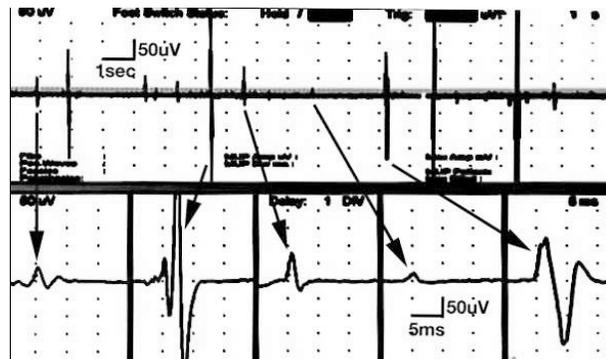
RA: 2/min to 2/sec

RHY: "WILDLY" IRREGULAR

O: PREJUNCTIONAL

DS: ABNORMAL:
based on
company
they keep

THE TOP PANEL IS ONE
CONTINUOUS SWEEP AT 1 sec
PER DIVISION. THE BOTTOM
DISPLAYS SINGLE
FASCICULATIONS AT 5 ms
PER DIVISION.



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DS: FASCICULATION POTENTIALS

NORMAL: FATIGUE

ABNORMAL

LOWER MOTOR NEURON DISEASE

ALS (3 of 4 regions of the body)

PRIMARY MUSCULAR ATROPHY

KENNEDY SYNDROME (X LINKED RECESSIVE BULBOSPINAL MUS ATROPHY)

POST POLIO

ROOT COMPRESSION

CONDUCTION BLOCK

PERIPHERAL NEUROPATHIES

METABOLIC/TOXIC

THYROTOXICOSIS

TETANY (HYPOCALCEMIA; PREDILECTION for FLEXOR HAND MUSCLES and LARYNGOSPASM)

ANTICHOLINESTERASE OVERDOSE

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SPONTANEOUS POTENTIALS

MUSCLE FIBER POTENTIALS

NORMAL ENDPLATE ACTIVITY

NON-PROPAGATED: MEPP's

PROPAGATED ENDPLATE SPIKES

ABNORMAL POTENTIALS

MEMBRANE INSTABILITY { FIBRILLATIONS
POSITIVE SHARP WAVES
MYOTONIA
CRD's } ALL THESE POTENTIALS DRIFT - DIFFER from VOLUNTARY MUPs WHICH RANDOMLY VARY

MOTOR UNIT POTENTIALS

MYOKYMIA

FASCICULATIONS

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RECRUITMENT PATTERN:

QUALITATIVE and/or QUANTITATIVE DESCRIPTION of the

SEQUENCE of APPEARANCE of the

MUP's DURING INCREASING VOLUNTARY MUSCLE CONTRACTION

INTERFERENCE PATTERN:

PATTERN of ELECTRICAL ACTIVITY RECORDED with a

NEEDLE DURING VOLUNTARY EFFORT

A FULL INTERFERENCE PATTERN IMPLIES THAT NO MUP's CAN BE CLEARLY IDENTIFIED

Modified from MUSCLE NERVE: GLOSSARY OF TERMS: SUPPLEMENT 10:2001

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RECRUITMENT FREQUENCY

**FIRING RATE (Hz) of a MUP
WHEN a SECOND MUP
BEGINS CONTRACTING**

NORMAL RECRUITMENT: FREQUENCY < 20Hz

DECREASED RECRUITMENT: FREQUENCY \geq 20 Hz

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RECRUITMENT RATIO

**FIRING RATE of the FIRST
RECRUITED MUP DIVIDED by the
NUMBER of RECRUITED MUP's**

NORMAL RECRUITMENT: RATIO < 10Hz

DECREASED RECRUITMENT: RATIO \geq 10 Hz

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RECRUITMENT

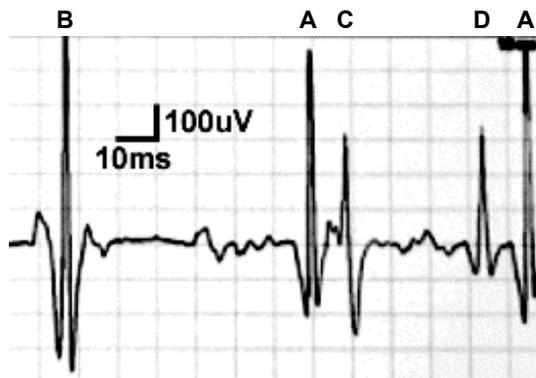
NORMAL

RECRUITMENT FREQUENCY: FIRING RATE (Hz) of a MUP when a 2nd MUP BEGINS CONTRACTING: NORMAL < 20

RECRUITMENT RATIO: FIRING RATE of the FIRST RECRUITED MUP DIVIDED by the NUMBER of RECRUITED MUP's: NORMAL < 10

NEUROPATHIC MYOPATHIC

A VOLUNTARY
MUP FIRES in
a RANDOMLY
IRREGULAR
PATTERN



THE TWO "A's" ARE the SAME MUP with ABOUT 60ms INTERVAL (RATE ABOUT 16/s. B, C & D ARE DIFFERENT MUP's. RECRUITMENT RATIO = $16/4 = 4$. ALTHOUGH "B" IS THE FIRST MUP IN THE ABOVE FIGURE, "A" WAS THE FIRST RECRUITED MUP.

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RECRUITMENT

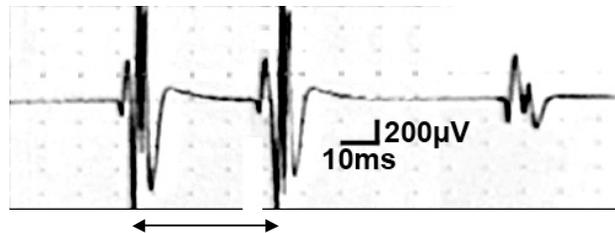
NORMAL

NEUROPATHIC: DECREASED RECRUITMENT

FREQUENCY: ≥ 20 Hz

RATIO: ≥ 10 Hz

MYOPATHIC

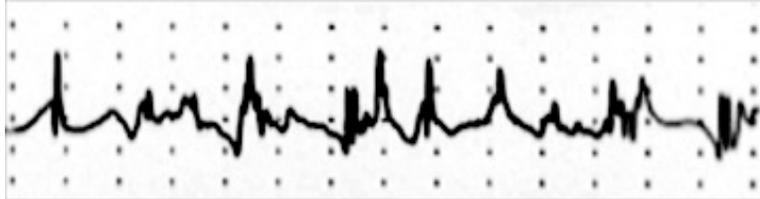


ABOUT 40 ms INTERVAL= RATE of ABOUT 25Hz.
RECRUITMENT FREQ = 25
RECRUITMENT RATIO = 12.5

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RECRUITMENT

NORMAL
NEUROPATHIC
MYOPATHIC



EARLY RECRUITMENT OF SMALL MUP's
WITH 1/5 GRADE MUSCLE CONTRACTION

200uV
10ms

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RECRUITMENT

NORMAL
NEUROPATHIC: DECREASED
MYOPATHIC: EARLY

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LESS COMMON SPONTANEOUS MUP'S

EXCESS MOTOR UNIT ACTIVITY

CRAMPS (Begin & end with twitching of the muscle)
STIFF PERSON SYNDROME
NEUROMYOTONIC DISCHARGES

VOLUNTARILY INITIATED MUP'S

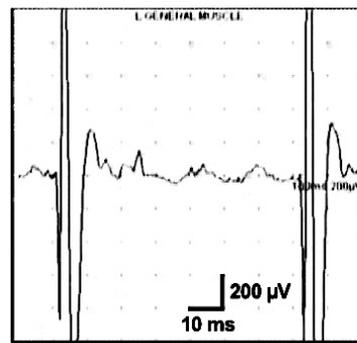
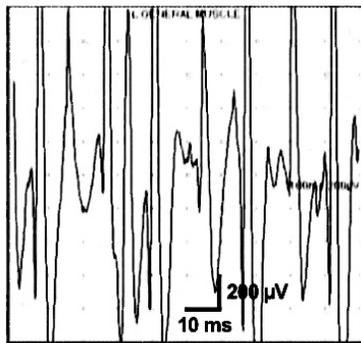
DOUBLETS
TRIPLETS
MULTIPLETS

TREMOR

PARKINSON
ESSENTIAL

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- Q23
- a. CRAMP
 - b. DECREASED RECRUITMENT
 - c. CRAMP & DECREASED RECRUITMENT



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DS: CRAMPS

NORMAL

BENIGN NOCTURNAL CRAMPS
HEAVY EXERCISE IN WARM ENVIRONMENT

ABNORMAL

CHRONIC NEUROGENIC ATROPHY
SALT DEPLETION
HYPOKALEMIA
UREMIA
PREGNANCY
MYXEDEMA
ALCOHOL
DRUGS (nifedipine, clofibrate, penicillamine, etc.)

Daube JR. Muscle Nerve 1991; 14: 685 - 700

LESS COMMON SPONTANEOUS MUP's

EXCESS MOTOR UNIT ACTIVITY

CRAMPS (Begin & end with twitching of the muscle)

STIFF PERSON SYNDROME (SUSTAINED INTERFERENCE)(Auger 1994)

Syndrome: Stiff prox > dist: fixed increase in lumbar lordosis
Sweating, tachycardia, fluctuations in BP, increased DTR's
Spares facial muscles
Spasms (painful) occur:
Spontaneously
Response to stimuli: emotional, auditory, cutaneous, proprioceptive

Seen in patients with:
Anti GAD (Glutamic Acid Decarboxylase) Antibodies
Paraneoplastic with no anti GAD antibodies
Idiopathic

NEUROMYOTONIC DISCHARGES

VOLUNTARILY INITIATED MUP's

DOUBLETS

TRIPLETS

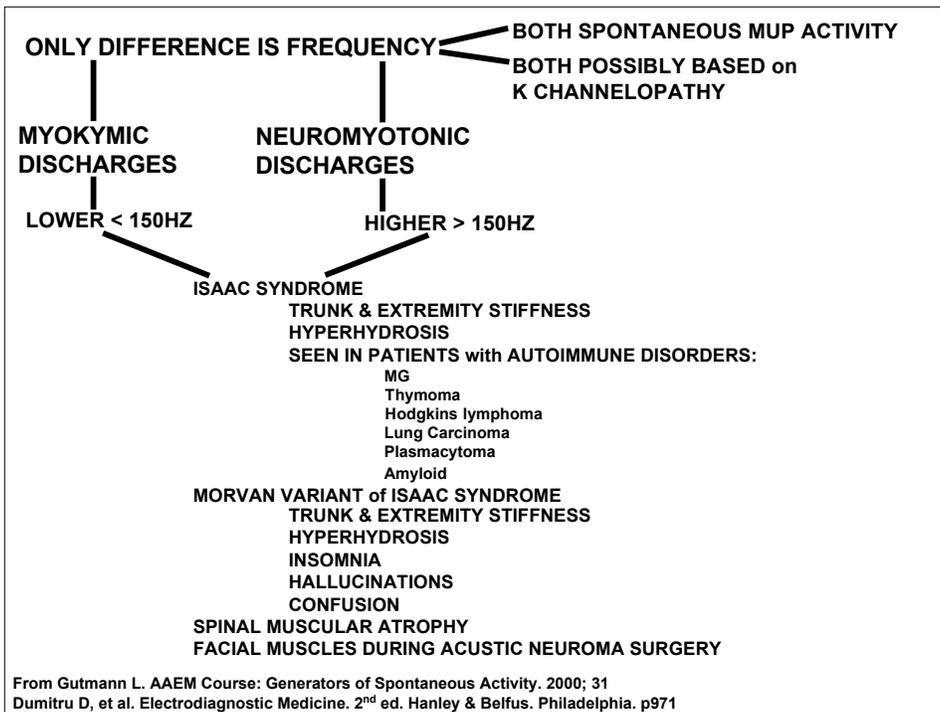
MULTIPLETS

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CONTINUOUS MUSCLE FIBER ACTIVITY WITH STIFFNESS

	NEUROMYOTONIC DISCHARGES	STIFF PERSON SYNDROME
SOUND	HIGH PITCHED (150 TO 300 Hz)	SUSTAINED INTERFERENCE
SLEEP	PERSISTS	ABOLISHED
GENERAL ANESTHESIA	PERSISTS	ABOLISHED
NERVE BLOCK	VARIABLE RESPONSE	ABOLISHED
CURARE	ABOLISHED	ABOLISHED
DIAZEPAM	PERSISTS	ABOLISHED
CARBAMAZEPINE (TEGRETAL)	ABOLISHED	PERSISTS
DILANTIN	ABOLISHED	PERSISTS

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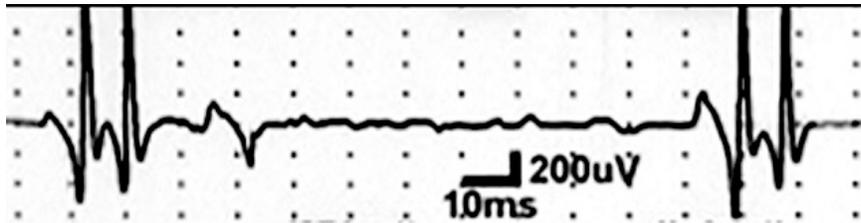
LESS COMMON SPONTANEOUS MUP's

EXCESS MOTOR UNIT ACTIVITY

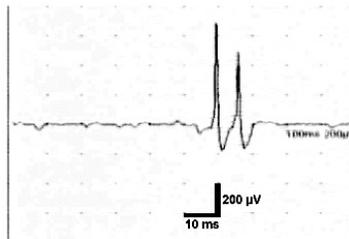
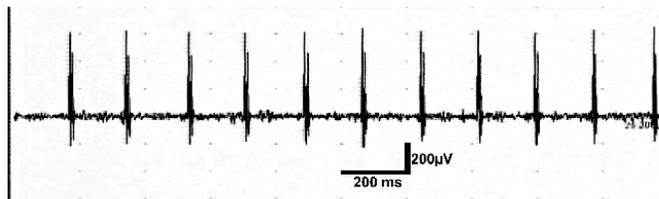
CRAMPS (Begin & end with twitching of the muscle)
STIFF PERSON SYNDROME
NEUROMYOTONIC DISCHARGES

VOLUNTARILY INITIATED MUP's

DOUBLETS
TRIPLETS
MULTIPLETS



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- Q24 a. DOUBLE DISCHARGES
b. MYOKYMIC DISCHARGES

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LESS COMMON SPONTANEOUS MUP'S

DOUBLETS, TRIPLETS & MULTIPLETS

HYPOCALCEMIA *

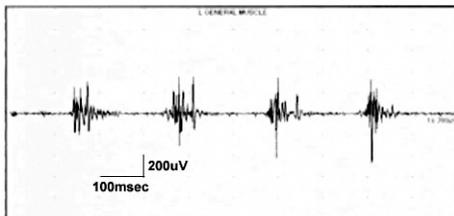
HYPERVENTILATION

MOTOR NEURON DISEASE (infrequent)

* HYPOCALCEMIA: PREDILECTION for FLEXOR HAND MUSCLES and LARYNGOSPASM

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TREMOR @ 4/sec



TREMOR @ 7/sec



200uV
100ms

200uV
100ms

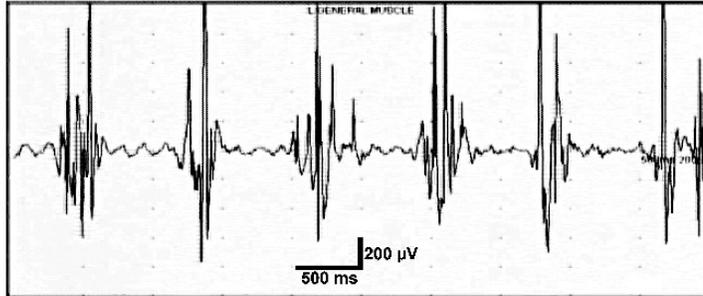
- Q25
- a. Improved with alcohol
 - b. Associated with bradykinesia
 - c. Polyphasic voluntary MUP
 - d. Myokymic discharges
 - e. Multiplets

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IS IT A POLYPHASIC MUP

Q26

- a. YES
- b. NO



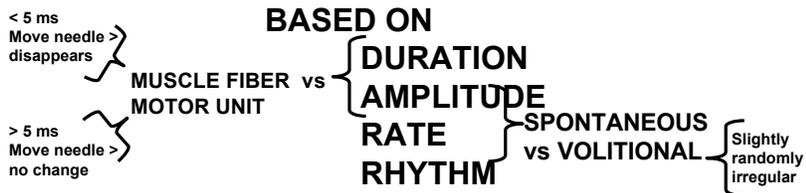
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WAVE FORM IDENTIFICATION

PURPOSE:

DESCRIBE:

COMMON SPONTANEOUS POTENTIALS
 NORMAL & ABNORMAL RECRUITMENT PATTERNS
 LESS COMMON MUP's



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