H REFLEX

Ernest W Johnson MD, Emeritus Professor, PM&R, The Ohio State University
objectives

- To know how to elicit the H Reflex
- To use the H reflex in L/S Radiculopathy
- To use H reflex in cervical radiculopathy
- To use H reflex in other diseases
S-1 Radiculopathy

- Walking on toes is only a gross test
  - Must do heel raises unilaterally and compare (10)
  - MSR - Ankle jerk
  - Numbness lateral foot and sole

- *H reflex can be helpful*
H-REFLEX OF PAUL HOFFMANN, M.D., 1918

IA AFFERENT SENSORY
From Muscle Spindle

DORSAL ROOT GANGLION

SPINAL NERVE

α MOTOR FIBERS
To Muscle Fibers

From Courtice
History of H reflex

- Magladery, Mc Dougal, and others have studied recovery curve of H reflex after conditioning shock in ‘50’s
- Hohmann & Goodgold showed H reflex in upper limb in stroke patients. 1961
- Noterman used reflex latency to study L-S radiculopathies in 1974
- Braddom & Johnson prepared a formula to predict latency and then used it for identifying S-1 radiculopathy 1974
Noterman – H Reflex

- Studied onset of M to onset of H
- Did not differentiate L-5 from S-1
- 1974
INTERVAL LATENCY TIME (ILT)

NOTERMANS 1974
Procedure (ala Johnson)

- Stimulate Tibial nerve in popliteal space (junction of middle and lateral 1/3) with a long duration (1 ms) low intensity current.
- Recording electrodes – E-1 over lateral dista1/3 of leg and E-2 over achilles tendon
- Repeat stimuli at LOW frequency
- H must be larger than M wave if M is present
Formula to calculate H latency

- \(.46 \times \text{distance from stimulation to medial malleolus}\)
- + \(.1 \times \text{age in years}\)
- + constant – 9.14

- Difference side to side > 1.0 ms (conservative)
- My opinion is > .5 ms is “red flag”
Radiculopathy

Predicted H-Reflex Latency

= 0.46L + 0.1A + 9.1

Where

L = Leg length in cm
A = Age in years
‘H’ REFLEX LATENCY IN LUMBAR RADICULOPATHY

- Will be prolonged in S-1 radiculopathy from the onset of radicular pain.
- Difference in latency, side-to-side, = or < 1 millisec or even .5 millisec is a red flag.
  - Original study (1974) mean 2 st.dev. = .8 ms (3 st. dev = 1.4 ms)
  - More recent series difference side-to-side .3 ms
Why calculate ‘predicted latency’?

If determined is greater than predicted bilaterally (but same: side to side) – one should consider underlying peripheral neuropathy.
We are recording from SOLEUS

This is a large muscle and one can record it from any position around leg.
H reflex - Influences

- Facilitate -
  - Slight contraction of agonist

- Depress -
  - Contraction of antagonists
  - Strong co-contraction
  - Unreliable parameter in conscious person

Ref: McHugh, Reeser, Johnson: Am J PM&R 1994
H ampl change
With muscle activity

Figure 1. Electrodes positioned for H reflex latency determination. Note stimulation is with the monopolar needle to ensure identical intensities.

Figure 2. H Reflex tracings. Note variations in amplitudes but consistent latencies and stimulation intensities.
Surrogate “H”

Use mean of 10 F waves
If can’t get H Reflex
- Change gain to 200 uV and stimulus duration to .1 ms
- Get 10 F waves
  - Mean of 10 is 1.8 ms longer than ipselateral H latency
  - Side-to-side difference of mean of 10 F waves - .6 ms
Use of H reflex latency

- Early in course of L/S radiculopathy
- When abnormal irritability is only in paraspinals
- Underlying peripheral neuropathy (diabetic)
- If muscle exploration is confusing
- Post laminectomy with recurrent symptoms
Use of H reflex latency when positive waves are only in paraspinals

- 90 – 95% of all first appearing radiculopathies are L-5 or S-1
- Ratio of frequency – L-5:S-1 = 2:1
- H latency is prolonged – S-1; if normal – L-5
Other uses for H Reflex

Other than S-1 radiculopathy
H reflex in Huntington disease

- In discussions with George Paulson about early identifying children from HD parent, we suggested that since the corticospinal tracts are involved in this condition – H reflex could be a diagnostic indicator.
- If H reflex could be elicited in peroneal or other peripheral nerve than tibial, this could be an early marker.
- We found the H reflex present in anterior tibial muscle in 8/9 persons with HD and in 5/8 persons at risk (ie. progeny of HD parent).
H reflex in peroneal nerve (anterior tibial)

- 34 y/o lady presented with unilateral limp
- Operated (arthroscopy) for torn meniscus
- Drop foot seemed to have appeared after surgery
- EDX – H reflex in anterior tibial when peroneal nerve stimulated. No abnormal irritability in limb muscles. BUT positive waves present in mid dorsal paraspinal muscles (also + babinski)
- Then – MRI - massive HNP at T-6,7
Needle stimulation of S-1 spinal nerve

- Find posterior inferior iliac spine
- Insert monopolar needle 1 cm cephalad and medial
- Apply 50 – 100 us duration stimulation for direct S-1
- Apply 500-1000 us duration stimulation for H reflex (low intensity)
Needle stimulation of S-1 spinal nerve

- Find posterior inferior iliac spine
- Insert monopolar needle 1 cm cephalad and medial
- Apply 50 – 100 us duration stimulation for direct S-1
- Apply 500-1000 us duration stimulation for H reflex (low intensity)
S-1 Spinal Nerve

- Stimulate 1 cm medial and cephalad to posterior superior iliac spine
- Record from soleus to use in H latency
- Record from tibial muscle (Abd hall) or peroneal muscle (proximal – ant tib; distal – ext dig br)

- NB. If cannot stim prox to entrapment compare contralateral muscle.
S-1 Direct Latency vs Reflex Latency

- Stimulate S-1 spinal nerve (PSIS) 50-100 uS
- Stimulate as above with 1 ms duration

- Latencies: S-1/H = 48% normal
- Latencies: S-1/H = 45% if S1 radiculopathy
S-1spinal nerve stimulation of H reflex

- **Ratio**
  - Efferent limb – S-1 to soleus
  - Side-to-side difference - .16 ms (range 0-.8 ms)
  - Afferent limb – tibial nerve in popliteal fossa to H wave in soleus
    - Equals about 47%
    - If slowing at spinal nerve – ratio becomes <45%
S-1 Spinal nerve in H latency

- Record from soleus
- Stimulate with 1 ms duration and low intensity to get an H wave from afferent orthodromic impulse and CMAP (M) efferent motor to soleus
S-1 spinal nerve H reflex

- Stimulate with 1 ms duration and low intensity
- H wave will appear 1st and M wave following by 6-8 ms
- If take-off appears for M wave, there is usually more than 8-9 ms between H & M
S-1 spinal nerve stimulation and *central loop*

- If stimulation duration at spinal nerve is 1 ms:
  - Both efferent arm and afferent arm will be stimulated
    - Soleus CMAP will appear 1st and H wave will appear 2d
    - Time between the two waves will be the rate of speed nerve impulse travels thru “central loop”
Inflamed S-1 nerve root
Central loop values

Normal – 7-9 ms

- Probable S-1 radiculopathy (or proximal tibial nerve compromise) >9 ms

- NB. If H wave can be seen with a “take-off” it is likely that central loop time is prolonged
Gain: 1 millivolt/cm

Sweep Speed: 2-5 ms/cm
H reflex latency in L-5 radiculopathy

- H reflex was performed on patients with EMG evidence of L-5 radiculopathy
  - N = 25
  - Difference R/L = .11 +/- .08 ms
    - L-5 – EMG abnormalities in ant tib; ext dig long;
    - S-1 – EMG abnormalities in soleus, abd hall
H reflex in upper limb

- Stimulate median nerve in antecubital space
- Record with surface electrodes over flexor carpi radialis
- Use long duration stimulation (.5-1 ms)
- Probably slow in C-7 radiculopathy


references


references

Back surgery rates are higher in the Rocky Mountain states and the Northwest than in the Northeast or the Upper Midwest.
THANK YOU

Questions ????