CALCULATING DEGREE OF NEURAL IMPINGEMENT IN RADICULOPATHY USING H-REFLEXES IN LOADING AND UNLOADING: EVIDENCE ON HOW TO TREAT

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INTRODUCTION
Measurement of the degree of neural/root impingement in LBP is largely subjective. It is dependent on imaging results that is a snap shot in unloaded posture. The degree of neural/root impingement is dependent on loading VS unloading, dynamic Vs static posture, single or double axis postures. This can only be done using EMG (H-Reflex studies)

Soleus H-reflex is considered the golden electrophysiological standard for nerve root function.

HYPOTHESIS
It is hypothesized that nerve root function (impingement/dis-impingement) can be measured on-line using H-Reflex testing during static and dynamic posture. The number of axonal drop (due to impingement) is directly correlated to the degree of neural pressure causing reduction of the H-amplitude

The H-reflex Pathway & Measured Parameters
Ia afferents to @-motoneurones to @-axons to extrafusal muscle fibers (one synapse)

• Parameters: 1) Peak-to-peak amplitudes
  2) Latency to deflection
  • Amplitude= # axons travelling the signal (highway lanes
  Amplitude reduction to 50% of healthy (normal) indicates 50% neural impingement.
  An increase in H-amplitude of 25% in a trunk posture indicates neural decompression of 25%.

PURPOSE OF STUDY
To assess the degree of neural compression of S1 or L5 radiculopathy ,in the right and left legs, using the soleus H-reflex during
A) unloading (lying)
B) Loading (standing) and during C) different end-range trunk Postures.
@ To calculate the degree of directional impingement on the affected nerve root.
METHODS

Soleus H-reflex was recorded (0.2 PPS, 1 msec. @ H-Max) from both lower limbs during:
A. lying (unloading)
B. Neutral Standing (loading)
C. end-range trunk posture in side bending (R & L), Rotation (R & L), backward bend, forward bend, right side bend & left rotation, left side bend & right rotation.
The Peak-to-peak amplitude & deflection latency was measured.

Clinical testing of SLR, lumbar spinal ROM, neurological exam (DTR, Skin sensation) & gait.

• The % of the smaller mean amplitude (usually the symptomatic leg)/ the larger amplitude was calculated during:
  • A. Lying (the degree of neural impingement in unloading)
  • B. standing (the degree of neural impingement during postural loading)

The % of H-right (standing/lying) & H-left (standing/lying) was calculated. This measures the degree of spinal mechanical shift during loading versus unloading. This is called the STATIC TEST

The leg with the smallest H-reflex was then tested with dynamic test (side bending (R & L); Rotation (R & L), FB, BB, RSB + LR, LSB +RR)
The % amplitude in each spinal posture (SB, Rot., BB & FB)/amplitude during neutral stand was calculated. (The degree of foraminal narrowing (neural impingement) in each spinal posture.

IDENTIFY THE TREATMENT POSTURES (OSP, USP, PSP, CSP)

• Optimum Spinal Posture (OSP): Max Amplitude; decompression posture (Treatment posture)
• Unwanted spinal posture (USP): Min. Amplitude: compression posture (NO T)
• Preferred Spinal posture (PSP): Partial reflex recovery (may T)
• Compromising spinal posture (CSP): Partial reflex depression(NOT.)

DATA AND STATISTICAL ANALYSES

This is a descriptive study.
Five H-reflexes were averaged for each position/trial in lying or standing (called static test).
Data were tabulated in 4-cell tables. The vertical (column) for lying or standing & Horizontal (rows) for right or left leg.
comparison was made to assess the degree of mechanically-driven neural impingement for the patient.
In Dynamic test: The spinal posture causing maximum reflex recovery was identified as the Optimum Spinal posture (OSP).
The spinal posture causing maximum reflex depression was identified as the Unwanted Spinal Posture (USP)
The larger the number the PSP, the smaller the # the CSP: the better the patient prognosis.
OSP usually one posture/8.
USP usually one/8.
Count # of CSP/8.
Count # of PSP/8.
Signal Analysis & Calculation - H-Amplitude
Measure Peak- to- Peak (mv) in right, left (during Lying & Sitting.)
Calculate H-ST/H ly. % (for the right & left). The smaller value indicate the loading effect on right and left legs
Calculate H-sym/H-non-sym % (during ST & Ly). Smaller value measure the severity of neural dysfunction
OSP was double axes in 68/103 patients
RSB + LR: 31 Patients
LSB +RR: 37
OSP was single axis in 21/103 patients:
FB: 8  -BB: 2
RSB: 8  - LSB: 2
Rotation: 1
* Rest of patients not tested by dynamic testing.

Electrophysiological Classification of LBP:
- Measurement degree of foraminal compression in Dynamic Test.
Testing dynamic H-Reflex during different trunk posture.
What are the number of trunk postures (out of 8) that cause?:
Mild neural compression (as tested by H-amplitude)(1-2, P.)
Moderate neural compression (3-6 Postures))
Severe neural compression (6-7). MOSTLY POST SPINE SURGERY.
Mild neural recovery (OSP/neutral stand%): 100-110%.
Moderate neural recovery: 110- 130%.
Significant neural recovery: > 130%
** Assessing the degree of reflex recovery in OSP
EXAMPLES: STATIC TESTS
H-ST/H-Ly% = 70% for the leg indicates mild neural impingement during standing.
H-ST/H-Ly= 30% indicate severe neural compression during standing.
H-ST/H-Ly= 120% indicate neural compression in lying > standing.

CASE STUDIES
EXAMPLE CASE: W.S, Age: 36 y/o
Acute LBP with left leg pain
Acute LBP (one week)
Pain at L5S1 with soreness at the left para-spinal muscles.
No radicular symptoms,
No changes in Skin sensation; DTR: WNL
Pain at 7-8/10
Gait: stiff
WS- Calculation of Static test
Lying: L/R= 4119/4633 = 89%
Standing: L/R= 4573/ 5026 = 91%
Left Leg: Standing/Lying: 4573/4119 = 111%
Right Leg: Standing/Lying: 5026/4633 = 108%
Calculating Reflex asymmetry (H/H Ratio)
Calculate % of smaller H-amplitude /larger amplitude (in unilateral radiculopathy)
Healthy subject= 90-100%
Hypothetically the H/H ratio should get bigger as the patient improve with less pain and healing nerve root.
Case 1: Chronic Patient.

Case 2: Acute Patient

RESULTS

Preliminary Results: Sample of 103 Patients
H-symp/H-non-symp in lying (20-95%)
H-symp/H-non-symp in standing (16.7-83%)
OSP/Neutral% (102.5->200% !!!!)
USP/Neutral % (5-72.7%)
Data are still in processing.
What does this mean?
Degree of reflex asymmetry and neural compression (static Test)
H-symp/H-non-symp. (LY & ST) = 90% -> mild neural compression (or acute)
H-symp/H-non symp (LY & ST) = 10-30% -> severe (chronic)
H-symp/H-non symp (LY & ST) = 30-60% -> moderate to severe
H-symp/H-non symp (LY & ST) = 60-89% -> mild to moderate
Examples
Hosp/H-neutral = 200%, indicate possibility for good & fast recovery with our protocol.
H-osp/H-neutral = 110%, indicate slow possible recovery.
H-usp/H-neutral: 20%, indicate severe neural compression on nerve root with posture (post surgeries)
Calculating reflex Changes and Dynamics
Calculate the HOSP/H-neutral %.
The value has a prognostic significance of how much the compromised reflex can recover
Calculate the H-USP/H-neutral %.
The value indicates how much bad trunk posture can injure nerve root
Cumulative Analysis of 103 Patients
PSP: Patients with 4 or more = 18.(un-encroached spinal foramina)
Patients with 2-4 = 49 patients.(slight encroachment spinal foramina)
Patients with ONE PSP= 6 patients (severely limited spaced spinal foramina)
CSP: Patients with 4 or more= 4.(severely encroached spinal foramina)
Patients with 2-4 = 55 patients. (moderate encroachment in spinal foramina)
Patients with ONE CSP = 23 patients. (slight encroachment in spinal foramina)
DISCUSSIONS

Static tests provide information about the nerve root status during stationary conditions. Dynamic tests provide information about the nerve root condition during movements & in 3-D.

The larger the H-amplitude in OSP the larger the size of the spinal foramina the best position for neural decompression and the optimum posture for treatment.

The smaller the amplitude in USP the smaller the size of the spinal foramina the worst position for neural compression and the worst posture for treatment.

It is assumed that patients with larger # of PSP might have lesser pain with movements and better prognosis.

It is similarly assumed that patients with larger # of CSP might have more pain with more movements and questionable prognosis.

RECOMMENDATIONS:

The degree of neural impingement can be measured in patients with LBP using H-reflexes. Electrophysiologic testing should be an adjunct to our clinical testing in patients with LBP.

The reported calculation (static & dynamic) may have bearing on treatment strategies & prognostic values.

It can provide an evidence-based approach to our testing & treatment of patients with LBP.

REFERENCES

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