Laryngeal Electromyography (LEMG)

Laryngeal electromyography (LEMG) studies the electrical activity of the laryngeal musculature. It is performed by placing an electrode, typically a monopolar or concentric needle or a hooked wire, into the muscle in question and measuring both the spontaneous and volitional activity. LEMG is used in the setting of vocal fold immobility to evaluate neural integrity as well as to provide prognostic information in the setting of neurogenic paralysis. It may also provide utility in the diagnosis of other neurologic disorders affecting the larynx such as paresis. It is most commonly utilized for guidance of botulinum toxin injections to the larynx.

Technique [1]

- Standard electromyography equipment is utilized including a ground, reference and recording electrode. The recording electrode may be a concentric or monopolar needle or a hooked wire.
- Local anesthetic is typically not used as it may interfere with the electrical signal
- The thyroarytenoid (TA) and the cricothyroid muscles (CT) are the most common muscles evaluated as the TA can give information about the recurrent laryngeal nerve (RLN) and the CT can give information about the superior laryngeal nerve (SLN).
    - The CT muscle is located by "walking" the needle laterally along the superior border of cricoid cartilage from the midline. Placement is confirmed by activation of the muscle with a glide or high pitched phonation and lack of activation with flexion of the neck against resistance
    - The TA muscle is located by passing the needle through the cricothyroid membrane just off the midline in a superolateral direction. Placement is confirmed by activation with phonation.

Analysis and Interpretation [2]

Once placement within the correct muscle is confirmed both the spontaneous and volitional activity of the muscle is measured. A small burst of activity is also noted when the needle is inserted into the muscle, referred to as insertional activity, which has little diagnostic utility.

- Spontaneous Activity

- In a normal muscle there is minimal spontaneous activity when a muscle is at rest.
- Positive sharp waves and fibrillation potentials which occur spontaneously are indicative of denervation and are poor prognostic indicators of neural recovery

- Volitional Activity
  - Contraction of a muscle fiber results in an electrical signal called a motor unit potential (MUP). The MUP is a compound action potential generated by the muscle fibers of a motor unit.
  - With increased force of contraction, there is increased firing of the individual motor units and activation of adjacent motor units, a phenomenon referred to as recruitment. This results multiple overlapping MUPs which create an interference pattern (figure 1). When a normal interference pattern is not generated with maximum effort this is suggestive of denervation (figure 2).
  - Polyphasic MUPs occur in patients with neural injury in which reinnervation has occurred
  - Synkinesis is detected by having the patient perform an action you would not expect to activate the muscle in question (for example, significant activation of the TA muscle with sniff)

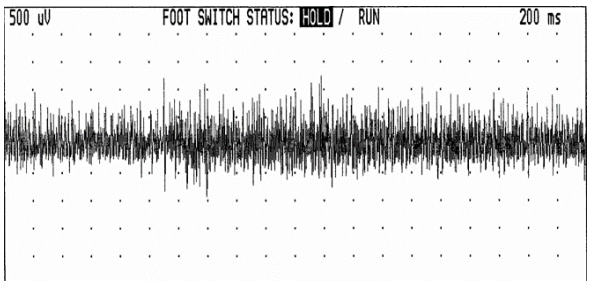

Figure 1. Full interference pattern showing good recruitment and multiple MUPs

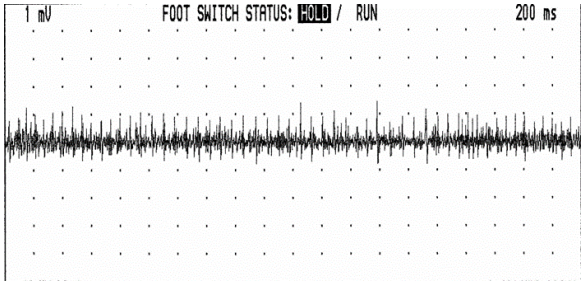

Figure 2. "Picket fence" interference pattern indicative of denervation

Figures courtesy of Dr. Andrew Blitzer

Clinical Applications

- Vocal fold immobility
  - Distinguish between cricoarytenoid joint fixation and neurogenic paralysis
  - Determine site of injury: testing the cricothyroid muscle can distinguish between vagal and RLN paralysis

- Provide prognostic information in the setting of vocal fold paralysis.
    - As reinnervation is not synonymous with return of function, LEMG is better at predicting when a vocal fold will not recover motion rather than when it will.
    - Poor prognostic indicators include the presense of sponatenous activity including positive sharp waves and fibrillation potentials, absense of volitional MUPs and synkinesis
    - Good voluntary motor unit recruitment (normal interference pattern) is a positive prognostic indicator. Polyphasic potentials suggest reinnervation but not necessarily return of motion.

- Diagnosis of neurologic disorders of the larnx
    - LEMG can be useful in diagnosis of certain neurolgoic disorders of the larynx including spasmodic dysphonia, essential tremor, myasthenia gravis
- Guidance of botulinum toxin injections to the larynx
- LEMG has a positive predictive value of 90.9% (patients with a predicted poor recovery had poor recovery) and a negative predictive value of 55.6% (patients with a predicted good recovery had return of motion) [3].
- The presence of sykinesis downgrades the prognosis for recovery in the setting of good voluntary motor unit recruitment [4].

References

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