

Title: USE OF PERIPHERAL NERVE STIMULATOR TO MONITOR NEUROMUSCULAR BLOCKADE (NMBA).

Responsibility: RN's caring for patients receiving neuromuscular blocking agents

Equipment:

1. Peripheral Nerve Stimulator
2. Two gelled electrode pads (such as those used for external cardiac monitoring)

Standard of Care: Use of peripheral nerve stimulator (PNS) by train-of-four (TOF) method to determine depth of paralysis of patients receiving non-depolarizing neuromuscular blocking agents.

Procedure

Point of Emphasis

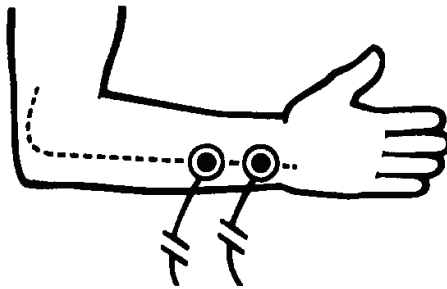
1. Setting up the Peripheral Nerve Stimulator:

Apply the two electrodes either at the ulnar nerve area, the facial nerve area or the posterior tibial nerve area. (Please see pictures below to verify proper placement.)

The optimal placement of the electrodes is the ulnar nerve. However, the conduction of the impulses is affected by wounds, edema and invasive lines, and hair, therefore, if any of these are present the facial nerve or the posterior tibial nerve should be used instead.

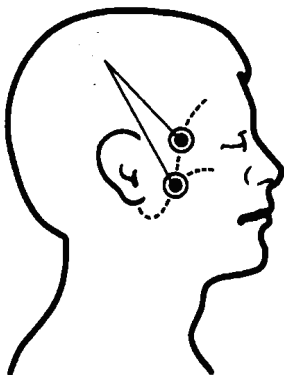
Ulnar nerve area placement of electrodes:

Place the distal electrode on the skin at the flexor crease on the ulnar surface of the wrist. Place the second electrode approximately 1-2 cm. proximal to the first, parallel to the flexor carpi ulnaris tendon.



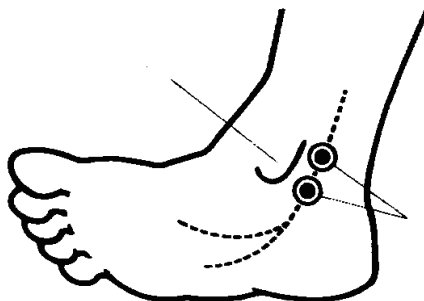
Facial nerve area placement of electrodes:

Place one electrode on the face at the outer canthus of the eye and the second electrode approximately 2 cm below, parallel with the tragus of the ear.



Posterior tibial nerve placement of electrodes:

Place one electrode approximately 2 cm from the posterior to the medial malleolus in the foot. Place the second electrode approximately 2 cm above the first electrode.



NOTE: It is important to carefully place the electrodes, to avoid direct stimulation of the muscle rather than the nerve. If the electrodes are placed on the muscle, it is impossible to accurately assess the effect of the NMBA.

Practice Guidelines

Plug in the lead wires to the nerve stimulator, attaching the negative (black) and positive (red) leads to the black and red connection sites.

Turn on the PNS and select a low mA (10 to 20 mA is typical).

- b. Depress the TOF button and observe and count the number of twitches of the thumb (do not count finger movements, only the thumb), the number of twitches of the muscle above the eyebrow or the number of twitches of the great toe.

2. Determining the Supramaximal Stimulation (SMS).

- a. Increase the mA in increments of 10, until four twitches are observed.
- b. Note the mA that corresponds to four vigorous twitches. Administer one to two more TOFs.

Points of Emphasis

Ulnar Nerve Placement: Connect the negative (black) lead to the distal electrode over the crease of the palmar aspect of the wrist and the positive (red) lead to the proximal electrode.

Facial Nerve Placement: Connect the negative (black) lead to the distal electrode at the tragus of the ear and the positive (red) lead to the proximal electrode at the outer canthus of the eye.

Posterior Tibial Nerve Placement: Connect the negative (black) lead to the distal electrode 2 cm posterior to the medial malleolus in the foot. Connect the positive (red) lead to the proximal electrode 2 cm above the medial malleolus.

Excessive amount of mA can lead to over stimulation and repetitive nerve firing.

Finger movements are a result of muscle stimulation, not nerve stimulation. In a person not receiving NMBA therapy, a TOF stimulus, produces four serial thumb adductions. In a person receiving NMBA therapy, the twitches gradually fade. For example, may see only 2 twitches in a person receiving NMBA therapy.

Four electrical stimuli are given at 0.5 second intervals.

The set of four stimuli should not be repeated more frequently than every 20 seconds, otherwise over stimulation can occur.

If there is no increase in intensity of the muscle twitch when the mA is increased, the SMS is the level at which four vigorous twitches was observed. For example, if a strong response was observed at 20mA, raise the current to 30 mA. If there is no increase in intensity of the twitch, the SMS is 20mA. If there is an additional increase in twitch intensity, raise it to 40. If the intensity shows no further increase, the SMS is 30 mA.

Practice Guidelines

Points of Emphasis

3. Determining the TOF response during NMBA infusion.

- a. Assess electrode condition and placement for quality.
- b. Retest the TOF 10 to 15 minutes after a bolus dose and/or continuous infusion of NMBA is given/initiated/changed.
- c. If more than one or two twitches occur and neuromuscular blockade is unsatisfactory for clinical goals, increase the infusion rate as prescribed or according to hospital protocol and retest in 10 to 15 minutes.
- d. Retest every 4 to 8 hours after clinically stable and a satisfactory level of blockade is achieved.

Evaluates the level of blockade provided.

Signifies that less than 85% to 90% of receptors are blocked.

Evaluates the level of blockade and avoids under- and overestimation of blockade.

4. Troubleshooting when there is zero twitches.

- a. Change electrodes.
- b. Check lead connections and PNS for mechanical failure (i.e. change the battery)
- c. Increase the stimulating current.
- d. Retest another nerve (the other ulnar nerve or facial or posterior tibial nerves).
- e. If there are no other explanations for a zero response, check the NMBA rate infusion dose and concentration. Reduce the infusion rate as needed.

Dry electrode gel or poor contact effects conduction

Excessive neuromuscular blockade produces absence of twitch response. The desired goal is 1-2 brisk twitches, as this represents 85-90% receptor blockade. Adjust infusion rate of NMBA based upon clinical indicators and TOF testing in order to obtain the 1-2 twitches. Maintaining a receptor block of greater than 90% has been linked to long-term complications such as muscle weakness, prolonged paralysis and difficulty weaning from the ventilator. In addition, longer hospital stays result.

Practice Guidelines

Points of Emphasis

5. Patient monitoring and care issues

- a. Cleanse and dry the skin before applying the electrodes.
- b. Change the electrodes whenever they are loose or when gel becomes dry.
- c. Select the most accessible site with the smallest degree of edema, with no wounds, catheters, or dressings that impede accurate electrode placement over the selected nerve.
- d. Never use the “Single Twitch”, “Tetany” or “Double Burst” settings if available on the PNS.
- e. The patient may demonstrate subtle movement of the extremities with an acceptable TOF response.
- f. Micro shock hazard may be a risk to patients with external pacing catheters. Extreme caution must be used to prevent the PNS lead wires from contacting the pacing catheter or pacing lead wires.
- g. Perform TOF testing every 4-8 hours during NMBA therapy once stable. For bolus therapy, perform TOF testing before every dose and every 15 minutes after every dose.
- h. If using NMBA therapy, **ALWAYS** provide the patient with adequate sedation and analgesia.

Improves contact and adhesion of electrode.

These are less accurate and can cause severe discomfort for the patient.

Clinical decisions should never be made based upon one parameter, such as the TOF testing. Assessment of oxygenation and ventilation, neurological function, tissue perfusion, etc. must be used to evaluate before deciding to increase the rate of NMBA infusion.

NMBA drugs do not provide any sedating or analgesic effects.

Resource Person: Tricia Yates, MSN, RN, FNP-C, CCRN

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Reviewed by Policy & Standard Committee

References: Whetstone Foster, J. G. (2005). Peripheral Nerve Stimulators. In D. J. Lynn-McHale & K. K. Carlson (Eds.), AACN

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