PERIPHERAL NERVE STIMULATION (TRAIN OF FOUR) MONITORING IN CICU - SCH

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- The assessment of the depth of neuromuscular blockade in ICU patients should be both clinically and through the use of peripheral nerve stimulation (PNS). [1,2,3,4]
- All patients receiving a neuromuscular blockade agent (NMBA) should be deeply sedated. [1,2,3,4]
- PNS can be used to assess the depth of neuromuscular blockade when patients are receiving a continuous intravenous infusion of an NMBA [1,2,4]
- A series of 4 light shocks, known as train-of-four (TOF), are applied to a peripheral nerve and visual observation of the muscular response to each shock is used to measure the degree of neuromuscular blockade.[4,5]
- The desired response depends on the depth of paralysis required. Generally aim for-1-2 weak twitches; the dosing of the NMBA should be adjusted appropriately.. [2,3]
- Nurses caring for patients receiving NMBAs must be competent in operating a PNS to measure TOF which indicates the patient's degree of neuromuscular blockade [6]
- The peripheral nerve stimulator used in CICU is the Fisher and Paykel "Innervator 252/272."
- Once achieved, the depth of blockade must be assessed every 12 hours and documented on the CICU flow chart in the events box and should include the amount of twitches and the milliamperes (mA) used on testing.
- There are international guidelines published that recommend the use of PNS in paediatric and adult populations for assessment of neuromuscular blockade, but there is little evidence to guide the safe use of PNS in neonates and it should be used with caution in this group [2,3,7]

Approved by:	SCHN Policy, Procedure and Guideline Committee	
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CHANGE SUMMARY

- This SCH Practice Guideline replaces a previous versions of the document.
- Advice that depth of neuromuscular blockade should be assessed clinically as well as with the PNS
- Advice that there is a lack of international guidelines on the safe use of neuromuscular blockade and assessment in the neonatal age group.
- Advice that factors such as obesity, hypothermia, and electrolyte imbalances can affect the results seen from TOF testing.
- References updated

READ ACKNOWLEDGEMENT

- CICU staff are required to read and acknowledge they understand the contents of this document.

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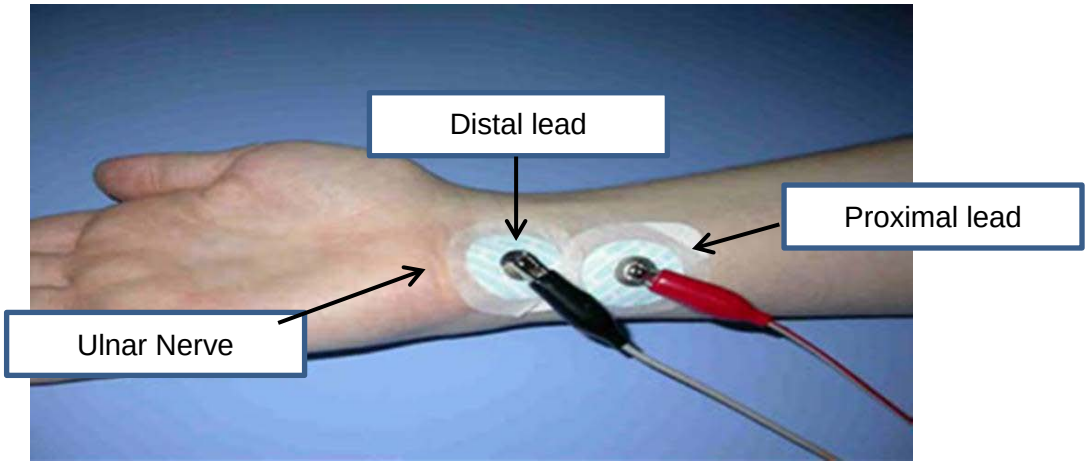
Standard

- Any concerns or marked changes to the patient's condition should be reported immediately to the NUM1 / Team leader and appropriate medical officer.
- Four small electrical stimuli are given consecutively to the patient at low frequency 2Hz for 2 seconds (1 stimulus every half second).[5] The degree of neuromuscular blockade can be assessed by observing or palpating the number of muscle twitches elicited during the series of 4 electrical stimuli.
- The desired response from the TOF stimulation using the ulnar nerve is flexion of the thumb from contraction of the muscle.[5]
- During administration of NMBA'S, a total of 1-2 muscle twitches in response to 4 successive nerve stimuli is desirable, corresponding to 80% to 90% blockade.[1]
- The mA used may vary depending on the resistance between the electrode and the nerve. If the maximum current is reached with nil response either the patient is excessively muscle relaxed or there is a problem with the contact or location of the electrode indicating the need for review.
- Most common nerve-muscle unit used for neuromuscular monitoring is the ulnar nerve-adductor pollicis muscle and this is the preferred method of PNS monitoring in CICU.[5]
- Monitoring of PNS is a joint responsibility of all members of the CICU team.
- Several factors play a role in the assessment of TOF monitoring and can all contribute to inaccuracies in interpreting the TOF response:
    - loss of electrode skin adhesion / incorrect electrode placement
    - obesity, electrolyte imbalances, peripheral oedema [4]
    - hypothermia (dampens peripheral stimulator twitch responses)[4]
    - Neuromuscular junction is immature in infants and continues to develop in the first 4 to 12 months of life. [1, 7]

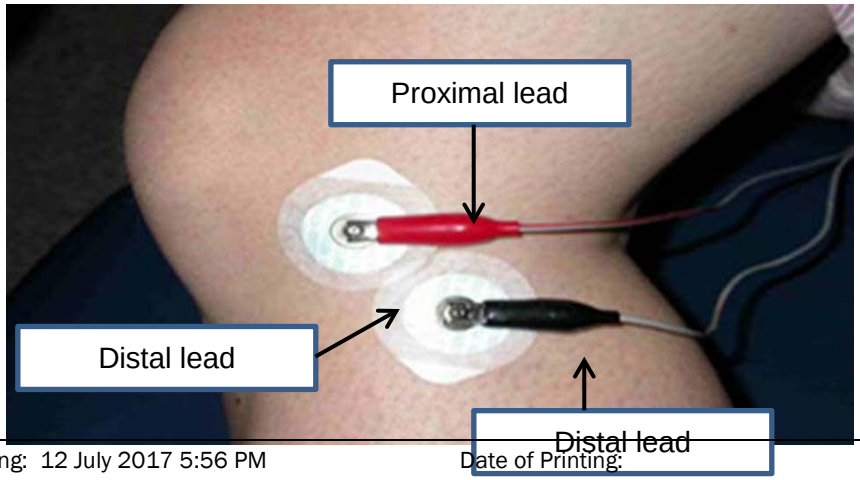
Procedure

Lead Placement

- Electrodes should be placed correctly at the site to ensure that the current stimulates the target nerve appropriately.[4, 5]
- Place two infant electrodes over the wrist in line with the smallest digit over the ulnar nerve.



- Ensure the nerve stimulator is switched off whilst connecting the device to the patient to prevent accidental delivery of a pulse.
- Connect the leads to the Fisher and Paykel "Innervator 252/272" by inserting the appropriate jacks into the proximal (red) and distal (black) output jack.
- Connect the other end of the leads to the patient electrodes. The proximal jack is positive and is connected to the proximal electrode on the patient. The distal jack is negative and is connected to the distal electrode on the patient.
- The negative (black) electrode should be placed as close as possible to the nerve at the point where it is most superficial (as identified in the photo).
- In circumstances when the ulnar nerve cannot be used, lead placement should occur on the common peroneal nerve over the neck of fibula (lateral aspect of the knee).



Delivery of the train of four

- The current delivered to the patient is always shown in milliamperes (mA).
- Neonates and infants less than 20kg begin at 30mA to a maximum of 60mA.
- Children and Adolescents greater than 20kg begin at 50mA to a maximum of 80mA.
- Switch the nerve stimulator on.
- If using the 'Innervator 272' turn on whilst holding the 'EXT' button and check that the display shows 'EXTERNAL'. If 'internal' mode is used, the current dose will be limited and higher doses will not be able to delivered.
- Set the required current output level within the range stated above.
- Administer the desired pulse pattern (TOF). Increase the current within the range displayed above observing for an appropriate twitch response, indicating the desired blockade has been achieved.
- If the NMBA infusion is adjusted (increased or decreased), then TOF should be carried out within an hour to assess for the effectiveness of the change.
- Once a steady state has been achieved, TOF should be carried out and documented every 12hrs (once per nursing shift).
- Turn off the stimulator between uses.
- Leave the electrodes in place, removing them following the cessation of NMBA's administration. There will be instances when the electrodes will require replacement due to loss of integrity and this should be attended when necessary with attention paid to the prevention of skin breakdown.

Troubleshooting

- Larger ECG electrodes can render monitoring inaccurate
- If a continuous tone is heard for 2 seconds after the audible pulse delivery indicator, this indicates the current selected is not being delivered to the patient. This may be caused by:
  - Excessive impedance due to oedema or incorrect electrode placement.
  - Dried or faulty leads.
  - Disconnected lead - examine the leads for the source of problem.

Outcome

Appropriate dosage of NMBA infusion will be administered based on the child's clinical condition and desired clinical end point for therapeutic muscular blockade utilising assessment of the child's response to PNS.

References

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