GE HealthCare

Quick Guide

Neuromuscular Transmission with B1x5M Patient Monitors

What is neuromuscular transmission?

Neuromuscular transmission (NMT) is the transfer of an impulse between a nerve and a muscle in the neuromuscular junction. NMT can be blocked by neuromuscular blocking agents – drugs which cause transient muscle relaxation and prevent the patient from moving and breathing spontaneously.

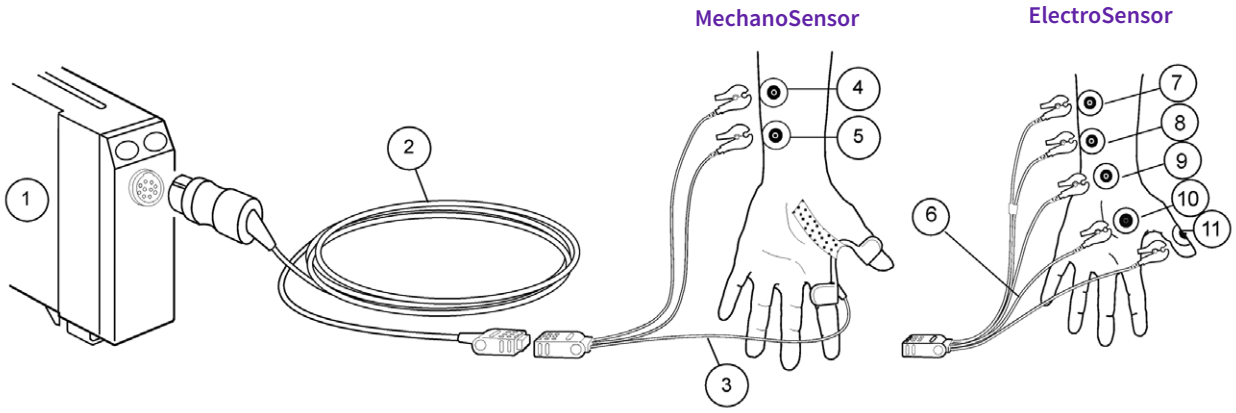
Muscle relaxation is used during general anesthesia to enable endotracheal intubation and to provide the surgeon with optimal working conditions. In critical care, muscle relaxation is used during mechanical ventilation to minimize the patient's work of breathing and to improve oxygenation.

How is the NMT block measured?

The level of neuromuscular block is routinely measured by stimulating a peripheral nerve, usually in the hand and by subjectively evaluating the muscle response either visually or tactilely with a device. Evidence suggests that subjective neuromuscular monitoring techniques can't determine adequate recovery from neuromuscular blockade and as a consequence, a large percentage of patients arrive to the PACU with residual paralysis.[1]

By comparison, GE HealthCare offers the NMT module, which provides quantitative, automatic measurements of muscle response to stimulus and consequentially, the level of block. This objective measurement can be used to assess the adequate level of blockade throughout the surgery and safely time the administration of antagonist and extubation to help avoid occurrence of residual paralysis

GE HealthCare offers two different sensor types for the NMT module. The innovative MechanoSensor measures the motion of the thumb with a piezoelectric sensor, which converts the physical motion to an electrical signal and quantifies the evoked mechanical response. The MechanoSensor sensor is available in adult and pediatric sizes. The ElectroSensor directly measures the electrical activity of the muscle with recording electrodes, quantifying the response to nerve stimulation. The ElectroSensor can be used on the patient's hand or foot in both adult and pediatric patients. It works reliably even when the hand movement is obstructed.



NMT measurement setup with MechanoSensor based on Kinemyography (KMG) for routine clinical NMT monitoring. Use a narrow tape to secure MechanoSensor securely on the patient's hand. Traditional electromyography (EMG) measurement with Electro Sensor.

1. Module with NMT measurement capability
2. NMT sensor cable
3. MechanoSensor or Pediatric MechanoSensor lead wire set
4. Electrode, white lead connection site for nerve stimulation
5. Electrode, brown lead connection site for nerve stimulation
6. ElectroSensor leadwire set
7. White stimulating electrode
8. Brown stim ulating electrode
9. Electrode, black lead connection site, ground
10. Electrode, green lead connection site, recording muscle-contraction effect
11. Electrode, red lead connection site, recording muscle-contraction effect

Nerve stimulus

A supramaximal stimulus is recommended to ensure that all muscle fibers are stimulated with sufficient intensity and that reliable measurements are achieved during deep neuromuscular block. The NMT module automatically determines the current needed for the supramaximal stimulus and maintains this current throughout the procedure.

Train-of-four (TOF) is used as the default stimulation mode. Four supramaximal stimuli are generated at 0.5 second intervals. Each stimulus in the train causes the muscle to contract.

Stimulation modes

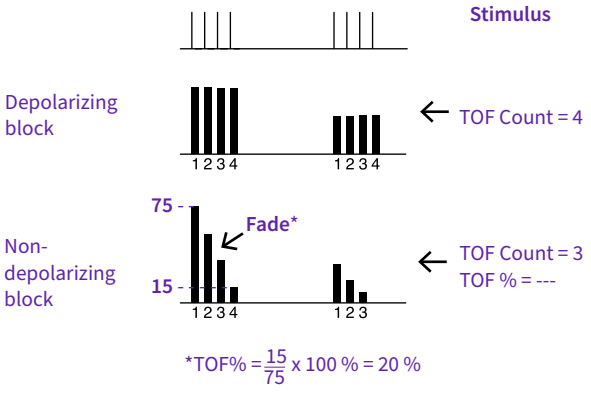
- Train of four, TOF: Recommended for most cases. It is also the default setting.
- Double burst stimulation, DBS: It enables better visual observation of the fading in responses.
- Post tetanic count, PTC: Used for estimating the relaxation level with tetanic stimulation.
- Single twitch, ST: Single twitch mode is practical when using depolarizing relaxants: in the cases, TOF% does not give any additional information about the patient status.

Quantitative muscle response

The muscle response can be quantified with different parameters depending on the type and the level of neuromuscular block

TOF Count is the number of detected muscle responses. **Train- of-four ratio (TOF%)** is the ratio of the fourth muscle response to the first one. TOF% indicates fade in non-depolarizing block. Once the TOF Count drops below four responses or T1% is less than 10%, the TOF% is not calculated.

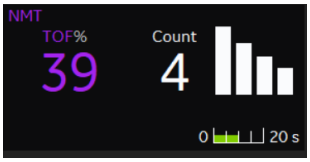
When depolarizing agents are used, no fade occurs, and the height of the four responses indicates the level of block.[2]



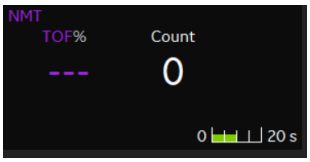
When no responses are detected to TOF stimulation, the **post tetanic count (PTC)** is the only way to measure the neuromuscular block. A tetanic stimulation (50 Hz) is generated for five seconds and post-tetanic responses to single twitch stimulation are counted. The larger the PTC, i.e., the number of detected responses, the sooner the normal TOF responses return.[2]

Monitoring of neuromuscular block in five steps

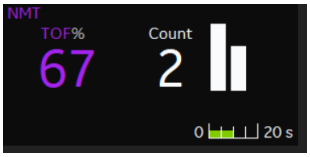
1. Properly secure the sensor of choice (as depicted on page 1). Press measurement start-up. monitor will start the measurement by setting the stimulus current automatically and by performing a reference measurement. With the unrelaxed patient, TOF% is 100.



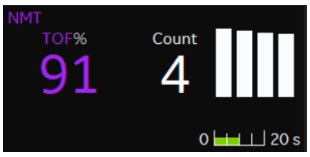
2. Non-depolarizing relaxants cause a fade in the responses, indicated by a lower TOF% and a slope in the bar graph. Depolarizing relaxants result in an equal drop in all four responses, without fade.



3. Neuromuscular block can be used to facilitate endotracheal intubation. The physician can use the time when all responses disappear (i.e., TOF Count is 0) as a guide to determine when to intubate[3].



4. During surgery and in critical care, TOF Count is used to maintain steady optimal level of neuromuscular block. When TOF Count exceeds a level set by the user, the GE HealthCare monitor will give a “Block recovery” message



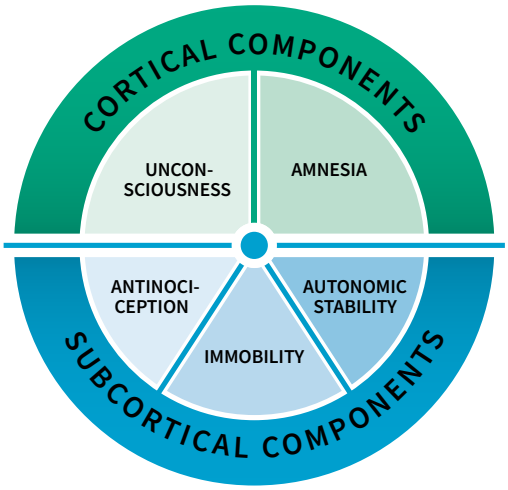
5. Based on type of reversal agent you want to use; you can time the administration by using TOF % and twitch count. For safe extubation, TOF% should be higher than 90[3].

How to interpret the NMT values

When neuromuscular block deepens, different stimulation modes may be needed to assess the relaxation status. The following table describes the depth of relaxation[4].

TOF%	100%	10%	---		
TOF Count	4		3 or 2	1	0
PTC				10	< 10	0
Relaxation	None	→			Deep

Adequacy of Anesthesia



Adequacy of Anesthesia consists of several interrelated components as depicted below.

One of the objectives of general anesthesia is **immobility**, i.e., the assurance that the patient does not move. Often neuromuscular blocking agents are used to achieve this goal. Anesthetic agents prolong and amplify the effects of neuromuscular blocking agents, therefore, it is recommended to use quantitative NMT monitoring when anesthetic agents are used together with neuromuscular blockade. NMT is an important part of adequacy of anesthesia concept and, when combined with other parameters such as the Entropy and hemodynamic measurements, it helps to achieve a more complete picture of the patient's status.

Why use the NMT module?

Automatic and hands-free

Neuromuscular block measurements with the NMT module are easy. Simply attach the sensor and push the Start-up key.

The module will set the supramaximal current and automatically cycle according to the user-defined measurement interval.

Optimal dosage during anesthesia and in critical care

Quantitative NMT monitoring gives a clear picture of the individual dosage needs of the patient and helps the clinician facilitate optimal and cost-effective administration of neuromuscular blocking drugs.

Optimized recovery

Monitoring the level of neuromuscular block enables follow-up and prediction of recovery and helps in correct timing of the antagonists, which may decrease the incidence of residual paralysis.

Enhanced patient safety

Objective, quantitative monitoring is one of the only means to safely indicate recovery of neuromuscular block (TOF%>90%).[3] Therefore, utilizing the NMT module may help decrease the incidence of residual paralysis which has been associated with respiratory complications.

Fast patient throughput

Patients that arrive to the PACU with residual paralysis (TOF%<90) stay on average 90 minutes longer.[5] Using NMT to guide extubation times can support shorter length of stay.

Integrated information

When the NMT measurement is integrated in a monitoring system, the measured values are displayed, trended and automatically documented together with all the other monitored parameters.

Additional resources

For white papers, guides and other instructive materials about our clinical measurements, technologies and applications, please visit **http://clinicalview.gehealthcare.com/**

References

1. Murphy GS, Brull SJ. Residual neuromuscular block: Lessons unlearned. Part 1: Definitions, incidence, adverse psychological effects of residual neuromuscular block. *Anesth Analg* 2010;111:120-128
2. Naguib M, Brull SJ, Johnson KB: Conceptual and technical insights into the basis of neuromuscular monitoring. *Anaesthesia* 2017; 72 (Suppl. 1), 16-37.
3. Naguib M, Brull SJ, Kopman AF, *et al.* Consensus Statement on Perioperative Use of Neuromuscular Monitoring. *Anesth Analg* 2018; 127:71-80.
4. Howardy-Hansen P, Viby-Mogensen J, Gottschau A, *et al.*, Tactile Evaluation fo the Posttetanic count (PTC). *Anesthesiology* 1984, 60:372-374.
5. Butterly A, Bitner EA, George E, Sandberg WS, Eikermann M, Schmidt U. Postoperative residual curarization from intermediate-acting neuromuscular blocking agents delays recovery room discharge. *Br J Anaesth.* 2010; 105: 304-309.

NMT is compatible with B1x5M VSP3.

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