GE Healthcare

Quick Guide

Neuromuscular Transmission (NMT)

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MEDICAL SYSTEMS

WHAT is Neuromuscular Transmission (NMT)?

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 paralysis and prevent the patient from moving and breathing spontaneously.

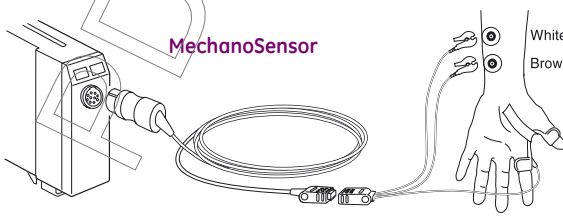
Muscle relaxation is used during general anesthesia to enable endotracheal intubation and to provide the surgeon with optimal working conditions. In critical care, muscle relaxation is used during mechanical ventilation to minimize the patient's work of breathing and to improve oxygenation.

HOW is NMT measured?

The level of neuromuscular block is routinely measured by stimulating a peripheral nerve, usually in the hand, and by evaluating the muscle response either visually or by touching the hand.

The NMT module provides quantitative, automatic measurement of muscle response to a stimulus.

The unique MechanoSensor quantifies the evoked mechanical response by measuring the motion of the thumb by a piezoelectric sensor, which converts the physical motion to an electrical signal. This sensor is available for adults and for pediatric use.



NMT measurement setup with MechanoSensor. Note the location of the electrodes. Use tape to tie the MechanoSensor securely on the patient's hand. Traditional Electromyography (EMG) measurement with ElectroSensor is also available.

Nerve stimulus

A supramaximal stimulus is needed 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 searches the current needed for the supramaximal stimulus, and maintains this current throughout the procedure.

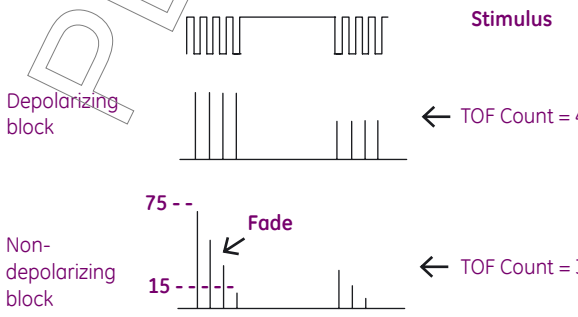
Train-of-four (TOF) is used as a standard stimulation mode. Four supramaximal stimuli are generated at 0.5 second intervals. Each stimulus in the train causes the muscle to contract.

Quantitative muscle response

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

Train-of-four ratio (TOF%) is the ratio of the fourth muscle response to the first one. TOF% indicates fade in non-depolarizing block. When fade increases, not all four stimuli produce a measurable response and TOF% cannot be calculated.

TOF Count, ie. the number of detected muscle responses, then indicates the level of neuromuscular block. When depolarizing agents are used, no fade occurs, and the height of the four responses indicates the level of block.



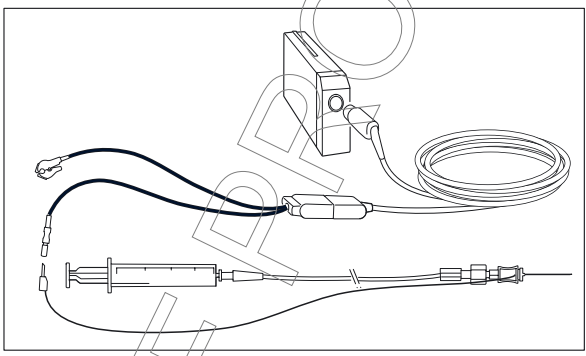
$$TOF\% = \frac{15}{75} \times 100\ \% = 20\ \%$$

When no responses are detected to TOF stimulation, the **Post Tetanic Count (PTC)** is the only way of measuring 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, ie. the number of detected responses, the sooner the normal TOF responses return. This is rarely used in critical care.

100	TOF%	20	4	Count	0	10	PTC	0	
Light	—	—	—	—	—	—	—	—	Deep

Relaxometer illustrates the level of neuromuscular blockade

Nerve Location for Regional Block



The NMT module enables location of the nerve to be blocked in regional anesthesia.

A puncture needle is stimulated with small repeated 2.0 mA stimuli while the nerve is approached. Then, each nerve stimulus should result in muscle contraction. The closer the needle is to the motor nerve, the lower is the current needed to give a response. When even a small stimulus current (eg. < 0.5mA) results in a visible muscle contraction, the optimum site has been located and local anesthetic can be injected.

The method helps in finding the optimum site of the regional nerve to be blocked and thus optimizes the bolus of the anesthetic to be injected. The correct location also protects the patient against mechanical nerve and vessel lesions.

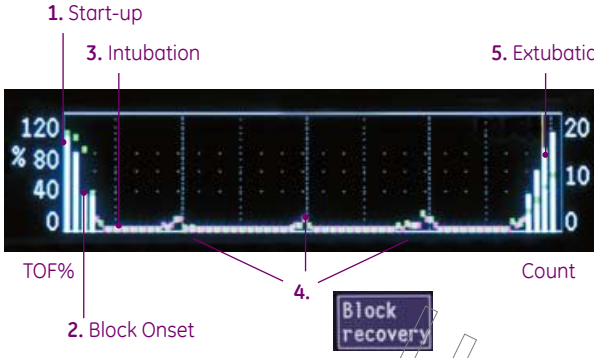
1. Attach MechanoSensor to the patient's hand with tape. The monitor will start measurement by setting the stimulus current automatically and by performing a reference measurement. With the unrelaxed patient, TOF% is 100.

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.

4. During surgery and in critical care, TOF Count is used for maintaining steady optimal level of neuromuscular block. When TOF Count exceeds a level set by the user, the monitor will give a "Block recovery" message.

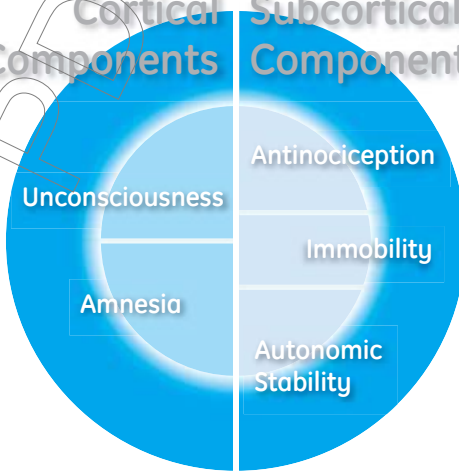
5. When using an antagonist, it should not be given before TOF count rises to 4. For safer extubation, TOF% should be higher than 90.



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. It is known that anesthetic agents prolong and amplify the effects of neuromuscular blocking agents. Therefore it is particularly recommended to use quantitative NMT monitoring, when anesthetic agents are used together with neuromuscular blockade. NMT is an important part of adequacy of anesthesia monitoring 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.



Automatic and hands-free

Relaxation measurement with the NMT module is easy. You just attach the two electrodes and the MechanoSensor and push the Start-up key.

The module will automatically search for the supra maximal stimulus current and set the reference level for the unrelaxed patient. Automatic cycling, with a user-defined measurement interval, is then started. After that your hands are free for taking care of the patient.

WHY use the NMT module?

Optimal dosage during anesthesia and in critical care

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

Optimized recovery

Monitoring of the level of neuromuscular block enables follow-up and prediction of recovery and helps in correct timing of the antagonism, and may this decrease the incidence of residual paralysis. In recovery room low current stimulation can be used for revealing possible residual block by observing fade in TOF.

Patient safety after extubation

Adequate recovery from neuromuscular block, indicated by TOF>90%, can be reliably determined only with a quantitative measurement. If the patient is extubated too early when there is still residual block, respiratory complications may occur.

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.