

# Train-of-Four monitoring: overestimation

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According to a survey on the use of muscle relaxants, there are a lot of cases where routine monitoring of the neuromuscular junction using a nerve stimulator is not applied, nor is quantitative evaluation of the Train of Four (TOF) performed when using a non-depolarizing muscle relaxant. Moreover, the need for monitoring is itself being questioned [1]. Thus, unless the physician has a special interest in monitoring the effect of muscle relaxants, there is a lack of interest in the correct method of monitoring. Therefore, it is essential to promote the need for accurate monitoring when using muscle relaxants through education, especially when the incomplete block of the neuromuscular junction is in question.

Monitoring of the neuromuscular junction can be an effective method in determining the dose and time of administration of muscle relaxants for induction or intubation, especially where deep muscular relaxation is required to repress detrimental reflexes. It is also useful in cases where maintenance of muscle relaxation is continuously required, to identify residual muscle relaxation during recovery from anesthesia, during long periods of mechanical ventilation, or in cases where a motor evoked potential is monitored during surgery.

Acceleromyography (AMG) which employs a TOF-Watch<sup>®</sup> (TOF-Watch S<sup>®</sup> or TOF-Watch SX<sup>®</sup>: upgraded TOF-Watch<sup>®</sup>, Organon Teknika, the Netherlands) is an easy way to monitor a stimulated neuromuscular junction. And the monitoring device is commercialized, which makes it convenient to monitor the effects of muscle relaxation. It uses the acceleration force of the adductor pollicis muscle, which is the only thenar muscle innervated by the ulnar nerve. It is widely used for its convenience in the clinical field, but it lacks accuracy compared to conventional mechanomyography (MMG) or

electromyography (EMG), and one should be cautious about an exaggerated estimation of recovery from muscle relaxation [2,3]. There was a discussion on recommendations for good clinical research practice (GCRP) involving neuromuscular blocking agents at the 2005 'International Neuromuscular Meeting' held in Stockholm. This was the third debate of its kind since 1996, and 'Standards' common to all types of neuromuscular monitoring were proposed, and are now considered as a guideline by many researchers [4].

The pattern (rectangular), frequency, amount (supramaximal) of the current, and duration of stimulation are considered important in general, but the most important factor is stabilizing the basic neuromuscular junction in order to keep the stimulated muscle twitch constant, because this can cause a vital bias. Even when the same examiner is measuring the results, it can differ in relation to the method of measurement of stimulated muscle contraction [2]. Furthermore, the results can be dissimilar according to the place of measurement, as between the right arm and the left [5]. There has also been a report stating that when stimulating the same nerve innervating two different muscle groups, the measurement can be similar using two different measuring methods, implying that the muscle responding to the nerve being stimulated can influence the response [6]. In clinical situations where adequate measurement devices are not available, the observer has to evaluate the state of muscle relaxation visually or by touch, and this can show disparities for different methods of evaluation [7]. When using the TOF Watch<sup>®</sup>, the moving thumb corresponds to the mass and the movement itself acts as momentum. Therefore, fixation of the thumb can influence the results [2]. The TOF often exceeds a 100% ratio after stimulation, and

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stabilization is needed to minimize this, and the results require correction by comparing them with pre-experiment and post-experiment values [8-10].

Choosing the wrong nerve to be stimulated can result in an exaggerated evaluation of the state of muscle relaxation recovery. A paper published in this months' issue of compares the single twitch (T1) and TOF ratios of the ulnar nerve of one arm and the median nerve on the other arm of the same person simultaneously. The values of TOF ratios and single twitch (ST) ratios of the median nerve are higher than of that of the ulnar nerve by 16.2% and 72.9%, respectively, and they cannot be directly compared. Unlike the ulnar nerve, the median nerve directly stimulates the thenar muscle, making it difficult for it to accurately reflect the neuromuscular junction [11]. Since the measurements obtained were from both arms of the same person, it is thought to have little or no margin of error. But, if it was MMG or EMG and not AMG, and measurements were taken from the same arm, the outcome may have been different. But is expected to have clinical limitations.

There are many factors to consider when measured results prove to be abnormal or smaller than expected. On the other hand, misuse of the monitoring device can lead to exaggerated results. The TOF-Watch<sup>®</sup> has the advantage of being available when needed and can be easily used to show immediate results, but lacks precision in accurately stimulating the ulnar nerve, which ends up causing exaggerated results. Thus, it has to properly stimulate the correct nerve.

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