Neuromuscular monitoring by intensive care nurses: comparison of acceleromyography and tactile assessment

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Summary
We have compared tactile assessment of the train-of-four (TOF) count and TOF ratio by nursing staff, with measurements made by a new acceleromyographic monitor, the TOF-Watch. We assessed neuromuscular block in 30 sedated intensive care patients receiving a continuous infusion of atracurium. Five nurses made a tactile assessment of neuromuscular block in each patient within a 5-min period. Each assessment was paired with a blinded TOF-Watch measurement. The nurses were accurate in assessing twitch count in 55% of measurements and they tended to overestimate the degree of block using tactile assessment of TOF ratio. (Br. J. Anaesth. 1998; 80: 384–385)

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The use of neuromuscular blocking drugs in the intensive care unit is commonplace. It is important to monitor neuromuscular function in the critically ill because the action of these drugs varies widely in this population. Tactile assessment of the train-of-four (TOF) is used commonly in anaesthetic practice to assess the degree of block, but there are few published data on tactile assessment of neuromuscular block in the intensive care unit. The majority of routine monitoring of vital signs in the intensive care unit is performed by nurses. Our aim was to compare the accuracy of nurse assessment of TOF responses with acceleromyography, which is a reproducible method of measurement.

Acceleromyography uses the principle that acceleration of a contracting muscle is proportional to the force of contraction (Newton’s second law). In a previous study it was demonstrated that a similar acceleromyography device gave results comparable with those of a standard mechanometric device (Myograph 2000) but there was greater variation in responses to acceleromyography. The TOF-Watch (Organon teknika) is an electromyographic device. It comprises a standard nerve stimulator and a small piezoelectric acceleration transducer that is attached to the thumb. The TOF-Watch enumerates the TOF ratio and TOF count on a liquid crystal display.

Methods and results
We investigated 30 stable, sedated adult patients receiving an infusion of atracurium in our intensive care unit. ECG-type electrodes were placed over the ulnar nerve of both wrists. The TOF-Watch was used to obtain acceleromyographic measurements of neuromuscular block at one thumb (adductor pollicis). The stimulating leads of the TOF-Watch were then disconnected and reconnected to similar electrodes on the contralateral wrist when tactile assessment was made. In this way the same nerve stimulator was used for tactile and acceleromyographic measurements at different wrists. We used two wrists to avoid displacement of the sensitive acceleration transducer between measurements: a small change in position could have affected the results. The same stimulating current was used at both wrists (60 mA). We ensured that the electrode position was identical at both wrists and we assigned at random the dominant and non-dominant hands for measurement. The nurse caring for the patient (nurse A) made a tactile TOF assessment and then a TOF-Watch measurement. Four subsequent assessments were made by four different nurses who were blinded to the TOF-Watch result. At the same time as each tactile assessment, nurse A made a TOF-Watch measurement on the patient’s other hand. Each of the four nurses stated the number of twitches she could feel in response to a TOF stimulus and if four were palpable she declared a TOF ratio. One minute elapsed between measurements. In this way we obtained five pairs of data for each patient. The nurses were given standard instructions in the simple theory and relevance of neuromuscular function; however, they were not given practical experience in the technique before commencement of the study.

The nurses estimated correctly the twitch count in 80 assessments (54%); they overestimated the count in 38 assessments (25.3%) and underestimated it in 31 (20.6%). Seventeen percent of assessments were inaccurate by two twitches (fig. 1). A Bland and Altman plot demonstrated that nurses tended to overestimate the TOF ratio by a small amount. There was also greater variability among the nursing assessment of the TOF ratio than among the TOF-Watch measurements. No learning effect could be demonstrated by comparing the assessments of the first 10 patients and the last 10.

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Comment

The use of neuromuscular blocking drugs in the intensive care unit is common. However, monitoring of neuromuscular function in the intensive care unit is not performed routinely. It is important to assess the degree of block in critically ill patients because the action of these drugs varies widely in this population. Changes in the pharmacokinetics and pharmacodynamics of neuromuscular blocking drugs may occur and these patients may demonstrate increased or decreased sensitivity to these agents. Differing degrees of block are required depending on the clinical indication for the use of neuromuscular blocking agents in the intensive care unit.

Acceleromyography has been described as a method of measurement of neuromuscular block during anaesthesia. Acceleromyographic and mechanomyographic measurements of TOF responses compare well during stable neuromuscular block. Our study of tactile assessment of TOF count found that the nurses were inaccurate in 45% of measurements and the degree of inaccuracy was two twitches or more in 17% of cases. Underestimation of twitch count leads to overestimation of the level of block, which may mislead doctors and nurses into reducing the rate of infusion of atracurium. A patient in whom a deep level of block is required to avoid an increase in intracranial pressure or to improve thoracic compliance may be put at risk by this course of events.

Measurement of TOF ratio is an important method of assessing recovery from neuromuscular block. It has been shown that tactile assessment of TOF ratio by medical staff is inaccurate at low levels of block. Our results demonstrated that nursing staff tended to overestimate TOF ratio. There was also greater variability in the assessments by the nursing staff. Full recovery from neuromuscular block is important when it is necessary to make neurological or respiratory assessments after a period of block. Underestimation of the degree of block may lead to inaccurate patient assessment and inappropriate changes in therapy.

We suggest that acceleromyography is a useful tool in the intensive care unit. In particular, the TOF-Watch appears to be an appropriate neuromuscular monitor in this setting. The accuracy of tactile assessment of TOF twitch count and TOF ratio by nursing staff may not be a sufficient basis on which to make decisions on clinical management in the intensive care unit.

References