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An Episode of Malignant Hyperthermia Followed by a Persisting Muscle Weakness

To the Editor:—We have read with great interest the report by Maeda *et al.*¹ describing a case of malignant hyperthermia during sevoflurane anesthesia followed by a muscle weakness persisting for almost 3 months after the event. However, a few questions regarding the diagnosis and management of what was thought to be an episode of malignant hyperthermia remain to be answered.

The signs and symptoms described are strongly suggestive of malignant hyperthermia, however, for reasons of better comparison we would have appreciated the use of the clinical grading scale for malignant hyperthermia.² According to the data given, we calculated a score exceeding 50 points. Thus, the probability of malignant hyperthermia would have to be considered as almost certain.

Second, the dose of dantrole (100 mg in a patient weighing 80 kg) seems to be rather low, which requires more detailed explanation. Unfortunately no data are given as to the postoperative concentration of creatine phosphokinase. As no muscle biopsy was performed, what was the evidence of muscle destruction in this patient? Why was no *in vitro* contracture test performed to test the susceptibility for malignant hyperthermia? Despite the high score in the clinical grading scale, the *in vitro* contracture test would have been the only means to confirm the diagnosis of malignant hyperthermia.³

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In Reply:—I appreciate the interest in our article¹ expressed by Dr. Andrea Michalek-Sauberer. She raises four points regarding the diagnosis and management of malignant hyperthermia.

We agree that the use of "clinical grading scale for malignant hyperthermia"² is useful for evaluating the probability of malignant hyperthermia. However, in our case report, we did not show the grading scale because the signs and symptoms indicated malignant hyperthermia undoubtedly. According to our hospital therapeutic protocol for malignant hyperthermia, dantrolene should be used initially at a dose of 1 mg/kg, body weight, and if the signs are not improved, additional doses of dantrolene, up to 7 mg/kg, are recommended. In this case, signs were improved with initially administered dantrolene at a dose of 100 mg. The highest concentration of creatinine phosphokinase was recorded at 78,672 U/l on the next day of the operation. The high concentration of creatinine phosphokinase strongly suggested the muscle destruction. Because we could not obtain the patient's consent to the muscle biopsy, no histologic nor pharmacologic information was available.

The patient, whose occupation was a manual laborer, had been healthy before the anesthesia. The muscle weakness occurred just after the episode of malignant hyperthermia. Because the recovery

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from muscle weakness was a matter of deep concern to the patient, we performed careful tests of his muscle strength repeatedly. Although there have been numerous reports regarding diagnosis or treatment of malignant hyperthermia, to our best knowledge, no precise description concerning muscle weakness as a post-episode of malignant hyperthermia have been made. In our case, it took 3 months to recover from this weakness. Our report may provide helpful information about the post-malignant hyperthermia muscle weakness.

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Pulse Oximetry May Not Reliably Assess Peripheral Perfusion

To the Editor:—Findlay *et al.* propose that pulse oximetry can be used to confirm adequate foot perfusion during radical perineal prostatectomy.¹ Specifically, they recommend that a pulse oximeter probe be attached to a toe when the legs are positioned in a fashion that potentially compromises extremity perfusion. Their theory is that "when the foot is perfused, the pulse oximeter displays a normal tracing." Conversely, "when the blood pressure decreases below a threshold value for that patient, no pulse waveform is displayed."

That pulse oximetry might be a useful measure of perfusion is intuitive and has been proposed numerous times.²⁻⁶ The difficulty with this approach, however, is that pulse oximeters are "too good." Specifically, they contain extremely powerful amplifiers that can detect saturation and display a waveform even when flow is critically compromised. A further difficulty is that oximeters actually evaluate arterial pulsation, not flow *per se*. The result is a substantial potential for false-normal results.

The consensus among vascular and hand surgeons is that prolonged digital systolic arterial blood pressures <40 mmHg are likely to result in tissue injury.⁷⁻¹¹ My concern about using pulse oximetry as an index of flow is that the technique appears unreliable. In one study, for example, the technique failed to detect critical reductions in distal extremity pressure in two of three cases.¹² Another study demonstrated that the pulse oximeter signal is maintained (without even a "low perfusion" warning) until flow is reduced to ≈8% of normal.¹³ Pulse oximetry obviously detects the most extreme reductions in tissue flow—those bordering on complete ischemia. However, the method proposed by Findlay *et al.*¹ seems likely to provide false reassurance in a substantial number of cases where flow is actually seriously restricted.

I would thus like to propose an equally easy, but potentially more reliable, measure of foot perfusion: ankle blood pressure. Simply position the cuff of an oscillometric blood pressure monitor around the ankle and confirm that the systolic arterial pressure exceeds 40 mmHg. An alternative is to attach a cuff sized for premature infants to the long toe. Obviously, pressure at these sites should be monitored at relatively infrequent intervals, say ≈10-min intervals, so the measurements themselves do not excessively restrict flow.

Human extremities are, fortunately, relatively resistant to ischemia. It would nonetheless be risky to maintain critically low foot perfusion for the duration of a radical prostatectomy or similar procedure. Measurements of ankle blood pressure will alert anesthesiologists

to inadequate perfusion, allowing interventions that might include increasing systemic blood pressure or altering patient position.

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