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## Elevated Blood Glucose Levels May Increase the Danger of Neurological Deficit Following Profoundly Hypothermic Cardiac Arrest

*To the Editor:*—The recommendation that administration of sugar-containing solutions should be avoided in all patients at risk for impending cerebral ischemia<sup>1</sup> prompted us to review our experience with infants and children subjected to profoundly hypothermic circulatory arrest (PHCA) for intracardiac surgery. Though this technique is usually followed by complete recovery, some patients have demonstrated transient or persistent postoperative neurologic deficits. As it has been common practice to infuse dextrose solutions during pediatric cardiac surgery or to add dextrose to pump priming formulae, and as a result of the neuro-endocrine response to surgery, blood glucose levels are often elevated intraoperatively.

We reviewed the records of 34 patients less than 1 yr old who underwent PHCA, and noted the blood glucose level immediately prior to induced circulatory arrest, the duration of arrest, and the neurologic outcome. Nine patients demonstrated detectable evidence of neurologic deterioration that was usually transient and varied from mild seizure activity to cortical blindness. No relationship was seen between duration of PHCA and neurologic outcome.

When the patients were grouped by pre-arrest blood glucose levels, one of six patients with a level under 12 mmol/l (216 mg/dl) demonstrated impairment, six of 25 with levels of 12–24 mmol/l (216–432 mg/dl) showed impairment, and two of three with levels over 24 mmol/l (432 mg/dl) showed impairment (fig. 1).

The small number of patients available for review and the uneven distribution between blood glucose groups makes statistical analysis of the data difficult. However, we consider that we have demonstrated an important trend that should alert physicians against unnecessary dextrose infusions during pediatric cardiac surgery.

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## Management of Patients in Whom Trismus Occurs Following Succinylcholine

*To the Editor:*—The editorial view of Dr. Rosenberg, "Trismus is not trivial,"<sup>1</sup> approaches, but doesn't quite reach, the conclusion that seems to me inescapable after examination of the evidence. There is no doubt that

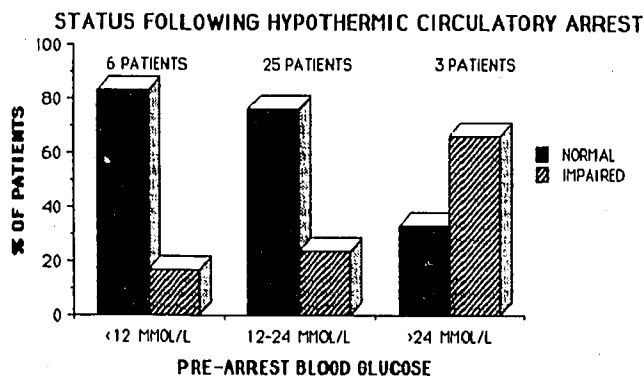


FIG. 1. Neurological status of 34 patients following cardiac surgery using PHCA related to immediate prearrest blood glucose level.

Further prospective studies are needed to fully define the danger of dextrose-containing solutions in pediatric cardiac surgery patients.

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retrospective analyses of pediatric anesthetics involving halothane and succinylcholine demonstrate a 1% incidence of trismus in the absence of clinical episodes of malignant hyperthermia.<sup>2,3</sup> In addition, there is addi-

tional human evidence that, in normal patients deeply anesthetized with halothane, succinylcholine routinely increases jaw muscle tone.<sup>4</sup>

With this information in mind, I believe that the clinician should now regard trismus in a different light. In the situation described in these two retrospective studies, *i.e.*, pediatric use of halothane and succinylcholine, trismus obviously does not herald the onset of malignant hyperthermia 50% of the time. Thus, our philosophy in regard to management of such patients should change. It seems warranted that, when trismus occurs after such an induction, the case need not be stopped immediately. There should be judicious monitoring of end-expired CO<sub>2</sub>, venous and perhaps arterial blood gases, blood pressure, pulse, temperature, urine color, and muscle tone. Should these be stable, the procedure may be continued. Should any changes occur suggesting an abnormal metabolic response, then the case should be halted if at all possible and treatment instituted for malignant hyperthermia. However, to properly evaluate these cases of trismus, it is desirable that these patients undergo muscle biopsy and contracture responses. This will enable us to eventually determine the true relevance of this response. In addition, values for creatine phosphokinase should be determined to examine whether a greater-than-normal increase occurred.

This proposed management of trismus is a radical departure from prior philosophy, and may be controversial in regard to medical-legal questions. If the clini-

cian wishes to be more conservative, then he or she should follow Dr. Rosenberg's advice, and not attempt to change his or her approach. The ability to answer this question concerning trismus may be progressively evaporating as the use of succinylcholine is replaced by newer non-depolarizing muscle relaxants. In fact, this is the course that Dr. Rosenberg and others<sup>5</sup> suggest, as they recommend that the use of succinylcholine should now be reserved for specific indications.

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*In Reply:*—Dr. Gronert proposes that patients who experience trismus after succinylcholine need not have anesthesia stopped and surgery rescheduled. Instead, anesthesia may be continued with non-triggering agents and sufficient monitoring to ensure that, should malignant hyperthermia develop, it would be detected and treated early. Indeed, others also espouse this recommendation.<sup>1</sup> I do not. My reasons are as follows:

End expired CO<sub>2</sub> monitoring, the most sensitive means of detecting malignant hyperthermia, is not available in all operating rooms, and, if it is, the monitor requires time for calibration (during which time the patient would be anesthetized). Insertion of arterial (and venous?) catheters is time consuming and detracts from close patient observation.

However, my major objection is that malignant hyperthermia may not occur immediately after trismus, but may occur sometime during the operative procedure. Now the surgeon would have to be told to abort

the operative procedure, perhaps at an inconvenient time, or rush through the surgery. Dantrolene would then have to be secured and administered. By these actions, we have unnecessarily increased the risks for the patient.

Finally, patients who have experienced trismus without any other sign of malignant hyperthermia may experience significant muscle destruction, myoglobinemia, and myoglobinuria. If myoglobinuria is not recognized and treated, then it is possible that myoglobinuric renal failure may ensue. There is no information to indicate if continuing the anesthetic with a non-triggering technique would worsen such muscle destruction; I think it might.

Certainly, for an elective procedure, I believe that the additional problems that might be engendered by continuing the anesthetic are simply not justified. Therefore, I advise practitioners that, following trismus in a patient having an elective procedure, surgery should be