Postoperative changes in serum creatine kinase in paediatric orthopaedic patients with preoperative hyperCKaemia: review of three cases

An elevated serum creatine kinase (CK) level is commonly known as hyperCKaemia, and anaesthesiologists must take into account the potential susceptibility of hyperCKaemia patients to develop malignant hyperthermia during general anaesthesia as well as acute onset of rhabdomyolysis postoperatively. Three paediatric patients with hyperCKaemia were scheduled for orthopaedic surgery. With the consent of their parents, their CK changes were monitored for seven days postoperatively to detect rhabdomyolysis. The results showed that the postoperative CK change patterns were almost the same as those for patients whose CK levels were within reference range. Maximum CK levels tended to be higher in these patients than in the CK reference-range patients studied previously, although the reason remains unclear. This experience and previous studies suggest that measuring CK levels at least on postoperative days 1 and 2 might be better for detecting early signs of rhabdomyolysis, even in paediatric patients with hyperCKaemia.

Keywords: postoperative change, creatine kinase, preoperative hyperCKaemia, malignant hyperthermia, rhabdomyolysis

Sir,

HyperCKaemia is commonly defined as an elevated serum creatine kinase (CK) level. Preoperative hyperCKaemia is a concern for anaesthesiologists, who must consider the patient's potential susceptibility to malignant hyperthermia (MH) during general anaesthesia and acute-onset rhabdomyolysis postoperatively. Although postoperative normal-range CK changes have been reported,[1-3] CK level changes in patients with preoperative hyperCKaemia remain unexplained even though a steep rise in postoperative CK levels may indicate rhabdomyolysis, a symptom related to MH. We therefore report postoperative changes of serum CK in paediatric orthopaedic patients with hyperCKaemia. The patients' parents gave written informed consent to publish this report.

Three paediatric patients with hyperCKaemia were scheduled for orthopaedic surgery. Because their postoperative serum CK changes were unpredictable, and massive rhabdomyolysis with or without MH was anticipated, we monitored their CK changes for seven days postoperatively. According to previous studies, hyperCKaemia and rhabdomyolysis were defined, respectively, as CK levels > 1.5-fold[4] and 5.0-fold[5] the upper limit of normal (ULN). Patients' characteristics are shown in Table I.

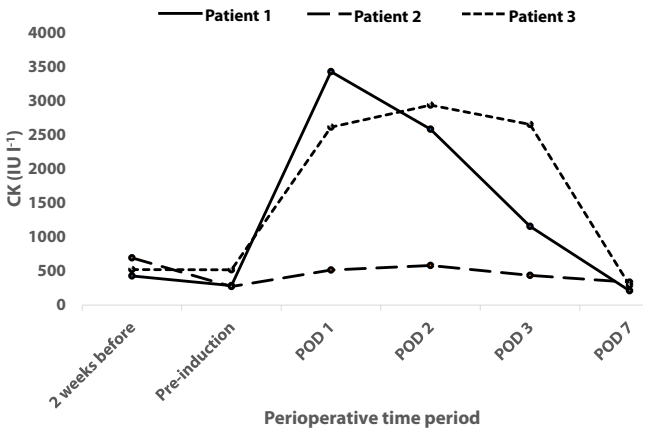

Figure 1: Perioperative changes in serum creatine kinase (CK) in Patients 1, 2 and 3. CK upper limits of normal were 270 IU l^{-1}, 275 IU l^{-1}, and 190 IU l^{-1} in Patients 1, 2 and 3, respectively. POD, postoperative day.

An association between hyperCKaemia and MH remains controversial, with the predictive value of serum CK for a positive or negative result in diagnosing MH susceptibility generally low.[6] Johannsen et al.[6] stated that patients with hyperCKaemia without clinically obvious myopathy require special pre-anaesthesia attention for safety. Then, if there is any doubt, volatile anaesthetics and depolarising muscle relaxants are avoided. Hence, we chose total intravenous anaesthesia using propofol, remifentanil, and rocuronium in each case.

Figure 1 shows the perioperative changes in serum CK. Blood samples were obtained preoperatively (two weeks preoperatively and before induction of anaesthesia) and postoperative days (PODs) 1 to 3 and 7. Serum unfractionated CK levels were measured using The Japan Society of Clinical Chemistry recommended method. CK reference values were based on the Japanese population and differences in the age and sex of each patient. Preoperative CK levels of Patients 1, 2 and 3 were 1.6-, 2.5- and 2.8-fold the ULN, respectively, indicating hyperCKaemia. At pre-induction, CK levels of two patients (nos. 1 and 2) were almost at the ULN, with only Patient 3 hyperCKaemic (2.7-fold ULN). Patient 1 had the maximum CK level (3,424 IU l^{-1}, 12.7-fold ULN) on POD 1, which gradually decreased to its pre-induction level (212 IU l^{-1}) on POD 7. In contrast, the maximum CK levels of Patients 2 and 3 were 582 IU l^{-1} (2.1-fold ULN) and 2,933 IU l^{-1} (15.4-fold ULN), respectively, on POD 2. The maximum CK levels of Patients 1 and 3 indicated that they had rhabdomyolysis. Postoperative blood urea nitrogen and creatinine levels were within the reference range in all patients.

Laurence measured serum myoglobin and CK levels for up to seven days in adult patients following minor (e.g. simple mastectomy) or major (e.g. total hip replacement) muscle-cutting surgery.[2] He found that CK levels were significantly higher in the major surgery group, peaking between PODs 1 and

Table I. Clinical characteristics of three patients with preoperative persistent CK elevation

Characteristic	Patient 1	Patient 2	Patient 3
Sex	M	M	F
Age (years)	12	17	14
Weight (kg)	11.5	77	46
Height (cm)	94	164.5	146
BMI (kg m^{-2})	13	28.5	21.6
Primary disorder	CP	Left hemiplegia	CP
Surgical method	SEMS (hip, thigh)	Soft-tissue release (Lt upper & lower extremities)	SEMS (hip, thigh)
Anaesthetic method	TIVA	TIVA	TIVA
Surgery time (min)	296	155	252
Anaesthesia time (min)	410	235	325

CK, creatine kinase; BMI, body mass index; CP, cerebral palsy; Lt, left; SEMS, single-event multilevel surgery; TIVA, total intravenous anaesthesia.

2 and reaching their maximum one day after that for myoglobin in most subjects. Regarding the postoperative CK changes in children within the reference range, Yousef et al.[3] showed the normal rise of serum CK at 6–24 h after minor and major surgery in children aged one month to 17 years. Their results showed a significant rise in the CK level, mainly after major surgery, consistent with the results of Laurence. Our patients showed a similar peak pattern of postoperative CK change. Therefore, although further studies are required, postoperative CK levels change in patients with hyperCKaemia may be considered the same as for patients within the CK reference range.

The maximum CK levels of Patients 1 and 3 were much higher (> 10-fold ULN) than previously reported ordinary cases. Tabatabai et al.[1] studied perioperative variations in serum CK levels and found a significant correlation between the severity of skeletal muscle damage and the serum CK level 22 h after skin incision in adult patients undergoing orthopaedic surgery (including such major surgery as total hip arthroplasty). The mean CK level, however, was not > 1,000 IU l^{-1} throughout the perioperative period. Laurence found that the maximum CK level was 1,339 IU l^{-1} on POD 2 in a patient who underwent latissimus dorsi flap transfer (major surgery).[2] Yao et al.[7] reported postoperative rhabdomyolysis with maximum CK at 36,113 IU l^{-1} on POD 2 in a non-hyperCKaemic cerebral palsy child who underwent single-event, multilevel surgery. Although primary disorders and the extent of surgical stress in previous studies differed from those in our cases, surgical procedures themselves might have caused postoperative CK elevation, at least in Patients 1 and 3. Thus, our experience and previous studies suggest that the maximum postoperative CK level tends to be higher in patients with hyperCKaemia than in those with reference-level CK level. It might therefore be wise to measure CK levels at least on PODs 1 and 2 to detect early signs of rhabdomyolysis, even in paediatric patients with hyperCKaemia.

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