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Anesthetic management for a patient with oculocerebrorenal (Lowe's) syndrome

HISAO KOMATSU[1], MASATOMO SAKAKIBARA[2], YUTAKA YOSHIMURA[1], HIROYUKI KINOSHITA[2], SATOSHI YOKONO[2], and KENJI OGLI[2]

[1] Department of Anesthesia, National Kagawa Children's Hospital, 2603 Zentuji-cho, Zentuji, Kagawa, 765 Japan, and
[2] Department of Anesthesiology and Emergency Medicine, Kagawa Medical School, 1750, Ikenobe, Miki-cho, Kagawa, 761–07 Japan

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Introduction

The oculocerebrorenal syndrome (Lowe's syndrome) is an X-linked recessive disorder mapped to Xq24–26 [1,2] and is characterized by congenital cataract, cognitive impairment, and renal tubular acidosis (Fanconi's syndrome) [3]. Additional clinical features include glaucoma, corneal keloid [4], hypotonia and areflexia [5]. The primary biochemical defect in Lowe's syndrome remains unknown. Therapy consists of replacement of renal losses and symptomatic treatment of nonrenal complications, such as extraction of cataract, management of glaucoma, special education, and physical therapy. There is a paucity in the English literature of anesthesia-related complications associated with Lowe's syndrome (LS). We report here the anesthetic management of a patient with LS who underwent cataract and glaucoma surgeries (bilateral lensectomy, trabeculotomy, and trabeculectomy).

Case report

A 7-month-old, 6.9 kg boy with LS was scheduled for a cataract and glaucoma surgery. The patient was born after a full-term pregnancy with a 9-point Apgar score (1-min). He was noted to have congenital cataract, glaucoma, proteinuria, renal tubular acidosis, hypopotassemia, and slight iron-deficiency anemia. Elevated aspartate aminotransferase (AST), alkaline phosphatase (ALP), lactate dehydrogenase (LDH), creatine phosphokinase (CK), and choline esterase (ChE) levels were detected. He also presented with muscle weakness and repeated pneumonia. Preoperative medication including potassium citrate-sodium citrate (Ulalyt-U) and potassium L-aspartate for acidosis and hypopotassemia, and β-blockade for glaucoma successfully treated these abnormal states. Before the operation, elevated CK level improved to the normal range. Without premedication, anesthesia was induced and maintained with sevoflurane and nitrous oxide in oxygen. The trachea was smoothly intubated with hyperventilation and without neuromuscular blockade. To detect abnormal body temperature and the disturbance of peripheral circulation that could deteriorate metabolic acidosis, core and peripheral temperature probes were placed at the rectum, abdominal wall (on the part of the liver), and plantar region, respectively. During anesthesia, both rectal and abdominal temperature were maintained at 35.9°–38.2°C, and 32.5°–35.7°C at the plantar region with a warming mattress and humidified, heated gases. Throughout the anesthesia Spo_2 was maintained at 100%. The surgical procedures were performed with no complications. The patient quickly recovered from anesthesia and an arterial blood gas sample after extubation showed pH of 7.39, $Paco_2$ 35.5 mmHg, Pao_2 78.2, base excess —3.2, and oxygen saturation 95% under room air.

Discussion

LS is a relatively rare entity. It is present in all races, but predominantly among Caucasians and Asians [6]. The disease has three identifiable stages [6]. The first stage, during the newborn period, is characterized by ocular pathologic features. Nearly all affected patients have congenital, centrally located cataract frequently associated with glaucoma and a miotic pupil. Asymptomatic

Address correspondence to: H. Komatsu
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aminoaciduria develops by 1 year of age, and is often accompanied by various degrees of proteinuria. The second stage occurs during early childhood and is dominated by metabolic acidosis. The underlying basis for the disturbance is not known, but the symptoms include renal tubular dysfunction that results in urinary loss of bicarbonate, glucose, calcium, phosphorus, and protein. Secondary hyperparathyroidism occurs as a result of the serum metabolic acidosis and losses of calcium and phosphorus. Severe rickets and demineralization may develop leading to frequent fractures, pain, and delay or loss of normal motor physical development. The severe hypophosphatemia may lead to weakness and lethargy. In the third stage, the prominent manifestations of this period are largely related to the sequelae of the previous two stages. This includes blindness from a combination of glaucoma and cataracts and orthopedic disabilities associated with the severe bone disease.

Mental retardation has been described as moderate to severe and is of unknown origin. Computed tomography usually shows confluent irregular lucencies in the cerebral white matter, especially in the periventricular areas, and magnetic resonance imaging reveals patchy areas of white matter demyelination. Electroencephalograms often demonstrate nonspecific abnormalities; however, some may show overt seizure activity. Auditory acuity is generally normal. The metabolic disturbances of early childhood may continue or progressively improve, and have been reported to resolve entirely.

Some major problems in this patient were to be considered with respect to the anesthetic management.

Renal tubular acidosis

The patient in our report preoperatively required alkalization therapy and supplemental potassium that resulted in a satisfactory condition during anesthesia. During the operation it may be necessary to prevent deterioration of the renal tubular dysfunction and acidosis caused by anesthetics, hypotension, hypoxia, and hypercarbia. Although the effect of sevoflurane on his renal tubular function was not determined, it was reported that by inhalation of 1.29 MAC·h of sevoflurane, creatinine clearance, Na^+ excretion rate, urine β_2-microglobulin and urine *N*-acetyl-β-D-glucosaminidase showed no significant changes during anesthesia [7]. Thus, sevoflurane is not considered to affect renal tubular function [7].

Body temperature management

Patients with LS often require strict thermal control both in the peripheral and central regions because hypothermia, hyperthermia, and insufficient peripheral circulation can exacerbate metabolic acidosis. In our case, body temperature was well maintained using a heated humidifier and a water blanket. The difference between rectal (or abdominal) and plantar temperature was within 3°C and no deterioration of acidosis resulted. General anesthesia decreases the thermoregulatory threshold for hypothermia by approximately 2.5°C and increases that for hyperthermia by about 1°C [8]. The thermoregulatory threshold in halothane, enflurane, or fentanyl/N_2O anesthesia is reportedly 34.5°C. During isoflurane anesthesia, this threshold decreases about 3°C per percent of end-tidal concentration [9]. Although, a threshold change in sevoflurane anesthesia has not been reported, as far as we know, in our experience there were no special problems. One MAC sevoflurane with 66% N_2O in oxygen does not produce a significant decrease in cardiac index (about −6%) and produces a small decrease (about −12%, not significant) in systemic vascular resistance index [10]. This may help maintain sufficient peripheral circulation.

Glaucoma

Increased intraocular pressure (IOP) can occur from active squeezing by extraocular muscles, direct external pressure (face mask), and increased venous pressure caused by coughing, straining, bucking, obstructive breathing, or the Valsalva manuever [11]. An increase in IOP due to hypercapnea or hypoxia appears to be associated with changes in intracranial pressure and with retinal vasodilation [12]. The IOP is also increased by succinylcholine [13] and endotracheal intubation especially when it is difficult or prolonged [14]. Preventing fasciculations by pretreatment with a small dose of a nondepolarizing muscle relaxant may attenuate the IOP response to succinylcholine without causing obvious eye damage [15]. The increase in IOP following laryngoscopy and intubation may be attenuated by pretreatment with intravenous lidocaine, 1.5 mg/kg [16]. Pretreatment with clonidine [17], β-blockers, or high dose short-acting narcotics [18] has also been shown to minimize this IOP response to intubation.

In our case, neither atropine nor scopolamine were used as premedication because of a possible increase in IOP due to dilatation of pupil [19] and possible elevation of body temperature [3]. The trachea was smoothly intubated under deep anesthesia with sevoflurane that was reported to lower the IOP [20].

Muscle weakness

The elevation of serum CK concentrations in conjunction with the frequent occurrence of substantial concentrations of MB isoenzymes, the elevated AST and LDH concentrations under normal liver function, and an LDH isoform I to isoform II ratio of close to 1 suggest

muscle involvement in LS [21]. Minor anomalies in the ratios of fiber types and elevated CK levels suggest that there may be both muscular and central contributions to the hypotonia seen in the LS patients [22,23]. These may suggest an increased susceptibility to malignant hyperthermia (MH) associated with LS [24]. The boy in our case had repeated pneumonia presumably due to muscle weakness. We used no neuromuscular blockers and the patient was extubated after a complete recovery from anesthesia. As we have described, sevoflurane has many advantages as an anesthetic for this patient; however, possible association of MH with sevoflurane anesthesia must be noted [25,26]. In summary, recognition and treatment of renal tubular acidosis; strict body temperature management, the successful care of glaucoma, and the possibility of MH are the major anesthetic considerations in patients with Lowe's syndrome.

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