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General Anesthesia for a Patient with *GNE* Myopathy: a case report

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GNE, or bifunctional UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase, myopathy presents with symptoms of foot drop, followed by lower and upper extremity muscle weaknesses and sparing of the quadriceps. Myopathies usually increase the risks of complications related to general anesthesia. The anesthetic management of patients with *GNE* myopathy has not been previously reported. Herein, we report a case of *GNE* myopathy in a 37-year-old woman and discuss anesthetic considerations for elective laparoscopic hysterectomy and bilateral salpingectomy, focusing on the postoperative airway management. We avoided administering neuromuscular-blocking agents and instead used a laryngeal mask airway.

The anesthetic management combining the use of a laryngeal mask airway and desflurane without neuromuscular-blocking agents provided sufficient abdominal and diaphragmatic muscle relaxations for sustaining the pneumoperitoneum for laparoscopic surgery.

Key Words: *GNE* myopathy, Laryngeal mask airway, Neuromuscular Blocking Agents

GNE, or bifunctional UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase, myopathy is also known as a distal myopathy with rimmed vacuoles, quadriceps-sparing myopathy, and hereditary inclusion body myopathy.[1–3] It took 33 years to identify that the same clinical symptoms manifest in all these diseases caused by *GNE* mutations, and thus, they are the same disease.[4] Clinical presentation first starts with foot drop, followed by lower and upper extremity muscle weaknesses but sparing the quadriceps force.[3]

GNE myopathy is a rare disease, and although hyposialylation of muscle glycans is thought to play an essential role, its pathophysiology is not entirely understood and is associated with increased risks of complications of general anesthesia.[5] Induction of general anesthesia is challenging in patients with myopathies, and sufficient preparation and attentive management benefit patients.

Herein, we report a case of *GNE* myopathy in a 37-year-old woman who underwent elective laparoscopic hysterectomy and bilateral salp-

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ingectomy. We reviewed the literature on general anesthesia for adults with *GNE* myopathy. Our key management technique involved the use of a laryngeal mask airway (LMA) and completely avoiding neuromuscular-blocking agents.

CASE

A 37-year-old woman (height, 160 cm; weight, 40 kg; and body mass index score, 15.6 kg/m^2) with *GNE* myopathy was scheduled for laparoscopic hysterectomy and bilateral salpingectomy at our institution. She had no other significant comorbidities. At the age of 20 years, she had developed proximal lower limb weakness and was diagnosed with *GNE* myopathy. The weakness was progressing in all extremities. She had no history of surgery, general or regional anesthesia, or hospitalization for aggravated episodes of *GNE* myopathy.

Blood test results were within normal ranges, and chest X-ray, electrocardiogram, and two-dimensional transthoracic echocardiogram were unremarkable. Muscle strength in the limbs was reduced by 2/5 according to the Medical Research Council scale for muscle strength.[6] The pulmonary function test (PFT) showed a severe restrictive pattern. Preoperatively, glycopyrrolate 0.2 mg was injected intramuscularly, and a 20-gauge intravenous cannula was inserted into the dorsum of the left hand. The patient was placed in the supine position, and all basic monitors were applied. She had a preoperative blood pressure of 120/74 mmHg, heart rate of 66 bpm, and peripheral capillary oxygen saturation of 100% while breathing room air. The bispectral index (BIS, XP version 4.1; Aspect Medical Systems, Newton, MA, USA) was used to monitor the depth of anesthesia. For anesthesia induction, 1% propofol 80 mg and 1% lidocaine 20 mg were administered, and remifentanil (0.05 – 0.50 μg/kg/h depending on the patient's vital signs and the surgical procedure) was infused continuously. No neuromuscular blocking agents were used. After loss of consciousness was confirmed, LMA (LMA Supreme^{TM}, Teleflex, Ireland) was inserted. Desflurane (5 – 6 vol%) was used for maintenance, and fraction of inspired oxygen was maintained at 0.6 (mixture of medical air and oxygen).

A nasal temperature probe was inserted, and temperature was maintained above 36°C. Invasive positive pressure ventilation was maintained throughout the operation with time-cycled, volume-controlled ventilation at a tidal volume of 320 mL and respiratory rate of 10 – 14 breaths/min. End-tidal CO_2 partial pressure was maintained at 34 – 37 mmHg. Peak inspiratory pressure did not exceed 20 mmHg throughout the procedure. Oral suction was performed through the port in the LMA using a small nasogastric tube for infants. Anesthesia lasted 75 min, and the LMA was removed uneventfully in the operating room. A total of 300 mL of crystalloid solution was administered and no other additional medication were needed (e.g. vasopressors, inotropic agents etc.). There were no incidents of unwanted movement, coughing, difficulty in ventilation, difficulty achieving or maintaining pneumoperi-

toneum, or surgical technical difficulty resulting from the omission of neuromuscular blockade. During laparoscopic procedure, CO_2 insufflation pressure was kept at 12 - 13 mmHg, and no additional CO_2 pressure was required to achieve adequate pneumoperitoneum. Planned postoperative analgesia included a single intravenous bolus of 4 mg oxycodone with 4 mg nefopam.

After observation in the recovery room for 1 h, with no episodes of desaturation, she was discharged from the hospital on postoperative day 5 after achieving good pain control with oral analgesics and without complications from surgery or anesthesia.

DISCUSSION

GNE myopathy is a rare distal myopathy that progresses slowly and is caused by mutations in *GNE*. Although respiratory dysfunction has rarely been reported in patients with *GNE* myopathy, a retrospective review by Makdoka et al. revealed that *GNE* myopathy can cause severe respiratory failure.[7] Considering our patient's severely restrictive PFT pattern and *GNE* myopathy as the disease entity, we suspected that intentional respiratory muscle paralysis with neuromuscular blocking agents would lead to the requirement of mechanical ventilation support. Our main anesthetic goal was to maintain adequate anesthesia without using any neuromuscular blocking agent. Peripheral nerve stimulation is used to monitor dose-response to neuromulscular blocking agent and we concluded that it was not only unnecessary but also regarding progression of disease in this case, already affected distal myopathic muscle was unreliable to evaluate laryngeal or central respiratory muscle strength. In other patients, when the laparoscopic method is used for abdominal surgery, pneumoperitoneum with CO_2 is necessary, and during that time, adequate abdominal and diaphragmatic muscle relaxations are crucial. Volatile anesthetics, such as sevoflurane and desflurane, have some muscle relaxation properties, and therefore, reduced doses of neuromuscular blocking agents are required during general anesthesia.[8] Wiklund et al. revealed that halothane, sevoflurane, and desflurane relaxed the smooth muscles in the airways through the inhibition of the cholinergic neuroeffector transmission.[8] Hence, we used propofol for fast anesthesia induction and desflurane for maintenance.

In patients with general central myopathy (e.g. Duchenne's muscular dystrophy, myotonic disorders, congenital myopathies, etc.), anesthetic management requires avoiding drugs such as volatile anesthetics and succinylcholine, which are associated with malignant hyperthermia (MH)-like reactions and severe hyperkalemia. However, it is well understood that MH-like reactions in most myopathies are a separate disease entity that follow a different pathophysiologic pathway. The most common reason for congenital myopathies is the *RYR1* mutation, and only some cases are linked with MH susceptibility. Congenital MH-linked myopathies include central core disease, King-Denborough syndrome, multi/minicore disease, nemaline myopathy, and

Evans myopathy, but not *GNE* myopathy.[5] In specific myopathies with a high risk of anesthesia-induced rhabdomyolysis (AIR) or MH, volatile anesthetics and 1neuromuscular blocking drugs should be used with caution or avoided completely in some cases. However, muscular dystrophies, myotonia, and mitochondrial myopathies have little associations with malignant hyperthermia or AIR. In general, both propofol and desflurane are well tolerated in patients with distal muscular dystrophies, however, there are some concerns associated with the propofol-infusion syndrome when used as a maintenance agent.[6] In distal skeletal muscle-related GNE myopathies, both desflurane and induction-dose propofol can be safely used without causing unnecessary complications. However, considering the surgical method of involving laparoscopes, some muscle relaxation is necessary, thus validating the use of volatile anesthetics rather than propofol for maintenance of anesthesia.

In the laparoscopic method, endotracheal intubation is preferred to LMA insertion due to elevated abdominal pressure and the disadvantage of managing adequate airway. But it would require adequate laryngeal and tracheal muscle relaxation with neuromuscular blocking agent which would disarticulate from our goal not to use any previously mentioned drugs. This can explain our choice to use LMA rather than endotracheal tube and also we interpreted that the severely restricted pulmonary function of our patient could have caused the absence of coughing or sudden movement during surgery.

In summary, combining the use of LMA and desflurane for anesthesia maintenance, without any neuromuscular blocking agent, abdominal and diaphragmatic muscle relaxations were sufficient for sustaining pneumoperitoneum for laparoscopic surgery.

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