Anesthetic Management of a Patient With Congenital Insensitivity to Pain: A Case Report

Laura M. Parrott, CRNA

Pain protects the body from damaging effects of harmful stimuli. Congenital insensitivity to pain is a rare inherited disorder characterized by diminished or absent sensitivity to pain, touch, and pressure that leads to frequent trauma and self-mutilation. The disorder is part of the hereditary sensory and autonomic neuropathy (HSAN) family, in which 5 types have been recognized. Research and case reports of anesthetic risks and analgesic needs of these patients is limited due to the infrequent nature of the disorder. Recommendations for anesthesia include modification of intraoperative opioid requirements, use of anesthetics to ensure cooperation and immobility, and intraoperative temperature monitoring. It is imperative for anesthesia providers to understand which type of HSAN their patient experiences and to conduct a thorough preoperative interview because a different interpretation of sensory loss may occur in each HSAN category. This article reports the case of a patient with HSAN type 2 who presented for knee arthroscopy.*

Keywords: Congenital insensitivity to pain, hereditary sensory and autonomic neuropathy, pain.

Pain is a protective mechanism that is essential for survival.[1,2] The sensation of pain protects the body from tissue-damaging effects of noxious stimuli and causes a reflex withdrawal from the source of harm. Congenital insensitivity to pain (CIP) is a rare inherited disorder of the hereditary sensory and autonomic neuropathy (HSAN) family.[3] This disorder is characterized by a dramatically impaired perception to painful stimuli that leads to frequent trauma and self-mutilation. Individuals with CIP have diminished or absent sensitivity to pain, touch, and pressure.[1] This results from changes to the number and distribution of small myelinated and unmyelinated nerve fibers. Common injuries associated with HSAN include fractures and orthopedic injuries; burns; and self-mutilation of the teeth, lips, tongue, ears, eyes, nose, and fingers.[1] Affected individuals often die during childhood because of a failure to recognize injury and illness.[2]

Currently, 5 types of HSAN have been recognized.[1] The disorders in the HSAN family are categorized based on the pattern of sensory and autonomic dysfunction along with peripheral neuropathy and the occurrence of clinical features. This article reports the anesthetic management of a patient with HSAN type 2 (HSAN2) who presented for knee arthroscopy.

Case Summary

A 14-year-old boy presented for knee arthroscopy because of a right lateral meniscus tear. The patient was 165.1 cm (65 in) tall and weighed 52.6 kg. His medical history included a diagnosis of CIP (HSAN2) and asthma. The patient had no prior surgical history. After a thorough preoperative interview, it was determined that the patient could not feel pain, pressure, or temperature changes since birth but was able to sense touch. He had sustained a deep burn to his arm a few years earlier, with no knowledge of the incident at the time. He did not require any surgical intervention for this injury. The patient reported that he was unable to sense shortness of breath and could not discern when he was having an asthma attack because of the effects of his CIP. Current medications included a budesonide inhaler, formoterol inhaler, prednisone, fexofenadine, and ranitidine. The patient's mother reported that the patient had sensitivities to salmeterol, montelukast, iodinated contrast medium, and seafood. Salmeterol and montelukast led to behavioral changes, and iodinated contrast and seafood caused gastrointestinal upset. A complete blood cell (CBC) count from 2 months earlier was within normal limits; the orthopedic surgeon did not reorder a CBC count before surgery.

Findings of the physical examination revealed a white boy resting comfortably on his stretcher in the preoperative area. He answered questions appropriately. His lungs were clear to auscultation bilaterally, and he was breathing with ease at 16/min. A chest radiograph was not obtained. Preoperative vital signs included a blood pressure of 104/58 mm Hg, heart rate of 73/min, and oxygen saturation of 99% on room air. The patient reported no pain in his right knee on examination. A right antecubital 18-gauge peripheral intravenous (IV) catheter was inserted, with no discomfort to the patient, and lactated Ringer's solution was used for maintenance. Midazolam, 2 mg, was administered IV.

The patient was transported to the operating room, where standard physiologic monitors were applied. A blood pressure cuff was placed on the left upper extrem-

Type	Genetic transmission	Age at onset	Pathophysiology
HSAN1	Autosomal dominant	20-50 y	↓ Diameter of all axons: mostly C and A-δ
HSAN2	Autosomal recessive	Infancy	↓ Number of myelinated fibers: unmyelinated fibers preserved
HSAN3	Autosomal recessive	Infancy	Severe loss of unmyelinated fibers: complete loss of large-diameter myelinated fibers
HSAN4	Autosomal recessive	Infancy	No unmyelinated fibers:↓ small myelinated fibers
HSAN5	Autosomal recessive	Childhood	Drastically ↓ small myelinated fibers; ↓unmyelinated fibers

Table. Types of Hereditary Sensory and Autonomic Neuropathy (HSAN) and Associated Characteristics
Note: ↓, decreased.

ity and set to cycle every 3 minutes. A continuous pulse oximeter and 3-lead electrocardiography monitors were applied. Warm blankets were placed on the upper and lower parts of the body. After placement of a nasal cannula at 2 L/min, IV sedation was initiated with propofol at 150 µg/kg/min, with a bolus of 0.5 mg/kg. The patient was restless and laughed with every touch. The propofol infusion was increased to 200 µg/kg/min with boluses of 10 to 20 mg. Despite increased sedation, the patient was unable to remain still. He displayed signs of increased sensitivity to touch and stimulation. His vital signs remained stable, and he did not show any signs of distress. The propofol infusion was discontinued, and the patient was preoxygenated with 5 L/min of oxygen by mask. Subsequently, 150 mg of propofol was administered IV, and a size 4 laryngeal mask airway (LMA) was placed on the first attempt. Equal bilateral breath sounds were auscultated. Anesthesia was maintained with sevoflurane in 2 L/min fresh gas flow of oxygen and air. Spontaneous respirations were recovered, with tidal volumes of 6 to 8 mL/kg and a respiratory rate of 12/min to 16/min.

Cefazolin, 1 g, was given IV 16 minutes before incision. The patient's vital signs remained within 20% of his preoperative values following tourniquet inflation to 250 mm Hg and after incision. He did not require opioids. The procedure was completed in 54 minutes. Ondansetron, 4 mg, was administered IV 30 minutes before the end of the case. At the end of the procedure, sevoflurane treatment and air administration were discontinued, and the patient was given 100% oxygen. He emerged from anesthesia and opened his eyes spontaneously, regained purposeful movement of his extremities, and responded to verbal commands. The LMA was removed after thorough oropharyngeal suctioning. The patient was resting comfortably and hemodynamically stable. His lungs were clear to auscultation bilaterally, and he was breathing with ease at a rate of 16/min. Ketorolac, 15 mg, was then given IV prophylactically for any discomfort related to inflammation.

The patient was transported to the postanesthesia care unit, where his vital signs remained stable. The patient did not report any pain or discomfort. He was discharged home with his parents 1 hour 20 minutes later after receiving postoperative discharge instructions.

Discussion

Pain perception can be broken down into various components, including sensory-discriminative, affective-motivational, and cognitive-evaluative.[2] Congenital insensitivity to pain involves a variety of deficits based on these different components of pain. Pain is perceived by 2 primary ascending pathways, which include the lateral pain system that extends through lateral thalamic nuclei to the somatosensory cortex and the medial pain system that extends through medial thalamic nuclei to the anterior cingulate cortex and insula.[2] The sensory-discriminative component of painful stimuli is associated with the lateral system, whereas the affective response to pain is linked to the medial system. Pain is perceived differently depending on lesion location.

The HSAN disorders are associated with loss of pain sensation.[2] They are characterized by different patterns of sensory and autonomic dysfunction. The sensory-discriminative and affective-motivational components of pain perception are impaired in patients with underlying peripheral neuropathies. These disorders involve abnormalities of the small-diameter C and A-δ fibers that convey pain sensation. The types and associated characteristics of HSAN are summarized in the Table.

The most common type of HSAN disorder is HSAN1, an autosomal dominant neuropathy.[2] Distal loss of pain presents first, followed by loss of temperature sensation. Onset of HSAN1 occurs in the second through fourth decades of life. Affected areas lack reflexes; touch and pressure sensation deficits may develop as the disease progresses. Type 1 is associated with minor autonomic involvement that is limited to urinary dysfunction and decreased sweating in the feet. Peripheral nerve examination reveals loss of all diameters of axons, mostly involving the C and A-δ fibers. The dorsal root ganglia and dorsal columns also show degeneration.

The disorder presented in this case report, HSAN2, involves diffuse impairment of discriminative touch and pressure sensation that presents in infancy.[2] Ulcers, painless fractures, and joint injuries commonly occur because of lack of pain perception. Life expectancy is decreased because of extensive tissue injury and infections.[4] Patients may experience complete loss of sensation to diminished,

but present sensation.[2] Nerve biopsy specimens in patients with HSAN2 show a drastic loss of myelinated fibers, with preservation of unmyelinated fibers. Compound action potential measurements reveal loss of A-β and A-δ potentials and a reduced C potential. Type 2 is thought to be inherited through an autosomal recessive mode.

Patients with HSAN3 experience widespread autonomic dysfunction and loss of pain and temperature sensation that also present in infancy.[2] Early symptoms include difficulty feeding and episodes of increased body temperature along with hypoactive tendon reflexes and abnormal tearing. An autosomal recessive disorder, HSAN3 occurs predominantly in Ashkenazi Jewish families. The mortality rate is 50% before the age of 30 years. It is characterized by severe loss of unmyelinated fibers and complete loss of large-diameter myelinated neurons.

Hereditary sensory and autonomic neuropathy type 4 involves pain insensitivity and autonomic deficits with unaffected touch and pressure sensitivity.[2] It is a rare autosomal recessive disorder. Infants initially present with recurrent incidents of increased body temperature; mental retardation is often present. Patients with HSAN4 have no unmyelinated fibers and decreased numbers of small myelinated fibers. Sweat glands have no innervation.

Hereditary sensory and autonomic neuropathy type 5 is associated with pain and temperature insensitivity that presents during childhood.[2] Proprioception, touch, pressure, and vibration sensations remain intact. Autonomic involvement is variable. Individuals experience a drastic loss of small myelinated fibers with a diminished number of unmyelinated fibers.

The anesthetic risks and intraoperative analgesic needs of patients with HSAN are not well known because of the rare nature of the disorders.[4] Few cases of CIP have been reported in the literature.[5] Most case reports describe HSAN4; not many articles have been published that characterize the other categories of HSAN.

Weingarten et al[4] reported anesthetic management and outcomes of anesthesia in 5 patients with HSAN2, 4, and 5 and in 2 patients with unclassified variants of hyposensitivity to pain. In this report, general anesthesia was administered to all patients, without considerable changes to blood pressure, heart rate, or temperature. The volatile anesthetic requirements were reported within normal ranges. Intraoperatively, opioids were given in small amounts or not at all. Opioids may have been used as sedatives or anxiolytics related to partially preserved nociception or mechanoreceptor sensations in these cases. None of the patients reported pain in the postoperative period. Other case reports described successful inhalational anesthesia, epidural anesthesia, and monitored anesthesia care for patients with HSAN.[4] A case series describing anesthesia for patients with HSAN4 reported complications of mild hypothermia as well as transient hypotension and bradycardia. Several other reports of patients with HSAN4 described no anesthesia-related problems.

There have been no major adverse events described in patients with HSAN disorders.[4] It is important for anesthetists to understand which type of HSAN their patient experiences and to conduct a thorough preoperative interview because a different interpretation of sensory loss may occur in each HSAN category. Some patients with HSAN experience a variable pain sensation or tactile hyperesthesia. It is clear that opioid requirements must be altered for these patients. Other recommendations for patients with HSAN based on case reports include standard concentrations of inhalational anesthetics, use of anesthetics to ensure cooperation and immobility, and intraoperative temperature monitoring, especially for patients with HSAN4. Triggering agents for hyperthermia, such as succinylcholine and volatile agents, have been used without complications in patients with HSAN.

Despite feeling no pain, the patient in this case report experienced tactile hyperesthesia, resulting in the inability to use IV sedation for his procedure. To save time, we proceeded directly to general anesthesia with a LMA. An adjuvant such as an opioid may have attenuated the patient's heightened sensation of touch and allowed our sedation attempt to be successful. A thorough preoperative assessment is essential for patients with this disorder because it is difficult to predict their reactions to surgery. Sensory responses that may not include pain should be anticipated.

Knowledge reported about anesthesia safety for patients with HSAN is limited because of the infrequent nature of the disorders.[4] Because of the small number of patients with HSAN, it is not possible to conduct large-scale studies on the anesthetic risks and intraoperative analgesic requirements for these patients. Therefore, we must continue to report case studies to learn proper anesthesia techniques for patients with HSAN.

REFERENCES

1. Butler J, Fleming P, Webb D. Congenital insensitivity to pain—review and report of a case with dental implications. *Oral Surg Oral Med Oral Pathol Oral Radiol Endodontol*. 2006;101(1):58-62. doi:10.1016/j.tripleo.2005.08.002.

2. Nagasako EM, Oaklander AL, Dworkin RH. Congenital insensitivity to pain: an update. *Pain*. 2003;101(3):213-219. doi:10.1016/S0304-3959(02)00482-7.

3. Praveen Kumar B, Sudhakar S, Prabhat MPV. Case report: Congenital insensitivity to pain. *Online J Health Allied Sci*. 2010;9:4.

4. Weingarten TN, Sprung J, Ackerman JD, Bojanic K, Watson JC, Dyck PJ. Anesthesia and patients with congenital hyposensitivity to pain. *Anesthesiology*. 2006;105(2):338-345. doi:10.1097/00000542-200608000-00017.

5. Varshney M, Girdhar KK, Taneja S, Agarwal M, Varshney PG. Anesthetic management of a pediatric patient with congenital insensitivity to pain. *Paediatr Anaesth*. 2009;19(5):552-553. doi:10.1111/j.1460-9592.2009.02967.x.

AUTHOR

Laura M. Parrott, CRNA, is employed by C.S. Mott Children's Hospital, Ann Arbor, Michigan. Email: kovlaura@gmail.com.