
CASE REPORTS

ULTRASOUND-GUIDED REGIONAL ANESTHESIA IN A PEDIATRIC PATIENT WITH ACUTE INTERMITTENT PORPHYRIA: LITERATURE REVIEW AND CASE REPORT

YETUNDE OLUTUNMBI*, HARSHAD G. GURNANEY**,
JORGE A. GALVEZ* AND ALLAN F. SIMPAO*

Abstract

Ultrasound-guided regional anesthesia techniques placed under general anesthesia have not been reported in pediatric patients with acute intermittent porphyria (AIP). A 9-year-old male with AIP presented for right inguinal herniorrhaphy. Family history included one relative's death after anesthesia. Preoperative preparation included reviewing medications safe for AIP patients, minimizing known AIP triggers (fasting, stress) and ensuring access to rescue medications. Intraoperative management included a propofol induction with the patient's mother present in the operating room. We performed an ultrasound-guided ilioinguinal-iliohypogastric nerve block under general anesthesia. The surgery proceeded without complications and the patient did not demonstrate signs of an AIP crisis.

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Introduction

Acute intermittent porphyria (AIP) is an autosomal dominant deficiency in porphobilinogen deaminase that can manifest as a sudden, possibly fatal neurovisceral crisis, symptoms of which include severe abdominal pain, seizures, respiratory and limb weakness, hypertension, and tachycardia^{1,2}. In rare occasions, AIP may present with symptomatic hyponatremia secondary to syndrome of inappropriate antidiuretic hormone secretion³ acute pancreatitis⁴, or spontaneous hemothorax⁵. Triggers include many aspects of the perioperative setting, such as fasting, stress, dehydration and medications⁶.

* MD.

** MBBS, MPH.

Affiliation: Department of Anesthesiology and Critical Care Medicine, Perelman School of Medicine at the University of Pennsylvania and The Children's Hospital of Philadelphia, Philadelphia, PA.

Corresponding author: Allan F. Simpao, MD; Department of Anesthesiology and Critical Care Medicine at Perelman School of Medicine at the University of Pennsylvania and the Children's Hospital of Philadelphia, 34th Street and Civic Center Blvd., Suite 9329, Philadelphia, PA, 19104, Tel: 1-215-590-1000, Fax: 1-215-590-1415. E-mail: simpaoa@email.chop.edu

Case Description

A 9-year-old, 25.7 kg male with a confirmed genetic marker for acute intermittent porphyria (AIP) presented for right inguinal hernia repair. Clinical signs on admission included an innocent heart murmur and anxiety. The family history was rife with anesthetic complications: one relative died on induction with a barbiturate, an aunt had an AIP episode while under anesthesia necessitating alkaline heme treatments, and the patient's mother had "nearly died" during an anesthetic for cardiac surgery.

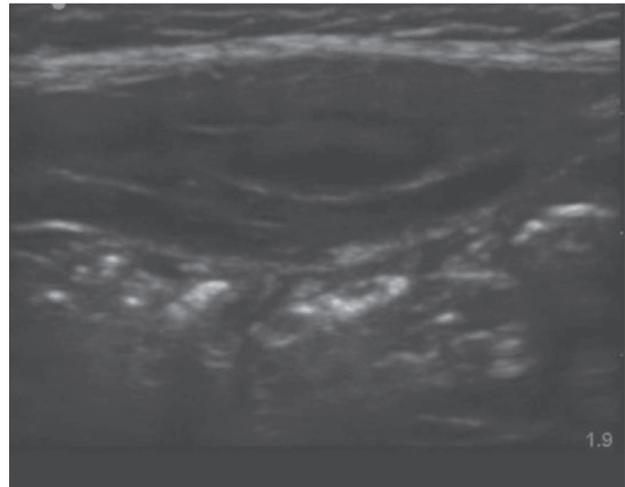
Pre-operative management included a thorough AIP literature search, a metabolism and genetics consultation, and extensive communication with the surgeon and the patient's mother prior to the surgery. Evidence-based lists of safe medications in AIP were reviewed⁷ and a clinical pharmacist was contacted to verify the information. Gabapentin and hemin were ordered and available in the pharmacy in case of a crisis^{8,9}.

The patient was encouraged to drink clear white grape juice until 2 hours prior to surgery. On the recommendation of metabolism/genetics, the patient received an intravenous (IV) catheter in the holding area, and an infusion of dextrose 10%/saline 0.45% (D10/0.5NS) was started. A comprehensive metabolic profile was checked to rule out inappropriate secretion of antidiuretic hormone; the lab values were in the normal range. In lieu of administering oral midazolam (due to conflicting safety data in AIP patients), we arranged a parental induction and gave IV fentanyl for mild sedation prior to transport into the operating room.

We performed a parental-presence IV induction with propofol, placed a laryngeal mask airway (LMA) and administered sevoflurane. We performed a right-sided ultrasound-guided ilioinguinal-iliohypogastric nerve block using a Sonosite S (Sonosite, Bothell, WA) with an L25X (6-13 MHz) probe with clear visualization of both nerves. Four mL of 0.25% bupivacaine with 1:200,000 epinephrine were injected with satisfactory spread of local anesthetic visualized with the ultrasound in the plane between the internal oblique and the transversus abdominis muscles around the two nerves (Fig. 1). The D10/0.5NS infusion was

continued; a glucose check was within the normal range. Patient temperature was maintained between 36-38C via an underbody circulating water mattress and an upper body forced-air blanket.

Fig. 1
Ultrasound-guided ilioinguinal-iliohypogastric
nerve block



During the procedure, a left inguinal hernia and undescended left testes were discovered by the surgeon. The patient's mother was contacted and she consented to a bilateral surgical procedure. The patient was given a 1.5 mg of IV morphine bolus prior to the initiation of the left-sided portion of the procedure. Ondansetron 4mg IV was administered during skin closure. To minimize the stress of emergence, we removed the LMA under deep plane of anesthesia (i.e., 1.3 MAC) after ensuring that the patient was breathing spontaneously with tidal volumes of approximately 5-6 mL/kg. A plastic oral airway was placed to maintain airway patency.

The patient was transported uneventfully with supplemental oxygen delivered via a Mapleson circuit and face mask to the post-anesthesia care unit (PACU), where he emerged safely from anesthesia. The patient received a total of two 1mg boluses of IV morphine over the following 15 minutes for reported 5/10 pain located in the left inguinal region. There were no AIP sequelae noted (e.g. abdominal pain, neurological findings) and vital signs were stable throughout the two-hour PACU stay prior to discharge home.

A nurse practitioner spoke with the mother during a post-operative phone call 72 hours after discharge

and determined that no AIP symptoms nor anesthesia-related problems had occurred. Furthermore, the patient had no new complaints nor any reported AIP-related symptoms at his one-month follow-up visit with the surgeon.

The Institutional Review Board at The Children's Hospital of Philadelphia gave permission to publish this report and written informed consent was obtained from the parent of the patient.

Discussion and Literature Review

Acute intermittent porphyria is caused by an inherent error of porphyrin metabolism characterized by a deficiency of porphobilinogen deaminase and increased activity of delta-aminolevulinic acid synthase. An increased concentration of heme precursors results from the dysfunction of these two key heme biosynthesis enzymes^{10,11}.

Porphyric crisis can be precipitated by many anesthetic and nonanesthetic drugs^{6,12,13}. The medications that are recommended as safe for use in anesthesia for AIP patients is largely based on cumulative anecdotal experiences (i.e. case reports and case series)^{13,14}. A constantly updated list is maintained by the American Porphyria Foundation, which rates medications' safety in AIP patients based on evidence in the literature⁷. In light of this patient's strong family history of anesthesia-related AIP complications, the decision was made in conjunction with the patient's mother to use solely those medications that had received the top safety rating of "OK!" (i.e. "very likely to be safe for prolonged use by individuals with an acute porphyria, based on consistent evidence"). The list of planned perioperative medications was verified as safe by a clinical pharmacist.

Acute seizures can present a treatment challenge in AIP patients, as some medications given to ameliorate acute seizures (e.g. barbiturates) are either known or questionable AIP crisis precipitants¹³. Lorazepam and magnesium have been shown to be safe treatments for acute seizures in AIP patients^{15,16}. Gabapentin—a GABA analog prescribed commonly both as an antiepileptic drug and to treat neuropathic pain—has been shown to be a safe, effective treatment of status epilepticus due to AIP^{8,17}. Gabapentin pharmacokinetic profiles in

children ages 1 month to 12 years has shown similar peak plasma concentrations across the entire age group after a single dose of 10 mg/kg, and gabapentin doses of 24 to 70 mg/kg/day were shown to be well tolerated and have sustained efficacy in a large population of children aged 3 to 12 years^{18,19,20}. If seizures continue despite gabapentin administration, then propofol (1-1.5 mg/kg IV bolus over 5 min followed by 1-2mg/kg/hr IV infusion) can be delivered as a concurrent treatment²¹. Electrolyte abnormalities that are associated with AIP and can cause seizures (e.g. hyponatremia) should be corrected^{2,3}.

Hemin (i.e. exogenous heme) was made available preoperatively as a precaution. Hemin has been shown to be an effective treatment for acute AIP attacks after conservative measures have been employed (e.g. IV fluids containing carbohydrates); hemin ameliorates symptoms via down-regulation of aminolevulinic acid synthase^{22,23,24,25}. Side effects experienced in cases of overdose or overly rapid administration include reversible renal shutdown and liver failure^{26,27}.

In addition to extensive medication safety review and preparations, thorough precautions were taken to limit non-pharmacological stressors that might precipitate an AIP attack^{1,2}. Both a liberal fasting protocol and preoperative IV placement with administration of dextrose-containing fluids were initiated to minimize dehydration and calorie restriction^{1,3}. A parental-presence induction, placement of a regional block, and LMA removal under a deep plane of anesthesia were all undertaken to minimize the stresses of anxiety and pain. Lastly, steps were taken to identify AIP crisis sequelae (e.g. preoperative comprehensive metabolic panel to assess for hyponatremia)³.

While regional techniques in AIP patients have been reported in the literature^{28,29,30}, ultrasound-guided regional anesthesia techniques placed under general anesthesia have not been described in pediatric patients with acute intermittent porphyria. In summary, we present a successful general and ultrasound-guided regional anesthetic course in a high-risk pediatric AIP patient following the careful selection of safe perioperative and rescue medications, liberal fasting policy and preoperative administration of dextrose-containing IV fluids, and vigilant minimization of other potential AIP crisis precipitants.

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