

Spinal Anesthesia for Open Gastrostomy in an Infant after Stage I Norwood for Hypoplastic Left Heart

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ABSTRACT

Infants with hypoplastic left heart are at increased risk of adverse events including mortality when they undergo procedures with general anesthesia in the inter-stage period after stage I Norwood. This is primarily caused by an imbalance between pulmonary and systemic blood flows augmented by decreased function of the single ventricle. These factors can be aggravated by general anesthesia, hence the increased risk. Many of these infants experience feeding dysfunction and require a gastrostomy to optimize nutrition. We report a case of open gastrostomy in an infant with Norwood physiology under spinal anesthesia with an excellent outcome.

Keywords: Gastrostomy, hypoplastic left heart syndrome, infant spinal, Norwood, spinal anesthesia, sub-arachnoid block

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Submitted: 06-Oct-2020 Accepted: 12-Apr-2021 Published: 11-Apr-2022

INTRODUCTION

Feeding dysfunction is common after stage I Norwood procedure for hypoplastic left heart syndrome (HLHS) and is associated with increased morbidity and mortality.^[1] Many infants after stage I Norwood do not tolerate oral feedings and more than 25 to 50 per cent of the patients require a feeding gastrostomy prior to discharge.^[2] Administration of anesthesia for non-cardiac surgery for infants with HLHS during the Norwood inter-stage period between stage I and II (hemi-Fontan, Glenn) is associated with a high risk of hemodynamic instability and adverse events.^[3]

When compared to general anesthesia, spinal anesthesia produces fewer hemodynamic changes in infants, eliminates the need for tracheal intubation, oxygen supplementation and mechanical ventilation, thus reducing the incidence of

adverse respiratory events.^[4] Spinal anesthesia eliminates the need for another exposure to volatile anesthetics in a group of patients who are already at risk for poorer neurodevelopmental outcomes. Spinal anesthesia also minimizes or eliminates the need for perioperative opioid analgesics.

We present a case of spinal anesthesia for open gastrostomy performed three weeks after stage I Norwood in a one-month-old infant with HLHS. Written permission for publication of this case report was obtained from the infant's mother.

CASE HISTORY

A one-month-old male infant (3.5 kg) with prenatally diagnosed HLHS underwent a stage I Norwood procedure

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How to cite this article: Acquaviva MA, Hardacker DM, Packiasabapathy S, Burns RC. Spinal anesthesia for open gastrostomy in an infant after stage I Norwood for hypoplastic left heart. *Ann Card Anaesth* 2022;25:233-5.

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|---|--------------------------------|
| Quick Response Code: | Website: www.annals.in |
|  | DOI: 10.4103/aca.aca_262_20 |

at one week of age. The immediate postoperative course was uneventful. The sternum was closed three days after stage I Norwood and the infant was extubated 24 hours after sternal closure. Although the patient tolerated tube feeds, weight gain was poor and pediatric general surgery was consulted for placement of a feeding gastrostomy. A preoperative echocardiogram revealed typical anatomy after a stage I Norwood with expected right ventricular hypertrophy, normal right ventricular systolic function, trivial tricuspid regurgitation, mild narrowing of the distal aortic arch with no gradient, and a patent central shunt with continuous flow and a peak gradient of more than 50 mm Hg.

After consultation with the general surgeon, the pediatric anesthesiologist elected to perform a spinal anesthetic for the gastrostomy procedure. Preoperative vital signs were blood pressure: 79/43; heart rate: 142 beats per minute, arterial oxygen saturation on room air: 83%. After arrival in the operating room and placement of physiologic monitors, 3 mg/kg of intramuscular (IM) Ketamine was administered to provide sedation for intravenous catheter placement and insertion of the spinal needle. Sedation, however, was considered inadequate and another 2 mg/kg of IM Ketamine provided adequate sedation. After placement of a peripheral intravenous catheter, the spinal was performed with infant supported in the sitting position with 0.7 ml of 0.5% Bupivacaine (3.5 mg) and 3.5 micrograms of Clonidine through a one inch 25-gauge needle. The infant was placed supine in a neutral position. The infant maintained spontaneous ventilation with room air throughout the surgical procedure. After spinal anesthesia and during the surgical procedure, systolic blood pressure varied between 80 and 95 mm Hg and heart rate was stable between 130 and 135 beats per minute. Arterial oxygen saturation varied between 81 and 83%. End-tidal carbon dioxide was measured via a nasal cannula and varied between 35 and 39 mm Hg during the procedure. Surgical time for placement of the gastrostomy was 12 minutes. The immediate postoperative course was uneventful, and the infant required only two doses of acetaminophen (15 mg/kg) during the first 24 hours after surgery for analgesia.

DISCUSSION

The increased survival rate of infants with HLHS has increased the need for noncardiac surgical procedures, such as placement of a feeding gastrostomy, that may contribute to better quality of life and improved long-term survival. The risk of mortality and adverse events after non-cardiac surgery in infants with HLHS, however, is increased when compared to outcomes in infants with normal

hearts. A retrospective review of over 2,000 patients with HLHS who underwent non-cardiac surgery between 1988 and 1997 revealed a 19% mortality.^[5] A more recent retrospective review of 102 anesthetics in patients with single ventricle physiology from one major pediatric cardiac center demonstrated no mortality but an 11.8 per cent incidence of adverse perioperative events.^[6]

Intraoperative anesthetic management of the patient with single ventricle physiology is aimed at maintaining good balance between pulmonary blood flow and systemic blood flow. An arterial oxygen saturation of 75 to 80% and a systemic blood pressure of greater than 60/30 are indicative of satisfactory pulmonary and systemic blood flow. An anesthetic technique that minimizes the risk of myocardial depression, hypotension, and hyper-oxygenation is desired. Spinal anesthesia has the potential to fulfill all of the desirable hemodynamic and respiratory goals for the patient with HLHS.

Spinal anesthesia has been reported once in an infant with HLHS. In that case, the anesthetic was administered soon after birth, but before the stage I Norwood, to perform a colostomy for anorectal atresia. During the procedure, systemic hypotension and increased arterial oxygen saturation (100 per cent) was indicative of an imbalance between systemic and pulmonary blood flow. Postoperatively, the neonate developed severe systemic hypoperfusion and died on the seventh postoperative day.^[7] Combined general and caudal/epidural anesthesia has been associated with hemodynamic instability and an increased need for inotropic support.^[8]

Selection of the type of anesthesia for infants with HLHS after stage I Norwood must be highly individualized and depends on preoperative cardiac function and the relationship between systemic and pulmonary blood flow. Our infant was stable preoperatively with well-balanced systemic and pulmonary blood flow and exhibited good right ventricular function with only trivial tricuspid regurgitation.^[9,10] The spinal anesthetic resulted in only minimal changes in heart rate and blood pressure, allowed the infant to breathe room air spontaneously without any airway intervention and eliminated the need for postoperative analgesic opioids.

Administration of anesthesia to any infant with complex congenital heart disease requires great care and skill. It is important that the pediatric anesthesiologist be skilled with spinal anesthesia in infants and that the surgeon be experienced with open gastrostomy in high-risk infants.

We feel that spinal anesthesia should be considered for abdominal surgical procedures in selected infants after a stage I Norwood procedure for HLHS. There are some useful guidelines while performing spinal anesthesia in infants:

1. Conus medullaris may extend up the 3rd lumbar level (L) in infants, hence it is advisable to insert the spinal needle in the L4-5 interspace.
2. Total CSF volume is relatively greater in infants compared to adult, and a higher dose of local anesthetic based on body weight may be required (0.8 to 1 mg/kg of 0.5% bupivacaine).
3. The duration of anesthesia (45-60 minutes) is shorter in infants compared to adults and the addition of clonidine (1 mcg/kg) helps prolong the duration (60-90 minutes). The duration of the planned procedure will influence case selection.
4. Spinal anesthesia can be performed in either the sitting or lateral position. After injection of the spinal anesthetic, the infant must be gently positioned in a neutral supine position to prevent a high spinal.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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