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Anesthesia Management of Laparoscopic Pancreatectomy for Pediatric Insulinoma

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ABSTRACT

Insulinoma, a rare neuroendocrine tumor in pediatrics, presents with hyperinsulinism and recurrent hypoglycemia. Surgical excision, particularly through laparoscopy, is the preferred treatment. Anesthesia management during laparoscopic insulinoma resection demands meticulous blood glucose control due to the risk of fluctuations during tumor manipulation. A 2-month-old infant with recurrent seizures and hypoglycemia was diagnosed with insulinoma. The patient also had congenital hypothyroidism, heart disease, and growth failure. Laparoscopic pancreatectomy was performed under general anesthesia. Anesthesia induction involved sevoflurane, fentanyl, and atracurium, with caudal analgesia using Bupivacaine. Maintenance included sevoflurane, fentanyl, and close glucose monitoring. The 5-hour surgery maintained stable hemodynamics. Postoperatively, meticulous blood glucose management continued in the Pediatric Intensive Care Unit, along with pain control and treatment for comorbidities. Pediatric insulinoma is a rare neuroendocrine tumor causing hypoglycemia with various manifestations. Surgical excision is the primary treatment, and laparoscopy is favored. Anesthesia management is crucial, and the choice of anesthetic agents and hemodynamic stability are essential considerations. This case adds to the limited literature on pediatric insulinoma anesthesia. Anesthetic management of pediatric insulinoma cases, particularly during laparoscopic resection, requires a tailored approach to ensure perioperative blood glucose control. The combination of general anesthesia with caudal analgesia presents advantages, including stable hemodynamics and expedited postoperative recovery. This report contributes valuable insights into the successful management of a rare pediatric condition, emphasizing the importance of collaboration between anesthesia and surgical teams for optimal outcomes.

1. INTRODUCTION

Insulinoma is an infrequent neoplasm encountered in the pediatric population, representing a subtype of functional neuroendocrine tumor (NET). It is characterized by the hypersecretion of insulin, leading to hypoglycemia. Patients with insulinoma often experience recurrent episodes of hypoglycemia, typically

referred to as fasting hypoglycemia. The preferred treatment modality is surgical excision, with laparoscopic resection gaining popularity due to shorter hospital stays and comparable outcomes. Anesthesia management during laparoscopic insulinoma resection demands meticulous control of fluctuating blood glucose levels, requiring special attention from the anesthesiologist. It is crucial to anticipate glycemic fluctuations during tumor manipulation and the postoperative phase, which may include rebound hyperglycemia or hypoglycemia. In this case report, we present the clinical course of a 2-month-old infant diagnosed with insulinoma and persistent hypoglycemia, who underwent successful laparoscopic excision under general anesthesia.2

2. Case Report

A 2-month-old infant, weighing 3450 grams, was referred to Prof. Ngoerah Hospital from a private hospital due to recurrent seizures. Initially, the infant was admitted to the private hospital for the management of a nasogastric tube. However, during their stay, the infant experienced two seizures, each lasting approximately 5 minutes. Following these episodes, the patient regained consciousness. Subsequently, a third seizure, also lasting 5 minutes, occurred, prompting the administration of phenobarbital as an anti-seizure medication. An initial assessment at the private hospital revealed the presence of hypoglycemia.

Upon evaluation at Prof. Ngoerah Hospital, the diagnosis of insulinoma was confirmed. Blood glucose levels exhibited fluctuations, ranging from 74 to 140 mg/dL. The infant was also diagnosed with congenital hypothyroidism and initiated on a daily regimen of levothyroxine at 40 mcg. This infant, born as the second child with a gestational age of 32 weeks via cesarean section, exhibited spontaneous crying at birth but subsequently developed hypoglycemia. Additionally, the infant presented with congenital heart disease, which had resolved upon reevaluation, and there was no history of cyanosis.

During the physical examination, the respiratory rate was recorded at 30-32 breaths per minute, with normal breath sounds. The heart rate ranged from 130 to 135 beats per minute, and pulse oximetry consistently showed readings of 97-98%. Laboratory findings indicated elevated C-peptide levels (2.58 ng/mL) and insulin levels (16.1 µU/mL), with normal thyroid-stimulating hormone (TSH) levels (2.77 µIU/mL) and free thyroxine (FT4) levels (1.38 ng/dL). Abdominal ultrasound revealed no abnormalities. However, abdominal CT-scan (Figure 1) displayed solidification of the pancreatic tail, raising suspicion of insulinoma. Additionally, ground glass opacities were observed in the inferior lobe of the right lung. Echocardiography revealed the presence of an atrial septal defect secundum, a small patent ductus arteriosus, and mild tricuspid regurgitation.

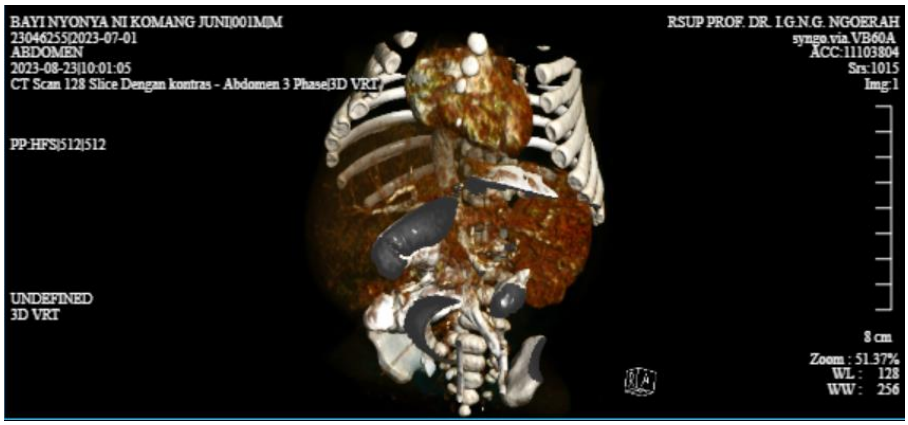

Figure 1: Abdominal MSCT Scan Reveals Solidification of the Caudal Pancreas (Suspected Insulinoma)

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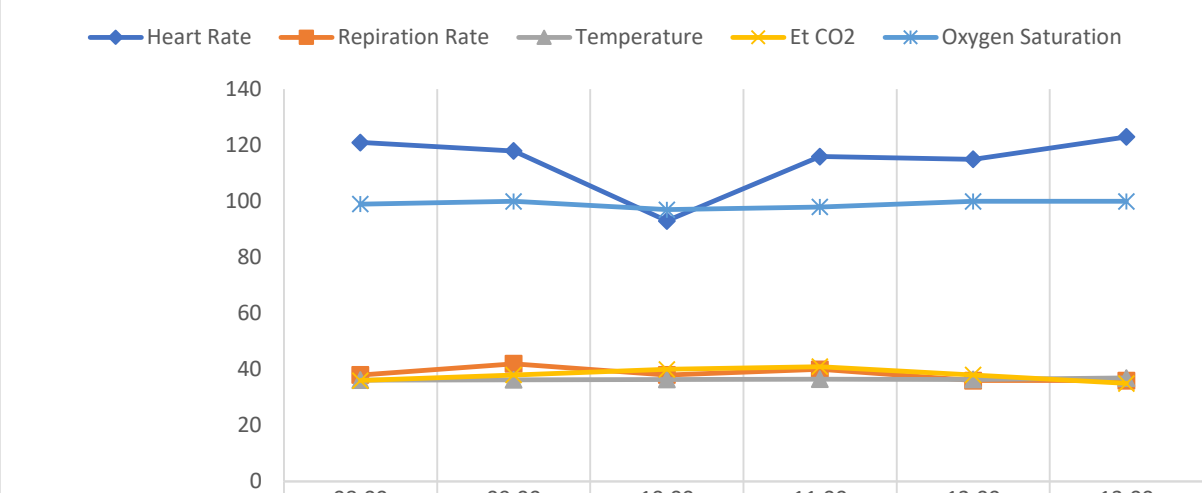
The infant was diagnosed with multiple medical conditions, encompassing growth failure, persistent hypoglycemia attributed to insulinoma, generalized epilepsy with motor tonic-clonic seizures, metabolic etiology (hypoglycemia with comorbid hypothyroidism), and congenital hypothyroidism. The treatment plan included a comprehensive regimen, comprising intravenous D25% administered at a rate of 11 ml per hour to achieve a target Glucose Infusion Rate (GIR) of 12.9. Additionally, the treatment regimen encompassed the administration of 20 ml of formula milk every 2 hours, breastfeeding on demand six times a day, octreotide at a dosage of 105 mcg every 8 hours, nifedipine at 1 mg every 8 hours, levothyroxine at 40 mcg once daily, and phenobarbital at 10 mg every 12 hours.

The patient underwent laparoscopic excision of the insulinoma under general anesthesia. The induction phase commenced with sevoflurane, fentanyl at 5 mcg, and atracurium at 1.5 mg. Following intubation, caudal analgesia was administered utilizing Bupivacaine at a concentration of 0.125%. The patient's maintenance during surgery included oxygen, compressed air, sevoflurane, and fentanyl. The surgical procedure, lasting 5 hours, was marked by stable hemodynamics (refer to Figure 2). Over the course of the 5-hour surgery, a cumulative dose of 10 mcg of fentanyl and 1.5 mg of atracurium was administered. To prevent hypothermia during surgery, the infant was enveloped in plastic, maintaining a favorable temperature range of 36-36.8°C. A continuous infusion of Dextrose 25% was administered to sustain the target Glucose Infusion Rate (GIR) of 12.9. Blood glucose levels were meticulously monitored, with measurements taken every 30 minutes to 1 hour (refer to Figure 3). The tumor was localized in the caudal portion of the pancreas, necessitating pancreatectomy performed with the assistance of monopolar instrumentation (refer to Figure 4). Histomorphological examination disclosed the presence of ductuloinsular complexes and nucleomegaly in islet cells, prompting suspicion of congenital hyperinsulinism.



	08.00	09.00	10.00	11.00	12.00	13.00
Heart Rate	121	118	93	116	115	123
Repiration Rate	38	42	38	40	36	36
Temperature	36.2	36.3	36.4	36.5	36.4	36.9
Et CO2	36	38	40	41	38	35
Oxygen Saturation	99	100	97	98	100	100

Figure 2: Hemodynamic Monitoring

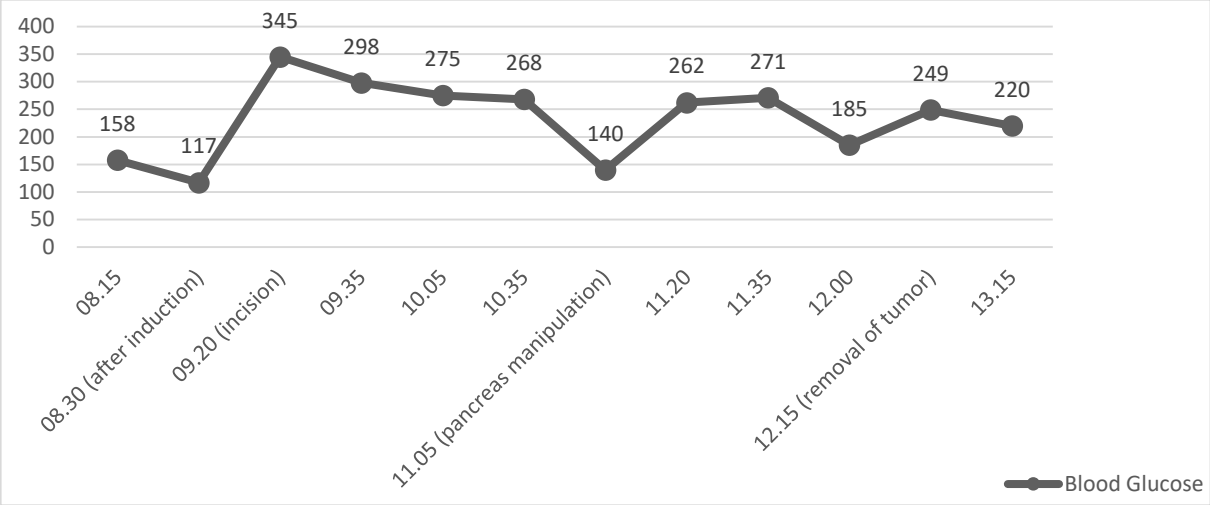


Figure 3: Blood Glucose Monitoring

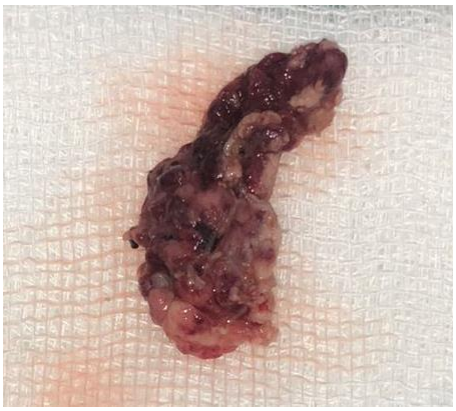


Figure 4: Macroscopic Appearance of the Tumor in the Pancreas

The surgical procedure was successfully concluded, and the patient was extubated before transfer to the Pediatric Intensive Care Unit (PICU). In the PICU, analgesia was meticulously managed, involving fentanyl administration at a dosage of 30 mcg diluted in 20 cc of normal saline, with a continuous infusion rate of 0.8 cc per hour. Furthermore, paracetamol was administered orally at a dose of 30 mg every 6 hours to manage pain. The ongoing administration of octreotide, phenobarbital, nifedipine, and levothyroxine was continued to address the patient's various medical conditions.

The intravenous fluid infusion of D25% was adjusted daily based on blood sugar results, with rigorous post-operative monitoring of blood glucose levels (refer to Figure 5). After receiving comprehensive care in the hospital for a duration of 10 days, the patient was discharged to continue their recovery in a home setting.

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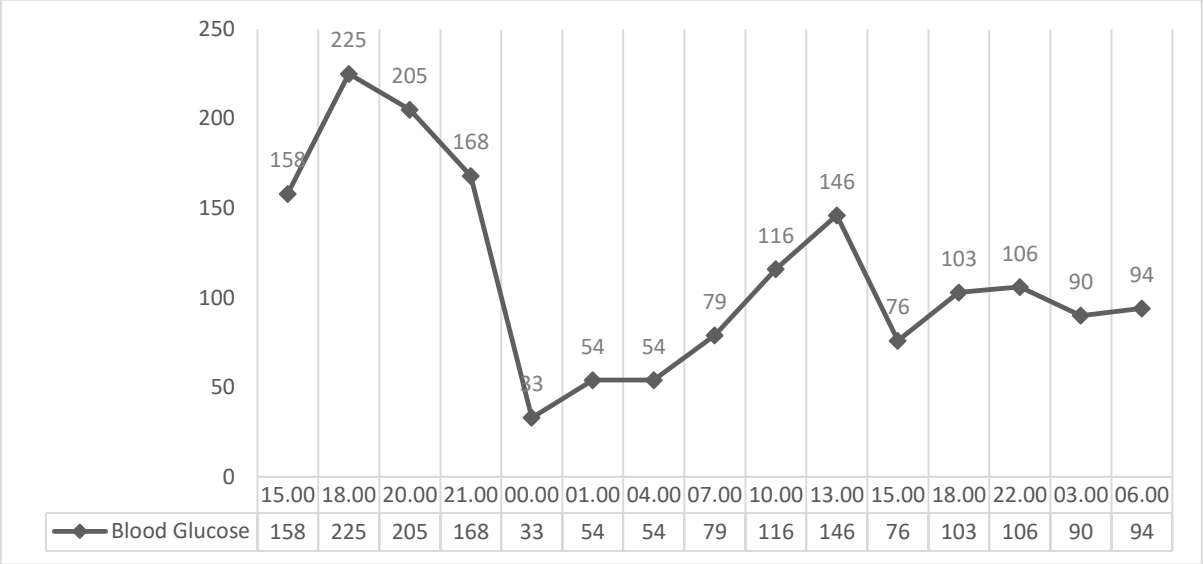

Figure 5: Blood Sugar Monitoring 24 Hours Post-Operative

3. Discussion

Insulinoma is a rare pediatric tumor that leads to endogenous hyperinsulinism, primarily resulting in fasting hypoglycemia, although occasional hypoglycemic episodes may occur. It is sporadically associated with familial multiple endocrine neoplasia type 1 (MEN1) syndrome. As per Whipple's triad, individuals with insulinoma present with hypoglycemia and neuroglycopenic symptoms that can be alleviated through carbohydrate administration. Elevated insulin levels trigger hypoglycemic symptoms, which can be categorized into two groups: neurologic (neuroglycopenic) and adrenergic (catecholamine reaction). Neurologic manifestations are often the most prominent and potentially the most reliable, encompassing symptoms such as diplopia, visual disturbances, altered mental status, unusual behavior, memory impairment, coma, and seizures. In the case of this infant patient, seizures were recurrent. Although the patient did not present with seizures upon hospital arrival, oral phenobarbital was administered as maintenance therapy due to ongoing seizure risk.

The preferred treatment for insulinoma is surgical excision. In severe and refractory cases, especially those associated with Noninsulinoma pancreatogenous hypoglycemia syndrome (NIPHS), distal pancreatectomy is the treatment of choice. In this instance, the patient was scheduled for laparoscopic surgical excision. Laparoscopic enucleation is the standard approach for all benign insulinomas. It's essential to note that pneumoperitoneum during laparoscopy can induce various physiological changes. Hemodynamic alterations include a decrease in cardiac output, an elevation in blood pressure, and an increase in systemic vascular resistance (SVR), potentially triggering the release of catecholamines and vasopressin. Cortisol production also increases as a response to pneumoperitoneum, stimulating glucose synthesis. Consequently, intraabdominal pressure (IAP) is a crucial factor, as an increase exceeding 15 mmHg can lead to a 28% reduction in cardiac output. Thus, efforts were made to maintain IAP at 6-8 mmHg in this case.

In preoperative management, intravenous dextrose infusion was initiated to address the preoperative fasting regimen, and blood sugar levels were monitored every two hours, with the lowest recorded value being 74 mg/dL. Octreotide at a dose of 0.1 mg every 6 hours was administered.

Regarding anesthetic agents, no specific recommendations exist. Some researchers have suggested that a combination of general anesthesia with propofol and epidural block can be an effective choice for insulinoma

excision. Enflurane and halothane have been noted to suppress pancreatic insulin release, with enflurane exerting a more potent inhibitory effect than halothane. In this particular case, sevoflurane was utilized due to its availability at our institution, and the addition of caudal analgesia resulted in favorable hemodynamics and reduced fentanyl requirements.

There is limited literature available discussing anesthetic management in pediatric patients with insulinoma, with most publications focusing on adult populations. A single journal, written in Korean, addresses anesthesia management in infants with insulinoma. Therefore, this case report represents a novel contribution to the literature, detailing the anesthetic management of an infant with congenital insulinoma.

In the postoperative phase, blood glucose levels typically normalize physiologically. However, this normalization can take anywhere from a few hours to several days. During this period, glucose infusion and meticulous monitoring are essential. Blood glucose levels may temporarily rise to 180-230 mg/dL, necessitating modest insulin doses. Frequent glucose level assessments during hospitalization and continued monitoring for at least one day post-discharge are recommended. In this case, severe hypoglycemic episodes were observed, particularly during nighttime, which was expected given the physiological adjustment period. Parents were provided with guidance on glucose management.

4. Conclusion

Pediatric insulinoma excision through laparoscopic surgery poses distinctive challenges. Ensuring effective perioperative blood glucose management is of utmost importance to guarantee the safety and success of these procedures. The use of a combination of general anesthesia with a caudal block presents notable advantages, including the maintenance of stable hemodynamics and the acceleration of postoperative recovery.

Declaration of Patient Consent

The authors hereby confirm that they have obtained the necessary informed consent from the patient's parents. In the consent document, the patient's parents have willingly granted permission for the publication of the patient's images and pertinent clinical information in the journal. The patient's parents are fully cognizant that their identities, including their names and initials, will be kept confidential, and all reasonable measures will be taken to ensure their anonymity.

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Conflicts of Interest Statement:

The authors declare that there are no conflicts of interest to disclose.

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