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Case Report

"Keeping it steady": Anaesthetic challenges in insulinoma surgery

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ABSTRACT

Insulinoma is a tumor of the pancreas that secretes excessive insulin, causing recurrent hypoglycemia. The median presentation age of 47 years and a mild female preponderance. Most cases are benign, with only 10% showing malignant potential. A typical presentation involves Whipple's triad, which includes symptomatic hypoglycemia, fasting blood glucose below 50 mg/dL, and immediate relief of symptoms after glucose administration. This case report discusses the perioperative anaesthetic management of a 54-year-old patient with insulinoma who underwent laparoscopic enucleation. A comprehensive approach involving preoperative blood glucose optimization through medications and dietary adjustments, vigilant intraoperative monitoring with timely dextrose infusion during tumor manipulation, and careful postoperative control of rebound hyperglycemia using insulin infusion is essential for improved outcomes in these patients. The primary treatment is surgical enucleation, but managing perioperative glycemic fluctuations presents significant challenges for anesthesiologists.

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1. Introduction

Insulinoma is a rare neuroendocrine tumor in the pancreas' islets of Langerhans causing excessive insulin production [1]. Most insulinomas are small and benign, with malignancy observed in only 10% of the cases [2]. Management typically involves surgical enucleation of the tumor, while malignant cases require both medical and surgical interventions [3]. Preoperative control of hypoglycemia and careful intraoperative monitoring are essential to avoid permanent neurological damage.

Managing such patient during perioperative period is challenging for anaesthesiologists. Normally, insulin secretion is tightly regulated by blood glucose concentration. In insulinoma, this regulation is lost - the tumor secretes insulin independently of blood glucose, Inhibition of Hepatic Gluconeogenesis and Glycogenolysis, Chronic hyperinsulinemia may blunt the physiological response of counter-regulatory hormones like glucagon and cortisol, making hypoglycemia episodes more severe and prolonged [4].

Treatment of hypoglycemia in insulinoma focuses on: Acute correction of hypoglycemia, Preoperative control of blood glucose, Definitive surgical removal of tumor.

Acute Treatment of Hypoglycemia: Dextrose Bolus: 50 mL of 50% dextrose (D50) IV bolus, Continuous Dextrose Infusion: D10W or D5W at a rate titrated to maintain normoglycemia, Frequent Blood Glucose Monitoring: Every 1–2 hours.

Definitive Treatment: Surgical Resection-Enucleation: For small, localized tumors (<2 cm), Distal pancreatectomy: If tumor is in body/tail, Whipple's procedure: For Pancreatic head tumors. Utilizing imaging modalities like CT, MRI, endoscopic ultrasonography, or calcium stimulation studies to accurately localize the tumor prior to surgery is crucial.

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2. Case Presentation

A 54-year-old male presented with episodes of fatigue, dizziness, restlessness, and recurrent hypoglycemia, occasionally resulting in loss of consciousness, relieved by dextrose administration. No significant medical or surgical history was reported, except for recent tobacco chewing. PET-CT (Positron emission tomography-computed tomography) with Ga-68 DOTA scan revealed a 3.7×2.7×3.2 cm necrotic, tracer-avid lesion at the superior margin of the pancreas, confirming insulinoma. A multidisciplinary approach was adopted. Involving anesthesiologist, surgeon, and endocrinologist. A plan was proposed to surgically excise the tumor after taking patient written consent. We have also obtained written consent from the patient to present and publish this case. Laboratory investigations of the patient are given in Table 1.

Table 1. Blood chemistry of the patient.

Factor	Patient values	Normal range
Cortisol	13.53mcg/dl	5.2-35mcg/dl.
Fasting insulin level	13.10mU/L	2-25Mu/dl
C PEPTIDE	4.42ng/ml	1.1-4.4ng/ml.
D-3-Hdroxybutyrate(ketone)	0.10mmol/L	0.02-0.27
Prolactin	8.696ng/ml.	Male-1.99-19.40ng/ml

The patient was admitted for glucose monitoring and optimization. During observation, symptomatic hypoglycemia (45 mg/dL) was managed with intravenous glucose. Pre-anaesthesia assessment revealed normal vital signs, airway examination (Modified Mallampati Grade II), and good effort tolerance. The patient's BMI was 29.06 kg/m^2.

To minimize fasting-related hypoglycemia, clear glucose-containing liquids were allowed up to two hours before surgery, and 10% dextrose was infused at 50 mL/h intravenously during the fasting period.

The patient was transferred to the operating room (OR) and standard ASA (American Society of Anaesthesiology) monitors attached. An epidural catheter was secured at the L1-L2 inter-space. Premedication with Injection ondansetron 4 mg iv, Injection glycopyrrolate 0.2 mg iv, and Injection Midazolam 2 mg iv was given, Injection fentanyl 100mcg iv was given after premedication. Patient was induced with Injection propofol 100 mg iv, and Injection. Vecuronium 8 mg iv, followed by endotracheal intubation with 7.5 sized ET tube. Oxygen:N_2O (50:50) and Isoflurane was used for maintenance of anaesthesia intraoperatively. Blood glucose was monitored every 30 minutes during surgery, the Graph 1 below depicts the intraoperative trends of GRBS (General random blood sugar) levels over time. Effect of increased abdominal pressure on cortisol release and disturbance in glucose metabolism was discussed with surgeon. Intra-abdominal pressure changes and its effects on the tumor was also discussed and was kept at minimal 10–12 mmHg throughout the procedure to minimize the effect of Intra-abdominal pressure on glucose metabolism. A firm, nodular mass (3×4 cm) was successfully excised from the proximal pancreatic body. Prior to removal of tumor dextrose containing fluids were used as maintenance fluid to avoid hypoglycemia during tumor handling. After tumor resection, dextrose infusion was replaced with normal saline (100 mL/h). Intra-operative glucose levels remained within normal limit and has been plotted in Fig. 1 and the patient's hemodynamics were well-controlled throughout the five-hour surgery. Reversal of neuromuscular blockade was done using Injection Sugammadex (190 mg) iv, and the patient was extubated uneventfully.

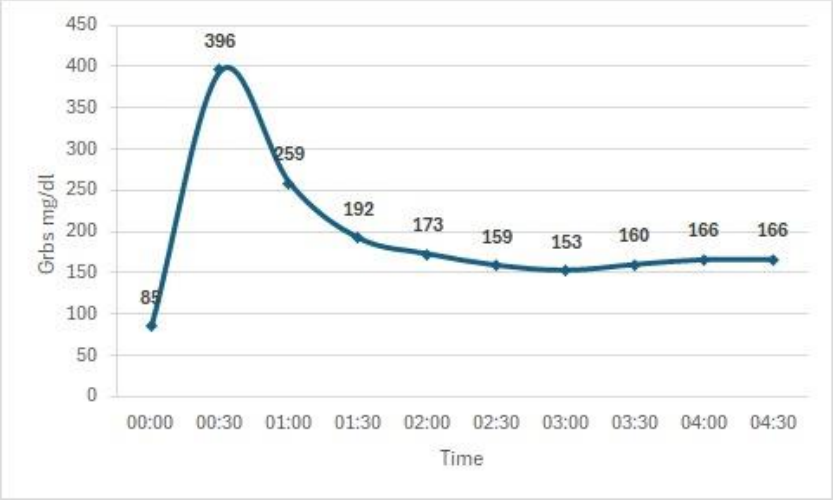

Fig. 1. Blood sugar level checked half hourly (GRBS: General random blood sugar in mg/dl).

The patient was transferred to the PACU and NS infusion at 1–2 mL/kg/h was continued for four hours. Blood glucose levels were checked 4th hourly, which remained stable initially but rose above 200 mg/dL on postoperative day 1. Regular insulin was initiated according to sliding scale to maintain glucose levels between 100–150 mg/dL. Insulin therapy was discontinued by postoperative day 7, with the patient maintaining normal glucose levels. He was discharged on postoperative day 9 with advice for regular glucose monitoring at home (Fig. 2).

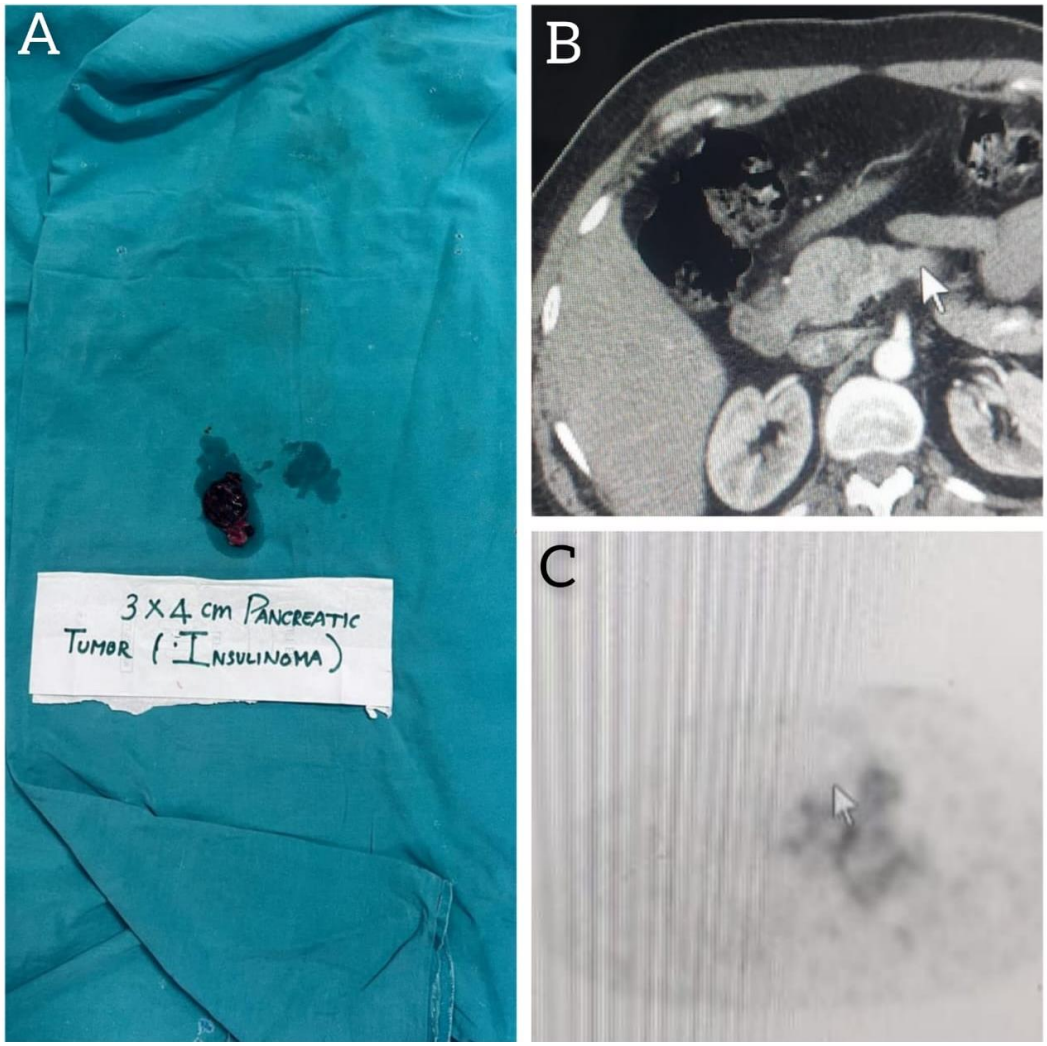

Fig. 2. (a) Excised pancreatic tumor (insulinoma); (b) CECT (Contrast enhanced computed tomography) abdomen showing solitary nodule in tail of pancreas near hilum of spleen (white arrow); (c) PET scan of insulinoma.

3. Discussion

Insulinoma is the most common cause of endogenous hyperinsulinism, presenting with Whipple's Triad: neuroglycopenic symptoms (e.g., confusion, agitation) and rapid symptom relief with glucose administration [2,5–7]. Diagnosis may be delayed or misinterpreted as a psychiatric or neurological disorder. A supervised 72-hour fasting test, demonstrating inappropriately high insulin (≥6 U/mL) and C-peptide levels (≥0.2 nmol/L), remains the gold standard for diagnosis [2].

While surgical enucleation is the definitive treatment, perioperative glycemic control is crucial to prevent hypoglycemic episodes that could lead to neuronal injury [3]. Monitoring glucose every 15–30 minutes intraoperatively is recommended as signs of hypoglycemia are masked under general anaesthesia [4]. Here we closely monitored the perioperative glucose levels throughout the procedure, adjusting the fluids administration based on GRBS readings. Propofol is preferred for induction as it maintains stable insulin-glucose homeostasis, Halothane and Enflurane are avoided due to the fact that they influence insulin sensitivity [4].

Here we used propofol for induction as it helps maintain stable insulin glucose homeostasis during the perioperative period. Elevated intra-abdominal pressure during laparoscopic procedures can trigger cortisol release, complicating glucose control [8]. Even though laparoscopic enucleation was done in our case, we discussed the risk of cortisol release on increasing intra-abdominal pressure and disturbance in glucose metabolism intra operatively with the surgeon, and intra-abdominal pressure was kept to a minimum of 10–12 mmHg throughout the procedure [8]. Immediate normalization of insulin levels post-resection is a strong indicator of successful surgery [9,10]. Usually insulin levels come to

normal level 20 minutes post-surgery, but may take 2–3 days. In our case there were no hypoglycemic episodes seen post resection and post operatively, indicating normalization of insulin secretion post enucleation [1]. Monitoring of sugars in post-operative period every 4th hourly is recommended to avoid hypoglycemic episodes.

The long-term prognosis of insulinoma depends on complete resection, with cure rates between 75–98% [2]. Patients with multiple endocrine neoplasia type 1 (MEN 1) have higher recurrence [6].

Incidence of insulinoma is exceedingly rare, and perioperative management of sugars and hypoglycemia is challenge for anaesthesiologists.

In our case, we administered general anaesthesia in combination with thoracic epidural analgesia, which aligns with many reported practices but also offers distinct advantages. While the literature often emphasizes general anaesthesia alone or with peripheral blocks such as transversus abdominis plane (TAP) blocks for laparoscopic procedures, our approach prioritized superior visceral analgesia, intraoperative hemodynamic stability, and optimal postoperative pain control. The thoracic epidural allowed us to reduce intraoperative opioid use and improve bowel recovery, which are critical considerations in abdominal surgeries. Alternative anesthetic techniques could include total intravenous anaesthesia (TIVA) using propofol and remifentanil, especially in patients with increased risk of postoperative nausea or requiring neuromonitoring. For regional alternatives, nerve blocks like TAP or rectus sheath blocks may be considered, particularly when epidural is contraindicated. Regarding postoperative analgesia, a multimodal regimen including paracetamol, NSAIDs (where not contraindicated), and continued epidural infusion (or local infiltration if epidural is not feasible), interfacial plane blocks like Erector Spinae Plane block, TAP block, QL (Quadratus lumborum) block can provide effective pain relief while minimizing opioid-related side effects. Multimodal analgesia can certainly incorporate regional techniques enhancing recovery and reducing complications. Our method, therefore, reflects a balanced, patient-tailored strategy emphasizing hemodynamic control, effective analgesia, and early mobilization, thereby early recovery and discharge of patient.

4. Conclusions

Anesthetic management of insulinoma requires strict perioperative glycemic control to prevent both hypoglycemia and hyperglycemia. In this case, meticulous intraoperative glucose monitoring and timely postoperative insulin therapy led to a smooth recovery. Close-loop communication between the anaesthesia and surgical teams was vital during tumor handling. Surgical resection remains the definitive treatment with good outcomes when complete excision is achieved. Vigilant monitoring helped prevent hypoglycemia and potential neurological damage. Given the rarity of such cases, we documented this report to highlight the importance of tight glucose control and effective interdisciplinary coordination in the anesthetic management of insulinoma.

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Conflict of Interest
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Data Availability
The datasets created and/or analyzed during the current study are not publicly available, but are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate
Not applicable.

Author Contributions
Prakash Muralidhar Padamukhe: *conceptualization, methodology, investigation, writing – original draft, supervision.*
Swetha R. Gowda: *literature review, writing – review & editing.*
Siri Chandana Kanamarlapudi: *visualization, validation, data curation.*
Pragna Hospet: *formal analysis, perioperative monitoring, writing – review & editing.*

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