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Case Report

COMBINED SPINAL-EPIDURAL ANESTHESIA WITH ISOBARIC ROPIVACAINE 0.375% FOR INGUINAL HERNIA SURGERY IN A HEART FAILURE PATIENT WITH EJECTION FRACTION OF 36%

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ABSTRACT

Introduction: Heart failure is a condition caused by myocardial abnormalities that interfere with the fulfillment of the body's metabolism. It is one of the primary causes of high perioperative morbidity and mortality rates, and its management presents a challenge to anesthesiologists. **Objective:** To demonstrate combined spinal-epidural anesthesia with isobaric ropivacaine 0.375% for inguinal hernia repair surgery in a heart failure patient with an ejection fraction of 36%. **Case Report:** A 53-year-old man presented with a complaint of a lump on his left groin accompanied by pain with a visual analog scale (VAS) pain score of 3/10 three days before admission. The patient was also known to often complain of shortness of breath and chest palpitations when lying down at night and during strenuous activity. Based on the examination, the patient was then diagnosed with reducible left lateral inguinal hernia and heart failure with LVEF 36%. Subsequently, the patient was scheduled for elective herniotomy-hernioraphy surgery under low-dose combined spinal-epidural anesthesia. Spinal anesthesia was performed with isobaric ropivacaine 0.375% and fentanyl 25 µg in a total volume of 3.5 ml at the L3-L4 intervertebral space. Epidural anesthesia was performed with isobaric ropivacaine 0.375% and fentanyl 25 µg in a total volume of 8 ml at the L2-L3 intervertebral space. After 10 minutes, the sensory block reached the T6 level, but the motor block was only partial (Bromage 1). A continuous infusion of isobaric ropivacaine 0.1875% 1 ml/hour was administered through the epidural catheter to control postoperative pain. During surgery and hospitalization, the patient's hemodynamic condition remained stable. **Conclusion:** Combined spinal-epidural anesthesia with isobaric ropivacaine 0.375% can provide adequate anesthesia with relatively stable hemodynamics, thus making it safe for inguinal hernia repair surgery in heart failure patients with reduced ejection fraction.

Keywords: Combined Spinal-Epidural Anesthesia; Isobaric Ropivacaine 0.375%; Inguinal Hernia; Heart Failure; Case Report; Anesthesia Management

ABSTRAK

Pendahuluan: Gagal jantung adalah penyakit yang disebabkan oleh abnormalitas miokardium yang mengganggu pemenuhan metabolisme tubuh. Kondisi ini menjadi salah satu penyebab utama tingginya angka morbiditas dan mortalitas perioperatif sehingga penatalaksanaannya menghadirkan tantangan bagi ahli anestesi. **Tujuan:** Untuk memaparkan penggunaan kombinasi anestesi spinal-epidural dengan ropivacaine isobarik 0.375% untuk operasi perbaikan hernia inguinalis pada pasien gagal jantung dengan fraksi ejeksi 36%. **Laporan Kasus:** Seorang pasien laki-laki berusia 53 tahun datang dengan keluhan terdapat benjolan pada lipatan paha sebelah kiri disertai nyeri dengan skor nyeri *visual analog scale* (VAS) 3/10 sejak tiga hari sebelum masuk rumah sakit. Pasien juga diketahui sering mengeluhkan sesak napas disertai dada yang berdebar-debar saat berbaring di malam hari dan saat beraktivitas berat. Berdasarkan pemeriksaan, pasien kemudian didiagnosis dengan hernia inguinalis lateralis kiri yang dapat direduksi dan gagal jantung dengan LVEF 36%. Selanjutnya, pasien dijadwalkan untuk menjalani operasi herniotomi-herniorafi elektif dengan kombinasi anestesi spinal-epidural dosis rendah. Anestesi spinal dilakukan dengan ropivacaine isobarik 0.375% dan fentanil 25 µg dalam volume total 3.5 ml pada *intervertebral space* L3-L4. Anestesi epidural dilakukan dengan ropivacaine isobarik 0.375% dan fentanil 25 µg dalam volume total 8 ml pada *intervertebrale space* L2-L3. Setelah 10 menit, blok sensorik tercapai hingga T6, tetapi blok motorik hanya parsial (Bromage 1). Infus kontinu ropivacaine isobarik 0.1875% 1 ml/jam diberikan melalui kateter epidural untuk mengontrol nyeri pascaoperasi. Selama operasi dan perawatan di rumah sakit kondisi hemodinamik pasien tetap stabil. **Kesimpulan:** Kombinasi anestesi spinal-epidural dengan ropivacaine isobarik 0.375% dapat menghasilkan

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anestesi yang adekuat dengan hemodinamik yang relatif stabil sehingga aman untuk operasi perbaikan hernia inguinalis dari pasien gagal jantung dengan fraksi ejeksi berkurang.

Kata Kunci: Kombinasi Anestesi Spinal-Epidural; Ropivacaine Isobarik 0.375%; Hernia Inguinalis; Gagal Jantung; Laporan Kasus; Manajemen Anestesi

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INTRODUCTION

Heart failure reflects a complicated disorder of the heart caused by functional or structural damage of the myocardium. This disorder reduces the capacity to fill the ventricles or expel blood into the systemic circulation, leading to an inability to fulfill the body's metabolic demands. In general, heart failure can be classified based on the level of left ventricular ejection fraction (LVEF), including heart failure with reduced ejection fraction (HFrEF), ejection fraction <40%; heart failure with mildly reduced ejection fraction (HFmrEF), ejection fraction 41-49%; and heart failure with preserved ejection fraction (HFpEF), ejection fraction ≥50%. The incidence of heart failure reaches 64 million cases worldwide, and many of these cases require non-cardiac surgery, including inguinal hernia repair. On the other hand, heart failure itself is one of the risks of increased perioperative morbidity and mortality (1–3).

Whenever heart failure patients require surgical procedures, the decision to perform surgery is often a challenge for anesthesiologists. Reports suggest the likelihood of death during elective surgery in individuals with heart failure rises by up to 14%. This is because anesthesia and the surgical procedure itself can potentially worsen the heart failure condition. Therefore, anesthesiologists should be able to determine the appropriate type of anesthetic technique and perioperative management to minimize the risk of cardiac complications during surgery. Combined spinal-epidural anesthesia has become an increasingly common approach to providing anesthesia in patients with complex medical conditions, such as heart failure. It can provide precise sensory and motor blocks in the area to be operated on while allowing for better management of hemodynamic changes that may occur during surgery (4,5).

However, the use of combined spinal-epidural anesthesia in the context of inguinal hernia surgery in patients with heart failure and reduced ejection fraction has yet to be widely described in the literature. Therefore, this case report aims to present the use of combined spinal-epidural anesthesia with isobaric ropivacaine 0.375% for inguinal hernia repair surgery in a heart failure patient with an ejection fraction of 36%.

CASE REPORT

A 53-year-old male farmer presented to the emergency department with a one-year history of a lump on the left groin that had been in and out. Three days before admission, the patient began complaints of pain, especially when the lump came out. In addition, the patient also often complained of shortness of breath when lying down at night and during strenuous activity accompanied by chest palpitations. The patient denied any complaints of nausea, vomiting, difficulty defecating, or farting. The patient's previous medical history included a heart attack five years ago and uncontrolled hypertension. The patient denied having diabetes mellitus but was a heavy smoker and had quit since the heart attack. The patient was previously treated by a cardiologist

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with atorvastatin 20 mg, sacubitril-valsartan 50 mg, bisoprolol 2.5 mg, spironolactone 25 mg, and furosemide 40 mg, each once daily.

On preoperative physical examination, the patient appeared moderately ill; weight 65 kg; height 160 cm; Glasgow Coma Scale (GCS) E4V5M6; patent airway; maximal mouth opening; Mallampati II; free neck motion; no short neck or mandibular protrusion; vital signs: blood pressure 149/75 mmHg, pulse rate 69 beats/min, body temperature 36.7 °C, respiratory rate 16 breaths/min, and SpO2 97% in room air. Respiratory and cardiovascular examinations were normal, with no wheezing, rhonchi, murmurs, or S3 gallop. Abdominal examination showed a flat abdominal wall with no ascites. Auscultation showed normal peristalsis of 12 times/min. The percussion examination sounded tympanic throughout the abdominal field. Palpation revealed no mass or muscular defense, and the borders of the spleen and liver could not be identified. The lump that came out on the left groin can be repositioned, and there is pain when pressed with a visual analog scale (VAS) pain score of 3/10.

Preoperative laboratory and blood gas analysis results are presented in Table 1 and Table 2. Anterior-posterior (AP) chest X-ray demonstrated cardiomegaly with a cardiothoracic ratio (CTR) of 67% (Figure 1). A 12-lead electrocardiographic (ECG) indicates sinus rhythm, heart rate of 75 beats/min, left axis deviation (LAD), and left ventricular hypertrophy (LVH). Furthermore, an echocardiographic investigation showed mild aortic regurgitation, left ventricular dilatation (LVIDd 7.18 cm), decreased left ventricular systolic function (LVEF 36% with Teich), impaired left ventricular diastolic function (DT 246 ms, E/A 0.6, E/E' 15.7, PCWP 21 mmHg), and normal right ventricular function (TAPSE 2.1 cm). Segmental LV analysis showed mid-anterior basal kinetics, normokinetics of other segments, and eccentric LVH.

Table 1. Preoperative Laboratory Test Results

Parameters	Value	Parameters	Value
Hb	13.3 g/dl	**ALT**	23 U/L
NLR	4.96	**Albumin**	4 g/dl
WBC	8.1 x 10^3/uL	**Random blood glucose**	104 mg/dl
HCT	38.8%	**Na**	140.3 mmol/L
Platelets	427 x 10^3/uL	**K**	3.7 mmol/L
PT	11.4 secs	**Cl**	107.6 mmol/L
APTT	30.1 secs	**Serum creatinine**	1 mg/dl
AST	14 U/L	**BUN**	12 mg/dl

Table 2. Preoperative Blood Gas Analysis Results

Parameters	Value	Parameters	Value
Temperature	36 °C	**TCO2**	31 mmol/L
FiO2	0.21	**HCO3**	30 mmol/L
Ca	1.14 mmol/L	**Hb**	12.5 g/dl
pH	7.52	**SO2**	96%
pO2	72 mmHg	**AaDO2**	32 mmHg
pCO2	35.8 mmHg	**Na**	143 mmol/L
BE	7.1	**K**	3.5 mmol/L

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Based on the examination, the patient was diagnosed with a reducible left lateral inguinal hernia and planned for elective herniotomy-hernioraphy surgery with low-dose combined spinal-epidural anesthesia. On pre-anesthesia evaluation, the patient was labeled with American Society of Anesthesiologists (ASA) Physical Status III, Revised Cardiac Risk Index for Pre-Operative Risk (RRCI) 3 with an estimated risk of a major adverse cardiac event in 30 days of 15%, New York Heart Association (NYHA) Class II, and estimated metabolic equivalents of task (MET) score ≥ 4.

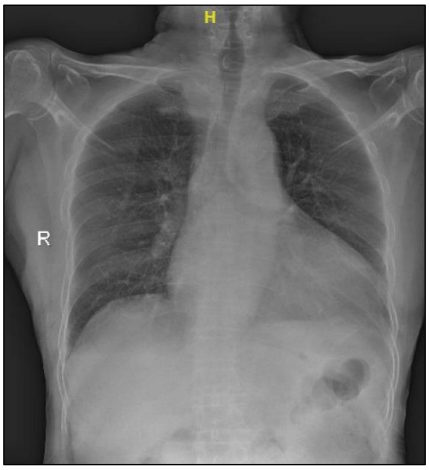

Figure 1. Preoperative Chest X-Rays

The surgery was performed one week after the hospital admission. Before the surgery, the patient was fasted for 6 hours, and the medication given by the cardiologist was continued during the perioperative period. ECG, heart rate, SpO2, and blood pressure were closely monitored in the operating room. The patient was positioned sitting, and the hanging-drop technique was used to identify the epidural space at the L2-L3 intervertebral space with a median approach. Then, the epidural catheter was inserted to a depth of 12 cm. Spinal anesthesia was carried out at the L3-L4 intervertebral space through a paramedian approach using a 27G Quincke needle. Next, a test dose was performed through the epidural catheter with epinephrine 1:100.000 1 ml plus lidocaine 2% 2 ml. Then, isobaric ropivacaine 0.375% plus fentanyl 25 µg in a total volume of 3.5 ml was injected into the subarachnoid space. Epidural anesthesia was administered with isobaric ropivacaine 0.375% plus fentanyl 25 µg in a total volume of 8 ml. Sensory block was achieved up to the level of T6 segment at the 10th minute as checked by pinprick test. However, the motor block was not entirely achieved as the patient could still move his knee slightly during intraoperative (Bromage 1).

The surgical procedure lasted 75 minutes and went smoothly, with a relatively stable hemodynamic status without the support of vasopressor or inotropic agents (Figure 2). During surgery, 500 ml of 6% hydroxyethyl starch (HES) was infused, and the patient was given 5 liters/minute of oxygen using a simple mask. The patient was then transferred to the intensive care unit (ICU) shortly after the surgical procedure. Estimated blood loss and urine output were 30 ml and 100 ml, respectively. To control postoperative pain, a continuous infusion of isobaric ropivacaine 0.1875% 1 ml/hour was given through an epidural catheter plus an intravenous injection of metamizole sodium 1 gram three times a day. The patient's hemodynamic condition remained stable during the ICU stay, with no adverse events or complications related to anesthesia and surgical procedures. After two days of hospitalization in the ICU, the epidural catheter was removed, and oxygen administration was changed to 4 liters/minute via nasal cannula. Finally, the patient was transferred to a regular inpatient room and discharged the following day.

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DISCUSSION

Inguinal hernia repair is one of the most common surgical procedures performed by surgeons globally, with over 20 million patients operated on each year. Current guidelines recommend that hernia repair be tailored according to expertise, resources, and factors related to the patient's condition, including comorbidities such as heart disease (6). Comorbid heart disease is a medical condition that significantly contributes to illness and death in individuals having non-cardiac surgery. More precisely, the percentage of patients who die within 30 days following surgery is notably greater among individuals with heart failure (9.3%) compared to those with atrial fibrillation (6.4%) and coronary heart disease (2.9%). Furthermore, the mortality rate of patients with heart failure was also markedly higher in patients with LVEF <40% compared to those with normal LVEF (7).

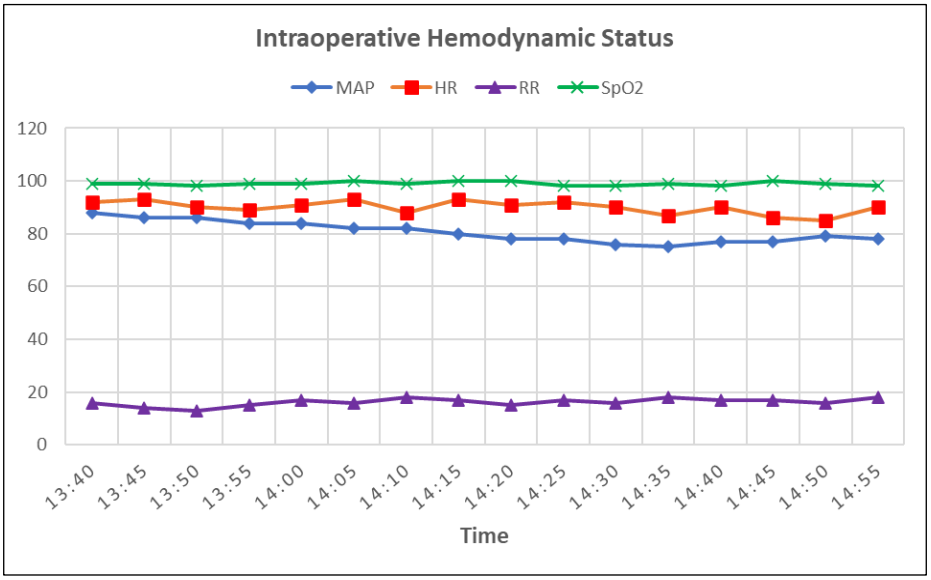

Figure 2. Intraoperative Hemodynamic Status

Effective pain management is a crucial aspect of caring for surgical patients. Additionally, it is important to note that pain is a contributing factor to the occurrence of postoperative myocardial ischemia. This is because the associated tachycardia can shorten the diastolic phase and diminish the supply of blood flow to the myocardium (7). There is no consensus on which anesthetic technique should be used in inguinal hernia surgery. The most widely used anesthetic technique for inguinal hernia surgery is general anesthesia (almost 80%), as it can facilitate laparoscopy by relaxing the abdominal muscles, allowing additional procedures, such as laparotomy or bowel resection, and securing the airway. However, general anesthesia tends to be contraindicated in patients with cardiac disease, as induction of anesthesia and intubation are often associated with hemodynamic instability. Regardless of how tight blood pressure control is in the preoperative period, not a few hypertensive patients experience hypotension in response to anesthetic induction agents, followed by hypertension due to increased catecholamine secretion in response to intubation or surgical procedures (5,8,9).

Over the past few years, the use of spinal anesthesia has recently become a popular anesthetic technique for lower abdominal and

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inguinal hernia surgery. However, the use of this technique is often associated with the incidence of hypotension and bradycardia. These conditions are mainly caused by arterial and venous vasodilation due to excessive sympathetic block accompanied by activation of cardioinhibitory receptors that disrupt sympathovagal balance and increase parasympathetic tone. Therefore, to overcome this, modification of anesthetic techniques, adjustment of the dose and type of drugs used, and preloading colloidal fluids before starting anesthesia can be done (10,11). In this case, we performed a combined spinal-epidural anesthesia technique with isobaric ropivacaine 0.375%. Sensory block was achieved up to the T6 level, but motor block was only partially achieved. This implies that a low dose of ropivacaine is sufficient to produce the anesthetic block required for hernia surgery. In addition, our patient was preloaded with 500 ml of 6% HES. Furthermore, the patient was also asked to continue treatment from a cardiologist during the perioperative period as recommended by the 2014 American Heart Association guidelines (7).

Ropivacaine is a long-acting local anesthetic. It has the same pharmacokinetic and pharmacodynamic features as bupivacaine by reversibly inhibiting sodium ion entry into nerve fibers, but with lower cardiovascular toxicity. It is also less lipophilic than other local anesthetics, such as bupivacaine, and has a lower ability to reach large myelinated motor fibers. As a result, it tends to act on nociceptive fibers A, B, and C rather than motor fibers, resulting in minimal motor block (12). Based on a clinical trial by Mohtadi et al., which compared the use of spinal anesthesia with ropivacaine 0.5% 3.5 ml plus fentanyl 25 µg and ropivacaine 0.5% 3.5 ml plus sufentanil 2.5 µg, it was indicated that there was no significant difference in the duration of analgesia and motor block. Nevertheless, the group treated with ropivacaine plus fentanyl exhibited superior hemodynamic stability and a lower incidence of pruritus compared to the group given ropivacaine with sufentanil (13).

Meanwhile, another study by Wang and Xu compared the use of combined spinal-epidural anesthesia with ropivacaine 0.1% 2-3 ml and epidural anesthesia with ropivacaine 0.5% 3 ml for labor analgesia (each group also received a continuous infusion of ropivacaine 1% 10 ml plus sufentanil 0.3-0.4 µg/ml in 100 ml normal saline at a rate of 5 ml/hour via an epidural catheter), showed that the combined spinal-epidural anesthesia group had significantly lower VAS pain scores during labor than the epidural anesthesia group. In addition, the incidence of side effects, such as nausea, vomiting, and pruritus, was also significantly lower in the combined spinal-epidural anesthesia group (14).

Currently, combined spinal-epidural anesthesia has been widely used for lower abdominal surgery. With low-dose combined spinal-epidural anesthesia, anesthesia can be done by administering small amounts of local anesthetic drugs into the subarachnoid space, followed by continuous infusion into the epidural space. Spinal anesthesia can provide rapid sensory and motor block onset and sufficient muscle relaxation. Meanwhile, an epidural catheter insertion allows titration and extension of anesthesia and analgesia, especially for postoperative pain control. This technique facilitates the adjustment of the block to the appropriate level, resulting in better hemodynamic stability and a decreased occurrence of hypotension. As a result, this decreased the requirement for vasopressors and inotropic drugs (15). Therefore, the use of low-dose combined spinal-epidural anesthesia may

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be an option for a safe and effective anesthetic modality in patients with heart failure who are typically contraindicated with other anesthetic modalities.

The goals of anesthetic management in patients with cardiac disease consist of preventing tachycardia, maintaining normovolemia, preventing increased afterload, and avoiding drug-induced myocardial depression. Neuraxial anesthesia can be used as the primary anesthetic or in combination with general anesthesia for patients with cardiac disease. Several factors, including the presence of other medical conditions, the type of surgery, and the patient's preference, play a crucial role in assessing the advantages and disadvantages of neuraxial anesthesia (16). Since this is a case report, the main limitation of this study is that we only included one patient, making our findings difficult to generalize to a broader population. In addition, the absence of a comparator also makes it impossible to compare outcomes between those exposed and unexposed.

CONCLUSION

This case report demonstrates that combined spinal-epidural anesthesia with isobaric ropivacaine 0.375% is feasible and safe to use in a heart failure patient with an ejection fraction of 36% undergoing inguinal hernia repair surgery as it can provide adequate analgesia and good hemodynamic stability without side effects, and thus can be an option for patients with similar conditions. However, further studies with a randomized controlled trial (RCT) design and larger samples are still needed to confirm these findings.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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Authors' Contribution

Muhammad Isra Rafidin Rayyan, Salman Sultan Ghiffari, Achmad Hariyanto – conceptualization, data collection, data analysis and interpretation, and manuscript preparation; **Achmad Wahib Wahju Winarso, Haris Darmawan, Ichlasul Mahdi Fardhani** – supervision, critical review, and final approval of the manuscript.

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