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Case Report

Anaesthesia Section

Segmental Spinal Anaesthesia with Sequential Hyperbaric and Isobaric Ropivacaine for Laparoscopic Hysterectomy in a High-risk Kyphoscoliosis Patient: A Case Report

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ABSTRACT

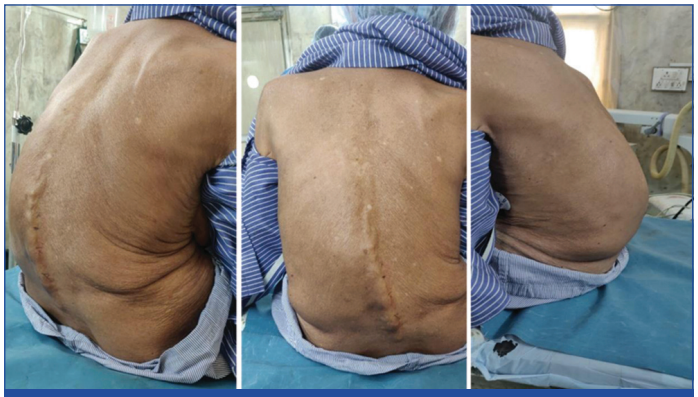
Anaesthesia management in patients with multiple comorbidities and anatomical challenges poses significant perioperative risks when scheduled for complicated surgeries. This case report highlights the successful application of sequential hyperbaric and isobaric ropivacaine in segmental spinal anaesthesia in a 65-year-old female patient with kyphoscoliosis and multiple comorbidities undergoing Laparoscopic-Assisted Vaginal Hysterectomy (LAVH). Her comorbidities included bronchial asthma, type 2 diabetes mellitus, hypertension, hypothyroidism, ischaemic heart disease, and early-stage Chronic Kidney Disease (CKD). Her anaesthetic management was further complicated by a challenging airway (Mallampati grade III, limited mouth opening, and restricted neck movements), uncontrolled blood pressure, elevated blood glucose levels, and compromised renal status. Considering her complex medical profile and anatomical challenges, segmental spinal anaesthesia was chosen as the primary anaesthesia modality, with general anaesthesia as a fallback plan and the necessary instruments readily available. Surgical anaesthesia was achieved with two-drug sequential segmental spinal anaesthesia administered in the T9-T10 intervertebral space using hyperbaric ropivacaine 0.75% (9 mg) and isobaric ropivacaine 0.75% (11.25 mg), with a 60-second interval between the two drug injections. The operative course was uneventful, requiring only mild sedation and analgesia. A single episode of intraoperative hypotension and bradycardia was managed promptly. The patient experienced excellent postoperative analgesia and required intravenous analgesics eight hours after the surgery. She was later discharged uneventfully on the fourth postoperative day. This case demonstrates the feasibility and safety of using sequential hyperbaric and isobaric ropivacaine for segmental spinal anaesthesia in high-risk patients with anatomical challenges, offering a viable alternative to General Anaesthesia (GA) in complex surgical scenarios.

Keywords: General anaesthesia, Gynaecological surgery, Kyphosis, Local anaesthetics, Scoliosis, Subarachnoid block

CASE REPORT

A 65-year-old female patient, para 4, presented for pre-anaesthetic assessment prior to elective Laparoscopic-Assisted Vaginal Hysterectomy (LAVH) for heavy post-menopausal bleeding that she had been experiencing for one year. She had a complex medical history, including kyphoscoliosis, which was evident from an abnormal curvature of her spine in the thoracolumbar region [Table/Fig-1-3]. She had long-standing bronchial asthma managed with metered-dose inhalers containing formoterol and budesonide, which she had been using for the past 20 years. Additionally, she had type 2 diabetes mellitus treated with Metformin (500 mg, twice daily), hypertension managed with Telmisartan (40 mg, once daily), and hypothyroidism treated with Thyronorm (100 µg, once daily) for the last 15 years, which she had been taking irregularly.

Her obstetric and gynaecological history revealed four normal deliveries and complaints of uterine prolapse (Grade II). She also had a history of ischaemic heart disease, managed with oral medication five years prior, which she discontinued on her own after one year. There was no documentation of the treatment received. Furthermore, she had early-stage Chronic Kidney Disease (CKD) managed with Renagel (800 mg, three times a day), Calcitriol (0.5 mcg, once a day), and Ferrous gluconate (325 mg, twice daily), with renal function tests showing serum creatinine of 2.2 mg/dL, Blood Urea Nitrogen (BUN) of 42 mg/dL, and estimated Glomerular Filtration Rate (eGFR) of 65 mL/min/1.73 m^2. She had never required dialysis. Her preoperative blood workup revealed a haemoglobin level of 9 g/dL, for which blood and blood products were kept ready. Fasting blood sugar and postprandial blood sugar were 120 mg/dL and 186 mg/dL, respectively. All other investigations, including



[Table/Fig-1-3]: Lateral and back images of patient's back and spine. (Images from left to right)

serum electrolytes, thyroid profile, and Arterial Blood Gas Analysis (ABGA), were within normal limits. An echocardiogram showed an ejection fraction of 45%, and a chest X-ray revealed prominent bronchovascular markings.

Physical examination noted a short neck with a thyromental distance of 5 cm, limited mouth opening of 3 cm, and restricted neck movements, with a Mallampati grade III airway. Her vitals were recorded as a pulse of 87 beats per minute and blood pressure of 154/90 mmHg. Neurological examination was normal, with no motor or sensory deficits. Her exercise tolerance was fair, with a breath-holding time of 22 seconds.

The surgeons decided to perform LAVH on the patient in view of large fibroids and grade II uterine prolapse. Thus, the nature of the surgery, along with the patient's complex medical profile, necessitated

meticulous perioperative consideration of all possible anaesthesia options to ensure safe anaesthesia management. Informed consent was obtained from the patient for potential publication purposes preoperatively.

The patient underwent thorough counselling regarding anaesthesia options, including their benefits and drawbacks. The specifics of segmental spinal anaesthesia were discussed, such as its technique, benefits, potential complications, and the possibility of conversion to General Anaesthesia (GA) if the quality of anaesthesia proved inadequate or if the patient experienced intolerance to pneumoperitoneum or airway compromise. The patient was also informed about the potential complications associated with GA, including challenges in securing the airway, haemodynamic disturbances, and postoperative pain and ventilatory support. In preparation for the potential failure of segmental spinal anaesthesia, a comprehensive backup plan was established, which included having all necessary equipment and medications for GA readily available, along with advanced airway management tools such as a fibre-optic bronchoscope and video laryngoscope, to effectively manage a potentially difficult airway. To facilitate the administration of segmental spinal anaesthesia and minimise discomfort, an Eutectic Mixture of Local Anaesthetics (EMLA) patch was applied to the T6-T12 area on the patient's back in the preoperative area, anticipating potential technical difficulties due to the patient's kyphoscoliosis.

Upon arrival in the operating theatre, standard monitoring was applied, and the patient received premedication with Inj. Ondansetron 8 mg. Under strict aseptic precautions, a two-drug sequential segmental spinal anaesthesia was administered via a 25G Quincke's needle at the T9-T10 intervertebral space using a paramedian approach in the sitting position, successfully achieved on the second attempt. Hyperbaric ropivacaine 0.75% (9 mg, 1.2 mL) with dexmedetomidine 5 µg was given, followed by isobaric ropivacaine 0.75% (11.25 mg, 1.5 mL), with the stylet kept in the spinal needle in place for 60 seconds between the two drug injections to minimise cerebrospinal fluid and drug loss [Table/Fig-4]. This technique provided extensive anaesthesia from T4 to S4 dermatomes despite using a small total volume of 2.7 mL, facilitating patient positioning, catheterisation, and laparoscopic surgical instrumentation. Pneumoperitoneum with an intra-abdominal pressure of 12-15 mmHg was created. The patient received mild sedation with Inj. Midazolam 1 mg and Inj. Fentanyl 50 µg initially at the start of surgery, and later Inj. Paracetamol 1000 mg and Inj. Ketamine 10 mg were administered in two boluses to relieve any discomfort from the pneumoperitoneum and positioning. An episode of bradycardia (heart rate 52/min) and hypotension (BP 86/47 mmHg) was effectively managed with Inj. Glycopyrrolate 0.6 mg and Inj. mephentermine 6 mg. Apart from this episode, vital parameters remained stable throughout. Blood sugar monitoring and corrections were made accordingly.

[Table/Fig-4]: Patient after administration of segmental spinal anaesthesia.

The 90-minute surgical procedure was uneventful, with meticulous dissection and evacuation of the mass [Table/Fig-5]. Strict input and output monitoring was conducted in view of renal compromise. The patient received 1100 mL of crystalloids, had a urine output of 250 mL, and experienced 150 mL of blood loss. Postoperatively, she was transferred to the Post-Anaesthesia Care Unit (PACU) for six hours without complications and was later shifted to the postoperative ward after full recovery from the motor blockade. Analgesia in the form of Inj. Paracetamol 1000 mg was required after eight hours when her Visual Analogue Scale (VAS) score was 4. The patient's postoperative period was uneventful, and she was discharged on the fourth day.

[Table/Fig-5]: Specimen of LAVH.

DISCUSSION

Laparoscopic surgery has advanced significantly in recent years; however, GA remains the predominant anaesthetic technique due to its ability to manage pain, discomfort from pneumoperitoneum, and facilitate longer procedures with a secured airway and patient unawareness [1,2]. Despite these advantages, GA carries risks, including airway trauma, bronchospasm, drug-related side effects (e.g., Postoperative Nausea and Vomiting {PONV}, prolonged sedation, residual paralysis), and cardiovascular or pulmonary complications [3]. Segmental spinal anaesthesia offers a promising alternative with several benefits such as reduced blood loss, improved haemodynamic stability, superior postoperative analgesia, decreased incidence of PONV, early recovery, and a shorter hospital stay [4]. It selectively anaesthetises specific spinal segments, thus minimising systemic effects—particularly advantageous in high-risk patients.

Although segmental spinal anaesthesia has been successfully reported in laparoscopic cholecystectomy and other abdominal, breast, and thoracic procedures [5-8], its application in LAVH is less common due to challenges, including the requirement of extensive anaesthesia and the Trendelenburg positioning, which reduces pulmonary compliance and may increase discomfort in awake patients.

We present a case of a high-risk patient with multiple comorbidities—bronchial asthma, ischaemic heart disease, diabetes, hypertension, hypothyroidism, early-stage CKD, and kyphoscoliosis—who was posted for LAVH, where GA posed significant risks. The presence of kyphoscoliosis further complicates the execution of both general and regional anaesthesia due to spinal deformities and associated cardiopulmonary limitations. GA in such cases could be complicated by difficulties in airway management, reduced respiratory reserve, and an increased need for postoperative ventilation. Regional techniques, particularly neuraxial blocks, can be technically demanding owing to distorted anatomy, which hinders positioning, landmark identification, and consistent spread of local anaesthetics.

The administration of an isobaric solution in the subarachnoid space in such patients tends to remain at the level of injection and mixes uniformly with cerebrospinal fluid, minimising the influence of gravity on their spread. This characteristic prevents the uneven or inadequate anaesthesia seen with hyperbaric drugs due to pooling in dependent areas [9].

Author	Study/Case report	Surgery	Patient details	Anaethesia plan	Outcome
Fayyad A et al., [1]	Case report	Total laparoscopic hysterectomy	Elderly female of 75 years with several comorbidities like severe lung fibrosis, COPD and heart failure	Combined spinal-epidural anaesthesia	Successful case management
Della CL et al., [10]	Case series	Laparoscopic hysterectomy	ASA I and II patients	Spinal anaesthesia	Quicker recovery, minimal postoperative analgesics
Singhal G et al., [11]	Clinical study	Laparoscopic hysterectomy	ASA I and II patients	General Anaesthesia (GA) vs segmental spinal anaesthesia (hyperbaric levo-bupivacaine 0.5%, 0.7 mL along with dexmedetomidine 4 µg followed by isobaric levo-bupivacaine 0.5% 1.5 mL with dexmedetomidine 6 µg in sitting position) in segmental spinal in T9-10 space)	TSA provided better haemodynamic stability, fewer analgesic needs, and fewer adverse events (e.g., sore throat, hypertension)
Sharma N et al., [12]	Case series	Bi-level lower thoracic and lumbar spine surgeries	Six patients of ASA I and 12 patients of ASA II	Two-drug layered segmental anaesthesia (1 mL of 0.5% hyperbaric bupivacaine and then after waiting for 60 seconds to avoid mixing of two drugs, 2 mL of 0.5% isobaric Ropivacaine with 30 mcg of preservative free Buprenorphine)	Effective anaesthesia with minimal side-effects
Raj PG et al., [13]	Case series	Various surgeries	Kyphoscoliosis	Two-drug segmental spinal anaesthesia (0.8 cc of Inj. ropivacaine heavy 0.75% in T9-10 intervertebral space and then after five minutes 1.2 cc of Inj. ropivacaine 0.5% isobaric with Inj. fentanyl 25 µg) administered	Effective anaesthesia with stable haemodynamics
Shaikh R et al., [14]	Case series	PCNL surgeries	ASA I and II	Two-drug segmental spinal anaesthesia (0.5 mL of 0.5% hyperbaric bupivacaine followed by 0.5% isobaric levobupivacaine 1.2 mL with 30 mcg fentanyl as adjuvant (total volume of 2 mL) in T10-T11)	Effective anaesthesia with minimal side-effects

[Table/Fig-6]: Case reports and studies using segmental spinal anaesthesia [1,10-14].
ASA: American society of anesthesiologists; PCNL: Percutaneous nephrolithotomy; TSA: Thoracic spinal anaesthesia

Thus, we selected two-drug segmental spinal anaesthesia as the primary modality using intrathecal 0.75% hyperbaric ropivacaine 9 mg (1.2 mL) with dexmedetomidine 5 µg, followed after 60 seconds by 0.75% isobaric ropivacaine 11.25 mg (1.5 mL) in the same intrathecal space (T9-T10). This combination provided adequate anaesthesia with a smaller volume of drug while minimising cephalad spread and the potential for a high spinal block. GA was kept as a backup with full preparation to ensure patient safety in case segmental spinal anaesthesia was not feasible or effective.

Case reports from various authors who have documented the use of segmental spinal or other regional anaesthesia for laparoscopic hysterectomy, those who have used segmental spinal anaesthesia in patients with kyphoscoliosis posted for other surgeries, and those who have implemented two-drug segmental spinal anaesthesia have been tabulated in [Table/Fig-6] [1,10-14].

The majority of the case reports [11-14] in which two-drug segmental spinal anaesthesia was used were focused on American Society of Anaesthesiologists (ASA) I or II patients, whereas we document the successful administration and management of this technique in a high-risk patient with multiple comorbidities.

Thus, a comprehensive understanding of thoracic spinal anatomy, the physiological effects of thoracic segmental spinal anaesthesia, and the recognition and management of its potential complications are essential for its successful application. When performed by experienced clinicians, the two-drug technique in segmental spinal anaesthesia—combined with careful patient selection, thorough preoperative preparation, and active patient cooperation—offers a safe, effective, and cost-efficient alternative to GA. This approach is particularly beneficial for patients with significant comorbidities undergoing laparoscopic procedures requiring broad anaesthetic coverage, as it reduces the risk of perioperative complications and promotes favourable outcomes. With the right clinical judgement and procedural expertise, this unconventional technique can serve as a dependable and efficient alternative to GA.

CONCLUSION(S)

This case report demonstrates the successful use of segmental spinal anaesthesia for LAVH in a patient with multiple comorbidities and kyphoscoliosis, providing effective perioperative pain management and minimising postoperative complications. The patient's rapid recovery and discharge highlight the benefits of this anaesthetic technique in reducing hospital stay and promoting early mobilisation. This approach may be considered a viable alternative to traditional GA or epidural anaesthesia for patients undergoing LAVH, offering improved outcomes and enhanced patient satisfaction.

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