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Optimizing Anesthesia for Major Surgery: The Role of Sequential Combined Spinal-Epidural Technique

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Abstract

The Combined Spinal Epidural (CSE) approach has been widely employed over the last decade because it achieves rapid onset and substantial blockage while also allowing for the modification or prolongation of the block. ***Background:*** *Sequential spinal-epidural anesthesia (SSEA) combines the rapid onset and dense blockade of spinal anesthesia with the prolonged duration and adjustable analgesia of epidural anesthesia. This technique is particularly beneficial in major surgeries requiring prolonged operative time and stable hemodynamics.* ***Objective:*** *To evaluate the efficacy and safety of SSEA in major surgical procedures compared to single-shot spinal or epidural anesthesia alone.* ***Methods:*** *A systematic review of clinical studies and case reports analyzing patient outcomes, hemodynamic stability, anesthetic efficacy, and postoperative analgesia with SSEA in major surgeries, including orthopedic, abdominal, and vascular procedures.* ***Results:*** *SSEA provides superior intraoperative hemodynamic stability, extended postoperative analgesia, and reduced anesthetic and opioid requirements. The combination allows for precise control of anesthesia depth, minimizing complications, such as hypotension and excessive motor blockade.* ***Conclusion:*** *For major surgery, SSEA is a safe and efficient method that improves patient outcomes and perioperative management. To improve techniques and increase their use, more extensive research is required.*

Keywords: Sequential Spinal Epidural Anesthesia, Combined Spinal-Epidural Anesthesia, Major Surgery, Hemodynamic Stability, Postoperative Analgesia, Orthopedic Surgery

INTRODUCTION

Two important localized treatments that have a long history of successful application for a range of surgical operations and pain management are epidural and spinal blocks. However, there are disadvantages to both methods. Two of spinal block's main drawbacks include precipitous hypotension and trouble regulating the amount of analgesia [1]. Opioids or local anesthetics can be used to relieve post-operative pain, but epidural block with the catheter approach offers better control over the amount of analgesia. However, it still has disadvantages such patchy anesthesia, longer start of action, higher doses of local anesthetics, and the risk of neurotoxicity and cardiovascular damage [2].

To prolong analgesia beyond the postoperative phase, the CSE approach attempts to combine the advantages of spinal block with the adaptability of an indwelling epidural catheter. Soresi used the "single needle – single interspace" technique to introduce it in 1937 [3]. Later, a variety of adjustments and techniques were employed, each with certain benefits over the others. The CSE block can be used to relieve labor and postoperative pain, as well as for several procedures [4]. A small dosage of subarachnoid local anesthetic is injected as part of the sequential CSE procedure, and the block is subsequently extended by administering the medication via an epidural catheter.

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The purpose of this study was to evaluate sequential CSE and epidural block in terms of surgical analgesia, muscle relaxation and hemodynamic response.

The first use of combined spinal and epidural anesthesia was performed in 1979, marking a significant advancement in regional anesthesia techniques. He used dual puncture technique, first inserted an epidural catheter through Tuohy needle and then a dural puncture, one to two lumbar segments distally using a 26G spinal needle. He called it the double segment or the double space segment.

Although the introduction of continuous epidural anesthesia has revolutionized the intraoperative and postoperative management, especially in long surgical cases, the CSEA technique has given a new dimension to regional anesthesia. In 1981, Brownbridge used CSEA technique using two interspaces. In 1982, Coates advocated CSEA technique in single intervertebral space and in1986, Narinder rawal started giving sequential CSEA blocks. Thus, CSEA began its journey in 1981 and over the last three decades it has progressed immensely to become one of the most versatile regional anesthesia techniques. Combined spinal-epidural anesthesia preserves advantages of both SA and EA and if used sensibly also minimizes or eliminates their drawbacks.

Three techniques can be used to administer combined spinal-epidural anesthesia: “Needle through needle method” in a single segment.

- Double barrel/single segment approach.
- Technique of double segments.

The single segment “needle-through-needle” approach is advised by modern anesthesia practice over double segment technique because it causes less discomfort and trauma to the patient. With it, there is 50% decrease in morbidity associated with intervertebral space penetration (backache, epidural vein puncture hematoma, infection) in contrast to two level punctures.

Types of Combined Spinal Epidural Needles

- Tuohy needle with an additional aperture, back eye or hole in the distal curve which allows the passage of 26G spinal needle (needle through needle technique). A 26G spinal needle,12 cm length passes through a 16G Tuohy needle.
- *Double needle:* Tuohy needle with straight tube: a short 20G guide tunnel is welded onto the lateral side of Tuohy needle through which a 25G spinal needle can be inserted. The epidural catheter is inserted as usual through the needle before the subarachnoid block.
- “Portex secure” CSE needle: epidural needle has marking on its hub starting from 0, in the increment of 0.5mm, till 15mm. even numbers are written against the markings.

Spinal needle has corresponding notches on and under its hub. When the spinal needle is introduced through the Tuohy needle, the hub of the spinal needle lies over the hub of the Tuohy needle. Once the dura is punctured, the spinal needle which has a locking mechanism, can be locked over the Tuohy needle so that the displacement of the spinal needle is prevented while injecting, this avoiding failed or patchy subarachnoid block.

RECENT RESEARCH AND DEVELOPMENTS

Recent Studies Have Explored Various Aspects of CSSEA

- Comparative Efficacy: Research comparing CSSEA with single-shot spinal anesthesia in lower limb orthopedic surgeries found that CSSEA provided longer duration of sensory and motor blockade, with greater hemodynamic stability.

- Technique Variations: Investigations into different approaches, such as the needle-through-needle versus separate-needle techniques, have been conducted to determine optimal methods for specific surgical contexts
- Patient Outcomes: Studies have assessed patient-centered outcomes, including postoperative pain control and recovery profiles, highlighting the benefits of CSSEA in enhancing patient comfort and reducing hospital stay durations.

REVIEW OF LITERATURE

Gupta et al. [5] conducted a study demonstrating that Combined Spinal-Epidural (CSE) anesthesia is a superior alternative to epidural block. Their findings highlighted several advantages of CSE, including a faster onset of action, enhanced quality of analgesia, improved muscle relaxation, and a reduced requirement for local anesthetics to achieve the desired level of anesthesia. The study particularly emphasized the benefits of Sequential CSE in optimizing anesthetic efficacy. Both the blocks have comparable rates and intensities of hypotension and bradycardia. The duration of analgesia by two segment regression methods need to be further analyzed. Thus, CSE offers the best of both spinal and epidural techniques and has a promising future in regional anesthesia

The anesthetic care of a patient undergoing an urgent cesarean delivery who had a single ventricle and phasic flow in the pulmonary artery was examined by Catarci et al. [6]. Their findings highlighted that combined spinal-epidural anesthesia (CSEA) was the most suitable technique in such a high-risk scenario. The authors emphasized that CSEA provided a rapid onset of anesthesia while minimizing hemodynamic fluctuations, which is critical in patients with complex congenital heart disease. Given the hemodynamic stability observed, the study supports the use of CSEA as a preferred approach in similar cases requiring urgent surgical intervention.

Agarwal et al. [7] reported the successful anesthetic management of a patient with ventricular septal defect and pulmonary atresia (VSD-PA) undergoing hysterectomy. The study highlighted the effectiveness of combined spinal-epidural (CSE) anesthesia with the epidural volume extension (EVE) technique in providing stable hemodynamics and adequate surgical anesthesia. The authors emphasized that this approach allowed controlled anesthetic depth while minimizing cardiovascular compromise, making it a suitable choice for patients with complex congenital heart disease undergoing major surgical procedures.

Rawal et al. [8] analyzed the advantages and limitations of regional anesthesia techniques, particularly comparing epidural and spinal blocks with the combined spinal-epidural (CSE) technique. They concluded that while epidural and spinal blocks are widely accepted, they have inherent disadvantages. By combining the flexibility of an epidural catheter for long-term analgesia with the quick onset, density, and dependability of a subarachnoid block, the CSE approach successfully overcomes these drawbacks. The study emphasized that CSE is routinely used in many institutions, especially in major orthopedic surgeries and obstetric procedures, due to its superior efficacy and adaptability.

Choi et al. [9] examined the effects of intravenous dexmedetomidine versus midazolam for procedural sedation in patients receiving combined spinal-epidural (CSE) anesthesia during total knee arthroplasty (TKA). Their study found that dexmedetomidine not only provided effective sedation but also prolonged sensory block duration without increasing the incidence of adverse events. The authors suggested that dexmedetomidine may be a preferable alternative to midazolam, especially in cases where extended surgical duration necessitates prolonged sensory blockade. These findings highlight the potential benefits of dexmedetomidine in enhancing anesthetic management during TKA.

METHODOLOGY

Materials and Methods of Combined Sequential Spinal Epidural Anesthesia (CSSEA) in Major Surgery

Combined Sequential Spinal Epidural Anesthesia (CSSEA) is a technique that integrates both spinal and epidural anesthesia, providing rapid onset anesthesia with prolonged duration and post-operative analgesia. It is commonly used for major surgeries, including lower abdominal, pelvic, and lower limb surgeries.

MATERIALS REQUIRED

Drugs & Solutions

- Local Anesthetics.
- *Spinal anesthesia:*
  - Bupivacaine 0.5% heavy (most used, typically 1.5–3 mL).
  - Ropivacaine 0.75% (alternative).

Epidural Anesthesia

- Bupivacaine 0.5% plain or Ropivacaine 0.5%.
- Lidocaine 2% with epinephrine (for faster onset).
- Adjuvants (optional for prolonging and improving block quality).
- Opioids: Fentanyl (10–25 mcg), Sufentanil (2–5 mcg), Morphine (100–200 mcg).
- Clonidine (30–150 mcg) or Dexmedetomidine (5–10 mcg).
- Epinephrine (2–5 mcg) to reduce local anesthetic systemic absorption.
- Resuscitation & Emergency Drugs.
- Atropine, Ephedrine, Phenylephrine, Epinephrine, Naloxone.
- Intravenous fluids: Ringer's lactate, Normal saline.

Equipment

Needles & Catheters

- *Spinal needle:* 25G or 27G Quincke/Pencil-point (Whitacre/Sprotte).
- *Epidural needle:* 16G or 18G Tuohy needle.
- *Epidural catheter:* 20G, multi-orifice catheter.
- *Monitoring Equipment:*
  - Non-invasive blood pressure (NIBP) monitor.
  - ECG, pulse oximeter.
  - Capnography (if deep sedation or conversion to general anesthesia is required).
  - Sterile Field Preparation.

Chlorhexidine or Povidone-Iodine Antiseptic Solution

- Sterile drapes, gloves, gauze
- Dressing for catheter fixation

METHODS

Patient Preparation

- Preoperative Assessment.
- History, physical examination, airway evaluation.
- Coagulation profile (avoid if INR >1.5, Platelets <100,000).
- Assessment of spinal deformities, previous surgeries.
- Preload with IV Fluids (500–1000 mL Ringer's lactate or normal saline).

Positioning

- Sitting or lateral decubitus position.
- Identifying the L2–L3 or L3–L4 intervertebral space.
- Technique of Combined Sequential Spinal Epidural Anesthesia.
- Epidural Catheter Placement.

- Insert 18G Tuohy needle in the epidural space using the loss-of-resistance (LOR) technique with saline or air.
- Confirm epidural space (usually at L2–L3 or L3–L4 level).
- Insert 20G catheter into the epidural space (3–5 cm inside).
- Test dose: 3 mL of 2% lidocaine with epinephrine (to rule out intrathecal or intravascular placement).

Spinal Anesthesia Administration

Insert 25G spinal needle through the Tuohy needle (needle-through-needle technique) or at an adjacent intervertebral space.

- Aspirate clear cerebrospinal fluid (CSF) to confirm intrathecal placement.
- Inject 0.5% hyperbaric bupivacaine (1.5–3 mL) with/without opioid adjuvants.
- Withdraw the spinal needle and reposition the patient.
- Epidural Anesthesia Augmentation (Sequential Block).

After 30–60 minutes, administer 5–10 mL of 0.25–0.5% bupivacaine through the epidural catheter if prolonged anesthesia or additional segmental coverage is needed.

Titrate further boluses based on hemodynamic response and surgical requirement.

Postoperative Analgesia

Continuous Epidural Infusion

- Bupivacaine 0.125% + Fentanyl 2 mcg/mL at 4–8 mL/hr.
- Ropivacaine 0.2% at 5–10 mL/hr.
- *Patient-Controlled Epidural Analgesia (PCEA):*
  - Bupivacaine 0.1% + Fentanyl 2 mcg/mL, 5 mL bolus with a 20-minute lockout.

Complications & Management

- Complication Management.
- Hypotension IV fluids, Ephedrine 5–10 mg or Phenylephrine 50–100 mcg.
- Bradycardia Atropine 0.5 mg IV.
- High spinal block Head elevation, Oxygen, Vasopressors if needed.
- Post-dural puncture headache (PDPH) Bed rest, Hydration, Caffeine, Epidural blood patch if severe
- Epidural hematoma Neurology consult, MRI, Possible decompression surgery.

RESULTS

Combined sequential spinal-epidural anesthesia (CSSEA) is an advanced regional anesthesia technique that combines the benefits of spinal anesthesia with the flexibility of an epidural catheter.

This technique is particularly useful in major surgeries, providing profound analgesia, stable hemodynamics, and prolonged postoperative pain control.

- Results and Benefits of CSSEA in Major Surgeries.
- Improved Hemodynamic Stability.

Compared to single-shot spinal anesthesia, CSSEA provides better cardiovascular stability by allowing incremental dosing through the epidural catheter, reducing the risk of sudden hypotension.

Extended Duration of Anesthesia

While spinal anesthesia provides rapid onset and deep sensory and motor blockade, the epidural catheter enables prolonged anesthesia for longer procedures.

Better Intraoperative and Postoperative Analgesia

The combination ensures effective intraoperative pain control, and postoperative analgesia can be managed through continuous epidural infusion, reducing the need for opioids.

Reduced Complications and Side Effects

- Lower incidence of post-dural puncture headache (PDPH) compared to single-dose spinal anesthesia.
- Reduced chance of systemic opioid-related adverse effects, including nausea, vomiting, and respiratory depression.

Suitability for High-Risk Patients

Ideal for elderly patients or those with cardiovascular comorbidities who may not tolerate general anesthesia well. can be applied to major surgeries, including abdominal, gynecological, and orthopedic operations.

Faster Recovery and Early Mobilization

Patients experience reduced post-anesthesia grogginess, allowing for quicker mobilization and lower risk of deep vein thrombosis (DVT).

Limitations and Considerations

- Requires skilled anesthesiologists to place both spinal and epidural components correctly.
- Risk of epidural catheter migration or failure, necessitating close monitoring.
- Potential for high spinal blockades if dosing is not carefully controlled [10–15].

CONCLUSIONS

Combined Sequential Spinal Epidural Anesthesia provides the benefits of rapid onset, prolonged duration, and flexibility in anesthesia management. It is particularly useful in major surgeries requiring long procedural times and post-operative pain control. Proper technique, monitoring, and timely management of complications ensure safe and effective anesthesia.

REFERENCES

1. Datta S, Alper MH, Ostheimer GW, Weiss JB. Method of ephedrine administration and nausea and hypotension during spinal anesthesia for cesarean section. Anesthesiology. 1982;56(1):68–70.
2. Thorburn J, Moir DD. Bupivacaine toxicity in association with extradural analgesia for caesarean section. Br J Anaesth. 1984;56(6):551–3.
3. Soresi A. Episubdural anesthesia. Anesth Analg. 1937;16(6):306–10.
4. Holmström B, Laugaland K, Rawal N, Hallberg S. Combined spinal block versus spinal and epidural block for orthopedic surgery. Can J Anaesth. 1993;40(7):601–6.
5. Gupta S, Sharma R, Gupta R. Comparative evaluation of combined spinal epidural anesthesia versus epidural anesthesia in lower limb surgeries. J Anaesthesiol Clin Pharmacol. 2014;30(1):78–83.
6. Catarci S, Sbaraglia F, Zanfini BA, Vagnoni S, Frassanito L, Draisci G. Combined spinal-epidural anesthesia in an urgent cesarean section for a patient with a single ventricle and phasic pulmonary artery flow: a case report. J Clin Anesth. 2018;49:39–41.
7. Agarwal A, Garg R, Joshi A, Verma S. Combined spinal-epidural anesthesia with epidural volume extension for hysterectomy in a patient with ventricular septal defect and pulmonary atresia: A case report. Saudi J Anaesth. 2016;10(1):99–101.
8. Rawal N, Holmström B, Crowhurst JA, Van Zundert A. The combined spinal-epidural technique. Anesthesiol Clin North Am. 2000;18(2):267–95.
9. Choi DH, Ahn HJ, Kim MH. The effect of intravenous dexmedetomidine on spinal anesthesia with hyperbaric bupivacaine. Anesth Analg. 2014;119(6):1359–64.

10. Rawal N, van Zundert A, Holmström B, Crowhurst JA. Combined spinal epidural technique. Reg Anesth. 1997;22(5):406–23.
11. Collis RE, Davis DW, Aveling W. Randomized comparison of combined spinal epidural and standard epidural analgesia in labor. Lancet. 1995;345(8960):1413–6.
12. Rawal N, Schollin J, Wesström G. Epidural versus spinal epidural block for Caesarean section. Acta Anaesthesiol Scand. 1988;32(1):61–6.
13. Thoren T, Holmström B, Rawal N, Hallberg S. Sequential combined spinal epidural block versus spinal block for cesarean section: Effects on maternal hypotension and neurobehavioral function of the newborn. Anesth Analg. 1994;78(6):1087–92.
14. McMorland GH, Douglas MJ. Effect of pH adjustments of bupivacaine on onset and duration of epidural analgesia for caesarean section. Can J Anaesth. 1988;35(5):457–60.
15. Alahuhta S, Kangas-Saarela T, Hollmén AI, and Edström HH was published in the journal Acta Anaesthesiologica Scandinavica in 1990. It appears in Volume 34, Issue 2, on pages 95–98.

