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# CONTINUOUS SPINAL ANAESTHESIA: A PROMISING TECHNIQUE FOR PROLONGED LOWER LIMB ORTHOPAEDIC SURGERIES

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**ABSTRACT** **Background:** Continuous Spinal Anaesthesia (CSA) is an advancing technique for prolonged lower limb orthopaedic surgeries. It awards prompt anaesthesia and analgesia, controlled sensorimotor blockade along with better haemodynamic stability using titrated and lower doses of Local Anaesthetic (LA) agents. This mode of regional anaesthesia using intrathecal catheter thus demonstrated to be an efficient and safe technique providing lesser incidence of Local Anaesthetic Systemic Toxicity (LAST) and Post Dural Puncture Headache (PDPH). This study integrates our experience with CSA for prolonged lower limb orthopaedic surgeries. Methodology: Our study comprised six cases posted for lower limb orthopaedic surgery belonging to ASA grades I and II. A 20-gauge catheter was threaded in subarachnoid space. The catheter was inserted 3cm intrathecally through 18-Gauge Touhy's needle in L3-L4 interspace. 1ml of hyperbaric Ropivacaine 0.75% with 10µg Dexmedetomidine as an adjuvant was injected. In our case series, we considered aliquots of isobaric Ropivacaine with a concentration of 0.75% for maintenance of anaesthesia wherefore 0.375% for analgesia. **Results:** All of our patients were hemodynamically stable intraoperatively as well as in the postoperative period. The average duration of analgesia in the postop period was 14-16 hours on the first top-up. Excellent patient and surgeon satisfaction was experienced. **Conclusion:** Our case series concludes that CSA is an effective and better option for Single-Shot and Epidural Anaesthesia in lower limb orthopaedic surgeries under skilled expertise

**KEYWORDS :** Continuous Spinal, prolonged orthopaedic surgeries, Ropivacaine, Dexmedetomidine

## INTRODUCTION

The concept of Continuous Spinal Anaesthesia (CSA) was first introduced by a British surgeon, Henry Dean in 1907. He kept a needle in the subarachnoid space throughout surgery and injected repeated doses of local anaesthetics through it. Further, this notion was improvised by Lemmon in 1993 to a malleable needle left in the space, for intermittent local anaesthetic administration via a rubber tube. The catheter technique was first described by Edward Touhy in 1944 ensuring a safer method for continuous spinal anaesthesia.[–1] CSA is found to be an effective choice of anaesthesia in obese, long-duration lower limb surgery, compromised respiratory and cardiac functions, history of previous back surgery and cases where General anaesthesia is contraindicated.

It has various advantages over techniques including Single-shot Spinal anaesthesia and Continuous Epidural anaesthesia like lower dosage requirements of local anaesthetic drugs. Hence, lesser risk of Local Anaesthetic Systemic Toxicity (LAST) and the ability to maintain an adequate level of a dense block with titrated doses of local anaesthetics even in a prolonged surgery with haemodynamic stability [3]

Although CSA has a higher association of post-dural puncture headache [PDPH] with larger bore needles and catheters, it is now acknowledged that PDPH is due to the cerebrospinal fluid [CSF] leakage through the dural puncture caused by the larger size of a needle. Therefore, the invention of microcatheters significantly decreased the percentage of complications. [2]

There is very little literature about CSA. We report our experience with a series of cases where CSA was used for lower limb Orthopaedic Surgeries.

## METHODOLOGY

The present study was conducted on six patients of the American Society of Anaesthesia (ASA) grade I and II who underwent elective lower limb Orthopaedic surgeries under Continuous Spinal Anaesthesia (CSA). Patients who were not willing for regional anaesthesia were excluded from the study.

The pre-anaesthetic check-up was done and all routine investigations i.e., hemogram, coagulation profile, kidney and liver function tests, chest X-ray and electrocardiogram (ECG) were done. All were within normal limits.

Patients were explained about the procedure by the anaesthesiologist along with its risks and benefits in the preoperative visit. They received oral Alprazolam 0.25mg the night before the surgery.

On the day of surgery, written informed consent was taken. Availability of cross-matched blood and nil by mouth (NBM) hours were confirmed. In the pre-operative room, an 18-gauge intravenous catheter was secured and the patient was shifted to the Operative Room. Standard monitors were attached. The patient's baseline blood pressure (BP), pulse rate (PR), saturation (SPO2), respiratory rate (RR) and ECG were recorded.

Inj. Ondansetron 4 mg IV was given as premedication and patients were preloaded with ringer lactate solution 15 ml/kg. Vasopressors were kept ready for any episode of hypotension.

A sitting position was given to the patient. Under all aseptic precautions, after local infiltration, 18-gauge Touhy's needle was inserted in L3-L4 interspace. After confirming the cerebrospinal fluid (CSF) free flow, a 20-gauge catheter was threaded cephalad through the needle in the subarachnoid space. A catheter was placed 3cm intrathecally. After the CSF test, 1st dose of 0.75% Inj. Ropivacaine (Heavy) 1cc + Inj. Dexmedetomidine 10µg was given through the catheter. Thereafter every 5mins, the level was assessed and a dose of 0.75% Inj. Ropivacaine (Heavy) 0.5cc was given through the catheter to achieve the desired level for surgery i.e., T10. Subsequent doses of 0.75% Inj. Ropivacaine (Isobaric) 0.5cc were given according to the surgical duration.

Intra-operative monitoring of BP, PR, SPO2, RR and ECG was done. Postoperatively, patients were assessed hourly for the duration of analgesia. Top up of 0.375% Inj. Ropivacaine (Isobaric) 0.3cc + Inj. Dexmedetomidine 5 µg was administered as per the patient's analgesic demand or VAS >4. Inj. Dexmedetomidine 5 µg was added according to the need and hemodynamic parameters.

Patients were observed for: Quality of anaesthesia (surgeon's satisfaction); Haemodynamic stability: intraoperatively and postoperatively; Sedation score (Ramsay sedation score);

Postoperative analgesia; Side effects if any [shivering, bradycardia, episodes of apnoea, pruritus or post-operative nausea vomiting (PONV)]; PDPH and patient's satisfaction.

**Table1: Demographic data:**

| SR NO. | AGE (years) | SEX | DIAGNOSIS | SURGERY NAME | ASA GRADE | CSA LEVEL |
|---|---|---|---|---|---|---|
| 1. | 53 | Male | 20-year-old O/c/o Left subtrochanteric femur fracture | Implant Removal | II | L3-L4 |
| 2. | 56 | Female | Right femur head AVN fracture | Hemiarthroplasty | I | L3-L4 |
| 3. | 40 | Male | Left distal 1/3rd tibia-fibula fracture | ORIF with Plating | I | L3-L4 |
| 4. | 42 | Male | Right neck femur fracture | ORIF with Dynamic Hip Screw insertion | II | L3-L4 |
| 5. | 69 | Female | Left hip AVN | Left Total Hip Replacement | II | L3-L4 |
| 6. | 46y | Male | Right acetabulum fracture | ORIF with Plating | II | L3-L4 |

[*ORIF-Open Reduction and Internal Fixation]

**Table 2: CSA Characteristics:**

| CASE NO. | Onset of action (minutes/seconds) | | DURATION OF ANALGESIA | CATHETER REMOVAL | COMPLICATION |
|---|---|---|---|---|---|
| | SENSORY | MOTOR | | | |
| 1 | 1min | 1min 46sec | 15hours 50mins | 24 hours after surgery | None |
| 2 | 1min 10sec | 1min 50sec | 15hours | 24 hours after surgery | None |
| 3 | 1min | 1min 26sec | 16hours 32mins | 24 hours after surgery | None |
| 4 | 50sec | 1min 10sec | 14hours 18mins | 24 hours after surgery | None |
| 5 | 1min 20sec | 1min 33sec | 15hours 24mins | 24 hours after surgery | None |
| 6 | 1min | 1min 28sec | 13hours 50min | 32 hours after surgery | None |

## RESULTS

- All of our patients were hemodynamically stable and satisfied with anaesthesia and analgesia in the postop period.
- The average total dose requirement was:

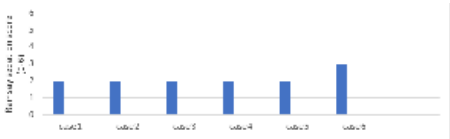
1.5cc of 0.75% Ropivacaine (Heavy)
1cc of 0.375%. Ropivacaine (Isobaric)
10µg of Dexmedetomidine

- The average duration of analgesia (as shown in Table 2) in the postop period was 14-16 hours on the first top-up of intrathecal Inj. Ropivacaine 0.375% 0.4cc and Inj. Dexmedetomidine 5µg combination.
- None of our patients developed shivering, bradycardia, episodes of apnoea, pruritus or postoperative nausea and vomiting.
- The patient's saturation and baseline parameters were within normal limits.
- Patients were sedated but easily arousable on command with an average Ramsay sedation score of 2-3 (Fig.1.1).
- None of the patients developed post-dural puncture headache.
- Excellent patient and surgeon satisfaction (Table 3 and Fig 1.2)
- The catheter was removed after 24 hours for five cases whereas, for one case of acetabulum fracture was removed after 32 hours to provide adequate analgesia as the patient was hypertensive, diabetic and chronic alcoholic.

**Table 3: Quality of anaesthesia (surgeon's satisfaction)**

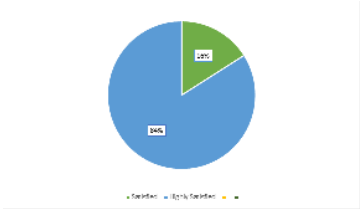
| Features | N=6 |
|---|---|
| Surgical field | 5 (83%) |
| Muscle relaxation | 6 (100%) |
| Immobility of patient | 6 (100%) |

**Figure1.1: Sedation score (Ramsay sedation score)**



[ Ramsay score: Level 1- Awake, agitated, conscious, restless; Level 2- Awake, cooperative, tranquil; Level 3- Responds to commands; Level 4- Asleep, brisk response to stimuli; Level 5- Asleep, sluggish response to stimuli, Level 6- Asleep, no response]

**Figure1.2: Patient Satisfaction**



[Patient's satisfaction: N=6; 16% - Satisfied; 84% - Highly Satisfied]

## DISCUSSION:

The major anaesthetic considerations of lower limb orthopaedic surgeries include the elderly age group with comorbidities and longer operative periods. These surgeries demand adequate muscle relaxation, good surgical field and patient immobility. Regional anaesthesia has many advantages including awareness of the patient, maintenance of protective reflexes, good postoperative analgesia, and early postoperative ambulation. [4] Continuous Spinal Anaesthesia (CSA) provides intraoperative controlled sensory and motor blockade to desired dermatomal level using an intrathecal (IT) catheter. This study includes a series of six patients posted for elective lower limb orthopaedic surgeries where CSA was found to be a safe and effective anaesthetic technique.

CSA has several benefits viz. it enables to titrate the dose of local anaesthetic thus allowing better sensory and motor block levels, lesser risk of local anaesthetic toxicity and shorter recovery periods. It helps to control the consequences of sympathetic blockade associated with epidural and single-shot spinal anaesthesia, ensuring better hemodynamic stability.[5]

In our study we used Inj. ropivacaine (Heavy) as it shows greater cardio stability and lesser neurotoxicity than bupivacaine. Ropivacaine has lower lipid solubility than bupivacaine, which results in lower penetration into myelinated motor fibres causing lesser motor blockade with greater sensory-motor differentiation. [6]

Ropivacaine can be used for epidural anaesthesia and analgesia, caudal block, sub-arachnoid block, peripheral nerve blocks, local infiltration as well as intra-articular administration. As compared to bupivacaine, although considering its subordinate efficacy with lower concentrations, it has proven to have similar potency with higher concentrations when used in peripheral nerve blocks[7]

We have used Ropivacaine (heavy) 0.75% for faster onset anaesthesia, however, for analgesia, we used Ropivacaine (isobaric) with lower concentration i.e., 0.375% which has a slower onset, well-predicted spread, lesser motor blockade and cardio stability. Hence, early

assessment of motor function was possible by the orthopaedic which promoted early ambulation of the patient.

The reduced dosage and less concentration of Local Anaesthetics (LA) can limit the extent of the block. Hence, various additives have been used in LA. In our study we used Inj. Dexmedetomidine, an alpha2 agonist, has been used as an adjuvant in central nerve blockade and peripheral nerve blockade. Due to various beneficial effects viz faster and early onset of the sensorimotor blockade, it has shown prolonged sensory as well as a motor block when combined with prilocaine, bupivacaine and ropivacaine. [8]

Mohamed T et.al. recorded a 50% increase in the two-segment regression time of sensory block after adding 5µg of Dexmedetomidine when compared to the same dose of hyperbaric bupivacaine alone. [9] Naaz et al. also concluded from their study that 10 µg of dexmedetomidine is the optimum intrathecal dose evaluating the need for the extent of anaesthesia and analgesia and its side effects. [10] Intrathecal Dexmedetomidine potentiates the effect of small dose LA and also gives hemodynamic stability without any side effects such as nausea, vomiting, pruritis and respiratory depression which are usually seen with other adjuvants like opioids. Hence, we used 10µg Dexmedetomidine for anaesthesia and 5 µg for analgesia.

Sabry Mohammed et al. with their study concluded CSA is a safe and effective technique in patients with cardiomyopathy undergoing lower abdominal surgeries. [11] They experienced events of hypotension (5%), bradycardia (10%) and arrhythmia (2.5%) in patients. However, none of the events was witnessed in any of our cases as our study exclusively included American Society of Anaesthesia grading I and II.

It has been observed that CSA provided superior cardiovascular stability with ease to perform with the surgeon and patient satisfaction. In our study, we experienced excellent haemodynamic constancy with CSA using Ropivacaine and Dexmedetomidine.

The frailty of cardiovascular balance among parturients having significant cardiac diseases requires a limited impact to the greatest extent possible on labour, surgical or vaginal delivery and analgesic interventions like labour analgesia. Palmer et al. observed that CSA for labour can be conducted using intrathecal opioids alone as well as local anaesthetics in progressive aliquots allowing the anaesthetist to compensate for undesired effects.[12] We preferred opioid-free analgesia in our cases which gave us ample results compared to studies carried out using intrathecal opioids.

In old age patients, physiological compensatory mechanisms are smothered which implies the instability associated with spinal anaesthesia which may be more serious and longer lasting. Reduced cardiovascular adaption especially in old age can cause increased morbidity with the rapid spread of sympathetic block. [13]

In this study, using CSA allowed titrated administration of LA which contributed to overcome this effect. Michaloudis et al. [14] studied that CSA provides safe intraoperative anaesthesia and effective postoperative analgesia with minimal side effects in elderly or high-risk surgical patients.

Lonjaret L et.al. reported the use of continuous spinal anaesthesia for hip fracture surgery in a patient with pulmonary arterial hypertension can be the first choice of anaesthesia where GA would be associated with higher morbidity.[15]

With a history of prior spinal surgery, epidural block failure is a little higher (40%) [16], where CSA can be a better option as CSF aspiration indicates the endpoint for the correct placement of the IT catheter.

There have been various recommendations for CSA in obese patients where Challenges mainly comprise of: difficult airway, Higher rates of Epidural catheter failure and unintentional dural puncture.[17] CSA can be an attractive option with rapid titration and greater assurance of successful blockade.

Spinal or microcatheters might be mistaken as epidural catheters. In our study, we have used an 18 Gauge Tuohy's needle with 20 Gauge epidural catheter as an intrathecal catheter due to its easy availability and its cost-effectiveness. Furthermore, microcatheters like Spinocath are expensive. However, none of our patients developed Post Dural Puncture Headache (PDPH) or other complications.

Denny et.al studied various factors causing Cauda Equina Syndrome in cases with CSA. He concluded that; a catheter placed caudally inserted in lateral position, use of 5% lignocaine and hyperbaric solutions along with excess local anaesthetic can be considered as major factors leading to Cauda Equina Syndrome. Thus, we availed a safer recommendation of insertion of catheter in sitting position not more than 3cm in subarachnoid space. [20]

These intrathecally placed catheters may lessen the risk of PDPH. The mechanism of PDPH is known to be leakage of CSF from the subarachnoid space into the epidural compartment, leading to intrathecal hypotension and causing traction on pain-sensitive intracranial structures. An experimental study described the formation of fibrin around this IT catheter at the dural tear which additionally reduces the rate of CSF losing rate from subarachnoid space.[18]

In our study, we kept the IT catheter in situ for a minimum of 24 hours. Ahuja P et al. concluded that the span of IT catheterization affects the incidence of PDPH, with numerous studies supporting 24hrs of placing the catheter intrathecally.[19]

Our overall experience with CSA included excellent hemodynamic stability using Ropivacaine. Administration of Dexmedetomidine as an adjuvant provided a better surgical field and comfort for the surgeon and a prolonged analgesic period. Thereby, we preferred opioid-free analgesia which favoured early ambulation.

All our patients were calm and co mfortable without any respiratory depression throughout the procedure and postoperative period. Patients were followed up in subsequent OPD visits to enquire about any event of PDPH. We did not encounter any incidence of PDPH.

Thus, CSA provided extensive intraoperative and postoperative satisfactory results with the patient as well as the Orthopedician.

We suggest large multicentric studies especially in high-risk cases using Spinocath to validate our study results and patient benefits. Proficiency can be achieved by adequate knowledge, training and making the necessary equipment available for CSA.

## CONCLUSION:

Our case series concludes that CSA is an effective and better option for Single-Shot and Epidural Anaesthesia in lower limb orthopaedic surgeries under skilled expertise.

## CONFLICTS:

Nil.

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