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Original Research Article

Retrospective Evaluation of Continuous Spinal Anesthesia in Lower Abdominal Surgeries: Assessment of Efficacy, Ease of Administration, and Safety

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Abstract:

“**Background:** Continuous Spinal Anesthesia (CSA) is a neuraxial anesthetic technique that allows incremental administration of local anesthetics, providing controlled sensory blockade, prolonged anesthesia, and improved hemodynamic stability during lower abdominal surgeries.

Aim: To retrospectively evaluate the efficacy, ease of administration, and safety of CSA in patients undergoing lower abdominal surgeries.

Methodology: This retrospective observational study was conducted in the Department of Anaesthesiology, SNMMCH, Dhanbad, Jharkhand. Medical records of 90 patients who underwent lower abdominal surgeries under CSA were reviewed. Data regarding demographic characteristics, technical aspects of catheter placement, efficacy outcomes, hemodynamic parameters, and perioperative complications were analyzed using descriptive statistics.

Results: Most patients were aged 41–60 years (42.2%) and belonged to ASA II status (46.7%). Successful catheter placement on the first attempt was achieved in 70% of cases, with technical difficulties reported in only 13.3%. Surgery was successfully completed under CSA in 94.4% of patients, while adequate surgical anesthesia was achieved in 92.2%. Conversion to general anesthesia was required in 5.6% of cases. Hypotension was the most common complication (20%), whereas no neurological complications were observed.

Conclusion: CSA is an effective, technically feasible, and safe anesthetic technique for lower abdominal surgeries, providing high success rates, satisfactory hemodynamic stability, and a low incidence of manageable complications.

Keywords: Continuous Spinal Anesthesia, Lower Abdominal Surgery, Efficacy, Safety, Hemodynamic Stability, Regional Anesthesia.

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Introduction

Continuous spinal anaesthesia (CSA) is one of the regional anaesthetic techniques that is based on the insertion of a catheter into the subarachnoid space, enabling the frequent injection of local anaesthetic agents for the maintenance of anaesthetic for long surgical interventions [1]. CSA has since been modified and improved, and is a valuable alternative to single-shot spinal anaesthesia and epidural anaesthesia in specific patient groups. This method is useful for the delivery of small discrete doses of local anaesthetic, so that the level of sensory and motor blockade can be controlled [2]. This is especially useful in lower abdominal surgery, where the requirement for anaesthetic is dependent on the length of the surgery and where haemodynamic stability is a significant issue, particularly for elderly and high-risk patients.

Lower abdominal surgery covers a wide spectrum of procedures, such as urological, gynaecologic, colorectal and general surgical procedures [3]. These procedures are often carried out in individuals with other co-existent diseases, aged people and weak physiological reserve. Though frequently used, general anaesthesia can be associated with numerous peri-operative complications including respiratory depression, postoperative nausea and vomiting, delayed postoperative recovery and haemodynamic instability. Therefore, the use of regional anaesthetic techniques has become important because they offer effective anaesthetic coverage, decrease the use of systemically administered drugs and enable quicker recovery after surgery. Of these, the ability to provide continuous and adjustable neuraxial blockade as per the surgical needs and patient response is the unique advantage of the technique provided by CSA.

The use of a CSA provides one of the major advantages of being able to titrate the dose of local anaesthetic over time, thus reducing a rapid onset of sympathetic blockade often seen with single shot spinal anaesthetic. In conventional spinal anaesthesia, a full spinal dose may cause sudden hypotension and bradycardia, especially in elderly patients and those with an underlying cardiovascular disease [4]. By contrast, the incremental dosing provided by a indwelling spinal catheter provides a controlled onset of anaesthetic in CSA which results in increased haemodynamic stability. This is particularly appealing for patients who have long surgeries in the lower abdomen and cannot withstand large swings in blood pressure and heart rate.

Although it has potential benefits, the use of CSA is underutilized in everyday anaesthetic practice. Despite its limited use, some factors such as technical difficulty, unfamiliarity of anaesthesiologists to use spinal catheter, and historical reports of complications caused by spinal catheter have contributed to its limited use [5]. In the case of the insertion of a catheter into the subarachnoid space, this will require expertise and experience and may be hampered by difficulties with the catheter being put in place, the catheter moving out of position, kinking or blockage. Moreover, the use of the technique has been limited by concerns about post-dural puncture headache (PDPH), infection, neurological injury and catheter-related complications.

Advances in neuraxial equipment and improved catheter design have greatly improved the safety profile of CSA. Use of modern microcatheters and dedicated spinal catheter systems have decreased the likelihood of PDPH and enhanced catheter handling [6]. However, evidence of neurological problems, such as the cauda equina syndrome from earlier microcatheter systems, resulted in a waning interest in the technique and fewer training opportunities for younger anaesthesiologists. As a result, very few institutions use CSA routinely with all their patients, but rather only use it in the subset of patients at high risk.

In recent years, the interest in the use of CSA has been regained because of its positive clinical results and the increasing focus on personalising anaesthetic treatment. However, there are some indications of good surgical conditions, extended postoperative pain and less need for systemic opioids after CSA [7]. This is especially useful when surgical time is longer than anticipated, without having to convert to general anaesthetic. In addition, there may be less risk of systemic toxicity since the total dose of local anaesthetic used in the CSA may be less, whilst still providing effective sensory and motor blockade.”

“The efficacy and safety of anaesthetic techniques in real-world practice is important and is greatly assisted by retrospective evaluation. They can also be useful for providing information on routine clinical practice, patient outcomes, technical difficulties, and rates of complications in different patient populations, as opposed to a controlled clinical study. These assessments can lead to the identification of factors associated with successful administration, procedural efficiency and perioperative safety. They also help inform evidence-based decision making and future clinical protocols and training efforts.

CSA efficacy is assessed at the level of whether surgical anaesthesia is adequate and the length of the block, as well as the need for supplemental analgesia and conversion to other anaesthetic methods. Ease of administration includes successful placement of the catheter, number of attempts needed to place the catheter, catheter function and time to place the catheter. Safety assessment involves surveillance for haemodynamic instability, neurological complications, PDPH, infection, urinary retention and other peri-operative complications. The complete evaluation of these parameters is crucial to assess the overall clinical value of CSA in lower abdominal surgeries.

Anaesthetic techniques that help to ensure haemodynamic stability, effective analgesia and a fast recovery are now appreciated in the era of improved recovery protocols and patient-centred perioperative care. CSA has some qualities that make it consistent with these goals but the use of CSA is restricted by ongoing concerns and lack of current evidence. Hence, a retrospective study of continuous spinal anaesthesia for lower abdominal surgeries is justified to obtain a detailed picture of the effectiveness, ease and safety in the day-to-day practice. This evidence could help fill knowledge gaps, aid in anaesthetic selection, and prompt increased use of this valuable neuraxial technique in the right surgical patients.

Methodology

Study Design: The present study will be a retrospective observational hospital-based study conducted to evaluate the efficacy, ease of administration, and safety of Continuous Spinal Anesthesia (CSA) in patients undergoing lower abdominal surgeries.

Study Area: The study will be conducted in the Department of Anaesthesiology, Shahid Nirmal Mahato Medical College and Hospital (SNMMCH), Dhanbad, Jharkhand, India.

Study Duration: The study will be carried out over a period of one year.

Study Participants: A total of 90 patients who underwent lower abdominal surgeries under Continuous Spinal Anesthesia and whose complete medical records are available will be included in the study.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients who underwent elective or emergency lower abdominal surgeries under Continuous Spinal Anesthesia.
- Patients with complete anesthesia records and hospital case files.
- Patients belonging to American Society of Anesthesiologists (ASA) physical status I–IV.
- Patients operated during the study period with documented perioperative data."

Exclusion Criteria

- Patients with incomplete or missing medical records.
- Patients who received general anesthesia or other regional anesthesia techniques without Continuous Spinal Anesthesia.
- Obstetric and gynecological surgical cases.
- Patients with documented contraindications to spinal anesthesia.
- Patients whose intraoperative or postoperative outcome data are unavailable.

Sample Size: The sample size for the present study will consist of 90 patients meeting the eligibility criteria.

Procedure: A retrospective review of hospital records and anesthesia charts of patients who underwent lower abdominal surgeries under Continuous Spinal Anesthesia will be conducted. Relevant data will be collected from electronic medical records, anesthesia records, operative notes, and postoperative follow-up documentation. Demographic variables including age, sex, body weight, and ASA physical status will be recorded. Clinical information regarding comorbidities, indication for surgery, type of lower abdominal surgery, and duration of the procedure will also be obtained.

Details related to Continuous Spinal Anesthesia will be evaluated, including the lumbar interspace selected for catheter placement, patient position during the procedure, number of attempts required for successful catheter insertion, technical difficulties encountered, local anesthetic agent used, initial intrathecal dose administered, supplementary top-up doses, and total anesthetic dosage. The ease of administration will be assessed based on the number of attempts required, successful catheter placement, and documented procedural difficulties.

The efficacy of Continuous Spinal Anesthesia will be determined by the ability to complete the surgical procedure without conversion to general anesthesia or the need for an alternative anesthetic technique. Intraoperative hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation will be reviewed. The requirement for vasopressor support, intravenous fluid administration, or additional analgesic supplementation will also be documented."

"Safety outcomes will be evaluated by recording perioperative and postoperative complications associated with Continuous Spinal Anesthesia. These complications may include hypotension, bradycardia, nausea, vomiting, post-dural puncture headache, neurological deficits, catheter-related complications, failed block, respiratory complications, and any other adverse events noted in the patient records. Postoperative recovery parameters and duration of hospital stay will also be assessed wherever available. The collected data will then be compiled and analyzed to determine the overall efficacy, ease of administration, and safety profile of Continuous Spinal Anesthesia in lower abdominal surgeries.

Statistical Analysis: The collected data will be entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 27.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics will be used to summarize the data. Continuous variables will be expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on data distribution. Categorical variables will be presented as frequencies and percentages. Associations between study variables will be analyzed using the Chi-square test or Fisher's exact test for categorical data and Student's t-test or Mann–Whitney U test for continuous variables, as appropriate. A p-value of less than 0.05 will be considered statistically significant. The results will be presented using tables, charts, and graphs wherever appropriate.

Result

Table 1 shows the distribution of patients according to their demographic and clinical characteristics among the 90 study participants. The majority of patients belonged to the age group of 41–60 years, accounting for 38 (42.2%) cases, followed by patients aged more than 60 years with 28 (31.1%) cases, while the 18–40 years age group comprised 24 (26.7%) patients. Regarding gender distribution, males predominated with 56 (62.2%) patients, whereas females constituted 34 (37.8%) patients. Assessment of preoperative physical status using the American Society of Anesthesiologists (ASA) classification revealed that most patients were categorized as ASA II, representing 42 (46.7%) cases, followed by ASA III with 24 (26.7%) cases and ASA I with 18 (20.0%) cases. Only 6 (6.6%) patients belonged to ASA IV status. Overall, the study population was predominantly composed of middle-aged male patients with moderate systemic disease (ASA II), indicating that continuous spinal anesthesia was mainly utilized in patients with relatively stable but clinically significant comorbid conditions."

Table 1: Distribution of Patients According to Demographic and Clinical Characteristics (n=90)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–40	24	26.7
	41–60	38	42.2
	>60	28	31.1
Gender	Male	56	62.2
	Female	34	37.8
ASA Status	I	18	20
	II	42	46.7
	III	24	26.7
	IV	6	6.6

Table 2 presents ˙the characteristics of continuous spinal anesthesia administration among the 90 patients included in the study. The findings show that the L3–L4 interspace was the most commonly utilized lumbar level for catheter placement, accounting for 54.4% (n=49) of cases, followed by L2–L3 (23.3%, n=21) and L4–L5 (22.3%, n=20). Regarding patient positioning during the procedure, the sitting position was preferred in the majority of patients (75.6%, n=68), whereas the lateral position was used in 24.4% (n=22) of cases. Successful catheter placement was achieved on the first attempt in 70% (n=63) of patients, while 22.2% (n=20) required two attempts and only 7.8% (n=7) required three or more attempts. Furthermore, technical difficulty was absent in most cases (86.7%, n=78), with only 13.3% (n=12) experiencing procedural difficulties. Overall, these findings indicate that continuous spinal anesthesia was generally easy to administer, with a high first-attempt success rate and minimal technical challenges.

Table 2: Characteristics of Continuous Spinal Anesthesia Administration (n=90)

Parameter	Category	Frequency (n)	Percentage (%)
Lumbar Interspace Used	L2–L3	21	23.3
	L3–L4	49	54.4
	L4–L5	20	22.3
Patient Position	Sitting	68	75.6
	Lateral	22	24.4
Number of Attempts	One	63	70
	Two	20	22.2
	≥ Three	7	7.8
Technical Difficulty	Present	12	13.3
	Absent	78	86.7

Table 3 presents the efficacy of˚ Continuous Spinal Anesthesia (CSA) in lower abdominal surgeries among 90 patients. The findings demonstrate a high success ˙rate, with 85 patients (94.4%) successfully completing surgery under CSA without the need for conversion to another anesthetic technique. Adequate surgical anesthesia was achieved in 83 patients (92.2%), indicating effective intraoperative pain control in the majority of cases. Only 5 patients (5.6%) required conversion to general anesthesia, reflecting a low failure rate. Supplemental intraoperative analgesia was needed in 11 patients (12.2%), while 18 patients (20.0%) required vasopressor support to manage hemodynamic changes. Overall, the results indicate that CSA is a highly effective anesthetic technique for lower abdominal surgeries.

Table 3: Efficacy of Continuous Spinal Anesthesia in Lower Abdominal Surgeries (n=90)

Outcome Parameter	Frequency (n)	Percentage (%)
Successful Completion of Surgery Under CSA	85	94.4
Conversion to General Anesthesia	5	5.6
Adequate Surgical Anesthesia Achieved	83	92.2
Intraoperative Supplemental Analgesia Required	11	12.2
Intraoperative Vasopressor Requirement	18	20

Table 4 presents the intraoperative hemodynamic changes observed following continuous spinal anesthesia among 90 patients. The mean baseline heart rate was 84.6 ± 10.8 beats/min, which decreased to a lowest recorded value of 72.3 ± 9.4 beats/min during surgery, indicating a moderate reduction in heart rate. Similarly, the mean baseline arterial pressure was 96.8 ± 11.5 mmHg and declined to 78.6 ± 10.1 mmHg intraoperatively, reflecting the expected sympathetic blockade associated with spinal anesthesia. The average duration of surgery was 96.4 ± 24.7 minutes. Patients received a mean total intrathecal bupivacaine dose of 9.2 ± 2.3 mg, demonstrating effective anesthesia with acceptable hemodynamic stability throughout the operative period.

Table 4: Intraoperative Hemodynamic Changes Following Continuous Spinal Anesthesia (n=90)

Hemodynamic Variable	Mean ± SD
Baseline Heart Rate (beats/min)	84.6 ± 10.8
Lowest Heart Rate Recorded (beats/min)	72.3 ± 9.4
Baseline Mean Arterial Pressure (mmHg)	96.8 ± 11.5
Lowest Mean Arterial Pressure (mmHg)	78.6 ± 10.1
Duration of Surgery (minutes)	96.4 ± 24.7
Total Intrathecal Bupivacaine Dose (mg)	9.2 ± 2.3

Table 5 presents the safety profile and complications associated with continuous spinal anesthesia among 90 patients. The findings show that the majority of patients, 58 (64.4%), experienced no complications, indicating a favorable safety profile of the technique. Among the observed adverse events, hypotension was the most common complication, affecting 18 (20%) patients, followed by nausea/vomiting in 10 (11.1%) patients and bradycardia in 8 (8.9%) patients. Failed block was reported in 5 (5.6%) cases, while post-dural puncture headache occurred in 3 (3.3%) patients. Catheter-related complications and respiratory complications were infrequent, occurring in 2 (2.2%) and 1 (1.1%) patients, respectively. Notably, no neurological complications were observed, suggesting that continuous spinal anesthesia is a relatively safe anesthetic technique with manageable and predominantly minor complications.

Table 5: Safety Profile and Complications Associated with Continuous Spinal Anesthesia (n=90)

Complication	Frequency (n)	Percentage (%)
Hypotension	18	20
Bradycardia	8	8.9
Nausea/Vomiting	10	11.1
Post-Dural Puncture Headache	3	3.3
Failed Block	5	5.6
Catheter-Related Complications	2	2.2
Respiratory Complications	1	1.1
Neurological Complications	0	0
No Complications	58	64.4

Discussion

This present study kinda evaluated how well continuous spinal anesthesia (CSA) worked, how easy it was to administer, and how safe it was in 90 patients undergoing surgeries of the lower abdomen. Overall, the results showed a high rate of success, decent hemodynamic stability, and a small number of complications, so it backs up the idea that CSA is actually a dependable anesthetic approach, especially for patients who also have other systemic diseases. In this work, most participants were in the 41–60 years band (42.2%), and 31.1% were more than 60 years old. Similar demographic patterns have been described by Lux (2012) [8], who reported that CSA is often chosen for older, higher-risk surgical groups, mainly because it can create a gradual sympathetic blockade and keep cardiovascular function steadier. Also, 73.4% of our patients were in ASA II and III categories, which is pretty much aligned with what Kumar et al. (2008) [9] found, where most individuals receiving CSA had notable systemic comorbidities and they needed careful anesthetic management.

The technical feasibility of CSA as seen in the current study was pretty encouraging actually. Catheter placement happened most often at the L3–L4 interspace (54.4%), and when it came to successful insertion, the first attempt worked in 70% of patients. In 86.7% of cases, technical difficulty was just not there. Overall, these outcomes fit with the prospective work by Van Gessel et al. (1995) [10], who described successful catheter placement for most patients while keeping procedural hassles to a minimum. Likewise, De Andrés et al. (1999) [11] reported that CSA was fairly simple in technical terms, but only when it was carried out by experienced anesthesiologists. Our relatively high first-attempt success rate implies that CSA can be folded quite well into routine anesthetic practice, assuming the right expertise is on hand and patient positioning is properly arranged.

The most significant finding of the present study was found to be the high effectiveness of CSA. The surgery was successful in 94.4% of patients under CSA and sufficient surgical anaesthesia was provided in 92.2%. The percentage of patients that needed to be converted to general anesthesia was 5.6%. The results are similar to those found by Lux (2012) who looked at 1212 CSA cases and found that over 90% of them were successful, while about 6% failed. Likewise, Horlocker et al. (1997) [12] reported a failure rate for CSA of 6% very similar to the failure rate of 5.6% in the present study. Only 12.2% required supplemental intraoperative analgesia, which further supports the safety of the neuraxial blockade results of continuous intrathecal dosing. The results suggest that CSA is a reliable anesthesia for lower abdominal surgery with the potential of extending the blockade if needed.

One of the major benefits of CSA is hemodynamic stability. The mean HR decreased from 84.6 to 72.3 beats per minute during the operation and mean arterial pressure (MAP) decreased from 96.8 to 78.6 mmHg intraoperatively. These cuts have not compromised cardiovascular parameters sufficiently to cause a significant increase in the proportion of patients who needed vasopressor support; this rate was only 20%. This was echoed by Favarel-Garrigues et al. (1996) [13] who showed that titrated CSA resulted in substantially less hypotension than single-shot spinal anesthesia (SSA). Another report by Minville et al. in 2006 [14] also found that hip fracture surgery done with CSA experienced fewer cases of severe hypotension. We found a mean intrathecal dose of bupivacaine of 9.2 mg, which is not a high dose and confirms the idea of incremental administration to attain effective anesthesia with the least degree of abrupt sympathetic blockade and instabilization of the cardiovascular system.

As far as safety is concerned, the present study showed a beneficial complication profile. 64.4% of patients had no complications in all, highlighting the safety of the technique. The most frequent complication was hypotension that presented in 20% of the patients. This incidence was similar to that reported by Horlocker et al (1997) where the most common adverse event was transient hypotension, which was easily treated with vasopressors and fluid. Bradycardia was seen in 8.9% and nausea and vomiting in 11.1% of the patients. These rates are comparable to previous CSA studies and are a measure of the physiological consequences of neuraxial sympathetic blockade and not a measure of any specific complication. Importantly, any events were dealt with without any appreciable morbidity.

Our incidence of post-dural puncture headache (PDPH) was only 3.3% which is comparable to previously published studies. Standl et al 1995 [15] reported an incidence rate of PDPH at around 1% and Kumar et al 2008 [16] found 5.6% of high-risk patients developing PDPH when undergoing major abdominal surgery under CSA. There may be several reasons for this relatively low incidence in the present study, such as careful placement of the needle, use of small-gauge spinal equipment, and the fact that most of the patients were middle-aged and older, who have lower risk for PDPH. In addition, serious complications were of low incidence (2.2%), corroborating the results of Horlocker et al. (1997) who reported that there were very few serious catheter-related adverse events in their study of 603 continuous spinal anesthesias.

The overall findings from the present study are consistent with the recent literature and show that CSA is a proven effective technically viable and safe anesthetic technique for lower abdominal surgery. The high surgical success rate (94.4%), low conversion rate to general anesthesia (5.6%), controllable incidence of hypotension (20%), and no neurological complication supports the use of CSA as a useful regional anaesthetic technique, especially in the elderly and medically compromised patient who requires accurate titration and is haemodynamically stable.

Conclusion

The present retrospective study concludes that Continuous Spinal Anesthesia (CSA) is an effective, technically feasible, and safe anesthetic technique for lower abdominal surgeries. The procedure demonstrated a high surgical success rate, with 94.4% of patients successfully completing surgery under CSA and 92.2% achieving adequate surgical anesthesia. Catheter placement was generally easy, as most patients required only a single attempt and experienced minimal technical difficulties. CSA also provided satisfactory intraoperative hemodynamic stability, with only a limited proportion of patients requiring vasopressor support. The safety profile was favorable, as the majority of patients experienced no complications, while observed adverse events such as hypotension, bradycardia, nausea, and post-dural puncture headache were infrequent and manageable. The absence of neurological complications further supports the reliability of CSA. Overall, CSA represents a valuable anesthetic option, particularly for patients requiring controlled neuraxial blockade and stable perioperative management.

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