ORIGINAL ARTICLE

Continuous spinal anesthesia for selective spinal block in lower limb surgery

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ABSTRACT

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Background: Continuous spinal anesthesia (CSA) is a reliable method for providing effective anesthesia and offers considerable advantages over 'single-shot' spinal anesthesia (SSSA), as it provides a well-controlled anesthesia using small doses of local anesthetics.
Objective: To compare the effectiveness and safety of CSA to get a selective spinal block in lower limb surgery and to assess the complications following the technique compared to single shot technique.
Methods: This study was a prospective randomized double blinded controlled clinical trial , conducted in Zagazig University Hospitals. Sixty both sexes patients of American Society of Anesthesiology physical status class I–II and undergoing unilateral lower limb elective surgeries were enrolled in this study during the period from Jan 2016 to Jan 2018. According to the used technique for establishment of selective spinal block, these patients were randomly allocated into two groups: one received CSA using epidural catheter (CSA group), and the other group received single shot spinal anesthesia (SSSA group).
Results: There was more hemodynamic stability in CSA group rather than SSSA group . The need for general anesthesia supplementation was higher in SSSA group than the CSA group. PDPH was more frequent and more severe in CSA group . No patient in our study developed motor loss , sensory loss or cauda equine syndrome .
Conclusion: We conclude that Continuous spinal anesthesia is an effective and safe choice with good hemodynamic stability and a high degree of success, for unilateral lower limb surgeries specially when haemodynamic stability is a concern.
Keywords: continuous spinal anesthesia; single shot spinal anesthesia; lower limb surgeries.

INTRODUCTION

Regional anesthesia has several benefits over general anesthesia for orthopedic surgery [1]. The technique of continuous spinal anesthesia (CSA) is thought to have the advantage of providing greater control over anesthetic management than the conventional single-shot needle injection technique [2].

Continuous spinal anesthesia (CSA) is the method of providing spinal anesthesia by small doses of local anesthetic which are injected frequently as required into the subarachnoid space [3] and provide adequate duration of anesthesia with only minimal hemodynamic changes [4]; thus, minimizing the risks of cardiovascular and respiratory disturbances [5].

CSA possesses numerous advantages over a single-shot spinal anesthesia (SSSA) as follows: (a) gives local anesthetics in small incremental doses

according to the patient's needs; (b) decreases doses of local anesthetics and thus decreases systemic toxic effects; (c) assures hemodynamic stability; and (d) prolongs anesthesia by supplemental doses of spinal local anesthetics when surgery is lengthened [6]. A standard epidural kit can be used to reduce the difficulties and complications of CSA with microcatheters [7], which involve difficult catheter insertion, breakage, poor anesthesia, post-dural puncture headache (PDPH), and infrequently, development of cauda equina syndrome [8].

The use of continuous spinal anesthesia with the conventional 18-G epidural needle is an effective and safe anesthetic approach especially in high-risk patients. The failure rate is very low as the escape of CSF easily detects placement of the Tuohy needle in the subarachnoid space [9]. The aim of our study is to compare the effectiveness and safety of CSA to get a selective spinal block in

lower limb surgery and to assess the complications following the technique compared to single shot technique.

PATIENTS AND METHODS

This study was a prospective randomized double-blind Comparative clinical trial. Sixty ASA ps class I and II both sexes patients undergoing elective unilateral lower limb surgeries (orthopedic, vascular or plastic surgery) were enrolled in this study. The age of these patients ranged from 21 –50 years, their body weight ranged from 72 to 109 kg and their height ranged from 164 to 185 cm. This study was achieved in the period between Jan 2016 and Jan 2018 at Zagazig University Hospitals, after obtaining a written informed consent from all patients and approval of our institutional review board (The research ethical committee of Faculty of Medicine, Zagazig University). This study was performed according to the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. According to the used technique for providing of selective spinal block, these patients were randomly allocated into two 2 equal groups. The first group received CSA via epidural catheter and was called CSA group and the second group received SSSA via spinal needle and was called SSSA group. The study procedures was written each on a separate paper and each paper was put in a sealed envelope and the first patient choose one of the two envelopes then every odd number patient received the procedure the first patient randomly chose and even number patients received the other procedure. The sample size was calculated by open Epi software program after comparing mean and standard deviation of both techniques from previous studies.

Patients excluded from the study were those refusing the technique or unable or unwilling to give informed consent, patients with a history of allergic reaction to local anesthetics, presence of a preexisting neurological disease, coagulation disorders and/or administration of thromboprophylaxis (Heparin less than 6 hours or LMWH less than 12 hours) , patients with chronic headache and/or history of PDPH, ASA ps class III or IV with significant coexisting disease or major organ dysfunction.

Method of establishment of selective spinal anaesthesia for lower limb surgery via continuous and single shot technique:

All patients were brought to anesthesia room 30 min pre-operatively. and the basal vital signs readings was taken. The Standard monitors were placed; pulse oximetry, non-invasive blood pressure cuff and ECG . Insertion of the largest cannula the patient can tolerate (preferred 18 G) and 500cc ringer solution was administered. Oxygen was delivered via a nasal cannula. Patients were sedated by midazolam (1 mg IV) repeated every 2 minutes until the patient was calm and cooperative. The patient's vital signs were monitored and recorded throughout the procedure. All facilities for induction of general anesthesia and resuscitation was ready and available to be used when indicated and in case of failure of the technique.

In CSA group, all blockades for CSA were performed by paramedian approach in the sitting position in L3-L4 or L4-L5 interspace using a 20-gauge epidural catheter through 18-gauge Tuohy needle. Under complete aseptic technique, local infiltration of the chosen interspinal space with 4 ml of epinephrine free 1% lidocaine, the skin wheal was done with an insulin needle followed by more deep injections with a longer needle 4 to 5 cm, 22 or 25G. The 18G Tuohy needle was introduced and using the loss of resistance technique for identification of the epidural space. The needle was pushed (with its point oriented laterally) a few millimeters forward, until the dura was pierced. This was confirmed by the appearance of spinal fluid at the hub of the needle then the point of the needle was turned cephaled to orient the catheter cephaled. The plastic catheter director was used to decrease CSF loss and avoid kinking of the catheter. At this moment, the catheter was threaded into the needle as fast as possible, to diminish the loss of CSF. It was inserted 2 to 3cm inside the subarachnoid space then the epidural needle was removed. CSF should come out easily through the catheter. It was then closed by a stopcock, with a bacterial filter, Injections were made under complete aseptic technique . The patient was turned on his/her side with the operating limb dependent and 5 mg (1 ml) of 0.5% hyperbaric bupivacaine, was injected intrathecally as initial loading dose. Considering the capacity of the catheter and bacterial filter (the volume of local anesthetic needed to fill the catheter and the bacterial filter which was already determined before about 0.8 ml), , so we flushed the catheter with 0.8 ml local anesthetic after each injection) . If within 10 minutes after the initial loading dose injection of hyperbaric bupivacaine, a motor or sensory block didn't occur or if the sensory level didn't reach at

least T 10 dermatome, a second dose of hyperbaric bupivacaine (half of the initial loading dose) was injected. If within 5 minutes after the second dose injection, a motor or sensory block didn't occur or if the sensory level didn't reach at least T 10 dermatome this was considered as failure of the technique. When the sensory level decreased during the operation and the surgical situation could allow, the operating table would be turned laterally 45˚ towards the operating side and an incremental dose (5 mg) of 0.5% hyperbaric bupivacaine would be given through the catheter. The position would be kept for 15 minutes.

In SSSA group, patients were placed in the lateral position with the operative side in the dependent position. Dural puncture was performed using a 25-gauge Quincke point spinal needle inserted in the L3-4 or L4-L5 interspace with a paramedian approach under aseptic conditions. With the bevel of the needle directed to the surgical side (dependant). After dural After dural puncture, 7.5 mg (1.5 ml) of 0.5% hyperbaric bupivacaine was injected over 60 s. If within 15 minutes after the intrathecal injection of bupivacaine motor or sensory block didn't occur or if the sensory level didn't reach at least T 10 dermatome this was considered as failure of the technique. 15 minutes after the intrathecal injection of bupivacaine, the patient position was turned from lateral to the supine position or any other position according to surgical needs. Also inability to either puncture the dura (dry tap) or obtain free flow of cerebro-spinal fluid (CSF) after alleged dural puncture was considered as a failure in both techniques and the patient received either single shot spinal in setting position or general anesthesia. vital signs were recorded every 5 min throughout the operation.

In this study, the following data were detected and recorded in both groups: 1- Patients demographic data, dural puncture level, types and duration of surgeries in the two tested groups: Patients demographic data (ages, body weights, body height, sex, ASA ps classes (clsss I&II), dural puncture level (L3-4 & L4-5), types and duration of surgeries (min.) were detected and recorded in both groups. 2- Characters of the used technique for providing selective spinal anesthesia: These include the following: a- Total performance time: It is the time from the start of skin puncture by either spinal or epidural needle till removal of spinal needle in SSSA technique or fixation of epidural catheter in CSA technique. b- Time per min to reach T10 sensory block level: Sensory block level of the blocked side was tested by pin prick every 2 min. c- The quality of the provided motor blockade: Motor power of the blocked lower limb was assessed every five minutes after intrathecal administration of local anaesthetic for 15 minutes via a Bromage scale [10]. This scale is 4 points scale:1=no motor block; 2=partial block, ability of flex the knee; 3=almost complete block, only plantar flexion of the ankle possible; and 4=complete block, no voluntary movement of the limb possible). At 15 minutes, the mean of motor block scores in each group were detected and recorded.

d- Total local anesthetic (LA) dose (mg/patient) which was used with each technique. e- Failure rate. 3- The hemodynamic changes: Heart rate (HR) and mean arterial pressure (MAP) were measured and recorded preoperatively (baseline values), intraoperatively at 30 min., 1hr, at end of surgery, and postoperatively at 1 hr after surgery.

4- Respiratory changes: Respiratory rate (RR) i.e. (respiratory cycle/min), and SpaO2 (mmHg) were measured and recorded preoperatively (baseline values), intraoperatively at 30 min., 1hr, at end of surgery, and postoperatively at 1 hr after surgery.

5- The incidences of various associated side effects: These may include hypotension (a decrease in MAP is more than 20% of its baseline value), bradycardia (HR < 50 b/m), vomiting, shivering, urine retention, respiratory depression (RR < 8 breath/min and or SpO2< 92% with room air), post-dural puncture headache (PDPH) and neurological deficits., were assessed after 48 hours and 96 hours by direct contact or telephone calling.

STATISTICAL ANALYSIS

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Data showing normal distribution were presented as the means and standard deviation. For comparison between the means of two groups, the t-test was used. The non-parametric values were tested using the Mann–Whitney-U test. Qualitative data are represented by frequency and relative percentage and chi-square test was used for testing the association of the qualitative data. In all analyses, P values <0.05 were considered statistically significant.

RESULTS

Statistically, the patients demographic data (Age, body weight, height, sex and ASA ps Class distribution), distribution of various dural puncture levels, operation types and duration of surgeries of the two tested groups were comparable (Table 1).

Statistically, total performance time and total local anesthetic dose in CSA group were significantly longer and significantly higher respectively than the corresponding values in SSSA group. Mean time to reach T 10 sensory block level, mean motor block score at 10 min after intrathecal local anesthetic injection and failure rate in the two tested groups were comparable (Table 2).

There was a statistically significant difference between CSA group and SSSA group as regard HR at (60 min; Mean ± SD 85.9 ± 6.1 vs. 92.1 ± 7.8 respectively p value=0.002) and at the end of surgery (83.3 ± 6.2 vs. 92.4 ± 8.9 respectively p value <0.001). while there was no statistically significant difference regarding HR at other times of measurement. (table 3).

There was a statistically significant difference between CSA group and SSSA group regarding MAP at (30-60 min) and at the end of surgery as it was lower in SSSA group than CSA group while there was no statistically significant difference regarding MAP at (0 min) and one hour after surgery. (table 4).

Statistically, the corresponding respiratory rate (Table 5) and SpO2 (Table 6) values at various times of measurements in both tested groups were comparable.

Statistically, the incidences of various associated side effects in the two tested groups were comparable (Table 7).

Table 1: Patients demographic data, dural puncture level, types and durations of surgeries in the two tested groups.

Demographic data	CSA group (n=30)	SSSA group (n=30)	P-value (Sig.)
Gender			
Female N(%)	16 (53.3%)	10 (33.3%)	0.118 (NS)
Male N(%)	14 (46.7%)	20 (66.7%)	
Age (years)			
Mean ± SD	42.0 ± 12.9	38.9 ± 9.1	0.286 (NS)
Weight (kg)			
Mean ± SD	90.5 ± 18.3	84.7 ± 9.0	0.411 (NS)
Length (cm)			
Mean ± SD	174.4 ± 10.2	174.2 ± 8.5	0.766 (N.S)
BMI (kg/m2)			
Normal (18.5 – 24.9)	8 (26.7%)	11 (36.7%)	0.473 (N.S)
0verweight (25 – 29.9)	22 (73.3%)	19 (63.3 %)	
Operation types			
Above knee amputation	9 (30%)	15 (50%)	0.93 (N.S)
Femur / Tibia fracture fixation	12 (40%)	9 (30%)	
Femoral artery repair	9 (30%)	6 (20%)	
Duration of operation (min)			
	108 ± 42	84 ± 42	0.067 (NS)
ASA classes			
Class I N (%)	24(80 %)	24 (80 %)	1.00 (NS)
Class II N (%)	6 (20 %)	6 (20 %)	
Dural puncture level			
L3-L4 N (%)	17	24	0.121 (N.S)
L4-L5 N (%)	11	4	

Data are expressed as Mean ± Standard Deviation (SD). CSA = Continuous spinal anesthesia SSSA = Single shot spinal anesthesia n =Group number. N = number of each operation type in each group. ASA ps class =American Society of Anesthesiology physical status classes. P> 0.05 = non-significant difference.

Table 2: Characters of the used technique for providing selective spinal anesthesia

Procedural data	CSA group (n=30)	SSSA group (n=30)	P-value (Sig.)
Total performance time (min)			
Mean ± SD	6.8 ± 4.0	3.5 ± 0.8	<0.001 (HS)
Success of S.A space detection :			
Success N(%)	28 (93.3%)	28 (93.3%)	0.671 (NS)
Failure N(%)	2 (6.7%)	2 (6.7%)	
Time to reach T10 Sensory level /min			
Mean ± SD	5.20 ± 1.23	7.46 ± 5.19	0.07 (NS)
Motor block scores at 20 minutes			
Mean ± SD	3.1 ± 0.4	3.3 ± 0.5	0.199 (NS)
Total local anesthetic dose (ml)			
Mean ± SD	1.8 ± 0.7	1.5 ± 0.0	0.032 (S)
Mean ± SD	1.2 ± 0.2	1.3 ± 0.3	0.112 (NS)

Data are expressed as Mean ± Standard Deviation (SD).
CSA = Continuous spinal anesthesia SSSA = Single shot spinal anesthesia
n =Group number. P>0.05 = non significant difference. P< 0.05 = significant difference.

Table 3: The heart rate values (beat/min) at various times of measurements in both tested groups.

HR (beat/min)	CSA group (n=28)	SSSA group (n=28)	P-value (Sig.)
Preoperatively	87.8 ± 13.8	91.1 ± 12.2	0.339 (NS)
Intraoperatively at: 30 min.	83.0 ± 16.2	88.2 ± 23.8	0.342 (NS)
Intraoperatively at 1hr.	85.9 ± 6.1	92.1 ± 7.8	0.002 (S)
End of surgery.	83.3 ± 6.2	92.4 ± 8.9	<0.001 (HS)
Postoperatively at 1 hr after the end of surgery	84.8 ± 12.3	89.1 ± 9.6	0.465 (NS)

Data are expressed as Mean ± Standard Deviation (SD).
CSA = Continuous spinal anesthesia. SSSA = Single shot spinal anesthesia.
n =Group number. P>0.05 = non significant difference. P< 0.05 = significant difference.

Table 4: The MAP values (mmHg) at various times of measurements in both tested groups.

MAP (mmHg)	CSA group (n=28)	SSSA group (n=28)	P-value (Sig.)
Preoperatively	95.9 ± 6.1	92.5 ± 7.1	0.063 (NS)
Intraoperatively at:30 min.	87.7 ± 4.7	82.9 ± 4.3	<0.001 (HS)
Intraoperatively at 1hr.	92.4 ± 3.8	86.4 ± 6.6	<0.001 (HS)
End of surgery.	94.3 ± 4.6	88.9 ± 5.3	<0.001 (HS)
Postoperatively at 1 hr after the end of surgery	94.7 ± 5.1	90.4± 6.3	0.058 (NS)

Data are expressed as Mean ± Standard Deviation (SD).
CSA = Continuous spinal anesthesia SSSA = Single shot spinal anesthesia
n =Group number. P> 0.05 = non significant difference.
P< 0.05 = significant difference.

Table 5: Respiratory rate values (cycle /min) at various times of measurements in both tested groups.

Respiratory rate (cycle/min)	CSA group (n=28)	SSSA group (n=28)	P-value (Sig.)
Preoperatively	14 ± 3	14 ± 2	1.00 (NS)
Intraoperatively at: 30 min.	14 ± 4	15 ± 3	0.291 (NS)
Intraoperatively at 1 hr.	15 ± 3	14 ±3	0.224 (NS)
End of surgery.	14 ± 3	14 ± 2	1.00 (NS)
Postoperatively at 1 hr after the end of surgery	15 ± 3	15 ± 2	1.0 NS)

Data are expressed as Mean ± Standard Deviation (SD).
CSA = Continuous spinal anesthesia. SSSA = Single shot spinal anesthesia.
n =Group number. P> 0.05 = non-significant difference. P< 0.05 = significant difference.

Table 6: The SpO2 values (%) at various times of measurements in both tested groups.

Spo2 (%)	CSA group (n=28)	SSSA group (n=28)	P-value (Sig.)
Preoperatively	98.1 ± 0.9	98.2 ± 0.7	0.507 (NS)
Intraoperatively at: 30 min.	98.3 ± 0.8	98.5 ± 0.5	0.241 (NS)
Intraoperatively at 1hr.	98.4 ± 0.7	98.3 ± 0.8	0.730 (NS)
End of surgery	98.0 ± 1.0	98.2 ± 1.0	0.421 (NS)
Postoperatively at 1 hr after the end of surgery	98.2 ± 0.6	98.1± 0.7	0.631 (NS)

Data are expressed as Mean ± Standard Deviation (SD).
CSA = Continuous spinal anesthesia SSSA = Single shot spinal anesthesia
n =Group number. P> 0.05 = non significant difference.
P< 0.05 = significant difference.

Table 7: The incidences of various associated side effects in the two tested groups.

Postoperative complications	CSA group (n=28)	SSSA group (n=28)	P-value (Sig.)
Hypotension			
Yes N (%)	2 (7.2%)	4 (14.2%)	0.235 (NS)
No N (%)	26 (92.8 %)	24 (85.8 %)	
Bradycardia			
Yes N (%)	0 (0 %)	0 (0 %)	-
No N (%)	28 (100 %)	28 (100 %)	
Vomiting			
Yes N (%)	1 (3.6%)	3 (10.8 %)	0.402 (NS)
No N (%)	27 (96.4 %)	25 (89.2 %)	
Shivering			
Yes N (%)	4 (14.3%)	6 (21.4 %)	0.204 (NS)
No N (%)	24 (85.7 %)	22 (78.6 %)	
Urine retention			

Postoperative complications	CSA group (n=28)	SSSA group (n=28)	P-value (Sig.)
Yes N (%)	0 (0 %)	0 (0 %)	-
No N (%)	28 (100 %)	28 (100 %)	
Respiratory depression			
Yes N (%)	0 (0 %)	0 (0 %)	-
No N (%)	28 (100 %)	28 (100 %)	
PDPH			
Yes	8 (28.6%)	4 (14.3%)	0.193 (NS)
No	20 (71.4%)	24 (85.7%)	
VAS of PDPH			
Mean ± SD	1.6 ± 2.5	0.9 ± 0.4	0.147 (NS)
Parasthesia			
Yes	6 (21.4%)	2 (7.1%)	0.252 (NS)
No	22 (78.6%)	26 (92.9%)	
Sensory loss			
Yes	0 (0%)	0 (0%)	-
No	28 (100%)	28 (100%)	
Motor loss			
Yes	0 (0%)	0 (0%)	-
No	28 (100%)	28 (100%)	
Cauda equina syndrome			
Yes	0 (0%)	0 (0%)	-
No	28 (100%)	28 (100%)	

Data are expressed as numbers (%).
CSA = Continuous spinal anesthesia SSSA = Single shot spinal anesthesia.
n =Group number. N= number of patients with each complication.
P< 0.05 = non-significant difference. P> 0.05 = significant difference.

DISCUSSION

In the last hundred years, CSA has been in and out of anesthesiology practice. CSA has remained controversial mainly because of reports of cauda equina syndrome associated with it following the use of micro-catheters [11]. However, with the availability of macro-catheters and less neurotoxic LAs, this technique is again being revived. Cauda equina syndrome has not been reported after macro catheters have been used [12]. Among the local anesthetics, 0.5% hyperbaric bupivacaine is the most commonly used drug for subarachnoid block; however, the most important disadvantage of the single injection is its limited duration [13].

In the present study, most patients received CSA at the level of L4-L5 interspace. The success rate of intrathecal catheter insertion was 93.3%. **Lux, [6]** in a retrospective analysis of the cases who had CSA for lower limb surgery, found that the success rate of intrathecal catheter insertion was 92.2 %.

In the present study, the mean total time of CSA technique performance was 6.8 ± 4.0 minutes. This agreed with **Elfeky et al. [14]** who found that the performance time was 6.09 min. Also, in the present study, the loading anesthetic dose was less in CSA group (1 ml bupivacaine) than SSSA group (1.5 ml bupivacaine). This agreed with **Saber and El Metainy, [15]** who found that the dose of bupivacaine was significantly less in the CSA group (0.5 ml of bupivacaine).

In the present study, in the CSA group, the heart rate (HR) increased slightly after 5 min from starting the technique then decreased slowly from minute 15 and over time during the 1.5 hour of anesthesia. The HR mean (SD) was 87.8 ± 13.8 bpm just before spinal anesthesia and 83.3 ± 6.2 bpm at the end of surgery. The greatest decrease in HR in CSA group was observed after 30 minutes from the initial intrathecal injection. It was 83 ± 16.2 bpm. The results are consistent with those by **Förster and his colleagues [16]**; the heart rate

decreased slightly but steadily over time during the first hour of anesthesia. The mean (SD) heart rate was 61 beats per minute before continuous spinal anesthesia and the greatest change on average heart rate was observed after 45 min when heart rate was 58 bpm.

In the current study the heart rate increased slightly in the first 10 minutes. This is in disagreement with the study done by **Reisli and his colleagues [17]**, the heart rate decreased over 10 min after the first LA administration and continued on the same average throughout the operation.

In the present study, in CSA group, the MAP decreased slowly and steadily and then increased over time during the first 1.5 hour of anesthesia. The MAP mean (SD) was 95.9 ± 6.1 mmHg just before spinal anesthesia and 94.3 ± 4.6 mmHg 9at the end of surgery. The maximum decrease in MAP was noted 30 minutes after the initial intrathecal injection. This came in agreement with other studies that have shown that hemodynamic stability is greater with CSA than with other neuraxial anesthesia techniques **[2,6,18, 19]**. In **Reisli et al. [17]** study, there was a significant decrease in the MAP in the continuous epidural anesthesia group compared with the CSA group. In another study comparing CSA with SSSA, the authors found less frequent and less pronounced decreases in MAP in the CSA groups **[20].**

The changes in MAP in our study are not consistent with the finding from the study done by **Minville and his colleagues [21]** (titration of 2.5 mg of isobaric bupivacaine was used) as 31% of patients experienced at least 1 episode of hypotension (decrease in MAP greater than 20% of baseline value) and among them 8% of patients experienced at least 1 episode of severe hypotension (decrease in MAP greater than 30% of baseline value).

Several studies have commented on the cardiovascular stability offered by CSA compared to SSSA or even to continuous epidural anesthesia (CEA) **[14,20].** This is also reflected in the present study. We recorded slight decreases in blood pressure from preoperative control values, which were easily controlled by appropriate transfusion of fluids.

In the current study, there was no statistically significant difference between the 2 groups as regards to SpO2 %. Also, in the study done by **Gülçin and his colleagues [22],** there were

no respiratory or cardiovascular complications recorded in the first 24 hours.

In the present study, patients in CSA group experienced less motor blockade than patients in SSSA group but this difference was not statistically significant. This was clinically important even in patients who are not allowed to move in the first 24 hours after surgery, because patients are encouraged to exercise their leg as early as possible in order to maintain good perfusion of the extremities even during bed rest. The results coincide with the results of the study done by **Förster and his colleagues [16]**; motor blockade was less in most of the patients receiving CSA.

As regard to the number of patient treated of intraoperative hypotension (> 20% decrease from baseline MAP) was lower in CSA group as compared to SSSA group (2 vs 4) but it was statistically insignificant. Also as regard to other intraoperative complication there were statistically insignificant different between CSA as compared to SSSA [vomiting (1 vs 3) and shivering (4 vs 6) respectively]. No patient in our study developed intraoperative bradycardia , urine retention or respiratory depression in both groups .

In the current study, 8 patients (28.6%) in CSA group and 4 patients in SSSA group recorded PDPH that was relieved by bed rest and adequate hydration. the difference in pain score was non-significant between the 2 groups in terms of VAS (p value = 0.147). In the study on CSA done by **Förster and his colleagues [16]** (used a 28 g catheter through 22 g needle) and in the study done by **Gülçin and his colleagues [22]** (used a 22-gauge spinal catheter over a 27-gauge Quincke-type spinal needle), no patient in the two studies recorded PDPH. This difference can be explained that we used a macrocatheter technique (20 g cath through 18 g needle) in our study while they used a microcatheter and a catheter over the needle technique in their studies.

In disagreement with our study, **Michaloudis et al. [23]** although they used the same technique that we used in our study but surprisingly they found that the PDPH after CSA was non-existent in their study. This disagreement can be explained that the incidence of PDPH is directly related to an increase in needle size and inversely related to increasing patient age. In our study the mean age of our patients was younger than those patients in the study by **Michaloudis and his colleagues**.

In the present study, 4 patients (14.3%) in SSSA group recorded PDPH. This came in agreement with **Flaatten et al. [24]** who reported 15.5% PDPH after single dose spinal anesthesia, using a 27-gauge Quinke spinal needle. In disagreement with our study, **Saber and El Metainy, [15]** found that there was no PDPH in both study groups. They used the same techniques we used in our study (the same needle and catheter sizes) but in elder age group (mean age 75 years) and this can explain the difference in incidence of PDPH between the studies.

In the present study, no patients in CSA group had cauda equina syndrome. Because we were careful to use macrocatheter (20 g) threaded in the cephaled direction and we used small doses of bupivacaine and the catheter was removed after 24 hours. This came in agreement with **Kilinc et al. [25]** who also found the same results.

There were no neurological sequelae (motor or sensory dysfunction) in any patient in the first post-operative week in the current study and in the study done by **Gülçin and his colleagues [22].**

The limitation of our study is the small size of study population. The available data about CSA is scanty as it is a new technique for our daily practice.

CONCLUSION

Our study shows that Continuous Spinal Anesthesia is an established anesthetic technique that combines the advantages of single dose spinal anesthesia; rapid onset and a high degree of success, with those of a continuous technique; ease of top-up and good hemodynamic control with small total dose of hyperbaric bupivacaine (0.5%) used. Correctly used, Continuous Spinal Anesthesia is an effective and safe technique. We recommend more randomized studies with higher number of subjects before adoption or generalization the technique of Continuous Spinal Anesthesia.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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