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Combined Sequential Spinal Epidural Anesthesia: A Prospective Study

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Abstract

Background: Aim of this prospective study was to evaluate the sensory block quality and hemodynamic effects in patients undergoing urologic surgery under Combined Sequential Spinal Epidural Anesthesia (CSSE).

Methods: Fifty patients were included in the study. Inclusion criteria were age ≥ 18 years and surgery scheduled to last ≤ 2 hours. Patients with a history of hypertension, congestive heart failure, any active medication for cardiovascular disease or any other absolute or relative contraindication to spinal anesthesia were excluded from the study. Patients undergoing urologic procedures received CSSE with 4 ml of Levobupivacaine 0.075% intratecally, followed by 10 ml of Levobupivacaine 1.5% epidurally. Sensory block spread was assessed by a pin prick test. Cardiac index (CI), blood pressure (BP), heart rate (HR) and arterial saturation of O_2 (SpO_2) were continuously monitored and recorded. Before discharge, patient's functional status was assessed by the Aldrete Score.

Results: CSSE allowed a pain free procedure. The pinprick test score was 1.2 ± 0.7 at the T7 dermatome level. CI, mean BP and HR were stable during the entire procedure. The Aldrete Score was 9.84 ± 0.4.

Conclusion: CSSE performed with low doses of local anaesthetics allowed a good sensory block and was associated with good hemodynamic conditions and recovery score.

Keywords: Combined sequential spinal epidural anaesthesia; Anesthesia in urologic surgery; Intrathecal levobupivacaine

Introduction

Major surgery below the umbilical level requires excellent surgical conditions and prolonged and effective postoperative analgesia. In such conditions, combined spinal epidural anesthesia (CSE) has been proposed as an alternative technique to standard spinal anesthesia (SA) [1]. Actually, CSE technique provides better surgical conditions than with epidural block alone, since the spinal component allows a rapid onset of anesthesia, while the administration of local anesthetics into the epidural space via catheter allows to titrate the spread of block and to supplement anesthesia if insufficient [2]. Furthermore, postoperative analgesia is performed through the epidural catheter.

In literature several data suggest that the intrathecal local anesthetic dose can be reduced by executing a sequential block with the epidural extension performed within 5 or 10 minutes of the intrathecal injection, leading to less hypotension and quicker recovery [1,3]. The combined *sequential* spinal epidural (CSSE) technique has been studied mostly for cesarean section, and it may be advantageous as well in other high-risk patients such as very old urologic patients, by increasing the safety of the central regional block [1,4-7].

Doses and concentrations of local anesthetic used for CSSE are of great importance in determining the clinical management of this technique, and local anesthetic pharmacodynamic and pharmacokinetic profile can influence CSSE outcome: recently Levobupivacaine emerged in regional anesthesia as a safer alternative to other local anesthetics, including its racemic parent bupivacaine, since it demonstrated less affinity and reduced depressant effects onto myocardial and central nervous vital centres in pharmacodynamic studies, and a superior pharmacokinetic profile [8]. Actually, CSSE with intrathecal dose of bupivacaine as low as 5 mg has been found to allow good surgical anesthesia in cesarean delivery [9]. However, to the best of our knowledge, few data are available on the use of lower intrathecal doses of Levobupivacaine during CSSE in this setting.

End points of this study were the sensory block quality achieved and the hemodynamic effects of low dose Levobupivacaine in patients undergoing urologic surgery under CSSE.

Materials and Methods

This prospective study was conducted in the Department of Anesthesiology and Critical Care and Department of Urology, University of Foggia, Italy. Ethical approval for this study (Ethical Committee N°35/CE/05) was provided by the Ethical Committee of Foggia University Hospitals of Foggia, Foggia, Italy (Dr. Rosanna Stea) on 08 November 2005 and informed written consent was obtained for all patients. Inclusion criteria were age ≥18 years and surgery scheduled to last ≤ 2 hours. Patients with a history of hypertension, congestive heart failure, any active medication for cardiovascular disease or any other absolute or relative contraindication to spinal anesthesia were excluded from the study.

The urologic surgery included transurethral resection of the prostate (TURP), transurethral resection of the bladder tumour (TURBT), ureterorenoscopy (URS), transurethral incision of the prostate (TUIP), inguinal hernia (IH).

All procedures were performed by anesthesiologists with more than five years experience in loco-regional anesthesia.

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No premedication and no fluid preloading were performed. On arrival in the operatory theatre, an 18 gauge I.V. cannula was secured in an antecubital vein, and an infusion of Ringers lactate 5ml/kg/hr was given to every patient during the procedure.

Perioperative management was performed according to institutional standards. Routine monitoring (Philips IntelliVue™ Monitoring; Philips Medical Systems, Andover, MA, USA) during the entire perioperative period included pulse oxymetry (SpO_2), five-lead ECG and invasive blood pressure measurement via a radial arterial access obtained using a radial artery catheterization set (Radial Artery Catheterization Set, Arrow International, Reading, PA, USA) that was connected to the FloTracTM sensor which in addition to arterial pressure transduction allowed Cardiac Output estimation from the arterial pressure waveform when connected to the Vigileo™ monitor (Edwards Life Sciences LLC, Irwine, CA, USA). The most recent software version 01.10 was used. All intravascular pressure measurements were zeroed to the mid-axillary line.

Double-space CSSE technique was performed with the patients in the sitting position. The epidural space was identified at L2-3 intervertebral level with an 18-gauge Tuohy needle using loss of resistance with saline technique [10].

A 20-gauge epidural catheter was positioned 3cm into epidural space and secured in place. No test dose was performed. Subsequently, a 25-gauge Whitacre spinal needle was advanced at L3-4 intervertebral level through an introducer until cerebrospinal fluid (CSF) was obtained. A 4 ml solution of Levobupivacaine 0.075% (3 mg) and Fentanyl 10 mcg was injected in a single bolus over 20 seconds. The needle was removed and patients were immediately placed in supine position.

After five minutes, a 10 ml solution of Levobupivacaine 1.5% (10 mg) was delivered through the epidural catheter.

Vital parameters were recorded at baseline (H^0), 3 min from intrathecal drugs delivery (H^{3min}) and then after 8 (H^{8min}), ten (H10min), fifteen ($H15^{5min}$), thirty (H^{30min}), forty-five (H^{45min}), sixty (H^{60min}), ninety (H90min) and one hundred five minutes (H^{105min}).

Sensory blockade were assessed by a pinprick test using the following score: 0= ability to appreciate a pinprick as sharp; 1= ability to appreciate a pinprick as less sharp; 2= inability to appreciate a pinprick as sharp (analgesia); 3= inability to appreciate a pin touching (anesthesia). It was recorded on H^{10min} at pubic region level (T10 dermatome), and at xiphoid process level (T7 dermatome).

The degree of motor block (scale 0-4, 0=no block, 4=complete motor block) of the lower extremities was recorded at dermatone T10 using the criteria described by Bromage.

Hypotension was defined as a fall in baseline systolic BP by 30% or < 90 mmHg, and was treated by intravenous ephedrine in 5 mg boluses to raise systolic blood pressure up to 80% of the baseline.

Bradicardia, defined as a value of HR < 50 bpm, was treated bolus of 0.5 mg of athropine. Arterial oxygen desaturation was defined as a value of SpO_2 <90% and was treated by O_2 delivery via vent mask.

Thirty minutes after the end of surgery, the Aldrete score was calculated [11]: patients were discharged to the ward if Aldrete score was >8. Postoperative analgesia was provided over 48 hours by ketoprofen, 150 mg/die via an i.v. elastomeric pump.

Statistical Analysis

Initial sample size estimation showed that 41 patients should be included for detecting a clinically meaningful variation in BP > 20% with CSSE (α=0,05, two side, power of 90%). This number was increased to 50 to allow for a predicted drop out of around one fourth of patients.

Demographic data were tested for normal distribution. The effect of treatment and time on BP was assessed by one-way ANOVA, the effect of treatment and time on the level of the sensory block (pin prick test) were assessed with nonparametric, one-way Friedman test. Changes in pin prick scores over time within group were statistically analyzed using individual repeated-measures design Friedman tests. Subsequent intragroup comparisons, when appropriate, were performed pair-wise using paired Wilcoxon's signed ranks tests. Data are presented as mean ± standard deviation (SD) or number (proportion). Ap value <.05 was considered statistically significant. All statistical calculation were performing using STATISTICA (data analysis software system), version 8.0, (Statistica StatSoft, Inc. (2007), Tulsa, OK, USA).

Results

Fifty patients were included in the study. The age, weight, height, sex distribution, type of urologic surgery and co morbidities are reported in Table 1.

The characteristics of neural block are reported in Table 2: on H^{10min} of sensory block showed a significant difference in sensory block was reached at dermatomes T7 and T10 when compared with baseline. Pinprick mean scores were 1.2 ± 0.7 on dermatome T7 and 2.2 ± 0.5 on dermatome T10 vs. T0 (p<.001). A differential sensory block was present: at the dermatome T10 level only the 24% of patients had complete anesthesia, while in the 76% a pinprick score 2 showing good analgesia was recorded. There were no failed or inadequate blocks. Moreover 21 of 50 patients (42%) had a complete motor block.

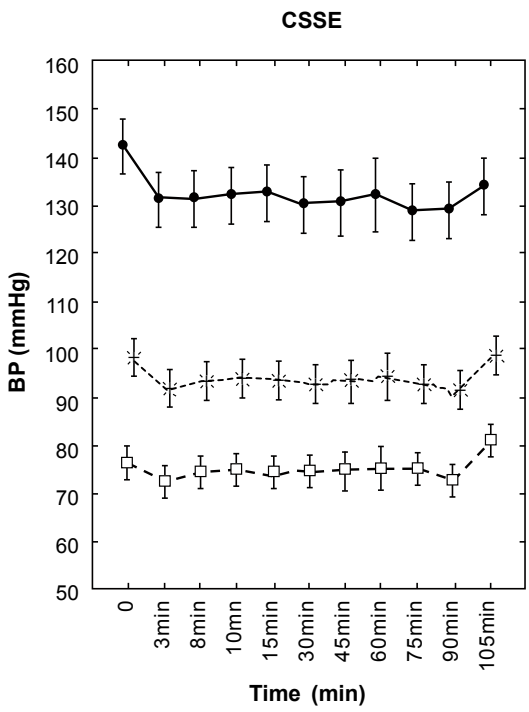

Figure 1: Systolic (PAS), diastolic (PAD) and mean arterial pressure (PAM) time course in patients undergoing urologic surgery under combined sequential spinal epidural anesthesia (CSSE).

	Group CSSE (n 50)
Sex (M:F)	42:8
Weight (Kg)	74.3 ± 12
Height (cm)	167 ± 7
Age (y)	64.5 ± 15
Surgery duration (min)	112 ± 12
Transurethral resection of the prostate	19 (38%)
Transurethral resection of the bladder tumour	
Ureterorenoscopy	11(22%)
Transurethral incision of the prostate	
Inguinal hernia	10(20%)
	3(6%)
	7(14%)
Comorbidities	
Hypertension n(%)	20 (40%)
Congestive heart failure n(%)	11 (22%)
Diabetes n(%)	6 (12%)
COPD n(%)	13 (26%)
Chronic renal failure n(%)	2 (4%)

Data are mean ± standard deviation, numbers (%) as appropriate.

Table 1: Patients demographic data.

	Group CSSE
Sensory block at T10	
Analgesia n(%)	38 (76%)
Anaesthesia n(%)	12 (24%)
Sensory block at T7	
Analgesia n(%)	11(22%)
Recovery n(%)	39 (78%)
Motor block	
Grade 3 block n(%)	21(42%)
Adverse events n(%)	
Hypotension/Bradycardia	5 (10%)
Post-dural puncture headache	0

Data are median (range), numbers (%) as appropriate.

Table 2: Characteristics of neural block and frequency of adverse events.

Systolic, diastolic and mean BP time course are reported in Figure 1. Cardiac Index (CI), and HR time course are reported in Table 3. Significant differences among BP, CI and HR values were found with regard to the effect of time. Intra group comparison showed that sBP decreased by 7% on H^{3min} ($p<.002$ vs. baseline), and then remained stable throughout the study period while dBP did not change throughout the study period. The mBP showed similar behaviour to sBP. CI and HR remained stable throughout the study (Table 3). 5 (10%) patients required ephedrine and/or athropine according to the hypotension/bradicardia protocol (Table 2).

Aldrete Score was 9.84 ± 0.4, then all patients were discharged to ward within thirty minutes after the end of surgery.

Discussion

The main result of the present study is that CSSE allowed complete surgical anesthesia, under stable hemodynamic conditions. Herein, we used the double-space CSSE technique because it has been recently demonstrated to have a greater success rate than the needle-through-needle technique and to be associated to a lower incidence of complications [12,13].

Although the exact mechanism by which an epidural top up reinforces intrathecal local anesthetic effect in CSSE is not fully understood, this mechanism can be explained partly by the action of local anesthetic and partly by an epidural volume effect [6]. These results were obtained with an intrathecal Levobupivacaine dose lower by 70% than in SA. Actually, the equilibrium between CSF pressure and sub atmospheric epidural pressure is disrupted firstly by the insertion of the Tuohy needle and secondly by the injection through the epidural catheter, that generates a "squeezing" of the CSF and more extensive spread of subarachnoid local anesthetic. Many data in literature show that when administering the same intra thecal dose of local anesthetic, the CSE technique results in a level of sensory blockade higher by > 5 dermatomes than SA. Therefore to obtain the same sensory blockade level, a reduction in the intrathecal dose of local anesthetic for CSE/CSSE has been proposed. Goy and Sia demonstrated that 20% reduction in intrathecal local anesthetic dose was effective yet when performing an epidural puncture without any delivery, which means that the introduction of a Tuohy needle in the epidural space enables *per se* to reduce the dose of intrathecal anesthetic: the administration of the epidural dose thus allows to further reduce the intrathecal local anesthetic dose delivered [14]. In literature many studies demonstrated the efficacy of low doses CSSE vs. SA for obstetric surgery: Lew et al. found comparable results delivering intrathecally 5 mg bupivacaine 0.5% plus 6 ml of normal saline epidurally vs. SA with a standard dose of 9 mg bupivacaine 0.5% [6]. Ben-David et al. demonstrated that 5 to 7 mg intrathecal bupivacaine are sufficient to provide effective anesthesia [9]. To our knowledge only one study with CSSE in urological surgery has been published in 2011 by Singh et al. who concluded that the combined spinal-epidural anesthesia is as effective and safe as percutaneous nephrolithotomy under general anesthesia [15].

The novelty of our study is that an intrathecal dose of local anesthetic reduced by 70% with respect to standard provided adequate anesthesia when adding the epidural delivery, so that surgery was successfully performed in every patient [16-19].

In literature there is limited evidence that reduced dose of Levobupivacaine has a favourable effect on the hemodynamic intraoperative stability. Hypotension is an important potential side effect of locoregional anesthesia: neuraxial blockade-related hypotension results from pharmacological denervation of the preganglionic sympathetic fibres [20]. Since the extension of the symphathetic block is bound to both the intrathecal dose of anesthetic and the extension of sensory and motor block, performing SA with low local anesthetic dose may reduce the incidence of hypotension [21]. Ben-David et al. demonstrated that a mini-dose of 4 mg bupivacaine instead than the normal dose of 10 mg causes a considerable reduction in the incidence of hypotension [9].

In the present study we measured cardiac output, which has shown to be a better predictor of organ perfusion than BP [22], using a minimally invasive uncalibrated cardiac output monitoring system (FloTrac™/Vigileo system™) to investigate hemodynamic variations. We found that CSSE anesthesia offered hemodynamic stability throughout the observation period. In addition, we observed that only 5 patients under CSSE required ephedrine and/or atropine.

Postoperative recovery measured by the Aldrete score resulted high in the CSSE group: this evidence can be easily explained taking into

		basal	3min	8min	10min	15min	30min	45min	60min	75min	90min	105min
Group CSSE												
	CI	2.9+0.4	2.8 ± 0.6	2.8 ± 0.7	2.9 ± 0.5	2.8 ± 0.5	2.7 ± 0.4	2.8 ± 0.3	2.9 ± 0.5	2.8 ± 0.3	2.5 ± 0.5	3.0 ± 0.6
	HR (b/min)	74+15	72+16	73+15	71 ± 13	67 ± 12	68 ± 11	69 ± 10	63 ±11	64 ± 13	64 ± 12	73 ± 9

Table 3: Hemodynamic parameters.

account the impact that motor block has in calculating Aldrete score and it is common to find differences in motor blockage between the CSSE and the SA technique [6]. Finally, the present study has some limitations: firstly, no control group with SA was performed, but in our opinion many data are available in literature. Second, the epidural catheter had to be removed at the end of surgery.

In conclusion, although more data are needed to confirm our findings, this study suggests that a CSSE anesthesia with epidural local anesthetic delivery could be a valid alternative in urologic surgery and allows reducing the local anesthetic intrathecal dosage up to 70%, thus preserving sensory block quality, hemodynamic stability and providing rapid patient recovery.

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