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Research Article

Single dose spinal analgesia: Is it a good alternative to epidural analgesia in controlling labour pain?

Tarek AbdElBarr [a], **Nirvana A. Elshalakany** [b,*], **Yasser M. Shafik** [c]

[a] *Cairo University, Egypt*
[b] *Six October University, Egypt*
[c] *Egyptian Military Medical Academy, Egypt*

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Abstract *Objectives:* Regional anaesthesia is considered the optimal technique for obstetric patients; nevertheless, the optimal method of regional anaesthesia for delivery remains to be determined. In our study we investigate the safety, efficacy and cost benefits of single-dose spinal analgesia in comparison with epidural analgesia during labour.

Study design: In our study women in advanced labour were randomly allocated into two equal groups using a computer-generated randomization table, one group (spinal group = S group) were given 3.75 mg hyperbaric bupivacaine +25 μg fentanyl with 0.75 ml saline, the other group (Epidural group = E group) were given 4 ml bupivacaine with 4 ml saline and 1 ml (50 μg) fentanyl pain intensity was recorded by the parturient on a visual analogue scale. The quality of pain relief was also rated with a verbal score directly after delivery. Side effects, such as hypotension, Pruritus, sedation, nausea and motor block were noted. Obstetric parameters were followed and recorded, Apgar score were noted, and all the results were compared in the two groups.

Results: Onset of sensory block (detected by pin-prick test) was early (4.4 ± 1.5 min vs 12.5 ± 2.3 min, $p < 0.001$) and duration of sensory block was longer (120.4 ± 15.6 vs 103.2 ± 18.3 min, $p < 0.001$) in S group compared to E group, time to reach maximum dermatome level of sensory block (T_{10}) was shorter in S than E group (8.3 ± 2.4 min vs 22.4 ± 5.7 min, $p < 0.001$), two segment regression occur late in S group compared to E group(75.6 ± 12.5 min vs 66.3 ± 9.4 min, $p < 0.001$). Visual analogue scores after 5, 15, 30, 60, 90, 120 and 150 min were lower in S group compared to E group, all the previous result is statically significant ($p < 0.001$).

* Corresponding author. Tel.: +20 1001489004.
E-mail addresses: tabarr59@hotmail.com (T. AbdElBarr), nirvanaelshalakany@yahoo.com (N.A. Elshalakany), yaser0002002@yahoo.com (Y.M. Shafik).

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88% of the parturients in S group vs 60% in E group scored the analgesic quality as excellent, the mean duration of analgesia (Mean ± SD) was longer in S group compared to E group. 8% of parturients in S group vs 14% of parturients in E group had hypotension. Motor block, sedation and nausea were 2–6% in both groups. Pruritus was seen in 60% in E group vs 25% in spinal one. No caesarean section was performed. Vacuum extraction was done in 15% vs 25% among S group and E group respectively. Oxytocin augmentation was needed in 48% vs 62% of the parturients among S group and E group respectively. Faetal heart rate disturbances following the spinal block were seen in 2 cases. Apgar score were high and no neonate had Apgar score <7 in both group. The overall cost was lower in S group compared to E group.

Conclusions: Based on the results of our study we concluded that single dose spinal analgesia is a good alternative to epidural analgesia in controlling labour pain i.e. spinal compared to epidural is more easy performed, faster, less expensive, and provide effective analgesia.

1. Introduction

The terms ''regional anaesthesia'', ''spinal block'' and ''epidural block'' are often used interchangeably. This is incorrect. Both spinal and epidural block are subsets of regional anaesthetic.

Spinal block differs from an epidural block in a number of ways. Firstly, a smaller needle is used to perform a spinal block than an epidural block. Secondly, the drugs are injected into the cerebrospinal fluid that bathes the spinal cord. In order to do that the needle makes a tiny hole in the dura, which is a tissue encasing the spinal cord and the cerebrospinal fluid. Small doses of local anaesthetic are required because they spread more easily in the spinal fluid [1]. With an epidural block, the drugs are delivered outside the dura, in the epidural space, hence the name for the block. Occasionally, the dura can be inadvertently breached in performing an epidural block, known as a dural puncture. Larger doses of local anaesthetic are required because the spread is through tissues rather than fluid [2]. Thirdly, a spinal block is a single injection of local anaesthetic medications and so there is only one opportunity to deliver the medications. With an epidural, a catheter sits in an epidural space so drugs can be delivered as needed to extend the duration of the block. An epidural block can be made to last longer than a spinal block [3].

Regional analgesia/anaesthesia is nowadays considered the optimal technique for obstetric patients. Maternal mortality under regional anaesthesia is 16 times lower than under general anaesthesia, mainly due to reduced the risk of gastric aspiration which is the major cause of direct maternal death [4]. Nevertheless, the optimal method of regional anaesthesia for delivery and caesarean section remains to be determined.

Spinal anaesthesia has the advantage that profound nerve block can be produced in lower half of the body by the relatively simple injection of a small amount of local anaesthetic. However, the greatest challenge in spinal anaesthesia is to control the spread of local anaesthetic through the cerebrospinal fluid (CSF) to provide a block which is adequate for the proposed surgery without unnecessary extensive spread, and increased risk of complications [5].

Spinal anaesthetic technique when used for obstetric purpose might be accompanied by side effects like hypotension, nausea and vomiting. Prolonged hypotension causes faetal bradycardia and acidaemia, which can further compromise critical faetal status. Therefore, extensive clinical investigation is dedicated to issues of optimal dose and combination of drugs which would balance haemodynamic stability and effective analgesia [6]. In our study we use small dose of local anaesthetic drug with small dose opioids to overcome the above mentioned side effect.

Most of the previously performed studies concentrated on the effect of low-dose spinal anaesthesia as a part of combined spinal–epidural anaesthesia (CSE) in labour, and did not use low dose spinal anaesthesia only they concluded that low-dose spinal combined with epidural analgesia offers several theoretical advantages. The onset of block is faster and block is potentially denser in comparison with conventional epidural analgesia [7]. Another advantage associated with CSE analgesia is adequate analgesia provided by small doses of local anaesthetics and opioids which cause less haemodynamic compromise than conventional epidural anaesthesia [8]. In our study we investigate the analgesic effect of low dose spinal anaesthesia, the maternal and faetal outcome and we verified that low dose spinal anaesthesia is sufficient technique for labour and can be used instead of CSE and produce satisfactory results for the mother and the baby as well.

Traditional epidural analgesia is the most common technique for labour analgesia and also for caesarean section when there is an indwelling epidural catheter present and when epidural anaesthesia offers advantages over spinal anaesthesia for example in morbidly obese parturients. The major disadvantage of epidural analgesia is the slow onset of action, prolonged labour, and use of Oxytocin augmentations and increased incidence of instrumental vaginal delivery. Haemodynamic instability, although less pronounced than in traditional spinal anaesthesia, might be of clinical relevance, as well. Another problem is reduced mobility due to motor effects of local anaesthetics which can cause discomfort and reduce maternal satisfaction [9].

The maternal and faetal effects of analgesia during labour remain central to discussions among patients, anaesthesiologists, and obstetrical caregivers. A number of randomized trials have taught to address the effects of different strategies for analgesia on maternal and faetal outcomes. Despite this effort, it has become increasingly clear that potentially unwanted effects of analgesia for women in labour and their children cannot be determined easily. Remaining controversies in obstetrical anaesthesia include that over the effects of regional anaesthesia on the progress and outcome of labour, as well as that over its effects on the neonate [10].

The aim of our study is to proof that single dose spinal analgesia is efficient, faster, easily performed and less expensive

technique that can effectively replace epidural analgesia during normal labour.

2. Patient and method

We designed a prospective, randomized, and controlled study to evaluate the efficacy of single dose spinal analgesia as an alternative to epidural analgesia in controlling labour pain. Following the institute's Ethics Committee approval and written informed consents, we enroled in each of the two groups(S group = Spinal group and E group = Epidural) women in advanced labour and fulfil inclusion criteria, ASA physical status I or II, aged 18–42 years nulliparous or multiparous parturients, at term, requesting for analgesia during labour.

Patients with past history of sedative drug abuse, opiates addiction, spinal, or epidural analgesia failure, patient with INR >1.3 or platelets count <100,000, were excluded from this study.

Only patients in active labour with cervical dilation between 4–5 cm multiparous and 5–6 cm primigravida and with normal faetal heart rate (FHR) tracings were considered. After the request for analgesia, each patient was randomized, using a computer-generated randomization table, to receive either spinal or epidural analgesia in October six university hospital.

Upon patient request for labour analgesia, each patient received at least 1000 mL Ringer lactate solution. Under complete aseptic conditions the blocks were performed with the patient in the sitting position. Patients in group S received spinal block using 25 gauge quicken needle inserted and directed to the middle line to reach the intrathecal space between L_3–L_4 or L_4–L_5 intervertebral space, after a successful dural puncture with acceptable cerebrospinal fluid flow, 0.75 ml (3.75 mg) hyperbaric bupivacaine with 0.5 ml (25 μg fentanyl) to improve intrathecal labour analgesia and diluted with o.75 ml sterilized saline were injected via spinal needle.

In patients in group E epidural analgesia was performed using 17-gauge Tuohy epidural needle using a loss-of-resistance-to-air technique, upon felling good loss of resistance an epidural catheter was introduced cranially through the needle for 2–4 cm in the L_3–L_4 or L_4–L_5 epidural space, after negative aspiration for blood or spinal fluid a test dose of 3 ml lidocaine was given via inserted catheter, with the patient in the same position 0.5% bupivacaine (4 ml) + 4 ml saline + 50 μg fentanyl was given. All patients in both groups were instructed to remain on strict bed rest and nursed with left uterine displacement and the head of the bed elevated to approximately 20–30″, and pelvic tilt to prevent Aortocaval compression.

Hypotension, defined as a systolic blood pressure of 20% decrease from baseline was measured by a nurse blinded to group assignment.

The duration of analgesia was defined as the time from the injection of the local anaesthetic solution until the patient requested additional analgesic dose.

After the administration of the anaesthetic solution, each patient was evaluated by an investigator every 5 min for the first 15 min. Patients were then assessed every 15 min until additional analgesia was requested. Patient appraisal included assessment of vital signs (blood pressure, heart rate, respiratory rate) and completion by the patient of a 10-cm linear visual analog scale (VAS) for pain (0 = no pain; 10 = severe pain). Patients were excluded from the final data analysis if the patient reported pain VAS >8 up to 15 min after the injection of the anaesthetic solution. At the same time intervals, somnolence was evaluated using a four-point ordinal scale in which 0 = wide awake, 1 = drowsy, 2 = rousable, 3 = non-rousable, and motor blockade was assessed using the four-point Bromage scale. The upper level of loss of sensation to both pinprick and ice was assessed in the midclavicular line 15 min after the injection of the anaesthetic solution, time 2 segment regressions was also assessed. Patients were monitored for the presence of other side effects such as Pruritus, nausea, or vomiting.

All patients had continuous electronic FHR monitoring throughout labour.

Any FHR abnormalities, identified by the obstetric team, were documented. After labour, the baby was assessed, and the mother was nursed in post anaesthetic care unit (PACU) and observed if there is nausea, vomiting, dyspnoea, haemodynamic changes (hypotension and reflex tachycardia), and Spo_2 changes were recorded too, also patient were evaluated for any sensory or motor complication.

3. Statistical analysis

Statistical presentation and analysis of the present study were conducted, using the mean, standard error, unpaired student *t*-test and chi-square tests by SPSS V17. Unpaired Student *T*-test was used to compare between two groups in quantitative data. Chi-square hypothesis that the row and column variables are independent, without indicating strength or direction of the relationship between Pearson chi-square and likelihood-ratio chi-square. Fisher's exact test and Yates' corrected chi-square are computed for 2×2 tables. A sample of 100 women in advanced labour (50 in each group) was calculated to detect no reduction with power of 90% (power of test) with type I error 0.05 (Alfa).

4. Results

100 women in advanced labour in the duration from June 2012 to February 2013 in October six university hospital were divided into 2 equal groups. All 100 parturients enroled completed the study. No technical difficulty or inadvertent dural puncture was encountered in the E group.

The groups were compared according to their age, weight, height, gestation age, duration of labour (Table 1), there were no significant difference between the 2 group as regard their demographic data($P > 0.05$).

onset of sensory block (detected by pin-prick test) was early (4.4 ± 1.5 min vs 12.5 ± 2.3 min, $p < 0.001$) and duration of sensory block was longer (120.4 ± 15.6 min vs 103.2 ± 18.3 min, $p < 0.001$) in S group compared to E group, time to reach maximum dermatome level of sensory block (T_{10}) was shorter in S than E group (8.3 ± 2.4 min vs 22.4 ± 5.7 min, $p < 0.001$), two segment regression occur late in S group compared to E group (Table 2), and Fig. 1.

Visual analogue scores after 5, 15, 30, 60, 90, 120 and 150 min were lower in S group compared to E group. 88% of the parturients in S group vs 60% in E group scored the analgesic quality as excellent, the mean duration of analgesia (hour) (Mean ± SD) was longer in S group compared to E group (Table 3 and Figs. 2–4 respectively).

Table 1 Patient's demographic characteristics.

Characteristic	Group S (n = 50)	Group E (n = 50)	T-test	
	Mean ± SD	Mean ± SD	T	P-value
Age (years)	28.65 ± 5.61	29.71 ± 4.85	1.011	0.314
Weight (kg)	74.6 ± 15.4	76.52 ± 14.3	0.646	0.520
Height (cm)	152.84 ± 20.8	153.7 ± 22.9	0.197	0.845
Gestation (week)	37.8 ± 3.4	39.22 ± 4.64	1.746	0.084
Duration of labour (min) (2nd and 3rd stage)	53.67 ± 6.73	52.95 ± 7.5	0.505	0.615

* P non sig. >0.05; sig. <0.05*.

Table 2 Anaesthetic effect of single dose spinal vs epidural.

Parameters	Group S (n = 50)	Group E (n = 50)	T-test	
	Mean ± SD	Mean ± SD	T	P-value
Onset of sensory block (min)	4.4 ± 1.5	12.5 ± 2.3	20.859	<0.001*
Duration of sensory block (min)	120.4 ± 15.6	103.2 ± 18.3	5.058	<0.001*
Time to reach maximum dermatome level of sensory block (min)	8.3 ± 2.4	22.4 ± 5.7	16.121	<0.001*
Two segment regression (min)	75.6 ± 12.5	66.3 ± 9.4	4.205	<0.001*

* P non sig. >0.05; sig. <0.05*.

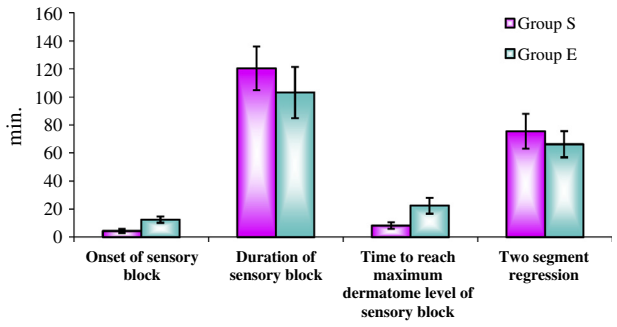

Figure 1 Anaesthetic effect of single dose spinal vs epidural.

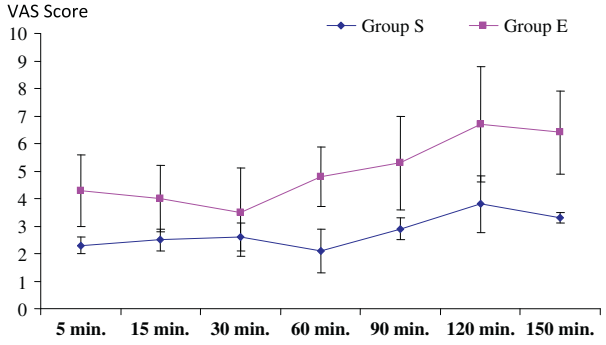

Figure 2 Analgesic effect of single dose spinal vs epidural.

Somnolence was 4% vs 6% in S and E group respectively (evaluated using a four-point ordinal scale), motor blockade 2% vs 4% in S and E group respectively (assessed using the four-point Bromage scale), nausea was 8% vs 6% in S and E group respectively, and sensory and motor complications were same % (4) in both groups. Four parturients in S group vs seven parturients in E group had hypotension, and Pruritus was seen in 60% in E group vs 25% in spinal one. Vacuum extraction was done in 15% vs 25% among S group and E group respectively, Oxytocin augmentation was needed in 48% vs 62% of the parturients among S group and E group respectively no caesarean section was performed (Table 4).

Faetal heart rate disturbances following the spinal block were seen in 2 cases. Apgar scores were high and No neonate had Apgar score >7 in both group (Table 5 and Fig. 5). The overall cost was lower in S group compared to E group.

Table 3 Analgesic effect of single dose spinal vs epidural.

VAS score time interval	Group S (n = 50)	Group E (n = 50)	Tests	
	Mean ± SD	Mean ± SD	T	P-value
5 min	2.3 ± 0.3	4.3 ± 1.3	10.600	<0.001*
15 min	2.5 ± 0.42	4.0 ± 1.2	8.343	<0.001*
30 min	2.6 ± 0.5	3.5 ± 1.6	3.796	<0.001*
60 min	2.1 ± 0.8	4.8 ± 1.08	14.205	<0.001*
90 min	2.9 ± 0.4	5.3 ± 1.7	9.717	<0.001*
120 min	3.8 ± 1.03	6.7 ± 2.1	8.767	<0.001*
150 min	3.3 ± 0.2	6.4 ± 1.5	14.485	<0.001*
The mean duration of analgesia Hr .	2.7 ± 0.5	2.1 ± 0.3	7.276	<0.001*
Analgesic quality as excellent N (%)	44(88%)	30(60%)	8.784	0.003*

* P non sig. >0.05; sig. <0.05*.

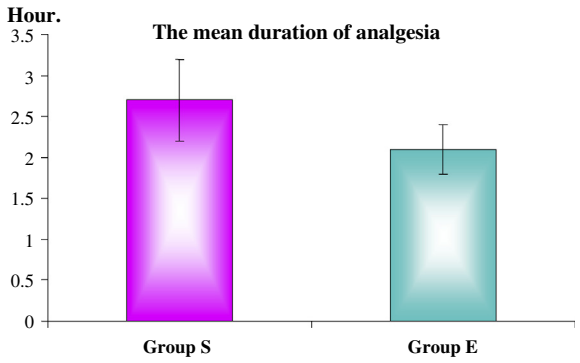

Figure 3 Mean duration of analgesia (in h) in group S vs group E.

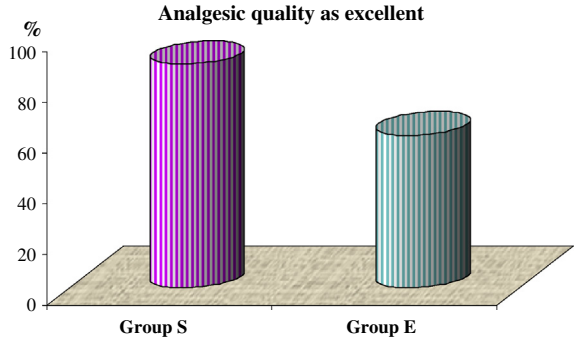

Figure 4 % of Analgesic quality in group S vs group E.

5. Discussion

Our study focused on safety, efficacy, and cost benefit of single-dose spinal analgesia in comparison with epidural analgesia during labour; it was found that single dose spinal analgesia is an effective alternative to epidural analgesia in controlling labour pain as duration of analgesia was better in low dose spinal compared to epidural technique, also the overall cost of spinal was lower compared to epidural anaesthesia.

Mazul-Sunko [11] studied the effect of low dose spinal vs epidural anaesthesia for delivery in a randomized prospective study on parturient evaluating effective analgesia and hemodynamic stability of both technique, and they concluded that epidural analgesia has disadvantage of slow onset and higher rate of instrumental delivery, while spinal anaesthesia in stander doses causes hypotension and bradycardia which might compromise faetal condition, but low dose intrathecal local anaesthetic or/and opioid offers advantage of faster onset and lower incidence of side effect. Their conclusion agreed with that in our study.

A study was performed by Riley ET etal comparing spinal vs epidural anaesthesia for caesarean section regarding time efficiency, costs, charges, and complications [12]. They retrospectively reviewed the charts of patients who had received epidural ($n = 47$) or spinal ($n = 47$) anaesthesia for non emergent caesarean section. Patients who received epidural anaesthesia had significantly longer total operating room (OR) times this were caused by longer times spent in the OR until surgical incision. Length of time spent in the post anaesthesia recovery unit was similar in both groups. Supplemental intraoprative intravenous (i.v.) analgesics and anxiolytics were required more often in the epidural group (38%) than in the spinal group (17%) ($P < 0.05$). Complications were noted in six patients with epidural anaesthesia and none with spinal anaesthesia ($P < 0.05$). Average per-patient charges were more for the epidural group than for the spinal group. They conclude that spinal block may provide better and more cost-effective anaesthesia for uncomplicated, elective caesarean sections. Their conclusion agreed with our study as regard effectiveness and cost benefit of spinal vs epidural, in spite of difference in procedure.

Ng et al. [9] carried out a study to assess the relative efficacy and side-effects of spinal vs epidural anaesthesia in women having caesarean section. 751 women included in the study received 0.5% bupivacaine as the local anaesthetic for both spinal and epidural groups; they concluded that both spinal and epidural techniques are shown to provide effective anaesthesia for caesarean section. Both techniques are associated with moderate degrees of maternal satisfaction. Spinal anaesthesia has a shorter onset time, but treatment for hypotension is more likely if spinal anaesthesia is used. Their conclusion agreed with ours as regard rapid onset of anaesthesia with spinal technique, but the difference in results between their study and ours is due to difference in the used local anaesthetic drug, dose difference, also difference in the type of the operative procedure than ours.

Minty RG et al. examines the safety and efficacy of single-dose spinal analgesia during labour [13]. Medline was searched and the references of 2 systematic reviews and a meta-analysis were reviewed to find articles on obstetric analgesia and pain measurement. The literature supports use of spinal anaesthesia as a safe and effective alternative to epidural anaesthesia; they concluded that single-dose spinal anaesthesia is useful alternative to epidural analgesia for appropriately selected patients, their conclusions agreed with the conclusion in our study.

Table 4 Adverse effect of spinal vs epidural.

Adverse effect	Group S $n = 50$ (%)	Group E $n = 50$ (%)	Chi-square	
			X^2	P-value
Hypotension	4(8)	7(14)	0.919	0.338
Pruritus	14(28)	30(60)	10.390	< 0.001*
Vacuum extraction	8(16)	13(26)	1.507	0.220
Oxytocin	24(48)	31(62)	1.980	0.159
Somnolence	2(4)	3(6)	0.211	0.646
Motor blockade	1(2)	2(4)	0.344	0.558
Nausea	4(8)	3(6)	0.154	0.695
Sensory and motor complications	2(4)	2(4)	0.000	1.000

* P non sig. > 0.05; sig. < 0.05.

Table 5 Faetal out come.

Faetal data	Group S ($N = 50$)	Group E ($N = 50$)	Tests	
			T	P-value
Apgar score mean ± SD	7.8 ± 2.6	7.5 ± 3.2	0.514	0.608
Faetal heart rate disturbances n(%)	2(4)	0(0.0%)	0.510	0.475

* P non sig. >0.05; sig. <0.05.

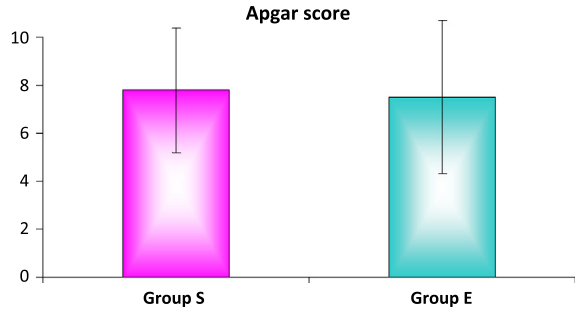

Figure 5 Faetal Apgar score in group S vs group E.

Krzysztof and Susilo Chandra assess maternal satisfaction with single-dose spinal analgesia for the management of obstetric pain in Indonesian women [14]. The investigation included 62 labouring women with single pregnancy at term, with 45 primigravida and 17 multigravida. All 62 parturients received single-dose spinal anaesthesia with a combination of bupivacaine, 2.5 mg; morphine, 0.25 mg; and clonidine, 45 μg. Maternal satisfaction, duration of pain relief, and side effects were studied. The overall maternal satisfaction with the single-dose spinal technique for labour analgesia in their study group was high, with 50 patients (81%) being very satisfied, and 7 patients (11%) being satisfied with the quality of labour analgesia. Forty-nine patients (79%) stated that they would select single-dose spinal analgesia for pain control in labour in the future. They concluded that single-dose spinal analgesia with a combination of bupivacaine, morphine, and clonidine provided effective labour pain control, and maternal satisfaction with this technique was very high. They concluded that spinal technique is very cost-effective and should be recommended for routine obstetric pain control. Their conclusion agreed with that mentioned in our study.

Holstrom et al. in a controlled study single segment combined spinal epidural (CSE) block was compared with spinal and epidural block for major orthopaedic surgery [15]. The study was carried out on seventy-five patients randomly assigned to receive one of the three blocks. Bupivacaine 0.5% and morphine were used for anaesthesia and analgesia; they concluded that analgesia and surgical condition provided by spinal and CSE were superior to those provided by epidural block. Their conclusions go with that in our study.

6. Conclusions

Based on the results of our study we concluded that single dose spinal analgesia is a good alternative to epidural analgesia in controlling labour pain i.e. spinal compared to epidural is more easy performed, faster, less expensive, and provide effective analgesia.

Conflict of interest

No conflict of interest.

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