ORIGINAL ARTICLE

CAN FRACTIONATED SPINAL ANESTHESIA BE AN ECONOMICAL ALTERNATIVE TECHNIQUE TO COMBINED SPINAL-EPIDURAL ANESTHESIA??

K. S. Sunitha[1], Mohammed Naveed[2]

HOW TO CITE THIS ARTICLE:
K. S. Sunitha, Mohammed Naveed. "Can Fractionated Spinal Anesthesia Be An Economical Alternative Technique To Combined Spinal-Epidural Anesthesia??". Journal of Evidence based Medicine and Healthcare; Volume 2, Issue 5, February 02, 2015; Page: 477-486.

INTRODUCTION: Central neuraxial blockade holds a very good place in anesthesia for surgical procedures on abdomen and lower limbs[1]. We have spinal anesthesia with rapid onset of action with precipitous hypotension, on the other hand we have epidural anesthesia with gradual onset of action with graded fall in BP and ability to prolong anesthesia for required duration and to provide post-operative analgesia. Combination of these two techniques can be of benefit in the form of rapid onset of action by spinal anesthesia and prolonging the duration of anesthesia by epidural. [2, 3] This combined technique appears to be demanding higher cost when compared to either of them[4, 5] and also associated with technical difficulties and catheter related problems.

Fractionated spinal anesthesia (FSA)[6,7] where local anesthetic is injected into subarachnoid space in fractions with time gap along with opioids like morphine[5, 8, 9] will not only reduce the degree of hypotension[10, 11] but also provides prolonged duration of anesthesia.[12, 13] Addition of morphine will take care of postoperative analgesia and this technique is devoid of complications related to the catheters like kinking, infections, difficulty in insertion, blockade etc.[12]

METHODS: This study was a prospective randomized comparative study. After obtaining the ethical Committee approval and written informed consent, 60 patients of ASA grading 1/2 scheduled for abdominal and lower limb surgeries were enrolled. Standard monitoring was used which included non-invasive arterial blood pressure (NIBP), electrocardiogram (ECG), heart rate (HR), pulse oximeter (SpO2). Preloading was done with 500ml of crystalloid solution. The procedure was performed either in sitting or lateral position.

Group I - Fractionated Spinal Anesthesia was performed at the level of L3-4/ L2-3 interspace using 25-26G Quincke's spinal needle. The dose of 20mg (4ml) 0.5% bupivacaine heavy given in two equal divided doses of 10mg (2ml) with time gap of 3mins followed by 300mcg of morphine intrathecally.

Group II - Epidural space was reached with LOR technique using 18G Tuohy's needles in Lumbar interspace and catheter threaded 3-4cm into epidural space and fixed. Test dose given to rule out intravascular/ intrathecal placement of the catheter. Then spinal anesthesia was performed one interspace below using 25-26G Quincke's spinal needle using 10mg (2ml) 0.5% bupivacaine heavy. In case the level is insufficient for incision, 5ml of 0.5% bupivacaine supplemented through epidural catheter. Followed by epidural top-up is given one hour after spinal anesthesia with 4-6ml of 0.5% bupivacaine.

The following data were recorded,

- Time taken for the anesthetic technique - from positioning to spinal injection.
- Onset of action - time taken from administration of spinal injection to attainment of level required for incision.
- Extent and degree of sensory / motor blockade - maximum sensory block attained was assessed by pin prick sensation using 23G hypodermic needle along the mid clavicular line bilaterally. The degree of motor blockade was assessed as per Modified Bromage Scale.
- Hemodynamic data - the baseline value of vital signs before performing the spinal anesthesia and at 2, 5, 15, 30, 60, 120, 180 mins after spinal injection. For the purpose of our study, hypotension was defined as SBP of < 90mmHg and bradycardia was defined as HR <50 beats/ min.
- Recovery from sensory and motor blockade - two segment regression, complete sensory and motor recovery was assessed from the time of highest sensory block.
- Analgesia and rescue analgesics - total duration of analgesia was noted (time elapsed from spinal injection to first rescue analgesia in the postoperative period). Postoperative pain was assessed by VAS scoring, analgesics were given whenever VAS score was >4 and number of rescue analgesics required within 24 hours were noted. Choice of rescue analgesics includes Inj. Tramadol, Inj. Diclofenac/Diclofenac Aqueous IV/IM in group I, the choice was dependent on surgeon. Rescue analgesic in group II included 0.125% bupivacaine as epidural top-ups plus Inj. Tramadol, Inj. Diclofenac/ Diclofenac Aqueous IV/IM, if patient complaints of pain in between epidural top-ups.
- Adverse effect like PDPH, shivering, nausea, vomiting, pruritus, urinary retention and respiratory depression are noted.

The total cost incurred for providing anesthesia and analgesia for 24 h is calculated in INR with following price list:

	FSA	**CSEA**
1	QUINCKES SPINAL NEEDLE 25/26G (BD) - INR 98/-	EPIDURAL SET 18 G (B BRAUN) - INR 1, 250/-
2	0.5% BUPIVACAINE HEAVY 4ML (ANAWIN) - INR 23/-	SPINAL NEEDLE 25/26G (BD) -INR 98/-
3	INJ MORPHINE 10MG (1ML) - INR 29/-	0.5% BUPIVACAINE HEAVY 4ML - INR 23/-
		0.5% BUPIVACAINE PLAIN 20ML - INR 77/-
		0.25% BUPIVACAINE PLAIN 20ML - INR 51/-
Total	**INR 150/-**	**INR 1499/-**

Table 1 (FIXED COST)

VARIABLE COST (depending on number and type of rescue analgesia used)

- INJ ONDENSETRON 4MG (EMESET) - INR 16.44/-
- INJ TRAMADOL 100MG (VTRAM) - INR 22/-
- INJ DICLOFENAC-AQ 75MG (DYNAPAR-AQ) - INR 20.35/-
- INJ DICLOFENAC 75MG (DYNAPAR) - INR 16/-

Statistical analysis: Statistical analysis was performed using computer statistical software system SPSS version 16. Data were expressed as either mean and standard deviation (SD) or numbers and percentages. Continuous co-variates (age, time) were compared using analysis of variants (ANOVA). For categorical co-variates (gender, ASA, nausea/vomiting, hypotension, bradycardia, use of ephedrine, atropine, post-operative analgesia requirements and type of surgery) a chi-square test was used, with the p value reported at the 95% confidence interval. The level of significance used was $p< 0.05$. The total sample size was calculated to be 60 (30 each).

RESULTS: 60 patients who completed the study protocol were included in the data analysis. The demographic data was comparable between the two groups as shown in table 2.

Group	Group I - FSA	Group II - CSEA
No of patients	n=30	n=30
Age(yrs)	40.5±14.1	39.2±16.8
Sex ratio M/F	14/16	13/17
ASA Status 1/2	16/14	14/16

Table 2

Table 2 shows the mean age was 40.5±14.1 yrs in group I and 39.2±16.8 yrs in group II. In both groups females were more with 53% and 57% in group I & II respectively.

Duration of technique: In our study the time taken for the technique of anesthesia was statistically significant. Mean time taken for the procedure was 13.91 ± 2.52 mins in group I and 29.4 ± 4.57 mins in group II, 'p' value of 0.0001.

Onset of action: In our study mean onset of action was comparable between two groups FSA vs CSEA (5.83±1.68 mins vs 5.53±0.95 mins, 'p' value of 0.4065). It is the time taken to reach initial sensory level required to start the surgery after spinal injection. None of the patients in group II required additional epidural top-up to facilitate sensory level required for incision.

Highest sensory and motor level achieved and time taken:

		Mean	Std. Dev
Thoracic Level(T)	FSA	6	2
	CSEA	7	3
Minutes	FSA	15	5
	CSEA	15	3

Table 3

Table 3 shows the mean maximum level achieved and time required for the same among the two groups FSA vs CSEA. Maximum level achieved and the time required was comparable between the two groups (T6 ± 2 vs T7 ± 3, 'p' value = 0.93 & 15±5 min vs 15 ±3 min, 'p' value < 0.05).

Hemodynamic effects: Hemodynamic parameters following FSA using 20mg of 0.5% bupivacaine heavy was comparable with 10mg of 0.5 % bupivacaine heavy. Number of patients experiencing hypotension (SBP < 90 mmHg) was comparable between two groups but patients belonging to FSA group required more dosage of ephedrine.

	FSA	**CSEA**
Number of Patients who had hypotension	7	6
Mean Lowest fall in SBP (mmHg)	85 ±3.6	86 ±3.3
Total dose of Ephedrine (mg)	3 ± 6.05	1.6 ±3.8

Table 4

Table 4 shows that maximum fall were seen between 15-30 mins of spinal anesthesia. Patients in FSA group had sustained hypotension requiring repeated doses of Inj. Ephedrine 6mg to maintain SBP >90mmHg. 3 patients required 18mg, 2 patients required 12mg and other 2 patients required 6mg of inj. ephedrine in FSA whereas, all 6 patients required 6mg in CSEA to maintain SBP >90mmHg.

Duration of surgery:

Duration in Minutes	**FSA**	**CSEA**
Mean duration of Surgery	134±22	138±26

Table 5

Table 5 shows the average duration of surgery among two groups. Duration of surgery was comparable between the two groups FSA vs CSEA. (134±22 mins vs 138±26 mins, 'p' value <0.0001).

Duration of regression and recovery:

Group	FSA	CSEA	'p' Value
	MEAN±SD in minutes		
Two segment regression	90±39	55±15	0.0001
Complete sensory recovery	265±65	164±36	0.0001
Complete motor recovery	280±68	174±40	0.0001

Table 6

Table 6 shows the recovery period among the two groups FSA vs CSEA.

Time taken for two segment regression was significantly prolonged in group I when compared with group II (90±39 mins vs 55±15 mins, 'p' value < 0.0001).

Time taken for total sensory recovery was significantly prolonged in group I when compared with group II (265±65 mins vs164±36 mins, 'p' value < 0.0001).

Time taken for total motor recovery was significantly in prolonged group I when compared with group II (280±68 mins vs 174±40 mins, p' value < 0.0001).

Analgesia and Rescue analgesics:

	FSA	CSEA
Total duration of analgesia (minutes)	840±79	209±28
No of rescue analgesics	3±1	7±1

Table 7

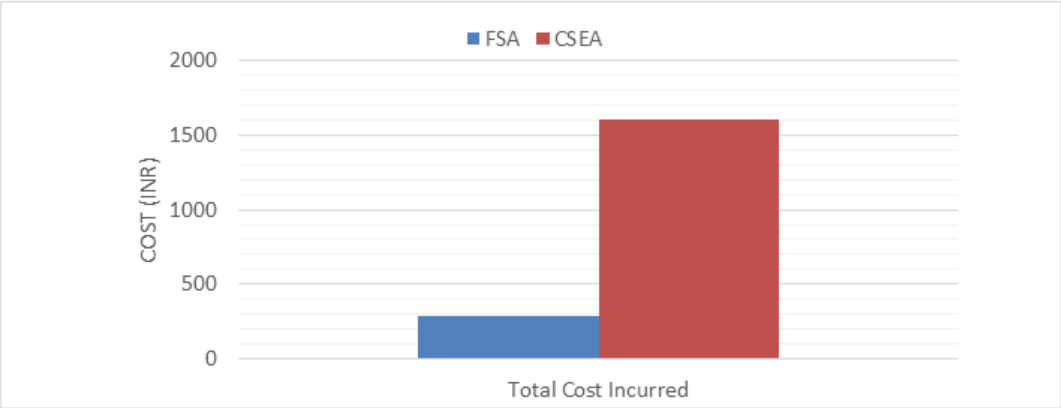
Table 7 shows the rescue analgesia in mins among the two groups. Time taken for rescue analgesia was significantly more in group I when compared with group II (840±79mins vs 209±2 mins, 'p' value < 0.0001). Total number of rescue analgesia required in 24 hours was less in group I with mean of 3±1 compared to group II with mean of 7±1, 'p' value < 0.0001(<0.05).

Complications: Only complications observed were shivering and PONV, managed with Inj. Ondensetron 4mg and Inj. Tramadol 15mg. There was no incidence of pruritus, PDPH, urinary retention, respiratory depression etc. The incidence of complications is elaborated in table 8.

COMPLICATIONS	FSA	CSEA
	No. of Patients	
Intra operative shivering	12(40%)	16(55%)
PONV	17(56%)	15(50%)

Table 8

Total cost incurred:



Graph 1

		Mean	Std. Deviation	Min	Max
Cost (INR)	FSA	285	34	224	344
	CSEA	1599	36	1536	1662

Table 9

Table 9 shows the total cost incurred in INR among the groups. As total cost incurred for providing anesthesia and analgesia were significantly less in group I with mean of 285±34 INR compared to group II with mean of 1, 599±36 INR, 'p' value < 0.0001.Total cost incurred for group I is 6 times lesser than group II.

DISCUSSION: Fractionated spinal is well known technique since 1906, but it is usually practiced by inserting catheter into subarachnoid space. In our study we have used incremental doses of bupivacaine through spinal needle and we found that the level of block achieved with FSA with 20mg was equivalent to CSEA where half the dose was used but FSA induced block lasted for longer duration.

FSA through spinal needle gives the benefits of fast onset, intense block and prolongs the blockade up to 4 hours accommodating prolonged surgical procedures without any complications associated with catheter. It saves operation theatre time as it consumes less time compared to spinal or epidural block performed with catheter. The degree of hypotension is comparable between two groups but the hypotension in FSA group is more sustained demanding larger doses of ephedrine. This can be very well correlated with the fact that the block lasts longer in FSA.

We do not have studies comparing FSA with CSEA, but Stefan Wilhelm et al[2] compared continuous spinal anesthesia (CSA) with CSEA using 0.5% bupivacaine in trauma patients having lower limb fracture. Study parameters of both studies have been tabulated below.

	Our study	Stefan Wilhelm et al,[2] University Hospital Eppendorf, Germany
Type of Study	Prospective randomized study	Prospective randomized trial study
Comparison between	FSA (no catheter) vs CSE	CSA (using microcatheter) vs CSEA
Age group	15 to 80 years	19 to 96 years
Total no of patients	30 each	30 each
Drug used	0.5 % bupivacaine heavy	0.5% bupivacaine plain
Preloading with 500ml crystalloid	yes	yes
Initial drug dosage	2ml+2ml with gaps of 3mins 0.5% bupivacaine heavy injected	2ml 0.5% bupivacaine plain
Anesthetic supplement before incision if level achieved is insufficient for surgery	Nil in FSA and 5ml of 0.5% bupivacaine plain top-ups in CSE	Additional 1ml of 0.5 % bupivacaine plain in CSA.& 5ml of 0.5% bupivacaine plain top-ups in CSE
Hemodynamics	Comparable between 2 groups	Comparable between 2 groups
Technical problems	Nil (the patients who did not complete the said procedure were eliminated)	Like kinking, blockage, displacement, disconnection of the catheter.
Technical performance	FSA consumes less time for the procedure	CSA consumes less time for the procedure
Onset of analgesia	Comparable (6 mins)	Comparable(6-7 mins)
Complications noticed	Intraoperative shivering and PONV	PDPH (CSA<CSEA) amenable to hydration and bed rest, Low back pain (CSA<CSEA).
Conclusion: Our study showed better performance and least complications related to the catheter		

Table 10

J.F Faravel et al, [10] compared hemodynamic effects of single dose vs titrated doses of 0.5% bupivacaine through catheter in elderly patients. Onset of anesthesia, hemodynamic variables and number of ephidrine doses were noted and they found degree of hypotension was less pronounced in CSA group. In our study we also saw that degree of hypotension was less with FSA for the dose injected (20mg) and was comparable with CSEA where we injected 10mg.

W. schinder et al,[14] J.F. Faravel et al,[10] and K. Maurer et al[12] all have used upto15-20mg of 0.5% bupivacaine in incremental doses and were able to maintain stable hemodynamics. We have also used same 20 mg 0.5% bupivacaine in fractionated manner and able to maintain stable hemodynamics. The maximum level of sensory block achieved in their study was comparable (T6) with our study.

S. Bowrey et al[8] compared the duration of postoperative analgesia with 0.2 mg and 0.5mg of intrathecal morphine along with 3.5 ml 0.5% bupivacaine heavy and concluded that post op analgesia was 10 h and 24 h respectively. We observed that in less invasive procedure (arthroscopic & laparoscopic procedures) postoperative analgesia was longer in duration when compared to more invasive procedures (THR, TKR), probably duration of postoperative analgesia depends on type of surgery which determines intensity of pain post operatively.[15, 16] In our study post of analgesia lasted up to 14 hours with 0.3 mg of intrathecal morphine.

Total cost incurred for providing anesthesia and analgesia for first 24h of surgery was significantly less in FSA when compared to CSEA(285±34 INR vs 1, 599±36 INR, 'p' value < 0.0001). Cost incurred is less in FSA due to decreased fixed cost of FSA along with reduced number of rescue analgesics needed in 24h when compared to CSEA. No studies were found in our search comparing cost-effectiveness between SA and EA or CSEA. Whereas, Christopher Gonano et al 2006, also found regional anesthesia (spinal anesthesia) is double the cost effective to general anesthesia employed for orthopedic surgeries.

Complications: K Maurer et al[12] showed nausea was significantly lower in CSA group and incidence of headache and pruritus was similar between the groups. In our study, incidence of PONV was more in group I when compared to group II (17/30 vs 15/30). Whereas, Stefan et al found negligible incidence of PDPH. We did not encounter any other complications like PDPH, pruritus, urine retention etc., except intra-operative shivering. In our study 12/30 in group I vs 16/30 group II had intra-op shivering.

CONCLUSION: Spinal anesthesia is highly versatile, at one end we have selective spinal anesthesia blocking only sensory aspect and can be used for day care anesthesia, at the other end we have FSA where we give incremental doses through the same spinal needle and obtained spinal anesthesia acting for prolonged period. Our study indicates that fractionated spinal anesthesia consumes less time for the technique and provides anesthesia for prolonged periods with stable hemodynamics and additional small dose of morphine extends postoperative analgesia lasting up to 14 hours. The cost incurred was 5-6 times lesser than CSEA. "Can FSA be poor man's Epidural?"

REFERENCES:

1. Pumberger M, Memtsoudis SG, Stundner O et al. An analysis of the safety of epidural and spinal neuraxial anesthesia in more than 100, 000 consecutive major lower extremity joint replacements. Reg Anesth Pain Med. 2013 Nov-Dec; 38(6): 515-9.
2. Stefan Wilhelm et al, . Comparison of continuous spinal with combined spinal-epidural anesthesia using plain bupivacaine 0.5% in trauma patients. Anesth Analg 1997; 85: 69-74.

3. Niinai H, Nakagawa I et al. Survey of combined spinal-epidural anesthesia in Japan - analysis of questionnaire from 148 hospitals. Article in Japanese 1999; Mar; 48(3): 295-300.
4. Christopher Gonano, et al, . Spinal Versus General Anesthesia for Orthopedic Surgery: Anesthesia Drug and Supply Costs, Anesth Analg 2006; 102: 524 –9.
5. Borendal Wodlin N, Nilsson L, Carlsson P et al. Cost-effectiveness of general anesthesia vs spinal anesthesia in fast-track abdominal benign hysterectomy. American Journal Obstetrics & Gynaecology 2011; 205: 326.e1-7.
6. Stefan Wilhelm et al. Comparison of continuous spinal with combined spinal-epidural anesthesia using plain bupivacaine 0.5% in trauma patients. Anesth Analg 1997; 85: 69-74.
7. Joseph Brill, . Fractional Spinal Anesthesia For Short Upper Abdominal Surgery California medicine, April, 1947 Vol. 66, No. 4.
8. S. Bowney et al. A comparison of 0.2 and 0.5mg intrathecal morphine for post op analgesia after TKR. Anesthesia, 2005, 60, pages 449-452.
9. B. Mugabure Bujedo, S. Gonz´alez-Santos, and A. Ur´ıa Azpiazu. "A review of epidural and intrathecal opioids used in the management of postoperative, " Journal of Opioid Management, vol. 8, no. 3, pp. 177–192, 2012.
10. Favarel-Garrigues JF, F Sztark, ME, Petitjean et al. Haemodynamic effects of spinal anesthesia in the elderly: single dose versus titration through a catheter. Reg Anesth Pain Med, 1999; 24[5] 417-42.
11. Pitkanen M. Rosenberg P, et al, . Hemodynamic changes during spinal anesthesia with slow continuous infusion or single dose of plain bupivacaine. ActaAnaesthesiolScand1992; 36[6]: 526-529.
12. Maurer K, Bonvini JM, Ekatodramis G et al. Continuous spinal anesthesia /analgesia versus single shot spinal anesthesia with patient controlled analgesia for elective hip arthroplasty.ActaAnaesthesiolScand2003; 47[7]: 878-883.
13. CasatiA, Zangrillo A et al, . Comparison between hemodynamic changes after single dose and incremental subarachnoid anesthesia. Reg Anesth 1996; 21[4]: 298-303.
14. Schneider TW, Mueller-Duysing S et al, Incremental dosing versus single dose spinal anesthesia and hemodynamic stability. Anesth analg, 1993; 77[6]: 1174-1.
15. Ganesh A, Kim A, Casale P. et al. Low-dose intrathecal morphine for post operative analgesia in children. International Anesthesia Reaserch Society. Anesthesia Analgesia Feb 2007; 104(2): 271-276.
16. Duman A, Apiliogullari S. Letters to the editor, International Anesthesia Research Society. Anesthesia Analgesia, Oct 2007; 105(4): 1170-1171.

AUTHORS:

1. K. S. Sunitha
2. Mohammed Naveed

PARTICULARS OF CONTRIBUTORS:

1. Professor, Department of Anaesthesiology, Vydehi Institute of Medical Sciences and Research Centre.
2. Post Graduate Student, Department of Anaesthesiology, Vydehi Institute of Medical Sciences and Research Centre.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. K. S. Sunitha,
A904, Mantri Greens,
Sampige Road,
Malleshwaram, Bangalore – 560003.
E-mail: relaxreverse@yahoo.co.in

Date of Submission: 17/01/2015.
Date of Peer Review: 19/01/2015.
Date of Acceptance: 21/01/2015.
Date of Publishing: 27/01/2015.