

Effect of Intrathecal Fentanyl on Haemodynamic Changes in Lower Segment Caesarean Section

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Abstract: *Background:* To compare the effects of spinal anaesthesia with hyperbaric bupivacaine with and without fentanyl on haemodynamics of patients undergoing Lower Segment Caesarean Section. *Methods:* 40 patients were divided into two groups of 20 each. Group B patients were given hyperbaric bupivacaine. Group F patients were given hyperbaric bupivacaine with fentanyl. *Results:* Patients in Group F had greater haemodynamic stability than the patients in Group B. *Conclusion:* There is low incidence of hypotension during LSCS when fentanyl is added to intrathecal hyperbaric bupivacaine.

Keywords: Intrathecal fentanyl, Spinal anaesthesia, LSCS, Haemodynamic changes

1. Introduction

In elective and emergency LSCS, spinal anaesthesia is the most preferred anaesthesia¹. Bupivacaine is considered as the best spinal anaesthetic agent for LSCS². For caesarean section, regional anaesthesia is preferred over general anaesthesia. Among the regional anaesthesia also, spinal anaesthesia is given the highest preference. There are several reasons for this choice. Spinal anaesthesia is having a rapid onset of action and maximum muscle relaxation. Spinal anaesthesia is simple in technique. The failure rate is less in spinal anaesthesia.

For LSCS, spinal anaesthesia needs lesser dose of local anaesthetic agent³. During pregnancy, there is increased penetration of local anaesthetic drugs through tissue membranes. Also due to reduced plasma protein binding, the serum level of local anaesthetics can go up. These factors make the pregnant patient very prone for local anaesthetic toxicity. So, it is desirable to reduce the dose of bupivacaine during LSCS. Also, by reducing the bupivacaine dose, increased haemodynamic stability is achieved.

Fentanyl is a common additive for bupivacaine in LSCS⁴. It improves haemodynamic stability. Intrathecal fentanyl is commonly used with 0.5% bupivacaine heavy for spinal anaesthesia in LSCS.

Hypotension is a common event after spinal anaesthesia in LSCS⁵. Hypotension reduces uteroplacental blood flow. This can affect the neonate. Also, hypotension causes nausea and vomiting in the patient. Hypotension results in increased maternal morbidity. To prevent hypotension after spinal anaesthesia, crystalloid loading and left lateral tilt of the operating table are used. Treatment of hypotension is by the usage of vasopressors especially ephedrine.

Bupivacaine dose is responsible for this hypotension⁶. If the dose of bupivacaine is reduced, then there is less incidence of hypotension. Reducing the bupivacaine should not end up in compromising the quality of spinal anaesthesia. So, to retain the quality of spinal anaesthesia, fentanyl is added along with bupivacaine and injected intrathecally. By adding fentanyl with bupivacaine, the hypotension is reduced. But at the same time adequate surgical anaesthesia is maintained. Inadequate bupivacaine can lead to incomplete spinal anaesthesia. A combination of fentanyl and bupivacaine

results in complete anaesthesia. Thus, it is possible in LSCS a complete anaesthesia with less hypotension. Since the hypotension is less, the fetoplacental perfusion is not compromised.

The addition of fentanyl to bupivacaine improves the quality of anaesthesia⁷. Addition of fentanyl to intrathecal bupivacaine provides haemodynamic stability during LSCS after spinal anaesthesia.

Many studies were done to study the effects of intrathecal fentanyl on several parameters of the mother and the baby. In our study we compare only the haemodynamic variables of the mother.

Low dose bupivacaine blocks lesser number of spinal segments. This reduces the magnitude of sympathetic blockade. Thus, more haemodynamic stability is ensured when we reduce the dose of intrathecal bupivacaine. The purpose of low dose bupivacaine spinal anaesthesia is to increase the cardiovascular stability of the pregnant patients. Intrathecal fentanyl with low dose bupivacaine provides good haemodynamic stability during LSCS.

2. Materials and methods

Aims and Objectives:

The purpose of this study was to evaluate haemodynamic stability following intrathecal 0.5% bupivacaine heavy with 10 µg fentanyl. We compare the mixture of fentanyl and bupivacaine with bupivacaine alone.

Design:

Randomized controlled clinical trial

Sample size:

The patients were pregnant women posted for LSCS. 40 patients were selected for the study. They were divided into two groups of 20 patients each.

Methodology:

Following the approval from the ethical and scientific committee of our institution, the study was started. Written informed consents were received from all the patients.

Selection criteria:

Patients posted for LSCS
ASA Grade I or II
Age group 20 – 35 years
Height group 140 – 170 cms
Normal coagulation profile

Exclusion criteria:

Hypertension complicating pregnancy
Heart diseases complicating pregnancy
Twin pregnancies
Coagulation abnormalities
Severe Respiratory infections

There were two groups of patients (Group B and Group F). Each group had 20 patients posted for LSCS. Group allocation was done randomly with the help of a computer. Group B patients received 1.8 ml of 0.5% bupivacaine

heavy. Group F patients received 0.2 ml preservative free fentanyl (10 µg) with 1.6 ml of 0.5% bupivacaine heavy. Fentanyl was loaded with a one ml syringe. In both the groups, the final volume of the drug was 1.8 ml. In both the groups, the drugs were injected intrathecally.

As soon as the patient enters the operation theatre, monitors were connected. Patients were started with preloading through an 18G intravenous cannula inserted into a wide and straight vein in the distal forearm. Crystalloids were used for preloading. We used isotonic normal saline at the value of 15 ml/Kg over a period of 15 – 20 minutes. After that the patients were given spinal anaesthesia in the left lateral position. Drugs were injected according to the allotted group of the patient. After the intrathecal administration of the drug, patients were placed in the supine position immediately. Then the operating table was put in reverse Trendelenburg position at 15 degrees. Afterwards the table was tilted 20 degrees left lateral position. The purpose of the left lateral tilt is to prevent aortocaval compression. After that all the patients were provided oxygen with a facemask at the rate of 4 litres per minute.

Haemodynamic variables viz., systolic blood pressure, diastolic blood pressure, mean blood pressure, heart rate and SpO₂ were recorded. Frequent recordings were done during the first half an hour.

Heart rate and blood pressures (systolic, diastolic and mean) were recorded at regular intervals. SpO₂ was recorded continuously. The recordings were done at 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 35, 40, 45, 50, 55 and 60 minutes from the time of subarachnoid injection of the drugs.

Hypotension was treated with incremental doses of intravenous ephedrine. Heart rate of less than 60 beats per minute was considered as bradycardia. Bradycardia was treated immediately with intravenous atropine 0.65 mg. Data were collected and analyzed.

Statistical Analysis:

The demographic data were analyzed by Mann Whitney test. The data of the haemodynamic variables were analyzed with Mann Whitney test and Barnard's test. The ephedrine requirement and atropine requirement were analyzed by Fisher's exact test.

3. Results

The demographic variables were analyzed for comparability of data in both the groups. We used Mann Whitney U test for this purpose.

Table 1: Comparison of sample based on age, height and weight

Parameter	Sum of ranks		U statistic		p value
	Group B (Bupivacaine)	Group F (Bupivacaine + Fentanyl)	U calculated	U critical	
Age	462	358	148	127	0.159545
Height	415	405	195	127	0.892414
Weight	439.5	380.5	170.5	127	0.424883

In all the parameters, $U - \text{calculated} > U - \text{critical}$. So, we accept null hypothesis.

In all the parameters, $p - \text{value} > 0.05$. So, the difference in the parameters viz., age, height and weight of both the groups is not significant. Hence the data of both groups are comparable with respect to age, height and weight.

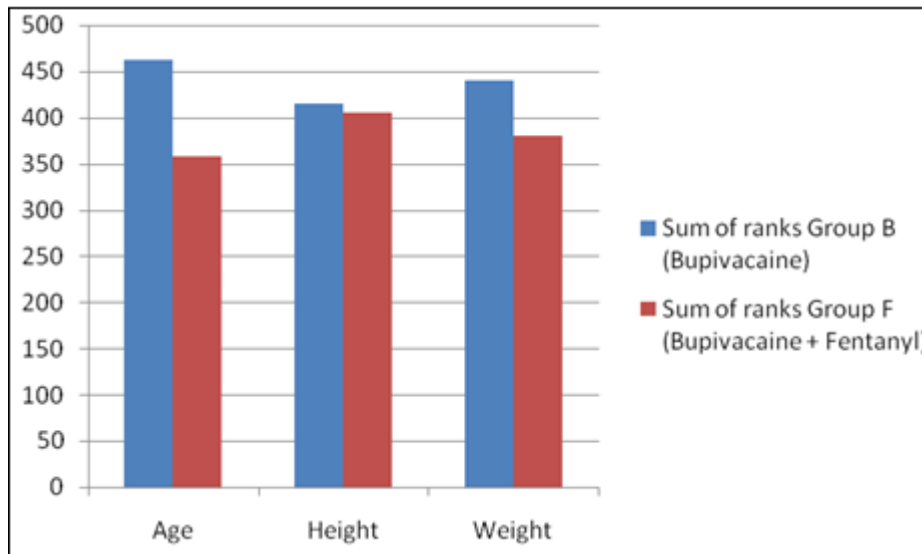


Table 2: Comparability of samples based on baseline Heart rate and BP

Parameter	Sum of ranks		U statistic		p value
	Group B (Bupivacaine)	Group F (Bupivacaine + Fentanyl)	U calculated	U critical	
Heart rate	427.5	392.5	182.5	127	0.635945
SBP	435	385	175	127	0.498881
DBP	460	360	150	127	0.176214
MAP	447	373	163	127	0.316898

Mann Whitney U test was used to check the comparability of samples based on baseline heart rate and BP.

In all the parameters, $p - \text{value} > 0.05$. So the difference in the parameters viz., heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) of both the groups is not significant. Hence the data of both groups are comparable with respect to heart rate, SBP, DBP and MAP.

In all the parameters, $U - \text{calculated} > U - \text{critical}$. So we accept null hypothesis.

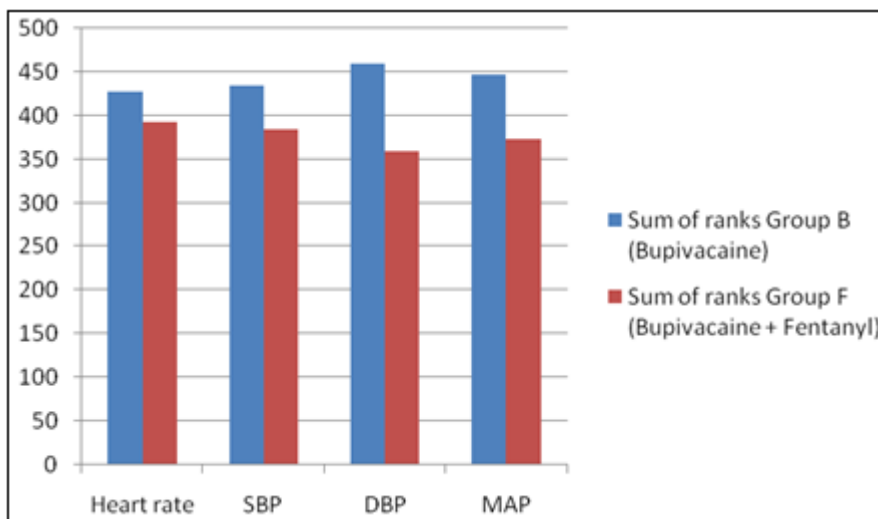


Table 3: Comparison of SBP at time intervals

Time (Minutes)	Sum of ranks		U statistic		p value	Statistically significant
	Group B (Bupivacaine)	Group F (Bupivacaine + Fentanyl)	U calculated	U critical		
0	442.5	377.5	167.5	127	0.379332	No
2	407.5	412.5	197.5	127	0.946084	No
4	380.5	439.5	170.5	127	0.424883	No
6	403.5	416.5	193.5	127	0.860431	No

8	392	428	182	127	0.626328	No
10	389.5	430.5	179.5	127	0.579218	No
12	399	421	189	127	0.766046	No
14	461	359	149	127	0.167724	No
16	399.5	420.5	189.5	127	0.776391	No
18	433	387	177	127	0.533842	No
20	411.5	408.5	198.5	127	0.967635	No
25	406	414	196	127	0.913837	No
30	387	433	177	127	0.533842	No
35	468	352	142	127	0.116670	No
40	447	373	163	127	0.316898	No
45	443	377	167	127	0.372043	No
50	459.5	360.5	150.5	127	0.180577	No
55	431	389	179	127	0.570000	No
60	469	351	141	127	0.110499	No

Systolic blood pressures of both groups were compared at corresponding time intervals. Mann Whitney U test was used for this analysis. At all time intervals, $U - \text{calculated} > U - \text{critical}$. So we accept null hypothesis.

At all time intervals, $p - \text{value} > 0.05$. So the difference in systolic blood pressures between both groups is not statistically significant.

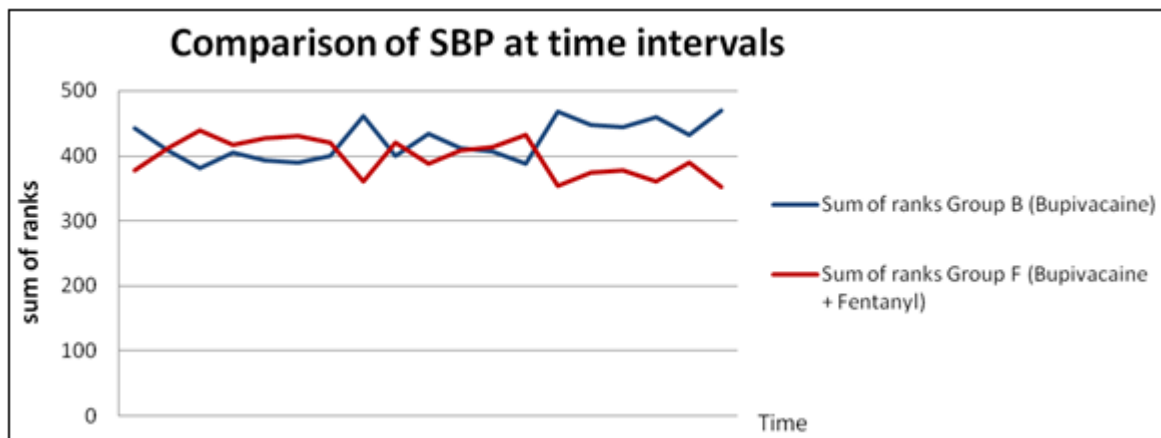


Table 4: Comparison of MBP at time intervals

Time (Minutes)	Sum of ranks		U statistic		p value	Statistically significant
	Group B (Bupivacaine)	Group F (Bupivacaine + Fentanyl)	U calculated	U critical		
0	447	373	163	127	0.316898	No
2	414	406	196	127	0.913837	No
4	399	421	189	127	0.766046	No
6	387	433	177	127	0.533842	No
8	397.5	422.5	187.5	127	0.735268	No
10	403	417	193	127	0.849818	No
12	428	392	182	127	0.626328	No
14	450.5	369.5	159.5	127	0.273285	No
16	363.5	456.5	153.5	127	0.208454	No
18	427	393	183	127	0.645623	No
20	421	399	189	127	0.766046	No
25	359	461	149	127	0.167724	No
30	373.5	446.5	163.5	127	0.323482	No
35	412.5	407.5	197.5	127	0.946084	No
40	400.5	419.5	190.5	127	0.797197	No
45	390	430	180	127	0.588506	No
50	406	414	196	127	0.913837	No
55	399	421	189	127	0.766046	No
60	426.5	393.5	183.5	127	0.655361	No

Mean blood pressures of both groups were compared at corresponding time intervals. Mann Whitney U test was used for this analysis. At all time intervals, $U - \text{calculated} > U - \text{critical}$. So we accept null hypothesis.

At all time intervals, $p - \text{value} > 0.05$. So the difference in mean blood pressures between both groups is not statistically significant.

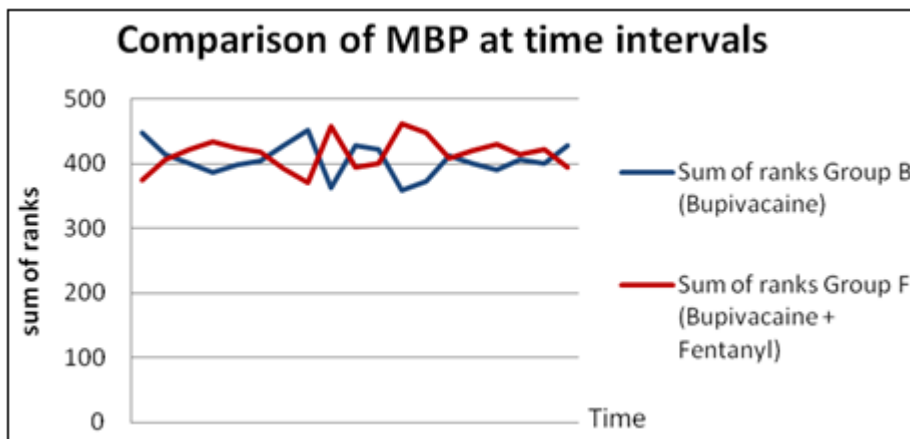


Table 5: Comparison of drop in SBP <90 mmHg

Group	Number of patients	
	Drop in SBP	No Drop in SBP
Group B (Bupivacaine)	12	8
Group F (Bupivacaine + Fentanyl)	6	14

If the systolic blood pressure drops below 90 mmHg, then that patient was considered as having hypotension. The patients who developed hypotension as per this norm were counted from both groups. This data was analyzed with Barnard’s test.

Wald Statistic is 1.906925. Nuisance parameter is 0.110100. The p - value is 0.033560.

Since $p - value \leq 0.05$, the difference is statistically significant.

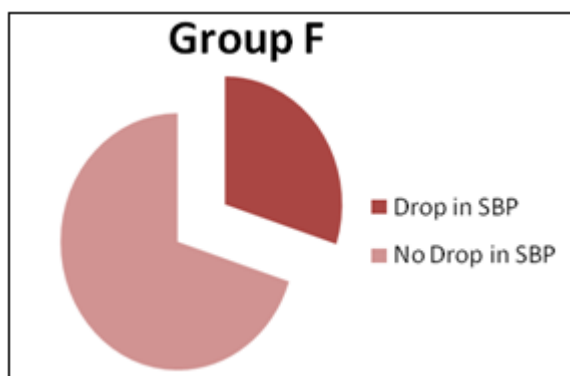
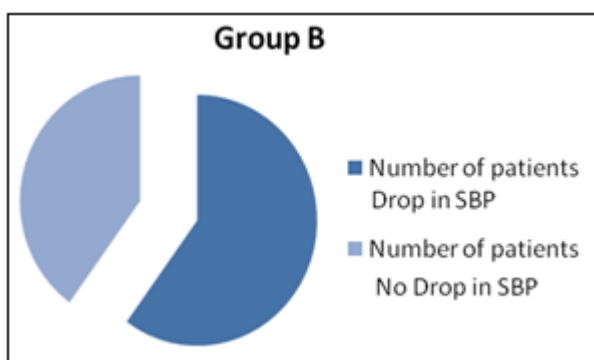


Table 6: Comparison of drop in SBP (20% from baseline)

Group	Number of patients	
	Drop in SBP	No Drop in SBP
Group B (Bupivacaine)	10	10
Group F (Bupivacaine + Fentanyl)	4	16

The patient was considered as having hypotension if the systolic blood pressure falls 20% below the baseline value. Applying this norm, patients who developed hypotension were noted from both groups. On this data, Barnard’s test was done. Wald Statistic is 1.988981. Nuisance parameter is 0.400100. The p - value is 0.027989. Statistically the difference is significant because the $p - value \leq 0.05$.

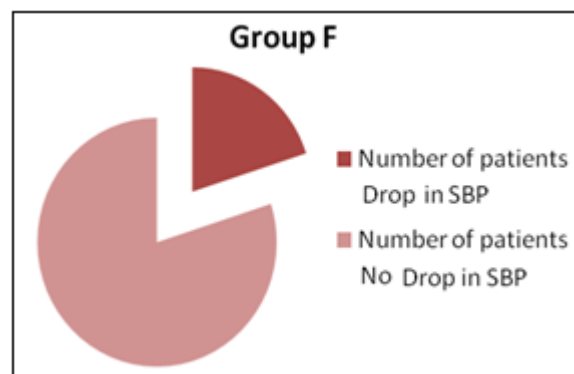
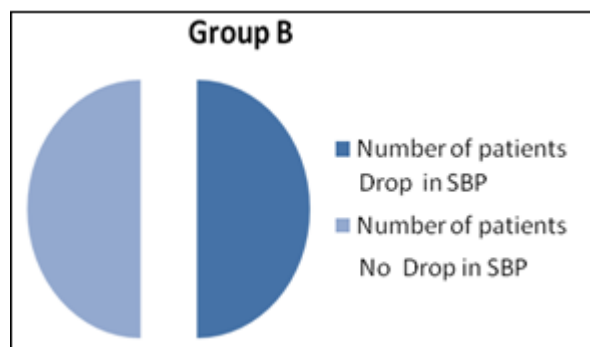


Table 7: Comparison of degree of maximum fall in SBP (From baseline SBP)

Group B (Bupivacaine)	Group F (Bupivacaine + Fentanyl)	Sum of ranks		U statistic	p value
		U calculated	U critical		
489.5	330.5	120.5	127	0.031517	

The degree of maximum fall in systolic blood pressure from the baseline systolic pressure was noted for each patient in both the groups. These values were analyzed using Mann Whitney U test.

The calculated value of U statistic is 120.5.

For 5% two - tailed level, Critical value of U is 127.

As calculated $U < U_{critical}$, we reject the Null Hypothesis - i. e. the result is significant.

p - value is 0.031517 i. e., p - value ≤ 0.05 which is statistically significant.

The two - tailed P value equals 0.0060, which is ≤ 0.05 . So the association between groups and ephedrine requirement is considered to be very statistically significant. Less patients in fentanyl group required ephedrine. This is statistically significant.

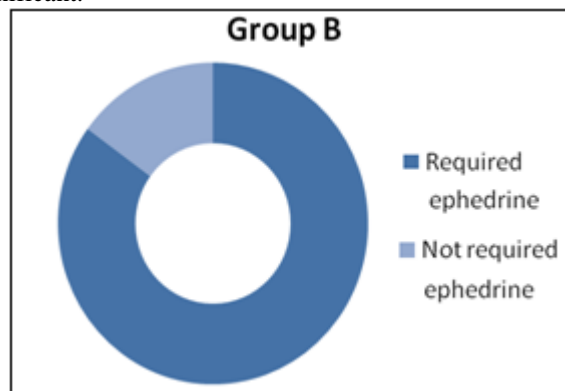
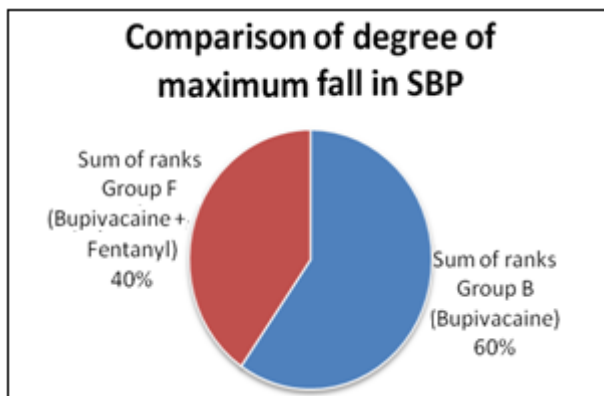


Table 8: Comparison of drop in MBP (30% from baseline)

Group	Number of patients	
	Drop in MBP	No Drop in MBP
Group B (Bupivacaine)	10	10
Group F (Bupivacaine + Fentanyl)	2	18

When the mean blood pressure falls more than 30% from the baseline mean blood pressure, then that patient is considered to have hypotension. Applying this concept, the patients who developed hypotension were identified from both the groups. This data was analyzed with the help of Barnard's test.

Wald Statistic is 2.760262. Nuisance parameter is 0.250100. The p - value is 0.003498.

Statistically the difference is significant because the p - value ≤ 0.05 .

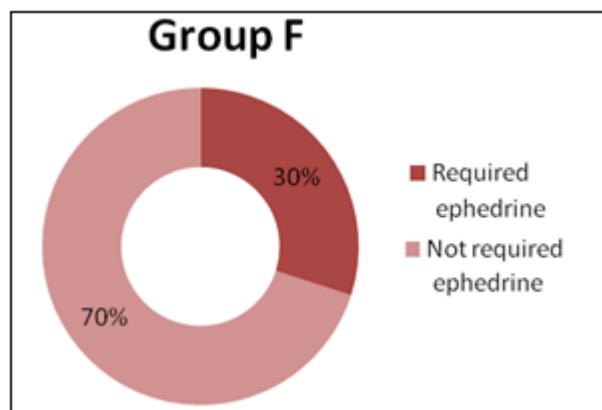


Table 10: Requirement of atropine

Group	Number of patients	
	Required atropine	Not required atropine
Group B (Bupivacaine)	3	17
Group F (Bupivacaine + Fentanyl)	7	13

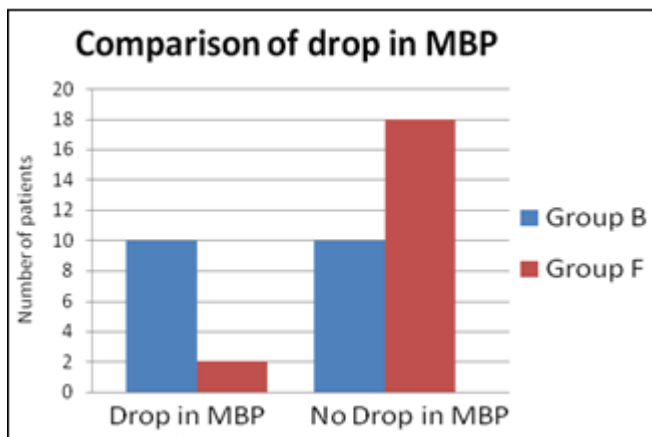
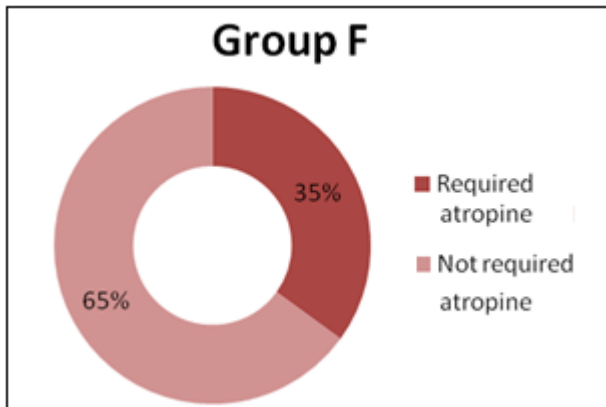
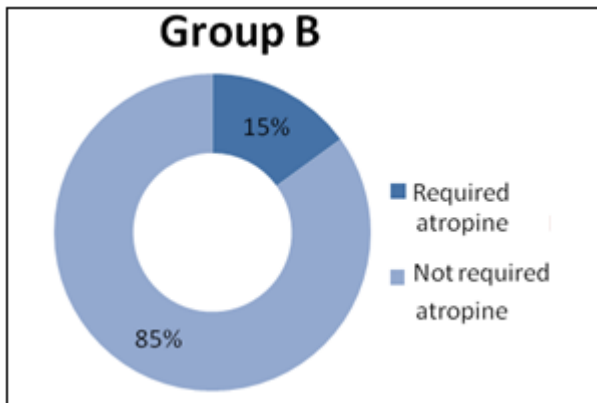


Table 9: Requirement of ephedrine

Group	Number of patients	
	Required ephedrine	Not required ephedrine
Group B (Bupivacaine)	17	3
Group F (Bupivacaine + Fentanyl)	6	14

As a part of the treatment of hypotension, some of the patients required ephedrine. Such patients were noted from both the groups. This data was analyzed using Fisher's exact test.

Some patients developed bradycardia. These patients were treated with atropine. The patients who were treated with atropine from both the groups were tabulated. This data was analyzed with Fisher's exact test. The two - tailed P value equals 0.2733, which is > 0.05 . The association between groups and atropine requirement is considered to be not statistically significant. Though more patients in fentanyl group required atropine, this is statistically not significant.



4. Discussion

The most preferred form of anaesthesia for LSCS is spinal anaesthesia. The commonest haemodynamic change after spinal anaesthesia is hypotension. Hypotension is an undesirable haemodynamic change because it can compromise the uteroplacental perfusion⁸. Hypotension during LSCS could be avoided or minimized by using lesser dose of bupivacaine. But this needs an additive like fentanyl. The combination of bupivacaine and fentanyl can cause minimal hypotension only.

In our study, we compared the haemodynamic changes after spinal anaesthesia during LSCS. The spinal anaesthetic agents were bupivacaine alone (Group B) and bupivacaine along with fentanyl (Group F).

With Mann Whitney U test we checked whether data in both the groups are comparable by analysing the demographic variables.

5. Results

Patients in Group B had greater haemodynamic stability than the patients in Group A.

6. Conclusion

There is low incidence of hypotension during LSCS when fentanyl is added to intrathecal hyperbaric bupivacaine.

Declaration of interest

None declared.

Funding

None declared.

Ethical approval

The study was approved by the Institutional Ethics Committee.

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