Original Article

Indian Journal of Anesthesia and Analgesia
2017, 4 (4, Part-I), 917-739
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.4417.16

Effects of Intrathecal 5µg Dexmedetomidine with Hyperbaric Bupivacaine as Compared to Plain Bupivacaine on Hemodynamic Changes

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Abstract

Introduction: Spinal anesthesia is characteristically associated with slowing of the rate. The degree of bradycardia as well as the frequency with which it can he roughly correlated with the extent of sympathetic denervation. Pronounced bradycardia is observed most frequently when cardiac output and arterial blood pressures have decreased significantly during anesthesia. *Methodology:* 60 patients selected for this study were randomly divided into two groups; Each group comprised of 30 patients each. Written informed consent was taken from all patients who participated in the study. Preoperative assessment with complete history, general physical examination and systemic examination was done for each patient along with airway assessment and spinal column examination. *Results:* The changes in heart rate at different intervals of time was not found to be statisticallysignificant between two groups. In group DB, the mean difference of heart rate from basal to 90 minutes, was 10.47 minutes and whereas among PB group, it was 3.83 minutes. This implies that heart rate reduction is more in case of DB group compared to PB group but it was not statistically significant *Conclusion:* There was a difference in basal MAP between two groups which was not statically significant.

Keywords: Dexmedetomidine; Hyperbaric Bupivacaine; Hemodynamic Changes.

Introduction

Hypotension is the most common immediate complication of spinal anesthesia. Hypotension following spinal anesthesia is primarily the result of paralysis of preganglionic sympathetic fibers that transmits motor impulses to smooth muscles of the peripheral vasculature. Degree of hypotension was proportional to the number of sympathetic fibers blocked. Exact mechanism whereby sympathetic blockade lowered blood pressure was not known. There were two schools of thought [1,2].

- One postulated that generalized arterial and arteriolar dilatation caused a decrease in peripheral vascular resistance enough to account for the major portion of the decrease in peripheral vascular resistance.
- Other postulated that the hypotension was secondary to a decrease in cardiac output as a result of peripheral pooling and a diminution on venous return to the heart.

While both theories are correct neither is by itself adequate to explain all the alterations in circulatory physiology caused by spinal anesthesia. The sympathectomy that results in the technique of spinal anesthesia is dependent upon the height of the block. The question at which level of arterial blood pressure decreases after central neuraxial block is acceptable remains unanswered. If the blockade extends above the level of T5, it becomes progressively more difficult to compensate for the hemodynamic change and the blood pressure will be markedly reduced. Hypotension during spinal anesthesia usually develops during the first 15-20 minutes; left untreated

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Received on 08.07.2017, **Accepted on** 28.07.2017

the blood pressure reaches its lowest level in 20-25 minutes following the subarachnoid injection. For this reason, the first half-hour of a spinal anesthesia is considered to be its dangerous period although the initial decrease in the blood pressure may develop with alarming rapidity in certain individual. After the blood pressure has reached its lowest point, the systolic blood pressure often increases spontaneously 5-10 mm Hg over the next 10-15 minutes after which its levels off and remains relatively fixed until the effect of anesthetic nerve roots has worn off. This small increase is a manifestation of compensatory circulatory activity mediated reflex by those proportions of sympathetic outflow that have been blocked and perhaps by a slight return of smooth muscle tone in the denervated portion of the peripheral vasculature [3].

Spinal anesthesia is characteristically associated with slowing of the rate. The degree of bradycardia as well as the frequency with which it can he roughly correlated with the extent of sympathetic denervation. Pronounced bradycardia is observed most frequently when cardiac output and arterial blood pressures have decreased significantly during anesthesia [4].

During spinal anesthesia, there is one factor which influences pulse rate and arterial blood pressure. A decrease in venous return results in reduction in cardiac output and cardiac output is one of the main determinants of the level of arterial blood pressure during spinal anesthesia. Decreased venous return to the heart may induce bradycardia by one of the three mechanisms. First the hydrostatic pressure in the right heart affects heart rate through intrinsic chronotropy stretch receptors located within the wall of right atrium. These baroreceptors independent of neural connection to the central nervous system form intracardiac reflexes in which the heart rate is proportional to pacemaker stretch. The baroreceptors normally respond to a fall in blood pressure by producing a compensatory tachycardia (Marey's law) through vagal afferent and efferent pathways. Most patients under spinal anesthesia exhibits bradycardia. Thus in spinal anesthesia venous pooling in the periphery reduces stimulation of the volume receptor nerves. The result is vagal preponderance and a slowing of the heart rate. The increase in pressure in the great veins or in the right atrium produces tachycardia reflexly via stretch receptors and vice versa. Within the walls of the ventricles there are nerve endings, which may be activated mechanically either by ventricular distension and stretching or by vigorous and rapid systolic contractions. The reflex, also called the "Bezold Jarisch reflex" arises from mechanoreceptors and chemoreceptors found primarily in the inferoposterior wall of the left ventricle. Activation of this reflex results in increased parasympathetic activity and inhibition of sympathetic activity [5].

Cerebral blood flow is governed by two main factors. Mean arterial blood pressure and local resistance to blood flow in cerebral vessels. Spinal anesthesia theoretically could influence cerebral blood flow altering either blood pressure or cerebrovascular resistance or both. Cerebrovascular auto regulatory mechanism maintains cerebral blood flow in humans at constant levels in the presence of wide fluctuations in mean arterial blood pressure. Cerebral blood flow will become pressure dependent until the Mean Arterial Pressure (MAP) falls below 55 mm Hg. Cerebrovascular auto regulation is independent at the sympathetic nervous system. Cerebral blood flow remains unaffected in normal persons even when mean arterial pressure decreases from 90 to 60 mm Hg during spinal anesthesia [6].

Methodology

This study was conducted on 60 patients between the age group of 18 to 60 years, of either sex, belonging to ASA grade I & II who were posted for elective lower abdominal, urological surgeries under spinal anesthesia. Only those patients were selected for the study from whom informed consent was obtained. 60 patients selected for this study were randomly divided into two groups;

Each group comprised of 30 patients each

Group DB (Study group)	0.5% hyperbaric bupivacaine 3ml (15mg) + Dexmedetomidine 5µg (0.5ml), total volume 3.5ml
Group PB (Placebo group)	0.5% hyperbaric bupivacaine 3ml(15mg) + Sterile saline 0.5ml, total volume 3.5ml

Method of Study

Written informed consent was taken from all patients who participated in the study.

Preoperative assessment with complete history, general physical examination and systemic examination was done for each patient along with airway assessment and spinal column examination.

The following laboratory investigations were done in the selected cases:

- Hemoglobin
- Urine analysis
- Blood sugar
- Blood urea
- Serum creatinine
- Coagulation profile
- Blood grouping and RH typing
- ECG for patients over 40years of age
- Chest x-ray

Preoperatively

- Patient's informed consent was taken.
- Nil per oral status was confirmed, 6hrs prior to surgery.
- The procedure of subarachnoid block was explained and the patient was informed to communicate to the anesthesiologists about perception of any pain or discomfort during the surgery.
- They were pre medicated with tab alprazolam 0.25mg and tab ranitidine 150 mg orally 10:00 pm at night.
- Verbal numerical scale for assessment of pain was explained to the patient

Procedure

On the day of surgery patients were shifted to the operation theatre, connected to multichannel monitor (BPL Extello-ECO) and base line heart rate, noninvasive blood pressure and SpO2 were recorded. IV access was obtained on the forearm with 18 Gauge IV cannula and Lactated Ringers solution 500 mL was infused intravenously over 30 minutes. The anesthesia machine, circuits, emergency resuscitation trolley and airway equipment were kept ready.

Patients were positioned on a flat operating table. Under strict aseptic precautions, lumbar puncture was performed after local infiltration of anesthetic solution, in left lateral position or sitting position by midline approach by using disposable Quincke spinal needle (25 G) at L3-L4 intervertebral space. After clear and free flow of CSF, the study drug was injected into the subarachnoid space; patients were turned supine immediately and are given supplemental oxygen 5 L/min via face mask. Patients were monitored continuously using noninvasive blood pressure, pulse oximeter and electrocardiogram. Fluid therapy was continued throughout the surgery. No intravenous analgesics or opioids were administered during the surgery.

Results

The mean age of study subjects in DB group is 35.6±10.5 years compared to 39.6±12.1 years of PB group. The age is slightly high in PB group compared to DB group. This difference is found to be not statistically significant.

The mean weight of study subjects in DB group is 67.6±12.5 Kgs compared to 62.3±5.4 Kgs of PB group. The mean weight is slightly high in DB group compared to PB group. This difference is not found to be statistically significant.

There is no much difference in height between two groups. The mean height in DB group is 161.8 cms and among PB group is 160.4 cms. This difference is not statistically significant.

There was a difference in basal heart rate between two groups which was statically significant.

The changes in heart rate at different intervals of time was not found to be statistically significant

Table 1: Baseline characteristics

Parameters	Group- DB		Group-PB		P value*
	Mean	SD	Mean	SD	
Age (years)	35.6	10.5	39.6	12.1	0.18
Weight (Kgs)	67.6	12.5	62.3	5.4	0.03
Height (cms)	161.8	7.0	160.4	5.2	0.38

*Independent T test

between two groups. In group DB, the mean difference of heart rate from basal to 90 minutes, was 10.47 minutes and whereas among PB group, it was 3.83 minutes. This implies that heart rate reduction is more in case of DB group compared to PB group but it was not statistically significant.

There was a difference in basal SBP between two groups which was not statically significant.

The changes in SBP at different intervals of time was found to be statistically significant at 2 min, 5min, 10 min, 20 min, 30 min, 40 min, 50 min, 60 min, 70 min, 80 min and at 90 min between two groups.

Table 2: Comparison of Heart rate changes at different intervals of time(bpm)

Time	Group- DB		Group-PB		P value*
	Mean	SD	Mean	SD	
Basal	88.90	16.0	81.40	07.2	0.02
At 0 min	92.90	15.1	89.37	06.1	0.24
At 2 min	87.60	17.2	82.43	07.5	0.13
At 5 min	79.00	17.1	77.50	07.6	0.66
At 10 min	74.43	14.3	76.67	08.7	0.46
At 20 min	74.93	10.8	75.57	06.1	0.78
At 30 min	74.07	09.8	75.43	07.2	0.54
At 40 min	76.40	09.3	76.23	05.8	0.93
At 50 min	76.93	11.3	76.93	04.8	1.00
At 60 min	77.17	11.9	75.73	04.6	0.54
At 70 min	78.77	12.1	75.47	05.3	0.17
At 80 min	78.40	11.6	77.17	05.7	0.60
At 90 min	78.43	11.0	77.57	15.1	0.80

*Independent T test

Table 3: Comparison of Systolic blood pressure changes at different intervals of time (mmHg)

Time	Group- DB		Group-PB		P value*
	Mean	SD	Mean	SD	
Basal	126.9	8.9	127.3	5.4	0.83
At 0 min	125.2	10.6	123.4	5.4	0.43
At 2 min	119.9	10.9	112.8	5.3	0.002
At 5 min	113.0	11.9	110.9	6.2	0.40
At 10 min	108.8	12.6	113.4	4.5	0.07
At 20 min	107.5	11.2	116.1	5.3	0.01
At 30 min	107.7	10.9	118.3	6.2	0.01
At 40 min	109.5	9.5	121.0	8.4	0.01
At 50 min	109.7	10.4	121.8	8.1	0.01
At 60 min	112.0	9.4	122.5	7.2	0.01
At 70 min	112.2	9.1	126.7	11.4	0.01
At 80 min	111.5	8.5	121.5	6.7	0.01
At 90 min	111.0	10.1	121.4	7.9	0.01

*Independent T test

Table 4: Comparison of Diastolic blood pressure changes at different intervals of time (mmHg)

Time	Group- DB		Group-PB		P value*
	Mean	SD	Mean	SD	
Basal	81.40	9.3	81.8	3.1	0.82
At 0 min	79.27	8.4	80.20	3.3	0.57
At 2 min	76.00	9.1	76.60	3.7	0.74
At 5 min	70.80	11.2	72.87	3.2	0.33
At 10 min	69.53	12.1	70.67	4.0	0.63
At 20 min	71.00	10.5	72.13	5.0	0.59
At 30 min	69.77	10.0	73.27	5.4	0.09
At 40 min	70.40	8.7	73.00	5.6	0.17
At 50 min	70.63	8.0	73.37	5.7	0.09
At 60 min	71.50	7.1	74.73	6.0	0.06
At 70 min	72.13	7.2	75.67	4.9	0.03
At 80 min	71.23	6.5	75.93	6.1	0.006
At 90 min	70.90	6.9	77.07	5.5	0.01

*Independent T test

In group DB, the mean difference of SBP from basal to 90 minutes, was 15.9 minutes and whereas among PB group, it was 5.9 minutes. This implies that SBP reduction is more in case of DB group compared to PB group and it was statistically significant.

There was a difference in basal SBP between two groups which was not statically significant.

The changes in DBP at different intervals of time was found to be statistically significant 70 min, 80 min and at 90 min between two groups

In group DB, the mean difference of DBP from basal to 90 minutes, was 11.5 minutes and whereas among PB group, it was 3.9 minutes. This implies that DBP reduction is more in case of DB group compared to PB group and it was statistically significant

There was a difference in basal MAP between two groups which was not statically significant.The changes in SBP at different intervals of time was found to be statistically significant 40 min, 50 min, 60 min, 70 min, 80 min and at 90 min between two groups. In group DB, the mean difference of MAP from basal to 90 minutes, was 10.27 minutes and whereas among PB group, it was 4.80 minutes. This implies that MAP reduction is more in case of DB group compared to PB group and it was not statistically significant.

Table 5: Comparison of Mean arterial pressure changes at different intervals of time (mmHg)

Time	Group- DB		Group-PB		P value*
	Mean	SD	Mean	SD	
Basal	95.70	8.9	96.13	6.4	0.83
At 0 min	94.70	9.1	94.53	5.3	0.93
At 2 min	89.10	9.8	89.83	5.4	0.72
At 5 min	84.17	10.7	85.73	4.5	0.46
At 10 min	83.33	10.3	84.57	4.1	0.54
At 20 min	84.43	10.1	85.13	4.8	0.73
At 30 min	81.93	9.3	87.07	3.9	0.007
At 40 min	83.97	8.5	87.87	5.0	0.03
At 50 min	84.27	8.6	88.83	4.8	0.01
At 60 min	84.33	7.5	89.83	5.5	0.002
At 70 min	85.17	7.4	91.17	4.8	0.01
At 80 min	85.23	6.7	91.70	5.4	0.01
At 90 min	85.97	6.0	92.93	5.3	0.01

*Independent T test

Discussion

In our study, the changes in heart rate at different intervals of time was not found to be statistically significant between two groups

These changes were statistically significant at 15, 20, and 30 minutes but clinically insignificant. There was no episodes of bradycardia in either group.

Sherif A Abdeihemid et al [7] Their study showed that difference in heart was statistically significant at 10, 15, 20 , 30 min but clinically insignificant.

GE. Kanaziet al [8] Their study concluded that heart rate was comparable between the dexmedetomidine group and control group.

Rampal Singh et al [9] Their study showed differ in heat rate was statistically significant at 10, 15, 20, 25, 30 mm. But clinically insignificant in both groups.

In group DB, the mean difference of SBP from basal to 90 minutes, was 15.9 minutes and whereas among PB group, it was 5.9 minutes. This implies that SBP reduction is more in case of DB group compared to PB group and it was statistically significant In group DB, the mean difference of DBP from basal to 90 minutes, was 11.5 minutes and whereas among PB group, it was 3.9 minutes. This implies that DBP reduction is more in case of DB group compared to PB group and it was statistically significant.

Our results with respect to changes in mean systolic and diastolic blood pressure was comparable with studies of Sharif A Abdelhainid et al [7] GE Kanazi et al [8] and Rampal Singh et al [9].

Hence we conclude that cardiovascular profile in our patients was found to be remarkably stable throughout the intraoperative and postoperative period in both the groups.

The mean age of study subjects in DB group is 35.6±10.5 years compared to 39.6±12.1 years of PB group. The age is slightly high in PB group compared to DB group. The mean weight of study subjects in DB group is 67.6±12.5 kg compared to 62.3±5.4 kg of PB group. There was no much difference in these parameters.

Conclusion

Bupivacaine alone and bupivacaine along with low dose dexmedetomidine provided adequate anesthesia for all lower abdominal surgeries with haemodynamic stability.

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