Original Research Article

Comparitive Study of (1%) 2-Chlorprocaine Versus 0.5 % Hyperbaric Bupivacaine for Spinal Anaesthesia for Ambulatory Surgeries: A Prospective Randomized Study"

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Abstract

Aim :This Study was performed to compare the anaesthetic efficacy and safety of two local anaesthetic agents :2-Chlorprocaine and Hyperbaric Bupivacaine ,in patients undergoing ambulatory surgeries. **Methods and materials** :Hundred patients ,ASA I-II, were randomized to receive an intrathecal injection of 2- Chlorprocaine or Hyperbaric Bupivacaine .Group A (n=50) received 4ml of Chlorprocaine10mg/ml (40mg).Group B (n=50) received 1.5ml of Hyperbaric Bupivacaine 5mg/ml (7.5mg). Onset and duration of sensory and motor blockade, hemodynamic changes, recovery parameters, side effects for the two agents were compared. **Results:**Time of onset of sensory block was faster in Group B (2.20±0.45) when compared with Group A (2.40±0.57). In Group B time to two segment sensory regression was prolonged (55.38±1.92) when compared with Group A (54.55±1.44) and it is statistically significant. Duration of Motor blockade was prolonged in Group B (92.24±5.7) when compared with Group A (67.69±4.61). Hemodynamic variables were more stable in Group A than Group B . Time to ambulation was prolonged in Group B (166.40±4.50) when compared with Group A (154.04±2.49). Time to micturition was prolonged in Group B (303.16±2.08) when compared with Group A (267.36 ±3.72). Time to stimulated discharge was prolonged in Group B (148.71±4.12) when compared with Group A (124.20±3.45). 34 patients in Group B had adverse effects when compared with 26 patients in Group A .**Conclusion:** Intrathecal 1% 2-Chlorprocaine compared with 0.5 % Hyperbaric Bupivacaine results in a significantly faster recovery of sensory and motor blocks. Time to mobilization, voiding, discharge were significantly shorter for 2-chlorprocaine than 0.5% Hyperbaric Bupivacaine. We concluded that 2-chlorprocaine represents an appropriate choice for spinal blocks for short or ultra short surgical procedures.

Keywords: Spinal anaesthesia

Introduction

Spinal anaesthesia was introduced into clinical practice by Karl August Bier in 1898. More than a century has passed and even today, it is one of the most popular techniques for both elective and emergency surgical procedures particularly Caesarean Sections, lower abdominal surgeries, orthopedic and urological surgeries just to name a few. Spinal anaesthesia is used for providing a fast onset and effective sensory and motor blockade. Bupivacaine is used most commonly for spinal anaesthesia. Spinal anaesthesia is a reliable and safe technique for procedures of lower part of the body. If some of its characteristics(delayed ambulation, urinary retention, pain after block regression) limit its use, in ambulatory surgery[1-3]. Availability of short-acting local anesthetics has renewed interest for this technique in the context of short and ultra short procedures. When introduced chemical structure Chlorprocaine has a very short half-life. Animal studies have proven the safety of preservative free formulation. It has been extensively evaluated in volunteer studies as well as in clinical practice with a favourable profile in terms of both safety and efficacy[4,5].

In comparison with Bupivacaine, Chlorprocaine showed faster offset times, unassisted ambulation and discharge from hospital. Findings suggest that Chlorprocaine may be a suitable alternative to low doses of long acting anesthetics in ambulatory surgery. Its safety profile also suggests that Chlorprocaine could be a valid substitute for intrathecal short acting local anesthetics such as Lignocaine[6,7].In this context, literature suggests a dose ranging between 30mg and 60mg of Chlorprocaine for procedures lasting 60 minutes or less, while 10mg considered no-effect dose.

Aim of the study

To compare the following factors in two groups(1%)2-Chlorprocaine and 0.5% hyperbaric Bupivacaine for day care surgeries under spinal anaesthesia with respect to :

Materials and Methods

After obtaining Ethical Committee approval from Osmania Medical College, Hyderabad, 100 people of physical status American Society of Anaesthesiologists (ASA) I and II between the age group of 18-65 posted for daycare Ambulatory surgeries at Osmania General Hospital, Afzalgunj, Hyderabad and other allied hospitals have been selected for the study. Patients are randomly divided into two groups involving 50 patients each.

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Inclusion criteria:ASA physical status I and II (without any co-morbid disease) of Age between 18 -65 years,Day care surgeries , elective lower abdominal and lower limb surgeries

Exclusion criteria: Allergy to local anaesthetics, intracranial pressure,severe hypovolaemia, Bleeding diathesis, local infection, Congenital abnormality of lower spine and meninges like Neurologic disease: Spinal stenosis, symptomatic lumbar herniated disc, multiple sclerosis and Liquid restriction (cardiac or renal insufficiency)

Methods

Each patient was reassured , explained the procedure and informed consent taken. All patients were confirmed to be physically fit. Minimal fasting period is 8 hrs, following application of routine monitors (NIBP ,ECG ,PULSE OXIMETRY),IV line secured with 18 G IV cannula. All patients were preloaded with RL 10-12 ml/kg . Baseline mean arterial BP and pulse rate, Spo2 were noted. Subarachnoid block(SAB)is instituted at L3-L4 or L4-L5 inter-vertebral space in sitting position using 25 -G Quincke's needle.

Using a sealed envelope technique, patients were equally and randomly divided into two groups: Group A (n=50);40 mg 1 %(4ml) Chlorprocaine Group B (n=50);7.5mg 0.5 %(1.5 ml) Bupivacaine Oxygen 6 L/min was administered via face mask.

Patients were treated with titrated doses of Inj. Mephentermine 6mg I.V if systolic BP <90 mm/Hg or <20 % baseline,Inj .Atropine 0.6 mg I.V .if Heart Rate <50 /min. The sensory level of spinal anaesthesia was assessed by pinprick in auxiliary line using a 26 G needle, and was recorded at baseline prior to spinal injection, then every 2 minutes for the first 15 min after injection, and every 5 minutes for the next 30 min. and at 45 min. Blood pressure, heart rate and the extent of motor block were recorded every 2 min. for first 15 min. 5 min for next 30 min. and at 45 min. Once a T4 -T 6 level has been reached, surgeon was told to start the surgery.

Parameters to be evaluated - Sensory:

- Time for onset of sensory block by pinprick
- Time taken to reach peak sensory block level
- Time to regression of two dermatomes of the sensory level
- Time to complete sensory regression

Sensory score

Score	Response
0	Normal sensation
1	Analgesia (loss of pinprick sensation)
2	Anaesthesia (loss of touch sensation)

Motor:

- Time of onset of motor block
- Time to complete motor regression

Motor block was assessed with Modified Bromage scale

Grade	Response	Degree of block
0	No motor block	Nil (0%)
1	Unable to straight leg raise	Partial (33 %)
2	Unable to flex knee against resistance	Almost complete (66 %)
3	Unable to flex ankle	Complete

Time to onset of motor block, time to complete motor regression were recorded. Patients were discharged from PACU after they had attained all of following criteria :a minimum 60-min. stay, stable vital signs, signs of regression of the motor block (bromage 0), no analgesia within previous 20 min, and normal consciousness. After discharge from PACU, patients were transferred to ambulatory surgical unit, where once patients tolerate liquids by mouth and feel a light touch to their legs, they were asked to ambulate without assistance. Success at walking was followed by an attempt to void. Discharge from hospital was possible when patients reached all of the following criteria: complete regression of the block to light touch, ability to void, ability to walk, stable vital signs, no nausea, pain controlled with oral medication (last dose given at least one hour before discharge) and ability to tolerate liquids by mouth. Occurrence of adverse effects like hypotension, bradycardia, pain requiring analgesia, PONV were also recorded.

Statistical Methods

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Student test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis). Mann Whitney U test has been used to find the significance between two groups for parameters on non-interval scale. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

* Moderately significant (P value: 0.01<P< 0.05) ** Strongly significant (P value < 0.01)

Statistical software: The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1 and Systat 12.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Observation and Results

All 100 patients in two groups completed the study without any exclusion. We did an intergroup analysis and the results were as follows.Of the 100 patients, 50 belonged to Group A(2-Chlorpro-caine 1%) and other 50 categorized as Group B (Hyperbaric Bupivacaine).Data were presented as range, mean, standard deviation. The probability value 'P 'of less than 0.05 considered, statistically significant.

Age, weight, height of the patient between both the groups were comparable and were not statistically significant (P >0.05).

Table 1:Comparison of Age (yr), Weight (kg), Height (cm) distribution between two groups

Parameter	Group	Mean	Standard Deviation	p-Value 't ' Test
Age	A	32.10	6.727	0.124
	B	29.75	5.2975	
Weight	A	71.14	6.39	0.63
	B	70.55	5.85	
Height	A	159.63	2.78	0.14
	B	160.46	2.82	

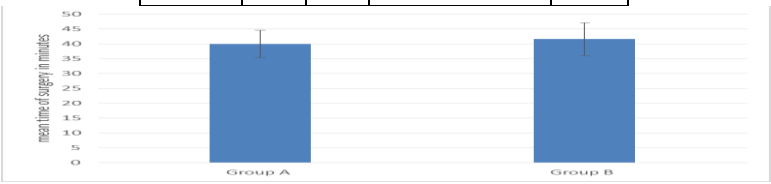

Fig 1: Comparison of duration of surgery (min) between the two groups

The average duration of surgery in both groups was comparable the 'p 'value of 0.10 which was not significant.

Table 2: Comparison of PR between two groups at various intervals

Pulse Rate	Group	Mean	Standard Deviation	'p' Value 't' Test
Baseline	A	92	12.93	0.45
	B	93.81	10.49	
2 Min	A	90.83	13.23	0.76
	B	90.04	12.78	
5 Min	A	89.47	12.62	0.004
	B	81.83	13.25	
10 Min	A	88.52	13.41	0.003
	B	80.70	12.99	
15 Min	A	87.39	12.83	0.80
	B	86.72	13.02	
30 Min	A	88.04	12.41	0.02
	B	83.20	6.82	
45 Min	A	87.12	12.16	0.55
	B	88.75	14.85	
End of Surgery	A	87.6	11.36	0.92
	B	87.83	13.73	

Table 3 shows distribution of pulse rate at various intervals between two groups and p value is statistically significant only at 5 and 10 mins after SAB.

Table 3: Comparison of MAP between two groups at various intervals

Map	Group	Mean	Standard Deviation	p Value 't ' Test
Baseline	A	83.95	8.81	0.15
	B	86.67	9.69	
2 Min	A	80.75	8.30	0.05
	B	84.20	8.81	
5 Min	A	78.55	7.80	0.003
	B	72.53	11.74	
10 Min	A	78.30	7.64	0.001
	B	72.06	10.55	
15 Min	A	77.34	7.23	0.0002
	B	71.36	8.23	
30 Min	A	76.89	6.54	0.48
	B	75.86	7.97	
45 Min	A	77.32	6.21	0.48
	B	76.40	6.75	
End of Surgery	A	77.85	7.19	0.13
	B	75.83	5.85	

Mean arterial pressures is significant at 2,5,10 and 15 minutes in between 2 groups .

Table 4: Comparison of SPO 2 between the two groups at various intervals

SpO2	Group	Mean	Standard Deviation	p Value 't 'Test
Baseline	A	99.28	0.95	0.63
	B	99.18	1.16	
2 Min	A	99.83	0.47	0.52
	B	99.77	0.46	
5 Min	A	99.85	0.47	0.46
	B	99.77	0.62	
10 Min	A	99.20	0.93	0.86
	B	99.16	1.35	
15 Min	A	99.51	0.71	0.31
	B	99.65	0.69	
30 Min	A	99.38	0.83	0.71
	B	99.44	0.81	
45 Min	A	99.53	0.71	0.88
	B	99.55	0.88	
End of Surgery	A	99.51	0.76	0.68
	B	99.57	0.70	

Table 5 shows distribution of SpO2 at various intervals between two groups which is statistically in significant.

Table 5: Comparison of time to complete sensory regression (min) between the two groups

Parameter	Group A	Group B
Time of Onset of Sensory block (min)		
Range	2-4	2-4
Mean	2.40	2.20
SD	0.57	0.45
P Value	0.054 Not significant	
time to peak sensory block (min.)		
Range	9-20	9-16
Mean	13.79	13.30
SD	1.44	1.26
P Value	0.11 Not significant	
time to two segment sensory regression (min.)		
Range	50-56	52-60
Mean	54.55	55.38
SD	1.44	1.92
P Value	0.016 Significant	
Time to complete sensory regression (min)		
Range	120-133	127-133
Mean	128.16	129.42
SD	2.26	1.19
P Value	0.0008 Significant	
onset of motor block (min)		
Range	3-6	3-6
Mean	4.57	4.69
D	0.88	0.89
P Value	0.49	
time to complete motor regression (min)		
Range	60-65	80-100
Mean	67.69	92.24
SD	4.61	
P Value	0.80	

time of onset of sensory block, time of onset of peak sensory block and time to complete motor regression,time of onset of motor block were statistically insignificant between two groups .

time to two segment sensory regression, complete sensory regression were statistically significant between two groups. Table 9 shows time to complete sensory regression which was statistically significant

Table 6: Comparison of length of stay in between the two groups

Parameter	Length of stay in PACU (min)	
	Group A	Group B
Range	66-68	66-70
Mean	67.16	67.32
SD	0.74	0.80
P Value	0.29 Significant	
Time to ambulation (min)		
Range	150-160	160-177
Mean	154.04	166.40
SD	2.49	4.50
P Value	0.005 Significant	
Time to simulated discharge (min)		
Range	117-130	142-157
Mean	124.20	148.71
SD	3.45	4.12
P Value	0.0007 Significant	
Time to micturition (min)		
Range	260-276	300-307
Mean	267.36	303.16
SD	3.72	2.08
P Value	0.014 Significant	

Length of stay in PACU between two groups which was statistically insignificant and time to ambulation which was statistically significant between two groups. Time to simulated discharge between the two groups which was statistically significant. Time to micturition between two groups which was statistically significant between two group.

Table 7: Comparison of Adverse effects between two groups

Adverse effects	Group A		Group B	
	No	%	No	%
Hypotension	2	3	6	10
Bradycardia	1	2	5	8
Pain requiring analgesia	10	19	5	9
PONV	0	0	1	2
Total cases with adverse effects	13	26	17	34
Total cases without adverse effects	37	74	33	66
Total	50	100	50	100

More than one adverse effect was present in one case in each group. There was more incidence of hypotension and bradycardia in group A than group B. But this was statistically insignificant. Pain requiring analgesia was more in group A. PONV was seen in group B only.

Discussion

Spinal anesthesia is a safe and reliable technique for ambulatory surgeries. Nevertheless, some of its characteristics may limit its use for ambulatory surgery including delayed ambulation, risk of urinary retention and pain after block regression. The choice of the correct local anesthetic for spinal anesthesia is therefore crucial in the ambulatory setting. Ideal local anesthetic should allow rapid onset and offset of its own effect for fast patient discharge with minimal side effects. Chlorprocaine was developed to meet the need for a short -acting spinal anesthetic that is reliable and has safety profile to support the growing need for day-care surgery. The purpose of this study was to compare 2-Chlorprocaine with Bupivacaine for spinal anesthesia in an ambulatory surgery setting. Our principal finding was that spinal anesthesia with 2-Chlorprocaine can provide a satisfactory surgical block while permitting earlier discharge from hospital than spinal Bupivacaine. This advantage is due to more rapid regression of the sensory and motor block, which helps patients ambulate and void faster. The finding that shows significant advantage is the time for regression of the sensory block to S2, as 2-Chlorprocaine was 2.3 times faster than Bupivacaine. We conducted a randomized case control study to compare 2-Chlorprocaine with Bupivacaine for spinal anesthesia in ambulatory surgery setting, which was based on studies of Yoos et al[8]

Yoos et al[8].demonstrated a 1.7 times faster regression of the sensory block with 2- Chlorprocaine (difference of 78min).In this study ,level of sensory block was assessed by using loss of sensation to pinprick with a dermatome tester. In our study, time for complete sensory block regression was faster with Chlorprocaine than Bupivacaine . The primary outcome of this study is time to eligibility for discharge from hospital was measured from the time spinal anesthesia was performed to the moment the patient attained all of the discharge criteria. In our study, time to simulated discharge was earlier with 2-Chlorprocaine than Bupivacaine due to faster regression of block, resulting in earlier ambulation and earlier voiding. Delayed discharge due to urinary retention was particularly problematic in Bupivacaine group. Even with good block regression and successful ambulation, many patients who received Bupivacaine experienced a longer delay between their first attempt and their eventful successful complete voiding. This delay may be explained by need for a regression of the sensory block to at least S3 dermatome in order to obtain normal detrusor function. As health care costs are determined ,in part, by the length of hospital stay, achieving faster discharge from hospital through the utilization of 2-Chlorprocaine for spinal anesthesia could provide potential cost saving without compromising the quality of patient care. Ben-David et al[9]showed that spinal hyperbaric Bupivacaine 7.5 mg provided satisfactory anesthesia and rapid recovery for ambulatory arthroscopic knee surgery, but that further dilution resulted in failed blocks. Prior studies of 2-Chlorprocaine suggested that 40 mg would be the minimum dose required to achieve the rapid onset of a reliable sensory and motor block of sufficient duration. In our study,40mg of Chlorprocaine was minimum dose that achieved rapid onset of reliable sensory and motor block of sufficient duration. This was compared with 7.5mg of Bupivacaine in lower abdominal and lower

limb ambulatory surgeries. Yoos JR, et al[8]designed double blind randomized ,volunteer study to compare 40 mg of 2 -Chlorprocaine with small- dose (7.5 mg) Bupivacaine with measures of pinprick anesthesia, motor strength, tolerance to tourniquet and electrical stimulation ,simulated discharge criteria. Peak block height, regression to L1,tourniquet tolerance didn't differ between the two drugs. Time to simulated discharge (including time to complete block regression, ambulation, spontaneous voiding)was significantly longer with Bupivacaine. In our study, time to peak sensory block, time to onset of motor block was similar between two groups.Time to 2-segment sensory regression, time to complete regression to S2, time to complete motor regression was faster in Chlorprocaine group.

Marie -Andree Lacasse[10],enrolled 106 patients in randomized double -blind study.Spinal anesthesia was achieved with 7.5mg hyperbaric Bupivacaine or 2 % preservative free 2-CP 40 mg. The primary endpoint for the study was the time until reaching eligibility for discharge. Secondary outcomes included the duration of the sensory and motor blocks, the length of stay in the post anesthesia care unit, the time until ambulation and time until micturition.

In our study, duration of sensory and motor blocks was significantly shorter in 2 -CP group. Length of stay in PACU was similar in both groups. Time to ambulation ,micturition were all significantly shorter in the 2-CP group. M.A .Lacasse et al[10].found that more patients in 2-CP experienced pain in PACU as their spinal anesthesia regressed more rapidly. Goldblum et al[11] described 5 possible cases of Transient Neurological symptoms and 1 regressive incomplete caudaequina syndrome, in the past. In our study as preservative free 2 -Chlorprocaine was used, there was no case with transient neurological symptoms.

M.A .lacasse et al[10] found that during surgery, the incidence of hypotension, bradycardia, pain requiring analgesia, PONV was similar between two groups. In our study hemodynamics are more stable with Chlorprocaine than Bupivacaine, incidence of PONV was similar between two groups. Ben GYS[12]conducted a prospective five month observational study on patients undergoing day care surgery for an umbilical or unilateral inguinal hernia. Patients were given intrathecal 10.5mg Bupivacaine ,40 mg of 2 -Chlorprocaine,60 mg prilocaine each in combination with sufentanil (2 micro gram).In this study ,a significantly faster regression of motor and sensory block was seen for intrathecal 40mg of 2-Chlorprocaine as compared to 60mg of prilocaine, both with 2 micro grams sufentanil. In our study there was faster regression of motor and sensory block with 2-CP than Bupivacaine. Casati A,et al. [13]in randomized double blind study ,tested hypothesis that 50 mg of 1 % preservative -free 2 -Chlorprocaine would provide a faster resolution of spinal block than the same dose of 1 % plain lidocaine In our study we found that 40 mg of preservative free Chlorprocaine 1 % resulted in quicker recovery of sensory /motor function, unassisted ambulation ,no incidence of TNS.

In a recent retrospective examination of preoperative records of 601 patients who underwent spinal anesthesia, Chlorprocaine was found to be the most frequently used anaesthetic(84 % cases) with a median dose of 40 mg. In other patients, lidocaine (median dose 60 mg),less frequently Bupivacaine, procaine, mepivacaine were used. The primary outcome measurements were time from injection to ambulation and discharge. Compared to lidocaine, Chlorprocaine was associated with significant shorter time to ambulation (107+/-24 min vs 155 +/-40 min)and time to discharge (171 +/-45 min vs 224 +/-57 min).Incidence of urinary retention was similar between lidocaine and 2-CP groups. In our study, postoperative urinary retention was 0 % with Chlorprocaine and 12 % with Bupivacaine.

Yogita anarase[14] compared the efficacy of intrathecal 1% 2 -Chlorprocaine and 0.5 % Bupivacaine for day care infraumbilical surgeries. Prospective randomized study was carried out in 70 patients under spinal anesthesia at tertiary health care centre.

Out of 70 patients, 35 patients enrolled to Group A (Chlorprocaine group),35 patients to Group B (Bupivacaine group). In this study ,mean onset of sensory block was 2.45 +/-1.03 min in group A ,2.29 +/- 0.93 min in group B. Time of onset of motor block was 3.1 +/-0.34 in group A and 2.84 +/- 1.04in group B. Total duration of sensory block was significantly higher in group B (167+/-43.87) than in group A (105.62 +/-30.56). Total duration of motor block was significantly greater in group B (133+/-54.32) than in group A (95.73 +/-30.76). Time for first rescue analgesia was prolonged in group B (175+/-32.61)mins than in group A (115.84 +/-52.24) mins. Thus onset of sensory and motor blockade was comparable in both group but duration of motor block, sensory block is prolonged in group B. Time to ambulation, micturition, simulated discharge was prolonged in group B There was more incidence of hypotension and bradycardia in group B. Pain requiring analgesia was more in group A. PONV was seen in group B only These findings are similar to C.Camponovo et al ,Jessica et al[15] they found that the anesthetic properties of both the groups were similar except that the anesthetic recovery in Chlorprocaine was fast, similar finding observed in Laccasse et al .

Conclusion

Intrathecal 1% 2-Chlorprocaine compared with 0.5 % Hyperbaric Bupivacaine results in a significantly faster recovery of sensory and motor blocks. Time to mobilization, voiding, discharge were significantly shorter for 2-Chlorprocaine than 0.5% Hyperbaric Bupivacaine.We concluded that 2-Chlorprocaine represents an appropriate choice for spinal blocks for short or ultra short surgical procedures.

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