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Original Research Paper

Anaesthesiology

TO STUDY AND ASSESS THE EFFECTS OF INTRATHECAL 1% 2-CHLOROPROCAINE VERSUS HYPERBARIC BUPIVACAINE HYDROCHLORIDE IN UROGENITAL AND PERINEAL SURGERIES: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT

Background and Objective: Spinal anaesthesia is often addressed as one of the most desired modes of anaesthesia because of its high reliability, simple and straight forward technique, the advantage of avoidance of the undesirable complications of general anaesthesia in addition to being comparatively more economical. It offers better patient comfort, early ambulation and discharge with excellent postoperative pain relief. This study was designed to compare 2-Chloroprocaine with Hyperbaric Bupivacaine Hydrochloride for spinal anaesthesia in Elective urogenital and perineal surgeries. The study assesses and compares the onset, level and regression of sensory and motor block, intraoperative and postoperative analgesic effects, haemodynamic stability and side effects if any after giving 1% 2-Chloroprocaine (50mg) Vs 0.5% Hyperbaric Bupivacaine hydrochloride (15mg) in urogenital and perineal surgical procedures. **Methods:** This comparative study includes 80 patients, of ASA grade I and II, in the age group of 20-60 years, posted for elective surgeries under spinal anaesthesia procedures in Bapuji Hospital, Chigateri General Hospital and WCH, attached to J.J.M. Medical College, Davangere. Lumbar puncture will be done by 23G Quincke Babcock needle at L3-L4 intervertebral space. Clear and free flow of CSF will be confirmed. Patients receive one of the two study drugs, Group A will receive intrathecal 1% 2-Chloroprocaine 5ml (50mg) and Group B will receive intrathecal 0.5% Hyperbaric Bupivacaine Hydrochloride 3ml (15mg). Intra and Post operative parameters were documented and compared between the groups. **Results:** The mean age of the study group A is 42.6 ± 10.9 years whereas group B is 45.4 ± 9 years. Group A has 65% of males and 35% of females whereas Group B had 55% of males and 45% of females, which is statistically insignificant. The time onset of sensory block is 141 ± 4.1 seconds in Group A and 143.28 ± 3.8 seconds in Group B, the time of onset of motor block which is 3.6 ± 1.4 minutes in Group A and 5.7 ± 1.1 minutes in Group B, the time for the need of first rescue analgesic in Group A was 113.50±4.14 minutes and Group B was 226.57 ± 3.39 minutes. The intraoperative and postoperative heart rate (bpm), Mean arterial pressure, Respiratory rate at various time points compared using unpaired t test between two groups in the study population were comparable and not statistically significant. the mean time for ambulation among Group A was 193.35 minutes and among Group B it was 294.45 minutes. **Conclusion:** Intrathecal administration of 50 mg of local anesthetic 1% 2- Chloroprocaine for urogenital and perineal surgeries of short duration, when compared with 15mg of hyperbaric 0.5% Bupivacaine resulted in a quicker recovery from anesthesia and a shorter time for first rescue analgesic and unassisted ambulation. Hence in a dose of 50mg, 1% 2-Chloroprocaine can be used effectively for urogenital and perineal surgeries of short duration.

KEYWORDS : Chloroprocaine, Bupivacaine, Spinal anaesthesia, Intrathecal block, Day care surgery, Complications.

INTRODUCTION

A spinal block is a central regional block method characterized by transient sensory, motor, and sympathetic block, which is formed by injection of local anesthetic and additive agents into the subarachnoid space. Spinal anesthesia (SA) blocks the nerve roots through the subarachnoid.[1]

Spinal anaesthesia is often addressed as one of the most desired modes of anaesthesia because of its high reliability, simple and straight forward technique, the advantage of avoidance of the undesirable complications of general anaesthesia in addition to being comparatively more economical. It offers better patient comfort, early ambulation and discharge with excellent postoperative pain relief. [1]

Infra-umbilical, perineal procedures are most commonly performed under spinal anaesthesia [1], the short duration of the procedure and high turnover of case necessitates the choice of local anaesthetic that exhibit fast onset and quick recovery profile. [2]

Bupivacaine, an amino amide local anaesthetic is one of the long acting local anaesthetic agents. First report of its use was in 1963. [3] Bupivacaine hydrochloride is the most commonly used local anaesthetic in neuraxial anaesthesia. Bupivacaine has a decreased frequency of transitory neurological complaints and can prolong postoperative analgesia. However, the longer duration of action may delay the recovery of motor function, cause urinary retention, and therefore ultimately may lead to delayed discharge from the hospital.[4] It is available in two forms in the above mentioned study the hyperbaric form will be used.

Chloroprocaine is an ultra–short-acting ester local anaesthetic that was introduced in the 1950s. Like other local anaesthetics, it blocks the generation and the conduction of nerve impulses, presumably by slowing the propagation of the nerve impulses. Also it reduces the rate of rise of the action potential.[5]

2-chloroprocaine is an amino-ester local anaesthetic agent with a short half-life and a potentially favourable for short outpatient procedures in spinal block.[6,7] 2-chloroprocaine was withdrawn from the market in the 1980s because of concern about neurotoxicity.[8,9] 2-chloroprocaine with a new formulation without preservatives that have no longer been associated with neurotoxicity[10,11] which was introduced into clinical practice since 2004. 2-chloroprocaine is characterized by both a very fast onset and a quick recovery time.[11,12]

Recently, interest in 2-Chloroprocaine has increased for use in spinal anaesthesia for ambulatory surgeries. Modern, preservative-free preparations of 2-Chloroprocaine administered in small doses (30 to 60 mg) produce reliable, short-duration spinal anaesthesia with a faster recovery time than Procaine, Lidocaine, and Bupivacaine.[13]

This study was designed to compare 2-Chloroprocaine with Hyperbaric Bupivacaine Hydrochloride for spinal anaesthesia in Elective urogenital and perineal surgeries. The study assesses and compares the onset, level and

regression of sensory and motor block, intraoperative and postoperative analgesic effects, haemodynamic stability and side effects if any after giving 1% 2-Chloroprocaine (50mg) Vs 0.5% Hyperbaric Bupivacaine hydrochloride (15mg) in urogenital and perineal surgical procedures.

OBJECTIVES OF STUDY

1) To study and assess the effects of intrathecal 1% 2-chloroprocaine versus hyperbaric bupivacaine hydrochloride in urogenital and perineal surgeries.
2) To compare the onset level and regression of sensory and motor block.
3) To compare intraoperative and postoperative analgesic effect, hemodynamic stability, side effects if any between intrathecal 1% 2-chloroprocaine versus hyperbaric bupivacaine hydrochloride in urogenital and perineal procedures.

METHODOLOGY

The present study is a Prospective comparative study conducted from March 2021 – June 2022. 80 Patients of ASA grade I and II were selected, within age group between 20-60 years, posted for elective surgeries under spinal anaesthesia procedures in Bapuji Hospital, Chigateri General Hospital and WCH, attached to J.J.M. Medical College, Davangere.

Inclusion Criteria

- Age group 18-60yrs,
- ASA grade I or II,
- Both sexes,
- Posted for elective urogenital (cystoscopy, circumcision, transurethral bladder tumor resection, vericocelectomy, hydrocelectomy, etc.) and perineal surgeries (hemorrhoidectomy, rectal biopsy or any short anorectal surgery) under spinal Anaesthesia

Exclusion Criteria

- Previous history of allergy to anaesthetic medication
- Any contraindications to spinal anaesthesia
- Patients with pre-existing neurological disease
- ASA III and IV
- Patients on hypnotics, sedatives and other CNS depressant drugs
- Patients with coagulopathies, infection at the local site of injection
- Patients refusal

80 patients belonging to ASA I and II aged between 20-60 years undergoing elective surgeries were randomly selected. Informed consent was taken after explaining the procedure to the patient.

Preanaesthetic check-up was done with a detailed history, general physical examination and systemic examination. Airway assessment and spinal column examination were done and preoperative routine investigations like complete Haemogram, Random Blood Sugar, Renal function test, ECG, HIV, HBsAg, RT-PCR for COVID-19 (if needed) and others (if required) were done. Weight and height of the patients were also recorded.

Preoperatively, Nil per oral status was confirmed, Procedure of subarachnoid was explained and premedication with Tab. Alprazolam 0.5 mg and Tab. Ranitidine 150 mg orally the night before the surgery was administered. Patient was shifted onto the OT table and intravenous access was established on the forearm with 18 or 20 G IV cannula and Lactated Ringers Solution 8-10 ml/kg infused intravenously before the block.

Pulse Oxymeter, NIBP, ECG were applied to the patient on arrival to the operation theatre. Maintenance of IV fluid continued. Baseline parameters like Pulse rate, Respiratory rate, Blood pressure, Oxygen saturation, ECG were recorded.

Patient was placed in sitting or lateral position and under aseptic precautions patients back painted and draped. Lumbar puncture by 23G Quincke Babcock needle at L3-L4 intervertebral space was done. Clear and free flow of CSF was confirmed.

Patients received one of the two study drugs

1) Group A received intrathecal 1% 2-Chloroprocaine 5ml (50mg).
2) Group B received intrathecal 0.5% Hyperbaric Bupivacaine Hydrochloride 3ml (15mg).

After spinal anaesthesia, patient was made to lie in supine position. Oxygen at 4 l/min with a face mask administered to all the patients during the surgery. After intrathecal drug administration, the following paramters were noted in the patients:

Assessment Of Sensory Blockade: Onset of sensory block and Duration of sensory block were noted

Onset of sensory block is the time interval from administration of local anaesthetic into the subarachnoid space to the loss of pin-prick sensation at the site of surgical incision.

Highest level of sensory block was noted.

Duration of sensory block is the time taken from the maximum level of sensory block till the patient feels pain.

Assessment of motor blockade: Onset of motor block, Quality of motor block, Duration of motor block were noted

Onset Of Motor Block: The time interval from injection of drug into subarachnoid space till the patient is unable to lift the extended leg (modified Bromage scale block 1).

Quality of motor block assessed by Modified Bromage Scale.

Duration Of Motor Block: Duration of motor block recorded from onset time to time when the patient is able to lift the extended leg freely (grade 0).

Vital Parameters

Patients was continuously monitored using non invasive blood pressure, pulse oximeter, ECG.

- Heart rate, blood pressure, SpO2 and respiratory rate monitored every 3 minutes for the first 15 minute, every 10 minutes for the next 30 minutes, every 15 minutes for the rest of the surgery.
- Hypotension, taken as fall in 20% - 25% blood pressure from baseline reading, was treated with intermittent IV bolus of Ephedrine 6mg.
- For anxiolysis Intraoperative IV midazolam 1-2 mg used as an adjuvant.
- Bradycardia, taken heart rate less than 60 beats per minute with symptoms were treated with IV atropine 0.5mg.
- Postoperatively, vital parameters were monitored for every 15 minutes in the 1st hour, every 30 minutes for the 2nd hour, hourly for the 3rd, 4th, 5th, 6th hour and at the 12th and 24th hour.

Assessment of Analgesia

Duration of analgesia was taken from the time of complete injection of the drug to the time when the patient requests for rescue analgesics postoperatively.

Pain Assessment: will be done through VISUAL ANALOGUE SCALE

Rescue analgesia with injection Diclofenac 75mg intravenous infusion was given for patients complaining of pain, clinically correlating with VAS score of more than 3.

Side Effects: Pruritis, Nausea and vomiting were noted for 24

hours.

Statistical Analysis

- Categorical data will be represented in the form of frequency and percentage.
- Association of variables will be assessed with Chi Square test.
- Quantitative data will be represented as Mean & Sd. Comparison will be done with unpaired t-Test.
- P value of <0.05 was considered statistically significant.
- IBM SPSS Version 26 for windows will be used for analyzing the data.

RESULTS

In present study population of 80 patients, 40 patients each were distributed among Group A and group B. The distribution of age, sex, mean height and weight of patients among the two groups are statistically insignificant.

The mean duration of surgery in Group A was 45.1 ± 11.0 minutes and among Group B was 45.5 ± 12 minutes. On comparison using unpaired t test it was found to be statistically insignificant.

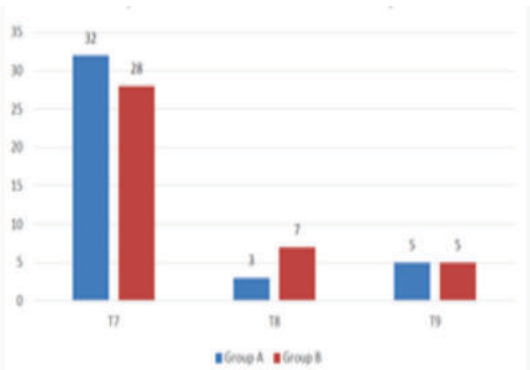
Table 1: Comparison Of Time Of Onset Of Sensory Block Among Study Groups

	Group				T score	P score
	Group A		Group B			
	Mean	St deviation	Mean	St deviation		
Time of onset of sensory	141.45 S	4.16	143.27 S	3.85	-2.034	0.045

In present study, the time from the injection of drug to the onset of loss of sensation at operative site is considered as the onset of sensory block which is 141.45 ± 4.16 seconds in Group A and 143.27 ± 3.85 seconds in Group B.

Table 2 : Comparison Of Maximum Level Of Sensory Block Among Study Groups

		Group			
		Group A		Group B	
		N	%	N	%
Maximum level of sensory block	T7	32	80%	28	70%
	T8	3	7.5%	7	17.5%
	T9	5	12.5%	5	12.5%
The chi-square statistic is 1.867 and p value is 0.393					



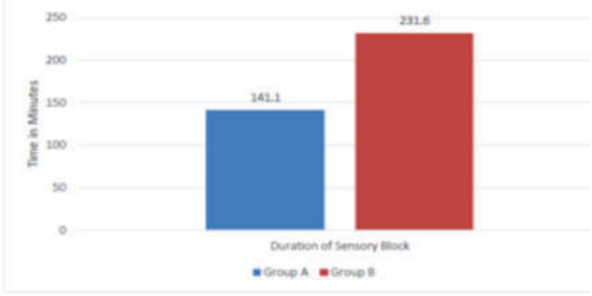
Graph 1 : Comparison Of Maximum Level Of Sensory Block Among Study Groups

In our study, 80% of Group A had maximum sensory block of T7 where as 70% of Group B had maximum sensory block of T7. In Group A 7.5% and 12.5% of patients had maximum sensory block of T8 and T9 respectively. In Group B 17.5% and 12.5% of patients had maximum sensory block of T8 and T9 respectively.

Table 3 : Comparison Of Duration Of Maximum Sensory Block

	Group				T score	P score
	Group A		Group B			
	Mean	St deviation	Mean	St deviation		
Duration of maximum sensory block	141.12	20.4	231.62	7.5	26.363	<0.0001

In present study, Among Group A the duration of maximum sensory block was 141.1 ± 20.4 minutes whereas, in group B it was 231.6 ± 7.5 minutes. On comparison using Unpaired t test, the duration of maximum sensory block between the study groups is statistically significant at p<0.05.



Graph 2: Comparison Of Duration Of Maximum Sensory Block

Table 4: Comparison Of Motor Block Among Study Groups

	Group				T score	P score
	Group A		Group B			
	Mean	St deviation	Mean	St deviation		
Time of onset of motor block	3.55	1.4	5.67	1.1	7.399	<0.0001
Duration of motor block	83.87	3.59	208.80	4.69	133.659	<0.0001

Graph 3 : Comparison Of Motor Block Among Study Groups

In our study, Among Group A the duration of motor block was 83.87 ± 3.59 minutes whereas, in group B it was 208.8 ± 4.69 minutes. On comparison using Unpaired t test, the duration of motor block between the study groups is statistically significant at p<0.05.

Table 5: Comparison Of Maximum Motor Block Among Study Groups

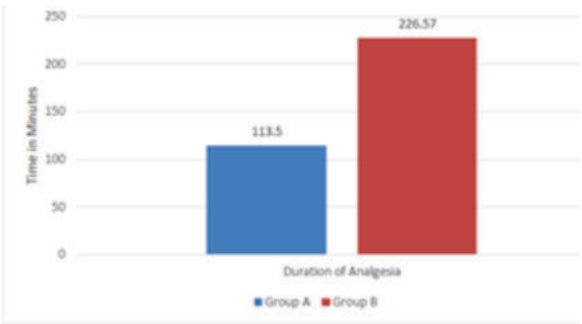
		Group			
		Group A		Group B	
		N	%	N	%
Maximum Motor block achieved	3.	34	85.5%	37	92.5%
	2.0	3	7.5%	2	5.0%
	1.0	3	7.5%	1	2.5%
The chi-square statistic is 1.327 and p value is 0.515					

In our study, motor block is described with Modified Bromage Scale. Among Group A, 85% of patients had Complete (degree3), 7.5% of patients had partial (degree 2) and 7.5% of patients had partial (degree 1) motor block.

Among Group B, 92.5% of patients had Complete (degree3), 5% of patients had partial (degree 2) and 2.5% of patients had partial (degree 1) motor block.

Table 6: Comparison Of Duration Of Analgesia Among Study Groups

	Group				T score	P score
	Group A		Group B			
	Mean	St deviation	Mean	St deviation		
Duration of analgesia	3.55	1.4	5.67	1.1	7.399	<0.0001



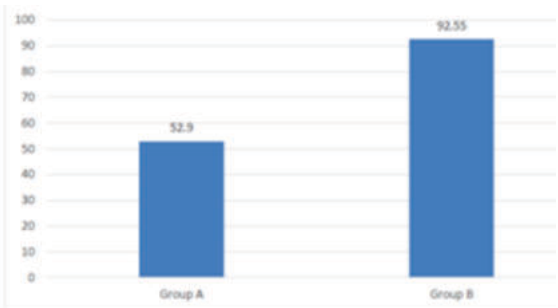
Graph 4 : Comparison Of Duration Of Analgesia Among Study Groups

In our study, the duration of analgesia i.e., the time for the need of first rescue analgesic in Group A was 113.5±4.14 minutes and Group B was 226.57±3.39 minutes. The distribution is statistically significant at p<0.05.

The intraoperative heart rate (bpm), intraoperative MAP (mmHg), intraoperative Respiratory rate (cpm), Postoperative respiratory rate (cpm) , Postoperative hear rate (bpm) at various time points compared using unpaired t test between two groups in the study population were comparable and not statistically significant.

Table 7: Comparison Of 2 Segment Sensory Regression Time Among Study Groups

		Group	
		Group A	Group B
Two Segment Sensory Regression Time	Mean	52.9	92.55
	Standard deviation	4.74	4.40
	Standard error of mean	0.75	0.69
	T score	38.700	
	P value	<0.0001	



Graph 5: Comparison Of 2 Segment Sensory Regression Time Among Study Groups

In our study the mean time for two segment sensory regression among Group A was 52.9 minutes and among Group B it was 92.55 minutes. On comparison by unpaired t test, it was found to be statistically significant.

Table 8: Comparison Of Mean Time For Ambulation Among Study Groups

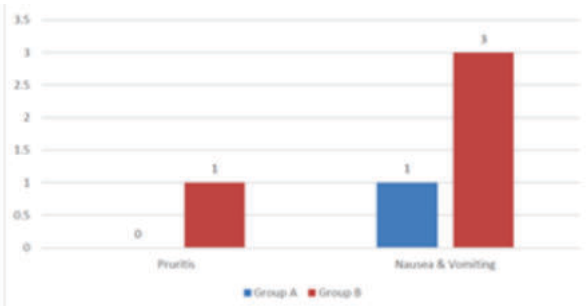
		Group	
		Group A	Group B
Time for Ambulation	Mean	193.35	294.45
	Standard deviation	8.64	9.18
	Standard error of mean	1.37	1.45
	T score	50.725	
	P value	<0.0001	

In our study the mean time for ambulation among Group A was 193.35 minutes and among Group B it was 294.45 minutes. On comparison by unpaired t test it was found to be statistically significant

Table 9: Comparison Of Postoperative Pain Scores Among Study Groups

		Group			
		Group A		Group B	
		N	%	N	%
Post OP pain	.0	10	25	9	22.5
	1.0	10	25	11	27.5
	2.0	11	27.5	9	22.5
	3.0	6	15.0	9	22.5
	4.0	2	5.0	1	2.5
	5.0	1	2.5	1	2.5
The chi-square statistic is 1.234 and p value 0.942					

Among the Group A, 3 patients had pain score of ≥4 in 24 hours whereas in Group B 3 patients had a pain score of ≥4 in 24 hours. The distribution is statistically insignificant at p<0.05.



Graph 6 : Comparison Of Postoperative Complications Among Study Groups

The distribution of postoperative complications among the study groups is statistically insignificant at P<0.05.

DISCUSSION

The purpose of this study was to compare 2-Chlorprocaine with Bupivacaine for spinal anesthesia in urogenital and perineal surgeries. Our principal finding was that spinal anesthesia with 2-Chlorprocaine can provide a satisfactory surgical block while permitting earlier regression than spinal Bupivacaine. This advantage is due to more rapid regression of the sensory and motor block, which helps patients ambulate and void faster with a satisfactory pain management.

The doses of Chloroprocaine and Bupivacaine used in this study are considered clinically equivalent, since the minimum dose chosen for each medication was believed to be clinically efficacious.

Kopacz [14] concluded that a dose of 40 to 60 mg of 2-Chloroprocaine had a reliable sensory block and motor block

for brief surgical procedures. The same findings were verified by Sell et al [15]., M. R. Hejtmanek et al.[16] showed that 10mg was the median dose of spinal Bupivacaine when used for day care surgeries.

M. Bengtsson et al., in a study on effects of volume and concentration of spinal Bupivacaine concluded that the dosage of Bupivacaine, up to 22.5 mg, seemed to be more important than either the volume or concentration when glucose-free Bupivacaine solutions were used. Hence, in present study 15mg of hyperbaric Bupivacaine as a 3ml solution in formulation was admnistered.[17]

The onset of sensory block in present study with 2CP was 141.45± 4.1 seconds and with bupivacaine is 143.275 ± 3.8 seconds. There is a significantly shorter duration of onset with 2CP. Similar results were reported by the studies by Agarwal AK et al[18], Haritha et al[19] , Jain N et al[20] and Bhaskara B et al[21]. Studies Thappa P et al[22] and Singh B et al[23] found that the duration of onset of sensory blockade was not significant.

The onset of motor block in our present with 2CP was 3.6 ± 1.4 minutes and with bupivacaine is 5.7 ± 1.1 minutes. There is a significantly shorter duration of onset with 2CP. Similar results were reported by the studies by Agarwal AK et al [18] and Jain N et al[20].

In contrast to present study, Studies by Haritha et al [19], Thappa P et al[22], Bhaskara B et al[21] and Singh B et al[23] found that the duration of onset of motor blockade was not significant.

The mean time taken for regression of motor block was shorter in Chloroprocaine group (83.87 ± 3.5 minutes) than in the Bupivacaine group (208.80 ± 4.69 minutes).

After surgery, all of our patients were shifted to post operative recovery room for routine observation. The mean time for first rescue analgesic was earlier in 2- Chloroprocaine group (113.50 ± 4.14 minutes) than in Bupivacaine group (226.57± 3.39 minutes). This is similar to the results of Camponova et al[24], Teunkens A et al[25].

Our results coincide with those of Lacasse et al[26] in which they found that the duration of motor block was significantly shorter in Group A (76 min) than in Group B (119 min) ($P < 0.05$).

In present study Pain requiring analgesia was more in group B. PONV was seen more in group B. These findings are similar to Haritha et al[18]., C. Camponovo et al[24] they found that the anesthetic properties of both the groups were similar except that the anesthetic recovery in Chlorprocaine.

CONCLUSION

Intrathecal administration of 50 mg of local anesthetic 1% 2-Chloroprocaine for urogenital and perineal surgeries of short duration, when compared with 15mg of hyperbaric 0.5% Bupivacaine resulted in a quicker recovery from anesthesia and a shorter time for first rescue analgesic and unassisted ambulation. Hence in a dose of 50mg, 1% 2- Chloroprocaine can be used effectively for urogenital and perineal surgeries of short duration.

REFERENCES

1) Kalra P, Jain P, Sharma S, Poddar R. Comparison of 0.5% hyperbaric bupivacaine versus 1% chloroprocaine in spinal anaesthesia in an ambulatory setting; a randomized double-blind interventional study. Int J Cur Res Rev 2020 Sept;12(18):73-79.
2) Liam BL, Yim CF, Chong JL. Dose-response study of lidocaine 1% for spinal anaesthesia for lower limb and perineal surgery. J Anaesth.1998;45:645-650.
3) Carpenter RL, Caplan RA, Brown DL, Stephenson C, Wu R. Incidence and risk factors for side effects of spinal anesthesia. Anaesthesiology. 1992 Jun;76(6):906-16
4) Nair GS, Abrishami A, Lermitte J, Chung F. systematic review of spinal anaesthesia using bupivacaine for ambulatory knee arthroscopy. Br J Anaesth.2009;102:307-315.
5) Pollock JE. Intrathecal chloroprocaine-not yet "safe" by US FDA parameters. Int Anesthesiol Clin. 2012; 50:93-100
6) Foldes FF, McNAll PG. 2-chloroprocaine: a new local anaesthetic agent. Anaesthesiology 1952;13:287–64.
7) Kouri ME, Kopacz DJ. Spinal 2-chloroprocaine: a comparisonwith lidocaine in volunteers. Anesth Analg 2004;98:75–80
8) Reisner LS, Hochman BN, Plumer MH. Persistent neurologic deficit and adhesive arachnoiditis following intrathecal 2-chloroprocaine injection. Anesth Analg.1980;59:452-454.
9) Ravindran RS, Bond VK, Tasch MD, Gupta CD, Luerssen TG. Prolonged neural blockade following regional analgesia with 2-chloroprocaine. Anesth Analg.1980;59:447-451
10) Hejtmanek MR, Pollock JE. Chloroprocaine for spinal anaesthesia: A retrospective analysis. Acta Anaesthesiol Scand.2011;55:267-272.
11) Drasner K. chloroprocaine spinal anaesthesia: Back to the future. Anesth Analg. 2005;100:549-552.
12) Goldblum E, Atchabahian A. The use of 2-chloroprocaine for spinal anaesthesia. Acta Anaesthesiol Scand. 2013; 57:545-552.
13) Thomas S, Pawar DB, Ruparel DH, Sedani S. Randomized controlled study comparing 2-chloroprocaine and bupivacaine for spinal anesthesia in gynecological surgeries. Anesth Essays Res 2022;16:12-6
14) Kouri EM, Kopacz JD. Spinal 2-Chloroprocaine: A Comparison with Lidocaine in Volunteers. Anesth Analg. 2004 Feb 1;98:75–80, table of contents.
15) Sell A, Tein T, Pitkanen M. Spinal 2-chloroprocaine: effective dose for ambulatory surgery. Acta Anaesthesiol Scand. 2008 May;52(5):695–9.
16) Hejtmanek MR, Pollock JE. Chloroprocaine for spinal anesthesia: a retrospective analysis. Acta Anaesthesiol Scand. 2011 Mar;55(3):267–72.
17) Bengtsson M, Malmqvist LA, Edström HH. Spinal analgesia with glucose□free bupivacaine□effects of volume and concentration. Acta Anaesthesiologica Scandinavica. 1984 Oct;28(5):583-6.
18) Agarwal AK, Bhasker RK. Bupivacaine Versus 2 Chloroprocaine Spinal Anesthesia Comparison Study at a Tertiary Hospital.
19) Haritha ML, Madhavi J, Baloji R, Sugali J, and Kalyanam P. Comparative Study of (1%) 2-Chlorprocaine Versus 0.5 % Hyperbaric Bupivacaine for Spinal Anaesthesia for Ambulatory Surgeries: A Prospective Randomized Study., International Journal of Health and Clinical Research, 2021;4(14):256-262.
20) Jain N, Jain K., Prajapat H, Sethi S.K., Patodi V, Khare, A. Intrathecal isobaric 1% 2-chloroprocaine versus hyperbaric 0.5% bupivacaine in parturients undergoing lower segment cesarean section: A randomized controlled trial. Journal of Mahatma Gandhi Institute of Medical Sciences. 2021:26(1), p.11
21) Bhaskara B, Shruthi S, Ramachandraiah R. A study to evaluate intrathecal 1% chloroprocaine and 0.5% levobupivacaine in perianal surgeries: A prospective randomized study. Anesthesia, Essays and Researches. 2020 Jul;14(3):406.
22) Thappa P, Jamwal A, Kumar A. 2- Chloroprocaine versus bupivacaine in spinal anaesthesia: a randomized controlled study. Int J Health Sci Res. 2022; 12(11):157-164.
23) Singh B, Anand A, Attri JP. A prospective open-label randomized controlled trial to compare intrathecal 1% 2-chloroprocaine versus 0.5% bupivacaine in ambulatory elective surgeries. Anesthesia, Essays and Researches. 2020. Apr;14(2):266.
24) Camponovo C, Wulf H, Ghisi D, Fanelli A, Riva T, Cristina D, et al. Intrathecal 1% 2-chloroprocaine vs. 0.5% bupivacaine in ambulatory surgery: a prospective, observer-blinded, randomised, controlled trial. Acta Anaesthesiol Scand. 2014 May;58(5):560–6.
25) Teunkens A, Vermeulen K, Van Gerven E, Fieuws S, Van de Velde M, Rex S. Comparison of 2-Chloroprocaine, Bupivacaine, and Lidocaine for Spinal Anesthesia in Patients Undergoing Knee Arthroscopy in an Outpatient Setting: A Double-Blind Randomized Controlled Trial. Reg Anesth Pain Med. 2016. Oct;41(5):576–83.
26) Lacasse MA, Roy JD, Forget J, Vandenbroucke F, Seal RF, Beaulieu D, et al. Comparison of bupivacaine and 2-chloroprocaine for spinal anesthesia for outpatient surgery: a double-blind randomized trial. Can J Anaesth J Can Anesth. 2011 Apr;58(4):384–91.