e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2023; 14 (1); 73-79

Original Research Article

Comparison of Recovery Characteristics by Using Low Dose Bupivacaine 10 mg and Injection 2- Chloroprocaine 40mg for Spinal Anaesthesia in Short Duration Surgeries

Bhoomika G Chaudhari[1], Mitali K Ahir[2*], Dhavalkumar C Patel[3], Sunaina Patel[4]

[1]Resident, Dept. of Anesthesiology, GMC, Surat
[2,3]Assistant Professor, Dept. of Anesthesiology ,GMC, Surat
[4]Associate Professor, Dept. of Anesthesiology, GMC, Surat

Received: 18-10-2023 / Revised: 21-11-2023 / Accepted: 26-12-2023
Corresponding author: Dr. Dhavalkumar C Patel
Conflict of interest: Nil

Abstract:

Introduction: An ideal local anaesthetic should have quick onset, reliable sensory and dense motor block and at the same time quick sensory and motor regression so that patient can ambulate and discharged early for day care surgery.

Method: Patients posted for short duration surgeries (1 to 1.5 hours) with day care procedure under ASA physical status I to III without any contraindication to spinal anaesthesia and allergy to local anesthetic agents were included in study. Patients in group A had received Inj. Bupivacaine 0.5% 10 mg (2 ml+0.5 ml sterile normal saline and group B had received Inj. Chloroprocaine 1 % 40 mg. (4 ml). Sensory and motor block between two groups in terms of duration and their regression, as well as time to micturition and time to assisted ambulation were compared between two groups.

Result: There was significant difference between both the groups in time for regression to L1 and S2 level. Group B had earlier regression of sensory blockage at L1 which was 96.46±31.18 min compared to bupivacaine group A which was 113.33 ±30.7 min (P<0.0001). Total duration for regression of Bromage score 0 was 133.3±34.02 min in bupivacaine group whereas 109.96±33.52 min in chlorprocaine group (P<0.0001). When compared time for assisted ambulation it was 148.33±40.15 min in bupivacaine group compared to 121.23±39.46 min in chlorprocaine group (P<0.0001).

Conclusion: From this study we observed that for short duration surgeries, intrathecal 2- chloroprocaine 40 mg shows faster regression in terms of sensory/motor blockade; earlier assisted ambulation and ability to micturate compared to Bupivacaine 10 mg without causing any significant hemodynamic compromise.

Keywords: 2-CP (2- chlorprocaine), ASA(American society of Anesthesiologist), PABA(Para Amino Benzoic Acid), SA(Spinal Anaesthesia).

Introduction

Spinal anesthesia is a common, safe and reliable technique for the infra umbilical and lower limb surgeries. If these surgeries are of short duration (lasting up-to 1 to 1.5 hour) then the choice of correct local anesthetic agent is crucial. An ideal local anesthetic should have quick onset, reliable sensory and dense motor block and at the same time quick sensory and motor regression so that patient can ambulate early and can be discharged early. This is very important, especially for ambulatory day care surgeries.

The various short duration surgeries are tunica vaginalis hydrocele, skin grafting of lower limbs, Perianal surgeries like hemorrhoidectomy, fistulectomy, fissurectomy, some urosurgeries, Trans urethral resection of prostate, cystoscopy, biopsy, some gynecological perineal procedures like polypectomy, cervical biopsy taking procedure, abdominal tubal ligation etc.

Initially, intrathecal Lignocaine was used for short procedures due to its faster onset (5 to 6 min) and short duration of action (2 hours). However, Transient Neurological symptoms (TNS), described as backpain radiating to lower extremities, have been reported with use of Lignocaine [16,17]. So, it was abandoned from its use. Attempts have been made to adapt hyperbaric Bupivacaine, a long-acting LA to the ambulatory settings in low doses. But there is always a risk for inadequate effect with such low doses.2-CP is an amino ester LA with a very short half-life. It was used previously for obstetric analgesia via epidural route. Occurrence

of neurotoxicity questioned its use in 1980. [3] Multiple studies have suggested that this neurotoxicity was due to combination of its low pH and presence of sodium metabisulfite as a preservative. So, subsequently pH of solution was adjusted and preservative free formulations were released which were available as 10mg/ml solutions [15,16]. So many studies have been done with this new formulation without any complications.

We have compared Inj. Bupivacaine in low dose (10 mg) with Inj. Chloroprocaine 40 mg for short duration surgeries lasting up to 1 to 1.5 hours.

Studies are done with different doses of 2-CP and bupivacaine for Spinal anesthesia [11,12,13]. We decided to check effectiveness of spinal anesthesia with fixed dose of 40mg 2-CP (1%; Chlorquick by NEON) and Bupivacaine (0.5%) 10 mg with 0.5 ml Normal saline (2.5 ml total volume) for short duration surgeries

Aim: Comparison of recovery characteristics by using low dose bupivacaine 10 mg and injection 2-chloroprocaine 40 mg for spinal anaesthesia in short duration surgeries.

Primary Objectives:

- To compare sensory and motor block between two groups in terms of duration and their regression.
- To compare time to micturition and time to assisted ambulation.

Secondary Objectives:

- Hemodynamic parameters.
- Incidence of side effects and adverse events.

Material and Method

After obtaining an institutional ethical committee approval and written informed consent from the patients, a prospective observational study was conducted in 60 adult patients of two groups each having 30 patients.

Inclusion Criteria: We included patients posted for tunica vaginalis hydrocele, skin grafting of lower limbs, Perianal surgeries like hemorrhoidectomy, fistulectomy, fissurectomy, some uro surgeries Trans urethral resection of prostate, cystoscopy, some gynecological perineal procedures like polypectomy, cervical biopsy taking procedure,abdominal tubal ligation etc.

Patients giving consent for participation in the study Patients aged 18 years to 60 years Patients with ASA physical status I, II, III posted for short duration surgeries (1 to 1.5 hr) surgery under spinal anaesthesia

Exclusion Criteria: Any contraindication to spinal anaesthesia (coagulopathy, localized infection, and neurological diseases)

Allergy to local anesthetic agents or PABA group of drugs.

Patient`s pre anesthetic checkup was done a day before surgery. The entire patient kept Nil by mouth for 6 hours preoperatively. The procedure to be done was explained to relatives and patient himself and informed written consent was taken.

On the day of surgery, in preoperative room, baseline vital parameters were recorded. Intravenous line was secured with 20 G (pink) iv. cannula and Inj. RL (10 ml/kg) was started slowly. Inj. Midazolam (1mg) i.v. slowly was given as premedication.

After taking patient inside operation theatre, pulse oximetry, NIBP and ECG monitors were attached and baseline vitals were recorded. Spinal anesthesia was given with 25G spinal Quinkie`s spinal needle with bevel facing cephalic in lateral decubitus position or sitting position in L2-3/ L3-4 inter-spinous space, intrathecally, after free flow of CSF and after confirming CSF aspiration under all aseptic and antiseptic precautions. 30 patients who were given Inj. Bupivacaine 10 mg 2 cc+0.5 cc= total volume 2.5 cc and inj. Chloroprocaine 40 mg (1%) was given in another 30 patients. Both the groups are names as group A and group B respectively. Patient was made supine immediately after injection. HR, SBP, DBP, SpO2 were recorded at regular interval after spinal block. Sensory blockade was assessed by pinprick method and motor blockade was assessed by Modified Bromage scale.

Modified Bromage Scale:

- Grade 0- no motor blockage Grade 1- able to move knees
- Grade 2- able to move the feet only
- Grade 3- unable to move lower extremities.

Sensory and motor effect was checked at regular interval, till maximum satisfactory level was achieved. If sensory level was not achieved satisfactorily in 30 minutes of giving spinal anaesthesia, it was considered for general anesthesia and was excluded from the study.

Assessment of Sensory Block:

- Time of giving spinal anesthesia:
- Highest sensory level achieved and time
- Level of regression to L1 level
- Regression to S2 level (complete regression of block)

Assessment of Motor Block:

- Time for onset of motor block
- Level of motor block in PACU
- Time for motor block Bromage 0.

- Time for assisted ambulation
- Time for self-voiding.

Patient was shifted to recovery room and hemodynamic parameters monitored at regular interval. Sensory and motor effects were checked every 15 mins post operatively till complete regression, Time of urge and successful micturition and Time to assisted ambulation was noted and compared between both the groups.

Statistical Analysis: Results were statistically analyzed by independent student's t-test and results were expressed as mean ± SD. The results were considered significant according to the 'p' value.

The statistical analysis was done by chi -square test and independent t- test for intergroup comparison with the use of SPSS Version 23software. A value of P<0.05 was accepted as statistically significant.

Observation and Results: The study was conducted on 60 patients of either sex of age group between 18 to 60 years, who were scheduled to undergo infra umbilical, lower limb, gynecological surgeries of short duration in tertiary care hospital during January 2020- July 2021.

Group A: Patients received Inj. Bupivacaine 0.5% 10 mg (2 ml+0.5 ml sterile normal saline).

Group B: Patients received Inj. Chloroprocaine 1 % 40 mg. (4 ml)

Table 1: Demographic Characteristics

Parameters	Group A	Group B	P value
Age(years)	39.30±11.6	43.8333±11.8	0.2972
Sex(M/F)	22(73%)	24(80%)	
Female	8(27%)	6(20%)	
ASAII	16	19	P>0.5
ASAIII	14	11	P>0.5

Table 2: Types of Surgery:

Types of surgeries	Group A	Group B
General surgery	20	12
Genitourinary	5	14
Orthopedic	1	0
Gynecological	4	4

Table 3: Peak Block Height (Sensory):

Peak block height	Group A(n=30)	Group B(n=30)
L1	2(7%)	1(3%)
T12	10(30%)	5(17%)
T10	12(40%)	18(60%)
T8	6(20%)	6(20%)

Table 4: Sensory Characteristics

Parameters	Group A	Group B	P value
Time to achieve peak block height	7.8±2.15 min	7.03±2.04 min	0.2972
Regression to L1	113.33 ±30.7 min	96.46±31.18 min	0.00001
Regression to S2(near complete sensory regression)	141.1±33.30 min	117.51±33.75	0.00001

Table 5: Motor Characteristics

Parameters	Group A	Group B	P value
Time of motor onset (Bromage 1)	2.66 ±1.11min	2.67±1.09 min	0.485
Total regression toBromage 0	133.3±34.02 min	109.96±33.52	0.00001

Table 6: Time for Micturition

Parameters	Group A	Group B	P value
Time to Micturition	170±33.68 min	139±39.08	0.00001

Table 7: Time for Assisted Ambulation

Parameters	Group A	Group B	P value
Time to assistedambulation	148.33±40.15 min	121.23±39.46	0.00001

Table 8: Intra-Operative Side Effects (N=60)

Side effects	Group A	Group B
Bradycardia(,60/min)	3	3
Hypotension (SBP<100mmg)	3	2
Nausea, vomiting	1	0

Discussion

In our institute, tunica vaginalis hydrocele surgery, skin grafting of lower limbs, Perianal surgeries like fistulectomy, hemorroidectomy, fissurectomy, some uro surgeries like cystoscopy, transurethral resection of prostate, some gynecological perineal procedures like polypectomy, abdominal tubal ligation, abdominal wall hernias are done under spinal anesthesia. These surgeries are of short duration lasting upto 1 to 1.5 hours. So, we carried out a study by using Inj. Chlorprocaine 40 mg with inj. Bupivacaine 10 mg (2 ml) with added sterile normal saline (0.5 ml) to make a total volume of 2.5 ml.

After obtaining approval from institution ethical committee, a prospective study was conducted over a period of 12 months from February 2020 to July 2021 on 60 patients who fulfilled inclusion criteria, were enrolled for the study.

Demographic Data: All patients were between 18-60 years of age group of both genders, of ASA grade I, II, III and posted for short duration surgery. We took different type of surgeries in our study according to its type and duration [7,9].

Sensory Block: Sensory block was assessed by using pin prick method bilaterally along mid clavicular linewith 24G hypodermic needle in our study. We observed that 40% in group A and 60% cases in group B, T10 was the highest sensory level achieved. T8 level was achieved in about 20 % cases in both the groups. About 30% cases in group A and 17 % cases in group B highest sensory level was only up to T12. Only 3 % cases in both the groups, L1 level was the highest sensory level achieved.

In group A 2(7%) patients and in group B (1)3% patients achieved maximum sensory blockade of L1 level. Reason for inadequacy of inj. chloroprocaine might be failure of drug or technique or may be patient factor. Our results are similar with the following studies. Nivas R et al 2019 maximum cephalad spread was between T5-T9 dermatome level with dosage of Bupivacaine 7.5 mg and chlorprocaine 40 mg.[4] Tandan M et al 2018 had mean peak sensory block was T7 with both chloroprocaine 40 mg and bupivacaine 7.5 mg.[2] Ben G 2017 et al noted maximum sensory level was T3,T4,T5 with Bupivacaine 7.5mg, chloroprocaine 40 mg and prilocaine 40 mg respectively.[5]

Time to Achieve Highest Sensory Level: We observe that in Group A time to achieve peak block height was 7.8±2.15 min. In Group B time to achieve peak block height was 7.03±2.04 min, P >0.05, not significant. Both the group was comparable. Tandan M et al 2018 noticed time to achieve peak sensory level was 12 and 15 minutes with chloroprocaine 40 mg and bupivacaine 7.5 mg respectively. [2]

Total Duration of Sensory Blockade: Total duration of sensory blockade is calculated from time when maximum level of spinal anaesthesia was achieved to complete regression of sensory effect checked by pin prick method. In group A, mean of total duration of sensory blockade was 141.1± 33.30 minutes. In group A, 97% cases, total duration of sensory effect were more than 100 minutes. Only 1 case (3%) showed total sensory duration between 70-90 minutes. 30% cases of group A sensory duration was remained for 130 minutes and in 70 % cases sensory duration was >130 minutes. In group B, mean of total duration of sensory blockade was 117.51±33.75min. In 86% cases total duration of sensory effect was lesser than 100 minutes. Only 14% cases showed total sensory duration more than 100 minutes in group B. All cases sensory duration was < 130 minutes.

There is significant difference between both the groups in time for regression to L1 and S2 level. Group B had earlier regression of sensory blockage. Nivas R et al 2019 time for full recovery from sensory block was 152.54±20.33minutes, 203.51±36.77 minutes, 413.77±99.49 minutes with chloroprocaine 40 mg, lidocaine 40 mg and bupivacaine 7.5 mg respectively.[4] Agrawal A et al 2019 observed total duration of sensory block was 138±6 minutes with 40 mg chloroprocaine while 356±8 minutes with 12.5 mg bupivacaine.[6] Following studies showed longer duration of sensory block compared to our results. Tandan M et al 2018 observed time for complete regression of sensory block was 140 minutes and 320 minutes with chloroprocaine 40 mg and bupivacaine 7.5 mg respectively .[2] Marie-Andree Lacasse et al 2010 noted mean total duration of sensory block was 146 and 329 minutes with chloroprocaine 7.5 mg and bupivacaine 7.5 mg respectively.[1]. Yoos J R 2005 observed complete sensory regression time was 113±14 minutes with 40 mg 2-chloroprocaine and 191±30 minutes with 7.5 mg Bupivacaine, p being <0 .001.[8]

Time for Motor Onset: Mean time for motor onset (bromage 1) in group A was 2.66±11.1 min. Mean time for motor onset (bromage 1) in group B in group B was 2.67±1.09 min (p >0.05)so, there was no statistically significant difference in the mean time for motor onset between Bupivacaine and Chloroprocaine group.

Within 3 minutes all patients achieved bromage grade 1 all patients in both the groups.

Ankit Agrawal et al 2019 considered bromage grade 2 as an onset of motor block and it was 6±2 minutes with 12.5 mg bupivacaine and 5±3 minutes with 40 mg chloroprocaine.[6]

Maximum Motor Block Achieved: All patients in bupivacaine group achieved bromage scale 3 whereas Two patient (7%) in group B achieve maximum bromage grade 2. There was no problem with muscle relaxation during surgery.P>0.05 result is not significant. Within 3 minutes all patients achieved bromage grade 1 all patients in both the groups. Result was in accordance with following studies. Dr. Ram Nivas et al 2019achieved motor block of Bromage 3 in all the patients.[4] Ankit Agrawal et al 2019 achieved motor block of Bromage3 in all the patients.[6] Jessica R. Yoos2005 achieved motor block of Bromage 3 in all the patients.[8]

Total Duration of Motor Block: Total duration of motor block was calculated from the time of maximum sensory block. Mean of total regression of motor block also called total duration of motor block (bromage 0) was133.3 ±34.02 min in Group A while 83.56±32.97 min in Group B. In our study we observed that in group A only 5 patients (16%) showed total motor regression within 100 min and rest 84 % (25 patients) achieved bromage scale 0 after 100 minutes. In group B 86 % cases show motor regression within 100 minutes and 14 % cases show motor regression after 100 min. In study of Ankit Agrawal et al 2019 mean duration of motor block was 73±5 minutes with 40 mg Chloroprocaineand 124±7 minutes with 12.5 mg Bupivacaine .[6], Dr. Manjulata Tandan 2018 noted the mean total duration of motor block was 70minutes and 115 minutes with Chloroprocaine and Bupivacaine respectively [2], Marie-AndreeLacasseet al 2010 observed mean duration of motor block was 76 and 119 minutes with Chloroprocaine and Bupivacaine respectively.^1, Ben gys 2017 et al noticed total duration of motor block (mean) was 3.1 hours 1.8 hours and 2.2 hours with bupivacaine, chloroprocaine and prilocaine respectively.[5]

In our study, chlorprocaine group had early regression of sensory and motor effect than bupivacaine group. When compared with chloroprocaine (ester), the metabolism of bupivacaine (amide) is more complex and slower because former is rapidly metabolized by plasma psuedoscholinesterase. The duration of action is determined by the pharmacokinetics of drug itself. All local anesthetics exhibits dose response relationship so with increasing dose, duration of action also increases. Duration of action of intra thecal chloroprocaine (2-3%) is 35 to 50 minutes. Intra thecal Bupivacaine (0.5 to 0.75%) has duration of action 240 minutes. Thus, bupivacaine even in low dose of 10 mg exhibits a longer duration and regression time for sensory and motor effect as compare to chloroprocaine.

Time of Assisted Ambulation: Mean duration of ability to walk was 148.33 ± 40.15 minutes in group A and,mean duration of ability to walk was 121.23 ±39.46 minutes in group B. In our study, only 3.33 % patients in group A while 86.6 % in group B could walk with support before 100 min and 13.33 % took more than 100 minutes for assisted ambulation in group B.

Maximum duration for ambulation was within 3.5 hours in group A. In group B only one patient took maximum time of 215 minutes for assisted ambulation, after achieving maximum block of spinal anaesthesia. Agrawal et al 2019, noted time of un-assisted ambulation was 265±8 minutes with 40 mg chloroprocaine and 221±7 minutes with bupivacaine 12.5 mg.

Time for Micturition: Mean duration of ability to pass urine was 170±33.68 minutes in group. Mean duration of ability to pass urine was 139±39.08 minutes in group B. In our study we observed that only 3 % patients in group A while 30 % patients in group B could micturate before 100 min and 97 % patients in group A and 70 % patients in group B took more than 100 minutes to pass urine. Maximum duration for micturition was within 3.5 hours in both the groups A. In group B patient took maximum time of 215 minutes for micturition, after achieving maximum block of spinal anaesthesia. Not a single patient complained of urinary retention. Our results were comparable to studies in which bupivacaine was used. It is clear that chloroprocaine provides early ambulation compared to low dose bupivacaine[11,12,13].

No cases of urinary retention were there which make it beneficial for early discharge ofpatients and thereby provides good option for short duration surgery. In study of Ankit Agrawal et al 2019, they noted time of unassisted ambulation was 265±8 minutes with 40 mg chloroprocaine and 221±7 minutes with bupivacaine 12.5 mg. [6]

Ram Nivas et al 2019 noticed time to first micturition in minutes was 184.11±6.18,201.62±31.70 and 242±26.98 while time for ambulation in minutes was 171.54±41.53 minutes,211.45±20.14and 287.91±39.06 with chloroprocaine, lidocaine and bupivacaine respectively. Results cleared that in chloroprocaine group first micturition was earlier which facilitated early discharge of these patients [4]. Manjulata Tandan et al 2018 noticed mean time to ambulation was 220 and 245 minutes and mean time to micturition was 260 minutes and 330 minutes with chloroprocaine and bupivacainerespectively.[2]

Volker Gebhardt et al 2018 noted mean time for walking unaided was 117 minutes with chloroprocaine compared to 139.5 minutes with general anaesthesia.[14]

Hemodynamic Parameters: Mean of pulse rate at baseline was 82.15±13.32 per minute in group A .

Mean of pulse rate at baseline in group B. 82.48 ±13.24 per minutes. By comparing at all the time intervals with p value>0.05, intra and post-operatively. We did not observe any significant difference in mean pulse rate between both the groups at any time during and after spinal anesthesia.

Mean of SBP at baseline was 118±9 mm of Hg in group A and 122 ±10 mm of Hg in group B. In group A there is significant difference of fall in blood pressure at the all-time intervals p value (<0.05) of SBP from the baseline which was clinically insignificant, and in group B fall in systolic blood pressure was significant (p<0.05) at time intervals of 30 minutes and in PACU which was clinically not significant.

Mean baseline diastolic blood pressure was 77.2±5.47 mm of Hg in group A and 79.53.±6.92 mm of Hg group B. In group A, fall in Diastolic blood pressure showed statistically significant difference at 20, 30, 45minutes when compared to baseline but clinically it was within ±20% with baseline. In group B mean baseline DBP, there is no statistically and clinically significant difference when comparing to baseline mean diastolic pressure.

Mean baseline arterial pressure was 93.77 ± 6.77mm of Hg in group A and 93.93±8.86 mm of Hg in group B. There is no significant difference in fall mean arterial pressure from the baseline in group B at all the time intervals. There was no statistically and clinically significant difference in SPO2in both the groups at any time interval.

Adverse Events (Intra Operatively and Post Operatively): There was fall in Systolic Blood pressure in group A in 3 patients and in group B 2 patients, hypotension was treated with IV fluids, bradycardia was occurred in 3 patients in both groups but clinically insignificant. In study of M Tandan et al 2018, they observed that 2 cases with chloroprocaine40 mg and 3 cases with bupivacaine 7.5mg showed hypotension and 2 cases with chloroprocaine and 4 cases with bupivacaine showed bradycardia.[2]. K Bojaraaj et al 2017, noticed 2 cases of hypotension and 1 case of bradycardia with 10 mg bupivacaine and no case with chloroprocaine showed such side effects.[10] We observed two patient had vomiting post operatively in group A which was treated with Inj. Ondansetrone 4 mg iv. One patient had mild complain of pain which was treated by Inj. Paracetamol 1gm iv. None had complained urinary retention post operatively. One patient took time of 210 minutes for micturition in group A.

Conclusion

From this study we observed that for short duration surgeries, Intrathecal 2- chloroprocaine 40 mg shows faster regression in terms of sensory and motor blockade; earlier assisted ambulation and ability to micturate compare to Bupivacaine 10 mg without causing any significant hemodynamic compromise and serious side effects and adverse effects,

Strength

- Cost effectiveness.
- Fast patients' turnover is possible in tertiary care hospitals.
- Avoidance of side effects of regional blockade with low dose as compare to standard dosage hence better hemodynamic parameters.
- Early recovery from anesthesia in terms of ambulation, voiding so, better patient satisfaction.

Limitation: Study was done in small sample size (60). So, result of this study may not be similar if apply to larger population. We had not set target sensory level for our study previously, we took infra umbilical (requires level of at least T10) as well as lower limb surgeries, (for which even T12 level was sufficient). In study we took Inj. Chloroprocaine (1%) 40 mg and Inj. Bupivacaine (0.5%) 10 mg with 0.5 ml NS, so we cannot comment on different doses and concentrations of these local anesthetic agents. We did not observe and mentioned incidence of post-operative pain and analgesia.

Bibliography

1. Lacasse MA, Roy JD, Forget J, Vandenbroucke F, Seal RF, Beaulieu D, McCormackM, Massicotte L. Comparison of bupivacaine and 2-chloroprocaine for spinal anesthesia for outpatient surgery: a double-blind randomized trial. Can J Anaesth. 2011 Apr; 58(4):384-91.
2. M Tandan, A akara, S Bhagat, S Dwvivedi. Hyperbaric bupivacaine and 2-chloroprocaine for spinal anaesthesia in outpatient procedures: aa comparative study.Indian journal of applied research, volume-8, issue-6, June-2016.
3. Khare A, Thada B, Yadav D, Mathur V, Singh M. A randomized double blind study to compare 1% 2-chloroprocaine and 0.5% hyperbaric bupivacaine in spinal anesthesia for infra-umbilical surgeries. Anaesth. Pain & intensive care. 2019; 23(2):162-167.
4. Nivas R, Meena N, Parsad R, Solanki RK, Sharma V . Comparison of 2- Chloroprocaine, bupivacaine, and lidocaine for spinal anesthesia in infraumbilical day-care surgeries. International Journal of Medical and Health Research. Oct 2019; 5(10): 89-95
5. G Ben & L Thierry & G Tobie & J Luc. Intrathecal prilocaine, 2-chloroprocaine and bupivacaine for ambulatory abdominal wall herniorrhaphy: A prospective observational

study. Ambulatory Surgery. 2017; 23: 8-12.
6. A Agarwal, U Bhatia and M Tripathi. 'Comparative Evaluation between Bupivacaine and 2-Chloroprocaine for Spinal Anaesthesia In Ambulatory Surgeries: A Randomized Controlled Trial, International Journal of Current Medical AndPharmaceutical Research, 2019; 05(04): 4153-56.
7. C Andrea, F Guido, D Giorgio, B Marco, Spinal Anesthesia with Lidocaine or Preservative-Free 2-Chlorprocaine for Outpatient Knee Arthroscopy: A Prospective, Randomized, Double-Blind Comparison, Anesthesia & Analgesia: April 2007;104:959-64
8. Yoos JR, Kopacz DJ. Spinal 2-chloroprocaine: a comparison with small-dose bupivacaine In volunteers. Anesth Analg. 2005 Feb; 100(2): 566-72.
9. 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 Sep-Oct; 41(5): 576-83.
10. Dr. Kannan Bhojaraaj, Dr. M. Lalitha. Spinal anaesthesia for perineal surgeries: a comparison of 1% 2-chloroprocaine with 0.5% bupivacaine. Indian Journal of Applied Research. 2017;7(11): 212-18.
11. F IrsterJ G, Rosenberg PH Revival of old local anesthetics for spinal anesthesia in ambulatory surgery. Curr Opin Anaesthesiol. 2011; 24(6):633-7
12. Sell A, Tein T, Pitk Anen M Spinal 2-Chloroprocaine: effective dose for ambulatory surgery Acta Anaesthesiol Scand. 2008;52(5):695-9.
13. Ghisi D, Bonarelli S. Ambulatory surgery with Chloroprocaine Spinal Anaesthesia: a review Ambulatory Anesthesia, 2015: 2;111-20
14. Goldblum, E. and Atchabahian, A., Chloroprocaine for spinal anaesthesia. Acta Anaesthesiol Scand, 2013;57: 545-52.
15. V. Gebhardt, Muellerhansen, A. Schwarz, D. Bussen C- wiess. M D schmittenrdid. Choloroprocaine 10 mg/ml low dose spinal anesthesia in peianal surgery-a randomized dose finding study. 2016:105-15
16. Drasner K. Chloroprocaine spinal anesthesia: back to the future? Anesth Analg. 2005 Feb;100(2):549-52.
17. Miller RD, Cohen H. Neal, Erkisson LI, Fleisher A. Lee, Weiner-Kronish P, Jeanine, Young WL. Editors. Local anesthetics. Miller's anaesthesia. 8th edition. Charles B. Berde, Gary R. Strichartz. Inc. 2015; 1:1028-52.
18. Miller RD, Cohen H. Neal, Erkisson LI, Fleisher A. Lee, Weiner-Kronish P, Jeanine, Young WL. Editors. Spinal, epidural, and caudal anesthesia. Miller's anaesthesia, 8th edition. Richardbrull, ALANJ. R. Macfarlane, Vincent W.S. ChanInc. 2015; 1:1684-1716.