



Comparison of Intrathecal Bupivacaine with Clonidine Versus Intrathecal Bupivacaine with Fentanyl for Post-operative Pain Treatment in Lower Limb Procedures

Priyanka Deshmukh ^{a≡}, Pratibha Deshmukh ^{aω*}, Sohal Parate ^{a#},
Sweety Agrawal ^{a≡} and Vivek Chakole ^{b†}

^a Department of Anaesthesiology, Datta Meghe Medical College, SMRC Hospital Hingana, Nagpur, India.

^b Department of Anaesthesiology, Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences, Sawangi (Meghe), India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i60B35086

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/80106>

Original Research Article

Received 20 October 2021
Accepted 26 December 2021
Published 28 December 2021

ABSTRACT

Background: One of the anaesthesiologist's key goals during spinal anaesthesia is to keep the body physiology as close to normal as feasible. As we all know, subarachnoid block causes significant hemodynamic changes, especially in trauma and elderly individuals. Sympathetic nervous system denervation, skeletal muscle weakness, or loss of proprioception are not linked to neuraxial opioids. They primarily operate on the receptors found in the substantia gelatinosa of the spinal cord to exert their synergistic analgesic impact on visceral pain. Opioids and local anaesthetics delivered intrathecally have a powerful synergistic analgesic effect. A 2 adrenergic agonist, Clonidine is sometimes used as a local anaesthetic adjuvant with mixed effects. The

[≡] Assistant Professor;

^ω Professor & Head;

[#] Senior Resident;

[†] Professor;

*Corresponding author: E-mail: pratibhauday@gmail.com;

effects of intrathecal Clonidine vs Fentanyl with 0.5 percent hyperbaric bupivacaine on postoperative analgesic duration and adverse effects were compared.

Objectives: The purpose of this study was to compare the efficacy of 0.5 percent hyperbaric bupivacaine with Clonidine (75 gs) vs Fentanyl (25 gs) for spinal anaesthesia in patients undergoing lower limb procedures, as well as the postoperative pain alleviation and adverse effects in both groups.

Methods: This was a prospective study involving 80 patients who were scheduled for elective lower limb surgery under spinal anaesthesia. The participants were randomly assigned to one of two groups: Group C (15mg 0.5 percent bupivacaine + 75gs Clonidine) or Group F (15mg 0.5 percent bupivacaine + 25gs Fentanyl).

Results: We discovered a time delay in the start of sensory and motor block in group C after assessing the outcomes of our investigation. Group C's sensory and motor block lasted significantly longer compared to group F. The average duration of analgesia in groups C and F was 234.7529.71 minutes and 170.8732.38 minutes, respectively. Compared to group C, the demand for rescue analgesics was higher in group F throughout 24 hours. Bradycardia affected 12 individuals in group C, while pruritus affected 12 patients in group F. Five of the patients in group F experienced nausea.

Conclusion: In compared to 25gs Fentanyl, adjuvant use of Clonidine 75gs with hyperbaric bupivacaine prolongs the duration of both sensory and motor blockage, as well as the length of analgesia postoperatively, without generating substantial hemodynamic compromise or other side effects.

Keywords: Spinal anaesthesia; lower limb surgery; clonidine.

1. INTRODUCTION

"Pain is a more terrifying lord of people than death [1]." Albert Schweitzer. The surgical stress response peaks during the postoperative phase and has significant effects on practically all bodily systems. Any surgical procedure with a pain-free postoperative phase minimises morbidity and death. Karl August Bier was the first to put spinal anaesthetic into clinical practise in 1898 [2]. Even after a century, spinal anaesthesia is still one of the most used approaches for both elective and emergency surgical procedures, such as Cesarean sections, lower abdominal surgery, orthopaedic, and urological procedures, to name a few [3]. For spinal anaesthesia, hyperbaric Bupivacaine, an amide local anaesthetic, is most usually utilised. A tiny dosage of hyperbaric bupivacaine generates a brief spinal anaesthetic that could be beneficial in ambulatory surgical operations. However, for the majority of lower limb orthopaedic procedures, a higher-quality, longer-lasting analgesia is required on the operating side. Clonidine Hydrochloride is a 2-adrenergic agonistic imidazoline derivative with a selectivity ratio of 200:1 in favour of 2 receptors. Clonidine, unlike opioids, does not cause pruritus or respiratory depression. It also extends the sensory blockage [4] and minimises the quantity of local anaesthetic necessary for postoperative analgesia [5]. It has an opioid-independent mechanism for pain alleviation. On the other

hand, Intrathecal clonidine appears to be linked to bradycardia, relative hypotension, and sedation. Fentanyl is a synthetic opioid receptor agonist that is derived from phenylpiperidine. Because of its early start and brief duration of effect, it is chosen as an adjuvant in spinal anaesthesia. It also has a lower incidence of respiratory depression [6,7].

The purpose of this study was to determine the efficacy, duration of pain relief, and incidence of adverse effects and complications when Clonidine or Fentanyl is combined with Bupivacaine for intrathecal injection in patients undergoing lower limb procedures.

2. MATERIALS AND METHODS

The study was cross-sectional, prospective, and observational. The research was started once the Institutional Ethical Committee approved it. A complete clinical history and examination and the necessary investigations were all part of the pre-operative evaluation. The trial excluded patients with less than 150 cm height, any contraindication to regional anaesthesia, patient refusal, and any known drug allergy. The ten-point visual analogue scale was explained to all of the patients (VAS). The study comprised 80 patients with ASA (American Society of Anesthesiologists) status I or II who were scheduled for lower limb procedures. All patients

signed a written informed consent form. Patients were divided into two groups of 40, one receiving 3.0ml injection Bupivacaine (H) + (75g) 0.5ml clonidine (Group C) and the other receiving 3.0ml injection Bupivacaine (H) + (25g) 0.5ml injection fentanyl (Group F). The total volume of agents administered was 3.5 ml, and all of the study medications were injected intrathecally.

Monitors were linked to the patient in the operating room, and data such as heart rate, systemic arterial pressure, and peripheral arterial oxygen saturation were recorded. All of the patients were given 10ml/kg of Ringer lactate as a preload. Subarachnoid block was performed in the L3-L4 space with a 25G Quincke's spinal needle in a sitting position, following all aseptic precautions and using a midline approach. The drug was delivered into the appropriate group. The patient was placed in the supine position right away. Sensory analgesia and motor blockade onset were investigated. A pinprick test is used to determine the level of sensory anaesthesia, which is defined as the loss of keen sensation. The modified Bromage score was used to assess motor blockage. Every minute for the first 20 minutes, the time it took to complete a complete motor blockade was recorded. The time it took to reach the maximal sensory level was recorded. The patient's heart rate, blood pressure, respiratory rate, and oxygen saturation were monitored every minute for the first five minutes, then every five minutes for the next 30 minutes, and finally every ten minutes until the surgery was completed. The number of rescue analgesics provided, the duration for 2 segment regression, and the time for the first rescue analgesia were all recorded. The postoperative pain reduction was measured using the Visual Analogue Scale. Injection Diclofenac 75mg was given intramuscularly as a rescue therapy at a score of 5.

Hypotension was defined as a drop in mean arterial pressure of less than 60mmhg from

baseline in this trial, and it was treated with Injection Mephentermine IV. Atropine Sulphate 0.6mg IV injection was used to treat Bradycardia, which was described as a drop in pulse rate to less than 50 per minute. For the next 24 hours, all patients were monitored. Any occurrence that occurred throughout the surgical and postoperative periods up to 24 hours was recorded and dealt with appropriately. The data was analysed statistically. The descriptive and inferential statistics were used in the statistical analysis, which included the student's paired and unpaired t test and the chi-square test. The software used in the analysis were SPSS 17.0 version and GraphPad Prism 5.0 and $p < 0.05$ is considered as level of significance ($p < 0.05$).

3. RESULTS

The comparison of initial block characteristics in both groups is shown in the Table 1. The clonidine group had a mean onset of sensory block of 96.25 ± 16.66 seconds, while the fentanyl group had a mean onset of sensory block of 89.75 ± 14.40 seconds (sec). The mean onset of sensory block in both groups was significantly different (p-value 0.017). Similarly, the clonidine group's mean onset of motor block was 122.25 ± 18.04 (sec), while it was 110.75 ± 23.46 (sec) in the fentanyl group. The difference was statistically significant (p-value 0.016), with the clonidine group having a faster onset of motor block.

The average duration of sensory block in the clonidine group was 299 ± 28.69 minutes, while it was 282.62 ± 30.98 minutes in the fentanyl group (p-value 0.016). Similarly, the average duration of motor blockade in the clonidine group was 234 ± 27.36 minutes, while it was 219.12 ± 28.34 minutes in the fentanyl group (p-value 0.019, S). When clonidine was compared to fentanyl, the difference was statistically significant.

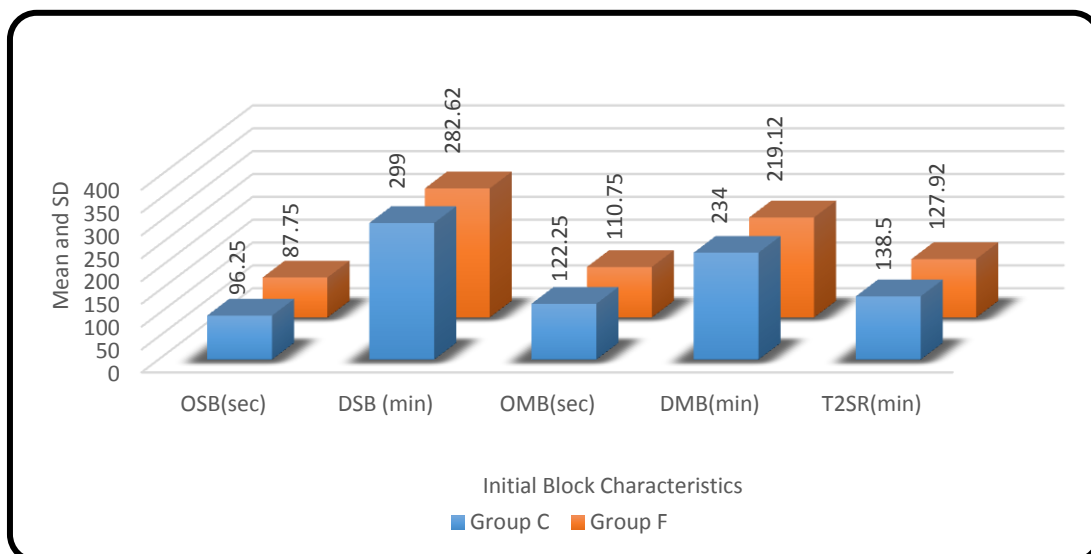
Table 1. Comparison of initial block characteristics in patients in both the groups

Initial Block Characteristics	Group C (n=40)	Group F (n=40)	t-value	p-value
OSB(sec)	96.25±16.66	87.75±14.40	2.44	0.017, S
DSB (min)	299±28.69	282.62±30.98	2.452	0.016, S
OMB(sec)	122.25±18.04	110.75±23.46	2.457	0.016, S
DMB(min)	234±27.36	219.12±28.34	2.388	0.019, S
T2SR(min)	138.50±20.45	127.92±23.75	2.13	0.036, S
TDA(min)	234.75±29.71	170.87±32.38	9.19	0.000, S

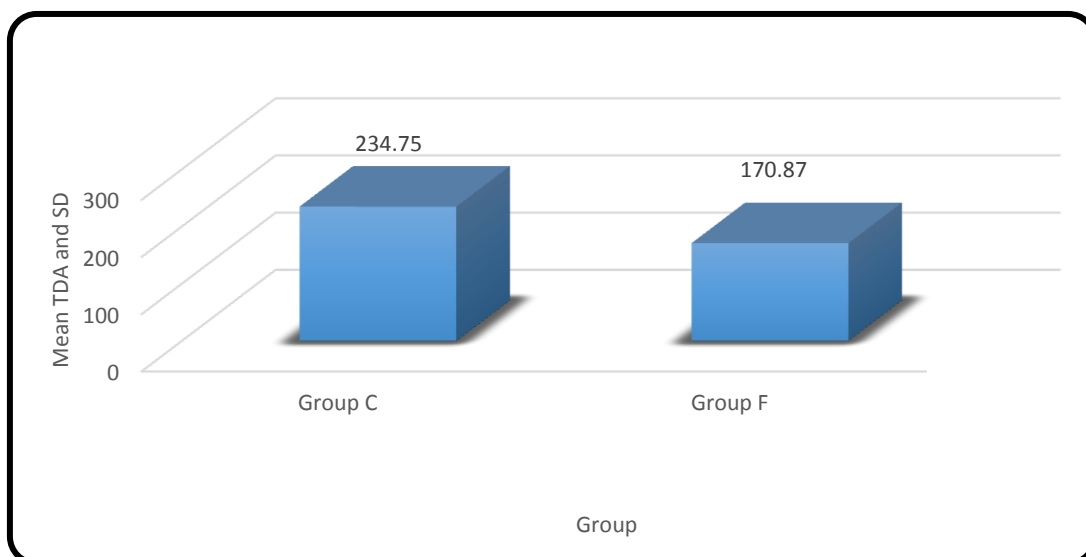
S: Significant; NS: Non-significant

In the clonidine group, the mean time for two segment regression was 138.50 ± 20.45 (min), while in the fentanyl group, it was 127.92 ± 23.75 (min). There was a statistically significant difference (p-value 0.036, S).

There was a statistically significant difference in overall analgesia duration in both groups. It was 234.75 ± 29.71 (min) in group C and 170.87 ± 32.38 (min) in group F. (p-value 0.000, S).



Graph 1. Comparison of initial block characteristics in patients in both the groups

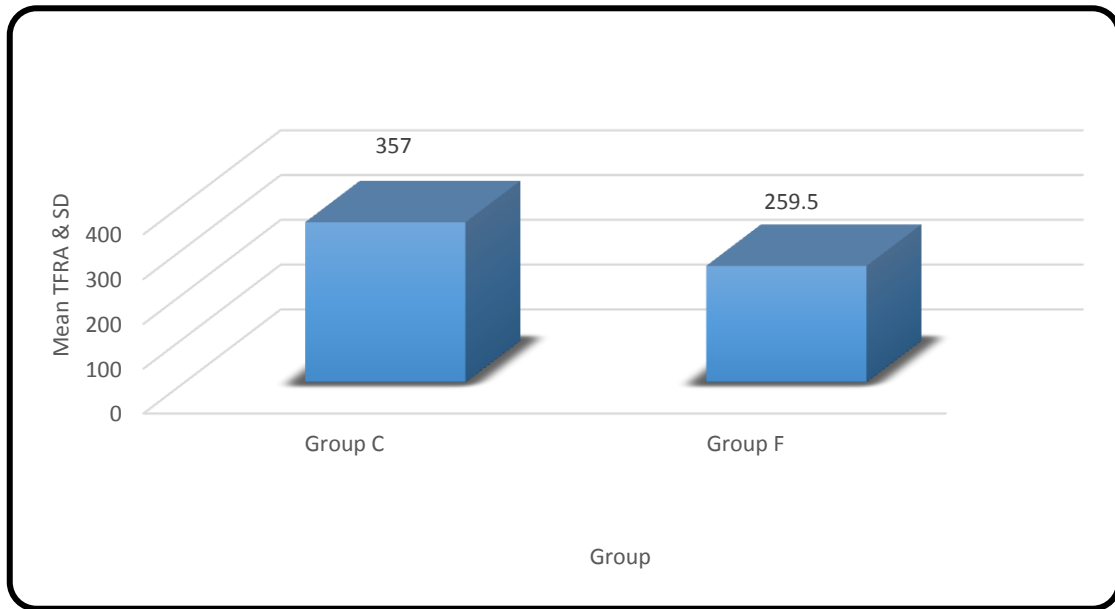


Graph 2. Mean total duration of analgesia in patients in both the groups

Table 2. Comparison of time for rescue analgesia in both the groups

Group	N	Mean	Std. Deviation	Std. Error Mean	t-value	p-value
Group C	40	357.00	54.26	8.57	9.19	0.000
Group F	40	259.50	39.35	6.22		S,p<0.05

S: Significant; NS: Non-significant

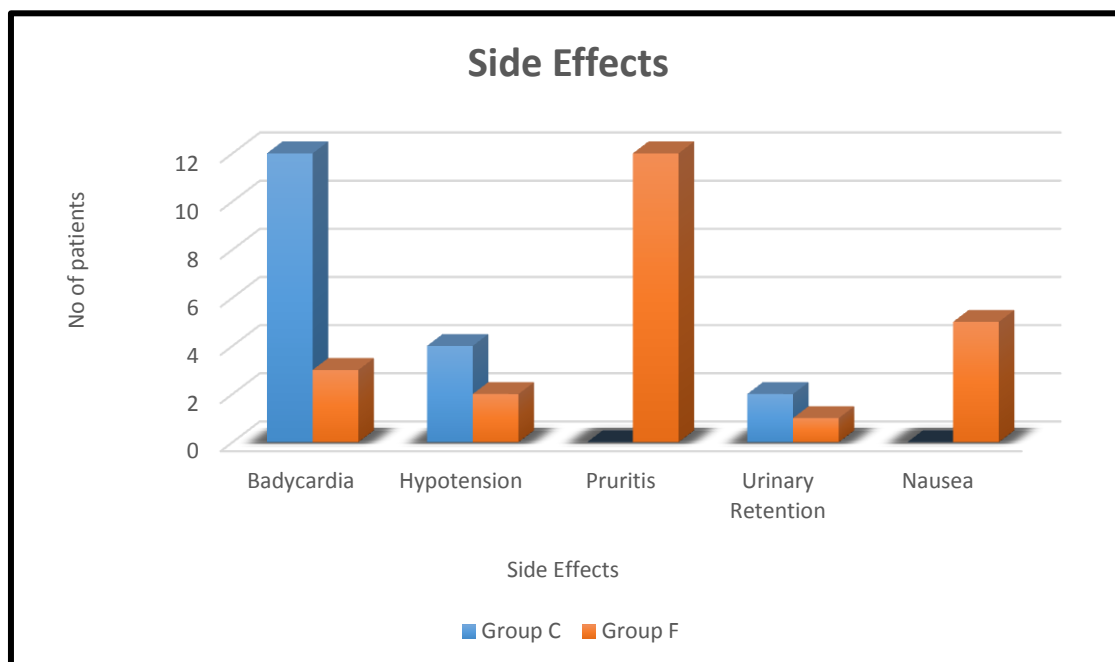


Graph 3. Comparison of Time for Rescue Analgesia in both the groups

Table 3. Comparison of side effects in patients in both the groups

Complications	Clonidine		Fentanyl		χ ² -value
	No	%	No	%	
Bradycardia	12	30	3	7.5	15.72 P<0.0001,S
Hypotension	4	10	2	5	0.68 P=0.40,NS
Pruritus	0	0	12	30	12.77 P=0.0007,S
Urinary Retention	2	5	1	2.5	0.52 P=0.47,NS
Nausea	0	0	5	12.5	13.90 P=0.0002,S

S: Significant; NS: Non-significant



Graph 4. Comparison of side effects in patients in both the groups

The mean time required for rescue analgesia dose in both groups is shown in the Table 2 and Graphs 2 and 3. The mean time for rescue analgesia in the clonidine group was 357.00 minutes, which was substantially longer than the 259.00 minutes in the fentanyl group (p -value >0.05 , NS).

The percentage of adverse effects seen in both groups is shown in the Table 3 and Graph 4. Only 7.5 percent of patients in the fentanyl group exhibited bradycardia, compared to 30% in the clonidine group. In both groups, the difference was significant (p -value 0.05, S). Patients in the clonidine group had 10% hypotension, while only 5% of those in the fentanyl group had hypotension. In both groups, the difference was not significant (p -value 0.40, NS). Pruritus was not experienced by any of the patients in the clonidine group, whereas it was experienced by 30% of the patients in the fentanyl group. In both groups, the difference was statistically significant (p -value 0.0007, S). Urinary retention occurred in 5% of clonidine patients and 2.5 percent of fentanyl patients, a statistically insignificant difference (p -value 0.47, NS). Patients in the clonidine group did not experience nausea, whereas 12.5 percent of those in the fentanyl group did. In both groups, the difference was statistically significant (p -value 0.0002, S).

4. DISCUSSION

The effects of adding clonidine and fentanyl to Bupivacaine were studied in order to determine which additive was the best by weighing effects versus side effects. According to several studies, adding Clonidine to bupivacaine, even in very tiny dosages, considerably increases the onset and duration of sensory block. Clonidine's antinociception activity is mediated through post-junctional adrenoceptor-mediated noradrenaline release in the dorsal horn [8]. Clonidine (Group C) provided greater early postoperative analgesia, as evidenced by a considerable delay in the first request for analgesia, less need for rescue analgesic diclofenac, and a lower VAS score. In a study by van Tuijl et al. [9] using 75µg clonidine, the duration of analgesia was reported to be up to 120 (min), in contrast to the current study, where the mean duration of analgesia remained for 234.75±29.71 minutes, which is substantially longer than the previous study.

The duration of analgesia with Fentanyl was 170.87±32.38 (min), which is consistent with

previous investigations by Biswas et al. [10] and Belzarena [11]; 12.5g Fentanyl caused analgesia that lasted 248±11 minutes. Biswas et al. [10] and 305±89 minutes [11]. In this study, the Fentanyl group had a faster onset of sensory block (87.75±14.40 sec) than the Clonidine group (96.25±16.66 sec) ($p<0.017$).

Sensory and motor block lasted 299±28.69mins and 234±27.36mins in the clonidine group, and 282.62±30.98mins and 219.12±28.34mins in the fentanyl group, respectively. There was a statistically significant difference.

In our trial, the average time for rescue analgesia in the clonidine group was 357 minutes, while it was 259 minutes in the fentanyl group. At VAS values of 5 or higher, the rescue analgesic Diclofenac 75mg was given intramuscularly. Two doses of rescue analgesic were necessary in the Fentanyl group, whereas only one dosage was required in the clonidine group. Our findings matched those of Chandrashekarappa k et al. [12], who found that the period for initial rescue analgesia was 169.57 minutes in patients given 0.5 percent (2.5mg) hyperbaric bupivacaine and 30g clonidine. Though there is a substantial difference in time for initial rescue analgesia compared to our data, this could be because our trial used a higher volume of local anaesthetic and clonidine, resulting in a longer period of analgesia.

The most prevalent side effects associated with the use of intrathecal Clonidine are hypotension and bradycardia. Hypotension was observed in this investigation, however it was not statistically significant. ($p=0.94$). This finding was similar to that of Van Tuijl et al. [9] who found that while mean arterial pressure (MAP) reduced with 75g intrathecal Clonidine, it was not clinically significant. In the Fentanyl group, 12 patients complained pruritus and 5 patients reported nausea. PONV (postoperative nausea and vomiting) is a well-known side effect of opioid therapy. Our findings are consistent with those of Biswas BN et al. [10] who identified a 5% incidence of nausea and vomiting in their research. Some of the related studies on different combinations in anaesthesia were reviewed [13-18]. Clonidine can cause nausea and vomiting, however these are uncommon side effects. No one in our Clonidine group felt nauseous. The side effect of opioid administration has been observed to be pruritus. It happens as a result of opioids migrating cephalad in the CSF and interacting with opioid

receptors in the trigeminal nucleus. Patients with minor pruritus with Fentanyl, but with self-limiting symptoms, were found by Biswas BN et al. [10] in their trial, which was similar to ours.

5. CONCLUSION

The current study found that combining intrathecal Clonidine 75 mg or Fentanyl 25 mg with hyperbaric Bupivacaine 15 mg increases sensory and motor block onset and duration while maintaining relative haemodynamic stability. Both medicines had minor adverse effects that could be effectively handled, despite Fentanyl having a lower frequency of side effects. Clonidine came in second. There were no negative side effects to be concerned about. The technique's cost-effectiveness and simplicity add to these benefits.

Despite the fact that Fentanyl is a good adjuvant, our research demonstrates that Clonidine is a better medicine in terms of anaesthetic quality and post-operative pain relief duration. As a result, we would like to propose Clonidine as a safe adjuvant for spinal anaesthesia, providing that the user is aware of the drug's effect-side effect profile and follows rigorous protocol when performing the procedure. The patients must be monitored by competent people after surgery.

As a result, we would like to suggest Clonidine as a safe adjuvant for spinal anaesthesia in patients having lower limb surgery.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

All patients signed a written informed consent form.

ETHICAL APPROVAL

The research was started once the Institutional Ethical Committee approved it.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Schweitzer A. Pain is more terrible lord of mankind than even death itself. *Pain Policy & Palliative Care*; 2011.
2. Parameshwara G. Spinal, epidural to combined spinal epidural analgesia, the history of central neuraxial block. *Indian J Anaesth.* 2001;45(6):406-12.
3. Dureja GP, Jayalaxmi TS. Colloid preloading before spinal and epidural anaesthesia. *Hospital Today.* 2000;11:601-603.
4. Racle JP, Benkhadra A, Poy JY, Gleizal B. Prolongation of isobaric bupivacaine spinal anesthesia with epinephrine and clonidine for hip surgery in the elderly. *Anesth Analg.* 1987;66:442-6.
5. Bonnet F, Buisson VB, Francois Y. Effects of oral and subarachnoid clonidine on spinal anesthesia with bupivacaine. *RegAnesth.* 1990;15;211-4.
6. Dobrydnjov I AK, Samarutel J, Holmstrom B. Postoperative pain relief following intrathecal bupivacaine combined with intrathecal or oral clonidine. *Acta Anaesthesiol Scand.* 2002;46(7):806-14.
7. Park J, Forrest J, Kolesar R. Oral clonidine reduces postoperative PCA morphine requirements. *Can J Anaesth.* 1996;43: 900-6.
8. Eisenach JC, De Kock M, Klimscha W. Alpha(2)-adrenergic agonists for regional anesthesia. A clinical review of clonidine. *Anesthesiology.* 1996;85:655-74.
9. Van Tuijl I, Van Klei WA, Van Der Werff DB, Kalkman CJ. The effect of addition of intrathecal clonidine to hyperbaric bupivacaine on postoperative pain and morphine requirements after Caesarean section: A. *Br J Anesthesia.* 2006;97(3): 365-70.
10. Biswas BN, Rudra A, Bose BK, Nath S, Chakrabarty S, Bhattacharjee S. Intrathecal Fentanyl with hyperbaric Bupivacaine improves analgesia during caesarean delivery and in early post operative period. *Indian J Anaesth.* 2002; 46(6):469-72.
11. Belzarena, Sergio D. Clinical Effects of Intrathecally Administered Fentanyl in Patients Undergoing Cesarean Section.

- Anesthesia and Analgesia. 1992;74(5): 653-657.
12. Chandrashekarappa K, Ravindra CG, Kumara AB, Kiran M. Intrathecal use of clonidine with hyperbaric bupivacaine in orthopaedic surgeries for lower limb. Journal of Evolution of Medical and Dental Sciences. 2014;3(14):3556-3562.
 13. Sen J, Singh S, Sen B. The Effect of Intrathecal Magnesium Sulphate on Bupivacaine-Fentanyl Subarachnoid Block for Infraumbilical Surgeries. Available: <https://doi.org/10.14260/jemds/2020/170>
 14. Singh AN, Singh A. Comparative evaluation of intravenous dexmedetomidine and clonidine on the extent and duration of bupivacaine spinal anaesthesia: A randomised control trial. Journal of Clinical & Diagnostic Research. 2020;14(3). Available: <https://doi.org/10.7860/JCDR/2020/43496.13596>
 15. Gantasala BV, Singam A, Taksande K. Bupivacaine (0.5%) versus (0.5%) bupivacaine with ketamine (50 mg) for subarachnoid block in lower abdominal surgeries: A randomised comparative study. Journal of Clinical & Diagnostic Research. 2019;13(3). Available: <https://doi.org/10.7860/JCDR/2019/40338.12723>
 16. Latwal BS, Singam A, Shrey S, Jejani A, Nagpure P. A comparative study of intrathecal 0.5% hyperbaric bupivacaine & intrathecal 0.75% isobaric ropivacaine in lower abdominal surgeries. J Evol Med Dent Sci. 2020;9:256-61. Available: <https://doi.org/10.14260/jemds/2020/58>
 17. Singh AN, Singam A. Comparative evaluation of intravenous dexmedetomidine and clonidine on the extent and duration of bupivacaine spinal anaesthesia: A randomised control trial. Journal of Clinical & Diagnostic Research. 2020;14(3). Available: <https://doi.org/10.7860/JCDR/2020/43496.13596>
 18. Charan N, Hijam B, Ninave S, Singh ST, Keisham U, Heisnam I. A double blind comparative study of IV Clonidine and Fentanyl to see the haemodynamic response during laryngoscopy and intubation. Journal of Evolution of Medical and Dental Sciences. 2014;3(39):10015-26. Available: <https://doi.org/10.14260/jemds/2014/3300>.

© 2021 Deshmukh et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/80106>