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Comparing the Efficacy of Dexmedetomidine and Clonidine as Adjuncts to Intrathecal Bupivacaine for Lower Abdominal Surgeries

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KEYWORDS
Aortic aneurysm; Aortic dissection; Antimal flap intussusception.

Abstract: Background: The preferred method for lower abdominal surgeries is administering a spinal block. Bupivacaine is a commonly used local anesthetic; however, it has a relatively short duration of action. To enhance the analgesic quality throughout the postoperative period, various enhancers have been explored. In this particular research, α^2-agonists were employed [1], [2]. **Objective:** This study aimed to compare the effects of intrathecal dexmedetomidine and clonidine when used as adjuvants to hyperbaric bupivacaine. The comparison was focused on the onset and duration of sensory and motor blockade, analgesic duration, and the incidence of side effects. Study Design: This was a prospective randomized double-blind study. **Methods:** A hundred patients, classified under the American Society of Anesthesiologists Classes I and II based on their physical condition, were randomly allocated into Groups B, C, and D. Each group received a different administration: bupivacaine with normal saline, clonidine, and dexmedetomidine, respectively. [3], [4] **Results:** In Group B, the mean onset of sensory effects was 2.6 0.6 minutes. Comparatively, in Group C, it was 1.6 0.4 minutes, and in Group D, it was 1.4
0.6 minutes. Additionally, the mean duration of sensory regression by two segments in Group B was 76.5 9.6 minutes, in Group C was 134.7 10.7 minutes, and in Group D was 136.4 11.7 minutes. **Conclusion:** The intrathecal administration of α^2-agonists alongside hyperbaric bupivacaine demonstrates a quicker onset for both motor and sensory block. Furthermore, itextends the duration of analgesia.

I. INTRODUCTION

When it comes to lower abdominal surgeries, there are different options for anesthesia, including regional (spinal or epidural) or general anesthesia [5], [6]. Among these choices, spinal block remains the primary preference due to its advantages, such as rapid onset, superior blockade, lower infection risk, reduced failure rates, and cost-effectiveness. However, it is important to note that spinal block does have its limitations, including a shorter duration of block and less postoperative analgesia. The commonly used local anesthetic for spinal anesthesia is bupivacaine, although it has a relatively short duration of action. To enhance the qual- ity of intraoperative analgesia and extend its effectiveness into the postoperative period, various adjuvants have been administered intrathecally. Among these adjuvants, opioids are frequently employed, as they provide effective pain relief without causing significant motor or autonomic blockade. α^2-adrenergic agonists are emerging as novel neuraxial ad- juvants in research, aiming to enhance the quality of sub-arachnoid blockade in terms of sensory and motor blockades. Numerous studies have provided evidence supporting their effectiveness as individual adjuvants [7], [8]. Notably, both dexmedetomidine and clonidine have shown promise in this regard. These agents are believed to primarily exert their effects at the spinal cord level. At the postsynaptic level, it acts to inhibit the development and subsequent transmission of integrated pain signals within the second-order neurons located in the substantia gelatinosa. Clonidine, which is a selective partial α^2-adrenergic agonist, is currently under evaluation as an adjuvant for intrathecal local anesthetics. These evaluations have not revealed any clinically significant side effects associated with its use. Dexmedetomidine, a novel and highly specific α^2-adrenergic agonist, is currentlyundergoing evaluation. It is noted for its ability to maintain stable hemodynamic

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conditions and provide excellent intra- operative analgesia as well as extended postoperative pain relief, all while minimizing side effects. While clonidine has been utilized as an adjuvant to bupivacaine in subarachnoid blocks, there is limited existing research on the intrathecal application of dexmedetomidine. As a result, we initiated this study to assess and compare the synergistic effects of adding both clonidine and dexmedetomidine to intrathecal hyperbaric bupivacaine. Our study focuses on evaluating the onset and duration of sensory and motor blockade, as well as any associated side effects that may arise from this combination. The primary objective of this study is to investigate and compare the synergistic effects and safety profiles of adding dexmedetomidine to bupivacaine versus clonidine to bupivacaine for subarachnoid blocks performed in lower abdominal surgeries. To achieve this, we will assess several key parameters. Firstly, we will evaluate the time of onset and duration of sensory blockade using both pinprick and the Visual Analog Score (VAS) as indicators. Secondly, we will closely monitor the time of onset and duration of motor blockade, employing the modified Bromage scale for assessment. Additionally, vital signs such as heart rate (HR), noninvasive blood pressure (NIBP), and oxygen saturation (SPO2) will be continuously monitored throughout the pro- cedures to detect any potential variations or fluctuations [9]. By conducting this study, we aim to enhance our understanding of how dexmedetomidine and clonidine influence these critical factors during lower abdominal surgeries, ultimatelycontributing valuable insights into the efficacy and safety of these adjuvants in the context of subarachnoid blocks.

II. MATERIALS AND METHODS

Following approval from the Institutional Ethics Committee, this study was conducted over a period of one year. The studyencompassed patients falling within the American Society of Anesthesiologists (ASA) Classes I and II, aged between 20 and 60 years, who were scheduled for lower abdominal surgeries. A total of three hundred patients met the inclusioncriteria and were randomly allocated into three groups for the study. Exclusion criteria consisted of various factors, including patient refusal to participate, any history of allergies to local anesthetics, dexmedetomidine, or clonidine, spinal abnormalities, localized skin infections, bleeding or clotting disorders, uncontrolled hypertension or diabetes mellitus, elevated intracranial pressure, asthma, epilepsy, as well as ahistory of thyroid, renal, hepatic, or cerebrovascular diseases. These criteria were applied to ensure the safety and integrity of the study [10].

The sample size for this study was determined based on the mean time to reach the T10 sensory block reported in the study by Kanazi et al., utilizing these values with a 90% confidence limit and 80% statistical power. As a result, a sample size of 46 was calculated for each group. To account for a potential 10% non-response rate, the sample size was adjusted to 45 + 4.6, which approximates 100 cases included in each group. This approach was adopted to ensure the study's statistical reliability and validity. A prospective randomized double-blind study was meticulously designed. Before the surgery, each patient received a preoperative visit during which the procedure was thoroughly explained to them. Written informed consent was diligently obtained from all participants. Routine preoperative evaluations and the necessary investigations for the proposed surgery were conducted as per protocol. To prepare the patients for the pro- cedure, they were premedicated with a tablet of alprazolam (0.5 mg) and a tablet of ranitidine (150 mg) the night before and on the morning of the surgery. Additionally, patients were instructed to abstain from oral intake for a minimumof 8 hours prior to the procedure.

The patients in this study were randomly assigned to one of three groups, each consisting of a hundred participants. The allocation was determined using a computer-generated table. Each group received a specific subarachnoid block formulation as follows:

1) Group B (n = 100): This group received a 3.5 ml volume of injection bupivacaine 0.5% hyperbaric and an additional 0.5 ml of normal saline.
2) Group C (n = 100): Patients in this group were ad- ministered a 3.5 ml volume of injection bupivacaine 0.5% hyperbaric and an additional 0.5 ml of injection clonidine (30 μg).
3) Group D (n = 100): This group was given a 3.5 ml vol- ume of injection bupivacaine 0.5% hyperbaric, along with an additional 0.5 ml of injection dexmedetomi- dine (3 μg).

These allocations allowed for the investigation of the effects of different additives in subarachnoid blocks on the study parameters.

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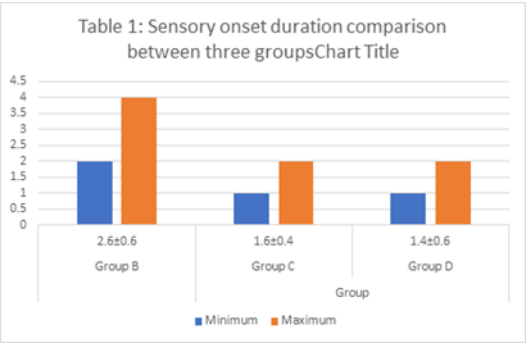
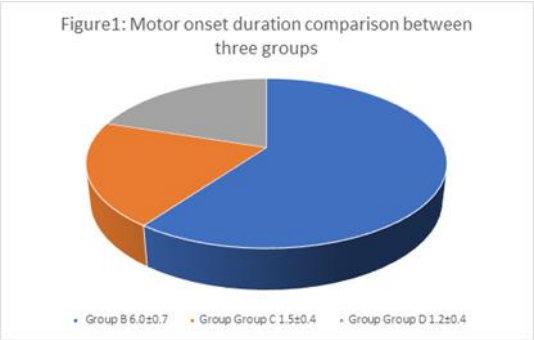
III. RESULTS

As depicted in Table 1, the mean sensory onset times variedacross the three groups. Specifically, in Group B, the mean sensory onset was 2.6 0.6 minutes, while in Group C, it was notably quicker at 1.6 0.4 minutes. Group D exhibitedthe fastest sensory onset, with a mean time of 1.4 0.6 minutes. It's important to note that these differences in meansensory onset times among the three groups were found to be statistically significant. Notably, Group D exhibited the fastest onset, while Group B had the slowest onset of sensoryblock. [11] As outlined in Table 2, the mean motor onset times displayed variation among the three groups. In Group B, the mean motor onset was 6 0.7 minutes, whereas Group C exhibited a substantially faster onset at 1.5 0.4 minutes. The quickest motor onset was observed in Group D, with a mean time of 1.2 0.4 minutes. Importantly, the differences in mean motor onset times among these three groups were found to be statistically significant. Group D demonstrated the fastest motor onset, while Group B exhibited the slowest onset of motor block. The mean duration of motor block- ade, as shown in the results presented, varied across the three groups. In Group B, the mean duration was 160.9
20.6 minutes, whereas in Group C, it was notably longer at 270.2 24.1 minutes. Group D exhibited the longest duration of motor blockade, with a mean time of 300.6
36.6 minutes. Significantly, these differences in mean motor blockade durations among the three groups were found to be statistically significant. Group D had the highest duration of motor blockade, while Group B had the lowest [12].





Analysis of systolic blood pressure (SBP) during the study revealed several significant findings. When comparing Group B to Group C, notable differences in mean SBP were ob- served at the 20-minute mark and between the 60 to 90- minute intervals. Similarly, in the comparison of Group B to Group D, significant differences in mean SBP were noted at the 20-minute interval and again between the 60 to 90- minute intervals. Interestingly, between Group C and Group D, a significant difference in mean SBP was only observed at the 60-minute mark, while at other time intervals, no sig- nificant distinctions in mean SBP were found between these two groups. These results underscore the dynamic nature of systolic blood pressure variations across the different groups and time points during the study.

IV. DISCUSSION

Achieving effective and long-lasting postoperative analge- sia is a critical goal in medical practice. In the context of spinal anesthesia, the most commonly used local anesthetic is bupivacaine 0.5% hyperbaric; however, its postoperative analgesic duration is limited. To address this limitation and prolong the duration of anesthesia, the addition of specific agents to these local anesthetics has proven to be a reliable method and has gained widespread acceptance [13]. A sim- pler technique involving the use of various drugs as additives has been embraced in clinical practice. These drugs encom- pass opioids such as fentanyl, nalbuphine, pethidine, and buprenorphine, as well as benzodiazepines like midazolam, ketamine, and neostigmine. These additives serve as valuable tools in extending the duration of anesthesia while minimiz- ing side effects, thereby enhancing the overall quality of post- operative pain management. Opioids have traditionally been the primary choice for managing postoperative pain due to their effectiveness. When administered intrathecally, opioidshave shown the capability to extend

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the duration of analgesia. However, their use can also be associated with late and unpredictable side effects, including respiratory depression, pruritus, nausea, vomiting, and urinary retention. These side effects are often undesirable and can lead to complications. Therefore, there has been a growing need for alternative adjuvants that can prolong analgesia without causing the aforementioned side effects commonly associated with opi- oids. Intrathecal α^2-agonists have been identified as having valuable antinociceptive properties, effectively addressing both somatic and visceral pain. Consequently, they have been integrated into clinical practice as adjuvants alongside bupivacaine for spinal anesthesia. Clonidine, specifically, functions as a partial α^2-adrenergic agonist and enhances the sensory and motor blockade induced by local anesthetics. Its analgesic effects are mediated through the activation of postsynaptic α^2-receptors located in the substantia gelatinosa of the spinal cord. By doing so, clonidine reduces the release of nociceptive substances within the substantia gelatinosa, primarily by activating the descending inhibitory medul- lospinal pathways. This mechanism of action contributes to its role in enhancing pain management during spinal anesthesia. Numerous studies have extensively explored the intrathecal use of clonidine, consistently highlighting its ef- fectiveness as a definitive adjuvant in extending the duration of analgesia. Clonidine has proven to be a valuable addi- tion to spinal anesthesia protocols, offering enhanced pain relief [14]. Dexmedetomidine, on the other hand, represents another promising α^2-receptor agonist, and it is recognized for its higher specificity compared to clonidine. Besides its intrathecal application, dexmedetomidine is also commonly employed as a premedication agent in general anesthesia. Its multifaceted benefits include reducing the requirements for opioids and inhalational anesthetics, contributing to more balanced and efficient anesthesia management. Indeed, the availability of studies examining the intrathecal efficacy of dexmedetomidine is limited, prompting the need for a com- prehensive evaluation of its effectiveness as a spinal adjuvant when compared to clonidine. To address this gap, our study was designed with the aim of assessing and contrasting the impact of adding clonidine versus dexmedetomidine to hy- perbaric 0.5% bupivacaine in the context of spinal anesthesia for elective lower abdominal surgeries. Both clonidine and dexmedetomidine belong to the α^2-agonists group, and this study aimed not only to determine the overall efficacy of α^2-agonists but also to discern which of the two, clonidine or dexmedetomidine, exhibited superior efficiency as a spinal adjuvant in this specific clinical setting. This research con- tributes valuable insights into optimizing anesthesia proto- cols for improved patient care.

V. CONCLUSION

The findings of our study lead us to the conclusion that when administered intrathecally alongside hyperbaric bupivacaine, both dexmedetomidine and clonidine, at doses of 3 μg and 30 μg, respectively, exhibit several noteworthy effects. These include a faster onset of both motor and sensory block, as well as a significant prolongation of the duration of analgesia. These results underscore the potential benefits of utilizing these α^2-agonists as adjuvants in spinal anesthesia, offering improved anesthesia quality and postoperative pain manage-ment. [15]

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTIONS

All authors equally contributed to preparing this article.

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