A Cross-Sectional Study to Evaluate the Efficacy of Two Different Doses of Intrathecal Dexmedetomidine in Combination with Hyperbaric Bupivacaine for Lower Abdominal and Lower Limbs Surgeries

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ABSTRACT

Background

Spinal anesthesia is widely used for lower abdominal and lower limb surgeries due to its rapid onset, reliability, and cost-effectiveness. However, limited duration of postoperative analgesia with local anesthetics such as bupivacaine necessitates the use of adjuvants. Dexmedetomidine, a highly selective alpha-2 adrenergic agonist, has emerged as a promising intrathecal adjuvant due to its analgesic, sedative, and sympatholytic properties.

Methods

This hospital-based cross-sectional study was conducted among 80 patients aged 20–50 years undergoing elective lower abdominal and lower limb surgeries under spinal anesthesia. Patients were divided into two groups: Group A received 5 mcg dexmedetomidine and Group B received 10 mcg dexmedetomidine, both combined with 0.5% hyperbaric bupivacaine. Onset and duration of sensory and motor blockade, duration of analgesia, hemodynamic parameters, and complications were assessed.

Results

Group B demonstrated significantly faster onset of sensory block (2.69 ± 0.49 vs 3.56 ± 0.53 minutes) and motor block (4.99 ± 0.45 vs 5.43 ± 0.44 minutes). Duration of sensory block (316 ± 25.21 vs 257 ± 16.91 minutes), motor block (268.5 ± 27.60 vs 227.25 ± 18.53 minutes), and analgesia (352.25 ± 32.69 vs 289.25 ± 11.48 minutes) were significantly prolonged in Group B ($p < 0.001$). Hemodynamic parameters were lower in Group B but remained clinically stable. Complication rates were comparable between the groups ($p > 0.05$).

Conclusion

Intrathecal dexmedetomidine significantly enhances the quality of spinal anesthesia in a dose-dependent manner. The 10 mcg dose provides superior block characteristics and prolonged analgesia without increasing adverse effects, making it a preferable adjuvant in spinal anesthesia.

Keywords: Dexmedetomidine; Spinal Anesthesia; Bupivacaine; Intrathecal Injection; Postoperative Analgesia; Regional Anesthesia; Alpha-2 Adrenergic Agonists

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Introduction :

Spinal anesthesia is one of the most widely utilized regional anesthetic techniques for lower abdominal and lower limb surgeries because of its rapid onset, simplicity, cost-effectiveness, and reliable sensory and motor blockade [1]. Since its first successful use by Bier in 1898, spinal anesthesia has evolved significantly with advances in pharmacology and

technique, making it an integral component of modern anesthetic practice [2]. The historical development and refinement of this technique have contributed to its current status as a safe and effective anesthetic modality [3]. It is now routinely employed across a wide range of surgical procedures due to its favorable safety profile and reduced need for airway manipulation [4]. Additionally, it has demonstrated particular utility in obstetric and infraumbilical surgeries, where rapid onset and predictable block characteristics are essential [5].

The global burden of surgical procedures continues to increase, with a substantial rise in both elective and emergency surgeries. In this context, spinal anesthesia has emerged as a key strategy for improving perioperative outcomes. It has been associated with reduced perioperative morbidity and mortality compared to general anesthesia, particularly in high-risk patients, by minimizing complications such as respiratory depression and thromboembolic events [6]. These benefits are especially important in resource-limited settings, where cost-effective and safe anesthetic techniques are required to manage increasing surgical demands.

Despite these advantages, postoperative pain remains a significant clinical challenge. A large proportion of patients experience moderate to severe pain following surgery, which can delay mobilization, prolong hospital stay, and negatively affect recovery [8]. Effective postoperative analgesia is therefore a critical component of perioperative care. The ideal anesthetic technique should not only provide adequate intraoperative anesthesia but also extend analgesia into the postoperative period without causing significant adverse effects.

Bupivacaine, an amide-type local anesthetic, is the most commonly used drug for spinal anesthesia due to its long duration of action and favorable sensory blockade characteristics [7]. Its pharmacological profile allows for effective intraoperative anesthesia; however, when used alone, it has certain limitations, including a relatively shorter duration of postoperative analgesia and potential dose-dependent adverse effects such as hypotension and cardiotoxicity [9]. Efforts to enhance its efficacy have led to the exploration of various adjuvants aimed at prolonging analgesia while minimizing side effects [10].

Among these, alpha-2 adrenergic agonists have gained considerable attention due to their analgesic, sedative, and sympatholytic properties [12]. Dexmedetomidine, a highly selective alpha-2 receptor agonist, has emerged as a promising intrathecal adjuvant. It acts at the spinal level by inhibiting nociceptive transmission and enhancing neuronal hyperpolarization, thereby prolonging both sensory and motor blockade [13]. In addition to improving analgesia, dexmedetomidine provides sedation without significant respiratory depression, making it particularly suitable for use in regional anesthesia.

Recent trends in anesthetic practice emphasize multimodal analgesia and opioid-sparing strategies to reduce adverse effects associated with opioid use, such as nausea, vomiting, pruritus, and respiratory depression [8]. Dexmedetomidine aligns with these evolving practices by enhancing analgesic efficacy without the typical opioid-related complications. Its ability to provide hemodynamic stability and prolonged analgesia further supports its role as an effective intrathecal adjuvant.

However, despite increasing clinical use, there remains a lack of consensus regarding the optimal dose of intrathecal dexmedetomidine that provides maximum benefit with minimal side effects. Different studies have used varying doses, resulting in variability in outcomes related to onset time, duration of blockade, analgesic efficacy, and hemodynamic changes. This highlights an important gap in the existing literature and underscores the need for comparative evaluation of different dosing strategies.

In view of the increasing demand for effective and safe spinal anesthesia techniques, and the need to optimize postoperative analgesia while minimizing complications, the present study was undertaken. It aims to evaluate and compare the efficacy of two different doses of intrathecal dexmedetomidine in combination with hyperbaric bupivacaine in patients undergoing lower abdominal and lower limb surgeries. By assessing parameters such as onset and duration of sensory and motor blockade, duration of analgesia, and incidence of complications, this study seeks to contribute to evidence-based optimization of intrathecal anesthetic practice.

Methodology

This hospital-based cross-sectional study was conducted in the Department of Anesthesiology at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee and written informed consent from all participants. The study population included adult patients of either sex, aged between 20 and 50 years, belonging to American Society of Anesthesiologists (ASA) physical status I and II, who were scheduled to undergo elective lower abdominal and lower limb surgeries under spinal anesthesia.

A total of 80 patients who fulfilled the inclusion criteria were enrolled and allocated into two groups of 40 each. Group A received 2.4 ml of 0.5% hyperbaric bupivacaine combined with 5 mcg of dexmedetomidine, while Group B received 2.4 ml of 0.5% hyperbaric bupivacaine combined with 10 mcg of dexmedetomidine intrathecally. Patients with contraindications to spinal anesthesia such as coagulopathy, infection at the injection site, known allergy to study drugs, significant cardiovascular or neurological disorders, or those who refused consent were excluded from the study.

All patients underwent a thorough preoperative evaluation, including clinical examination and relevant laboratory investigations. Standard fasting guidelines were followed. On arrival in the operating room, baseline vital parameters including heart rate, systolic and diastolic blood pressure, and oxygen saturation were recorded. Intravenous access was secured, and all patients were preloaded with appropriate intravenous fluids prior to the procedure.

Under strict aseptic precautions, spinal anesthesia was administered in the sitting or lateral decubitus position at the L3–L4 interspace using a standard spinal needle. After confirming free flow of cerebrospinal fluid, the study drug was injected intrathecally. Following administration, patients were positioned supine, and oxygen supplementation was provided if required.

The onset of sensory block was assessed using pinprick method, and the onset of motor block was evaluated using the Bromage scale. Hemodynamic parameters, including heart rate and blood pressure, were recorded at baseline, immediately after the block, and at regular intervals intraoperatively. The duration of sensory block was defined as the time from injection to regression to the S1 dermatome, while the duration of motor block was defined as the time taken to achieve complete recovery to Bromage score 0. The duration of analgesia was measured as the time from intrathecal injection to the first request for rescue analgesia.

Any intraoperative or postoperative complications such as hypotension, bradycardia, nausea, vomiting, or other adverse events were recorded and managed appropriately. Data collected were entered and analyzed using appropriate statistical methods. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. Statistical significance between the two groups was assessed using appropriate tests, and a p-value of less than 0.05 was considered statistically significant.

Results :

TABLE 1: Baseline Demographic and Clinical Characteristics

Variable	Category	Group A (n= 40)	%	Group B (n= 40)	%	P value	Significance
Age (years)	20–30	9	22.5	10	25		
	30–40	13	32.5	16	40		
	40–50	18	45	14	35		
	Mean ± SD	37.6 ± 6.205	—	36.55 ± 5.809	—	0.5937	NS
Gender	Male	19	45.5	8	20		
	Female	21	53.5	18	45	0.4257	NS
BMI (kg/m²)	Mean ± SD	22.7843 ± 1.5879	—	22.79 ± 1.5822	—	0.8827	NS

Both groups were comparable with respect to age distribution, gender, and BMI ($p > 0.05$), indicating that the baseline characteristics were homogeneous and unlikely to confound the study outcomes.

TABLE 2: Heart Rate Changes Over Time

Time Interval	Group A Mean	SD	Group B Mean	SD	P value	Significance
Baseline	81.19	5.847	77.57	5.94	0.0149	Significant
After block	80.35	7.609	76.62	6.658	0.0186	Significant
15 minutes	79.9	7.444	78.85	6.643	0.0477	Significant

30 minutes	77.6	7.305	75.75	5.999	0.5600	NS

Heart rate was significantly lower in Group B at baseline, immediately after block, and at 15 minutes ($p < 0.05$), suggesting a greater sympatholytic effect of the higher dose of dexmedetomidine. However, the difference was not significant at 30 minutes.

TABLE 3: Blood Pressure Changes Over Time

A. Systolic Blood Pressure (SBP)

Time Interval	Group A Mean	SD	Group B Mean	SD	P value	Significance
Baseline	129.7	14.113	122.1	13.619	0.0172	Significant
After block	128.97	11.180	123.05	11.734	0.0212	Significant
15 minutes	128.82	9.584	122.65	10.310	0.0175	Significant
30 minutes	125.85	9.206	123.7	9.811	0.0175	Significant

B. Diastolic Blood Pressure (DBP)

Time Interval	Group A Mean	SD	Group B Mean	SD	P value	Significance
Baseline	80.525	4.776	78.525	5.481	0.04776	Significant
After block	80.2	5.066	77.46	6.308	0.03303	Significant
15 minutes	78.9	5.382	75.62	7.362	0.01127	Significant
30 minutes	83.30	6.558	78.82	7.452	0.00025	Significant

Both systolic and diastolic blood pressures were significantly lower in Group B across all time intervals ($p < 0.05$), indicating enhanced hemodynamic modulation with the higher dose of dexmedetomidine.

TABLE 4: Block Characteristics (Onset and Duration)

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P value	Significance
Sensory Block Onset (min)	3.5625 ± 0.5323	2.69 ± 0.49	<0.0001	Significant
Motor Block Onset (min)	5.43 ± 0.4487	4.995 ± 0.4534	0.0005	Significant
Sensory Block Duration (min)	257 ± 16.917	316 ± 25.213	<0.0001	Significant
Motor Block Duration (min)	227.25 ± 18.537	268.5 ± 27.606	<0.0001	Significant

Group B demonstrated a significantly faster onset and prolonged duration of both sensory and motor blockade ($p < 0.001$), reflecting improved efficacy of the higher dose of intrathecal dexmedetomidine.

TABLE 5: Duration of Analgesia and Complications

A. Duration of Analgesia

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P value	Significance
Duration of Analgesia (min)	289.25 ± 11.4801	352.25 ± 32.698	<0.0001	Significant

B. Complications

Outcome	Group A (n=40)	%	Group B (n=40)	%	P value	Significance
Yes	15	37.5	17	42.5	0.6530	Non significant
No	25	62.5	23	57.5	—	—

The duration of analgesia was significantly longer in Group B ($p < 0.0001$), indicating superior postoperative pain relief. There was no statistically significant difference in complication rates between the

groups ($p > 0.05$), suggesting that the higher dose is safe without increasing adverse effects.

Discussion :

The present study was undertaken to compare the efficacy of two doses of intrathecal dexmedetomidine (5 mcg and 10 mcg) combined with 0.5% hyperbaric bupivacaine in lower abdominal and lower limb surgeries. The results clearly demonstrated that the higher dose (10 mcg) was associated with faster onset of block, prolonged duration of sensory and motor blockade, significantly extended postoperative analgesia, and acceptable hemodynamic stability without an increase in complications.

The baseline demographic parameters in the present study were comparable between the two groups, with mean age being 37.6 ± 6.205 years in Group A and 36.55 ± 5.809 years in Group B ($p = 0.5937$). Gender distribution and BMI (22.78 ± 1.58 vs 22.79 ± 1.58 kg/m²; $p = 0.8827$) were also similar, ensuring uniformity between groups. Alam et al. reported comparable baseline characteristics with no statistically significant difference between study groups, thereby confirming that demographic variables do not influence the outcomes of intrathecal dexmedetomidine studies [16]. Similarly, Minagar et al. demonstrated comparable demographic distribution across groups, strengthening the internal validity of such comparative trials [17].

In the present study, the onset of sensory block was significantly faster in Group B (2.69 ± 0.49 minutes) compared to Group A (3.5625 ± 0.5323 minutes), with a highly significant p-value (<0.0001). The onset of motor block also followed a similar trend, with Group B showing faster onset (4.995 ± 0.4534 minutes) compared to Group A (5.43 ± 0.4487 minutes), with $p = 0.0005$. Alam et al. observed that the addition of dexmedetomidine resulted in early onset of sensory block, typically around 2.5–3 minutes, and motor block around 4–5 minutes, which closely parallels our findings [16]. Minagar et al. also reported a significant reduction in onset time with dexmedetomidine, although exact values ranged slightly higher, likely due to variations in dose and patient population [17]. The faster onset in our higher-dose group suggests enhanced diffusion and receptor interaction at the spinal level.

The duration of sensory block in the present study was markedly prolonged in Group B (316 ± 25.213 minutes) compared to Group A (257 ± 16.917 minutes), with $p < 0.0001$. Similarly, motor block duration was significantly longer in Group B (268.5 ± 27.606 minutes) compared to Group A (227.25 ± 18.537 minutes), with $p < 0.0001$. Gupta et al. reported sensory block duration extending up to approximately 300 minutes with dexmedetomidine, which is comparable to the 316 minutes observed in our study [20]. Mowar et al. demonstrated that increasing the dose of intrathecal dexmedetomidine significantly prolonged both sensory and motor blockade, with higher doses producing durations exceeding 300 minutes for sensory block, closely aligning with our findings [21]. This dose-dependent prolongation can be attributed to inhibition of substance P release and sustained hyperpolarization of dorsal horn neurons.

The duration of analgesia was significantly longer in Group B (352.25 ± 32.698 minutes) compared to Group A (289.25 ± 11.4801 minutes), with $p < 0.0001$. Alam et al. reported prolonged analgesia duration in the dexmedetomidine group, often exceeding 300 minutes, which is consistent with our results [16]. Malla et al. observed that dexmedetomidine provided analgesia lasting approximately 320–360 minutes compared to shorter durations with fentanyl, which closely corresponds with the 352 minutes observed in our study [18]. Varghese et al. reported postoperative analgesia lasting approximately 7 hours (~420 minutes) with dexmedetomidine, further supporting its superior analgesic efficacy [19]. The increased duration of analgesia observed in our study reinforces the opioid-sparing advantage of dexmedetomidine.

Hemodynamic parameters in the present study showed that heart rate was significantly lower in Group B at baseline (77.57 ± 5.94 bpm vs 81.19 ± 5.847 bpm; $p = 0.0149$), after block (76.62 ± 6.658 bpm vs 80.35 ± 7.609 bpm; $p = 0.0186$), and at 15 minutes (78.85 ± 6.643 bpm vs 79.9 ± 7.444 bpm; $p = 0.0477$), while at 30 minutes the difference was not significant ($p = 0.5600$). Similarly, systolic blood pressure was significantly lower in Group B at baseline (122.1 ± 13.619 mmHg vs 129.7 ± 14.113 mmHg; $p = 0.0172$) and remained lower throughout the observation period. Diastolic blood pressure also followed a similar pattern, with Group B showing lower values at all time intervals, including 30 minutes (78.82 ± 7.452 mmHg vs 83.30 ± 6.558 mmHg; $p = 0.0025$). Al-Ghanem et al. reported significantly lower heart rate and blood pressure in dexmedetomidine groups compared to fentanyl, consistent with our findings [24]. Basuni et al. observed mild reductions in blood pressure with dexmedetomidine without clinical instability [25]. Konakci et al. further confirmed that dexmedetomidine produces controlled hemodynamic depression without adverse outcomes [26]. Thus, while dexmedetomidine

exerts a sympatholytic effect, it maintains overall cardiovascular stability.

The incidence of complications in the present study was 37.5% in Group A and 42.5% in Group B, with no statistically significant difference (p = 0.6530). Halder et al. reported no significant difference in complication rates between different doses of dexmedetomidine, supporting the safety of higher doses [27]. Shashikala et al. also observed comparable complication rates between dexmedetomidine and fentanyl groups [28]. A meta-analysis by Sun et al. demonstrated that dexmedetomidine does not significantly increase adverse events compared to other adjuvants [29]. Similarly, Zhang et al. reported no significant difference in safety outcomes between dexmedetomidine and clonidine [30]. These findings confirm that the use of 10 mcg dexmedetomidine is safe and does not increase perioperative complications.

Overall, the present study clearly demonstrates a dose-dependent improvement in anesthetic characteristics with intrathecal dexmedetomidine. The higher dose (10 mcg) significantly improved onset time, prolonged sensory and motor blockade, and extended postoperative analgesia while maintaining hemodynamic stability and safety. These findings are in strong agreement with previous studies and meta-analyses, thereby reinforcing the role of dexmedetomidine as an effective intrathecal adjuvant.

Thus, the present study adds to the existing body of evidence and supports the use of 10 mcg intrathecal dexmedetomidine as an optimal dose for enhancing the efficacy of spinal anesthesia in lower abdominal and lower limb surgeries.

Conclusion :

This study has certain limitations that should be considered while interpreting the findings. First, the sample size was relatively small (n=80), which may limit the generalizability of the results to a broader population. Second, the study was conducted in a single tertiary care center, and institutional practices may influence outcomes. Third, the study design was cross-sectional without long-term follow-up, thereby limiting assessment of delayed complications or prolonged neurological effects. Additionally, only two doses of dexmedetomidine (5 mcg and 10 mcg) were evaluated, and intermediate or higher doses were not studied, which could provide further insights into dose-response relationships. Variability in surgical procedures and individual pain perception may also have influenced analgesic outcomes.

Despite these limitations, the present study demonstrates that intrathecal dexmedetomidine is an effective adjuvant to hyperbaric bupivacaine. The higher dose of 10 mcg provided significantly faster onset of sensory and motor blockade, prolonged duration of anesthesia, and extended postoperative analgesia compared to 5 mcg, without a significant increase in complications. Hemodynamic changes observed were clinically manageable and did not result in adverse outcomes. These findings support the use of 10 mcg dexmedetomidine as an optimal dose for enhancing the efficacy of spinal anesthesia in lower abdominal and lower limb surgeries. Further multicentric studies with larger sample sizes and long-term follow-up are recommended to validate these findings and establish standardized dosing guidelines.

References:

1. Morgan GE, Mikhail MS, Murray MJ. *Clinical Anesthesiology*. New York: McGraw-Hill Medical; 2006.
2. Bier A. Versuche über Cocaini Sirung des Rückenmarkes. *Dtsch Z Chir*. 1899;51(3-4):361-9.
3. Moffitt P. August Bier 1861–1949. *J Neurol Neurosurg Psychiatry*. 2008;79(1):101.
4. Brull R, Macfarlane AJR. Spinal, epidural, and caudal anesthesia. In: Miller RD, editor. *Miller's Anesthesia*. 9th ed. Elsevier; 2019.
5. Gogarten W. Spinal anesthesia for obstetrics. *Best Pract Res Clin Anaesthesiol*. 2006;17(3):377-92.
6. Rodgers A, Walker N, Schug S, McKee A, Kehlet H, van Zundert A, et al. Reduction of postoperative mortality and morbidity with epidural or spinal anesthesia. *BMJ*. 2000;321(7275):1493.
7. Liu SS, Hodgson PS. Local anesthetics. *Anesth Analg*. 2001;93(4):1055-9.
8. Vadivelu N, Kai AM, Tran D, Kodumudi G, Legler A. Challenges of pain control in outpatient surgery. *Ochsner J*. 2014;14(2):242-9.
9. Becker DE, Reed KL. Local anesthetics: pharmacological considerations. *Anesth Prog*. 2012;59(2):90-101.
10. Burlacu CL, Buggy DJ. Update on local anesthetics: levobupivacaine. *Ther Clin Risk Manag*. 2008;4(2):381-92.
11. Rosenblatt MA, Abel M, Fischer GW, Itzkovich CJ, Eisenkraft JB. Lipid emulsion in bupivacaine toxicity. *Anesthesiology*. 1989;110(4):978-9.

12. Kamibayashi T, Maze M. Clinical uses of alpha2-adrenergic agonists. *Anesthesiology*. 2000;93(5):1345-9.
13. Bekker A, Sturaitis M. Dexmedetomidine in neurosurgery. *Neurosurgery*. 2005;57(1 Suppl):1-10.
14. Barash PG, Cullen BF, Stoelting RK, et al. *Clinical Anesthesia*. 8th ed. Philadelphia: Wolters Kluwer; 2017.
15. Butterworth JF, Mackey DC, Wasnick JD. *Morgan & Mikhail's Clinical Anesthesiology*. 6th ed. New York: McGraw-Hill; 2018.
16. Alam SS, Abbas N, Asgher A, Rafique M, Anees-ur-Rehman, Abid K. Intrathecal dexmedetomidine with bupivacaine for lower abdominal surgery. *J Ayub Med Coll Abbottabad*. 2022;34(Suppl1):S936-S939.
17. Minagar M, Alijanpour E, Jabbari A, Rabiee SM, et al. Dexmedetomidine as adjuvant to intrathecal bupivacaine. *Caspian J Intern Med*. 2019;10(2):142-149.
18. Malla S, Gupta P, Agrawal D, Behera R, Kumar S. Dexmedetomidine vs fentanyl with intrathecal bupivacaine. *J Clin Diagn Res*. 2019.
19. Varghese LA, Taksande K. Dexmedetomidine vs fentanyl in spinal anesthesia. *Anesth Essays Res*. 2017.
20. Gupta A, Gupta KL, Yadav M. Dexmedetomidine with hyperbaric bupivacaine in infraumbilical surgeries. *Int J Contemp Med Res*. 2016;3(7):2136-2138.
21. Mowar A, Singh V, Pahade A, Karki G. Effect of different doses of intrathecal dexmedetomidine. *J Clin Diagn Res*. 2022.
22. Yousef AA, Salem HA, Moustafa MZ. Epidural dexmedetomidine in cesarean section. *J Anesth*. 2015;29(5):708-14.
23. Li Z, Tian M, Zhang CY, Li AZ, Huang AJ, Shi CX, et al. Intrathecal bupivacaine with adjuvants in cesarean section. *Drug Res (Stuttg)*. 2015;65(11):581-6.
24. Al-Ghanem S, Massad I, Al-Mustafa M, Zaben K, Qudaisat I, Qatawneh A, et al. Dexmedetomidine vs fentanyl intrathecally. *Am J Appl Sci*. 2009;6:882-7.
25. Basuni AS, Ezz H. Dexmedetomidine with levobupivacaine in spinal anesthesia. *Egypt J Anaesth*. 2014;30(2):149-53.
26. Konakci S, Adanir T, Yilmaz G, Rezanko T. Epidural dexmedetomidine efficacy and safety. *Eur J Anaesthesiol*. 2008;25(5):403-9.
27. Halder S, Das A, Mandal D, Chandra M, Ray S, Biswas MR, et al. Dexmedetomidine dose comparison in spinal anesthesia. *J Clin Diagn Res*. 2014;8(11).
28. Shashikala TK, Sagar SS, Ramaswamy P, Hudgi VV. Dexmedetomidine vs fentanyl with ropivacaine. *Anesth Essays Res*. 2019;13(4):654-62.
29. Sun S, Wang J, Bao N, Chen Y, Wang J. Dexmedetomidine vs fentanyl: meta-analysis. *Drug Des Devel Ther*. 2017;11:3413-24.
30. Zhang C, Li C, Pirrone M, Sun L, Mi W. Dexmedetomidine vs clonidine meta-analysis. *J Clin Pharmacol*. 2016;56(7):827-34.