Hemodynamic effects of fentanyl and dexmedetomidine in spine surgery

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ABSTRACT

Introduction: Spinal surgery is of interest to anesthesiologists because it is often accompanied by perioperative problems, including blood pressure fluctuations and postoperative pain. Dexmedetomidine is one of the agents frequently used in spinal surgery. Dexmedetomidine is the dextro isomer of medetomidine, which is a selective alpha-2 agonist with high activity against alpha-1 adrenergic receptors. Hemodynamic stability during spinal surgery is essential to support rapid recovery, allowing early neurological assessment and more effective management of complications.

Method: This study was an experimental double-blind randomized controlled trial conducted at the Adam Malik General Hospital in Medan, involving 50 adult patients undergoing elective spinal surgery. Patients were divided into two groups: dexmedetomidine and fentanyl, with consecutive sampling technique. Inclusion criteria included patients aged 17–60 years with ASA physical status 1–3, while exclusion criteria included a history of drug hypersensitivity, cardiac anatomical abnormalities, and blood vessel disorders. Trial registration: ClinicalTrials.gov NCTxxxxxxx. Registered 23 September 2025. Retrospectively registered. Collected data were tabulated tabulated using SPSS, with numerical data presented as mean ± SD and categorical data in frequency and percentage. Hypothesis testing was performed using the T-test or Wilcoxon test, and normality testing with Shapiro-Wilk, with a p value <0.05 considered significant.

Result: showed that there was no significant difference in Mean Arterial Pressure (MAP) values between the two groups before T0 induction, with the dexmedetomidine group being 83.8 ± 12.58 and the fentanyl group being 85.7 ± 13.11. However, after induction at 15 minutes, MAP in the dexmedetomidine group dropped significantly lower than the fentanyl group ($p < 0.05$). In the Pulse of the two groups before induction (T0) there was no significant difference ($P> 0.005$), but at 15 minutes after induction there was a significant difference, where the pulse value in the dexmedetomidine group was lower than the fentanyl group.

Conclusion: There was a significant difference in MAP and pulse values between dexmedetomidine and fentanyl administration during spinal surgery at Adam Malik Hospital starting from 15 minutes after induction. The dexmedetomidine group had lower MAP and pulse values compared to the fentanyl group.

Keywords : Spine surgery, fentanyl, dexmedetomidine, hemodynamics

INTRODUCTION

The prevalence of spinal surgery has increased, which is balanced by the complexity of the surgical procedure. The World Health Organization (WHO) in 2019 stated that the number of spinal surgery cases in the world was around 9,542 people. From the 2021 Riskesdas data in Indonesia, around 4,528 people underwent spinal surgery. Based on data from the Adam Malik Hospital in Medan in 2022, there were 182 spinal surgery patients. Spinal surgery is a concern for anesthesiologists because it is accompanied by perioperative problems including blood pressure fluctuations and severe postoperative pain. General anesthesia is a commonly used anesthesia modality and is more acceptable to patients.1,2

General anesthesia can trigger a transient but significant sympathoadrenal response such as hypertension and tachycardia.2 Spinal surgery is a surgery with severe postoperative pain. The source of pain after spinal surgery is due to skin incision, inflammation of muscle tissue, roots, and neurons, excision of the vertebral bone and internal fixation devices that react with tissue. Spinal surgery is mostly performed under general anesthesia. Postoperative pain management is usually done conventionally with paracetamol, NSAIDs, and opioids used alone or in combination.1

Other methods to reduce bleeding during spinal surgery include acute hypervolemic or isovolemic hemodilution, perioperative blood recovery, antifibrinolytic drugs, and controlled hemodynamics. Although acute hypervolemic hemodilution and acute normovolemic hemodilution play an important role in blood protection, hemodilution can affect the body's blood clotting function. Autologous blood transfusion can minimize the need for allogeneic blood transfusion, but spinal surgery is traumatic and causes a lot of bleeding, so allogeneic blood transfusion cannot be completely avoided. Antifibrinolytic drugs can reduce perioperative blood loss and the need for blood transfusion during spinal surgery, but this drug is still controversial because it can increase the risk of venous thromboembolism. Therefore, the application has a low risk. 1

Stable hemodynamics can reduce intraoperative bleeding and ensure a clear field of vision, avoid damage to important nerves and blood vessels and shorten the duration of surgery, and reduce the need for blood transfusion, tissue ligation and cauterization, and the degree of edema,

along with accelerating wound healing. This is a useful method in reducing intraoperative bleeding during spinal surgery.[1]

There are several techniques to control hemodynamics, namely pharmacological and non-pharmacological techniques. Pharmacological by numbing the pain and using active hypotensive drugs such as nitroglycerin, in addition according to the Ministry of Health, giving 500-1000 cc of crystalloid fluid can also help manage hypotension. From several research results, it was found that non-pharmacological therapy for hypotension can be done by giving leg elevation treatment. The results of research conducted by Raditya Fauzan by giving a sitting position for 5 minutes after anesthesia obtained data on a smaller decrease in mean arterial pressure compared to the position of being directly lying down. Anesthetic techniques can also reduce mean arterial blood pressure (MAP) which is done by giving fentanyl or dexmedetomidine. Fentanyl is a primary synthetic opioid, 100 times more potent than morphine. Fentanyl interacts with μ opioid receptors. This mu-binding is evenly distributed in the brain, spinal cord, and other tissues. Clinically, fentanyl has pharmacological effects especially on the central nervous system. The primary therapeutic actions of fentanyl are analgesia and sedation. Fentanyl is a synthetic opioid agonist derived from phenylpiperidine. It is structurally related to meperidine.[3] Doses of 2 to 20 micrograms/kg IV are given as an adjunct to blunt the circulatory response to direct laryngoscopy for tracheal intubation or during surgical stimulation. Its analgesic potency is 50–100 times greater than that of morphine. Fentanyl is a very popular anesthetic because of its short time to peak analgesic effect, cardiovascular safety, and rapid cessation of effects after small bolus doses. Fentanyl undergoes hepatic metabolism and renal excretion. Therefore, with higher doses or prolonged infusions, the effects of fentanyl are prolonged. [3,4,5]

Dexmedetomidine, is a dextro isomer and a pharmacologically active component of medetomidine, highly selective for alpha 2 adrenergic agonists with alpha-1 adrenergic receptors (selectivity ratio 1620:1) compared to 220:1 for clonidine which reduces the pressor response mediated by the sympathetic nervous system during general anesthesia. It also has anxiolytic, anesthetic and analgesic properties without respiratory depression and reduces postoperative shivering. Termination of pain signals is controlled by pre-synaptic activation of α2 adrenoceptors which inhibit norepinephrine release, decrease in heart rate (HR) and blood pressure (BP) is caused by activation of postsynaptic α2 receptors in the central nervous system which inhibits sympathetic activity. This reduces opioid requirements, helps early recovery after surgery. Dexmedetomidine

undergoes hepatic metabolism involving hydroxylation and N-methylation, followed by conjugation. Metabolites are excreted in the bile and urine.[6,7]

Research conducted by Rizkiya et al in 2020 found that the addition of dexmedetomidine provided significant stability of pulse and MAP during endotracheal intubation, prone positioning and incision in patients undergoing major spinal surgery.[8,9,10] The addition of dexmedetomidine also caused a significant reduction in the need for opioid analgesia fentanyl up to 2x lower and a reduction in the average MAC isoflurane by 30% during surgery, thus providing a faster recovery process from anesthesia.[11]

From another study conducted by Shujun et al in China in 2017 concluded that compared with fentanyl, dexmedetomidine (DEX) as an adjuvant local anesthetic in spinal anesthesia prolongs the duration of spinal anesthesia, improves postoperative analgesia, reduces the incidence of pruritus, and controlled hemodynamics. 10 The results of the study conducted in India showed that dexmedetomidine and fentanyl can be used safely to attenuate hemodynamic responses without significant side effects, while dexmedetomidine was shown to have better hemodynamic stability and was more effective in attenuating hemodynamic responses after intraoperative infusion when compared to Fentanyl. [1,2]

Based on the background above, this study was conducted to determine "Comparison of Hemodynamics Between Fentanyl and Dexmedetomidine in Spinal Surgery at Adam Malik Hospital, Medan".

METHOD

Study Design and Setting

This study was a randomized, double-blind, controlled trial conducted at the Adam Malik General Hospital in Medan, Indonesia. The trial was carried out after obtaining ethical clearance and a research permit from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Sumatera Utara, and the Ethics Committee of RSUP Haji Adam Malik. Patient recruitment and data collection were performed after these approvals, during the period following February 2024 (after ethical approval) until the target sample size was achieved. The study followed CONSORT guidelines for randomized trials and adhered to the principles of the Declaration of Helsinki.

Participants (Inclusion and Exclusion Criteria)

The study population included adult patients undergoing elective spinal surgery at Adam Malik Hospital. A total of 50 patients were enrolled, based on a priori sample size calculation (see below). Inclusion criteria were:

- Age 17–60 years, undergoing elective spinal surgery expected to last more than 4 hours (for conditions such as traumatic injury, tuberculous spondylitis, or degenerative spine disease).
- American Society of Anesthesiologists (ASA) physical status I–III.

Exclusion criteria included:

- Known hypersensitivity or allergy to dexmedetomidine or fentanyl.
- Significant cardiac abnormalities (structural heart disease, significant arrhythmias, or history of cardiac arrest).
- History of occlusive vascular disorders involving the heart or brain (e.g. coronary artery disease or cerebrovascular stroke).

Patients meeting the inclusion criteria and none of the exclusion criteria were approached for participation. Written informed consent was obtained from all participants prior to enrollment.

Sample Size

The required sample size was determined using a two-group comparison of means formula. Based on an expected minimum meaningful difference in mean arterial pressure of 0.18 (with standard deviation of 0.36), with a Type I error $\alpha = 0.05$ (one-tailed) and power $(1–\beta) = 80\%$, the calculation indicated a minimum of 25 patients per group. To account for this, we set a total sample size of 50 (25 in each group). Fifty eligible patients were consequently recruited consecutively to reach this target.

Randomization and Allocation Concealment

After enrollment, patients were randomly assigned in a 1:1 ratio to one of two groups: the dexmedetomidine group or the fentanyl group. A computer-generated random sequence (simple randomization) was used to determine group assignments. Allocation concealment was ensured by using sequentially numbered, opaque, sealed envelopes containing the group assignments. An independent researcher prepared the envelopes and the study drug infusions according to the

assignment. The envelopes were opened only once the patient had been consented and just before induction of anesthesia.

Blinding

This trial was conducted with a double-blind design. Neither the patients nor the attending anesthesiologists, surgeons, or outcome assessors were aware of the group allocations. The dexmedetomidine and fentanyl infusions were prepared in identical syringes (of the same volume and appearance) by a third party not involved in patient care or data collection. These syringes were labeled with a code (Group A or B) to mask the drug identity. The anesthesiologist administering the drugs and monitoring the patient intraoperatively was blinded to the syringe content, as were the patients and the staff recording the hemodynamic data. Blinding was maintained until all data analyses were completed.

Anesthetic Procedure and Interventions

All patients received a standardized anesthesia protocol. Upon arrival in the operating room, standard monitors (electrocardiogram, noninvasive blood pressure, pulse oximetry, etc.) were attached and baseline vital signs were recorded. Prior to induction, patients were premedicated with midazolam 0.07 mg/kg IV for anxiolysis. Baseline hemodynamic measurements (heart rate and blood pressure) were taken 5 minutes before induction of anesthesia (this pre-induction time point was designated T0).

General anesthesia was induced in all patients with fentanyl 2 µg/kg IV (as an analgesic dose during induction) and propofol 2 mg/kg IV, followed by rocuronium 0.5 mg/kg IV to facilitate endotracheal intubation. After intubation, mechanical ventilation was initiated and adjusted to maintain normocapnia. No inhalational anesthetic or additional sedative was started at this point, to ensure that the only difference in anesthetic maintenance between groups was the study drug infusion.

Immediately after induction and intubation, the study drug infusions were commenced according to group assignment:

- Dexmedetomidine group: A loading dose of dexmedetomidine 1 µg/kg IV was given over 10 minutes, followed by a continuous infusion at 0.5 µg/kg/hour intravenously using a syringe pump.

- Fentanyl group: A continuous infusion of fentanyl at 0.5 µg/kg/hour IV was started (without any dexmedetomidine) using a syringe pump.

These infusions were maintained throughout the surgery as the primary difference in anesthetic management between the two groups. Aside from the assigned study drug infusion, all other aspects of anesthesia management were kept identical to both groups to reduce bias. If additional anesthesia depth was required, minimal supplemental doses of anesthetic agents were given in both groups in a similar manner (none were routinely needed due to the effects of the study drugs). Intraoperative fluids, ventilation parameters, and other medications were managed according to standard practice and patient requirements, equally in both groups. Emergency drugs such as ephedrine (5 mg boluses) and atropine (0.25–0.5 mg) were prepared and administered as needed for hypotension (mean arterial pressure < 65 mmHg or > 30% drop from baseline) or bradycardia (heart rate < 50 beats/min), respectively. Vasopressors (e.g., norepinephrine) or inotropes (e.g., dobutamine) were available and used if severe hemodynamic instability occurred. All significant interventions and events were recorded.

Outcome Measurements

The primary outcomes of this study were the intraoperative hemodynamic parameters: mean arterial pressure (MAP) and heart rate (HR). These were measured at predefined time points to assess changes over time and differences between groups. Hemodynamic data were recorded at: baseline (T0, 5 minutes before induction, prior to drug administration) and at 5, 10, 15, 20, 25, 30, 60, 120, 180, and 240 minutes after induction (T5, T10, T15, T20, T25, T30, T60, T120, T180, T240, respectively). These time points correspond to minutes elapsed after the completion of anesthesia induction/intubation and the start of the study drug infusion. Blood pressure was measured as non-invasive arterial pressure and MAP was calculated (diastolic pressure plus one-third of pulse pressure). Heart rate was measured from the continuous ECG monitoring. All measurements were taken using the same multiparameter monitor (Infinity® monitor) to ensure consistency. If surgery lasted less than the maximum 240 minutes, data collection ended at the end of surgery (however, all cases in this study reached the 240 minute mark as per inclusion criteria of surgery duration).

The hemodynamic readings at each time point were recorded on the case report form by investigators who were blinded to group allocation. The secondary outcomes evaluated included

any requirement for rescue medication for hemodynamic instability, total intraoperative opioid consumption, and intraoperative blood loss, but the primary focus was on MAP and HR stability.

Statistical Analysis

All collected data were compiled and analyzed using IBM SPSS Statistics (IBM Corp., Armonk, NY; version 25). Prior to hypothesis testing, all numeric data were checked for completeness and assessed for normality of distribution using the Shapiro–Wilk test. Continuous variables are presented as mean ± standard deviation (SD) if normally distributed, or as median with interquartile range (IQR) if distribution was non-normal. Categorical variables are presented as counts and percentages.

For baseline comparisons between the two groups, we used the independent samples t-test for continuous variables (or the non-parametric Mann–Whitney U test if the data were not normally distributed) and the chi-square test (or Fisher's exact test when appropriate) for categorical variables. For the primary outcome (hemodynamic parameters at various time points), between-group differences at each time point were evaluated using independent t-tests (or Mann–Whitney U tests for non-normal data). A repeated-measures analysis (e.g., ANOVA) was not performed due to the focus on comparing groups at each individual time point; instead, each time point was analyzed separately with appropriate adjustment for multiple comparisons if needed.

A two-tailed p value of < 0.05 was considered statistically significant for all tests. The results are presented with 95% confidence intervals where relevant. No interim analyses were performed. There were no missing data for the primary outcomes, as all enrolled patients completed the surgery and all scheduled measurements.

Ethical Approval

This study received ethical approval from the Health Research Ethics Committee of the University of Sumatera Utara Medical Faculty and from the Ethics Committee of RSUP Haji Adam Malik Medan (approval reference No. No. 216/KEPK/USU/2024).). All methods were carried out in accordance with relevant guidelines and regulations. Each patient provided written informed consent after a thorough explanation of the study objectives, procedures, potential benefits, and risks. Participants were informed that their involvement was voluntary and that they

could withdraw from the study at any time without consequence. The privacy and confidentiality of all patient data were strictly maintained throughout the study.

RESULTS

Table 1. Characteristics of the Samples

Characteristics	Dexmedetomidine	Fentanyl	Nilai P
Age (years)	43,3 ± 10,5	42,01 ± 13,23	0,565*
Gender (%)			0,644**
- Male	16	15	
- Female	9	10	
Etiology of Spinal Disease (%)			0,312**
- Degenerative	10	11	
- TB	3	3	
- Trauma	8	9	
- Tumor	4	3	
BMI	28,82 ± 8,59	27,90 ± 9,05	0.590
Duration of surgery (hours)	5,4 ± 1,34	5,13 ± 1,76	0,341*
Amount of bleeding	283 ± 50,4	351,44 ± 70,8	0,061*
Bleeding class			
I	0	0	
II	75%	52%	
III	25%	48%	
IV	0	0	

*Test T Independent
**ChiSquare

As shown in Table 1 Sample Characteristics, there was no statistically significant difference between the Dexmedetomidine and Fentanyl groups in terms of age, gender, disease etiology, or duration of surgery. However, the amount of bleeding The amount of bleeding during surgery showed a difference approaching significance. In the group using Dexmedetomidine, the average bleeding was 283 ± 50.4 cc, while in the Fentanyl group the average bleeding was higher, which was 351.44 ± 70.8 cc, with p = 0.061. Although not statistically significant, the p value approaching the significance limit (0.05) suggests that Dexmedetomidine may have the potential to reduce intraoperative bleeding compared to Fentanyl.

Table 2. Comparison Pulse rate changes Between Dexmetomidine and Fentanyl

Time (Minutes)	Dexmedetomidine (Mean ± SD)	Fentanyl (Mean ± SD)	P-Value
0	85,0 ± 8,11	88,2 ± 11,11	0,311
5	83,1 ± 7,98	88,5 ± 14,13	0,08
10	83,3 ± 7,12	87,2 ± 11,14	0,052
15	81,7 ± 7,01	87,1 ± 12,12	0,003
20	80,7 ± 6,92	87,2 ± 10,4	0,002
25	80,0 ± 8,11	85,4 ± 13,12	0,003
30	79,5 ± 7,50	84,8 ± 12,50	0,004
60	78,0 ± 6,90	83,0 ± 11,20	0,002
120	77,0 ± 6,80	81,5 ± 10,90	0,003
180	75,0 ± 6,50	80,0 ± 10,00	0,001
240	73,5 ± 6,10	79,0 ± 9,80	0,001

The table above shows a comparison of pulse changes between the groups given Dexmedetomidine and Fentanyl from 5 minutes to 240 minutes. The Dexmedetomidine group had an average pulse of 83.1 ± 7.98, while the Fentanyl group had 88.5 ± 14.13 with a p-value of 0.08, indicating an insignificant difference. At 10 minutes, the pulse of the Dexmedetomidine group decreased slightly to 83.3 ± 7.12, while Fentanyl became 87.2 ± 11.14, with a p-value of 0.052, which still showed a nearly significant difference. At 15 minutes, the difference in pulse between the two groups became more pronounced, with Dexmedetomidine recording 81.7 ± 7.01 and Fentanyl 87.1 ± 12.12, with a p-value of 0.003, indicating a significant difference. At 20 minutes, the Dexmedetomidine group showed an average heart rate of 80.7 ± 6.92, lower than Fentanyl which reached 87.2 ± 10.4, with a p-value of 0.002 indicating a significant difference. At 25 minutes, the Dexmedetomidine heart rate was 80.0 ± 8.11, while Fentanyl recorded 85.4 ± 13.12 with a p-value of 0.003, indicating a significant difference. At 30 minutes, Dexmedetomidine recorded an average heart rate of 79.5 ± 7.50, while Fentanyl had a heart rate of 84.8 ± 12.50, with a p-value of 0.004 indicating a significant difference. At 60 minutes, the pulse of the Dexmedetomidine group was 78.0 ± 6.90 and Fentanyl 83.0 ± 11.20 with a p-value of 0.002 indicating a significant difference. At 120 minutes, the pulse of the Dexmedetomidine group was

recorded at 77.0 ± 6.80, while Fentanyl 81.5 ± 10.90, with a p-value of 0.003 indicating a significant difference. At 180 minutes, the pulse of Dexmedetomidine was 75.0 ± 6.50, while Fentanyl 80.0 ± 10.00 with a p-value of 0.001 indicating a significant difference. At 240 minutes, Dexmedetomidine recorded a pulse of 73.5 ± 6.10, while Fentanyl was 79.0 ± 9.80 with a p-value of 0.001, indicating a significant difference.

Table 3. Comparison of MAP Between Dexmedetomidine and Fentanyl

Time (Minutes)	Dexmedetomidine (Mean± SD)	Fentanyl (Mean± SD)	P-Value
0	83,8 ± 12,58	85,7 ± 13,11	0,073
5	82,72± 10,02	85,1 ± 14,12	0,059
10	81,7 ± 10,11	86,1 ± 11,11	0,053
15	70,7 ± 6,72	82,1 ± 10,23	0,002
20	70,2 ± 7,21	81,0 ± 12,30	0,001
25	69,8 ± 7,10	80,5 ± 11,85	0,001
30	68,2 ± 6,85	78,2 ± 11,20	0,002
60	66,5 ± 6,70	76,9 ± 10,80	0,002
120	65,3 ± 6,65	75,2 ± 10,55	0,001
180	64,1 ± 6,60	74,0 ± 10,30	0,001
240	63,5 ± 6,60	73,2 ± 10,30	0,001

*T Independen

Table 3 shows a comparison of mean arterial pressure (MAP) in 39 patients given Dexmedetomidine and Fentanyl during intubation, prone position, and incision. Data are presented at time intervals of 0, 5, 10, 15, 20, 30, 60, 120, 180, and 240 minutes, with analysis using the Independent T Test. The following is a detailed narrative based on the data: Intubation: At minute 5, Dexmedetomidine showed a lower MAP (82.72 ± 10.02) compared to Fentanyl (85.7 ± 13.11), the value was not statistically significant (P = 0.073). At 10 minutes, MAP in Dexmedetomidine (81.7 ± 10.11) was lower than Fentanyl (86.1 ± 11.11), with a P value = 0.053, statistically not significant. However, at 15 minutes, the difference was more obvious with MAP Dexmedetomidine (70.7 ± 6.72) lower than Fentanyl (82.1 ± 10.23), with P = 002, indicating a significant difference. At 20 minutes, Dexmedetomidine still showed a lower MAP (70.2 ± 7.21) than Fentanyl (81.0 ± 12.30), with P = 0.01. At 25 minutes, MAP for Dexmedetomidine (69.8 ± 7.10) was lower than Fentanyl (80.5 ± 11.85), with P = 0.001. At 30 minutes, Dexmedetomidine (68.2 ± 6.85) was lower than Fentanyl (78.2 ± 11.20), with P = 0.02. At 60 minutes, MAP for

Dexmedetomidine (66.5 ± 6.70) was lower than Fentanyl (76.9 ± 10.80), with P = 0.002. At 120 minutes, the MAP of Dexmedetomidine (65.3 ± 6.65) was lower than that of Fentanyl (75.2 ± 10.55, with P = 0.001. At 180 minutes, the MAP of Dexmedetomidine (64.1 ± 6.60) was lower than that of Fentanyl (74.0 ± 10.30), with P = 0.001. At 240 minutes, the difference in MAP between Dexmedetomidine (63.5 ± 6.60) and Fentanyl (73.2 ± 10.30) was significant with P = 0.001.

DISCUSSION

Dexmedetomidine has a faster effect in regulating heart rate and MAP, providing better hemodynamic stability in patients immediately after intubation. This shows the potential of Dexmedetomidine to prevent spikes in blood pressure and heart rate that can occur after anesthesia, which is a critical period in anesthesia procedures. In contrast, Fentanyl is slower in reducing cardiovascular parameters, although it still provides better pain control during the procedure, but does not provide hemodynamic stability as good as Dexmedetomidine in the early phase. Dexmedetomidine shows greater superiority in maintaining these parameters stable at longer time points. This can be explained by Dexmedetomidine's ability to provide a longer-lasting sedative effect and reduce cardiovascular fluctuations that can occur due to significant changes in body position. Meanwhile, the use of Fentanyl in this phase tends to show a less consistent decrease, with greater fluctuations in heart rate and MAP, indicating that Fentanyl may not be as effective as Dexmedetomidine in maintaining cardiovascular stability for a longer duration, such as in the prone and incision phases.

A meta-analysis showed that the use of perioperative dexmedetomidine can reduce cortisol and catecholamine levels in the blood and this difference is quite significant when compared with placebo, but not significant when compared with other perioperative anesthetic drugs. Dexmedetomidine through activation of α2 adrenoceptors in the spinal cord provides an opioid sparing effect. In this study, the addition of dexmedetomidine 0.5 µg/kgBW/hour to the use of fentanyl 1.5 µg/kgBW/hour, has a synergistic effect. Proven by reducing the total dose of fentanyl administration in the study subjects. The administration of fentanyl maintenance in the dexmedetomidine group can be titrated down to off, with an average maintenance dose of 0.75 µg/kgBW/hour and almost no need for additional rescue analgesia during surgery. This was found to be significantly different in the control group that only received fentanyl analgesia, where a

maintenance dose of fentanyl was required up to 2 times greater and rescue analgesia was added more frequently during surgery.[12,13]

Study by Zhai et al, 2020. This study examined the effects of dexmedetomidine on hemodynamic changes and inflammatory responses in patients undergoing off-pump coronary artery bypass grafting (OP CABG). Of the 300 patients studied, 123 received dexmedetomidine infusion, while the other 116 received physiological saline. The results showed that patients who received dexmedetomidine had lower heart rates and mean arterial pressures and lower levels of inflammation compared to the control group. Although not significant, IL-10 levels were also lower in the control group. Administration of dexmedetomidine was shown to stabilize hemodynamics and 45 reduce inflammation during OP CABG.[13]

In the context of pharmacodynamics, Dexmedetomidine also improves the stability of the cardiovascular system during surgical procedures. By reducing sympathetic activity, it helps maintain stable blood pressure and heart rate. The bradycardia effect often observed with Dexmedetomidine, although caution should be taken, may be beneficial in conditions where control of sympathetic stimulation is desired. These pharmacological effects make Dexmedetomidine very useful for maintaining the physiological balance of patients during and after surgery, reducing the risk of complications, and supporting a faster and safer recovery.[13]

CONCLUSION

The average age in the dexmedetomidine group undergoing spinal surgery was 43.3 ± 10.5 while in the fentanyl group it was 42.01 ± 13.23. The gender in the dexmedetomidine group undergoing spinal surgery was 64% male and 36% female. The duration of surgery in the dexmedetomidine group was 5.4 ± 1.34, while in the fentanyl group it was 5.13 ± 1.76.In both groups there were significant differences in MAP and HR after 15 minutes. The dexmedetomidine group was lower in MAP and HR after 15 minutes compared to the fentanyl group.

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