Original Article

Comparison Between Sedative And Analgesic Effects Of Dexmedetomidine Versus Fentanyl For Pediatric Patients Following Cardiac Surgery In Intensive Care Unit

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Abstract

The ICU staff should make careful pharmacological choices for sedation following cardiac surgery. The purpose of this research was to assess the effectiveness and safety of dexmedetomidine versus fentanyl for postoperative sedation, hemodynamic and ventilatory parameters in pediatric patients admitted to the ICU following cardiovascular surgery. A total of 60 pediatric patients admitted to the ICU following heart surgery, ranging in age from one day to fifteen years, and requiring mechanical ventilation upon admission, were included in the prospective and comparative research. They were randomly assigned to one of two groups: Group D (n = 30) received dexmedetomidine, whereas Group F (n = 30) received fentanyl. In terms of age, weight, height, gender, and type of surgery, there was no statistically significant difference between the two groups. There were no significant variations in ventilatory measures such as respiratory rate, oxygen saturation, or arterial blood gases in either group when compared to baseline or to each other. There were no significant variations in sedation (COMFORT-B) or pain (FLACC) scores between the two groups. There was no statistically significant difference in the use of rescue sedatives between the two groups. There was a statistically significant difference in intubation length between the two groups. In comparison to fentanyl, dexmedetomidine is a safe and similarly effective medication for the sedation of mechanically ventilated pediatric patients admitted to the ICU following cardiac surgery, with good hemodynamic stability and earlier extubation.

Keywords: Dexmedetomidine, fentanyl, pediatrics, congenital heart disease.

1. INTRODUCTION

Sedation is used in patients admitted to the intensive care unit (ICU) following cardiovascular surgery to minimize patient's pain, ventilator asynchrony, mechanical ventilation tolerability, inadvertent device removal, and metabolic demands during respiratory and hemodynamic instability [1-2]. The ICU staff should make careful medication selection for sedation following cardiothoracic surgery so that patients can be readily weaned from mechanical ventilation when sedation is terminated, resulting in a shorter duration of mechanical ventilation and a shorter length of stay in ICU [3].
It is critical in the intensive care unit to provide enough sedation and analgesia for young patients while minimizing adverse effects. Benzodiazepines and opioids are commonly utilized in current medication regimens to attain these aims. However, these medications have been linked to serious adverse effects including as tolerance, physical reliance, paradoxical agitation, withdrawal symptoms, respiratory depression, and prolonged recovery time upon infusion termination. Furthermore, animal studies have shown that benzodiazepines and opioids might cause neuro-apoptosis and neurodevelopmental problems [4].

Dexmedetomidine is a sedative, analgesic, anxiolytic, sympatholytic, and opioid-sparing -2 adrenoceptor agonist having sedative, analgesic, anxiolytic, sympatholytic, and opioid-sparing effects [5]. Because it offers a distinct type of sedation, "conscious sedation," in which patients emerge to be sleepy but are easily aroused, cooperative, and communicative when stimulated, the medication has shown efficacy in decreasing the need for opioids, benzodiazepines, propofol, and other sedative medications. It has a rapid start and a relatively short duration of action, making dexmedetomidine suited for a critical care unit, postoperative cardiac and noncardiac patients, and invasive and noninvasive operations since it is readily titrated. Short-term sedation has been found in certain trials to be safe, with hypotension and bradycardia being the most serious adverse effects. It also appears to have little respiratory depression, allowing it to be administered safely in both mechanically ventilated and spontaneously breathing patients. Dexmedetomidine's characteristics make it a beneficial medication in the present era of early extubation and rapid tracking of postoperative cardiac patients [6-7].

So, the purpose of this study was to assess the efficacy and safety of dexmedetomidine versus fentanyl for pediatric patients admitted to the intensive care unit (ICU) following cardiothoracic surgery for postoperative sedation and analgesia.

2. SUBJECTS AND METHODS

2.1. Subjects

2.1.1. Study design: Between April 2020 and December 2021, this randomized prospective study was conducted in pediatric cardiac intensive care units at Al-NAS and Cairo University Pediatric hospitals. This research included sixty pediatric patients of both sexes who were scheduled to have cardiac surgery for various congenital heart problems.

2.1.2. Study population: The patients were randomly allocated into two groups of 30 patients each using the lottery technique of randomization, as follows: Group D patients (n = 30) were given dexmedetomidine at a loading dosage of 0.5 mcg/kg IV over 10 minutes, followed by a maintenance infusion of 0.2-1.5 mcg/kg/hr, whereas Group F patients (n = 30) were given fentanyl at a maintenance infusion of 1-3 mcg/kg/hr. Pediatric patients aged one day to 15 years old with congenital heart disease who are receiving corrective or palliative cardiac surgery were eligible. Pediatric patients with neuromuscular disorders, demyelinating illness, cerebral palsy, developmental and behavioral issues, inborn metabolic errors, acute severe neurological condition, decompensated heart failure, acute hemodynamic instability, and septic shock were excluded. Pediatric patients having a heart rate of 60 beats per minute and an atrioventricular conduction block grade II or III were also excluded from the trial.

2.1.3. Ethical Considerations: This study was approved by the Departmental Ethics and Research Committee, written informed consents were obtained from patients' guardians.

2.2. Methods

2.2.1. Preoperative assessment: All patients had a thorough history taking and clinical assessment. All regular tests were performed, including a CBC, coagulation profile (prothrombin time and concentration), liver function tests (ALT/AST), renal function tests (urea and creatinine), blood grouping, a chest X-ray, and a recent echocardiogram, if needed.

2.2.2. Anesthetic Management and cardiopulmonary bypass procedure: Premedication: 5 minutes before induction of anesthesia, 0.05-0.1 mg/kg midazolam or atropine 0.02 mg/kg and 5mg/kg ketamine were administered intravenously. Preparation: Upon arriving in the operating room, an ECG and pulse oximetry were performed, a peripheral venous cannula was placed and secured, and an antibiotic was administered as a gradual bolus. The patient was placed on a heated surface blanket (37°-38°C). Induction: 2 mcg/kg fentanyl was administered, along with sevoflurane1-2 MAC. Cisatracurium 0.15mg/kg IV was administered to aid in endotracheal intubation. Face mask 100% oxygen ventilation for 3 minutes, followed by tracheal intubation Tidal volume will be 6-8 ml/kg, with the rate adjusted to maintain PaCo2 at 35-40 mmHg. **Maintenance:** All patients were given general anesthesia with a sevoflurane 1-2 MAC in oxygen mixture. Both groups got 1-2 g/kg/hr fentanyl infusions that were terminated at the conclusion of bypass. **Neuromuscular blocker:** 1g/kg/min infusion of cisatracurium to sustain neuromuscular blockade. In the Dexmedetomidine group (30 patients), loading was done with 0.5 mcg/kg IV over 10 minutes, followed by 0.2-1.5 mcg/kg/hr maintenance infusion. Maintenance infusion of 1-3 mcg/kg/hr was provided to the Fentanyl group (30 patients). Volume controlled mechanical ventilation adjusted to keep PaCO2 between 30 and 35 mmHg.

2.2.3. Parameters to be measured in the study: (1) Hemodynamic parameters (Heart rate (HR), blood pressure; systolic, diastolic and mean (SBP, DBP, MAP) before start of sedation infusion and at 1, 3, 6 hrs after start of infusion. (2) Ventilatory parameters (respiratory rate (RR), peripheral arterial oxygen saturation (SaO2%), arterial blood gases (ABG) findings (pH, PaCO2, and HCO3) before start of sedation infusion and at 1, 3 and 6 hrs after start of infusion. (3) level of sedation using COMFORT-behavior (COMFORT-B) sedation scale b. (4) level of pain using The FLACC (face, legs, activity, cry, and consolability) pain scale before start of sedation infusion and at 1, 3 and 6 hrs after start of infusion. (5) Frequency of rescue sedation requirement to achieve optimal sedation. (6) Intubation duration (duration from stopping the sedative drugs till extubation). (7) Financial cost. (8) Mortality rate.

2.2.4. The COMFORT-behavior (COMFORT-B) sedation scale: It is a non-intrusive scoring system comprised of six behavioral characteristics that are rated after a two-minute observation period. The modified COMFORT Behavioral Score was created by deleting the original tool's physiological features and altering the respiratory category to allow evaluation of both intubated and self-ventilating children. It has been validated for use in measuring pain and discomfort in PICU patients who are intubated or self-ventilating. COMFORT B can evaluate the efficacy of sedation. Individual patient comfort must be prioritized over the risk of adverse outcomes associated with sedation in the PICU. The COMFORT B Score is appropriate for measuring pain and discomfort in mechanically ventilated and self-ventilating children aged 0 to 18 years. **(Table 1).**

Table 1. COMFORT-B sedation scale:

Alertness	1 - Deeply asleep (eyes closed, no response to changes in environment) 2- Lightly asleep (eyes mostly closed, occasional responses) 3 - Drowsy 4 - Awake & alert 5 - Awake & hyper-alert	How responsive is the patient to the ambient light, sound and activity around them? Monitors, phones, talking
Calm/ Agitation	1 – Calm 2 - Slightly anxious 3 - Anxious 4 - Very anxious 5 - Panicky	How would you rate the patient's level of anxiety?
Respiratory response *(Intubated & ventilated)*	1 - No spontaneous respiration, no cough 2 - Spontaneous breathing no resistance to ventilator 3 – occasional cough or resistance to ventilator 4 - Actively breathes against ventilator or coughs 5 - Fights ventilator coughing or choking	How comfortable and compliant is the patient with ventilation via ET tube?
Respiratory response *(crying & self ventilated)*	1 – Quiet breathing, no crying sound 2 – Occasional sobbing or moaning 3 – Whining or monotonous sound 4 – Crying 5 – Screaming or shrieking	How would you score the intensity of verbal response? *Significance should be given to the characteristics of the cry not to the presence of tears*
Physical Movement	1 - No movement 2- Occasional (three or fewer) slight movements 3 - Frequent, (> 3) slight movements 4 - Vigorous movements limited to extremities 5 - Vigorous movements include torso & head	What is the intensity & frequency of the patient's movements?
Muscle Tone	1 - Muscles totally relaxed; no muscle tone 2 - Reduced muscle tone; less than normal 3 - Normal muscle tone 4- Increased muscle tone, increased flexion of fingers & toes 5- Extreme muscle rigidity & flexion of fingers & toes	How does the patient's muscle tone compare to a normal awake & alert child of the same age/stage of development? Flex /extend limb. *In cases of complex needs/CP/underlying neuromuscular condition assess with a parent for the 1st assessment.* ***Assess this section last.***
Facial Muscles	1 – Facial muscles totally relaxed 2 – Normal facial tone 3 – Tension evident in some muscles (not sustained) 4- Tension evident throughout muscles (sustained) 5- Facial muscles contorted and grimacing	How does the patient's facial movement/ tension compare to that of an awake & alert child of the same age/stage of development?

2.2.5. FLACC (face, legs, activity, cry, and consolability) pain scale: It is a pain evaluation measure for nonverbal or preverbal individuals who are unable to self-report their level of discomfort. Rate your kid in each of the five measurement categories, sum the results, and record the overall pain score (0 – 10). Awakening children: Keep an eye on it for at least 1-2 minutes. Examine the exposed legs and body. Reposition the patient or monitor the activity and check the body for tenseness and tone. If necessary, initiate comforting interventions. Children who are sleeping: Keep an eye on them for at least 2 minutes, if not longer. Examine the exposed legs and body. Reposition the patient if feasible. Examine the body for tenseness and tone **(Table 2.).**

3. TABLE 2. FLACC PAIN SCALE:

FLACC scale

Behavioral Observation Pain Rating Scale

Categories	Scoring		
	0	1	2
Face	No particular expression or smile; disinterested	Occasional grimace or frown, withdrawn	Frequent to constant frown, clenched jaw, quivering chin
Legs	No position or relaxed	Uneasy, restless, tense	Kicking, or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid, or jerking
Cry	No crying (awake or asleep)	Moans or whimpers, occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging, or talking to. Distractable	Difficult to console or comfort
Each of the five categories (F) Face; (L) Legs; (A) Activity; (C) Cry; (C) Consolability is scored from 0-2, which results in a total score between 0 and 10.			

3.1. Statistical Analysis: The SPSS v25 computer software suite was used for data input. Quality control was performed at the coding and data entry stages. This study's statistical presentation and analysis were carried out utilizing repeated measurements. ANOVA was used to compare the means of the study variables across time points, the chi square test was used to compare the levels of the study variables across time points, and the independent t test was used to examine both groups at the same time. A sample size of 60 patients evenly divided into two groups (30 patients each) was able to identify a big effect size of 0.8 at the time of extubation with a P value of 0.05, highly significant at 0.001, and inconsequential at > 0.05. Estimation of sample size was performed by using G*Power program.

4. RESULTS

This research comprised 60 pediatric patients who were scheduled to have cardiac surgery for various congenital heart problems. The patients were randomly divided into two groups, each with 30 patients: Dexmedetomidine (Group D)

patients got a loading dose of 0.5 mcg/kg IV for 10 minutes, followed by a maintenance infusion of 0.2-1.5 mcg/kg/hr, and Fentanyl (Group F) patients received a maintenance infusion of 1-3 mcg/kg/hr.

Table 3. Displayed demographic data and surgery types for both groups, including age, weight, height, and gender. Both research groups were equivalent in terms of demographic data and kind of surgery, with no statistically significant difference in age, weight, height, or gender. In terms of heart rate, there is no statistically significant difference between the two groups. The heart rate was greater in the dexmedetomidine group at baseline, then equalized in both groups after one hour, and subsequently increased in the fentanyl group after both 3-6 hours of infusion. In terms of mean arterial pressure (MAP), there is no statistically significant difference between the two groups. The mean arterial pressure was slightly higher in the dexmedetomidine group at baseline, then equalized after one hour, then increased in the fentanyl group after both 3-6 hours after infusion initiation. In terms of respiratory rate and peripheral oxygen saturation, there was no statistically significant difference between the two groups at various time periods.

Table 4. In terms of sedation score, both groups demonstrated ideal sedation as shown by optimal sedation scale values, and there is no significant statistical difference between both groups at the various time periods. In terms of intubation time, there was a highly significant statistical difference between the two groups. The length of intubation was significantly shorter in the Dexmedetomidine group than in the Fentanyl group. In terms of the number of rescue sedatives (fentanyl boluses), there was no statistically significant difference between the Dexmedetomidine and Fentanyl groups. In terms of financial cost, there was a statistically significant difference between the two groups. The financial cost of Dexmedetomidine was significantly higher than that of Fentanyl. There was no mortality in either the Dexmedetomidine or Fentanyl groups (**Fig 1,2**).

Table 5. In terms of pain score, both groups had considerable pain alleviation as evidenced by optimum pain scale values, and there is no significant statistical difference between both groups at different time periods.

Table 3. Demographic and clinical characteristics of the included groups:

Variables	Dexmedetomidine (n=30)		Fentanyl (n=30)		p
	Mean	SD	Mean	SD	
Age (months)	28.30	19.97	25.70	18.84	.58
Weight (kg.)	11.68	5.36	11.39	5.71	.81
Height (c.m)	84.70	16.52	82.70	17.12	.86
Gender	**No.**	**%**	**No.**	**%**	**p**
Male	10	33.3	13	43.3	.43
Female	20	66.7	17	56.7	
HR Baseline After 1 hr After 3 hr After 6 hr	128.47 129.77 125.80 125.13	14.10 15.74 15.29 15.99	123.20 129.87 132.17 130.73	13.26 12.41 10.56 13.0	0.63 0.14 0.07 0.14
MAP (mmHg) Baseline After 1 hr After 3 hr After 6 hr	64.23 65.13 63.60 64.10	7.97 8.34 8.29 8.79	64.10 65.10 65.83 67.30	6.59 6.64 6.01 5.81	0.26 0.20 0.12 0.07
RR (breath/min) Baseline After 1 hr After 3 hr After 6 hr	27.50 27.80 27.77 28.00	3.12 2.99 3.74 3.26	27.30 28.33 28.90 28.73	4.02 5.21 3.74 5.50	0.21 0.17 0.35 0.06
SpO2 % Baseline After 1 hour After 3 hours After 6 hours	97.77 98.97 98.77	2.43 1.67 1.57	97.20 97.93 98.20	2.68 2.72 2.51	0.49 0.06 0.29 0.22

Table (4): Comparing the studied patients between Dexmedetomidine and Fentanyl groups according to their Rescue sedative score, financial coast, and Sedation score.

Variables	Dexmedetomidine (n=30)		Fentanyl (n=30)		p	
	Mean	SD	Mean	SD		
Rescue sedative (fentanyl boluses)	1.53		1.31	1.43	1.22	.97
Extubation time (min)	35.83		15.32	90.50	44.84	.00
Financial cost (E.P)	150.00		0.00	28.00	17.94	.00
Sedation score Baseline After 1 hour After 3 hours After 6 hours	10.87 12.00 11.23 13.03		1.04 1.36 1.70 1.61	10.57 11.07 10.37 13.00	0.82 1.39 1.47 1.23	0.42 0.47 0.54 0.06

Table (5): Comparing the studied patients between Dexmedetomidine and Fentanyl groups according to their pain score, ABG, and surgery type.

Variables	Categories	Dexmedetomidine (n=30)		Fentanyl (n=30)		Chi square test	
		No.	%	No.	%	χ2	p
Pain							
Baseline	Zero	30	100	30	100	-	-
After 1 hour	Zero	30	100	30	100	-	-
After 3 hours	Zero	30	100	30	100	-	-
After 6 hours	Zero	29	96.7	30	100	1.07	.31
	Two	1	3.3	0	0		
ABG							
Baseline	Normal	30	100	30	100	-	-
	Metabolic acidosis	0	0	0	0		
After 1 hour	Normal	30	100	29	96.7	1.02	.31
	Metabolic acidosis	0	0	1	3.3		
After 3 hours	Normal	29	96.7	27	90	1.07	.30
	Metabolic acidosis	1	3.3	3	10		
After 6 hours	Normal	29	96.7	28	93.3	.35	.55
	Metabolic acidosis	1	3.3	2	6.7		
Surgery type	ASD closure	4	13.3	5	16.7	1.07	.96
	VSD closure	12	40	13	43.3		
	TOF repair	5	16.7	4	13.3		
	SAM resection	4	13.3	2	6.7		
	Glenn	3	10	4	13.3		
	COA repair	2	6.7	2	6.7		

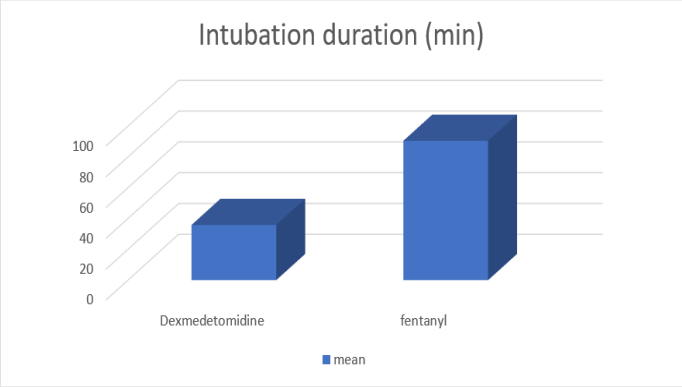

Figure (1): Comparing the studied patients between Dexmedetomidine and Fentanyl groups according to their intubation duration.

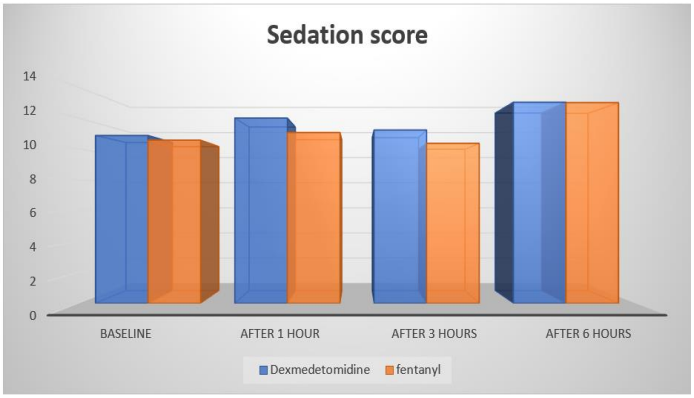

Figure (2): Comparing the studied patients between Dexmedetomidine and Fentanyl groups according to their sedation score at the different time points.

5. DISCUSSION

This study compared dexmedetomidine to fentanyl in the ICU for pediatric patients after heart surgery to assess its efficacy and safety. The research comprised 60 patients divided into two groups (30 each), Dexmedetomidine (group D) and Fentanyl (group F).

Our results showed optimal pain relief and optimal sedation in both groups, as indicated by the optimal values of COMFORT B and FLACC scales; however, there were no significant differences between the two groups in terms of sedation and pain scores. There was also no statistically significant difference in the frequency of administering rescue sedatives (fentanyl boluses) between the two groups.

A retrospective, observational case-control study in the pediatric intensive care unit by Keliana O'Mara et al (2012) compared the efficacy and safety of dexmedetomidine and fentanyl for sedation in mechanically ventilated infants and concluded that dexmedetomidine was safe and effective for sedation in the infants [8]. In compared to fentanyl, participants in the dexmedetomidine group required less adjunctive sedation and had longer days free of extra sedation. Furthermore, there were no variations in hemodynamic characteristics between the two groups, suggesting that the possible benefits of using dexmedetomidine versus fentanyl included a shorter time of mechanical breathing.

Furthermore, Constantinos Chrysostomou et al (2014) studied the safety, efficacy, and pharmacokinetic profile of dexmedetomidine in preterm and full-term neonates 28 to 44 weeks gestational age and concluded that dexmedetomidine is effective for sedating preterm and full-term neonates with no significant acute events or significant laboratory or electrocardiographic measurement changes that led to its discontinuation [9]. Similarly, Constantinos Chrysostomou et al (2009) concluded that dexmedetomidine use in infants and neonates after cardiac surgery was well tolerated in both intubated and non-intubated patients with little respiratory depression, making it a potentially useful agent in non-intubated patients [10]. In that trial, 95% of patients who were either non-intubated at the start or extubated while taking dexmedetomidine had no clinically significant respiratory impairment. However, it delivers enough sedation/ analgesia whether used alone or in conjunction with low-dose conventional drugs.

Li et al. (2016), who examined two surgical sedative regimens in children with pulmonary artery hypertension utilizing dexmedetomidine/fentanyl and midazolam/fentanyl sedation [11], found similar outcomes to ours. They discovered that the dexmedetomidine/fentanyl treatment group required much less extra sedative/analgesic throughout therapy, indicating that the former is a more effective sedative. Meanwhile, O'Mara K et al (2009) described a case of dexmedetomidine use for sedation in a 24-week gestational age premature neonate and concluded that it was an effective sedative and analgesic in a 24-week gestational age neonate treated for refractory agitation, allowing weaning of mechanical ventilation settings and eventual infant extubation, in addition to rapid tapering of other sedative medications [8]. Dexmedetomidine deserves additional investigation as first-line or adjunct therapy with opioids for sedation in ventilated infants, based on its demonstrated effectiveness for pain and sedation and its good side effect profile.

In contrast to our findings, Kimberly N. Le et al (2011) concluded that dexmedetomidine was rarely used as a single analgesic agent in post-operative pediatric cardiac patients compared to patients on standard sedation regimens without dexmedetomidine and that most patients required a morphine infusion and/or scheduled morphine bolus doses post operatively. The dexmedetomidine group, on the other hand, required more midazolam infusions and rescue dosages than the control group [12].

In addition, our study sought to examine the safety and efficacy of the two drugs under consideration, as measured by their impact on hemodynamics and the occurrence of serious adverse events. In terms of heart rate and mean arterial pressure (HR & MAP), our findings demonstrated that there were no significant changes in HR or MAP in either group when compared to baseline or to each other. In addition, there were no statistically significant changes in ventilatory parameters (RR, SpO2, and ABG) in both groups at different time periods (1 hr, 3 hr, and 6 hr after commencing infusion) compared to baseline.

In line with our findings, Francis Lam et al (2012) used dexmedetomidine infusion in infants and children with critical heart disease and concluded that dexmedetomidine infusion in neonates and infants with heart disease is safe from a hemodynamic standpoint and can reduce concomitant opioid and benzodiazepine dosing. In addition, 22 of 45 intubated patients were weaned off mechanical breathing and extubated while receiving dexmedetomidine infusion [13].

Meanwhile, Felice Suet al (2013) found that dexmedetomidine, given post-operatively to infants with congenital heart disease, is relatively safe and does not cause clinically significant hemodynamic changes in the dose range of 0.25-0.75 mcg/kg/hr, as it provides adequate sedation as a single first-line agent while reducing the need for supplemental analgesics. They also discovered that higher infusion doses were associated with a shorter time to extubation from ICU admission. They hypothesized that this was due to improved sedation and/or analgesia with higher doses of dexmedetomidine, which required fewer supplemental medications associated with respiratory depression [14].
In contrast to our findings, Chrysostomou et al (2009) reported that average systolic blood pressure (SBP) and heart rate (HR) were statistically lower after starting dexmedetomidine [9]. Blood pressure fell (5%), while HR fell (13%). A comparison of baseline and average lowest readings revealed a decrease in SBP (22%) and HR (24%), which contradicted

our findings. However, they attributed these variations to a paucity of data and the fact that the time of commencing dexmedetomidine after surgery was not consistent in all individuals. It was difficult to tell if the hemodynamic abnormalities were caused by low cardiac output syndrome (LCOS) or dexmedetomidine.

In terms of intubation duration (the time between ceasing the sedative medicines and extubation), our findings indicated a highly significant statistical difference between the two groups. The duration of intubation was considerably shorter in the dexmedetomidine group compared to the fentanyl group, allowing for shorter duration of mechanical breathing. In the same context, Kimberly N. Le et colleagues (2011) reported that dexmedetomidine had no significant influence on the postoperative course of children compared to conventional treatment as judged by success of early extubation, ventilator duration, and length of stay, which contradicted our findings [12].

According to our findings, both medications provide good analgesia and sedation. Both medications have equivalent hemodynamic properties. Dexmedetomidine has a shorter length of mechanical ventilation and a quicker time for extubation, although it is more expensive; nonetheless, assessing the net financial burden of longer ventilation may benefit the use of dexmedetomidine from a financial standpoint.

6. CONCLUSION AND RECOMMENDATIONS:

In comparison to fentanyl, dexmedetomidine is a safe and similarly effective medication for the sedation of mechanically ventilated pediatric patients admitted to the ICU following cardiac surgery, with good hemodynamic stability and quicker extubation. We recommend dexmedetomidine for mechanically ventilated pediatric patients following cardiac surgery.

Statements and Declarations:

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7. REFERENCES

1. Reichert MG, Jones WA, Royster RL, Slaughter TF, Kon ND, Kincaid EH. (2011) Effect of a dexmedetomidine substitution during a nationwide propofol shortage in patients undergoing coronary artery bypass graft surgery. Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy 31(7):673-7.
2. Jakob SM, Ruokonen E, Grounds RM, Sarapohja T, Garratt C, Pocock SJ, et al. (2012) Dexmedetomidine vs midazolam or propofol for sedation during prolonged mechanical ventilation: Two randomized controlled trials. JAMA. 307:1151–60.
3. Anger KE, Szumita PM, Baroletti SA, Labreche MJ, Fanikos J. (2010) Evaluation of dexmedetomidine versus propofol-based sedation therapy in mechanically ventilated cardiac surgery patients at a tertiary academic medical center. Crit Pathw Cardiol 9:221–6.
4. Greeley WJ, Berkowitz DH, Nathan AT. (2009) Anesthesia for pediatric cardiac surgery. In: Miller RD, editor. Miller's Anesthesia. 7th ed. Philadelphia: Churchill Livingstone p. 2633.
5. Carollo DS, Nossaman BD (2008) Ramadhyani U – Dexmedetomidine: a review of clinical applications. Curr Opin Anaesthesiol 21:457461.
6. Panzer O, Moitra V, Sladen RN (2009) Pharmacology of sedative-analgesic agents: dexmedetomidine, remifentanil, ketamine, volatile anesthetics, and the role of peripheral mu antagonists. Crit Care Clin 25:451-469.
7. Conti G, Ranieri VM, Costa R, Garratt C, Wighton A, Spinazzola G, et al. (2016) Effects of dexmedetomidine and propofol on patient-ventilator interaction in difficult-to-wean, mechanically ventilated patients: A prospective, open-label, randomised, multicentre study. Crit Care 20:206.
8. O'Mara, Keliana, et al. (2009) Successful use of dexmedetomidine for sedation in a 24-week gestational age neonate." *Annals of Pharmacotherapy* 43.10: 1707-1713.
9. Chrysostomou C., Schulman S., Castellanos M., & et al. (2014) A phase 11/III, multicenter, safety, efficacy, and pharmacokinetic study of neonates, J Pediatr dexmedetomidine in preterm and term 164:276-82.
10. Chrysostomou C., Toledo J., Avolio T., & et al. (2009) Dexmedetomidine use in a pediatric cardiac intensive care unit: Can we use it in infants after cardiac surgery. Pediatr Crit Care Med. 10(6):654-60.
11. Li B.L., Zhang N., Huang J.X. (2016) A comparison of intranasal dexmedetomidine for sedation in children administered either by atomiser or by drops. *Anaesthesia.* 71:522–528.
12. Le, Kimberly N., et al. (2011) "Impact of dexmedetomidine on early extubation in pediatric cardiac surgical patients." *Intensive care medicine* 37.4: 686-690.
13. Lam, Francis, et al. (2012) "Hemodynamic effects of dexmedetomidine in critically ill neonates and infants with heart disease." *Pediatric cardiology* 33.7: 1069-1077.
14. Felice S., Nicolson S., & Zuppa A . (2013) A dose-response study of dexmedetomidine administered as the primary sedative in infants following open heart surgery. Pediatr Crit Care Med 14(5): 499-507.