An analytical study of Comparison between Ketamine - Dexmedetomidine versus Ketamine - Propofol for Sedation in Children Undergoing Minor Cardiac Procedures in a Cardiac Catheterization Laboratory

Dr. Rahul Mamde[1], Dr. Ambika Mamde[2]

[1]Assistant Professor, Department of Anaesthesia, DVVPF's Medical College & Hospital, Ahmednagar-414111, Maharashtra, India. [2]Senior Resident, Department of Pharmacology, Seth GS Medical College & KEM Hospital, Mumbai-400012, Maharashtra, India.

Corresponding Author: Dr. Ambika Mamde

Email ID: ambikamamde76@gmail.com

Address: Department of Pharmacology, Seth GS Medical College & KEM Hospital, Mumbai-400012, Maharashtra, India.

Abstract :

Background: The management of children with heart diseases has been a major challenge for cardiac anesthesiologist. The anesthetic technique to be used should be easy, safer and provide cardiac stability throughout the operation. So interventional cardiologist prefer deep sedation with the patient breathing spontaneously and painlessly in the room. Propofol, Ketamine along with other combinations drugs have been used worldwide by cardiac anesthesiologist to achieve these goals. We carried out this study to evaluate the combination drugs for pediatric cardiac procedures which are Ketamine – Dexmedetomidine (KD) and Ketamine – Propofol (KP). **Methodology:** This study was conducted in the Department of Cardiology. A total number of 80 cases were selected, 40 from each comparative groups of Ketamine – Dexmedetomidine (KD) and Ketamine – Propofol (KP). Patient data was categorized into age, sex, procedure done and recovery time, analgesic boluses required and hemodynamic parameters during the surgery. **Results:** Mean age in KD group was 5.24 ± 1.25 years and in KP group was 4.95 ± 1.86 years. There were total 24 males (60%) and 16 females (40%) in KD group and total 22 males (55%) and 18 females (45%) in KP group. Most common procedures done in both the groups was ASD for device closure done in 12 patients (30%) in KD group and 13 patients (32.5%) in KP group. There was significant difference between the mean recovery time and number of ketamine boluses consumption in both the groups. ($p<0.05$) Heart rate was significantly lower in KD group at 5, 10, 15 and 20 min post induction when compared to KP group. No statistically significance was found in difference between the Mean Respiratory rate and MAP. **Conclusion:** Our study concludes that the use of KD combination is relatively safe, practical alternative, we did not find any hemodynamic or respiratory effects during the cardiac procedures but there was some delayed recovery.

Key Words: Pediatric Cardiac procedures, Cardiac anesthesia, Ketamine, Propofol, Dexmedetomidine.

Introduction:

The management of children with heart diseases including congenital heart disease has been a major challenge for anesthesiologist. since decades, especially during cardiac catheterization procedures.[1,2]

The better anesthetic technique needed for managing the pediatric patients who are scheduled to undergo complex cardiac procedures. The technique of anesthesia for cardiac catheterization should be easy to administer, safe, and it should provide cardiovascular hemodynamic stability, adequate sedation, immobility, as well as rapid and smooth recovery with minimal complications.

Positive pressure ventilation along with the General anesthesia can alter intra- cardiac pressures and also the shunt fraction in pediatric patients. Therefore, the interventional cardiologist prefers deep sedation with the patient breathing spontaneously and painlessly in the room. Propofol, Ketamine along with other combinations drugs have been used worldwide by cardiac anesthetists to achieve these goals.[3-5]

In A study by Jobeir et al,[5] they used low-dose midazolam and/or ketamine for the pediatric cardiac catheterization procedures. They suggested that the administration of ketamine and midazolam or their combination in small doses during cardiac procedures like catheterization in children was found to be safe. Kogan et al[6] reported that a combination of Propofol and ketamine combination was a feasible option in spontaneously breathing children posted for cardiac catheterization.

DOI: 10.46858/vimshsj.8107

Dexmedetomidine is a potent α 2-adrenoreceptor agonist with the sedative, analgesic, and anxiolytic effects. Worldwide it has been accepted for clinically effective sedation and significantly reduced analgesic requirements of post-surgical ventilated intensive care unit adult patients.[7-9]

Pediatric cardiac anesthesia is one of the most demanding branches of anesthesia which requires special considerations. Newer modalities for cardiac anesthesia with quicker sedation and recovery and minimal effects are being tried and tested every day.[10-12] Ard et al first described the use of Dexmedetomidine in pediatric neurosurgery in 2 children undergoing awake craniotomy.[13] Dexmed, Ketamine and Propofol are becoming favorite combinations of drugs for pediatric anesthetic procedures.[7, 11]

We carried out this study to evaluate the effectiveness of combination drugs for pediatric cardiac surgeries from Ketamine – Dexmedetomidine (KD) and Ketamine – Propofol (KP).

Methodology:

This study was conducted in the Department of Cardiology. A total number of 80 cases were selected, 40 from each comparative groups of Ketamine – Dexmedetomidine (KD) and Ketamine – Propofol (KP) for the study and patient data was categorized into age, sex, procedure done, recovery time, analgesic boluses required and hemodynamic parameters during the surgery.

Study Design: Comparative analytical study

Study Site: Department of Cardiology, DVVPF's Medical College & Hospital, Ahmednagar-414111, MS, India.

Study Duration: 1 year

Study Population: Pediatric Patients with cardiac procedures

Sampling Technique: Convenience sampling method was used in our study. Patients were randomized using computer generated random allocation numbers. Power used for our study was 0.80. We got sample size of 40 patients in each group.

Ethical approval was taken from the institutional ethics committee before starting the study, written informed consent was taken from the parents or guardian of the children before enrolling them in the study.

Our study included children between the age groups of 1 month to 10 years. Males and females undergoing cardiac catheterization procedures were included in our study. Patients with drug allergies, genetic abnormalities or other multiple anomalies and patients with the renal or hepatic diseases were excluded from our study.

All patients were kept overnight fasting for 6 hours before procedire. The patients were given premedication of Glycopyrrolate (10 µg/kg) and Midaz (50 µg/kg) IV 10 min before taking the patient inside the catheterization lab where appropriate measures to prevent hypothermia were observed. Standard monitors including ECG and pulse-ox were attached. Group (KD) received: dexmedetomidine IV infusion 1 µg/kg over 10 min + ketamine 1 mg/kg IV bolus for induction and then maintenance by IV infusion of 0.5 µg/kg/h of dexmedetomidine and 1 mg/kg/h of ketamine. Group (KP)received propofol 1mg/kg and ketamine 1 mg/kg IVfor induction and then maintenance by IV infusion of 100 µg/kg/min of propofol and 1 mg/kg/h of ketamine.

Additional doses of ketamine in the dose of 0.5 mg/kg IV were administered when a patient showed discomfort. Heart rate, respiratory rate, mean blood pressure (BP) and SpO2 were recorded at 5 min interval during the operation. Recovery time was observed.

Stewards Simplified Postanesthetic Recovery Score was used to record recovery time.

Results & Observations:

There were a total of 40 cases in each group.

Mean age in the KD group was found to be 5.24 ± 1.25 years and in the KP group it was 4.95 ± 1.86 years.

There were a total of 24 males (60%) and 16 females (40%) in KD group and a total of 22 males (55%) and 18 females (45%) in KP group.

Mean weight (kg) in KD group was 14.58 ± 4.65 kg and in KP group was 15.53 ± 6.46 kg.

Mean duration of surgery was 56.82 ± 14.52 min in KD group and 59.16 ± 16.27 min in KP group.

DOI: 10.46858/vimshsj.8107

Table 1: Comparison of type of procedure done in two groups

Procedure	KD group	KP Group	Total
ASD for device closure	12	13	25
PDA for device closure	11	10	21
VSD for device closure	8	9	17
Cath Study	9	8	17
Total	40	40	80

Most common procedures done in both the groups was ASD for device closure done in 12 patients (30%) in KD group and 13 patients (32.5%) in KP group. Followed by PDA for device closure and VSD for device closure.

Table 2: Mean recovery time and Number of ketamine boluses consumption

Procedure	KD group	KP Group	P Value
Mean recovery Time (min)	44.52 ± 9.52	26.74 ± 5.82	< 0.001
Ketamine boluses consumption	29	35	0.021

There was significant difference between the mean recovery time and number of ketamine boluses consumption in both the groups. ($p<0.05$)

Mean recovery Time (min) in KD group was 44.52 ± 9.52 min and in KP group was 26.74 ± 5.82 min. KP group has significantly lower recovery time as compared to KD group. ($p < 0.001$)

The Ketamine boluses consumption in KD group was 29 out of 40 patients (72.5%) significantly lower than in KP group of 35 patients (87.5%). ($p = 0.021$)

Heart rate was significantly lower in KD group at 5, 10, 15 and 20 min post induction when compared to KP group. After 20 min the heart rates were lower in both the groups without being statistically significant ($p = 0.014$) **(Figure 1)**. No statistically significance was found in difference between the Mean Respiratory rate, MAP **(Figure 2, 3)**. Mean SPO2 in both the groups throughout the surgeries was maintained 100%.

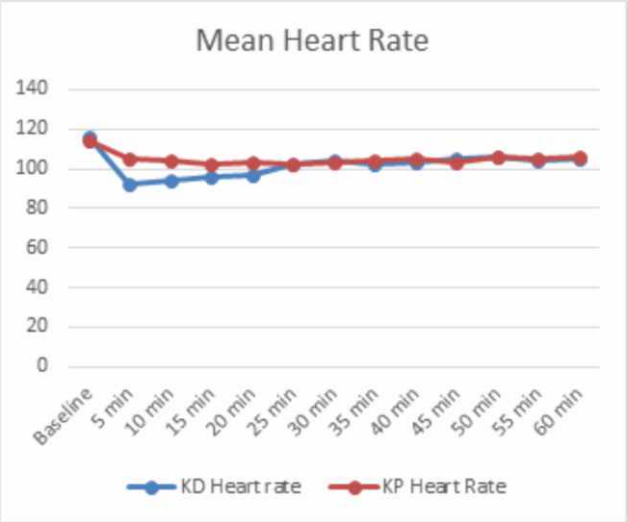

Fig 1: Mean heart rate between the two groups

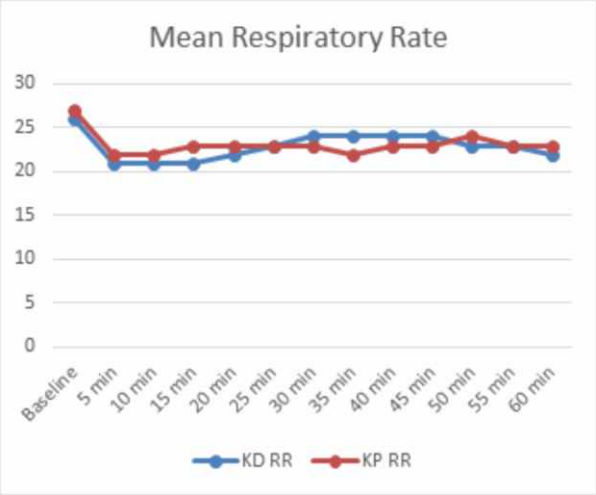

Fig 2: Mean Respiratory Rate between the two groups

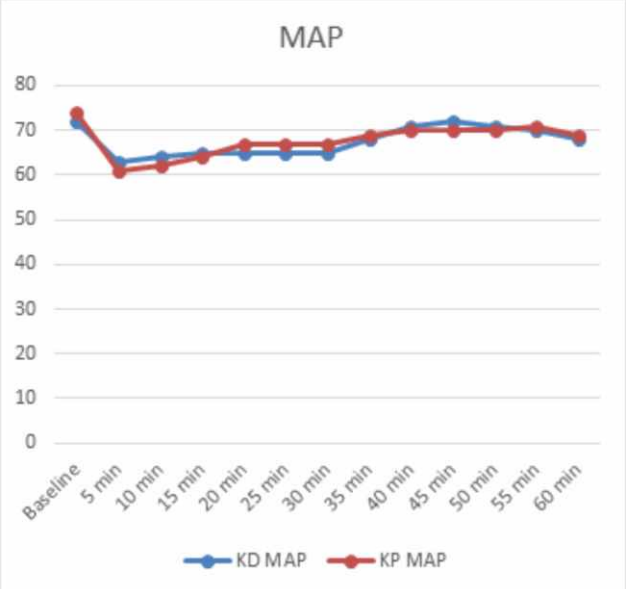

Fig 3: Mean Arterial Pressure between the two groups

DOI: 10.46858/vimshsj.8107

Discussion:

Pediatric cardiac catheterization procedures are different from the adults in many ways as there are different disease patterns in patients, requirements for the operation, sedation or GA to prevent movement in all patients and complete evaluation of anatomically abnormal heart.[8, 9]

In our study, we compared the KD and KP drug combinations on the hemodynamic stability and the recovery time in total 80 patients undergoing cardiac operations and procedures.

We observed that there were a total of 24 males (60%) and 16 females (40%) in KD group and a total of 22 males (55%) and 18 females (45%) in KP group. Tosun Z et al[14] had 58% males and 42% females in their study, similar to ours.

Mean weight (kg) in KD group was 14.58 ± 4.65 kg and in KP group was 15.53 ± 6.46 kg.

Mean duration of surgery was 56.82 ± 14.52 min in KD group and 59.16 ± 16.27 min in KP group. There was no any significant difference between the basic study parameters indicating homogeneity of the two groups, similar results were observed by Ali NP et al[15] with mean weight of the participants 13.98 ± 6.53 kg and mean duration of 55.36 ±13.21 minutes.

Most common procedures done in both the groups was ASD for device closure done in 12 patients (30%) in KD group and 13 patients (32.5%) in KP group. Followed by PDA for device closure and VSD for device closure.

Joshi VS et al[16]also observed that ASD, VSD & PDA were the three most common procedures done in their patients.

We observed a significant difference between the mean recovery time and number of ketamine boluses consumption in both the groups. ($p<0.05$) Joshi VS et al[16] observed the same in their study.

Mean recovery Time (min) in KD group was 44.52 ± 9.52 min and in KP group was 26.74 ± 5.82 min. KP group has significantly lower recovery time as compared to KD group. ($p < 0.001$)

In a study conducted by Heard C et al[17] which compared the Dexmed -Midaz with the Propofol for maintenance of anesthesia in the children undergoing MRI suggested that the time to full recovery was significantly longer after Dexmed administration than after Propofol by 15 min.

The Ketamine boluses consumption in KD group was 29 out of 40 patients (72.5%) significantly lower than in KP group of 35 patients (87.5%). ($p = 0.021$)

Joshi VS et al[16] observed that ketamine was used in 70% cases of KD group and 93.33% cases of KP group, similar to our study.

Similar study done by Tosun Z et al[14] which compared these drugs for the children undergoing some minor cardiac procedures in cardiac catheterization section, showed that the consumption of ketamine in Dexmed group was more than that of the Propofol group ($p<0.05$).

Heart rate was significantly lower in KD group at 5, 10, 15 and 20 min post induction when compared to KP group. After 20 min the heart rates were lower in both the groups without being statistically significant ($p = 0.014$) Similar findings were seen by Joshi VS et al[16] who observed that Heart rate was significantly lower in KD group at 5, 10, 15, 20 and 25 min post induction as compared to KP group.

Side effects like hypotension, bradycardia, convulsions, hiccups, shivering, oxygen desaturation, laryngospasm, agitation, raised oral secretions, vomiting, nausea were not seen in any patient from either of the groups. Many other previous studied have found the use of Dexmed Ketamine and propofol having less side effects in children.[18-21]

Conclusion:

We studied hemodynamic stability, respiratory variables, and recovery time in children undergoing minor cardiac procedures in cardiac catheterization laboratory using either of the KD of KP combination drugs. We conclude that the use of KD combination is relatively safe, practical alternative, we did not find any hemodynamic or respiratory effects during the cardiac procedures but there was some delayed recovery. We recommend multicentric studies with larger sample size to further evaluate our hypothesis.

DOI: 10.46858/vimshsj.8107

Conflict of interest: None

Source of Funding: This was a self-funded study.

References:

1. Argent AC, Balachandran R, Vaidyanathan B, Khan A, Kumar RK. Management of undernutrition and failure to thrive in children with congenital heart disease in low-and middle-income countries. Cardiology in the Young. 2017 Dec;27(S6):S22-30.
2. Hinton RB, Ware SM. Heart failure in pediatric patients with congenital heart disease. Circulation research. 2017 Mar 17;120(6):978-94.
3. Williams GD, Jones TK, Kimberley AH, et al: The hemodynamic effects of propofol in children with congenital heart disease. Anesth Analg 89:1411-1416, 1999.
4. Oklu E, Bulutcu FS, Yalcın Y, et al: Which anesthetic agent alters the hemodynamic status during pediatric catheterization? Comparison of propofol versus ketamine. J Cardiothorac Vasc Anesth 17:686-690,2003
5. Jobeir A, Galal MO, Bulbul ZR, et al: Use of low-dose ketamine and/or midazolam for pediatric cardiac catheterization: Is an anesthesiologist needed? Pediatr Cardiol 24:236-243, 2003.
6. Kogan A, Efrat R, Katz J: Propofol-ketamine mixture for anesthesia in pediatric patients undergoing cardiac catheterization. J Cardiothorac Vasc Anesth 17:691- 693, 2003.
7. Bhana N, Goa KL, McClellan KJ: Dexmedetomidine. Drugs 59:263-268, 2000
8. Xu J, Zhou G, Li Y, Li N. Benefits of ultra-fast-track anesthesia for children with congenital heart disease undergoing cardiac surgery. BMC pediatrics. 2019 Dec;19(1):1-5.
9. Guzzetta NA, Williams GD. Current use of factor concentrates in pediatric cardiac anesthesia. Pediatric Anesthesia. 2017 Jul;27(7):678-87.
10. Kanchi M. History of Cardiac Anesthesia in India. Journal of cardiothoracic and vascular anesthesia. 2019 Feb 1;33(2):582.
11. Sarkar M. Cardiac anesthesia as super-specialty: Need of the hour!. Indian Journal of Clinical Anaesthesia. 2019 Jan;6(1):3-5.
12. Nasr VG, DiNardo JA. The pediatric cardiac anesthesia handbook.Wiley Blackwell;2017 May 15.
13. Ard J, Doyle W, Bekker A: Awake craniotomy with Dexmedetomidine in pediatric patients. J Neurosurg Anesthesiol 15:263-266, 2003
14. Tosun Z, Akin A, Guler G, Esmaoglu A, Boyaci A. Dexmedetomidine-ketamine and propofol-ketamine combinations for anesthesia in spontaneously breathing pediatric patients undergoing cardiac catheterization. J Cardiothorac Vasc Anesth 2006;20: 515-9.
15. Ali NP, Kanchi M, Singh S, Prasad A, Kanase N. Dexmedetomedine-Ketamine versus Propofol-Ketamine as anaesthetic agents in paediatric cardiac catheterization. J Armed Forces Med Coll Bangladesh 2015;10:19-24.
16. Joshi VS, Kollu SS, Sharma RM. Comparison of dexmedetomidine and ketamine versus propofol and ketamine for procedural sedation in children undergoing minor cardiac procedures in cardiac catheterization laboratory. Annals of cardiac anaesthesia. 2017 Oct;20(4):422.
17. Heard C, Burrows F, Johnson K, Joshi P, Houck J, Lerman J. A comparison of dexmedetomidine -midazolam with propofol for maintenance of anesthesia in children undergoing magnetic resonance imaging. Anesth Analg 008;107:1832-9.
18. Jaikaria A, Thakur S, Singhal P, Chauhan D, Jayam C, Syal K. A comparison of oral midazolam-ketamine, dexmedetomidine-fentanyl, and dexmedetomidine-ketamine combinations as sedative agents in pediatric dentistry: A triple-blinded randomized controlled trial. Contemporary clinical dentistry. 2018 Sep;9(Suppl 2):S197.
19. Qian B, Zheng W, Shi J, Chen Z, Guo Y, Yao Y. Ketamine Enhances Intranasal Dexmedetomidine-Induced Sedation in Children: A Randomized, Double-Blind Trial. Drug Design, Development and Therapy. 2020;14:3559.
20. Bali BK, Patel A. Study of KETODEX; Combination of Dexmedetomidine and Ketamine in Upper Gastrointestinal Scopy in Adults: Observational Study. J Med Sci Clin Res. 2017;5(06):23986-93.
21. Chayapathi V, Kalra M, Bakshi AS, Mahajan A. A comparison of ketamine+ midazolam to propofol for procedural sedation for lumbar puncture in pediatric oncology by non anesthesiologists—a randomized comparative trial. Pediatric blood & cancer. 2018 Aug;65(8):e27108.

DOI: 10.46858/vimshsj.8107