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Original Research Article

A Comparison of Effects of Ketamine-Propofol vs Ketamine-Dexmedetomidine Combinations in Pediatric Patients Undergoing Short Surgical Procedures

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Abstract:

Background: The anaesthetic agent used during the short surgical procedures in pediatric patients should be hemodynamically safe and should provide adequate analgesia, sedation and with minimal or no side effects. This study aimed to evaluate the efficacy of ketamine-propofol (KP) and ketamine-dexmedetomidine (KD) combinations for pediatric patients undergoing short surgical procedures.

Methods: This prospective observational study was carried out in 80 pediatric patients who were scheduled for elective short surgical procedures at tertiary care teaching hospital of Gujarat All the patients were randomized in to two groups (40 each) using computer generated random numbers. Group KP received Inj. Ketamine 1 mg/kg + Inj. Propofol 1 mg/kg and Group KD received Inj. Ketamine 1 mg/kg+ Inj. Dexmedetomidine 0.5 mcg/kg slowly over 5 minutes. Hemodynamic parameters like heart rate, systolic, diastolic, mean blood pressure (SBP, DBP, MBP), SpO2 and complications were compared in both the groups.

Results: Both SBP, DBP and MBP were significantly less in patients receiving ketamine-propofol compared to those who received ketamine-dexmedetomidine after 5 min and thereafter. ($p<0.05$) Post operative SBP values were significantly low in ketamine propofol groups. There was no significant change in DBP and MBP in both groups postoperatively.

Conclusion: This study concluded that Ketamine-Dexmedetomidine combination provide better hemodynamic stability with fewer complications than Ketamine-Propofol group. So, Ketamine-Dexmedetomidine combination considered to be good and safe for pediatric patients undergoing short surgical procedures.

Keywords: ketamine, propofol, dexmedetomidine, hemodynamics.

Introduction

Short surgical procedures in pediatric patients may include circumcision, rectal biopsy, cystoscopy, herniotomy, hip spica, urethral calibration in patients with hypospadiasis, epispadiasis and bladder extrophy, suture removal in ophthalmic and other patients.

The anaesthetic agent used during the short surgical procedures in pediatric patients should be hemodynamically safe and should provide adequate analgesia, sedation and with minimal or no side effects [1]. Various anaesthetic agents like propofol, fentanyl, ketamine, midazolam, dexmedetomidine and their combinations have been used to provide monitored anaesthesia care during various short surgical procedures in pediatric patients [2]. Ketamine is N-methly-D-aspartate antagonist is one of commonly used agents for sedo-analgesia in several painful procedures. Ketamine increases heart rate, cardiac output and blood pressure. Beside these sympathomimetics effects, it does not suppress laryngeal reflexes and respiration result in bronchodilation and increase oropharyngeal secretion. Ketamine has distribution half-life of 45 minutes and terminal half-life of 2-3 hours [3].

Propofol is a 2, 6-diisopropylphenol which was developed in Europe in the 1970s. It produces general anaesthesia by facilitation of inhibitory neurotransmission mediated by GABA. It is one of the most commonly used induction agents in current practice. Its main advantages are its rapid induction and recovery, antiemetic effects and anticonvulsant effects. But its use is limited by various side effects associated with its use. Most prominent is high occurrence of cardiovascular and respiratory depression and is also associated with painful injections and transient cognitive dysfunction [4]. With propofol, various drugs like fentanyl, ketamine, midazolam have been studied to decrease the

dose of propofol and associated adverse hemodynamic effects [3].

Dexmedetomidine is highly selective alpha-adrenergic receptor agonist that exerts its antihypertensive, analgesic, and sedative properties by inhibiting release of endogenous catecholamine at adrenoreceptors located on vascular smooth muscle cells, substantia gelatinosa of spinal cord and locus ceruleus of brain respectively. Having distribution half-life of 8 minutes and terminal half-life of 3.5 hrs makes it suitable for ambulatory setting patients. It provides arousable sedation similar to natural sleep and allows spontaneous respiration even at large doses. In addition, it has antisialogue and anaesthesia sparing properties. Two most common side effects are hypotension and bradycardia [5].

The present study was carried out to evaluate the efficacy of ketamine-propofol (KP) and ketamine-dexmedetomidine (KD) combinations for pediatric patients undergoing short surgical procedures.

Materials & Methods

This prospective observational study was carried out in 80 pediatric patients who were scheduled for elective short surgical procedures at tertiary care teaching hospital of Gujarat. Patients' age group 2 to 10 years belonging to ASA physical status I or II of either sex selected for elective short surgical procedures were included in study. Patients with a history of allergy to ketamine, propofol, or dexmedetomidine, patients with increased intracranial pressure (hydrocephalus, head injury), patients with congestive heart failure and terminal valvular insufficiency, patients with severe hemodynamic instability like severe anemia, hypotension and patients with history of bleeding and coagulation disorders were excluded from the study.

All the patients were randomized in to two groups using computer generated random numbers. Group KP received Inj. Ketamine 1 mg/kg + Inj. Propofol 1 mg/kg and Group KD received Inj. Ketamine 1 mg/kg+ Inj. Dexmedetomidine 0.5 mcg/kg slowly over 5 minutes.

Preoperative Evaluation

Pre-operative history taking and clinical examination of all patients were done on the day prior to the operation. Detailed history was taken with special emphasis on any major illness, pastor ongoing drug therapy, previous surgery, previous anaesthesia and its complications, drug allergy and addiction etc. A thorough physical examination of all systems was carried out. The nature of study and procedure was explained to the parents or legal guardians and informed consent was taken from parents or guardians.

Routine investigations like random blood sugar, haemoglobin level, renal function test, liver function test and urine analysis weredone in all patients. Special investigations were only done as and when required.

Procedure

All the patients were pre-medicated with Inj. Glycopyrrolate 0.004mg/kg IV and Inj. Ondansetron 0.15 mg/kg IV. All the patients were kept nil by mouth at least for 6 hours before surgery. On arrival to operation theatre, an intravenous line was secured and ECG monitors, noninvasive blood pressure cuff and pulse oxymeter probe were applied. Baseline data for heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MBP) and arterial oxygen saturation (SpO2) were noted.

All the patients will receive 0-6 L/minutes of O_2 by venti mask to maintain saturation > 95%. Additional doses of Propofol or Dexmedetomine was given whenrequired to maintain anaesthesia during the procedures. All patients were monitored with ECG, Non- Invasive BloodPressure, O_2 saturation and respiratory rate after drug administration. These measurements were recorded every five minutes.

All unexpected events which took place during the anesthetic induction and during surgery were recorded as adverse effects. In recovery room pulse, NIBP, oxygen saturation etc. was monitored. Patients were given oxygen through venturi-mask.

Patient vitals like pulse, blood pressure monitored and systemic examinations like respiratory, cardiovascular and central nervous system was done in post operative period. Patient was monitored for any side effect of drugs. All intra-operative and post-operative complications were also recorded.

Statistical Analysis

Data was expressed as mean and standard deviation (SD). The data of two groups was analyzed using student t-test. A p value of less than or equal to 0.05 was considered as significant.

Results

Demographically both the groups were similar in terms of age, sex, weight and ASA status. Mean age of patients in group KP was 5.14±2.04 years and 5.18±2.09 years in group KD. (Table 1).

Table 1: Demographic characteristics of both the groups

	Group KP (n=40)	Group KD (n=40)	P value
Age (years)			
< 5	18(45%)	19(47.5%)	0.95
5-10	22(55%)	21(52.5%)	
Sex (Male/Female)	35/5	32/8	>0.05
Mean weight (kg)	15.6±4.63	18.12±6.57	0.051
ASA status (I/II)	32/8	34/6	>0.05

The preinduction values of pulse rate were comparable between two groups with no significant difference. In Ketamine-Propofol group pulse rate was significantly higher after 10 min and it remained higher throughout the procedures as compared to ketamine-dexmedetomidine group. (Figure 1)

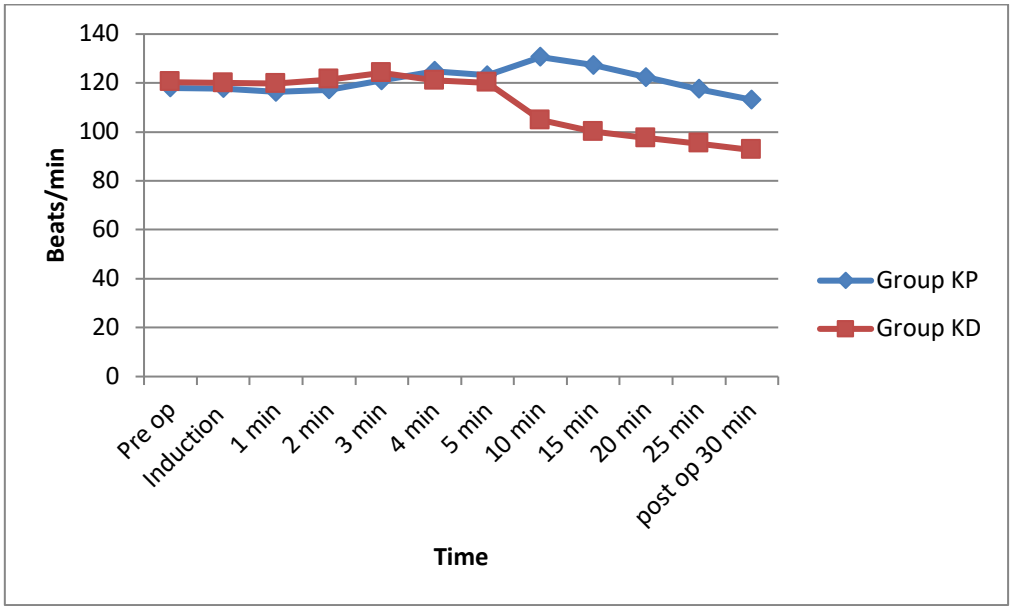

Figure 1: Comparison of heart rate between two groups

The preinduction values of SBP and DBP were comparable between two groups with no significant difference. Both SBP and DBP were significantly less in patients receiving ketamine-propofol compared to those who received ketamine-dexmedetomidine after 5 min and thereafter. ($p<0.05$) Post operative SBP values were significantly low in ketamine propofol groups. (Figure 2) There was no significant change in DBP in both groups postoperatively. (Figure 2)

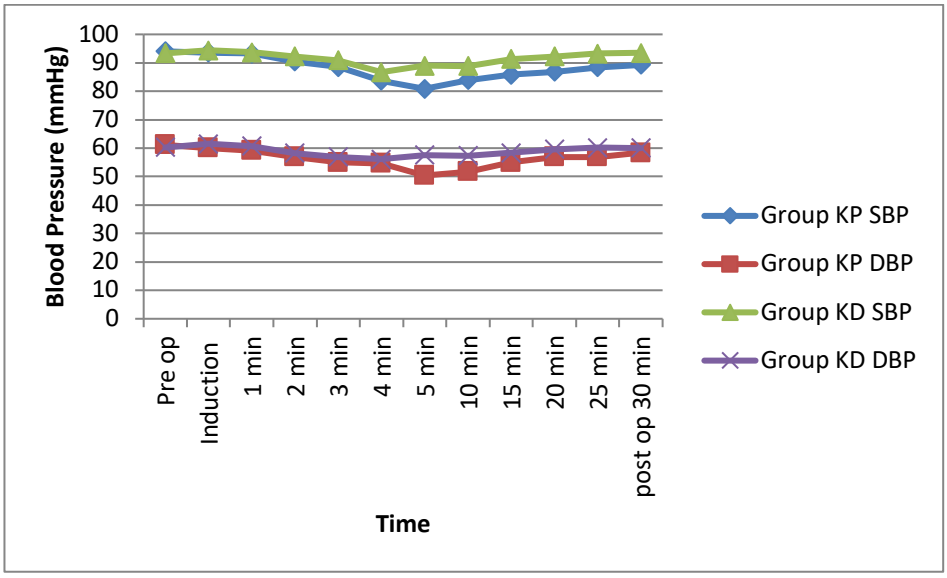

Figure 2: Comparison of Systolic and diastolic blood pressure in both groups

The preinduction values of MBP were comparable between two groups with no significant difference. MBP values were significantly less in patients receiving Ketamine-Propofol compared to those who received Ketamine-dexmedetomidine after 5mins and upto15 mins thereafter. ($p<0.05$) There was no significant change in MBP in both groups postoperatively. (Figure 3)

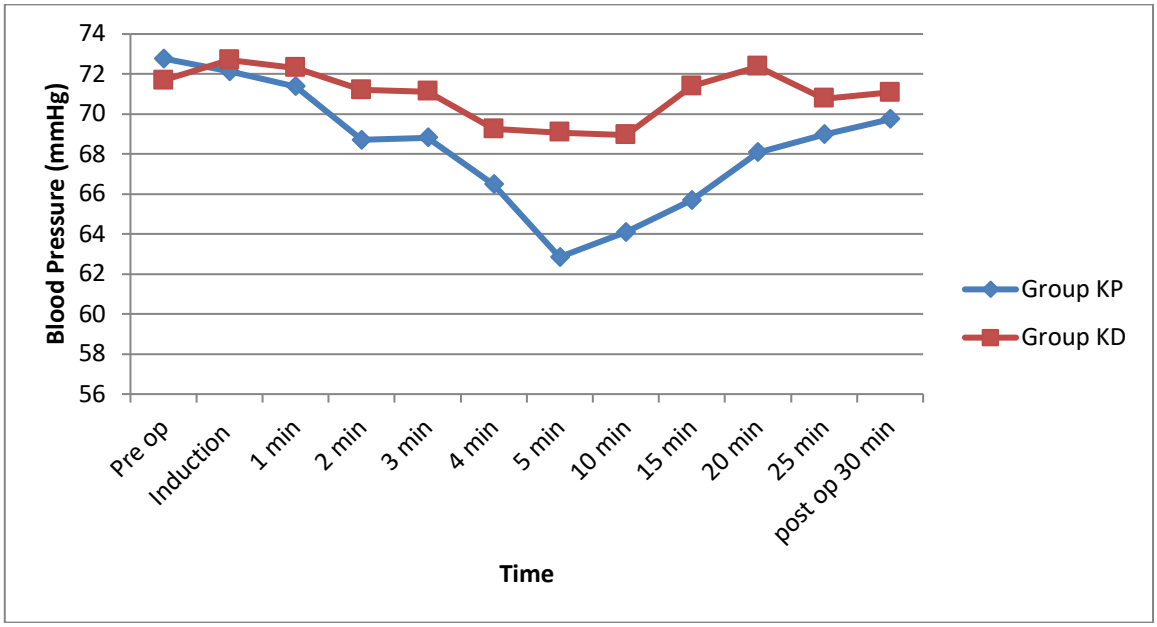

Figure 3: Comparison of Mean blood pressure in both the groups

Oxygen Saturation (SpO_2) showed statistically significant difference at 1 min, 5 min, 15 min, 20 min and 30 min interval but both the values are comparable, so clinically it was not significant. Postoperative SpO_2 value was also significantly different but clinically it was not significant. (Figure 4)

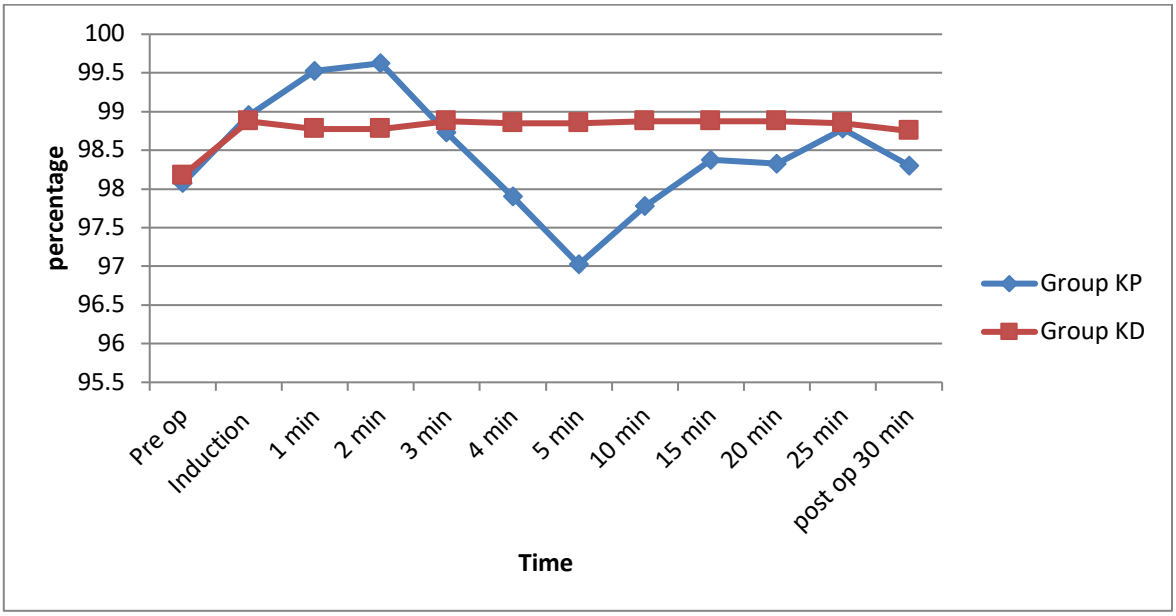

Figure 4: Comparison of SpO_2 in both groups

In present study hypotension was observed in 6(15%) patients among group Ketamine-Propofol and in 2(5%) patients among group Ketamine-Dexmedetomidine. Bradycardia was observed in 4(10%) patients among group Ketamine-Dexmedetomidine and none in group Ketamine-Propofol. Respiratory depression was observed in 4(10%) patients among group Ketamine-Propofol and none in group Ketamine-Dexmedetomidine.

Discussion

Short surgical procedures in pediatric patients require general anaesthesia with intravenous anaesthetic agents, inhalational anaesthetic agents or

with their combinations. Although generally effective for sedation during noninvasive procedures, dexmedetomidine as sole agent has not been successful for invasive procedures [6]. Therefore, the combination of dexmedetomidine with other sedoanalgesia agents such as ketamine or propofol may be preferred for invasive procedures.

There was no statistically significant difference between the mean age and mean weight among two groups. The sex distribution was almost equal in both groups.

In present study, the heart rate at baseline was comparable between the two groups. In comparison to the Ketamine-dexmedetomidine group, the pulse rate in the Ketamine-Propofol group was considerably higher after 10 minutes and remained higher throughout the procedures. The pulse rate in the Ketamine-Dexmedetomidine group remained constant during the operations and in the recovery time. 10% of patients in the Ketamine-Dexmedetomidine group had bradycardia, while no individuals in the Ketamine-Propofol group had bradycardia. The results of present study were comparable to study carried out by Koruk et al, Canpolat et al and Sinha et al [7-9].

In present study between the two groups, the SBP baseline levels were comparable. Patients receiving ketamine-propofol had significantly lower SBP than those receiving ketamine-dexmedetomidine after 5 minutes and thereafter. The ketamine-propofol groups had considerably lower postoperative SBP values. Between the two groups, the DBP baseline values were also comparable. In comparison to patients getting ketamine-dexmedetomidine, DBP were considerably lower in patients receiving ketamine-propofol after 5 minutes and for up to 20 minutes after that. Both groups' postoperative DBP did not significantly change. Between the two groups, the MBP baseline values were comparable. Patients receiving Ketamine-Propofol had MBP values that were considerably lower than those receiving Ketamine-dexmedetomidine after 5 minutes and for up to 15 minutes. There was no significant change in MBP in both groups postoperatively. The result of present study was comparable to study carried out by Koruk et al, Canpolat et al and Sinha et al [7-9]. In present study hypotension was observed in 15% patients among group Ketamine-Propofol and in 5% patients among group Ketamine-Dexmedetomidine. Similar reports of hypotension were also reported by the studies carried out by Canpolat et al and Kaygusuz et al [8,10].

Throughout the procedures, the SpO2 values for the two groups were comparable in present study. SpO_2 did not significantly alter in either group. 10% of patients in the Ketamine-Propofol group had respiratory depression, compared to nil in the Ketamine-Dexmedetomidine group. The results of present study were comparable to the study carried out by Canpolat et al and Kaygusuz et al [8,10]. It may be due to the fact that propofol lead to respiratory depression and dexmedtomidine is lacking effect on respiration [11].

Dexmedetomidine activates presynaptic α_2 receptors which lead to inhibition of release of norepinephrine and causes changes in hemodynamic parameters, such as reduction in heart rate and blood pressure, by inhibiting sympathetic activity and activating postsynaptic α_2 receptors.[5] Ketamine causes a significant increase in heart rate and arterial blood pressure via central and peripheral mechanisms [12]. Ketamine induced tachycardia, hypertension, salivation and emergence phenomena can be prevent by Dexmedetomidine; and Ketamine may prevent dexmedetomidine induced bradycardia and hypotension [13]. Similar results were also found in present study because symphathetic stimulation produced by ketamine counterbalanced by dexmedetomidine.

Conclusion

This study concluded that Ketamine-Dexmedetomidine combination provide better hemodynamic stability with fewer complications than Ketamine-Propofol group. So, Ketamine-Dexmedetomidine combination considered to be good and safe for pediatric patients undergoing short surgical procedures.

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