

Anesthesia Management for Pediatric Cardiac Catheterization

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Abstract: Cardiac Catheterizations done for therapeutic and diagnostic purpose are vastly used in children with CHD. Anesthetic techniques in these children are more likely challenging for anesthesiologist and requires a capable and experienced team. Therefore, the aim of the technique is to maintain adequate sedation, analgesia, anxiolysis, immobility of patient and in addition to secure the respiratory and cardiovascular system. Techniques done for the cardiac catheterization are either deep sedation or general anesthesia. Depending on cardiac defect, clinical appearance of a patient and experience of a cardiologist, various anesthetic techniques may be applied, furthermore, the ideal one does not exist. Moreover, taking in consideration that children are very vulnerable to hypoxia, so that, oxygenation of a child is very crucial within the procedure. It should be noted that hypercapnia may lead to pulmonary vasoconstriction, hence deteriorating the condition may bring up to undesirable findings like bradycardia, even cardiac arrest and brain damage. Hyperoxia and hypoxia may affect the pressure levels as well. Wrong measurements of carbon dioxide should also be mentioned. In many studies, the drugs and their combinations that are widely used for sedation are ketamine, propofol, fentanyl, midazolam, dexmedetomidine.

Keywords: Pediatric cardiac catheterization, sedation, anesthetic agents

1. INTRODUCTION

Currently, the amount of children surviving from congenital heart disease (CHD) rises fundamentally [1]. Deep sedation is one of the most important requirements in pediatric cardiac catheterization lab. Main factors of sedation in cardiac catheterization are prevention of respiratory depression and hemodynamic instability [2-5].

Ketamine as a NMDA (N-methyl-D-aspartate glutamate) receptor antagonist may provide sedation and deep analgesia with less side effects. Airway reflexes, spontaneous ventilation, and cardiovascular stability are actually preserved in patients [6]. Producing cortical dissociation that clinically shows up nystagmic gaze and cataleptic appearance, creating deep analgesia, sedation and amnesia are characteristics of Ketamine [7].

Fentanyl being 80 times as potent as morphine is a frequently used opioid agent in cardiac catheterization [8]. Fentanyl provides only analgesia, thus is used with the combination of other anesthetic drugs [9].

Midazolam the most commonly used benzodiazepine for anesthetic techniques may provide sedation, hypnosis, amnesia, muscle relaxation and anticonvulsive effects [10].

Propofol is vastly used in cardiac catheterization for its quick onset, short duration of action, short recovery time and antiemetic properties [11]. However, side effects like cardiovascular and respiratory depression must be kept in mind for instable patient [12].

Dexmedetomidine as a selective α_2 -adrenoreceptor agonist drug provides sedative, anxiolytic and analgesic effects. Minimal risk of respiratory and hemodynamic depression are the advantages of dexmedetomidine, however it must be avoided in patients with preexisting bradyarrhythmias and/or atrioventricular blocks. Side effects like bradycardia and hypotension may easily be prevented by decreasing the infusion rate [13].

2. RESULTS AND DISCUSSION

Ülgey et al.[14]in the study that 46 children undergoing transcatheter closure of atrial septal defect divided into two groups receiving either dexmedetomidine-propofol, or ketamine-propofol combination revealed that, ketamine-propofol combination provided excellent circumstances for the procedure and was less likely to create hemodynamic instability.

Tosun et al. [5] in the study that 44 children undergoing cardiac catheterization were divided

into two groups receiving dexmedetomidine-ketamine and propofol-ketamine combination, showed that, dexmedetomidine -ketamine group was not superior to the second one.

Kristin et al. [15] reported that administration of only dexmedetomidine as a primary sedative drug for the invasive procedure in six spontaneously breathing children at the age of 3 days-29 months with congenital heart defect, may provide sufficient sedation.

Mester et al. [3] in their cohort study included 16 infants undergoing cardiac catheterization revealed that ketamine and dexmedetomidine combination may provide efficacious sedation creating less cardiovascular and respiratory changes because of covering the side effects of each other.

Munro et al. [4] showed that the only dexmedetomidine infusion with the dose of 1µg/kg perhour titrated up to 2 µg/kg per hour was not effective thus 25% of patients moved in the procedure and 60% needed propofol administration.

Ulgey et al. [16] in the study where 60 children were randomly chosen to receive the sedation either with ketamine-propofol or ketamine-propofol-dexmedetomidine combination. Both groups received 1 mg/kg ketamine and 1 mg/kg propofol for induction, however the second group received dexmedetomidine infusion. The results showed that none of the patients was intubated in both groups. Adding dexmedetomidine for sedation decreased the requirements for respiratory intervention, reduced the patient's movement and shortened recovery time.

Lebovic et al. [17] in a study of 20 patients divided into two groups where 10 patients received ketamine and 10 received propofol concluded that propofol is superior to ketamine in order to the shorter recovery time.

Akin et al. [18] in a randomized double-blind study enrolled 60 children at the age of from one month till 13 years old undergoing cardiac catheterization revealed that propofol and low dose of ketamine combination excellently preserves mean arterial pressure and does not affect the recovery time at all.

Koruk et al. [19] in order to compare propofol-dexmedetomidine and propofol-ketamine combination effects in two groups of patients undergoing transcatheter ASD closure determined that ketamine significantly prolonged the recovery time.

Kogan et al [20] in a clinical study where 45 patients with the age of 6 months till 16 years

old undergoing cardiac catheterization received propofol and ketamine infusion. The doses of infusion and extra doses were arranged according the depth of anesthesia. Study concluded that propofol-ketamine combination is appropriate enough to achieve proper sedation in spontaneously breathing patients through the procedure.

Jobier et al. [21] in a retrospective study where 154 patients were chosen for cardiac catheterization received either ketamine, or midazolam or both. Study showed that low dose of ketamine and midazolam may safely be administered in pediatric patients.

Kaynar et al. [22] showed in a research work where 60 children undergoing cardiac catheterization were divided into two groups according to the infusion dose of remifentanyl, whereas the first group received 0.1 µg/kg/min and the second one received 0.2 µg/kg/min of infusion dose. Study concluded that premedication with midazolam and administration of 0.2 µg/kg/min remifentanyl infusion provided effective sedation with proper hemodynamic stability.

3. CONCLUSION

In cardiac catheterization spontaneous breathing with no oxygen supplement and immobility are highly important for the excellent quality of the procedure. [18, 23, 24] Main goals for the anesthesiologist are the reduction of pain and anxiety, maintaining respiratory and hemodynamic stability and providing appropriate recovery time in pediatric patients. [4, 25] Various combinations of drugs are used for the sedation in cardiac catheterization however results are mostly focused on ventilation and hemodynamic effects like spontaneous breathing, saturation, pulse and blood pressure. The aim of using the drug combination is covering the side effects of each other.

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