KETAMINE SEDATION FOR PEDIATRIC GASTROINTESTINAL PROCEDURES

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ABSTRACT

Objective: To study the safety and efficacy of Ketamine for pediatric gastrointestinal procedures.

Study Design: Quasi-experimental study

Place and Duration of Study: Military hospital Rawalpindi over a period of 11 years from January 1999 to December 2009.

Patients and Methods: The study was conducted in a series of children receiving ketamine administered by pediatric gastroenterologists skilled in basic airway management to facilitate pediatric gastrointestinal procedures. Patient's data was recorded for each sedation to determine age, gender, indication, effectiveness of the sedation and adverse effects. Initial dose of Ketamine 1.0 mg/kg was administered. A second dose of Ketamine1.0 mg/kg was given after 2 to 3 minutes if adequate sedation had not been achieved. Subsequent doses of 0.5 to 1.0 mg/kg Ketamine were given as necessary and adverse events associated with the sedative regimen were documented.

Results: Ketamine was administered to 954 patients who underwent G.I. endoscopies, ranging in age from 2 months to 17 years with mean age of 6.6 years (SD±3.5). Six (0.6%) patients experienced a significant drop in O_2 saturation (<85%) that required interruption of the procedure and/or mild stimulation/ oxygen supplementation. Increased oral secretions, requiring repeated oral suction was noted in most patients undergoing these procedures. Inadequate sedation was noted in just ten patients (1%). Two patient (0.2%) developed laryngospasm. Vomiting at recovery from sedation was noted in 35 (3.7%) patients. Myoclonic jerks and involuntary movements were noted in 5 (0.5%) patients. No episode of aspiration was observed. No patient required intubation or bag/mask ventilation.

Conclusion: Pediatric gastroenterologists skilled in ketamine administration and basic airway management can effectively administer this drug to facilitate gastrointestinal procedures.

Key words: Children, Colonoscopy, Esophagogastroduodenoscopy, Ketamine

INTRODUCTION

Pediatric gastrointestinal procedures such as esophagogastroduodenoscopy (EGD) and colonoscopy are uncomfortable and anxiety-producing for children and parents and require substantial immobilization for successful performance. For older patients an explanation of the procedure, frequent reassurances and mild sedation usually ensures cooperation. For younger children verbal reassurance is seldom effective in decreasing anticipation to pain and secondary combative behavior. Pediatric gastroenterologists use various sedatives for successful performance of such procedures. Some gastroenterologists use light IV sedation, or deeper sedation with benzodiazepines and opioids[1,2]. This is usually associated with a prolonged recovery time and an increased risk of cardiopulmonary depression and impairment of protective airway reflexes. Others use general anesthesia to perform these procedures. This often makes these procedures more difficult to obtain on a timely schedule. Another alternative for pediatric gastrointestinal procedures is Ketamine sedation. Ketamine, a dissociative anesthetic is widely used by non anesthesiologists for analgesia and sedation of children for diagnostic and therapeutic procedures in the emergency department and other non-operating-room settings for carrying out different procedures[3]. This drug is technically easy to administer (intravenously [IV] or intramuscularly [IM]), does not require endotracheal intubation, and reliably produces potent analgesia, sedation, and amnesia[2,4].

Efficacy of Ketamine sedation for pediatric gastrointestinal procedures has been reported

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in different studies and no adverse outcomes or airway complications have been described[13, 14]. Dissociative sedation for pediatric gastrointestinal procedures has been common at our department for more than a decade. Accordingly, we performed a prospective study to describe our experience with ketamine sedation in pediatric gastrointestinal procedures and to document the efficacy and safety profile of ketamine during pediatric endoscopies and colonoscopies.

PATIENTS AND METHODS

This study was performed at the department of pediatric medicine Military Hospital Rawalpindi. It included all patients for whom ketamine was used for inducing dissociate anesthesia for upper and lower gastrointestinal procedures (diagnostic / therapeutic) over an 11-year period (January 1999 to December 2009). The data of all patients undergoing GI endoscopies under Ketamine was entered in the departmental database prospectively. Patient's demographic data such as age, gender, procedural indication, adverse effects and drug's effectiveness for each sedation was recorded. We excluded all cases for which ketamine was not administered to facilitate pediatric gastrointestinal procedures.

All children receiving ketamine were restricted from oral intake for at least 4 hours if infants and at least 8 hours if older. All patients had an intravenous line in place for the duration of procedure and recovery. Resuscitation equipment including a resuscitation bag, face mask of appropriate size, suction catheter, supplemental oxygen and intubation equipment was immediately available prior to administration of medication. Pediatric gastroenterologist experienced with ketamine and basic airway management techniques performed all procedures. In addition to the person performing the procedure a second individual trained in airway management was in attendance to monitor the patient. Patients received continuous cardiac monitoring and pulse oximetry, and periodic vital sign measurements throughout the procedures. After the procedure the patients were monitored by the nursing staff until they gave age-appropriate responses to verbal commands, drank clear liquids (if desired by the patient and if not nauseated), and were able to walk (if age-appropriate).

After getting informed consent initial dose of Ketamine 1.0 mg/kg was administered. A second dose of Ketamine1.0 mg/kg was given after 2 to 3 minutes if adequate sedation had not been achieved. For lengthy procedures subsequent doses of 0.5 to 1.0 mg/kg Ketamine were titrated to the clinical effect observed and the anticipated time needed to complete the procedure. The quality of the sedation was assessed by the medical staff based on the ability to perform the procedure as planned. We recorded the presence or absence of the following adverse effects: cardiac arrest, apnea, respiratory depression, oxygen desaturation (<90%), aspiration, laryngospasm , seizure, involuntary movements, partial airway obstruction, excessive salivation, emesis during sedation, emesis during recovery, unpleasant agitation, unpleasant dreams, hallucinations, unusual behavior, or other complications. If not recorded on the medical record, each of these adverse events was assumed to be absent. We defined laryngospasm as occurrence of partial airway obstruction and oxygen desaturation that did not improve with airway repositioning.

Data was analyzed using SPSS version 15. Descriptive statistics were used to describe the data i.e mean and standard deviation for quantitative variables while frequency and percentage for qualitative variables.

RESULTS

Ketamine sedation was provided to 954 children for esophagogastroduodenoscopy (EGD) and colonoscopy ranging in age from 2 months to 17 years. Among them 778 children underwent EGD while 176 children had colonoscopies. Most of the children were adequately sedated, *i.e.,* allowed the procedure to be carried out comfortably and the procedure was not abandoned. Males were 58% and 42% were female (Table). The median age was 6.6 years (SD=3.5). Majority of children (58.9%) had dissociate sedation for EGD, 22.6% underwent sclerotherapy while 18.4% patients had colonoscopy. All GI procedures were

performed in the gastrointestinal suite in the department of pediatrics. No serious complications were encountered; no patient required intubation or bag/mask ventilation.

Mild tachycardia (increase in heart rate of 15 to 20 beats per minute) was noted in most patients after Ketamine administration. Vomiting at recovery from sedation was noted in 35 (3.6%) of 954 patients. All of these patients experienced vomiting, at a point in recovery from sedation when they were able to sit up and were talking or started taking orally. Ketamine can give rise to myoclonic jerks or involuntary movements. The myoclonic jerks can be very gross but are self-limiting. Transient myoclonic jerks were noted in 5 (0.5%) patients. Inadequate sedation was noted in just ten (1%) patients. Six (0.6%) patients experienced a significant drop in O_2 saturation (<85%) that required interruption of the procedure and/or mild stimulation/ oxygen supplementation to improve respiratory effort. Four of these patients had an underlying pulmonary pathology that would explain the hypoxemia. Two (0.2%) patients developed laryngospasm. Emergence reactions or recovery agitation with Ketamine occurred more often in older children rather than in younger children. The behavioral side effects were observed in 6 (0.6%) children, all were above 10 years of age. The most common adverse event with Ketamine sedation was a mild, transient decrease in O_2 saturation, of between 2% to 5% within 1 to 2 minutes after receiving Ketamine in 72.6% (n= 693) of patients. Subsequently, the O_2 saturation returned to baseline within 1 to 2 minutes. Most of the patients (74.6%) developed some degree of increased oral secretions, particularly during EGD, requiring repeated oral suctioning during or after the procedure; in no patient did the oral secretions interfere with respiratory effort. A number of mild and Transient SE were seen in these patients.

DISCUSSION

Gastrointestinal endoscopies cause considerable anxiety and discomfort in children particularly among those who are subjected to repeated G.I. endoscopies, e.g., endoscopic Sclerotherapy. Moreover many gastrointestinal endoscopic procedures require cooperation and substantial immobilization. Adequate sedation and alleviation of pain would enhance performance during endoscopy in children.

Table-1: Age distribution (n = 954)

Age (in complete years)	No. of Cases % of total, (n =954)
0-2 years	96 (10.1%)
3-5 years	253 (26.5%)
6-10 years	444 (46.5%)
11-17 years	161 (16.9%)

Ketamine has been in use since four decades[5-7]. It is an effective and safe drug for use as conscious sedation in children and it has been increasingly used in the paediatric outpatient and emergency settings over the last few years[7-9]. Ketamine is a nonbarbiturate, phenocyclidine derivative that produces a unique combination of anesthesia, analgesia, sedation and amnesia. It produces a functional and electrophysiological dissociation between cortical and limbic system. It provides analgesia but patients keep their eyes open and all protective reflexes are maintained. The intravenous anesthetic dose is 1-2 mg/kg which causes only a moderate decrease in PO_2 but CO_2 responsiveness is maintained[15]. Children require slightly higher plasma levels compared to adults and there is marked interindividual variability regarding the dose of Ketamine required. Recovery from unconsciousness is seen within 15-20 minutes after single intravenous anesthetic dose. However, recovery from amnesia occurs in one to two hours and analgesia persists for even longer time[6,8].

There have been various reports of the relative safety of ketamine for conscious sedation in children with largest paediatric series to date (n=1022) from Steven Green's group[9-11]. Ketamine can either be given intramuscularly (IM) or intravenously (IV). The optimal dose for IM ketamine is not known. Green et al found that intramuscular Ketamine doses of 4 to 5 mg/kg produced adequate sedation in 93% to 100% of their patients[12]. Both the routes have been found to be equally

effective, with the IM route having a slower onset of action (within three to five minutes) and the IV route having a quicker onset but shorter duration of sedation due to its rapid redistribution. We have been using an IV dose 1 to 2 mg/kg of Ketamine with subsequent aliquots of 0.5 to 1.0 mg/kg were given during the procedure, depending on the clinical response to the previous doses and the anticipated time needed to complete the procedure. Side effects of Ketamine are generally mild and self-limiting. Transient oxygen desaturation might occur. A mild, transient decrease in O_2 saturation was observed within 1 to 2 minutes after receiving Ketamine in 72.6% (n= 693) patients, the O_2 saturation returned to baseline within 1 to 2 minutes. In children, secretions induced by ketamine can sometimes cause significant pooling and obstruction of the airway[13]. For this reason Ketamine is used concurrently with atropine. In our study all patients developed some degree of increased oral secretions, particularly during EGD, requiring repeated oral suctioning during or after the procedure, in no patient did the oral secretions interfere with respiratory effort.

Emergence reactions or recovery agitation with Ketamine occurs more often in older children (more than 10 years old) and adults rather than in younger children[14,15]. The behavioral side effects of Ketamine may be due to its actions at the nicotinic receptors. In recent reviews, this phenomenon was found to be minimal in young children. It is possible that the incidence in younger children is lower because younger children might not be able to describe effects such as bad dreams. We noticed behavioral side effects in 6 patients, all were in 11-16 years age group. The practice of adding midazolam to the Ketamine/atropine combination to minimize the emergence phenomenon has been questioned[14,15]. Some studies suggest that there is a higher incidence of emergence reactions occurring with midazolam together with a higher risk of respiratory depression. Wathern et al concluded that addition of IV midazolam in 10 years or older was associated with more agitation (5.7% versus 35.7%) and that midazolam did not alter the incidence of emergence phenomenon[15]. In a study it was concluded that concurrent administration of IV midazolam with IV ketamine did not diminish agitation and had no measurable effect[14]. Only Green et al's series seem to indicate the reverse[11].

Vomiting at recovery from sedation was noted in 35 (3.7%) of 954 patients. All these patients experienced vomiting, during recovery from sedation. It was also noted that it occurred more commonly with increasing age (2.7% in those aged five years and above compared to 0.9% in those younger than five years old). Ketamine can give rise to myoclonic jerks or involuntary movements[17,18,26]. The myoclonic jerks can be very gross but are self-limiting. However, seizures associated with ketamine have not been previously reported. Transient myoclonic jerks were noted in 5(0.5%) patients. All episodes of myoclonic jerks were transient and self limiting.

CONCLUSION

Ketamine provided adequate sedation and analgesia without any significant side effects in majority of pediatric endoscopic procedures. Hence Ketamine can be used as a safe and effective anesthetic agent during pediatric endoscopic procedures without any extensive monitoring system. Personnel trained to intubate should be present during the procedure and facilities for administration of oxygen, intubation and ventilation should also be available during Ketamine anesthesia.

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