Research Article

Ketamine - Propofol Combination for Pediatric Procedural Sedation and Analgesia in a Low Resource Setting: an Observational Study

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Abstract

Background

Our objective was to evaluate the efficiency and tolerance of the ketamine-propofol combination for procedural sedation and analgesia in children.

Patients and methods

It was a prospective and observational study over 6 months involving children aged 1 to 15 years old, ASA I or II, requiring procedural sedation. The

children received an initial dose of the mixture made of ketamine 0.75 mg / kg and propofol 0.75 mg / kg. Variables studied included the indication for sedation, time to sedation onset, duration of sedation, recovery time, adverse effects, tolerance of sedation, efficiency of sedation and practitioner satisfaction. Data collection was carried out using a pre-established form, with. analysis performed using Cspro version 7.4 software. Data was expressed as means, medians, and absolute numbers for quantitative variables, and as percentages for qualitative variables.

Results

Sedation was performed for 46 children. The median age was 3 years. The indications were painful procedures (43.5%) and imaging (34.8%). The median drug dose administered was 0.75 mg / kg of ketamine and propofol (IQR = 0.73 to 0.80 mg / kg). Sedation was adequate in all patients. Minor adverse effects were encountered in 12 children (26.1%), with 8 cases of nystagmus (17.4%) and 2 cases of agitation (4.3%). The mean sedation time was 17 ± 10.4 minutes. The median recovery time was 10 minutes (IQR = 8 to 14.3). The mean time to onset of sedation was 32.2 ± 6.9 seconds. The satisfaction scores were high.

Conclusion

Procedural sedation and analgesia using the ketamine-propofol combination is an interesting and effective option. It presents with minor adverse effects and recovery time is short.

Key Words: Analgesia; Efficacy; Ketamine-propofol combination; Paediatric; Procedural sedation; Tolerance

1. Introduction

Procedural Sedation and Analgesia (PSA) consists of the administration of a sedative and analgesic agent in order to allow painful gestures to be performed while ensuring patient safety. It also helps reduce anxiety in children undergoing diagnostic and/or therapeutic procedures. This is important because pain, fear and anxiety are obstacles to performing certain procedures in children in the emergency room or in the intensive care unit.

These procedures include wound dressings, lumbar taps, orthopedic procedures (such as fracture reduction), and diagnostic imaging procedures requiring prolonged immobilisation. The use of PSA outside the operating room has become common practice in emergency rooms and in the intensive care unit [1-3]. PSA is not without risks. Adverse effects are related to the depth of sedation.

The ideal drug for use should have a short onset of action, a short duration of action, hemodynamic stability and a low incidence of side effects [4]. Would the ketamine-propofol combination used by several authors such as Yan et al in the USA have the same effect in our context? [5-9]. The aim of our study was to assess the safety and efficiency of procedural sedation in children, using the combination of ketamine and propofol.

2. Patients and Methods

This was an observational and prospective study, from January 31 to July 31, 2020, on children aged 1 to 15 years, ASA I or II, requiring procedural sedation. Sedation was indicated for the management of a painful or non-painful procedure, the foreseeable duration of which was between 5 and 60 minutes. This included any child to undergo a diagnostic, therapeutic or morphological examination at the Yaoundé Gynaeco-Obstetric and Pediatric Hospital during the study period. Parent or legal guardians of children included in the study were required to sign an informed consent form. Children with allergies or hypersensitivity to ketamine or propofol, recent or ongoing upper or lower respiratory tract infection, heart defects, conduction disorders, or whose parent or guardian refused to participate in the study were excluded. We carried out a consecutive and non-exhaustive sampling. Our research protocol was validated by the Ethics Committee of the Faculty of Medicine and Biomedical Sciences of the University of Yaoundé I. Recruitment was done during pre-anesthetic consultation. Before performing the procedure, resuscitation and monitoring equipment was checked. The initial parameters were saved. They were noted on the anesthesia monitoring sheet. Induction consisted of the administration of the ketamine-propofol combination at 1.5 mg / kg (0.75 mg / kg of ketamine + 0.75 mg / kg of propofol). Boluses of the ketamine-propofol combination were added per required needs at 1 mg / kg every 5 minutes. Sedation was assessed using the Rosen score, with a target score of 2. Vital signs, sedation score, and side effects were recorded at 5 minute intervals. Emergence was considered on recovery of cough and swallowing reflexes, and return to pre-procedural Rosen scores. Evaluated variables included pre-procedural data (age, sex, weight, ASA classification, indication for sedation), procedural data (the qualification of the practitioner who performed the therapeutic or diagnostic procedure, time of sedation onset, number of drug re-injections, side effects and their treatment, efficiency of sedation, duration of the procedure, duration of the sedation, total dose of drugs per weight), and post-procedural data (recovery time, side effects and their treatment, tolerance of sedation, practitioner satisfaction). Sedation was performed by the same anesthesiologist assisted by a nurse. The efficiency of sedation was evaluated by the positive response to 2 questions asked to the practitioner who performed the therapeutic or diagnostic procedure. They were: Did the sedation have the expected effect? Could the planned technical gesture have been carried out? Tolerance of the procedural sedation technique was assessed by the occurrence of procedural complications. Practitioner satisfaction was assessed using a numerical scale graded from 1 to 5. Data collection was carried out using a pre-established technical forms, which were completed using medical records, anesthetic consultation forms and postoperative monitoring forms. Data analysis was done using Cspro software version 7.4. Word processing and tables were done using Microsoft Word and Microsoft Excel version 2010 software. Data was expressed as means, medians, and absolute numbers for quantitative variables and as a percentage for qualitative variables.

3. Results

The sample size was 46 children. The sex-ratio was 1.09. The median age was 3 years with extremes of 1 and 11 years. The average weight was 17.5 ± 5.4 kg with extremes of 9 and 31 kg. The main indications were painful procedures (n = 20, 43.5%) (Table 1). The mean time to sedation onset was 32.2 ± 6.9 seconds with extremes of 21 and 53 seconds. The duration of procedures ranged from 3 to 41 minutes. The mean duration was 14.1 ± 9.5 minutes. The duration of sedation ranged from 5 to 50 minutes. The mean duration was 17.1 ± 10.4 minutes. The recovery time ranged from 5 to 34 minutes. The mean delay was 11.8 ± 5.9 minutes. Children who received a single bolus accounted for 45.6% (n = 21). The mean dose per weight of each molecule was 0.78 ± 0.08 mg / kg. The mean total dose was 1.51 ± 0.93 mg / kg. Adverse effects were observed in 12 children (26.1%), and these were minor. A drop in oxygen saturation (SpO_2 < 90%) during the procedure was observed in 1 patient. The planned procedure was performed in all patients. Sedation had the expected effect in all children. The practitioners who carried out the procedure were satisfied in 87% of cases and the nurses in 78.3%.

Variables		Number (n)	Percentage (%)
Age (years)			
< 3		14	30.4
[3 – 6]		22	47.8
[6 – 9]		9	19.6
[9 – 12]		1	2.2
Sex			
Male		24	52.2
Female		22	47.8
Weight (kg)			
< 15		18	39.1
[15 – 20]		12	26.1
[20 – 25]		8	17.4
≥ 25		8	17.4
ASA			
1		19	41.3
2		27	58.7
Indications			
Painful procedures	Wound dressing (9)	20	43.5
	Wound suture (6)		
	Wound debridement (3)		
	Burns (2)		
Diagnostic imaging procedures		16	34.8
Traumatology		7	15.2
Foreign body extraction		3	6.5

Table 1: Pre-procedural characteristics of the study population

Variables	Effectif (n)	Percentage (%)
Practitioner who perform the procedure		
Pediatric surgeon	27	58.7
Radiologist	16	34.8
ENT doctor	3	6.5
Sedation onset time (seconds)		
[20 – 30]	17	37
[30 – 40]	21	45.6
≥ 50	8	17.4
Number of boluses		
1	21	45.6
2	8	17.4
3	5	10.9
4	5	10.9
≥ 5	7	15.7
Recovery time (minutes)		
< 10	20	43.5
[10 – 20]	22	47.8
[20 – 30]	3	6.5
[30 – 40]	1	2.2
Procedure completed ?		
Yes	46	100
No	/	/
Expected effect of sedation obtained		
Yes	46	100
No	/	/
Adverse effects (n=12)		
Agitation	2	16.7
Nystagmus	8	66.7
Logorrhea	1	8.3
Drop in oxygen saturation	1	8.3
Practitioner satisfaction		
Satisfied	40	87
Not satisfied	6	13
Nurse satisfaction		
Satisfied	36	78.3
Not satisfied	10	21.7

Table 2: Procedural characteristics of the study population.

4. Discussion

The sample size was 46 children. The median age was 3 years old. The sex-ratio was 1.09. The main indications were painful procedures (43.5%). Sedation was efficient in all patients. The mean time to onset of sedation was 32.2 ± 6.9 seconds. The mean duration of sedation was 17 ± 10.4 minutes. The median recovery time was 10 minutes. Minor

adverse effects were found in 12 children (26.1%). Satisfaction scores were high. The median age was 3 years (the "baby walker" age group), with a predominance of males. These characteristics were similar to those of other studies performed in pediatric populations [10-12]. The male predominance was found in several series [10,11,13]. The most encountered indications were painful procedures (43.5%) related to trauma lesions, which are common in this age group and often require short duration procedures for which analgesia and sedation are essential. The most frequent indications found in other studies included trauma related procedures, dressings for burns of less than 10%, and diagnostic imaging procedures requiring prolonged immobilization [6,10,11,13]. Sedation was carried out by an anesthesiologist and a nurse. The presence of the anesthesiologist was mandatory for any anesthetic procedure. The nurse's role was patient monitoring. This was similar to proceedings in a similar study carried out by Caré et al [10]. They stipulated that PSA required significant material and human investment. PSA requires a trained team to ensure efficiency and safety. This is highly dependent on pre-procedural assessment and monitoring and requires at least two persons [14]. The average dose per weight of each molecule used in our study was 0.78 ± 0.08 mg / kg. This could be explained by the high proportion of patients requiring a single bolus of the mixture. This result was similar to that of the several studies [6,15,16]. The mean duration of sedation was consistent with the data in other series, which found an average duration of 15 minutes [6,15-17]. The duration of sedation correlated with the indication for sedation. The median recovery time was 10 minutes. Shah *et al* also found a median recovery time of 10 minutes [11]. Andolfatto et al found a duration of 14 minutes [12]. Willman et al found a duration of 15 minutes [15]. All procedures were carried out and the sedation was effective for all our children. This high efficiency was found in several studies: Care et al 100% [10], Cavalli et al 96% [16], and Willman et al 96.5% [16]. The ideal molecule for PSA in general and in children in particular should have a short onset, a short duration of action and definite efficacy [6]. The combination ketamine - propofol was characterized by the low incidence of side effects, at 26.1%. The side effects were minor. This incidence was similar to that found by Shah et al (25%) [11] and David et al (22%) [14]. The ketamine - propofol combination is of interest for performing PSA in the pediatric population. It allows for a more rapid onset of awakening, hemodynamic stability and a reduction in side effects [1, 5-7]. It helps to counteract the side effects of each molecule [14]. No adverse hemodynamic effects were noted in our study. This corroborated with the results obtained in other studies [11,13,15]. Yan et al in the USA, in a study comparing the ketamine-propofol combination and propofol alone for procedural sedation in emergency rooms, found less significant respiratory adverse events with the ketamine-propofol combination [8]. Jalili et al in Iran found fewer adverse effects in favor of the ketamine-propofol combination in a meta-analysis of trials comparing the ketamine-propofol combination versus propofol for procedural sedation [9]. Alletag et al claimed that the ketamine - propofol combination, in pediatric settings, provided a good hemodynamic profile, a reduction in the side effects of each of the

two agents, excellent patient and practitioner satisfaction and rapid recovery [16]. Practitioner satisfaction scores were high. This was related to the effectiveness and low incidence of side effects. This was found in several studies. Shah et al found 87% satisfaction for the doctor and 91% for the nurse [11]. David et al, had a satisfaction rate of 95% for the doctor and 94% for the nurse [13]. The small size of our sample was a limitation and did not allow us to generalize the results obtained. This was linked to the Covid-19 pandemic which resulted in a decrease in hospital attendance.

5. Conclusion

The ketamine-propofol combination is effective and well tolerated. It has an average sedation time, short recovery time, minor side effects, and good practitioner satisfaction.

Conflicts of interest

The authors declare no conflicts of interest.

Author Contribution

All authors contributed to the development and conduction of this manuscript. All authors have read and approved the final version of the manuscript.

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