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RESEARCH ARTICLE
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Comparison of two anaesthetic drug (propofol and midazolam) versus (chloral hydrate) for pediatric sedation in MRI suite

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ABSTRACT

Background and aims: Magnetic resonance imaging (MRI) is a common diagnostic imaging procedure for children that typically takes 30 - 60 minutes to complete. As a result, during an MRI, pediatric patients' cooperation is crucial. Propofol is a sedative-hypnotic agent that is frequently used to stay calm children undergoing diagnostic or therapeutic procedures. Midazolam can be administered concurrently with propofol to reduce the amount of the drug that is required to achieve an adequate level of sedation. Chloral Hydrate: is a non-opiate, non-benzodiazepine sedative-hypnotic drug that has long been utilized for pediatric sedation at a dosage of 20 - 100 mg/kg, Chloral hydrate can increase the number of incidences of bradycardia, apnea and decreased oxygen saturation, Sedation lasts from one to two hours after administration, with the duration of its action being quite variable. This study aimed to compare which of these drugs is more stable for vital signs and which is more in-depth for sedation and less side effect on the Pediatric patients during MRI examination.

Material &methods: in this cross-section 70 pediatric participants were enrolled in the propofol-midazolam and chloral hydrate group male and female age range (1-12 years old) who were candidate for elective exam and were in class I, II of ASA, parental consent, and NPO, participated in this study. Before, during and after examination we were assessed (SPO2, HR and MAR), Time to achieve sedation, Duration of MRI (min) and Duration of Recovery in both group (propofol-midazolam and chloral hydrate) we measure Side effect (long sedation, nausea and vomiting, agitation) and Respiratory Complication (Tachypnea, laryngeal spasm Respiratory Distress, Decrease SPO2).

Result: the age in this study (1-12 years). our finding show highly significant statistical differences in anesthetic drug (propofol and midazolam) group versus chloral hydrate group in time to achieve

sedation, duration of MRI and duration of recovery for pediatric sedation in MRI suite at $P < 0.001$. At $P < 0.05$ there were significant statistical differences in anesthetic drug (propofol and midazolam) group versus chloral hydrate group in side effect for pediatric sedation in MRI suite. Finally, our analysis showed no apparent distinction between both groups in terms of age, weight, the type of MRI, parental satisfaction, or UN satisfaction of the radiologists.

Conclusion: This study shows that using propofol-midazolam versus chloral hydrate to sedate pediatric for MRI examination takes less time and, as a result, allows for a more effective use of the MRI scanner's resources. The time between scans is particularly reduced by the extremely brief induction time. We feel that utilising propofol sedation allows for more effective use of the MRI facility and justifies the paediatric anesthesiology service's increasing involvement in this extremely expensive resource.

Keywords: *Magnetic resonance imaging (MRI), Midazolam, Propofol, choral hydrate, Pediatric sedation*

INTRODUCTION

Magnetic resonance imaging (MRI) is a common diagnostic imaging procedure for children that typically takes 30 - 60 minutes to complete. As a result, during an MRI, pediatric patients' cooperation is crucial. Deep sedation is required to obtain high quality images in order to ensure a fixed posture and to prevent involuntary movement due to noise. Ideal sedative agents should have rapid onset time, short recovery profile, and low potential for side effects (1,2,3). Propofol is a sedative-hypnotic agent is frequently used to stay calm children undergoing diagnostic or therapeutic procedures. Although it has a quick metabolism (The primary metabolic pathway is liver glucuronidation, and it is fastly excreted from the body (4). Midazolam can be administered concurrently with propofol to reduce the amount of the drug that is required to achieve an adequate level of sedation. As a result, giving midazolam along with propofol can be thought of as an ideal sedative combination because it shouldn't lower blood pressure (BP) or result in episodes of hypoxia. Among the medications frequently used in the context of Procedural sedation and analgesia are propofol and midazolam. Due to their high potency, rapid onset of action, quick recovery, and low potential for side effects, both drugs stand out among other members of their respective groups (5, 6). Chloral Hydrate: is a non-opiate, non-benzodiazepine sedative-hypnotic drug that has long been utilized for pediatric sedation at a dosage of 20 - 100 mg/kg (7, 8). In the recent past, chloral hydrate was considered to be the cornerstone of safe and efficient pediatric sedation. Chloral hydrate can increase the number of incidences of bradycardia, apnea and decreased oxygen saturation (9), Sedation lasts from one to two hours after administration, with the duration of its action being quite variable (10). The aim of study is to compare which of these drugs is more stable for vital signs and which is more in-depth for sedation and less side effect on the Pediatric patients during MRI examination.

METHOD AND MATERIALS

Setting of this study

It is important to note that this study was conducted from January 2023 to March 2023 in the MRI suite at Imam Hussein Medical City, with a total of 70 patients enrolled. All patients underwent a primary assessment for anesthesia risk by the responsible anesthesiologists in "Imam Hussein Medical City" before anything else, and the patient's parents verbally consented to their involvement in the study.

Data collection and sample size

This prospective descriptive-analytic cross-sectional study could proceed once the ethics committee of Tehran University of Medical Sciences gave its approval. We looked in MEDLINE, PubMed, Google scholar and Cochrane Evidence Based Medicine Reviews to find the most recent research. Additionally, manual searches of recent pediatric sedation in MRI examination-related journals and citation reviews. The patients in this study were blinded to the various sedation methods used during the MRI examination because the study was conducted using a randomized single-blinded study design. Then, they were non-randomly

divided into two groups based on the sedatives used to achieve that state. This cross sectional study starts by getting the consent of the parents, preparing the patient, taking his past history, and following all the preparatory steps that are followed during general anesthesia, such as fasting time and re-examination by the anaesthesiologist. After that, we begin by administering sedation via various routes (oral and intravenous), depending on the patient's situation and different doses for these drugs. Additionally, the patient must fit the inclusion criteria and uncomplicated cases (elective cases). Additionally, we focus solely on the constant age range of 1 - 12 years. Finally, we should divide the patients into two groups based on the type of medication used and the method of administration.

The participants in this study are those who have recently undergone an MRI examination, and samples are chosen cross-sectional using convince sampling.

$$n = N \times p\ (1 - p) / [[N - 1 \times (d2 \div z2)] + p\ (1 - p)]$$

Formula 1:sample size calculation

On the basic of Informed consent, inclusion criteria (elective cases, ASA I, II, average age 1 to 12 years, parental consent, and NPO), and lack of exclusion criteria (emergency cases, ASA III and more, age less than 1 year and over 12 years, and parent's refusal) are required for inclusion in this study for Pediatrics who have had an MRI examination in a hospital. These patients are chosen for the study. 70 patients total, split into two groups, make up the sample size for this study. Depending on the type of drug and how it is administered, each group had 35 patients. Group A (those will receive IV propofol in dose 0.5–1 mg/kg and midazolam in dose 0.05 mg/kg). Group B (those will receive orally chloral hydrate in dose 50 mg/kg).

Study design

In group A: consists of 30 participants, in both gender accordance with the sample size that was collected. In addition, the patient should be positioned supinely on the MRI bed before we begin cardiopulmonary monitoring (Heart rate, MAP, and Spo2). Furthermore, an IV cannula (24G) was inserted. And once everything is in order, we prepare the patient for an IV sedation injection. And starting IV sedative injections, such as using propofol in doses of 0.5 - 1 mg/kg combined with midazolam in a specific dose of 0.05 mg/kg. After injection, the patient begins close cardiopulmonary monitoring (HR, MAP, and Spo2) to detect any changes, such as respiratory depression if it occurred, as well as other signs like bradycardia, hypotension, and apnea. Throughout the procedure, these signs must be monitored closely, and any changes should be noted.

In group B: Furthermore, there are 30 participants in this group as it is group A, and they were chosen at random. Of all these, in both gender. We therefore starting by placing a cardiopulmonary monitoring device, as described in group A, Anesthesiologists must then re-evaluate the patient, and 30 minutes before the MRI, they must administer oral chloral hydrate at a dose of 50 mg/kg. Then, when the effects of the chloral hydrate start to take effect and the patient appears to be asleep, the child is then taken and placed on the examination bed where all of the cardiopulmonary monitoring device is placed to monitor any changes in heart rate, MAP and Spo2.

Statistical analysis

The data will use SPSS V. 26 software to manage and analyze the data. Descriptive statistics including number and percentage of frequency, mean and standard deviation and inferential statistics in proportion to the distribution of data will be used in terms of normality. Also will uses K-S for determining normal distribution of data. Pearson correlation test and analysis of variance, paired sample t-test and independent sample t-test are used to examine the differences and correlation between variables. Also, if the data are not normal, their nonparametric equations are used: Spearman correlation test, Mann-Whitney test and Kruskal -Wallis test, respectively and use regression analysis for estimating relationship between variables.

RESULTS

This part presents the result of the current study in tables and their correspondence with the objectives of the study as shown in the tables.

The results in table 1 showed there were highly significant statistical differences in anesthetic drug (propofol and midazolam) group versus

chloral hydrate group in time to achieve sedation, duration of MRI and duration of recovery for pediatric sedation in MRI suite at $P < 0.001$.

TABLE 1: Distribution of the (propofol and midazolam) group and chloral hydrate group according to their medical characteristics

Medical Characteristics	Subgroup	Propofol and Midazolam		Chloral hydrate		t-test analysis		
		f.	%	f.	%	t	df	p. value
MRI type	Brain	30	85.7	28	80.0	-1.186-	34	.244
	Brain and whole spine	3	8.6	1	2.9			
	Whole spine	2	5.7	4	11.4			
	Pelvic	0	0	2	5.7			
	Total	35	100.0	35	100.0			
ASA	Class I	28	80.0	28	80.0	.000	34	1.000
	Class II	7	20.0	7	20.0			
	Total	35	100.0	35	100.0			
Time to achieve sedation		Min – Max 1- 7 m Mean ± SD 2.74 ± 1.482		Min – Max 15- 42 m Mean ± SD 26.91 ± 6.482		-21.966-	34	.000
Duration of MRI		Min – Max 15- 45 m Mean ± SD 21.20 ± 8.163		Min – Max 10- 30 m Mean ± SD 17.17 ± 4.599		2.466	34	.019
Duration of recovery		Min – Max 2- 10 m Mean ± SD 4.57 ± 1.852		Min – Max 5- 38 m Mean ± SD 21.29 ± 7.835		-12.142-	34	.000

The results in table 2 showed there were significant statistical differences in anesthetic drug (propofol and midazolam) group versus chloral hydrate group in side effect for pediatric sedation in MRI suite at $P < 0.05$.

TABLE 2: Distribution of the (propofol and midazolam) group and chloral hydrate group according to their events.

Events	Subgroup	Propofol and Midazolam		Chloral hydrate		t-test analysis		
		f.	%	f.	%	t	df	p. value
Side effect	Without	34	97.1	27	77.1	-3.022-	34	.005
	Nausea and Vomiting	0	0	6	17.1			
	Agitation	0	0	2	5.7			
	Long sedation	1	2.9	0	0			
	Total	35	100.0	35	100.0			
Respiratory Complication	Without	32	91.4	35	100.0	1.785	34	.083
	Laryngeal spasm respiratory distress	3	8.6	0	0			
	Total	35	100.0	35	100.0			
Parent's satisfaction	**Satisfaction**	28	80.0	20	57.1	-1.850-	34	.073
	Un **satisfaction**	7	20.0	15	42.9			
	Total	35	100.0	35	100.0			
	Satisfaction	31	88.6	25	71.4	-1.785-	34	.083

Any un satisfaction of Radiology provide								
	Un **satisfaction**	4	11.4	10	28.6			
	Total	35	100.0	35	100.0			

In table 3 the results showed that the high percentage (37.2%) of pediatric in the Propofol and Midazolam group were equal from 1-4 years and 5-8 years with mean 6.00 years while the high percentage (45.7%) of pediatric in the Chloral hydrate group from 1-4 years with mean 5.13 years. Regarding the gender, the high percentage (57.1%) of pediatric in the Propofol and Midazolam group were male and the high percentage of male were 48.6% of pediatric in the Chloral hydrate group. According to the weight the high percentage (45.7%) of pediatric in the Propofol and Midazolam group were from 16-30 kg with mean 23.93 kg while the high percentage (51.4%) of pediatric in the Chloral hydrate group from 6-15 kg with mean 18.31 kg.

TABLE 3: Distribution of the (propofol and midazolam) group and chloral hydrate group According to their socio demographic data Characteristics

Demographic Characteristics	Subgroup	Propofol and Midazolam		Chloral hydrate	
		f.	%	f.	%
Age group	1-4 years	13	37.2	16	45.7
	5-8 years	13	37.2	13	37.2
	9-12 years	9	25.6	6	17.1
	Total	35	100	35	100
		Min – Max 1- 12 years Mean ± SD 6.00 ± 3.155		Min – Max 1- 12 years Mean ± SD 5.13 ± 3.260	
Gender	Male	20	57.1	17	48.6
	Female	15	42.9	18	51.4
	Total	35	100.0	35	100.0
Weight	6-15 kg	10	28.6	18	51.4
	16-30 kg	16	45.7	12	34.3
	Above 30 kg	9	25.7	5	14.3
	Total	35	100.0	35	100.0
		Min – Max 9- 45 kg Mean ± SD 23.93 ± 10.284		Min – Max 6- 54 years Mean ± SD 18.31 ± 10.300	

DISCUSSION

In Our cross-sectional study compared the sedative effects, hemodynamic parameters, and complications of propofol-midazolam and chloral hydrate in children receiving sedation for MRI. There were no studies comparing the effects of sedating children for MRI with propofol-midazolam versus chloral hydrate. Propofol and midazolam were administered to group A (Mean age 6.00), while chloral hydrate was given to group B (Mean age 5.13). Age, gender, weight, ASA, MRI type, time to achieve sedation, MRI duration, MRI recovery, SPO2, MAP, HR, side effects, respiratory complications, parent satisfaction, and any radiology provider dissatisfaction were similar between the two groups in our study. Before that, we must mention that all monitoring devices consist of non-magnetic parts to protect them from the MRI magnetic effect.

This study was identical to previous research, with some differences; the study of SAMUEL M.et.al (1994) in this study, the average induction time for chloral hydrate was 41 minutes, which was about equivalent to the average functioning time of 36 minutes. The induction time was also variable, varying from 21 minutes to 58 minutes at its longest **(11)**. Our study concurs with this study in terms of how long it takes to achieve drowsiness and recover, with average sedation times for CH being (mean SD 26.91 6.482) and average recovery times being (mean SD 21.29 7.835). However, the fact that CH can sometimes fall short of providing sufficient sedation is another issue, which is supported by our data about the number of patients who fail MRI examinations (3 patients,

at 8.57%), even when we use a greater dose than suggested (Greene 1991).

Another study that supports our findings in terms of the use of propofol or CH during MRI exams is that of Kamal Abulebda et al. (2017). His findings showed that 14% of our patients needed more than one dose of CH because they became agitated or awake during the test, which is consistent with our findings in terms of agitation and failure to pass the exam **{12},** this point agree to our investigation, which noted agitation (5.7%) and nausea and vomiting (17.1%). In addition, our data is similar to this study in terms of time efficacy, the mean procedure time, recovery time, and total nurse time were significantly lower in the PK group compared to the CH group, But we must point out that there is a significant disagreement between the results of this study that patients in the PK group had a 10% incidence of transient hypoxemia corrected with a regular nasal cannula compared to only 1% in the CH group and our observation that there were no cases of transient hypoxemia in group A because we used a modified dose of propofol (lower dose) by adding to a simple dose of midazolam (0.05 mg/kg). As well as comparing the chloral hydrate strategy to deep sedation, there was a higher frequency of temporary hypoxemia with the propofol and ketamine approaches. Similar to our study, which found that sedation doses of 0.05 mg/kg of midazolam combined with propofol were effective and low-complication.

In the study of Palak Garg et al. (2022), there is agreement related to age, gender, ASA class, and type of MRI exam; all of these are non-insignificant variables in both studies **{13}**. But there is a clear difference between our findings and those of this study about the requirement of an additional dose of propofol when it is taken alone. However, when we added a midazolam dose for simple sedation, which was a result of the prolonged duration of the sedative effect of the propofol-midazolam doses, we did not need to administer an extra dose of the drug in group A (propofol-midazolam).

Finally, our analysis showed no apparent distinction between both groups in terms of age, weight, the type of MRI, parental satisfaction, or UN satisfaction of the radiologists.

CONCLUSION

This study shows that using propofol-midazolam versus chloral hydrate to sedate pediatric for MRI examination takes less time and, as a result, allows for a more effective use of the MRI scanner's resources. The time between scans is particularly reduced by the extremely brief induction time. The extended time associated with CH sedation may begin to play a significant role in determining rates if improvements in technology allow the creation of faster scanners. We feel that utilising propofol sedation allows for more effective use of the MRI facility and justifies the paediatric anesthesiology service's increasing involvement in this extremely expensive resource.

Ethical approval

The study's ethical permission was granted by the ethical committee at Tehran University of Medical Sciences (IR.TUMS.SPH.REC.1401.267). Group data (rather than individual data) were published for all information gathered. The required data lacks any identity information, such as a name, ID number, country code, or other identifier.

Conflicting interests

The authors say they have no competing interests.

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