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Dexmedetomidine compared with propofol for paediatric patients requiring sedation for Magnetic Resonance imaging

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Abstract
Introduction: *Magnetic resonance imaging is a highly precise diagnostic modality for the diagnosis of congenital as well as acquired pathologies in pediatric age group. The advantages of MRI include its high sensitivity and specificity for the diagnosis of various intracranial pathologies. Moreover, its devoid of any radiation exposure. One of the prerequisites for MRI imaging is that patient needs to remain still during the procedure otherwise movement artefact will be produced making the interpretation difficult. Dexmedetomidine and propofol can be used as sedatives in pediatric patients undergoing MRI. We conducted this comparative study to analyses the utility of Dexmedetomidine and propofol as sedating agent in pediatric patients undergoing MRI imaging.*
Materials and Methods: *This was a comparative study in which pediatric patients between 2 - 12 years and undergoing MRI imaging were included on the basis of a predefined inclusion and exclusion criteria. The study was conducted in anesthesiology department of a tertiary care medical college located in an urban area. Total 60 pediatric patients undergoing MRI and who required sedation were included int this study. Out of 60 cases 30 patients (Group A) were given Dexmedetomidine 1 µg/kg initial dose followed by infusion of 0.5 µg/kg/hr (if needed). Remaining 30 patients (Group B) patients received propofol 3 mg/kg initial dose followed by infusion of 100 µg/kg/min (if needed). Demographic dataof patients in both the groups was recorded and compared. Onset of sedation time, recovery time, duration of sedation and ability to reduce motion resulting into good quality MRI and any adverse event were compared. For statistical analysis SSPE 21.0 software was used and p value less than0.05 was taken as statistically significant.*
Results: *Out of 60 studied cases there were 42 males and 18 females with a M:F ratio of1:0.42. Mean age of the patients in group A and group B was 6.2 +/- 2.12 and 5.9 +/- 1.98 years. The age groups were found to be comparable (P>0.05). Mean onset of sedation time in group A and group B was 10.2 +/- 3.12and 3.82 +/- 1.90 minutes (P<0.05). Mean recovery time in group A and B was found to be 24 +/-14.24 and 14 +/- 3.92 (P<0.05). Mean time needed for MRI was 22 +/- 5.12 and 24 +/- 4.42 in group A and B respectively (P>0.05). Mean sedation time was found to be 42 +/- 12.22 and 44 +/-11.82 minutes in group A and B respectively (P>0.05). The incidence of pediatric anesthesia mergence delirium was found to be 2 and 3 patients in group A and B respectively.*
Conclusion: *Dexmedetomidine was found have late onset of sedation time and prolonged recovery time as compared to propofol in children requiring sedation for MRI. Mean sedation time was found to be comparable. The adverse events were more common with propofol as compared to dexmedetomidine.*
Keywords: *Dexmedetomidine, propofol, sedation, Magnetic resonance imaging.*

Introduction

Magnetic resonance imaging is one of the most precise imaging modalities available for the diagnosis of various congenital as well as acquired pathologies in pediatric age group. The advantages of MRI include its high sensitivity and specicifity[1]. Moreover, it's devoid of any kind of radiation exposure and can be safely used in pediatric patients. One of the major drawbacks of using MRI in pediatric patients is that it's a time-consuming imaging modality and co-operation of patient is essential for optimum imaging[2]. Movements during MRI are known to produce motion artefact which makes it impossible to interpret the results[3]. Co-operation of pediatric patients is hard to obtain and it is difficult for children to remain calm and still during MRI[4]. For this reason, majority of the pediatric age group patients require some or the other kind of sedation while undergoing MR imaging[5].

In clinical practice multiple drugs have been used for the purpose of obtaining a satisfactory sedation level in children undergoing MRI[6]. On of the important desirable characteristic of the sedative drug to be considered for using in these children is high efficacy and safety characteristic. Moreover, the drug should also be short recovery time[7]. Dexmedetomidine and propofol are 2 of the common drugs for this purpose. In addition to high efficacy and safety characteristics they also have a short sedation and recovery time[8].

Dexmedetomidineis a S- enantiomer of medetomidine and is highly specific alpha-2 adrenoceptor agonist. It has an8-fold greater alpha2:alpha1 selectivity than clonidine[9]. Selectivity of Dexmedetomidine is dose dependent. At low to medium doses or low rates of infusion- high levels of alpha2 selectivity seen whereas high doses or rapid infusions of low doses are associated with both alpha1 and alpha2 activities[10]. It has got a Shorter elimination half-life of around 2 to 3 hours. Dexmedetomidine does not affect the synthesis, storage or metabolism of neurotransmitters and also do not block the receptors hence providing the possibility of reversing the hemodynamic effects with vasoactive drugs or the specific alpha2 antagonist[11]. It has been subject of immense interest amongst researchers for use in pediatric patients for sedation for invasive and non-invasive procedures[12]. Due to immaturity of enzymes responsible for metabolism of dexmedetomidine it is usually avoided in neonates and children below 1 year of age. Enzyme levels reach adult level by 1 year of age and hence it can be safely used after infancy[13]. On the other hand, propofol directly activates GABA (A receptors) and inhibits the NMDA receptors resulting in its classical global central nervous system depressant action. It has got a remarkable safety characteristics and complications following its administration are rare[14]. The most common dose dependent complication seen in patients in whom propofol is used for sedation is hypotension. Taking into consideration the excellent safety profile and efficacy of dexmedetomidine and propofol both of these drugs are being increasingly used for sedation in children for various invasive as well as non-invasive procedures[15]. comparative study to analyses the utility of Dexmedetomidine and propofol as sedating agent in pediatric patients undergoing MRI imaging.

Materials and Methods

This was a prospective comparative study in which 60 pediatric patients undergoing Magnetic resonance imaging and requiring sedation were included on the basis of a predefined inclusion criteria. Patients who had been found to meet any exclusion criteria were excluded from the study. The study was conducted in the department of anesthesiology of a tertiary care medical college situated in an urban area. Out of 60 cases 30 patients (Group A) were given Dexmedetomidine 1 μg/kg initial dose followed by infusion of 0.5 μg/kg/hr (if needed). Remaining 30 patients (Group B) patients received propofol 3 mg/kg initial dose followed by infusion of 100 μg/kg/min (if needed). Demographic details of patients in both the groups were noted. A detailed history

was taken with regards to indication of MRI and history of any significant illness in past. A through clinical examination was done. Baseline pulse rate, blood pressure, respiratory rate, and oxygen saturation was noted in all the cases. Cases were given either dexmedetomidine or propofol depending upon the group they belonged to. The sedation level was determined using Ramsay sedation scale and MRI commenced once the Ramsay sedation scale of 5 was reached. The patients were allowed to take spontaneous breathing during MRI and SPO2 was monitored throughout the scanning procedure. If Spo2 dropped below 95% then the scanning procedure was abandoned and patient was excluded from the study. At the end of imaging the children were transferred to recovery room. Onset of sedation time, recovery time, duration of sedation and ability to reduce motion resulting into good quality MRI and any adverseevent were compared. For statistical analysis SSPE 21.0 software was used and P value less than 0.05 was taken as statistically significant.

Inclusion Criteria

1- Pediatric patients undergoing MRI.
2- Age 2-12 years.
3- Physical Status 1-2 as per American Society of Anesthesiologists (ASA).
4- Written informed consent obtained from the guardians of the patient.

Exclusion Criteria

1- Known allergy to Dexmedetomidine or propofol.
2- Guardians Refused consent.
3- Age less than 2 or more than 12 years.
4- Any Neurological abnormality.
5- Hemodynamically Unstable patients.
6- Patients Requiring MRI contrast.

Results

This was a comparative study of 60pediatric patients who had undergone MRI under sedation. Out of 60 cases 30 patients (Group A) were given Dexmedetomidine and remaining 30 patients (Group B) patients received propofol in appropriate doses. In group A there were 20 (66.66%) males and 10 (33.33%) females whereas in group B there were 22 (77.33%) males and 8 (26.67%) females. Overall out of 60 patients there were 42 (70 %) males and 18 (30%) females with a M:F ratio of 1:0.42. The gender difference in both the groups was statistically not significant (P>0.05)

Table 1: Gender Distribution in the studied cases

Gender Distribution	Group A		Group B	
Males	20	66.66%	22	77.33%
Females	10	33.33%	8	26.67%
Total	30	100%	30	100%
P > 0.77 (Not Significant)				

The analysis of age groups of the patients showed that in both the groups most of the patients were between the age group of 9-12 years (43.33% (Group A) and 50.00% (Group B)) followed by 5-8 years (40 % (Group A) and 30.00% (Group B)) and 2-4 years (16.67% (Group A) and 20.00% (Group B)). The mean age of the patients in group A and group B was found to be 7.63 +/- 2.90 and **7.93 +/- 3.07** respectively. Mean age of the patients in both the groups was found to be comparable and there was no statistically significant difference in mean ages of both the groups (P>0.05).

Table 2: Age groups of the studied cases

Age Groups of the cases	Group A		Group B	
2-4 years	5	16.67%	6	20.00%
5-8 years	12	40.00%	9	30.00%
9-12 years	13	43.33%	15	50.00%
Total	30	100%	30	100%
Mean Age	7.63 +/- 2.90		**7.93 +/- 3.07**	
P =0.69 (Not Significant)				

The analysis of type of MRI requested showed that in majority of children non-contrast MRI brain (81.67%) was advised followed by MRI spine (8.33%) and musculoskeletal MRI (8.33%). Only in 1 girl (1.67%) MRI pelvis was advised.

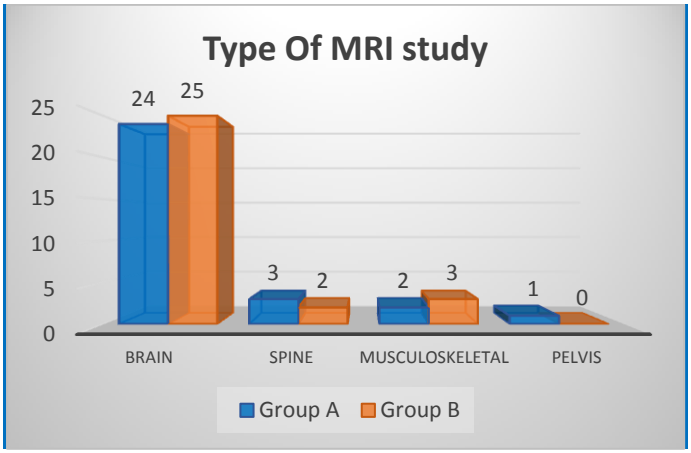

Figure 1 : Type of MRI Study

Mean Duration of MRI imaging in group A and Group B was Found to be 22 +/- 5.12 and 24 +/- 4.42 minutes respectively. The mean duration of MRI in both the groups were found to be comparable with no statistically significant difference between both the groups (P>0.05).

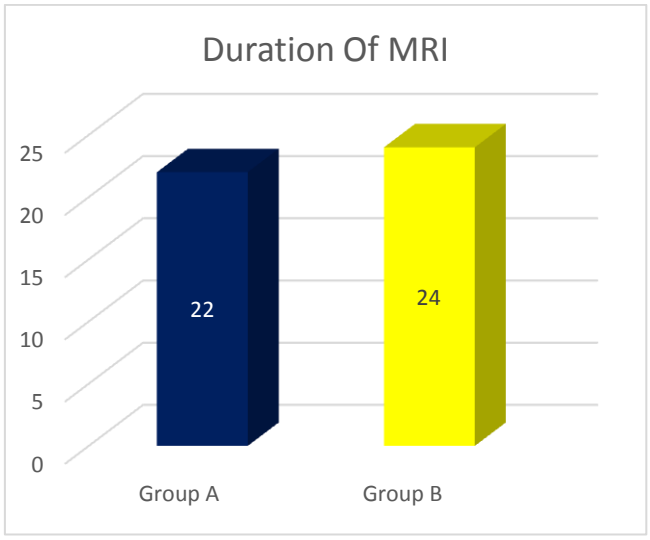

Figure 2: Mean Duration of MRI study

Patients in both the groups were analyzed for onset of sedation. Mean time for onset of sedation in group A was found to be 10.2 +/- 3.82 whereas in group B mean time for onset of sedation was 3.12 +/- 1.90. It was found that mean time for onset of sedation was more in group A as compared to group B and the difference was found to be statistically significant (P<0.0001).

Table 3: Onset of Sedation (in Minutes) in both the groups

	Onset of Sedation (Minutes)	Std Deviation
Group A	10.2	3.12
Group B	3.82	1.90
P <0.0001 (Significant)		

The analysis of patients in both the groups for mean sedation time (minutes) showed that the mean sedation time was 42 +/- 12.22 in group A whereas it was 44+/- 11.82 in group B. The difference was not found to be statistically significant (P = 0.521).

Table 4: Mean Sedation time (in Minutes) in both the groups

	Mean Sedation Time (Minutes)	Std Deviation
Group A	42	12.22
Group B	44	11.82
P = 0.521(NotSignificant)		

Mean recovery time in group A and B was found to be 24+/-14.24 (Minutes) and 14 +/- 3.92(P<0.05). The difference was found to be statistically significant (P <0.05).

Table 5: Mean recovery time (in Minutes) in both the groups

	Mean recovery time (Minutes)	Std Deviation
Group A	24	14.24
Group B	14	3.92
P < 0.05 (Significant)		

Finally, the analysis of adverse events showed that adverse events were more common in group B (7/30) as compared to group A (5/30). The most common overall adverse event was found to be anesthesia emergence delirium which was seen in 2 and 3 patients in group A and B respectively. The other adverse events were bradycardia (3/60), respiratory depression (2/60), vomiting (1/60) and hypotension (1/60). Patients who desaturated during procedure and in whom MRI was abandoned were excluded from the study.

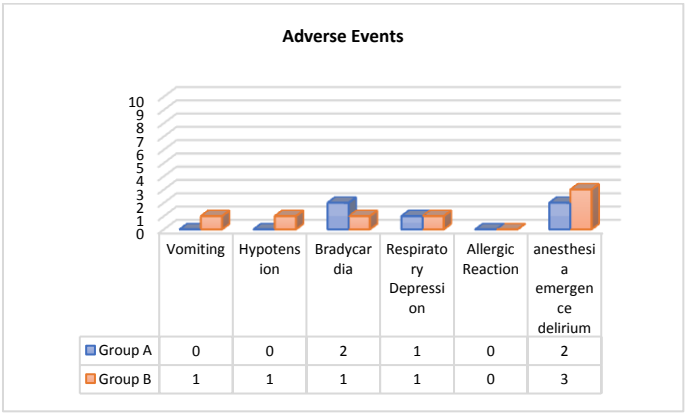

Figure 3: Comparison of adverse events in both the groups

Discussion

This was a comparative study of 60 pediatric patients who had undergone MRI under sedation. Out of 60 cases 30 patients (Group A) were given Dexmedetomidine and remaining 30 patients (Group B) patients received propofol in appropriate doses. The mean age of both groups was comparable. In our study duration of MRI was comparable in both the groups and was found to be 22 +/- 5.12 minutes in group A and 24 +/- 4.42 minutes in group B.

Mean time for onset of sedation in group A (Dexmedetomidine) was found to be 10.2 +/- 3.82 whereas in group B (Propofol) mean time for onset of sedation was 3.12 +/- 1.90. The difference was found to be statistically significant. Propofol is usually found to have a quick onset of sedation as compared to dexmedetomidine. Kamal K et al conducted a study to evaluate the efficacy and safety of dexmedetomidine versus propofol for sedation in children undergoing MRI. In this study sixty children aged 2-10 years and having physical status 1 or 2 according to the American Society of Anesthesiologists, undergoing MRI were included. The mean time for onset of sedation in Group D was much longer than in Group *P* (*P* = 0.000). Mean duration of sedation was comparable in the two groups. The authors concluded that Propofol had an advantage of providing rapid onset of sedation and quicker recovery time. Dexmedetomidine resulted in a better preservation of respiratory rate and oxygen saturation, so it may be more suitable in children who are prone to respiratory depression. The findings in our study was similar because we also found that propofol has a rapid onset of sedation but was found to be associated with more adverse events as compared to propofol[16].

The study of mean sedation time showed that it was 42 +/- 12.22 in group A whereas it was 44+/- 11.82 in group B. Mean sedation time was found to be comparable in both the groups and there was no statistically significant difference in the mean sedation time in between these 2 groups. Zhou Q et al undertook a meta-analysis aimed to compare the efficacy of dexmedetomidine and propofol in children undergoing MRI. PubMed, Cochrane Library and Web of Science were searched for this meta-analysis. Onset of sedation time, recovery time, sedation time, MRI time, MRI quality and emergence delirium were analyzed. 6 studies with 368 subjects were enrolled in this meta-analysis. The pooling data showed that propofol had a shorter onset of sedation time and recovery time than dexmedetomidine. But for sedation time and MRI scanning time, there were no differences between the two groups 0.15-5.00, *P* = 0.04). Thus, propofol should be encouraged in pediatric patients undergoing MRI for its better sedative effects and a low incidence of emergence delirium. The findings of the study were similar to our study as we also found that mean sedation time in both the groups was found to comparable with no statistically significant difference[17].

The analysis of mean recovery time in our study showed that it was 24 +/- 14.24 (Minutes) and 14 +/- 3.92 in group A and B respectively. The difference was found to be statistically significant. Fang H et al undertook a meta-analysis to assess the effects between dexmedetomidine and propofol in children undergoing MRI, especially outcomes and adverse events of patients. Five trials with a total of 337 patients were included. The authors found that Compared with propofol group, dexmedetomidine significantly increased the recovery time. The authors found that duration of sedation did not appear to decrease for the patients who received dexmedetomidine than for those who received propofol. Therefor the authors concluded that dexmedetomidine might lead to a longer recovery time. This was in contrast to our study which found that mean recovery time was comparable in both the groups[18].

Finally, we found that adverse events were more in common in propofol group as compared to patients who received dexmedetomidine. Peng Ke et al conducted a study to compare the safety and efficacy of dexmedetomidine with that of propofol for cerebral angiography in pediatric patients.

In this study Sixty-two patients (6-15 years) scheduled for elective cerebral angiography were apportioned randomly and equally to receive either propofol or dexmedetomidine sedation. The authors found dexmedetomidine to be a better alternative because of fewer respiratory adverse events. Hence it can be concluded that as compared to propofol dexmedetomidine is preferable to propofol in view of less adverse events[19]. Similar safety profile of dexmedetomidine as compare to propofol was also reported by John S et al[20].

Conclusion

Dexmedetomidine was found have late onset of sedation time and prolonged recovery time as compared to propofol in children requiring sedation for MRI. Mean sedation time was found to be comparable. The adverse events were less common with dexmedetomidine as compared to propofol thus making dexmedetomidine a preferable sedating agent in children undergoing MRI.

Conflict of Interest: None

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