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INTRAMASCULAR DEXMEDETOMIDINE AS AN ALTERNATE APPROACH TO SEDATION IN PAEDIATRIC AGE GROUP UNDERGOING NON -CONTRAST MRI IMAGING

Anaesthesiology

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ABSTRACT

Background: Sedation is of utmost importance in paediatrics age group for imaging purposes like MRI scanning. There are various techniques for achieving sedation in young children, however intramuscular dexmedetomidine had not described. **Objective:** To determine the efficacy and safety of intramuscular Dexmedetomidine for sedation & anxiolysis in non-contrast MRI imaging in patients of paediatric age group. **Materials and Methods:** 30 cases of paediatric age group (4-14 years) referred for non-contrast MRI imaging fulfilling the inclusion criteria were reviewed. A single or repeated doses of 1–4 μg/kg intramuscular dexmedetomidine had been administered to achieve a minimum Ramsay sedation score of 4. Patient demographics, diagnosis, vital signs, adverse events, and outcome measures were reviewed. **Results:** A total of 30 children underwent successful MRI imaging under IM dexmedetomidine sedation with an average dose of (58 ± 16.32) μg. Average time to achieve minimum Ramsay sedation score of 4 was (14.20 ± 0.86) minutes. There were no significant variations of heart rates and MAPs from baseline values in study population. **Conclusion:** Intramuscular dexmedetomidine is found to be effective in achieving sedation in children undergoing non contrast MRI without any adverse effects requiring active intervention. Moreover, it can be used as an alternative approach without requiring IV access.

KEYWORDS

Intramuscular Dexmedetomidine, Paediatric Sedation, Safety

INTRODUCTION:

There has been an increase in diagnostic and therapeutic procedures in paediatric radiography. It is difficult and sometimes even impossible to obtain quick and high-quality images without employing sedating techniques in certain children. The ultimate goal of Sedation in radiology is to provide safety and comfort for the patients.

Dexmedetomidine is a highly selective α2-adrenoceptor agonist that causes dose-dependent sedation, anxiolysis and analgesia without respiratory depression. It's only approved indication by US FDA (1999) for provision of short-term sedation (<24 h) in adult patients in ICU settings who are initially intubated and mechanically ventilated. Dexmedetomidine is being used off-label as an adjunctive agent in paediatric patients for sedation and analgesia, in critical care unit during non-invasive procedures. Drugs like propofol, ketamine and midazolam has been used for sedation purposes.

The disadvantages of these agents are largely related to their long duration of action & their associated prolonged recovery times & sedation related morbidity. Dexmedetomidine has several potential beneficial effects over older sedative including its faster onset of action, minimal respiratory depression and an option for repeated administration when needed for special procedures. Intramuscular Dexmedetomidine administration might avoid the most serious risks and complications associated with IV Dexmedetomidine & might reduce the need for titration of the dose essential for IV sedation[1]. This study is designed to determine the effects of IM Dexmedetomidine 1-4 μg /kg of body weight in MRI group for non-contrast radiological imaging and monitoring hemodynamic status in study population.

AIM OF STUDY:

To evaluate the safety and efficacy of intramuscular Dexmedetomidine for sedation and anxiolysis in non-contrast MRI imaging in patients of paediatric age group and to study the hemodynamic response and adverse effects related to drug.

MATERIALS & METHODS:

The present study was carried out in the Department of Anaesthesiology and critical care of Assam Medical College and Hospital, Dibrugarh for a period of one year (June 2021 to May 2022) with due permission from Institutional Ethics Committee of Assam Medical College and Hospital. A hospital based Observational Study was carried out in 30 cases of paediatrics age group (4-14 years) with following inclusion and exclusion criteria:

Inclusion Criteria:

- Patient who has given written informed consent.
- Patient aged 4-14 years
- ASA grading ASA I & II

Exclusion Criteria:

- ASA grade III and IV
- Obstructive sleep apnoea syndrome
- Cardiovascular, liver or renal disease
- Unsatisfactory preprocedural peripheral arterial oxygen saturation
- Neurological or psychiatric disease
- Coagulation disturbances
- Relevant drug allergies
- Obese patients

All patients underwent a detailed pre-anaesthetic evaluation and relevant investigations were carried out in OPD basis before the procedure. The patients were explained about the study procedure and a written informed consent was taken. Pre-procedurally, patients were prepared to maintain nil per oral status for 6 hours for solid, 4 hours for semi-solid & 2 hours for clear fluid. Patients were also instructed regarding the use of sedation assessment tool of Ramsay sedation scale ranging from 1 to 6[2].

Technique of Intervention:

On arrival, baseline vitals were measured (SpO2, Blood pressure, Heart rate). After proper anti-sepsis of the deltoid area an initial dose 1-4 μg/kg of undiluted dexmedetomidine for non-contrast MRI imaging were administered with the intent to achieve a Ramsay sedation score of 4. A repeat second dose of 1 μg/kg undiluted dexmedetomidine were administered intra-muscularly at second deltoid region if Ramsay sedation score of 4 was not achieved or maintained after a minimum observation period of 15 mins. Patient was monitored at regular intervals for sedation by Ramsay sedation scale. Heart rate was measured pre-procedurally, at 30 seconds,1 minute, 2 minutes, 3 minutes, 5 minutes, 10 minutes, 15 minutes, 30 minutes, 1 hour, 2 hour & 4 hours, respectively. MAP & SpO2 were also measured pre-procedurally, at 5 minutes, 10 minutes, 15 minutes, 1 hour, 2 hours & 4 hours respectively. The values were monitored non-invasively and

documented as described from the time of first dose of dexmedetomidine until discharge criteria were met in accordance with American academy of paediatrics guidelines[3]. Recovery unit discharge criteria include a return to a minimum Ramsay sedation score of 2. Periprocedural side effects if any were treated and recorded (e.g., hypertension, hypotension, bradycardia, tachycardia, arrhythmia, hypoxia, nausea, vomiting, excess secretions and respiratory depression)[4].

RESULTS:

Thirty paediatric patients undergoing MRI imaging received intramuscular dexmedetomidine. All patients underwent successful MRI imaging and were included in the analysis. The demographic data of study population & diagnosis were given below.

Table 1. Demographic data of study population

Demographic data		MRI (n =30)
AGE (years)		9.67 ± 2.35
SEX	Boys	17 (56.66%)
	Girls	13 (43.33%)
WEIGHT (kg)		29.00 ± 8.16
DIAGNOSIS	Encephalopathy	4 (13.33%)
	seizures	10 (33.33%)
	Developmental delay	12 (40.80%)
	macrocephaly	4 (13.33%)

Two paediatric patients undergoing MRI imaging received a second dose of dexmedetomidine to achieve Ramsay sedation score of 4. The average dose received by the study population was (58 ± 21.32) µg or 1.9 µg /kg. The mean time to achieve minimum Ramsay sedation score of 4 was (14.20±0.86) minutes. Mean duration of the procedure for non-contrast MRI was (18.9± 3.1) minutes.

Hypertension, hypotension, and bradycardia were defined for this study as a deviation of 20% from age-adjusted awake normal values[4]. This 20% deviation was from normal age adjusted value as pre-procedural vitals may not reflect the child's normal resting hemodynamic parameters in an inadvertent environment like nil per oral status, anxiety of anticipating IM injection.

None of the patients had hypertension, hypotension, bradycardia or fall in SpO2 in the present study. Two children in the current study had received one extra dose of IM dexmedetomidine 1 µg /kg after failing to achieve Ramsay sedation score of 4 with initial dose.

Table 2. Sedation characteristics of study population

Characteristics	Mean ±SD
Total Dose (µg)	58 ± 21.32
Time to achieve sedation (mins)	14.20±0.86
Duration of procedure (mins)	18.9±3.1
Total duration of sedation (mins)	56.7±14.3
Recovery time (mins)	20.1±3.6

DISCUSSION:

Despite not yet having paediatric approval, publications describe administering dexmedetomidine to children via IV, nasal, subcutaneous, and buccal methods.[4] Although intramuscular dexmedetomidine for surgical premedication in adult had been described as early as 1991[5,6] but few studies had described intramuscular delivery of dexmedetomidine in children.[4]

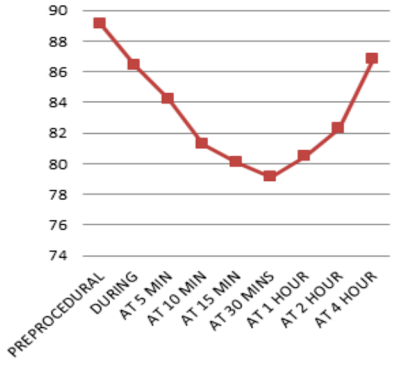
Dexmedetomidine has elimination half-life of approximately two hours. Pharmacokinetics of dexmedetomidine in the paediatric age group is similar to that of adult.

Following IM dexmedetomidine with an average dose of 1.9 µg /kg, sedation was achieved in 93.33% cases(28 out of 30 children)while one extra dose of 1 µg /kg required in two children. The average dose of IM dexmedetomidine administered in our study population was more than those used for adult sedation via IV route.

Mean time to achieve minimum Ramsay sedation score of four was 14 minutes which is equivalent to the time(12minutes)required to achieve peak concentration in adult after IM dexmedetomidine [7] with a dose of 2 µg /kg. There was no dose dependent deviation of heart rate & MAP observed 20% from age-adjusted awake normal values. Graph 1 Table 3

Table 3 and graph 1 show MAP variations of study population sequentially measured over a period of four hours

MAP (mm hg)	MRI	
	MEAN	SD
PREPROCEDURAL	89.1	4.27
DURING	86.4	5.67
AT 5 MIN	84.2	6.16
AT 10 MIN	81.24	5.48
AT 15 MIN	80.07	5.68
AT 30 MINS	79.1	6.02
AT 1 HOUR	80.5	4.68
AT 2 HOUR	82.3	3.87
AT 4 HOUR	86.78	4.71

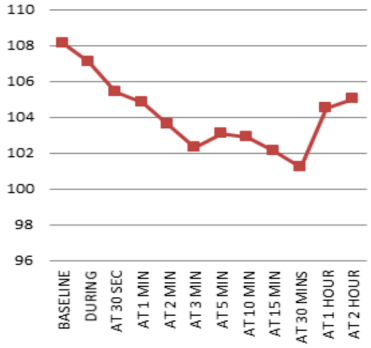


Graph 1

In a study conducted by **Dyck JB *et al,***[7] the mean time to achieve peak concentration in adults after receiving 2 mcg/kg of dexmedetomidine intramuscularly was 12 minutes (range: 2–60 minutes). This time period was often accompanied by a 20% reduction in mean arterial pressure from baseline at 4 hours and a 5% decline in baseline heart rate. In our study population, highest decline of MAP by 11.22% and 6.38% decline in heart rate from baseline values observed at 30 minutes interval. No participants showed deviation of more than 20% from age adjusted awake normal values of MAP and heart rate. Oxygen saturation throughout the procedure were around 98 -100%.

Table 4 and graph 2 show heart rate variations of study population sequentially measured over a period of four hours

HR (bpm)	Measured HR	
	MEAN	SD
BASELINE	108.1	9.55
DURING	107.1	9.61
AT 30 SEC	105.4	9.98
AT 1 MIN	104.8	10.93
AT 2 MIN	103.6	10.22
AT 3 MIN	102.3	11.79
AT 5 MIN	103.1	10.65
AT 10 MIN	102.9	11.08
AT 15 MIN	102.1	11.39
AT 30 MINS	101.2	10.34
AT 1 HOUR	104.5	10.10
AT 2 HOUR	104.99	9.17
AT 4 HOUR	107	8.17



Graph 2

We propose that once sedation is attained, patients may stay sedated throughout the procedure. When a patient enters the recovery unit, the routine stimulations are sufficient enough to awake the patients to meet the discharge criteria.

CONCLUSION:

In our study, IM Dexmedetomidine was found effective in producing sedation in children undergoing non-contrast MRI imaging. Hemodynamic parameters (Heart rate, mean blood pressure, Oxygen saturation) were stable during the procedure**.** There were no observed side effects in any of the group that required active intervention during the study period.

Thus, our study demonstrates that the IM dexmedetomidine may be an alternative approach in children undergoing sedation in non-contrast radiological imaging procedures. This day care procedure avoids IV access.

Limitations Of Our Study:

It is an observational study. It would have been more valid if we could have undertaken a double blinded randomized controlled trial.

This study had a sample size of 30 patients. More studies with larger sample size should be conducted for confirmation of results.

In the present study patients with ASA grade III & IV were excluded hence sedation could not be assessed in this high-risk groups.

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