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TOPIC-Safety and Efficacy of Single Intramuscular Dose Dexmedetomidine for Pediatric Sedation for CT scans

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A B S T R A C T

Effective sedation is crucial for pediatric patients undergoing CT scans, however the use of intramuscular dexmedetomidine for this purpose hasn't been extensively explored. Our aim was to assess the efficacy and safety of intramuscular dexmedetomidine for sedation and anxiety relief during CT imaging in pediatric patients. We reviewed 30 cases of children aged 4-14 undergoing non-contrast CT Scan, who received single or multiple doses of 1 mcg/kg intramuscular dexmedetomidine to achieve a minimum Ramsay sedation score of 4.We analyzed patient demographics, diagnoses, vital signs, adverse events, and outcomes. Our findings indicate that all 30 children successfully underwent CT Scan under intramuscular dexmedetomidine sedation, with an average dose of 2.55±0.55 µg and an average time to achieve a minimum Ramsay sedation score of 4 of 14.07±0.88 minutes. Importantly, there were no significant changes in heart rates and mean arterial pressures from baseline values. In conclusion, intramuscular dexmedetomidine proves to be an effective and safe sedation option for pediatric patients undergoing non-contrast CT scan, offering an alternative approach that does not require intravenous access

Key Words: *Intramuscular Dexmedetomidine, Safety, Sedation.*

INTRODUCTION:

The utilization of diagnostic and therapeutic procedures in pediatric radiography has seen a notable rise. Obtaining swift and high-quality images can pose challenges, often necessitating the use of sedation techniques, particularly in certain pediatric cases where it may be difficult or even unattainable otherwise. The primary objective of employing sedation in radiology is to ensure the safety and comfort of patients.

Dexmedetomidine, a highly selective α2-adrenoceptor agonist, induces sedation, anxiolysis, and analgesia in a dose-dependent manner without causing respiratory depression. Its sole approved indication by the US FDA in 1999 was for short-term sedation (<24 h) in adult patients in ICU settings who are initially intubated and mechanically ventilated. However, dexmedetomidine is frequently used off-label as an adjunctive agent in pediatric patients for sedation and analgesia, particularly in critical care units during non-invasive procedures. Other drugs such as propofol, ketamine, and midazolam have also been utilized for sedation purposes.

The drawbacks associated with these agents are primarily linked to their prolonged duration of action, resulting in extended recovery times and sedation-related morbidity. Dexmedetomidine offers several potential advantages over traditional sedatives, including its rapid onset of action, minimal respiratory depression, and the option for repeated administration as needed for special procedures. Administering dexmedetomidine intramuscularly may mitigate the most serious risks and complications associated with intravenous dexmedetomidine and possibly decrease the need for dose titration essential for intravenous sedation.[1]

This study aims to assess the effects of intramuscular dexmedetomidine at doses ranging from 1 to 4 µg/kg of body weight in pediatric patients undergoing CT Scan for non-contrast radiological imaging while also monitoring their hemodynamic status.

AIM:

To assess the safety and effectiveness of administering intramuscular Dexmedetomidine for sedation and anxiety reduction during non-contrast CT scans in pediatric patients and to examine the changes in hemodynamic responses and any potential adverse effects associated with the medication.

MATERIALS AND METHODOLOGY:

This study was conducted at the Department of Anaesthesiology and Critical Care at Assam Medical College and Hospital in Dibrugarh over a one-year duration, spanning from June 2021 to May 2022. Approval for the study was obtained from the Institutional Ethics Committee of Assam Medical College and Hospital.
It was carried out in 30 cases of paediatrics age group (4-14 years) with following inclusion and exclusion criteria:

Inclusion Criteria:

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

Exclusion Criteria:

1. ASA grade III and IV
2. Obstructive sleep apnoea syndrome
3. Cardiovascular, liver or renal disease
4. Unsatisfactory preprocedural peripheral arterial oxygen saturation
5. Neurological or psychiatric disease
6. Coagulation disturbances
7. Relevant drug allergies
8. 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 2 ranging from 1 to 6.[2]

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 CT 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 preprocedurally, 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 3 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 4 depression) .[4]

RESULTS:

Thirty paediatric patients undergoing CT imaging met our inclusion criteria were included in our study. They were given intramuscular dexmedetomidine and all of them could undergo CT imaging successfully. The demographic details of the patients & the diagnose are tabulated below.

Table 1. Demographics and diagnoses.

Demographic data		CT (n=30)
AGE (years)		9.20 +/- 2.21
SEX	BOYS	16
	GIRLS	14
WEIGHT (Kg)		25.53 +/- 5.51
DIAGNOSIS	Encephalopathy	4 (13.33%)
	Seizures	11 (36.66%)
	Developmental Delay	12 (40.8%)
	Macrocephaly	3 (10%)

Table 2. Sedation characteristics

Characteristics	Mean +/- SD
Dose (microgram/kg)	2.55 ± 0.55
Time to achieve sedation (mins)	14.07±0.88
Duration of procedure (mins)	2± 0.67
Total duration of sedation (mins)	56.7 +/- 14.3
Recovery time (mins)	20.1 +/- 3.6

None of the patients needed a second dose. The average dose received by the study population was (2.55 ± 0.55) µg /kg. The mean time to achieve minimum Ramsay sedation score of 4 was (14.07±0.88) minutes. Mean duration of the procedure for non-contrast MRI was (2± 0.67) minutes.

We defined Hypertension, hypotension, and bradycardia for this study as 20% deviation from age-adjusted awake values. The normal age adjusted values were taken as reference as pre- procedural vitals may be different from the child's normal resting parameters owing tofactors like anxiety of anticipating IM injection, nil per oral status, etc.

Nohypertension, hypotension, bradycardia or fall in SpO2 were noted in the present study.

Table 3 and graph 1 show Heart Rate variations measured over a period of four hours

HR	CT	
	MEAN	SD
PREPROCEDURAL	108.07	9.73
DURING	106.8	9.3
AT 30 SEC	105.13	9.64
AT 1 MIN	104.12	9.21
AT 2 MIN	104	9.9
AT 3 MIN	103.5	11.42
AT 5 MIN	103.9	10.67
AT 10 MIN	103.93	10.48
AT 15 MIN	104.8	11.27
AT 30 MINS	105.1	10.33
AT 1 HOUR	105	10.28
AT 2 HOUR	106	10.86
AT 4 HOUR	107.4	10

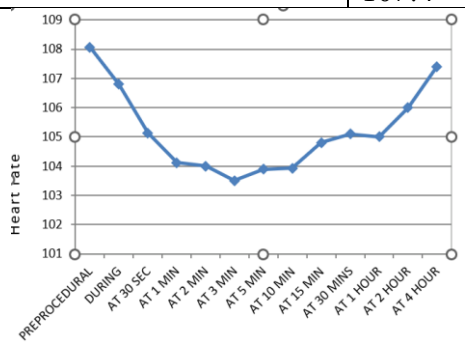
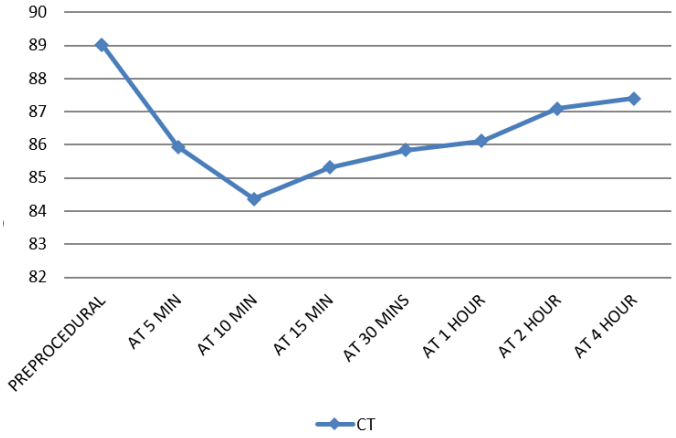


Table 4 and graph 2 show MAP variations measured over a period of four hours

MAP	CT	
	MEAN	SD
PREPROCEDURAL	89.02	3.02
DURING	86.70	3.87
AT 5 MIN	85.93	4.54
AT 10 MIN	84.36	4.68
AT 15 MIN	85.31	4.13
AT 30 MINS	85.84	3.81
AT 1 HOUR	86.11	4.07
AT 2 HOUR	87.09	3.20
AT 4 HOUR	87.40	3.01



DISCUSSION:

Though not approved for paediatric use yet, various studies have reported use of Dxmedetomidine through different routes viz. IV, nasal, subcutaneous, and buccal in children.[4]However intramuscular use of dexmedetomidine has been described in adults as surgical premedication.[5,6]

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 2.55 ± 0.55µg /kg, sedation was achieved in all the cases, none requiring any extra dose.The duration to reach a Ramsay sedation score of four was roughly 14 minutes, mirroring the time it takes (12 minutes) to attain peak concentration in adults following intramuscular administration of dexmedetomidine at a dosage of 2 µg/kg. No significant variations in heart rate or mean arterial pressure (MAP), deviating more than 20% from age-adjusted awake normal values were observed.

In a study, Dyck JB et al[7] reported the mean time to achieve peak concentration after a dose of 2 mcg/kg of dexmedetomidine intramuscularly in adults was 12 minutes (range: 2–60 minutes). This was often accompanied by a 20% decline in MAP from baseline at 4 hours and a 5% reduction in baseline heart rate. In our study however, the highest decline of MAP and heart rate were by 11.22% and 6.38% respectively at 30 minutes interval. No one showed more than 20% deviation from age adjusted reference values of MAP and HR. Oxygen saturation was maintained throughout the procedure (98 -100%).

We observed that after adequate sedation, patients stayed sedated for the entire procedure. In the recovery unit, routine stimulations sufficed to awaken the patients enough to meet the criteria for discharge.

CONCLUSION:

We observed in our study that intramuscular Dexmedetomidine effectively sedated children posted for non-contrast CT imaging while maintaining parameters like heart rate (HR), mean blood pressure (MAP), and oxygen saturation throughout the study. Further, no adverse effects were observed in the study that required intervention. Therefore we conclude that intramuscular Dexmedetomidine is an effective alternative for sedation in children undergoing imaging in a day care scenarioand where there is some difficulty in establishing an IV line.

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