The Journal of Emergency Medicine, Vol. ■, No. ■, pp. 1–13, 2018

0736-4679/$ - see front matter

https://doi.org/10.1016/j.jemermed.2018.04.025

Clinical Review

SYSTEMATIC REVIEW: RECTAL ADMINISTRATION OF MEDICATIONS FOR PEDIATRIC PROCEDURAL SEDATION

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☐ **Abstract—Background: Per rectum (PR) medication delivery is an alternative to traditional oral (PO), intravenous (IV), or intramuscular (IM) administration of medication for procedural sedation of pediatric emergency department patients. However, many emergency physicians are unfamiliar with its use, and there are no widely adopted guidelines or reviews dedicated to this topic. Objective: Our aim was to provide emergency physicians with an overview of PR procedural sedation medications in pediatric patients. Methods: We performed a PubMed literature search of relevant keywords limited to studies of human subjects published in English between January 1, 1990 and December 31, 2017. We excluded case reports, general review articles, editorial/opinion pieces, correspondence, and abstracts. Two of the authors then conducted a structured review of the selected studies. Results: A total of 315 PubMed citations meeting the search criteria were found. Twenty-eight articles were included for final detailed review. Only 4 of the 28 included studies were conducted in the emergency department setting. A total of 9 different medications have been studied for PR procedural sedation. Sedation effectiveness ranged from 40% to 98%. No life-threatening complications were reported in any of the included clinical trials. Hypoxia was found to occur in up to 10% of those receiving PR sedation. Conclusions: Pediatric procedural sedation with PR medications appears to be feasible, moderately effective, and safe based on our review of the current literature. However, further studies on its applicability in the emergency department setting are needed.**

☐ **Keywords—pediatric; rectal; sedation; review**

INTRODUCTION

Effective management of pain and anxiety in the pediatric emergency department (ED) patient is important not only for patient care and family satisfaction, but also for improvement of outcomes for many of the procedures performed in the ED that do not warrant general anesthesia. Magnetic resonance imaging scans and uncomplicated cutaneous laceration repairs, for example, require patients to remain immobile for extended durations for optimal image quality and wound closure, respectively. In young pediatric patients, sedation is usually necessary to achieve this degree of cooperation and to minimize the trauma associated with the procedure. As emergency physicians become more facile with the use of various sedative medications, use of ED procedural sedation has increased steadily (1).

Medications for sedation are frequently administered via the oral (PO), intravenous (IV), intramuscular (IM), and intranasal (IN) routes. Per rectum (PR) delivery of sedative medications to children is an alternative rarely used by emergency physicians. Advantages of the PR route include minimal active cooperation requirement from the patient, faster and more predictable onset than the PO route, and being less physically traumatic than the IV and IM routes. Additionally, parents and young children are often familiar with rectal temperature measurement and medications being given in suppository format in the ED setting, and may find PR sedation less

Received: 11 January 2018; Final submission received: 26 March 2018;
Accepted: 10 April 2018

threatening than the IN, IV, or IM route. However, the option of pediatric procedural sedation using medications delivered PR is mentioned only briefly in a few of the many review articles on the topic, and to date no synopsis on the spectrum or effectiveness of PR sedative medications has been published (2–8).

Our goal is to review the medical literature and provide emergency physicians with an overview of the use of medications administered via the PR route for the purpose of procedural sedation in pediatric patients, particularly in the ED setting. Specifically, this literature review will attempt to elaborate which PR medications and dosages are most appropriate for pediatric procedural sedation; assess medication effectiveness when delivered PR vs. PO, IV, or IM; and review the adverse effect profiles associated with these sedatives when given PR.

METHODS

We performed a structured review of the medical literature using PubMed, limited to studies published from January 1, 1990 to December 31, 2017. Inclusion criteria were all studies involving human subjects, written in the English language, and containing the following keywords: [“administration, rectal” OR “rectal”] AND [“pediatrics” OR “child” OR “adolescent” OR “teen” OR “children”] AND [“anesthesia and analgesia” OR “sedation”]. For this review, only studies enrolling patients 18 years of age and younger were included. The authors also screened references of the selected articles to search for additional potential relevant studies. Studies utilizing a variety of different operators and clinical settings were closely reviewed, but ultimately only those involving sedation for outpatient imaging or procedures were retained. Articles on sedation and pre-induction of anesthesia in the operating room setting were deemed dissimilar to current emergency medicine practices and were therefore excluded. Abstracts of articles found in this search were assessed independently by two of the authors to determine which papers should be pulled for further review based on suspected relevance to the clinical questions. Studies included for the final detailed review were limited to randomized controlled trials, prospective trials, retrospective cohort trials, and case series in human subjects. Case reports, general review articles, editorial/opinion pieces, correspondence, and abstracts presented at conferences were not included in the formal review.

Each of the selected articles was then reviewed in detail by at least two of the authors. Using definitions established in Supplementary Table 1, we assigned each article a Grade of Evidence based on the research design, methodology, and area of focus. The setting where the study was performed was also noted for each article and broadly categorized into ED, dental, radiology/imaging, and other outpatient settings. Each study was then reviewed in detail and assigned a quality ranking based on a critical assessment of the quality of the design (e.g., focus, model structure, presence of controls) and methodology. The definitions of the quality ranking scores are included in Supplementary Table 2. Finally, recommendations were made based on the review of the literature and assigned a level of recommendation that is defined in Supplementary Table 3.

RESULTS

The PubMed literature search using the method described here resulted in 315 unique articles of human studies written in English. Independent assessment of the article abstracts by two of the authors deemed a total of 28 articles to be appropriate for inclusion in this review, as outlined in Figure 1. These articles consisted of randomized trials (7 trials, 286 patients), prospective descriptive cohort studies (17 studies, 3628 patients), retrospective case reviews (3 reviews, 293 patients), and case series (1 case series, 9 patients).

Clinical Question 1: Which Medications (and Doses) Can Be Given PR for Pediatric Procedural Sedation?

Use of the following PR medications (with dose range) for pediatric sedation have been published in the medical literature:

Chloral hydrate (50–100 mg/kg) (9–11)
Diazepam (5 mg) (12,13)
Ketamine (3–5 mg) (14–16)
S(+)-ketamine (S-isomer of ketamine) (0.75 mg/kg) (17)
Methohexital (25 mg/kg) (18,19)
Midazolam (0.3–1 mg/kg) (13–15,20–26)
Pentobarbital (5 mg/kg) (27)
Thiamylal sodium (10 mg/kg) (28)
Thiopental sodium (15–50 mg/kg) (26,29–36)

Only four of these studies were conducted in the ED setting, mostly to facilitate imaging or laceration repair (19,21,23,29). The remaining studies were conducted in outpatient dental, radiology, and other procedural/imaging settings (9,11–18,20,22,24–28,30–36). Medications that have been studied in the ED setting include midazolam, methohexital, and thiopental.

Recommendation: A number of medications may be given PR for pediatric procedural sedation. However, only midazolam, methohexital, and thiopental have been studied in patients in the ED setting.

Level of Evidence: Class B1