Intramuscular ketamine to facilitate pediatric central vascular access

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ABSTRACT

Objectives: Obtaining prompt vascular access in young children presenting to the emergency department (ED) is frequently both necessary and technically challenging. The objective of our study was to describe our experience using intramuscular (IM) ketamine to facilitate the placement of central venous catheters in children presenting to our ED needing vascular access in a timely fashion.

Methods: We performed a retrospective medical record review of all pediatric patients <18 years of age who presented to our tertiary care pediatric ED between May 1, 1998, and August 7, 2003, and underwent the placement of a central venous catheter facilitated by the use of IM ketamine.

Results: Eleven children met our inclusion criteria. Most of the children were young and medically complicated. The children ranged in age from 6 months to 8 years. The only complication identified was vomiting experienced by an 8-year-old boy. Emergency physicians successfully obtained central venous access in all subjects in the case series.

Conclusions: The use of IM ketamine to facilitate the placement of central venous catheters in children who do not have peripheral venous access appears to be helpful. Emergency physicians may find it useful to be familiar with this use of IM ketamine.

Key words: ketamine; central venous access

RÉSUMÉ

Objectifs : Obtenir un accès vasculaire rapide chez de jeunes enfants reçus au département d'urgence est souvent à la fois nécessaire et techniquement compliqué. La présente étude avait comme objectif de décrire notre expérience d'utilisation de la kétamine intramusculaire (IM) pour faciliter l'insertion de cathéters veineux centraux chez des enfants reçus à notre département d'urgence nécessitant un accès vasculaire en temps opportun.

Méthodes : Nous avons effectué une revue rétrospective de dossiers médicaux de tous les patients pédiatriques âgés de <18 ans reçus à notre département d'urgence pédiatrique de soins tertiaires entre le 1er mai 1998 et le 7 août 2003 et qui subirent l'insertion d'un cathéter veineux central avec l'aide de kétamine IM.

Résultats : Onze enfants répondaient à nos critères d'inclusion. La plupart des enfants étaient jeunes et présentaient des complications médicales. Leur âge variait entre six mois et huit ans. La seule complication identifiée fut des vomissements chez un jeune garçon de huit ans. Les médecins d'urgence obtinrent avec succès un accès veineux central chez tous les sujets de cette étude.

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Conclusions : Le recours à la kétamine IM pour faciliter l'insertion de cathéters veineux centraux chez des enfants chez qui l'accès veineux périphérique est impossible semble être utile. Il pourrait être utile pour les médecins d'urgence de se familiariser avec le recours à la kétamine IM dans un tel contexte.

Introduction

Obtaining prompt vascular access in young children presenting to the emergency department (ED) is frequently both necessary and technically challenging. This is particularly true of medically complicated children, a population that is presenting to the ED with increasing frequency.[1–4] It has been recognized for more than 15 years that an intraosseous needle may be the preferred route for obtaining vascular access in comatose children who lack a peripheral intravenous (IV) catheter.[5,6] However, the placement of an intraosseous needle may not be well tolerated in children who are conscious.[5] When peripheral IV access cannot be established in a timely fashion, a reasonable option is to place a central venous catheter.[4,7] Although simple physical restraint may be adequate for other procedures in the ED,[8] the need for a relatively motionless patient during central venous catheter placement makes this approach suboptimal.

Studies dating to 1974 have documented the use of ketamine administered intramuscularly (IM) for pediatric procedural sedation in the ED.[9–11] Only one of these described the use of IM ketamine to facilitate central venous access, and, although the authors studied over 1000 children in total, only 8 underwent central venous catheter placement and the details of these cases were not reported.[11] In 2001, Green and colleagues reported a series of 442 consecutive ketamine administrations in a pediatric intensive care unit.[12] Of these, 118 involved the placement of central venous catheters. However, most (86%) of the 442 cases received IV rather than IM ketamine, and the authors did not specify which, if any, of the central venous catheter patients received IM ketamine.

The objective of the current study was to describe our ED experience using IM ketamine to facilitate central venous catheter placement in children requiring prompt vascular access.

Methods

We performed a retrospective medical record review of all pediatric patients <18 years of age who presented to our tertiary care pediatric ED between May 1, 1998, and August 7, 2003, and underwent the placement of a central venous catheter. During the study period, detailed nursing assessments were recorded for each patient undergoing sedation in our hospital, and this assessment is a part of the standard medical record. From this cohort, those subjects who underwent procedural sedation based on the billing code were identified and those to whom ketamine was administered were reviewed. Subjects who received IV ketamine and those for whom medical records were unavailable were excluded. The remaining subjects had received IM ketamine prior to the placement of a central venous catheter and constituted the main study cohort. The abstracted data included: age in months for those children less than 2 years of age and age in years for children 2 years of age and older, gender, ketamine dosing, adverse reactions to the administration of ketamine, vascular access sites of both successful and unsuccessful attempts, and related diagnoses. Given the objective nature of the data, inter-rater reliability testing was not performed. No statistical analyses were required for this small case series. This study was approved by our Institutional Review Board.

Results

During the study period, 208 children underwent central venous catheter placement in our ED. Eighteen (9%) had procedural sedation for the line placement. Of these, 3 were excluded because of unavailable medical records and 4 were excluded because they received IV rather than IM ketamine. Table 1 shows that most of the 11 children included in our case series were young and medically complicated. Although 4 children required attempts at more than one vascular access site, all children ultimately had a central venous catheter placed by the emergency physician. A single adverse event occurred: an 8-year-old boy vomited.

Six children received only a single 4 mg/kg IM ketamine dose, while 3 received an additional 4 mg/kg dose. One child received a first 4 mg/kg IM dose and a second 2 mg/kg dose. One child received three 3.5 mg/kg IM ketamine doses.

Discussion

IM ketamine appears to have been helpful to facilitate central vascular catheter placement in our ED. Although this

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was a relatively uncommon indication, with only 11 cases over a 5-year period, emergency physicians were universally successful in obtaining central venous access when ketamine was used.

IM ketamine has been shown to be safe when administered to healthy children in the ED,[11] to children with congenital heart disease in the catheterization lab,[12,13] to children with hemorrhagic shock in the operating room,[14] to children undergoing procedures in the gastrointestinal lab,[15] and to neonates requiring surgery.[16] IM ketamine has been safely administered by dentists,[17] radiologists,[18,19] gastroenterologists,[15] cardiologists,[13] anesthesiologists,[13] pediatric intensivists[20,21] and emergency physicians.[11,21–24] In relevant studies that included ASA (American Society of Anesthesiologists') classification 21 and IV patients, no complications were reported,[11,15] and in our small case series, only one patient had an adverse reaction (vomiting).

Based on the study by Green and colleagues, who reviewed over 1000 IM ketamine sedations and concluded that a dose of 4 to 5 mg/kg was optimal, we typically use an initial IM dose of 4 mg/kg.[25] Of note, the only patient in this series who required 3 ketamine injections had been given initial doses lower than 4 mg/kg. Four patients in this series had peripherally inserted central catheters (PICCs). These are typically used for long-term IV antibiotic therapy or parenteral nutrition, therefore may be less familiar to emergency physicians.[16] Due to the discomfort associated with inserting the catheter through a peripheral puncture into the central circulation, sedation is frequently required. All 4 patients who underwent PICC placement had no complications and tolerated the procedures well.

Limitations

In a retrospective study, the potential for incomplete records and missing data exists. This may include undocumented adverse events or central venous access attempts. Because we had no control over the patient selection process, we cannot provide clear indications as to which specific patients are most likely to benefit from ketamine-facilitated central access. During our study period, there were likely other children who would have benefited from IM ketamine but did not receive it.

During a 5-year period, we found only 11 children who received ketamine for central venous access procedures. In a previous 9-year study, Green and colleagues found only 8 such children.[11] These numbers are not sufficient to demonstrate safety; however, we believe the safety of IM ketamine in the ED has been adequately demonstrated by other authors.[11,21]

Conclusion

IM ketamine appears to be helpful to facilitate the placement of central venous catheters in children who do not have peripheral venous access.

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Table 1. Eleven children who underwent placement of a central venous catheter facilitated by the use of intramuscular ketamine

Age	Gender	No. of doses	No. of attempts	Indication for central venous access	Successful access site
6 mo	M	2	1	Bowel obstruction	Right subclavian
8 mo	F	1	1	Down syndrome, aspiration pneumonia, sepsis	Right subclavian
15 mo	F	2	2	Liver transplant, dehydration, respiratory distress	Right femoral
16 mo	F	3*	3†	Complex cardiac anomaly, post-surgical, respiratory distress, sepsis	Left subclavian
21 mo	F	1	3	Arthrogryposis, denydration, gastrointestinal bleeding	Right subclavian
2 yr	F	1	1	Lung empyema	PICC‡ line
2 yr	M	2	2	Cellulitis and sepsis	Left femoral
4 yr	F	1	1	Osteomyelitis	PICC‡ line
5 yr	F	2*	1	Gastrointestinal bleed and shock	Right internal jugular
6 yr	M	1	1	Nephrotic syndrome, hypoglycemia, metabolic acidosis	PICC‡ line
8 yr	M	1	1	Osteomyelitis	PICC‡ line

*Each dose was 4 mg/kg of intramuscular ketamine except in a 16-month-old, who received 3.5 mg/kg per dose and a 5-year-old whose second dose was 2 mg/kg.
†First 2 doses administered to facilitate intubation. third dose for central venous access attempt.
‡PICC = Percutaneous intravenous central catheter, typically placed in the upper extremity.

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