The Journal of Emergency Medicine, Vol. 57, No. 4, pp. 429–436, 2019

0736-4679/$ - see front matter

https://doi.org/10.1016/j.jemermed.2019.06.048

Original Contributions

RADIOLOGIC IMAGING IN TRAUMA PATIENTS WITH CERVICAL SPINE IMMOBILIZATION AT A PEDIATRIC TRAUMA CENTER

Brandi C. Barnes, MD,* Pradip P. Kamat, MD, MBA,† Courtney M. McCracken, PHD,‡ Matthew T. Santore, MD,§ Michael D. Mallory, MD, MPH,‖ Harold K. Simon, MD, MBA,*¶ and Carmen Denease Sulton, MD*¶

*Division of Emergency Medicine, Department of Pediatrics, Emory University School of Medicine, Atlanta, Georgia, †Division of Critical Care Medicine, Department of Pediatrics, Emory University School of Medicine, Children's Healthcare of Atlanta at Egleston, Atlanta, Georgia, ‡Division of Biostatistics, Department of Pediatrics, Emory University School of Medicine, Atlanta, Georgia, §Department of Pediatrics, Division of Pediatric Surgery, Department of Pediatric Trauma, Children's Healthcare of Atlanta, Atlanta, Georgia, ‖Pediatric Emergency Medicine Associates, Children's Healthcare of Atlanta at Scottish Rite, Atlanta, Georgia, and ¶Department of Emergency Medicine, Emory University School of Medicine, Atlanta, Georgia

Reprint Address: Carmen Denease Sulton, MD, Division of Pediatric Emergency Medicine, Department of Pediatrics, Children's Healthcare of Atlanta at Egleston, 1405 Clifton Road, NE, Atlanta, GA 30322

☐ **Abstract—Background: Pediatric trauma patients with cervical spine (CS) immobilization using a cervical collar often require procedural sedation (PS) for radiologic imaging. The limited ability to perform airway maneuvers while CS immobilized with a cervical collar is a concern for emergency department (ED) staff providing PS. Objective: To describe the use of PS and analgesia for radiologic imaging acquisition in pediatric trauma patients with CS immobilization. Methods: Retrospective medical record review of all trauma patients with CS immobilization at a high-volume pediatric trauma center was performed. Patient demographics, imaging modality, PS success, sedative and analgesia medications, and adverse events were analyzed. Patients intubated prior to arrival to the ED were excluded. Results: A total of 1417 patients with 1898 imaging encounters met our inclusion criteria. A total of 398 patients required more than one radiographic imaging procedure. The median age was 8 years (range 3.8–12.75 years). Computed tomography of the head was used in 974 of the 1898 patients (51.3%). A total of 956 of the 1898 patients (50.4%) required sedatives or analgesics for their radiographic imaging, with 875 (91.5%) requiring a single sedative or analgesic agent, and 81 (8.5%) requiring more than one medication. Airway obstruction was the most common adverse event, occurring in 5 of 956 patients (0.3%). All imaging procedures were successfully completed. Conclusion: Only 50% of CS immobilized, nonintubated patients required a single sedative or analgesic medication for their radiologic imaging. Procedural success was high, with few adverse events.** © 2019 Elsevier Inc. All rights reserved.

☐ **Keywords—radiologic imaging; cervical spine immobilization; pediatric trauma; sedatives; analgesics**

INTRODUCTION

Despite the low overall incidence of cervical spine (CS) injuries in children, a cervical collar is frequently placed to immobilize the spine in trauma patients presenting to the pediatric emergency department (ED) (1–3). Children with CS immobilization frequently require radiologic imaging due to subtle and unreliable physical examination findings (4). Difficulties in obtaining an accurate trauma history and inability to perform an accurate neurologic examination due to age or distraction are also challenges that may make radiologic imaging necessary (5–7).

Despite concerns about ionizing radiation exposure, computed tomography (CT) is the imaging modality of

RECEIVED: 2 May 2019; FINAL SUBMISSION RECEIVED: 21 June 2019;
ACCEPTED: 29 June 2019

choice in trauma due to the high sensitivity for detection of hemorrhages and fractures (8–10). However, image acquisition in this cohort may necessitate sedation and analgesics due to pain, anxiety, or need for immobilization to acquire quality images. Limited studies have described the use of procedural sedation (PS) in patients with CS immobilization with a cervical collar. The primary objective of this study was to describe the use of PS and analgesia for radiologic imaging of children at a regional trauma center with CS immobilization. The secondary objective was to assess procedural success and adverse events.

METHODS

This study is a retrospective medical record review of sedatives and analgesics for patients with CS immobilization from January 2015 to January 2017. Medical record data were obtained via trained medical records and business intelligence specialists, who worked directly with the primary researchers and statisticians. They are blinded to patient name and any other information other than the demographic variables of direct interest. They were independent and not directly involved with the study design or interpretation of the final results. The study statistician advised on data fields and integrity of the data abstraction. Our Institutional Review Board (IRB# 14-052) approved this retrospective study with a waiver of consent.

Patient Selection

Our institution has two separate campuses, each at a different location. One campus is a Level I trauma center and the other is a Level II trauma center. Annually, the Level I trauma center sees approximately 80,000 patients, and the Level II trauma center sees approximately 100,000 patients. Of this total patient volume, approximately 10–12% are trauma related.

Data were collected via electronic medical records for all trauma patients from birth to 21 years with CS immobilization. “Trauma patients” were defined as ED patients with International Classification of Diseases, Ninth Revision (ICD-9) or ICD-10 trauma diagnoses as identified in Table 1. Patients were classified as “cervical spine immobilized” if a cervical collar was placed at any point prior to acquisition of radiologic images. The cervical collar remained in place for the duration of imaging acquisition. Patients who were endotracheally intubated either in route or on arrival to the ED were immediately excluded from this study. Data extracted included demographics (age, weight, sex), imaging studies performed, and primary diagnoses. Sedatives and analgesics used, whether alone or in combination, were recorded. Adverse events were noted and included cardiac arrest; airway obstruction, including laryngospasm and aspiration; and the need for emergency anesthesia consultation. No patients were excluded due to missing chart data, namely missing demographic information, imaging study performed, sedatives/analgesics required, or missing primary diagnosis.

Sedation Team

At our institution, sedatives and analgesics are administered by pediatric emergency medicine fellowship-trained physicians who are credentialed in providing deep PS. Sedations are performed on an urgent or emergent basis within the ED. The sedation team includes the pediatric emergency physician, the sedation nurse, and the bedside nurse. The ED sedation nurse is responsible for sedation and analgesic medication administration and patient monitoring, whereas the ED sedation bedside nurse is responsible for assisting the physician performing the procedure. Our institution follows the American Academy of Pediatrics guidelines on PS (11).

Sedation Process

When a patient in a cervical collar was deemed to require sedation or analgesia, a presedation assessment was performed by the pediatric emergency physician and the ED sedation nurse. In this population, sedation/analgesia is often required for prolonged imaging, immobility, anxiety, or pain control. Any patients with a difficult airway, extensive facial fractures, morbid obesity, or cardiopulmonary instability were not provided sedation in the ED and were either referred to the Anesthesiology Department or had their procedure completed with an advanced airway. Patients selected for sedation were given medications at the bedside and then transported to the Radiology Department for imaging. When deep sedation was required with propofol, the physician administered propofol and remained at the patient’s bedside until imaging was completed and propofol administration was stopped. All patients are monitored per the American Academy of Pediatrics sedation guidelines (11).

Outcome Measures and Definitions

The outcome measures (defined below) are the occurrence of sedation-related adverse events associated with each sedation encounter and the interventions required for the same.

Sedation-related adverse events have been previously published and are also briefly described in the Appendix (12–15).

We have also used the following previously published definitions for sedation-related adverse events related to sedation practice.

Table 1. Demographic Data*

Characteristic	Finding
Total number of radiologic procedures	1898
Total number of patient encounters	1417
Age median (range), y	8 (3.8–12.75)
Age, y	
<1	173 (9.1)
1–2	201 (10.6)
3–4	214 (11.3)
5–6	203 (10.7)
7–8	242 (12.8)
9–11	318 (16.8)
> 12	547 (28.8)
Sex	
Male	773 (40.7)
Female	1125 (59.3)
Weight, (median) kg	30.5
Primary diagnosis	
Head injury	507 (26.7)
Neck injury	86 (4.5)
Abdominal injury	60 (3.2)
Spinal injury	9 (0.5)
Chest injury	5 (0.3)
Other injury†	1231 (64.9%)

* Data are presented as number (percentage) of radiologic procedures unless otherwise indicated.
† "Other injury" includes primary motor vehicle crash, multiple trauma nonspecific, gunshot wounds, pedestrian vs. automobile crashes, falls, facial injury, and bicycle injury.

Sedation-related minor events. Sedation-related minor events are events that are easily managed by the health care professional. These events are not expected during sedation, yet have low potential to cause irreversible harm to the patient. They may or may not require interventions such as providing jaw thrust, oxygen, airway suctioning, or positive pressure ventilation.

Sedation-related adverse events. Sedation-related adverse events are events that can cause serious irreversible neurologic damage to the patient and always require intervention. Adverse events include airway obstruction, cardiac arrest, laryngospasm (defined as complete or near-complete lack of air movement, with respiratory effort or stridor not relieved by chin repositioning or nasal/oral airway), aspiration, increased level of care or unplanned hospital admission, and need for emergency anesthesia consultation.

Sedation failure. Sedation failure is the inability to complete the procedure or imaging due to a sedation-related cause.

Statistical Analysis

Descriptive statistics were calculated for all variables of interest, including counts, percentages, medians, and interquartile ranges. Wilcoxon rank-sum tests were used to compare continuous variables. Statistical analyses were performed using SAS statistical software, version 9.4 (SAS Institute, Inc., Cary, NC). Statistical significance was considered to be $p < 0.05$ unless otherwise specified.

RESULTS

Patient Demographics

A total of 1417 patients with 1898 imaging encounters met our inclusion criteria. The median age was 8 years (range 3.8–12.75 years), and 773 (40.7%) were male. The most common primary diagnosis was head injury, occurring in 507 of the 1898 patients (26.7%). Patient characteristics and demographic data are given in Table 1.

Type of Radiologic Imaging

A total of 1898 radiologic procedures were reported. A total of 398 patients required more than one radiographic procedure. This was often due to multisystem trauma that required multiple CT scans (Figure 1). The most common radiologic imaging type reported was CT of the head in 974 of the 1898 patients (51.3%) (Table 2).

Sedation or Analgesic Requirements

Of the total 1417 patients who met inclusion criteria, only 696 (49.1%) required sedatives or analgesics. Of the total 1898 procedures documented, 956 (50.4%) required some form of a sedative or analgesic, with 875 (91.5%) requiring a single sedative or analgesic agent and 81 (8.5%) requiring more than one medication. Table 3 provides information on sedation medications, by procedure.

Sedation-Related Adverse Events

Nine total sedation-related adverse events were recorded (Table 4). The most common adverse event noted was upper airway obstruction, occurring in 5 patients (0.3%), followed by hypoxia/desaturation in 3 patients (0.2%) and hypotension with impaired perfusion in 1 patient (0.1%). Of the 5 patients with noted upper airway obstruction, all had a primary or secondary head injury diagnosis. Airway readjustment and oral airway/nasopharyngeal tube placement were the most common sedation-related interventions recorded, occurring in 4 patients (0.2%) each. Blow-by oxygen, continuous positive airway pressure, and bag-valve-mask oxygen were required in 1 patient each. No emergency airway interventions, anesthesia consultation, cardiac arrests, or deaths were documented. All procedures were successful using PS or analgesia.

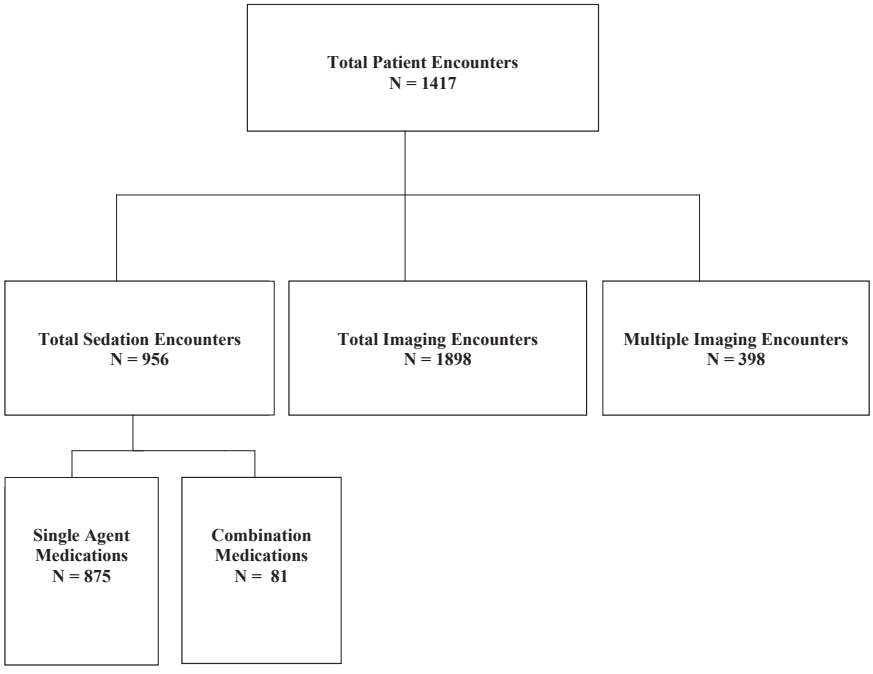

Figure 1. Flow chart of total patient encounters and total imaging encounters.

DISCUSSION

Placement of a cervical collar and use of cervical collar precautions for the significantly trauma-injured child are routinely performed (4). Although the overall incidence of CS injuries in children is < 2%, the mortality rate can be as high as 18–28% (16). This study describes the use of sedation or analgesic medications for radiologic imaging of pediatric trauma patients who have CS immobilization in cervical collars. Our study informs readers that PS or analgesia can be provided to patients with CS immobilization with a very low incidence of adverse events and a high success rate.

Any child in a cervical collar requiring CS immobilization can make airway management challenging, due to the need to minimize or avoid manipulation of the CS (17). Airway management in CS-immobilized or -injured children can be further complicated by the tendency to develop hypoxia, which can be worsened by the use of any sedative or analgesic agent. Frequent airway manipulation techniques increase the risk of secondary neurologic complications (18).

During PS, airway obstruction is the most common adverse event necessitating repositioning of the airway, commonly accomplished with the jaw thrust maneuver (14,19). Airway obstruction that requires airway repositioning using the jaw thrust maneuver or other interventions in patients with CS immobilization undergoing imaging PS can be concerning for the ED staff. However, as shown by our study, most trauma patients with CS immobilization who need PS or sedating analgesic agents require only one agent, with low rates of adverse events and a high success rate.

It is not surprising that none of the patients in our study required jaw thrust maneuvers, which we speculate is attributable to the placement of the cervical collar, which itself provides a prophylactic jaw thrust that may help prevent obstruction of the airway (19–21). Our study also found that most patients with CS immobilization can complete their imaging procedure without deep sedation with propofol, and most studies are completed

Table 2. Imaging Type

Imaging Type	No. (%) of Procedures (n = 1898)
CT head	974 (51.3)
CT abdomen/pelvis	262 (13.8)
MRI maxillofacial	224 (11.8)
CT spine/cervical spine	160 (8.4)
MRI spine/cervical spine	88 (4.6)
CT maxillofacial	66 (3)
MRI head	57 (3)
CT angiogram (head, neck, chest, extremity)	43 (2)
CT chest	5 (0.3)
MRI neck	2 (0.1)
Other*	17 (0.9%)

CT = computed tomography; MRI = magnetic resonance imaging; MRA = magnetic resonance angiography; MRV = magnetic resonance venography.
* Other: MRI chest, MRI pelvis, CT pelvis, MRA neck, CT extremity, MRA/MRV head.

Table 3. Medication Agents Used in Patients Requiring a Sedative or Analgesic Agent

Medication	No. (%) of Patients
Single-agent medications (n = 875)	
Fentanyl	447 (51.1)
Morphine	348 (39.8)
Versed	40 (4.6)
Ativan	17 (1.9)
Propofol	17 (1.9)
Ketamine	0 (0)
Combination medications (n = 81)	
Morphine + Fentanyl	41 (50.6)
Midazolam + Fentanyl	12 (14.8)
Propofol + Fentanyl	6 (7.4)
Midazolam + Morphine	5 (6.2)
Propofol + Fentanyl + Midazolam	4 (4.9)
Ketamine + Fentanyl	2 (2.5)
Ketamine + Fentanyl + Morphine	2 (2.5)
Ativan + Fentanyl	1 (1.2)
Dexmedetomidine + Midazolam	1 (1.2)
Dexmedetomidine + Morphine	1 (1.2)
Propofol + Midazolam	1 (1.2)
Propofol + Ketamine	1 (1.2)
Propofol + Ketamine + Morphine	1 (1.2)
Propofol + Ketamine + Fentanyl	1 (1.2)
Propofol + Fentanyl + Morphine	1 (1.2)
Fentanyl + Midazolam + Morphine	1 (1.2)

using narcotics or benzodiazepines. Fentanyl and morphine were the most commonly used single agents. Fentanyl and morphine followed by fentanyl along with midazolam were the most common combination agents. It is possible that these agents were given more for pain control, with added benefit of immobilization. A potential advantage of using narcotics or benzodiazepines is the ability to use a reversal agent such as naloxone or flumazenil, if the patient should become apneic. In addition, these shorter-acting analgesic or sedation agents may be more desirable for shorter imaging procedures, such as CT scans, making them desirable in the ED due to their shorter recovery period.

Table 4. Adverse Events and Interventions

	No.
Event	
Upper airway obstruction	5
Hypoxia/desaturation	3
Hypotension with impaired perfusion	1
Failed sedation	0
Increased level of care	0
Emergent anesthesia consult	0
Emergent airway intervention	0
Aspiration	0
Laryngospasm	0
Unplanned hospital admission	0
Cardiac arrest	0
Intervention	
Airway readjustment/jaw thrust	4
Oral airway/nasopharyngeal tube insertion	4
Blow-by oxygen	1
Continuous positive airway pressure (CPAP)	1
Bag-valve-mask oxygen	1
Emergent airway intervention	0

As expected, upper airway obstruction was the most common sedation-related adverse event (12). The low adverse event rate is likely explained by the use of a single narcotic agent or combination of a narcotic and a benzodiazepine, which likely results in a moderate level of sedation (22).

Cravero et al. describe a similarly low rate of sedation-related adverse events in patients requiring deep sedation without CS immobilization (19). In this 2009 study, more than 49,000 deep sedation encounters are described, namely with propofol as the main sedation agent. Opioids and benzodiazepines were the most common adjunct medications. The overall rate of adverse events is low. Airway obstruction rates, specifically, were also very low.

None of our patients received ketamine as a single sedation agent. Ketamine may be an appropriate single-agent choice for painful procedures in the emergency setting, rather than radiographic imaging, because it may not provide the required level of immobility. Ketamine is often a first-line choice as a single sedation agent for painful pediatric procedures, such as laceration and orthopedics repairs due to its analgesic and amnestic properties (23).

A small population of patients in our study required the use of propofol for completion of their imaging studies. These patients required sedation for longer imaging times, such as with magnetic resonance imaging. Magnetic resonance imaging of the face was the third most common imaging study reported in our patient population. Propofol has a documented success rate of more than 98%, specifically, for magnetic resonance imaging scans that may make it more desirable for longer, emergent imaging studies (14,24).

Despite the recent studies of the use of dexmedetomidine in radiologic imaging and the added benefit of dexmedetomidine's role in maintenance of airway and tone, only a small number of our patients received this medication (25,26). It is possible that prolonged duration of induction and increased time to discharge may be reasons that dexmedetomidine was not used for PS in our study. Recent reports of the use of intranasal dexmedetomidine, with decreased hemodynamic adverse events compared with intravenous dexmedetomidine, may warrant further investigation of the use of this drug in trauma patients (27).

Limitations

There are several limitations to this study. We used a retrospective study design that was largely observational. Although the data represent the practice of a single

institution, the institution has one of the largest pediatric emergency medicine programs in the country. As such, this study informs health care professionals, especially in community EDs, that PS or analgesia can be successfully administered in patients with CS immobilization who require various imaging modalities using traditional agents such as opioids and benzodiazepines, with minimal adverse events. Our team is highly organized and trained in moderate and deep sedation. In the ED, moderate and deep sedation is administered by fellowship-trained pediatric emergency physicians. In addition, a sedation service is also staffed by pediatric anesthesia, pediatric critical care, and pediatric emergency medicine providers, who are available for consultation. These physicians also provide procedural sedation services on an outpatient basis as needed at both campuses. We caution that community ED staff providing PS needs adequate training to anticipate, prevent, and manage airway events despite the low frequency noted in our study.

In addition, it is difficult to know the desired or intended level of sedation vs. the level of sedation that was achieved. However, with high success rates, we can assume that most patients reached a level of sedation, anxiolysis, and pain control required for the specific imaging when only a single agent was used, or moderate sedation when a combination of medications was used. We have no data on continuous hemodynamic monitoring or end-tidal dioxide values, although any significant change in blood pressure with impaired perfusion is reported.

CONCLUSION

Pediatric trauma patients with CS immobilization can be successfully sedated for imaging procedures with a very low incidence of adverse events. Most patients can successfully complete their procedure using a single sedative or analgesic. Traditional sedative agents such as opioids or benzodiazepines are often useful sedation or analgesic options. Health care professionals need to be trained in early recognition and management of airway obstruction, which is the most common adverse event seen in this cohort.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jemermed.2019.06.048.

REFERENCES

1. Viccellio P, Simon H, Pressman BD, et al. A prospective multicenter study of cervical spine injury in children. Pediatrics 2001;108:E20.
2. Platzer P, Jaindl M, Thalhammer G, et al. Cervical spine injuries in pediatric patients. J Trauma 2007;62:389–96. discussion 394–6.
3. Polk-Williams A, Carr BG, Blinman TA, et al. Cervical spine injury in young children: a National Trauma Data Bank review. J Pediatr Surg 2008;43:1718–21.
4. Patel JC, Tepas JJ, Mollitt DL, et al. Pediatric cervical spine injuries: defining the disease. J Pediatr Surg 2001;36:373–6.
5. Leonard JR, Jaffe DM, Kuppermann N, Olsen CS, Leonard JC. Pediatric Emergency Care Applied Research Network (PECARN) Cervical Spine Study Group. Cervical spine injury patterns in children. Pediatrics 2014;133:e1179–88.
6. Leonard JC, Kuppermann N, Olsen C, et al. Factors associated with cervical spine injury in children after blunt trauma. Ann Emerg Med 2011;58:145–55.
7. Brenner DJ, Hall EJ. Computed tomography–an increasing source of radiation exposure. N Engl J Med 2007;357:2277–84.
8. McGrew PR, Chestovich PJ, Fisher JD, et al. Implementation of a CT scan practice guideline for pediatric trauma patients reduces unnecessary scans without impacting outcomes. J Trauma Acute Care Surg 2018;85:451–8.
9. Ryu J, Yun SJ, Lee SH, Choi YH. Screening of pediatric facial fractures by brain computed tomography: diagnostic performance comparison with facial computed tomography. Pediatr Emerg Care 2018; https://doi.org/10.1097/PEC.0000000000001397. [Epub ahead of print].
10. Masaracchia MM, Tsapakos MJ, McNulty NJ, et al. Changing the paradigm for diagnostic MRI in pediatrics: don't hold your breath. Paediatr Anaesth 2017;27:880–4.
11. Cote CJ, Wilson S. Guidelines for monitoring and management of pediatric patients before, during, and after sedation for diagnostic and therapeutic procedures: update 2016. Pediatrics 2016;138: e20161212.
12. Mallory MD, Baxter AL, Yanosky DJ, Cravero JP, Pediatric Sedation Research Consortium. Emergency physician administered propofol sedation: a report on 25,433 sedations from the Pediatric Sedation Research Consortium. Ann Emerg Med 2011;57:462–4681.
13. Couloures KG, Beach M, Cravero JP, et al. Impact of provider specialty on pediatric procedural sedation complication rates. Pediatrics 2011;127:e1154–60.
14. Kamat PP, McCracken CE, Gillespie SE, et al. Pediatric critical care physician-administered procedural sedation using propofol. Pediatr Crit Care Med 2015;16:11–20.
15. Jones NE, Kelleman MS, Simon HK, et al. Evaluation of methohexital as an alternative to propofol in a high volume outpatient pediatric sedation service. Am J Emerg Med 2017;35:1101–5.
16. Brown RL, Brunn MA, Garcia VF. Cervical spine injuries in children: a review of 103 patients treated consecutively at a level 1 pediatric trauma center. J Pediatr Surg 2001;36:1107–14.
17. American College of Surgeons Committee on Trauma. Advanced trauma life support. 9th edn. Chicago, IL: American College of Surgeons; 2012.
18. Vanderhave KL, Chiravuri S, Caird MS, et al. Cervical spine trauma in children and adults: perioperative considerations. J Am Acad Orthop Surg 2011;19:319–27.
19. Cravero JP, Beach ML, Blike GT, Gallagher SM, Hertzog JH, Pediatric Sedation Research Consortium. The incidence and nature of adverse events during pediatric sedation/anesthesia with propofol for procedures outside the operating room: a report from the Pediatric Sedation Research Consortium. Anesth Analg 2009;108: 795–804.
20. Podolsky S, Baraff LJ, Simon RR, et al. Efficacy of cervical spine immobilization methods. J Trauma 1983;23:461–5.
21. Moustafa MA, Emara DM, Nouh MR. Effect of a neck collar on upper airway size in children sedated with propofol-midazolam combination during magnetic resonance imaging. Pediatr Anesth 2015; 25:421–7.
22. Grunwell JR, Travers C, Stormorken AG, et al. Pediatric procedural sedation using the combination of ketamine and propofol outside of the emergency department. Pediatr Crit Care Med 2017;18:e356–63.
23. Weisz K, Bajaj L, Deakyne SJ, et al. Adverse events during a randomized trial of ketamine versus co-administration of ketamine and propofol for procedural sedation in a pediatric emergency department. J Emerg Med 2017;53:1–9.

24. Mallory MD, Baxter AL, Kost SI. Pediatric Sedation Research Consortium. Propofol vs pentobarbital for sedation of children undergoing magnetic resonance imaging: results from the Pediatric Sedation Research Consortium. Pediatr Anesth 2009;19:601–11.
25. Sulton C, McCracken C, Simon HK, et al. Pediatric procedural sedation using dexmedetomidine: a report from the Pediatric Sedation Research Consortium. Hosp Pediatr 2016;6:536–44.
26. Sulton C, Kamat P, Mallory M, Reynolds J. The use of intranasal dexmedetomidine and midazolam for sedated magnetic resonance imaging in children. Pediatr Emerg Care June 2017; https://doi.org/10.1097/PEC.0000000000001199. [Epub ahead of print].
27. Reynolds J, Sedillo DJ. The evolving role of intranasal dexmedetomidine for pediatric procedural sedation. Hosp Pediatr 2018;8:115–7.

ARTICLE SUMMARY

1. Why is this topic important?

In the trauma setting, children are often placed in cervical spine precautions to both immobilize and protect the spine. This often necessitates radiographic imaging. Sedation or analgesia is often required to complete these procedures due to pain, anxiety, or both. There are few studies that address analgesia or sedation medication types, adverse events, and procedure success.

2. What does this study attempt to show?

The completion of radiographic imaging where sedating medications are given and a cervical collar in place can make management and manipulation of the airway difficult. This study attempts to describe a large population of cervical spine-immobilized patients at a regional pediatric trauma center. Patient demographic data, imaging data, types of medications used, and adverse events are described in detail.

3. What are the key findings?

This study shows that pediatric patients who may require either analgesia or sedation while cervical spine immobilized can complete their procedures successfully. Over 90% of the patients who required a sedating agent completed their procedure with a single agent.

4. How is patient care impacted?

This study informs health care professions, whether in pediatric, adult, or community settings, that analgesia or sedation can be administered with success to children who are cervical spine-immobilized. Traditional agents such as opioids and benzodiazepines can be used successfully, with few documented adverse events.