

ADVANCES

Emergency department procedural sedation and analgesia: A Canadian Community Effectiveness and Safety Study (ACCESS)

Mark Mensour, MD;* Robert Pineau, MSc, MD;† Vic Sahai, MSc;‡ Jennifer Michaud, BScN, RN§

ABSTRACT

Objectives: To determine the effectiveness and safety of procedural sedation and analgesia (PSA) in a Canadian community emergency department (ED) staffed primarily by family physicians and to assess the role of capnometry monitoring in PSA.

Methods: One hundred and sixty (160) consecutive procedural sedation cases were reviewed from the ED of a rural hospital in Huntsville, Ont. The ED is mainly staffed by family physicians who have received in-house training in PSA. Safety and effectiveness measures were extrapolated from a standardized PSA form by a blinded research assistant.

Results: The mean age of the patient population was 33.6 years (standard deviation = 23.6). Fifty-four percent of the patients were male, and 33% of the cases were pediatric. PSA medications included propofol (84%), fentanyl (51%) and midazolam (15%), and the procedural success rate was 95.6%. The adverse event (AE) rate was 18% and included apnea (10%), inadequate sedation (3%), bradycardia (2%), desaturation (1%), hypotension (1%) and bag-valve-mask use (1%). In those aged ≥ 65 years there was a greater incidence of apnea. There were no episodes of emesis and there were no intubations. A modified jaw thrust manoeuvre was used in 23% of the cases. In the 64% of cases where capnometry was used, there was no association between its use and any AE measures.

Conclusion: Procedural sedation was safe and effective in our environment. Capnometry recording did not appear to alter outcomes, although the data are incomplete.

Key words: emergency department, rural; emergency department, community; family physicians; general practitioners; safety effectiveness; capnometry; procedural sedation and analgesia

RÉSUMÉ

Objectifs : Déterminer l'efficacité et la sécurité de la sédation et de l'analgésie procédurales (SAP) dans un département d'urgence d'un hôpital communautaire canadien doté principalement de

*Assistant Professor, Department of Emergency Medicine, Northern Ontario School of Medicine, East Campus, Sudbury, Ont.; Resident Evaluation Coordinator, Northeastern Ontario Family Medicine Program; Emergency Medicine and Anesthesia, Huntsville District Memorial Hospital, Huntsville, Ont.

†Resident in Family Medicine, Emergency Medicine Program, Northeastern Ontario Family Medicine Program.

‡Northern Health Information Partnership, Northeastern Ontario Medical Education Corporation; Assistant Professor of Health Informatics, Northern Ontario School of Medicine, East Campus, Sudbury, Ont.

§Northeastern Ontario Medical Education Corporation

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médecins de famille et évaluer le rôle de la surveillance par capnométrie de la SAP.

Méthodes : Cent soixante (160) cas de sédation procédurale consécutifs dans un hôpital rural à Huntsville, Ontario furent examinés. Le département d'urgence est principalement doté de médecins de famille ayant reçu une formation sur place sur la SAP. Les mesures de la sécurité et de l'efficacité furent extrapolées à partir d'un formulaire standardisé de SAP par un adjoint à la recherche travaillant en aveugle.

Résultat : L'âge moyen de la population à l'étude était de 33,6 ans (écart-type = 23,6). Cinquante-quatre pour cent des patients étaient des hommes et 33 % étaient des enfants. Les médicaments utilisés pour la SAP incluaient le propofol (84 %), le fentanyl (51 %) et le midazolam (15 %), le taux de succès de la procédure étant de 95,6 %. Le taux d'événements indésirables était de 18 % et comprenaient l'apnée (10 %), la sédation inadéquate (3 %), la bradycardie (2 %), la désaturation (1 %), l'hypotension (1 %) et le recours au sac-valve-masque (1 %). Chez les patients âgés de plus de 65 ans, le taux d'incidence de l'apnée était plus élevé. Il n'y eut aucun épisode de vomissements et aucune intubation. Une manœuvre modifiée de luxation en avant de la mâchoire inférieure fut utilisée dans 23 % des cas. Parmi les cas où on eut recours à la capnométrie (64 %), il n'y avait pas d'association entre le recours à cette technique et aucun des événements indésirables.

Conclusion : La sédation procédurale est une technique sans danger et efficace dans notre environnement. L'enregistrement de la capnométrie n'a pas semblé modifier les résultats, bien que les données soient incomplètes.

Introduction

For more than a decade procedural sedation and analgesia (PSA) has enabled emergency physicians to safely perform pain- and anxiety-free emergent procedures.¹⁻¹⁷ These techniques have greatly improved patient care and comfort, and have been incorporated into emergency medicine training programs; however, they have only been minimally adopted in the non-academic, non-specialty settings.¹⁸⁻²⁰ Many patients in various emergency department (ED) settings may have suffered unduly because of the lack of such an approach. PSA may not have been initiated in such a setting because of a lack of efficacy and safety data. This study was designed to address this question.

Although many anesthetic agents have been proposed, propofol has been shown to be safe and effective, with minimal adverse events (AEs) when used in PSA.^{18,21-23} Standard PSA monitoring protocols include vital signs with O₂ saturations.³ As a further adjunct, end-tidal capnometry measurements have been suggested to better monitor sedated patients.^{24,25}

The objectives of this study are to determine the safety and effectiveness of PSA as provided by family physicians in a Canadian community ED, and to determine if capnometry can positively affect these outcomes.

Setting

The Huntsville District Memorial Hospital in Huntsville, Ont., (pop. 18 000) is a rural hospital with an ED annual census of approximately 30 000 visits/year. Anesthesiol-

ogy, general surgery and internal medicine coverage are available locally, as well as a 6-bed intensive care unit, and both land and air evacuations are available for patient transportation. The ED is staffed primarily by family physicians without formal emergency medicine or anesthesia training. *Canadian Emergency Department Triage and Acuity Scale (CTAS)*²⁶ data for the year of the study are provided in Table 1.

In-house training of established PSA protocols was undertaken by the family medicine and anesthesia staff to ensure its safe utilization by the ED staff. Regular in-house and extracurricular CME activities concerning PSA are encouraged within the ED.

Table 1. CTAS level and age categories of the 160 patients who required procedural sedation in the emergency department of Huntsville District Memorial Hospital during the study period

Variable	Percentage of patients (n = 160)
CTAS level	
I	0.4
II	7.7
III	30.5
IV	41.3
V	20.0
Age group	
Pediatric patients (<18 yr)	32.5
Elderly patients (>65 yr)	22.0

CTAS = Canadian Emergency Department Triage and Acuity Scale

Methods

Discrete PSA events were collected from February 2004 to May 2005 as a prospective consecutive case series. All patients requiring PSA were eligible for inclusion, and informed consent was obtained for the procedure and sedation. No specific research consent was required for the study, as per the Research Ethics Committee of the Sudbury Regional Hospital.

Each procedural sedation event was recorded on a standardized PSA record (Appendix 1), which included the ability to capture capnometry data. Vital signs were continuously monitored and recorded on the PSA record at 2-minute intervals. Physicians performed PSA as per their standard protocol. As such, the choice and dose(s) of medication(s) and the selection of capnometry was at the discretion of the physician(s) involved in the PSA. All patients received supplemental oxygen, most by non-rebreather mask. When performing PSA with propofol, a target fluid bolus of 12 mL/kg of crystalloid was recommended before administration. Typically, 40 mg of preservative-free lidocaine was added to the propofol before administration to minimize discomfort associated with the injection. When available, capnometry nasal prongs were used under the oxygen mask.

Safety was evaluated by the AE rate and the incidence of major airway interventions. The effectiveness of PSA was evaluated by the incidence of procedural success, procedural recall and adequate sedation as judged by the physician and RN. AEs were categorized as follows: 1) apnea — no respiratory effort for >20 seconds; 2) desaturation — O₂ saturation <90%; 3) hypotension — systolic blood pressure <90 mm Hg; 4) bradycardia — heart rate <50 beats/min; 5) inadequate sedation; 6) emesis; 7) unexpected bag-valve-mask (BVM) manoeuvre. The PSA record was formatted to

record discrete AEs. For the purpose of this study the modified jaw thrust was defined as a minor airway intervention, and the unanticipated use of the BVM or the need for intubation were considered major airway interventions. Aggregate data were extracted from the PSA records by a blinded research assistant using a data extraction sheet. Incongruous charting was resolved by consensus decision between the research assistant and the investigators.

Statistical analyses were performed with SPSS Version 13.1. The Pearson χ^2 test (χ^2) was used to assess the relationship between variables with statistical significance set at $p < 0.05$. Ethics approval was received from the Research Ethics Committee of the Sudbury Regional Hospital.

Results

A data extraction sheet was applied to 160 consecutive PSA charts. The average age was 33.6 (SD 23.6) years, and Table 2 describes the frequency of other study variables. One-third (32.3%) of the cases were pediatric and the majority (78.5%) of all cases were orthopedic. One-third (33.8%) of the patients were attended to by a lone physician, with nursing assistance. Table 3 contains the agents used, with an overall success rate of 95.6% (153/160), as judged by the attending physicians. The overall AE rate was 18%, and all were minor, as no intubations were required (Table 4). A modified jaw thrust was used in 36/160 (23%) of the cases, based on the PSA form.

Although a separate analysis showed that patients aged ≥ 65 years had a higher incidence of apnea (25%) than those aged <65 years (8%) ($\chi^2 = 5.49$, $p = 0.019$), there were no other AE associations with older group of patients.

Capnometry was used in 103/160 (64%) of the PSA cases. There were no associations noted between the use of capnometry and total or individual AEs, including apnea; nor was there an association between the use of capnometry and use of the modified jaw thrust manoeuvre. In addition,

Table 2. Details from data extraction sheets for the 160 emergency department patients who received procedural sedation and analgesia during the study period

Variable	No. (and %) of patients (N = 160)
Male	86 (53.8)
Female	74 (46.3)
Pediatric patient (<18 yr)	52 (32.5)
Procedures	
Orthopedic	124 (78.5)
Incision and drainage	11 (6.9)
Cardioversion	6 (3.8)
Other	19 (10.8)

Table 3. Agents used in procedural sedation and analgesia for the 160 study patients

Agent(s)	No. (and %) of patients (N = 160)
Propofol	134 (83.8)
Fentanyl	82 (51.3)
Midazolam	24 (15.0)
Ketamine	8 (5.0)
Etomidate	1 (0.6)
Propofol and fentanyl	69 (43.1)

tion, there was no association between the AE rate and number of physicians involved in the PSA. Males (21/86) were more likely to experience AEs than females (8/73) ($\chi^2 = 4.8, p = 0.029$).

Discussion

The authors could find no other study of family physicians using potent pharmacologic agents for procedural sedation in a rural or community ED. Many smaller EDs in Canada are staffed by a mixture of family physicians, some with additional training in emergency medicine and anesthesia. PSA guidelines followed those recommended by the Canadian Association of Emergency Physicians (CAEP).³ The use of propofol was based on the study by Swanson and colleagues¹⁶ looking at propofol use in the ED setting and 2 other studies outside the ED. The support for the safety of propofol demonstrated here and in larger centres may influence the rating of propofol relative to other agents in the next edition of the Canadian Consensus Guidelines.³

Our physicians have all had in-house training in the use of these medications, and we follow a standardized PSA protocol for monitoring and documenting the event. Some of our ED staff have attended courses offered to educate interested physicians in PSA through organizations such as CAEP. Furthermore, physicians participated in events that were dedicated to reviewing the literature on PSA, and they were trained one-on-one to perform PSA in the patient setting by one of the authors (M.M.). Those who had been trained then went on to educate their colleagues in the ED, thereby assisting in knowledge transfer. All ED physicians were able to join one of the authors (M.M.) in the operating room setting for training in airway management (i.e., modified jaw thrust, BVM ventilation), PSA, and rescue manoeuvres such as rapid sequence induction intubation. Although PSA, as outlined in this study, ap-

pears safe and effective when used by appropriately trained family physicians in a community ED setting, sample size was such that a risk of serious AEs could still be as high as 1.8%.

All of our patients receive supplemental oxygen to maximize the oxygen content of their pulmonary functional residual capacity. We therefore may have additional time before desaturation occurs compared with other PSA protocols where supplemental oxygen is not recommended. Most patients receive a fluid bolus to prevent the hypotensive effects that can be seen with propofol. No increase in complications was noted when fentanyl was used in conjunction with propofol, which is consistent with the literature showing its use is safe and efficacious.⁴⁻⁶ Litman suggested that when propofol is used alone it may cause apnea and necessitate BVM ventilation.²⁷ However, this was not our experience. Of the 134 PSAs where propofol was the primary agent, there were only 2 cases where the BVM was required. When using propofol we usually begin with a 1-mg/kg bolus and look for Verrill's sign (closing of the eyes). If present, we attempt gentle traction in the case of a reduction and provide further propofol in aliquots of 20–40 mg in adults, or if there is a withdrawal to pain, 0.5 mg/kg.

Our nursing staff is trained to perform the modified jaw thrust when airway obstruction is recognized. We strived to ensure normal vitals while performing PSA even though the clinical significance of isolated oxygen desaturation is uncertain. Sleep studies have shown greater desaturation for longer time periods than in our study, without known short-term adverse outcomes.²⁸

The increased apnea noted in patients 65 or older may be due to the initial bolus dosing of 1 mg/kg dosing of propofol. In this age group dosing at 0.5 mg/kg for the initial bolus and waiting longer than the 45–60-second arm–brain circulation time for effect may assist in decreasing the apnea rate. Another option would be to titrate propofol in mini-doses as suggested by Ducharme,²⁹ however, this warrants further study. Again, with no poor patient outcomes in our study, we are uncertain as to the clinical significance of brief periods of apnea. Burton and colleagues³⁰ reported AE rates similar to ours in 3 larger centres (looking at 792 patients) that had used similar dosing of propofol. We found that PSA was safe whether there was one or more physicians present, as long as at least one RN was dedicated to the procedure.

Despite publications stating that end-tidal capnometry may be a useful adjunct,^{24,25} we found no association with the outcome or with AEs in our study. However, use of capnometry measurement was at the discretion of the attending physician, and was only applied 64% of the time.

Table 4. Breakdown of adverse events for the 160 study patients

Adverse event	No. (and %) of patients (N = 160)
Apnea	16 (10.0)
Desaturations	2 (1.3)
Hypotension	2 (1.3)
Bradycardia	3 (1.9)
Emesis	None
Inadequate sedation	4 (2.5)
Bag-valve-mask	2 (1.3)
Intubation	None
Procedure recall	None

Limitations

Although the cases were collected consecutively, the study was essentially a moderately powered retrospective case review of 160 PSA procedures, and the limitations of a retrospective investigation apply. Unfortunately only 64% of the cases used capnometry monitoring, so further study is required.³¹

Conclusions

Procedural sedation and analgesia can be performed safely and effectively in a community ED staffed by family physicians with additional training in these procedures. The use of adjunctive capnometry monitoring requires further study.

Competing interests: None declared.

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Correspondence to: Dr. Mark Mensour, Muskoka East-Perry Sound Health Services, Huntsville District Memorial Hospital, 100 Frank Miller Dr., Huntsville ON P1H 1H7; mensours@cogeco.ca

**HUNTSVILLE DISTRICT
MEMORIAL HOSPITAL**

DRAFT

**PROCEDURAL
SEDATION RECORD**

(addressograph)

Mensour ©

Procedure: Reduction # / Dislocation Cardioversion
 I & D _____ Laceration
 RSI (Rapid Sequence Induction) Other _____

Date: day / month / year **Anesthesia Time: Start** _____ **hrs / Stop** _____ **hrs**

NPO since _____ h Liquid 0-2 h 2-4 h 4-6 h >6 h Height _____ m/in
 Solid 0-2 h 2-4 h 4-6 h >6 h Weight _____ kg/lbs

H_x Prior Anaesthetic Yes No Smoker Yes No COPD Yes No GERD Yes No
 Complications Yes No EtOH Yes No Sleep Apnea Yes No CAD Yes No
 Family H_x MH Yes No Asthma Yes No Aortic Stenosis Yes No
 MH Mag in Hyp tania **ASA Status** _____ **E***

Mallampati** **I** **II** **III** **IV** # **Thyromental distance (fingers)** _____
 Fo **pofo** **A** **h** **r** **2** **h** **h** **LR** **BMI** _____ **g/** **m**² **kw** **tk** **yt** **(m**²**)**
 Aa **De** **idefeq** **ireu** **d** **dit** _____ **(caps /big ed at ure loose?)**

Pre api on: Sa ₂O O₂ nonbre t a e E_O Mo nit or BP uff
 EG Mo nit r In fr md Co sa t C a Cart Su ti on

Pre di on mit T _____ HR _____ BP _____ / _____ RR _____ Sa 2 O _____ Et 2 _____

Dr ug In _____ Tim ofe de ry (talki ng) _____ Co pl ati ons None Apnea (>20sec)
 Proce du re gan _____ Tim Dis ar ged _____ Hypotension (<90sys) Desaturation (<90%)
 Proce du re nd _____ Proce du re cal l Ye No Bradycardia Emesis Inadequate Se dation

TIME (q2min)																		NOTES
BP(mm/ Hg)																		
HR (bpm)																		
RR /m(n)																		
SaO ₂ (%)																		
EtC O ₂ (mm/Hg)																		
Fentanyl (mcg)																		
Propofol/L do(mg)																		<input type="checkbox"/> Titrated to effect
Etomidate (mg)																		<input type="checkbox"/> Form filled out
Midazolam (mg)																		
Ketamine (mg)																		
Bag-Valv e-Mask																		<input type="checkbox"/> None
Apnea Alarm																		<input type="checkbox"/> None
Mod. Jaw T rust																		<input type="checkbox"/> None
Response Voice/Pain/No																		

D/C Criteria: Airway Stable Baseline LOC Able to Sit CVS Stable
 Able to Walk/Talk Can Take PO Fluids D/C Instructions Given

MD must fill out Bold areas Number of staff in room _____ Number of MDs in room _____

Procedure Successful: Yes No

Airway Person: _____ RN/MD **Attending MD:** _____ 3rd person: _____

Appendix 1. Procedural sedation and analgesia record