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Procedural sedation and analgesia in rural and regional emergency departments

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Introduction: Several agents can be administered during procedural sedation and analgesia (PSA) in the emergency department (ED). The purpose of this study was to determine the PSA agents commonly used by physicians working in nontertiary EDs, and to assess the physicians' comfort level administering the agents as well as their knowledge of adverse effects of the agents.
Methods: We distributed a confidential electronic survey to physicians working in nontertiary EDs in southwestern Ontario. Using a 5-point Likert scale, ED physicians were asked to rate their use of older and newer agents used for PSA in the ED, as well as their familiarity with the agents.
Results: A total of 55 physicians completed the survey. The most frequently used drugs were fentanyl (66.0% often or always) and propofol with fentanyl (59.2% often or always). Most respondents stated that they rarely used ketofol (54.2% rarely or never) or etomidate (77.1% rarely or never). Respondents were most comfortable using midazolam or fentanyl (96.1% somewhat or very comfortable), and least comfortable administering etomidate and ketofol (36.5% and 23.1% somewhat or very uncomfortable). These differences were magnified with comparison of physicians with CCFP (Certification in The College of Family Physicians) and CCFP(EM) (emergency medicine) designations. Additionally, etomidate's adverse effects were the least astutely recognized (19%), compared with midazolam combined with fentanyl (63%).
Conclusion: Physicians practising in nontertiary EDs used more often, remained more comfortable with and were more familiar with older sedation agents than newer agents.

Introduction : On peut administrer plusieurs agents pour la sédation et l'analgésie en cours d'intervention dans les services d'urgence. Le but de cette étude était de déterminer quels sont les agents les plus couramment utilisés par les urgentologues d'établissements de soins non tertiaires, de vérifier dans quelle mesure ils se sentent à l'aise de les administrer et de mesurer leur degré de connaissances au sujet des effets indésirables de ces agents.
Méthodes : Nous avons envoyé un sondage électronique confidentiel aux urgentologues des établissements de soins non tertiaires du Sud-Ouest de l'Ontario. En utilisant une échelle de Likert en 5 points, nous les avons invités à classer leur utilisation des agents anciens et récents pour la sédation et l'analgésie en cours d'intervention à l'urgence, de même que leur degré de connaissance de ces agents.
Résultats : En tout, 55 médecins ont répondu au sondage. Les médicaments les plus souvent utilisés ont été le fentanyl (66,0 %, souvent ou toujours) et le propofol avec fentanyl (59,2 %, souvent ou toujours). La plupart des répondants ont affirmé utiliser rarement le kétofol (54,2 % rarement ou jamais) ou l'étomidate (77,1 % rarement ou jamais). Les répondants étaient le plus à l'aise avec le midazolam ou le fentanyl (96,1 % relativement ou très à l'aise) et le moins à l'aise avec l'étomidate et le kétofol (36,5 % et 23,1 % relativement ou très à l'aise). Ces différences étaient amplifiées lorsqu'on comparait les médecins détenteurs d'un CCFM (certificat du Collège des médecins de famille) et d'un CCFM(MU) (médecine d'urgence). De plus, les effets indésirables de l'étomidate étaient les moins bien reconnus (19 %), comparativement à ceux du midazolam allié au fentanyl (63 %).

Conclusion : Les médecins qui exercent dans les services d'urgence des établissements de soins non tertiaires ont utilisé plus souvent des sédatifs plus anciens; ils se sentaient plus à l'aise d'utiliser ce type d'agents et les connaissaient mieux que les agents plus récents.

INTRODUCTION

There are numerous procedures performed in the emergency department (ED) that cause pain and anxiety in patients. Procedural sedation and analgesia (PSA), an essential component of emergency medicine and considered a core skill for emergency physicians,[1] is used to relieve these patients from their pain. The American College of Emergency Physicians defines procedural sedation as

> a technique of administering sedatives or dissociative agents with or without analgesics to induce a state that allows the patient to tolerate unpleasant procedures while maintaining cardiorespiratory function. PSA is intended to result in a depressed level of consciousness that allows the patient to maintain oxygenation and airway control independently.[2]

There are a number of potential anesthetics and analgesics that can be administered during PSA, such as propofol, ketamine, benzodiazepines (e.g., midazolam), opioids (e.g., fentanyl) and etomidate. Each of these drugs has its own benefits and risks, which need to be considered when performing PSA. In addition, the length and type of procedure, and the comorbidities of the patient should be taken into account when selecting the agent.

In urban centres, propofol with fentanyl has become the dominant medication of choice in adults,[3] although ketofol (a combination of ketamine and propofol) has been gaining popularity. However, not much is known about medication preferences in rural and community EDs. We hypothesized that practitioners of rural emergency medicine would be most familiar with traditional agents for PSA. This would highlight a differential practice pattern between rural and urban practitioners in emergency medicine. Our objective was to determine the PSA medications commonly used by a small sample of physicians working in rural and community EDs, and to ascertain their comfort level administering the medications as well as their knowledge of the common adverse effects.

METHODS

We distributed a confidential electronic survey to physicians working in 9 rural and community EDs in southwestern Ontario. The EDs chosen were within a 100-km radius of London, Ont., and were in non-tertiary centres. The communities ranged in population from 300 to 30 000. We contacted ED chiefs by telephone and email in September and October 2010 and asked them to participate in the study. We then emailed the surveys to the identified participants.

Using a 5-point Likert scale, emergency physicians were asked to rate their use of (5 = always use, 1 = never use) and comfort level with (5 = very comfortable, 1 = very uncomfortable) various drugs used for PSA. They were also asked about their knowledge of the adverse effects. We collected participants' demographic and practice characteristics, such as duration and location of practice. We recorded data into a standardized data extraction tool (SurveyMonkey) and analyzed the data using SPSS software. We calculated mean scores, standard deviations (SDs), confidence intervals and rank orders for each question within each study domain.

The Health Sciences Research Education Board at Western University gave ethics approval.

RESULTS

Of the 124 surveys distributed, 55 were returned, resulting in a response rate of 44.4%. Of the respondents, 50.0% had a CCFP (Certification in The College of Family Physicians) designation, 36.5% had a CCFP(EM) (emergency medicine) designation and 13.5% had a CCFP designation with a certification in anesthesia. Most had been in practice for up to 15 years and had performed 11 or more procedural sedations as a certified physician (Table 1). Of the respondents, 18.5% indicated that they had performed procedural sedations with no other personnel present. Among the 52 respondents who required assistance with procedural sedations, a nurse was the staff member most commonly present (Table 2).

The respondents were asked to select how frequently they used a particular medication and to rate their comfort level administering the drugs. We calculated the frequency and mean Likert scores for each. Overall, the most commonly used drugs were fentanyl (mean score 3.52), midazolam with fentanyl (mean score 3.31), propofol with fentanyl (mean score 3.18) and midazolam (mean score 3.10) (Fig. 1). Of the respondents, 42.9%, 54.2% and 77.1% stated that

they rarely or never used ketamine, ketofol and etomidate, respectively (Table 3). Only 73.1% of respondents were somewhat or very comfortable administering propofol combined with fentanyl, whereas a larger proportion were somewhat or very comfortable administering midazolam (96.1%), fentanyl (96.1%) or a combination of the two (94.1%). The largest proportion of respondents were very or somewhat uncomfortable administering etomidate (36.5%), ketofol (23.1%) and ketamine (15.7%) (Table 4).

Table 1. Characteristics of 55 survey respondents

Characteristic	No. (%) of respondents
Sex	
Male	37 (67.3)
Female	18 (32.7)
Designation (n = 52)*	
CCFP	26 (50.0)
CCFP(EM)	19 (36.5)
CCFP(Anesthesia)	7 (13.5)
Years of practice	
≤ 5	22 (40.0)
6–15	20 (36.4)
≥ 16	13 (23.6)
No. of procedural sedations conducted as staff (n = 54)†	
1–5	4 (7.4)
6–10	4 (7.4)
≥ 11	46 (85.2)

CCFP = Certification in The College of Family Physicians; EM = emergency medicine.
*Three respondents did not answer this question.
†One respondent did not answer this question.

Table 2. Category of personnel assisting with procedural sedation, reported by 52 respondents

Personnel	No. (%) of respondents
Another physician	15 (28.8)
Nurse practitioner	1 (1.9)
Nurse	51 (98.1)
Respiratory therapist	21 (40.4)
Resident	2 (3.8)

These differences were magnified with comparison of physicians with CCFP and CCFP(EM) designations. We used the nonparametric Mann–Whitney U test to compare the groups and found statistically significant differences ($p < 0.05$) in the frequency and comfort of use of certain medications. Physicians with the CCFP designation were more likely than CCFP(EM) physicians to use midazolam combined with fentanyl, and midazolam alone (mean Likert scores 3.62 and 3.35, respectively). Physicians with the CCFP(EM) designation were more likely than CCFP physicians to select propofol combined with fentanyl, or ketamine (mean scores 3.82 and 3.00, respectively) (Fig. 2). There were no significant differences in the frequency of use of the other medications. Although there were no significant differences in the comfort level of respondents when administering midazolam, midazolam with fentanyl, or fentanyl alone, physicians with the CCFP designation were much less comfortable administering etomidate, ketofol, ketamine, and propofol combined with fentanyl than CCFP(EM) physicians (Fig. 3). Furthermore, there were no differences in physicians' reported use of medications or their comfort level with administering them when compared with number of years in practice. Thus, drug preference was not likely due to the experience level of the physician, but more likely due to exposure.

The respondents' comfort level administering drugs was related to their knowledge of the drug's adverse effects. Of the respondents, 63% were able

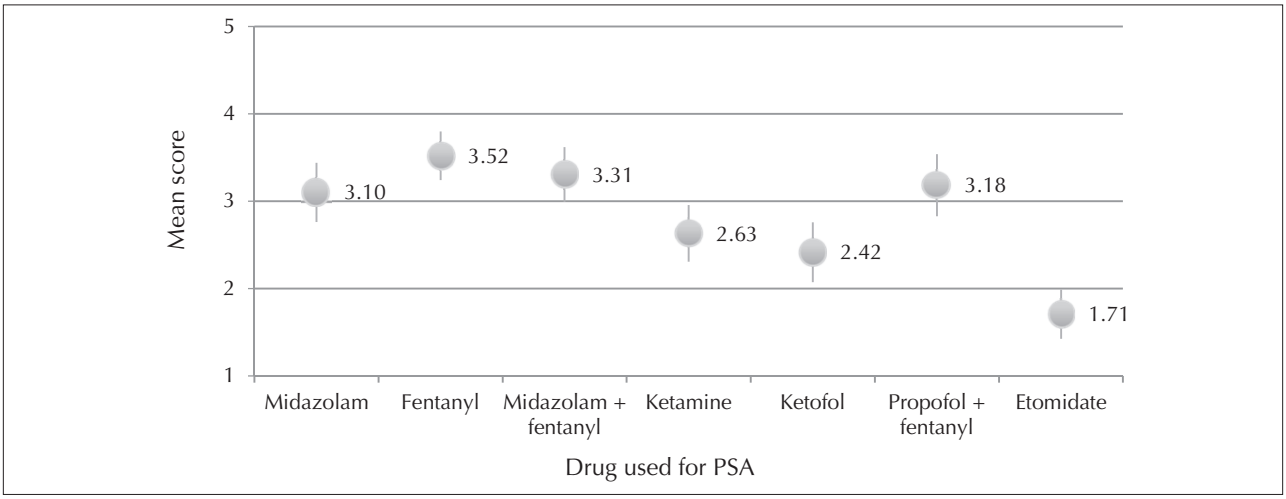

Fig. 1. Mean Likert scores and confidence intervals for frequency of medication use during procedural sedation and analgesia (PSA) in the emergency department (5 = always; 1 = never).

to correctly identify adverse effects of midazolam combined with fentanyl, such as hypoxia, apnea and respiratory depression. Only about 19% were able to identify etomidate's potential adverse effects, such as myoclonus and nausea, and only about 30% were able to identify respiratory depression as an adverse effect.

DISCUSSION

There are a number of different procedures frequently performed in the ED that require the use of PSA. Little is known about the agent(s) of choice for PSA by physicians working in rural and regional EDs. This study helps to identify some of these agents. The physicians surveyed here used medications such as fentanyl, and fentanyl with midazolam more frequently than newer medications such as propofol with fentanyl, ketamine, ketofol or etomidate. Etomidate was hardly used at all, and ketamine and ketofol were also not commonly selected. Physicians in rural and regional EDs seemed more comfortable administering more traditionally used agents.

Interestingly, propofol, which has become the dominant medication for PSA in most urban EDs in Canada,[3] was only the third most popular choice. In addition, only 73% of respondents were somewhat or very comfortable administering propofol combined with fentanyl, compared with the 96% who were comfortable administering midazolam, fentanyl, or midazolam combined with fentanyl.

The benefit of propofol over midazolam and fentanyl has been demonstrated in newer studies.[4,5] Although the degree of adverse reactions is similar, propofol has a shorter sedation time when compared with midazolam and fentanyl. In fact, studies that examined use of propofol for PSA reported recovery times from 7.6 (SD 3.4) minutes[6] to 23 (SD 11) minutes,[7] whereas studies of midazolam combined with fentanyl have shown recovery times ranging from 28.5 minutes[4] to 113.7 (SD 36.9) minutes.[5] Thus, propofol combined with fentanyl involves a shorter procedural time, which means patients tend to have a shorter stay in hospital.[4] This presumably translates into decreased nursing requirements and cost savings, because the total time for continuous patient monitoring is reduced in patients who are administered propofol.[8] Additionally, propofol has other theoretically desirable characteristics. These include its high reliability as a sedative and analgesic, even in highly painful procedures, its consistent duration of action and its very low failure rate.

Although midazolam and fentanyl can be used for more painful and lengthier procedures requiring deeper sedation, such as hip reductions, their sedation effects often outlast the duration of most other procedures, leaving patients sedated longer than required. It may arguably be a preferable option to use a drug such as propofol that leaves the patient at an adequate sedation level only for the duration of procedure.[9] Finally, although some discomfort may be associated with the initial injection, overall, propofol has been ranked high in patient satisfaction because of its euphoric and antiemetic properties.[10] Hence, there may be an increased benefit to administration of newer agents such as propofol over the more traditional agents used by our survey population. However, to our knowledge, no studies directly comparing the use of these agents in rural EDs have been published.

Another PSA medication that has been gaining popularity in urban centres is ketofol. Benefits of ketofol are reported to be its deeper sedation quality,[11] less use of propofol, and higher physician[12] and patient satisfaction.[13] However, in our study, 54% of respondents stated that they never or rarely used this medication, which suggests that it has not gained much traction in these nontertiary EDs. This

Table 3. Reported use of medications for procedural sedation and analgesia (*n* = 55)

	% of respondents		
Medication	Rarely or never	Sometimes	Often or always
Midazolam	36.7	18.4	44.9
Fentanyl	12.0	22.0	66.0
Midazolam + fentanyl	22.4	30.6	46.9
Ketamine	42.9	28.6	28.6
Ketofol	54.2	22.9	22.9
Propofol + fentanyl	26.5	14.3	59.2
Etomidate	77.1	16.7	6.3

Table 4. Reported comfort level administering medications for procedural sedation and analgesia (*n* = 55)

	% of respondents		
Medication	Very or somewhat uncomfortable	Neutral	Somewhat or very comfortable
Midazolam	2.0	2.0	96.1
Fentanyl	2.0	2.0	96.1
Midazolam + fentanyl	3.9	2.0	94.1
Ketamine	15.7	15.7	68.6
Ketofol	23.1	15.4	61.5
Propofol + fentanyl	11.5	15.4	73.1
Etomidate	36.5	17.3	46.2

could be because the benefits of ketofol over other medications are still being researched. Ketofol was originally reported to have a lower risk of respiratory depression compared with propofol; however, this has not been found to be the case in practice.[12] Ketofol and propofol have been associated with comparable adverse events in adults.[13] Nonetheless, ketofol has been shown to result in decreased vomiting in children, compared with ketamine alone.[14] Furthermore, recovery times were short and physician satisfaction was high with the use of ketofol.[13] Thus, ketofol is a viable option for PSA, but it was not commonly used in the nontertiary EDs surveyed.

Our results demonstrate a lack of propofol use in the rural and regional EDs studied. One explanation for this could be the rapid sedation onset seen with propofol. Together with its short-acting properties (compared with midazolam and fentanyl), this can result in rapid shifts in consciousness, breathing ability and blood pressure, which need to be moni-

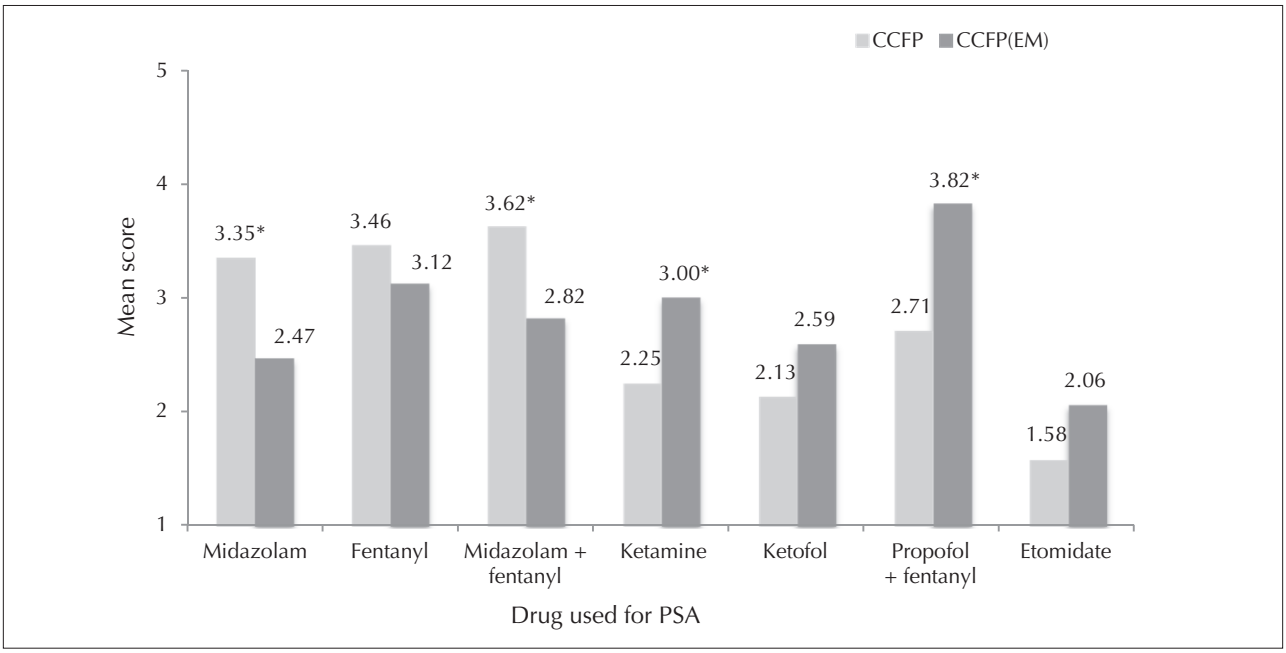

Fig. 2. Mean Likert scores for frequency of medication use during procedural sedation and analgesia (PSA) in the emergency department (5 = always; 1 = never), by CCFP (Certification in The College of Family Physicians) and CCFP(EM) (emergency medicine) designation. *Statistically significant difference ($p < 0.05$).

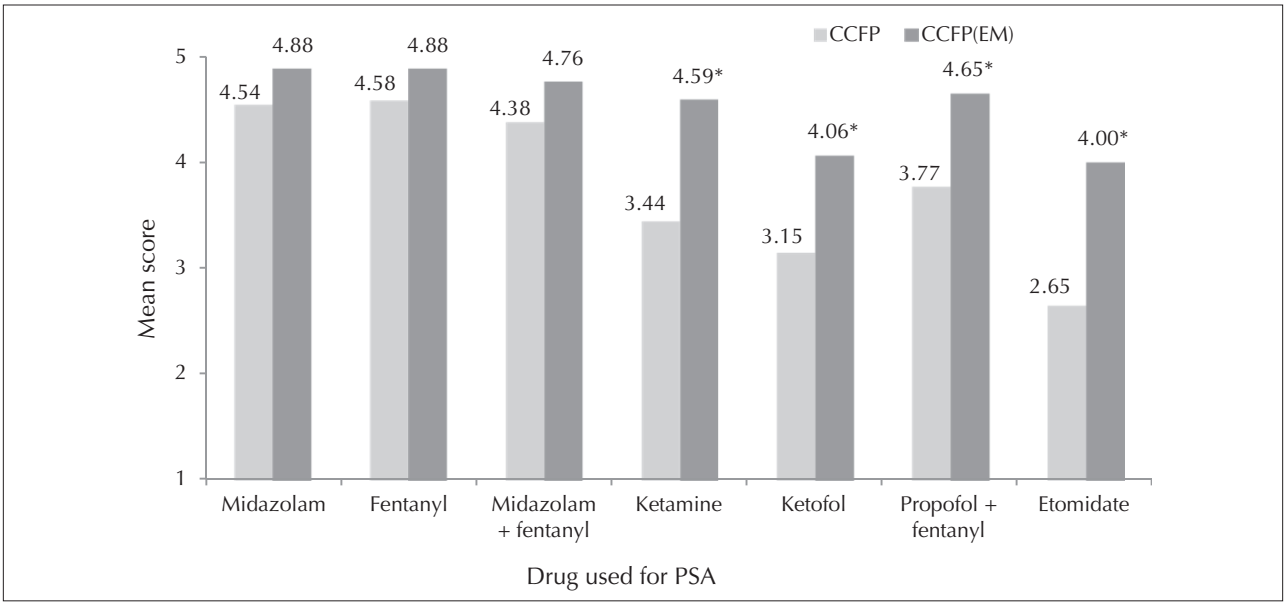

Fig. 3. Mean Likert scores for physicians' comfort level with administering medications during procedural sedation and analgesia (PSA) in the emergency department, by CCFP (Certification in The College of Family Physicians) and CCFP(EM) (emergency medicine) designation. *Statistically significant difference ($p < 0.05$).

tored carefully.[15] This could make physicians in rural and regional EDs uneasy if they do not have previous exposure to such anesthetics or if they have a limited ability to closely monitor patients. Most studies on the benefits of these agents have been conducted in tertiary centres where several personnel were present.[12–14] This may not be possible in smaller EDs, which could increase physicians' reluctance to use newer agents. However, a study conducted using the Procedural Sedation in the Community Emergency Department Registry illustrated that patient safety was maintained regardless of the number of physicians involved.[16] Therefore, the number of physicians available theoretically should not affect the decision about whether to use propofol. However, more practical resource limitations, physician comfort levels and site-specific considerations may pose more substantial barriers in rural and regional EDs.

Pathman's evidence pipeline, which describes 4 stages for moving evidence to practice, could be another possible explanation for the limited acceptance of propofol and newer agents in rural and regional EDs.[17] According to Pathman and colleagues, clinicians must be aware of the evidence, agree with it, adopt it and then adhere to it at appropriate times.[17] Each subsequent step tends to have lower uptake than the previous one. Thus, only a portion of physicians who are aware of the change in evidence end up adopting and adhering to it. However, this does not fully explain the hesitation in using newer agents. If knowledge translation were the sole factor, the degree of propofol uptake would be low among physicians in urban EDs as well. Larger studies are needed to investigate this further.

CCFP versus CCFP(EM)

Differences in drug preferences were magnified with comparison of physicians with CCFP and CCFP(EM) designations. Physicians with a CCFP designation most frequently used midazolam combined with fentanyl, or fentanyl or midazolam alone, and used propofol combined with fentanyl considerably less often. Physicians with a CCFP(EM) designation most frequently used propofol combined with fentanyl, followed by fentanyl alone. Although ketamine was not used often by either group, CCFP(EM) physicians were more likely to select this medication than CCFP physicians. In addition, whereas there was no significant difference in physicians' comfort level in administering fentanyl, midazolam or their combination, CCFP(EM) physicians felt more comfortable administering ketamine, ketofol, propofol combined with fentanyl, and etomidate. The extra training CCFP(EM) physicians gain could be one reason for comfort with the newer agents. This training could also be provided to physicians preparing for rural practice. However, the CCFP(EM) designation is relatively new and may have coincided with a temporal change in paradigm regarding use of sedation agents. Indeed, physicians without the CCFP(EM) designation may be older and may have trained at a time when older sedation drugs were the mainstay of therapy. Because their training is typically done in newer academic centres, CCFP(EM) physicians may be more likely to have been exposed to the use of newer agents. There were no differences in physicians' reported use of medications or comfort level with administering them when compared with number of years in practice, indicating that drug preference was likely not due to the experience of the physician, but more likely due to exposure. If larger studies in rural and regional EDs continue to demonstrate a benefit of newer agents for PSA, residency training programs for rural practitioners could incorporate more information on use of these newer agents, irrespective of formal training in emergency medicine.

Limitations

This study had several limitations. We studied propofol combined with fentanyl rather than propofol alone. We argue that because propofol does not have any analgesic effect, it should ideally be combined with an analgesic, the most common being fentanyl. Thus, theoretically propofol should not be used on its own, although this may not be the case in practice. In addition, we do not believe the decision to use the combination as an option biased the results, because respondents who used propofol alone would have selected propofol combined with fentanyl, and respondents who used the combination would have selected the same option.

This study had a small sample and a low response rate. We recognize that the sample size of 55 physicians and the response rate of 44% are less than ideal; however, we believe our results still represent a trend of clinical practice among surveyed physicians in this practice setting.

We used a survey method that relied on physician recall and so could have been influenced by recall bias. A future study could involve a chart review of the types of medications actually used in EDs for PSA, which would eliminate the recall bias. Alterna-

tively, many centres have a medication dispensing system that can link drug information to patients. This system can be electronically searched and can provide more details about the medications used for PSA.

We did not calculate the sample size or do a power calculation a priori. Our sample was limited in size by the geographic area we chose to investigate and was thus a convenience sample. We compared the means when determining frequency and confidence of drug use, which is an approach typically used for interval data, and not Likert scale items. However, our approach was consistent with Jaccard and Wan,[18] who state, "for many statistical tests, rather severe departures (from intervalness) do not seem to affect Type I and Type II errors dramatically."[18] When comparing physicians with CCFP and CCFP(EM) designations, however, we used Mann–Whitney *U* nonparametric testing, which is suitable for ordinal Likert scale items.

Finally, we focused on physicians' familiarity and comfort with medications used for PSA, but we did not assess safety, and we did not investigate differences in clinical outcomes between sites. Thus, future research could analyze whether PSA performed in community and rural settings using traditional agents is as safe and effective as in urban and tertiary centres using newer agents, and whether clinical outcome measures improve with the use of newer agents in rural and regional EDs.

CONCLUSION

Physicians practising in rural and regional EDs were most comfortable using traditional agents such as midazolam and fentanyl for PSA. Although propofol is one of the commonly used newer agents in urban centres, physicians in the setting studied were less comfortable administering propofol combined with fentanyl than midazolam and fentanyl. In addition, etomidate and ketofol were even less commonly used in the nontertiary EDs examined. These differences were magnified with comparison of physicians with CCFP and CCFP(EM) designations. However, there may be a temporal bias in these designations. Physicians with a CCFP(EM) designation tended to be more comfortable administering the newer medications, but this finding could reflect a newer practice pattern because CCFP(EM) is a newer designation. In addition, the CCFP(EM) group used propofol combined with fentanyl much more frequently than the CCFP group. Finally, the respondents in this survey were less likely to recognize the adverse effects of newer agents. Larger studies are needed to confirm these trends and ascertain the relevance to clinical outcomes and training patterns.

Competing interests: None declared.

REFERENCES

1. Innes G, Murphy M, Nijssen-Jordan C, et al. Procedural sedation and analgesia in the emergency department. Canadian consensus guidelines. *J Emerg Med* 1999;17:145-56.
2. American College of Emergency Physicians. Clinical policy for procedural sedation and analgesia in the emergency department. *Ann Emerg Med* 1998;31:663-77.
3. Bawden J, Villa-Roel C, Singh M, et al. Procedural sedation and analgesia in a Canadian ED: a time-in-motion study. *Am J Emerg Med* 2011;29:1083-8.
4. Taylor DM, O'Brien D, Ritchie P, et al. Propofol verses midazolam/fentanyl for reduction of anterior shoulder dislocation. *Acad Emerg Med* 2005;12:13-9.
5. Kennedy RM, Porter FL, Miller JP, et al. Comparison of fentanyl/midazolam with ketamine/midazolam for pediatric orthopedic emergencies. *Pediatrics* 1998;102:956-63.
6. Zed PJ, Abu-Laban RB, Chan WW, et al. Efficacy, safety and patient satisfaction of propofol for procedural sedation and analgesia in the emergency department: a prospective study. *CJEM* 2007;9:421-7.
7. Vardi A, Salem Y, Padeh S. Is propofol safe for procedural sedation in children? A prospective evaluation of propofol versus ketamine in pediatric critical care. *Crit Care Med* 2002;30:1231-6.
8. Holger JS, Satterlee PA, Haugen S. Nursing use between 2 methods of procedural sedation: midazolam versus propofol. *Am J Emerg Med* 2005;23:248-52.
9. Godwin SA, Caro DA, Wolf SJ, et al. Clinical policy: procedural sedation and analgesia in the emergency department. *Ann Emerg Med* 2005;45:177-96.
10. Green SM, Krauss B. Propofol in emergency medicine: pushing the sedation frontier. *Ann Emerg Med* 2003;42:792-7.
11. Andolfatto, G, Abu-Laban RB, Zed PJ, et al. Ketamine-propofol combination (ketofol) versus propofol alone for emergency department procedural sedation and analgesia: a randomized double-blind trial. *Ann Emerg Med* 2012:59;504-12.e1-2.
12. David H, Shipp J. A randomized controlled trial of ketamine/propofol versus propofol alone for emergency department procedural sedation. *Ann Emerg Med* 2011;57:435-41.
13. Andolfatto G, Wilman E. A prospective case series of single-syringe ketamine-propofol (ketofol) for emergency department procedural sedation and analgesia in adults. *Acad Emerg Med* 2011;18:237-45.
14. Shah A, Mosdossy G, McLeod S, et al. A blinded, randomized control trial to evaluate ketamine/propofol verses ketamine alone for procedural sedation in children. *Ann Emerg Med* 2011:57;425-33.e2.
15. Miner JR, Burton JH. Clinical practice advisory: emergency department procedural sedation with propofol. *Ann Emerg Med* 2007;50:182-7.
16. Hogan K, Sacchetti A, Aman L, et al. The safety of single-physician procedural sedation in the emergency department. *Emerg Med J* 2006;23:922-3.
17. Pathman DE, Konrad TR, Freed GL, et al. The awareness-to-adherence model of the steps to clinical guideline compliance. The case of pediatric vaccine recommendations. *Med Care* 1996; 34:873-89.
18. Jaccard J, Wan CK. *LISREL approaches to interaction effects in multiple regression*. Thousand Oaks (CA): Sage Publications; 1996.