Comparison of Procedural Sedation for the Reduction of Dislocated Total Hip Arthroplasty

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Introduction: Various types of sedation can be used for the reduction of a dislocated total hip arthroplasty. Traditionally, an opiate/benzodiazepine combination has been employed. The use of other pharmacologic agents, such as etomidate and propofol, have more recently gained popularity. Currently no studies directly comparing these sedation agents have been carried out. The purpose of this study is to compare differences in reduction and sedation outcomes, including recovery times, of these 3 sedation agents.

Methods: We performed a retrospective chart review examining 198 patients who presented with dislocated total hip arthroplasty at 2 academic affiliated medical centers. The patients were grouped according to the type of sedation agent. We calculated percentages of reduction and sedation complications along with recovery times. Reduction complications included fracture, skin or neurovascular injury, and failure of reduction requiring general anesthesia. Sedation complications included use of bag-valve mask and artificial airway, intubation, prolonged recovery, use of a reversal agent, and inability to achieve sedation. We then compared the data for each sedation agent.

Results: We found reduction complications rates of 8.7% in the propofol, 24.7% in the etomidate, and 28.9% in the opiate/benzodiazepine groups. The propofol group was significantly different from the other 2 agents ($p \leq 0.01$). Sedation complications were found 7.3% of the time in the propofol , 11.7% in the etomidate , and 21.3% in the opiate/ benzodiazepine group, ($p = 0.02$ propofol vs. others) . Average recovery times were 25.2 minutes for propofol, 30.8 minutes for etomidate, and 44.4 minutes for opiate/ benzodiazepine ($p = 0.05$ for propofol vs. other agents).

Conclusion: For reduction of dislocated total hip arthroplasty under procedural sedation, propofol appears to have fewer complications and a trend toward more rapid recovery than both etomidate and opiate/benzodiazepine. These data support the use of propofol as first line agent for procedural sedation of dislocated total hip arthroplasty, with fewer complications and a shorter recovery period. [West J Emerg Med. 2014;15(1):76–80.]

INTRODUCTION

Hip dislocations are a common complication after total hip arthroplasty but the reported frequency of hip dislocation varies widely. Previous reports found the dislocation rate to be 2.25% for those with a primary total hip arthroplasty versus 7.4% in patients with a revision hip in place.[1,2] Patients who experience this complication most often present to the emergency department (ED) with a great deal of discomfort and an inability to ambulate. The majority of patients with a dislocated total hip need rapid closed reduction as the first step in their treatment. These reductions most likely occur in the setting of the ED with procedural sedation or in the operating room under general anesthesia.[3–5]

Procedural sedation for a prosthetic hip reduction in the ED commonly involves the use of an opiate and benzodiazepine combination, etomidate, or propofol. All 3 forms of procedural sedation have been documented as safe to be used in an ED setting.[5–7] . Opiates and benzodiazepines have been used for years as a sedative combination. Fentanyl and midazolam are used often due to their fast onset; however, the duration of sedation (30–60 minutes) can lead to prolonged resource consumption in the ED. Etomidate, a carboxylated imidazole, and propofol, a phenolic compound, have gained popularity for their quick onset combined with a relatively short duration of action. Both are sedative hypnotics that provide no analgesia. Midazolam and fentanyl, as well as propofol can cause profound hypotension and hemodynamic instability. Etomidate carries a lower risk of hemodynamic compromise; however, it can cause myoclonus and adrenal suppression. Currently, limited literature exists comparing these 3 forms of procedural sedation for dislocated hip prostheses reduction.

When performed in the ED, procedural sedation commonly requires "one-to-one" physician and nursing monitoring for a prolonged period of time. It consumes many resources that can directly affect the efficiency and throughput of an ED. Identifying the most effective sedation agent to decrease reduction failure, reduction complication rates, and recovery times is of great interest to the emergency medicine community. This study is designed to compare the use of an opiate and benzodiazepine combination, etomidate, and propofol for procedural sedation for closed reduction of dislocated hip prostheses in the ED.

METHODS

We performed a retrospective chart review[8] for all patients presenting to the ED with total hip arthroplasty dislocations at 2 academic affiliated medical centers during a 5-year period. These 2 450-bed community teaching hospitals have approximate total of 120,000 annual ED visits. Closed reductions of total hip arthroplasty dislocations at each facility are initially handled in the ED with procedural sedation managed by a board-certified ED physician and the reduction procedure managed by an orthopedic resident and/or attending surgeon. Decisions for reduction in the OR suite or by surgical means are decided by attending orthopedic surgeons. Patients were identified using CPT codes for total hip arthroplasty dislocation. Diagnosis of hip dislocation was made by plain film. Our local institutional review committee reviewed and approved this project.

We classified patients into 3 groups based on the type of sedation administered at time of reduction; 1) propofol, 2) etomidate, or 3) opiate/benzodiazepine. These classifications were performed based on what was given immediately prior to the reduction procedure. It is standard of care at both facilities to provide immediate pain control upon presentation of hip dislocations, most commonly in opiate form. Standard weight-based dosages are part of the sedation protocols at each facility and are given in bolus form (Table 1). Redosing is performed at the discretion of the ED physician. We excluded patients who were immediately admitted for a revision surgery or taken directly to the operating room. The primary outcome of interest was reduction of procedure complications including failure to reduce in the ED, fracture, neurovascular injury, and skin injury. Secondary outcomes measured were sedation complications including bag/valve mask utilization, artificial airway placement, intubation, hypotension (defined as a mean arterial pressure of less than 65mmHG or requiring intravenous fluid bolus replacement during sedation), prolonged recovery, use of anesthesia reversal agents, inability to adequately sedate, and time from initial sedation induction to cognitive recovery. Recovery was evaluated and documented by the ED nursing staff after the patient was able to correctly answer his name, the name of the facility he was at, and the date, including day, month, and year.

Data were collected and recorded into an Excel database and then transferred into a statistical program for analysis. We compared a variety of outcome measures between the 3 groups. The reduction complication rates and sedation complications rates were compared using chi-square analysis. We analyzed the recovery times using an ANOVA. Statistical analysis was performed with SAS version 9.2 statistical software (SAS Institute, Cary, North Carolina).

RESULTS

During the 5-year data collection period, 2005–2009, we identified 329 hip arthroplasty dislocations. After excluding those patients taken directly to the OR, 198 patients were available for comparison. Of the available 198 who received procedural sedation in the ED, 69 received propofol, 77 received etomidate, and 52 received opiate/benzodiazepine for conscious sedation in the ED. The average patient age was 68 ± 14.0 (S.D.) years (25th percentile=57, median=71, 75th percentile=78.5) and 65.0% were female.

A reduction complication rate of 8.7% was identified for those patients who received propofol, with 2 of 6 events being reduction failures that required transfer to the OR for successful closed reduction under general anesthesia. In patients who received etomidate and opiate/benzodiazepine, reductions

Table 1. Sedation agent dosage guidelines.

Agent	Standard Dosage Guidelines	Re-dosing Guidelines
Midazolam	0.02-0.1 mg/kg initial bolus IV	25% of initial dose in 3–5 minute bolus
Etomidate	0.1-0.2 mg/kg bolus IV	given as single bolus dose
Propofol	0.5-1.0 mg/kg initial bolus IV	repeat dosing 0.5mg/kg q3-5 minutes bolus

IV, intravenous

complication rates were 24.7% and 28.9%, respectively. Midazolam in combination with dilaudid, morphine, or fentanyl were most commonly used. In only 1case was diazepam used in addition to midazolam. Significantly lower reduction complication rates were observed in patients receiving propofol when compared to either etomidate (-16%, $p=0.01$) or opiate/benzodiazepine (-20.2%, $p < 0.01$) (Table 2).

Sedation complications were observed in 21.2% of patients who received opiate/benzodiazepine. Sedation complication rates after propofol (7.3%) and etomidate (11.7%) were significantly lower when compared to opiate/ benzodiazepine conscious sedation. The majority of the sedation complications in patients who received opiate/ benzodiazepine were related to prolonged sedation recoveries. In addition, respiratory depression requiring reversal with naloxone was observed in patients who received opiate/ benzodiazepine while the majority of the sedation complications for patients who received propofol and etomidate involved the required use of bag valve mask ventilation for respiratory depression. Patients who received propofol were found to be the only group with the sedation complication of hypotension requiring intravenous fluid replacement. This occurred in 2 of 69 patients (2.9%) who received propofol. There was a statistically significant difference in the rate of sedation complications between patients who received propofol and opiate/benzodiazepine groups ($p=0.02$) (Table 3).

The average lengths of sedation for patients who received propofol, etomidate, and opiate/benzodiazepine were 25.1, 30.8, and 44.4 minutes, respectively (Table 4). The recovery times were significantly shorter for patients who received

propofol when compared with the opiate/benzodiazepine combination ($p < 0.05$).

DISCUSSION

The use of procedural sedation for closed reduction of dislocated hip prostheses in the ED is an accepted practice. Reductions can occur more quickly than awaiting general anesthesia.[4] Currently, there are numerous sedative agents that may be used, including propofol, etomidate, and an opiate/ benzodiazepine combination. Since each of these sedative agents has advantages and disadvantages, physicians across the country have used varying agents and combinations of agents to help patients. Opiate/benzodiazepine combinations have been used in EDs the longest, and thus are possibly preferred because of familiarity. Propofol has a rapid onset and recovery with anti-emetic effects, but may cause hypotension and metabolic acidosis. Etomidate also is fast acting and has a recovery profile with no clinically significant hemodynamic effects, but it is associated with myoclonus, adrenal insufficiency[9], and immunosuppression. None of these sedative agents have analgesic affects, which may require the addition of a short or ultra-short acting opiate, such as fentanyl for painful procedures.

The physician's choice of sedative agent should be evidenced based to provide patients with a safe and efficient means of sedation. The risks of airway compromise and hemodynamic instability must be balanced with the depth of sedation for successful closed reduction. In addition, length of recovery and length of stay are of great interest from both the perspective of patient safety and patient throughput initiatives in the ED.

The reduction and sedation complications and recovery times of patients who received the opiate/benzodiazepine

Table 2. Observed hip reduction complications.

Sedation Agent	# complications site 1	# complications site 2	# total complications	% total complications	Notes
Propofol	6/63	0/6	6/69	8.7	1 Greater trochanter fx, 3 multiple attempts, 2 failures required general anesthesia
Etomidate	0/0	19/77	19/77	24.7	19 failures required general anesthesia (1 associated skin tear)
Opiate/ Benzodiazepine	14/44	1/8	15/52	28.9	1 unstable admitted for rev, 14 failures required general anesthesia

Table 3. Observed sedation complications.

Sedation Agent	# complications site 1	# complications site 2	# total complications	% total complications	Notes
Propofol	5/63	0/6	5/69	7.3	2 IVF for BP, 1 BVM, 1 prolonged recovery, 1 unable to achieve sedation
Etomidate	0/0	9/77	9/77	11.7	4 BVM, 4 prolonged recovery, 1 unable to achieve sedation
Opiate/ Benzodiazepine	9/44	2/8	11/52	21.2	3 naloxone, 6 prolonged recovery, 2 unable to achieve sedation

BVM, bag-valve-mask

combination were greater compared to patients who received propofol or etomidate. Despite the higher reduction complications associated with opiate/benzodiazepine agents in our study, the reduction success rate is similar to findings reported by Frymann and colleagues.[3] However, they reported a mean time to reduction using procedural sedation of 1.83 hours, which is much longer compared to our findings with this sedative combination.[3]

We found respiratory complications with the use of all 3 sedative agents. While propofol was the only agent to produce clinically significant hypotension requiring intravenous fluid administration, the 2 patients who experienced hypotension were easily managed with fluid replacement. Overall, propofol had less reduction and sedation complications and required fewer trips to the operating room for reduction under general anesthesia. Thus, the data found in our study support the use of propofol for procedural sedation in the reduction of dislocated hip prostheses.

LIMITATIONS

There are several limitations to this study. Sample size for each treatment group was relatively small and the patients were not randomized to treatment groups. A large number of patients were excluded as they were directly taken to the OR for reduction. It is unknown why this proportion is so high; however, it could be associated with the preferred orthopedic practices of that time in the area. The majority of sedations with each agent were hospital-specific. The majority of propofol sedations were performed at Site 1 and all the etomidate sedations were performed at Site 2. It is standard practice at both sites for the ED attending to be overseeing the

sedation while an orthopedic resident performs the reduction. Although the majority of all reductions were performed by the same resident service, practice differences at each hospital could have skewed the sedation complication rates and recovery times. We could not perform further analysis to account for these variables by comparing these agents at a single site due to the small number of cases available. As noted previously, it is standard of care at both facilities to receive analgesia upon initial presentation to the ED. Essentially, all patients in this study cohort received a form of a narcotic (morphine, dilaudid, fentanyl) prior to initiation of sedation. What could not be extrapolated from the medical record information was the exact timing of when those medications were given prior to procedural sedation. Data on time of order placement were available; however, reviewers could not state with confidence or consistency when those medications were received. The timing and use of these adjuncts could affect the reported complication rates and length of recovery times. In addition, analysis on patient co-morbidities including ASA and Mallampati classification were not performed as these data were not available for review. It is unknown if the differences in complication rates found may have been skewed more because the patient population that received certain sedation agents were already at higher risk.

CONCLUSION

For procedural sedation during reduction of a dislocated total hip prosthesis, propofol provides a greater success rate than etomidate or an opiate/benzodiazepine combination. Although there was no advantage with regard to sedation complications and time to recovery when compared to etomidate, there was an advantage when comparing propofol to opiate/benzodiazepine. Our study suggests that propofol may be the agent of choice for the reduction of THA. It may lead to less reduction failures, decreased reduction and sedation complications, and shorter recovery times, which could relate to decreasing consumption of staff resources and improved throughput times. Further prospective studies with greater sample size are recommended and should include long-term

Table 4. Length of procedural sedation.

	Average minutes from initiation to alert & oriented (mean ± SD)
Propofol	25.17 ± 18.2
Etomidate	30.83 ± 21.5
Opiate/ Benzodiazepine	44.35 ± 25.8*

* statistically significant compared to Propofol, $p < 0.05$

outcomes and monitoring for subsequent ED readmission for dislocation.

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REFERENCES

1. Morrey BF. Instability after total hip arthroplasty. *Orthop Clin North Am*. 1992;23(2):237–248.
2. Alberton GM, High WA, Morrey BF. Dislocation after revision total hip arthroplasty : an analysis of risk factors and treatment options. *J Bone Joint Surg Am*. 2002;84-A(10):1788–1792.
3. Frymann SJ, Cumberbatch GL, Stearman AS. Reduction of dislocated hip prosthesis in the emergency department using conscious sedation: a prospective study. *Emerg Med J*. 2005;22(11):807–809.
4. Gagg J, Jones L, Shingler G, et al. Door to relocation time for dislocated hip prosthesis: multicentre comparison of emergency department procedural sedation versus theatre-based general anaesthesia. *Emerg Med J*. 2009;26(1):39–40.
5. Germann CA, Geyer DA, Perron AD. Closed reduction of prosthetic hip dislocation by emergency physicians. *Am J Emerg Med*. 2005;23(6):800–805.
6. Dursteler BB, Wightman JM. Etomidate-facilitated hip reduction in the emergency department. *Am J Emerg Med*. 2000;18(2):204–208.
7. Mathieu N, Jones L, Harris A, et al. Is propofol a safe and effective sedative for relocating hip prostheses? *Emerg Med J*. 2009;26(1):37–38.
8. Worster A, Bledsoe RD, Cleve P, et al. Reassessing the methods of medical record review studies in emergency medicine research. *Ann Emerg Med*. 2005;45(4):448–451.
9. Lundy JB, Slane ML, Frizzi JD. Acute adrenal insufficiency after a single dose of etomidate. *J Intensive Care Med*. 2007;22(2):111–117.