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Brief Report

Ultrasound-guided supraclavicular brachial plexus nerve block vs procedural sedation for the treatment of upper extremity emergencies

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Abstract

Background: Emergency physicians often treat patients who require procedural sedation for the management of upper extremity fractures, dislocations, and abscesses (upper extremity emergencies). Unfortunately, procedural sedation is associated with several rare but potentially serious adverse effects and requires continuous hemodynamic monitoring and several dedicated staff members. The purpose of this study was to determine the role of ultrasound-guided supraclavicular brachial plexus nerve blocks in the emergency department (ED) as an alternative to procedural sedation for the management of upper extremity emergencies.

Methods: In a prospective trial, a convenience sample of ED patients with upper extremity emergencies that would normally require procedural sedation were assigned to receive either procedural sedation or an ultrasound-guided supraclavicular brachial plexus nerve block. Emergency department length of stay (ED LOS) was the primary outcome measure and was analyzed using a paired 2-tailed Student *t* test.

Results: A total of 12 subjects were enrolled. Average ED LOS for subjects receiving the brachial plexus nerve block was 106 minutes (95% confidence interval, 57-155 minutes). Average ED LOS for subjects receiving procedural sedation was 285 minutes (95% confidence interval, 228-343 minutes). The ED LOS was significantly shorter in the nerve block group ($P < .0005$). Patient satisfaction was high in both groups, and no significant complications occurred in either group.

Conclusions: In our population, ultrasound-guided brachial plexus nerve blocks resulted in shorter ED LOS compared to procedural sedation for patients with upper extremity fractures, dislocations, or abscesses.

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1. Introduction

Emergency physicians often treat patients who require anesthesia for the treatment of acute traumatic or infectious processes. Direct infiltration of a local anesthetic agent can fail to provide adequate anesthesia for upper extremity fractures, dislocations, and abscesses. Although procedural sedation is often used to facilitate the treatment for these patients, it involves the risk of apnea, hypotension, and other adverse effects. Furthermore, procedural sedation requires continuous hemodynamic monitoring, several specialized

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personnel, preprocedural fasting, and observation during postprocedural recovery.

Regional anesthesia of the brachial plexus can be performed using interscalene, supraclavicular, infraclavicular, or axillary approaches. The supraclavicular approach is the preferred approach of the authors because of the easily identified sonoanatomy, the ability to perform the block with a single injection, and the low incidence of significant complications. Real-time ultrasound-guided brachial plexus nerve blocks have been reported extensively in the anesthesiology literature [1-4] and have proven more effective than the traditional landmark techniques [5]. Several studies suggest that nerve stimulation using insulated block needles is unnecessary when performing nerve blocks under direct ultrasound guidance, and we have previously reported a small case series of successful supraclavicular brachial plexus blocks in the emergency department (ED) [6]. Perhaps most important to emergency providers, regional anesthesia offers an alternative to the more time- (and resource-) consuming aspects of procedural sedation: preprocedural fasting, continuous monitoring with additional staff to observe the monitor and record vital signs, and observation during postprocedural recovery are no longer necessary. Given the ever-increasing phenomenon of ED overcrowding, we hypothesized that bed delays contribute significantly to the disposition of ED patients requiring procedural sedation and that patients receiving regional anesthesia would not experience these significant delays. The purpose of this study was to determine if real-time ultrasound-guided supraclavicular brachial plexus nerve blocks could provide an acceptable alternative and result in a decreased ED length of stay (LOS) compared to procedural sedation for the ED management of acute fractures, dislocations, or abscesses in the upper extremity.

2. Methods

2.1. Study design and setting

After approval from our institutional review board, a prospective observational trial was initiated to determine whether ultrasound-guided supraclavicular brachial plexus nerve blocks can decrease ED LOS compared to procedural sedation for ED patients with upper extremity fractures, dislocations, or abscesses. The study was conducted at an urban level II state-designated trauma hospital with an emergency medicine residency and an emergency ultrasound fellowship. All patients gave written informed consent before their participation in the study.

2.2. Subject selection

Patients older than 18 years with an upper extremity fracture, dislocation, or abscess that would otherwise require procedural sedation (as determined by the treating emergency medicine attending) were eligible. Exclusion criteria included pregnancy, known allergy to local anesthetic agents, hemodynamic instability, respiratory distress, use of oral anticoagulants, and inability to give informed consent because of impaired mental status or language barriers.

2.3. Study protocol

Emergency department patients with upper extremity emergencies (fractures, dislocations, or abscesses) presenting between December 2005 and May 2006 received evaluation by the treating emergency physician. Once the emergency physician determined that the patient would require procedural sedation for the treatment of their upper extremity emergency, a research assistant and/or one of the study investigators was contacted. Of the patients who met the study criteria and agreed to participate in the study, those with an even medical record number were assigned to receive an ultrasound-guided supraclavicular brachial plexus nerve block, and those with an odd medical record number received procedural sedation. Neither participants nor investigators were blinded to interventions. The treating emergency physician selected the medications used for procedural sedation, and all patients in our study received propofol (1 mg/kg intravenous [IV] initial dose) or etomidate (0.05-0.1 mg/kg IV initial dose). For the ultrasound-guided supraclavicular brachial plexus nerve block, the ipsilateral supraclavicular fossa was prepared with chlorhexidine solution, and a 10-5 MHz linear ultrasound transducer (Sonosite, Bothell, Wash) was applied in an oblique coronal plane in the supraclavicular fossa using sterile technique. The trunks of the brachial plexus were identified as a cluster of hypoechoic nodules superficial and lateral to the subclavian artery (Fig. 1). A 27-gauge needle or a 22-gauge noncutting spinal needle was introduced just lateral to the ultrasound

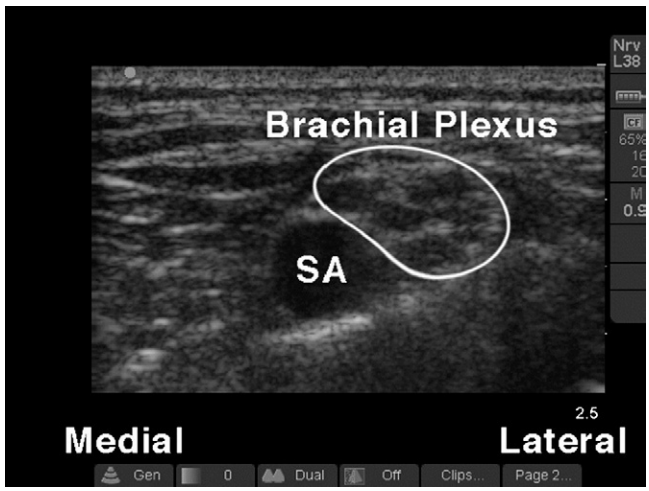

Fig. 1 The brachial plexus is seen lateral and superficial to the subclavian artery (SA).

transducer, in parallel with the long axis of the transducer. The needle tip was positioned just adjacent to the brachial plexus, and 30 mL of 1% lidocaine with epinephrine was injected after aspiration to prevent intraarterial injection, pausing to reaspirate the syringe after every 10 mL. The spread of local anesthetic was seen by ultrasound as the hypoechoic signal dispersed around and within the brachial plexus. If analgesia was incomplete after 30 minutes, a second brachial plexus nerve block was performed using 30 mL of 0.5% bupivicaine. Ultrasound-guided nerve blocks were performed by a group of emergency physicians trained by the primary investigator and included 4 second- to fourth-year emergency medicine residents, 2 emergency medicine ultrasound fellows, and 2 emergency medicine attending physicians.

The treating emergency physician determined the technique for reduction or incision and drainage and decided when it was appropriate to discharge the patient. The ED LOS was defined as the time from initial enrollment in the study to the time of discharge home. This interval was chosen to allow for inclusion of delays resulting from the lack of bed availability or personnel for procedural sedation. Additional data included patient demographics, the success of the reduction or incision and drainage, the need for additional analgesia, and any adverse reactions in either group. In addition, patient satisfaction was recorded just before patient discharge on a standard 10-point visual analog score, with 1 representing "extremely dissatisfied" and 10 "extremely satisfied."

2.4. Statistical analysis

The ED LOS data were analyzed using a paired Student *t* test. Prior research comparing intraarticular analgesia vs IV sedation for shoulder dislocation has demonstrated (with an $\alpha = .05$) that a sample size of 14 patients per group will have 90% power to detect a 30-minute difference in ED LOS [7]. We planned to use a sample size of 3 patients per group, which, with a standard $\alpha = .05$, would have 90% power to detect a 120-minute difference in ED LOS.

3. Results

A total of 12 patients were enrolled with 7 in the brachial plexus nerve block group and 5 in the procedural sedation group. Age, sex, and diagnosis of subjects are presented in Table 1. There were no adverse effects associated with the ultrasound-guided supraclavicular brachial plexus nerve block, and there was one self-limited apneic event that did not require mask ventilation in the procedural sedation group. All fractures, dislocations, and abscesses were adequately treated in both groups, and all patients were discharged home from the ED. No subjects required additional analgesia in the brachial plexus nerve block group, whereas all of the subjects in the procedural sedation group required additional analgesic agents (most commonly fentanyl and morphine) after the completion of the procedure. Average ED LOS in the supraclavicular brachial plexus nerve block group was 106 minutes (95% confidence interval [CI], 57-155 minutes), and the average ED LOS in the procedural sedation group was 285 minutes (95% CI, 228-343 minutes) ($P < .0005$). The average time from enrollment to initiation of the supraclavicular brachial plexus nerve block was 20 minutes (95% CI, 9-31 minutes), and the average time from enrollment to initiation of procedural sedation was 199 minutes (95% CI, 70-328 minutes) ($P < .001$). The average patient satisfaction score was 8.2 ± 3.1 for the brachial plexus nerve block group and 9.0 ± 1.2 for the procedural sedation group ($P > .5$).

Table 1 Age, sex, diagnosis, study group, and ED LOS for subjects enrolled

Subject	Age	Sex	Diagnosis	Study group	ED LOS (min)
1	33	M	Deltoid abscess	Brachial plexus block	102
2	43	M	Deltoid abscess	Brachial plexus block	152
3	50	F	Elbow dislocation	Brachial plexus block	93
4	28	M	Humerus fracture	Brachial plexus block	163
5	45	F	Elbow dislocation	Brachial plexus block	75
6	90	F	Humerus fracture	Brachial plexus block	95
7	46	F	Elbow dislocation	Brachial plexus block	62
8	30	M	Shoulder dislocation	Procedural sedation	299
9	32	F	Deltoid abscess	Procedural sedation	330
10	23	M	Shoulder dislocation	Procedural sedation	343
11	27	M	Wrist dislocation	Procedural sedation	148
12	36	F	Deltoid abscess	Procedural sedation	305

Brachial plexus block average ED LOS = 106 minutes (95% CI, 57-155 minutes); procedural sedation average ED LOS = 285 minutes (95% CI, 228-343 minutes); ED LOS was significantly shorter in the nerve block group ($P < .0005$).

4. Discussion

Ultrasound guidance for regional nerve blocks is rapidly becoming the standard of care in regional anesthesia. We have previously described the use of ultrasound-guided

supraclavicular brachial plexus nerve blocks by emergency physicians [6]. Our results suggest that ultrasound-guided supraclavicular brachial plexus nerve blocks reduce ED LOS when compared to procedural sedation for the treatment of upper extremity fractures, dislocations, or abscesses. In the era of ED overcrowding [8], this potential to decrease LOS may be the most appealing feature of this technique. Ultrasound-guided supraclavicular brachial plexus nerve blocks offer a number of other advantages when compared to procedural sedation. The use of a brachial plexus block eliminates the need for strict preprocedural fasting and dedicated staff members to monitor vital signs and oxygen saturation. This nerve block can also be used in lieu of procedural sedation for patients who are particularly poor candidates for procedural sedation such as obese patients, patients with anticipated difficult airways, or patients with concomitant head injuries. In our institution, the procedural sedation protocol includes a monitored bed in a critical care area, 2 physicians, a "sedation nurse" to record vital signs and assess the patient's level of consciousness, and a mandatory recovery period of at least 30 minutes during which the nurse performs frequent reassessments. Resource utilization is therefore quite substantial compared to a physician-performed nerve block without the need for a critical care bed and the prolonged, dedicated attention of additional staff. Although the ability to perform ultrasound-guided nerve blocks requires a degree of ultrasound proficiency, we found it possible to train senior ED residents by performing an ultrasound-guided supraclavicular nerve block with the resident and subsequently supervising them. Regardless of the level of training of the provider, sufficient anesthesia was achieved in all cases, eliminating the need for any additional oral or parenteral analgesia.

This study achieved statistical significance with a small number of patients as the difference in ED LOS was considerable. Although only patients with upper extremity fractures, dislocations, or abscesses were included, this technique may also be of benefit in patients with large lacerations, burns, or wounds that require extensive debridement and/or repair. Further trials are necessary to determine the full range of applications of ultrasound-guided supraclavicular brachial plexus nerve blocks in the ED.

5. Limitations

This study demonstrates that ultrasound-guided supraclavicular brachial plexus nerve blocks decrease ED LOS compared to procedural sedation for the treatment of upper extremity fracture, dislocation, or abscess. Despite the statistically significant difference in ED LOS, this study has several limitations. There are a small number of patients enrolled in the trial. Although this is partly because of a limited number of providers familiar with the technique, an additional 5 patients met inclusion criteria but were not enrolled. Discussions with the treating physicians revealed that these patients were not enrolled because bed availability at the time was remarkably limited. The physicians feared that patients would wait an unacceptably long period if they were assigned to the procedural sedation group. All 5 of these patients received supraclavicular brachial plexus nerve blocks and were successfully treated and released, but there was no data collection performed. Another limitation of the study is the convenience-sample design that, although necessary given the limited number of providers who were trained to perform the nerve block, decreases enrollment of eligible subjects and may increase potential enrollment bias. It is worthwhile to note that the treating physicians performed sedations exclusively with nonnarcotic sedatives, and this may have had a negative impact on the need for postsedation analgesia in the procedural sedation group. In addition, the incidence of adverse outcomes in both groups may be underestimated given the small population. There are multiple studies that demonstrate the overall safety of ultrasound-guided regional nerve blocks, but their safety in the ED has not been fully evaluated. Although the ED tracking system was reviewed at regular intervals and no patient was found to present with complaints related to the nerve block, telephone follow-up was not conducted, and there is therefore a possibility of unreported adverse effects. As our results indicate, most difference in ED LOS derives from the preprocedural phase and is likely because of limited bed availability and/or staffing constraints. Because our study was conducted in a busy urban ED where procedural sedation is often delayed for these reasons, it is unknown whether an ultrasound-guided supraclavicular brachial plexus nerve block would result in significantly decreased ED LOS in other settings where procedural sedation may be accomplished more rapidly.

6. Conclusion

In our ED, ultrasound-guided supraclavicular brachial plexus nerve blocks result in decreased LOS when compared to procedural sedation for the treatment of upper extremity fractures, dislocations, or abscesses. Further trials are necessary to determine the role and range of applications of ultrasound-guided supraclavicular brachial plexus nerve blocks in the ED management of patients with upper extremity emergencies.

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