ORIGINAL RESEARCH

Battlefield Acupuncture vs Ketorolac for Treating Pain in the Emergency Department

Eva Galka, PharmD[a]; Zane Elfessi, PharmD, BCPS, BCCCP[a,b]; Tulika Singh, MD[a]; Erica Liu, PharmD[a]; Caitlin Turnbull, PharmD, BCPS[a]

Background: Many patients arrive in the emergency department (ED) with acute pain. Battlefield acupuncture (BFA) uses small, semipermanent acupuncture needles in 5 set points anatomically located on each ear to reduce pain in a few minutes. Pain relief can last months, depending on the pathology of the pain. At the Jesse Brown Veterans Affairs Medical Center (JBVAMC) ED, ketorolac 15 mg is the preferred first-line treatment of acute, noncancer pain. In 2018, BFA was offered first to veterans presenting with acute or acute-on-chronic pain to the ED; however, its effectiveness in pain reduction vs ketorolac has not been evaluated in this patient population. The objective of this study was to determine whether BFA monotherapy was noninferior to ketorolac 15 mg for reducing pain scores in the ED.

Methods: This study was a retrospective, electronic chart review of patients who presented to JBVAMC ED with acute pain or acute-on-chronic pain and received ketorolac or BFA. The primary endpoint was the mean difference in the numeric rating scale (NRS) pain score from baseline. Secondary endpoints included the number of patients receiving pain medications, including topical analgesics, at discharge and treatment-related adverse events in the ED.

Results: A total of 61 patients were included in the study. Baseline characteristics were similar between the 2 groups except for the average baseline NRS pain score, which was higher in the BFA group (8.7 vs 7.7; P = .02). The mean difference in NRS pain scores from baseline to postintervention was 3.9 for the BFA group and 5.1 for the ketorolac group. The difference in reducing the NRS pain score between the intervention groups was not statistically significant. No adverse events were observed in either treatment group.

Conclusions: For treating acute and acute-on-chronic pain in the ED, BFA did not differ compared with ketorolac 15 mg in NRS pain score reduction. This study's results add to the limited existing literature suggesting that both interventions could result in clinically significant reductions in pain scores for patients presenting to the ED with severe and very severe pain, indicating BFA could be a viable nonpharmacologic treatment option.

Author affiliations can be found at the end of this article.
Correspondence: Zane Elfessi (zane.elfessi@va.gov)

Fed Pract. 2023;40(4). Published online April 18. doi:10.12788/fp.0369

Acute pain is a primary symptom for many patients who present to the emergency department (ED). The ED team is challenged with relieving pain while limiting harm from medications.[1] A 2017 National Health Interview Survey showed that compared with nonveterans, more veterans reported pain in the previous 3 months, and the rate of severe pain was 40% higher in the veteran group especially among those who served during the era of wars in Afghanistan and Iraq.[2]

The American College of Emergency Physicians guidelines pain management guidelines recommend patient-centered shared decision making that includes patient education about treatment goals and expectations, and short- and long-term risks, as well as a preference toward pharmacologic treatment with nonopioid analgesics except for patients with severe pain or pain refractory to other drug and treatment modalities.[3] There is a lack of evidence regarding superior efficacy of either opioid or nonopioid analgesics; therefore, the use of nonopioid analgesics, such as oral or topical nonsteroidal anti-inflammatory drugs (NSAIDs) or central analgesics, such as acetaminophen, is preferred for treating acute pain to mitigate adverse effects (AEs) and risks associated with opioid use.[1,3,4] The US Department of Veterans Affairs (VA) and Department of Defense (DoD) guideline on managing opioid therapy for chronic pain, updated in 2017 and 2022, similarly recommends alternatives to opioids for mild-to-moderate acute pain and encourages multimodal pain care.[5] However, use of other pharmacologic treatments, such as NSAIDs, is limited by AE profiles, patient contraindications, and severity of acute pain etiologies. There is a need for the expanded use of nonpharmacologic treatments for addressing pain in the veteran population.

The American College of Emergency Physicians guidelines recommend nonpharmacologic modalities, such as applying heat or cold, physical therapy, cognitive behavioral therapy, and acupuncture.[3] A 2014 study reported that 37% to 46% of active duty and reserve military personnel use complementary and alternative medicine (CAM) for a variety of ailments, and there is increasing interest in the use of CAM as adjuncts to traditional therapies.[6] According to one study, some CAM therapies are used significantly

TABLE 1 Baseline Characteristics

Characteristics	Acupuncture (n = 30)	Ketorolac (n = 31)	*P* value
Age, mean (SD), y	51 (15)	48 (13)	.23
Sex, No. (%)			.55
Male	24 (80)	22 (71)	
Female	6 (20)	9 (29)	
Serum creatinine, mean, mg/dL	0.97	1.18	.36
Weight, mean, kg	97	86	.09
NRS pain score, mean	8.7	7.7	.02
Location of pain, No. (%)			
Abdomen	1 (3)	5 (16)	.09
Back	10 (33)	7 (23)	.35
Chest	2 (7)	6 (19)	.14
Head	5 (17)	7 (23)	.56
Lower extremity	10 (33)	3 (10)	.02
Other	2 (7)	3 (10)	.67

Abbreviation: NRS, numeric rating scale.

more by military personnel than used by civilians.[7] However, the percentage of the veteran population using acupuncture in this study was small, and more information is needed to assess its use.

Auricular acupuncture originated in traditional Chinese medicine.[8] Contemporary auricular acupuncture experts view this modality as a self-contained microsystem mapping portions of the ear to specific parts of the body and internal organs. The analgesic effects may be mediated through the central nervous system by local release of endorphins through nerve fiber activation and neurotransmitters—including serotonin, dopamine, and norepinephrine—leading to pre- and postsynaptic suppression of pain transmission.

Battlefield acupuncture (BFA) uses 5 set points anatomically located on each ear.[9] Practitioners use small semipermanent, dart-like acupuncture needles. Patients could experience pain relief in a few minutes, which can last minutes, hours, days, weeks, or months depending on the pathology of the pain. This procedure developed in 2001 has been studied for different pain types and has shown benefit when used for postsurgical pain, chronic spinal cord injury–related neuropathic pain, and general chronic pain, as well as for other indications, such as insomnia, depression, and weight loss.[8,10-13] In 2018, a randomized controlled trial compared postintervention numeric rating scale (NRS) pain scores in patients presenting to the ED with acute or acute-on-chronic lower back pain who received BFA as an adjunct to standard care vs standard care alone.[14] Patients receiving BFA as an adjunct to standard care were found to have mean postintervention pain scores 1.7 points lower than those receiving standard care alone. This study demonstrated that BFA was feasible and well tolerated for lower back pain in the ED as an adjunct to standard care. The study was limited by the adjunct use of BFA rather than as monotherapy and by the practitioners' discretion regarding standard care, which was not defined by the study's authors.

The Jesse Brown Veterans Affairs Medical Center (JBVAMC) in Chicago, Illinois, offers several CAM modalities, such as exercise/movement therapy, chiropractic, art/music therapy, and relaxation workshops, which are widely used by veterans. Recent evidence suggests BFA could reduce pain scores as an adjunct or an alternative to pharmacologic therapy. We are interested in how CAM therapies, such as BFA, can help avoid AEs associated with opioid or NSAID therapy.

At the JBVAMC ED, ketorolac 15 mg is the preferred first-line treatment of acute, noncancer pain, based on the results of previous studies. In 2018 BFA was offered first to veterans presenting with acute or acute-on-chronic pain to the ED; however, its

TABLE 2 Secondary Endpoints

Prescriptions at discharge	Acupuncture, No. (n = 24)	Ketorolac, No. (n = 11)	*P* value
Topical diclofenac gel	6	2	.65
Oral muscle relaxant	6	2	.65
Topical lidocaine ointment	6	0	.07
Oral acetaminophen	3	2	.65
Oral NSAID	1	4	.01
Topical menthol/m-salicylate	1	0	.49
Oral opioid	1	0	.49
Oral steroid	0	1	.13

Abbreviation: NSAID, nonsteroidal anti-inflamatory drug.

effectiveness for pain reduction vs ketorolac has not been evaluated in this patient population. Limited literature is available on BFA and its use in the ED. To our knowledge, this was the first observational study assessing the difference between a single session of BFA vs a single dose of ketorolac in treating noncancer acute or acute-on-chronic pain in the ED.

METHODS

This study was a retrospective chart review of patients who presented to the JBVAMC ED with acute pain or acute-on-chronic pain, who received ketorolac or BFA. The study population was generated from a list of all IV and intramuscular (IM) ketorolac unit dose orders verified from June 1, 2018, through August 30, 2019, and a list of all BFA procedure notes signed from June 1, 2018, through August 30, 2019. Patients were included in the study if they had documented administration of IV or IM ketorolac or BFA between June 1, 2018, and August 30, 2019. Patients who received ketorolac doses other than 15 mg, the intervention was administered outside of the ED, received adjunct treatment in addition to the treatment intervention in the ED, had no baseline NRS pain score documented before the intervention, had an NRS pain score of < 4, had no postintervention NRS pain score documented within 6 hours, had a treatment indication other than pain, or had active cancer were excluded. As in previous JBVAMC studies, we used NRS pain score cutoffs (mild, moderate, severe, and very severe) based on Woo and colleagues' meta-analysis and excluded scores < 4.[15]

Endpoints

The primary endpoint was the mean difference in NRS pain score before and after the intervention, determined by comparing the NRS pain score documented at triage to the ED with the first documented NRS pain score at least 30 minutes to 6 hours after treatment administration. The secondary endpoints included the number of patients prescribed pain medication at discharge, the number of patients who were discharged with no medications, and the number of patients admitted to the hospital. The safety endpoint included any AEs of the intervention. Subgroup analyses were performed comparing the mean difference in NRS pain score among subgroups classified by severity of baseline NRS pain score and pain location.

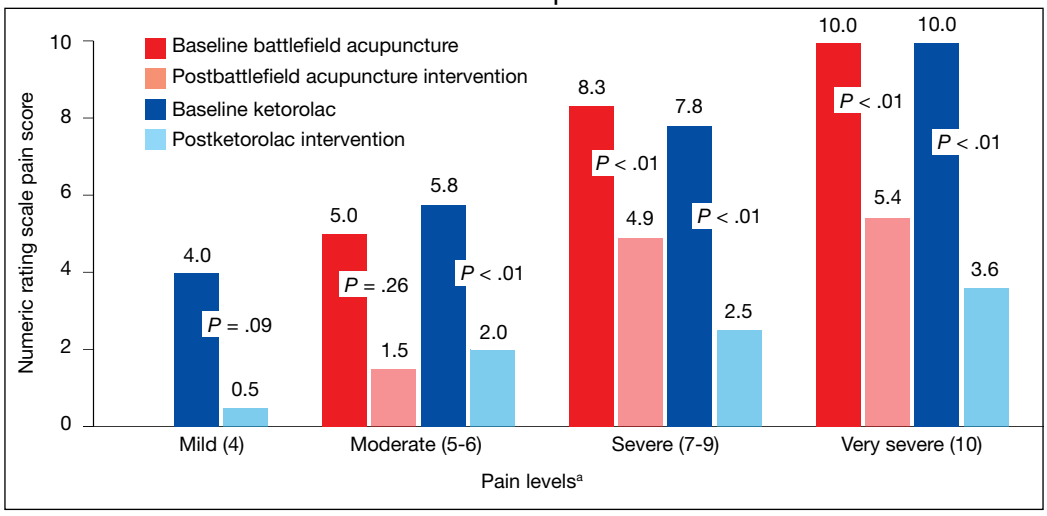
Statistical Analysis

Baseline characteristics and endpoints were analyzed using descriptive statistics. Categorical data were analyzed using Fisher exact test and *z* test for proportions, and continuous data were compared using *t* test and paired *t* test. An 80% power calculation determined that 84 patients per group were needed to detect a statistically significant difference in pain score reduction of 1.3 at a type-1 error rate of 0.05. The sample size was based on a calculation performed in a previously published study that compared IV ketorolac at 3 single-dose regimens for treating acute pain in the ED.[16] The 1.3 pain score reduction is considered the minimum clinically significant difference in pain that could be detected with the NRS.[17]

RESULTS

Sixty-one patients received BFA during the study period: 31 were excluded (26 received adjunct treatment in the ED, 2 had active cancer documented, 2 had an indication other than pain, and 1 received BFA outside of the ED), leaving 30 patients in the BFA cohort. During the study period, 1299 patients received ketorolac.

FIGURE Pain Score Reduction for All Groups



[a]Suggested pain score cutoffs as reported by Woo and colleagues.

These patients were selected using a random number generator and then screened to determine inclusion or exclusion in the study. We continued to randomly select patients for the ketorolac group until we had a similar number in each treatment group. Of these 148 patients who were randomly selected to be reviewed, 116 were excluded: 48 received adjunct treatment in the ED, 24 had no postintervention NRS pain score documented within 6 hours, 18 received ketorolac doses other than 15 mg, 12 received ketorolac outside the ED, 9 had no baseline NRS pain score documented, 3 presented with a NRS pain score of ≤ 3, and 2 had active cancer documented. The ketorolac cohort comprised 31 patients.

Baseline characteristics were similar between the 2 groups except for the average baseline NRS pain score, which was statistically significantly higher in the BFA vs ketorolac group (8.7 vs 7.7, respectively; $P = .02$). The mean age was 51 years in the BFA group and 48 years in the ketorolac group. Most patients in each cohort were male: 80% in the BFA group and 71% in the ketorolac group. The most common types of pain documented as the chief ED presentation included back, lower extremity, and head. Ten patients in the BFA group and 3 in the ketorolac group presented with lower extremity pain ($P = .02$) (Table 1).

Endpoints

The mean difference in NRS pain score was 3.9 for the BFA group and 5.1 for the ketorolac group. Both were clinically and statistically significant reductions ($P = .03$ and $P < .01$), but the difference between the intervention groups in NRS score reduction was not statistically significant ($P = .07$).

For the secondary endpoint of outpatient prescriptions written at discharge, there was no significant difference between the groups except for oral NSAIDs, which were more likely to be prescribed to patients who received ketorolac ($P = .01$). Patients who received BFA were more likely to receive oral muscle relaxants or topical analgesics, but the difference between the groups was not statistically significant (Table 2). There was no difference in the number of patients who received no prescriptions at ED discharge. Patients who received ketorolac were more likely to be admitted to the hospital ($P = .049$) (Table 3). No AEs were observed in either treatment group during the study.

Subgroup Analysis

An analysis was performed for subgroups classified by baseline NRS pain score (mild: 4; moderate, 5 - 6; severe, 7 - 9; and very severe, 10). Data for mild pain was limited because a small number of patients received interventions. For moderate pain, the mean difference in NRS pain score for BFA and

TABLE 3 Secondary Endpoints

Criteria	Acupuncture, No. (n = 30)	Ketorolac, No. (n = 31)	*P* value
Hospital admissions	1	6	.049
No prescriptions at discharge	11	16	.24

TABLE 4 Numeric Rating Scale Subgroup Analysis by Location

	Pain score difference, mean		
Locations	Acupuncture	Ketorolac	*P* value
Abdomen	3	3.2	—
Back	4.2	5.7	.31
Chest	1	5.5	.09
Head	4.2	5.6	.42
Lower extremity	3.6	3.3	.82
Other	6	7	.59

ketorolac was 3.5 and 3.8, respectively; for severe pain, 3.4 and 5.3; and for very severe pain, 4.6 and 6.4. There was a larger difference in the preintervention and postintervention NRS pain scores within severe pain and very severe pain groups. The mean difference in NRS pain score reduction between the intervention groups was not statistically significant for any subgroup (Figure). A subgroup analysis also was performed comparing pain locations, although no statistically significant difference was found among the subgroups (Table 4).

DISCUSSION

Both interventions resulted in a significant reduction in the mean NRS pain score of about 4 to 5 points within their group, and BFA resulted in a similar NRS pain score reduction compared with ketorolac 15 mg. Because the baseline NRS pain scores were significantly different between the BFA and ketorolac groups, a subgroup analysis revealed that BFA reduced mean NRS pain score in patients with severe and very severe pain but appears to be less beneficial for moderate pain, unlike the ketorolac results that showed a large reduction in all pain groups except for the small sample of patients with mild pain.

In this study, more patients in the BFA group presented to the ED with lower extremity pain, such as gout or neuropathy, compared with the ketorolac group; however, BFA did not result in a significantly different pain score reduction in this subgroup compared with ketorolac. Patients receiving BFA were more likely to receive topical analgesics or muscle relaxants at discharge; whereas those receiving ketorolac were significantly more likely to receive oral NSAIDs. Patients in this study also were more likely to be admitted to the hospital if they received ketorolac; however, for these patients, pain was secondary to their chief presentation, and the admitting physician's familiarity with ketorolac might have been the reason for choosing this intervention. Reasons for the admissions were surgical observation, psychiatric stabilization, kidney/gallstones, rule out of acute coronary syndrome, pneumonia, and proctitis in the ketorolac group, and suicidal ideations in the BFA group.

Limitations

As a limited number of patients received BFA at JBVAMC, the study was not sufficiently powered to detect a difference in the primary outcome. Because BFA required a consultation to be entered in the electronic health record, in addition to time needed to perform the procedure, practitioners might have preferred IV/IM ketorolac during busy times in the ED, potentially leading to underrepresentation in the BFA group. Prescribing preferences might have differed among the rotating physicians, timing of the documentation of the NRS pain score could have differed based on the treatment intervention, and the investigators were unable to control or accurately assess whether patients had taken an analgesic medication before presenting to the ED. Because pain and the treating physician are subjective, patients who reported a higher baseline pain severity might have been more likely to be discharged with topical analgesics or muscle relaxants. One way to correct for this subjectivity would be to conduct a larger prospective trial with a single treating physician. Finally, ED encounters in this

study were short, and there was no follow-up permitting identification of AEs.

CONCLUSIONS

NRS pain score reduction with BFA did not differ compared with ketorolac 15 mg for treating acute and acute-on-chronic pain in the ED. Although this study was underpowered, these results add to the limited existing literature, suggesting that both interventions could result in clinically significant pain score reductions for patients presenting to the ED with severe and very severe pain, making BFA a viable nonpharmacologic option. Future studies could include investigating the benefit of BFA in the veteran population by studying larger samples in the ED, surveying patients after their interventions to identify rates AEs, and exploring the use of BFA for chronic pain in the outpatient setting.

Author affiliations

[a]Jesse Brown Veterans Affairs Medical Center, Chicago, Illinois
[b]University of Illinois at Chicago College of Pharmacy

Author disclosures

The authors report no actual or potential conflicts of interest or outside sources of funding with regard to this article.

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Ethics and consent

This study was approved by the Jesse Brown Veterans Affairs Medical Center Institutional Review Board in Chicago, Illinois.

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