Treatment of Acute Orofacial Pain with Lower Cervical Intramuscular Bupivacaine Injections: A 1-Year Retrospective Review of 114 Patients

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Aims: *To describe 1 year's experience in treating orofacial pain with intramuscular injections of 0.5% bupivacaine bilateral to the spinous processes of the lower cervical vertebrae.* ***Methods:*** *A retrospective review of 2,517 emergency department patients with discharge diagnoses of a variety of orofacial pain conditions and 771 patients who were coded as having had an anesthetic injection between June 30, 2003 and July 1, 2004 was performed. The records of all adult patients who had undergone paraspinous intramuscular injection with bupivacaine for the treatment of an orofacial pain condition were extracted from these 2 databases and included in this retrospective review. Pain relief was reported in 2 different ways: (1) patients (n = 114) were placed in 1 of 4 orofacial pain relief categories based on common clinical experience and face validity and (2) pain relief was calculated based on patients' (n = 71) ratings of their pain on a numerical descriptor scale before and after treatment.* ***Results:*** *Lower cervical paraspinous intramuscular injections with bupivacaine were performed in 118 adult patients. Four charts were excluded from review because of missing or inadequate documentation. Pain relief (complete or clinical) occurred in 75 patients (66%), and partial orofacial pain relief in 32 patients (28%). No significant relief was reported in 7 patients (6%). Overall, some therapeutic response was reported in 107 of 114 patients (94%). Orofacial pain relief was rapid, with many patients reporting complete relief within 5 to 15 minutes.* ***Conclusion:*** *This is the first report of a large case series of emergency department patients whose orofacial pain conditions were treated with intramuscular injections of bupivacaine in the paraspinous muscles of the lower neck. The findings suggest that lower cervical paraspinous intramuscular injections with bupivacaine may prove to be a new therapeutic option for acute orofacial pain in the emergency department setting.* J OROFAC PAIN 2008;22:57–64

Key words: allodynia, bupivacaine, cervical, headache, injection, intramuscular, orofacial, pain, paraspinous, trigeminocervical

Orofacial pain is quite common in the general population,[1,2] and patients commonly present to emergency departments seeking relief from orofacial pain as well as definitive management of the underlying conditions.[3] It has recently been reported that the intramuscular injection of small amounts of 0.5% bupivacaine bilateral to the lower cervical spinous processes appears to have a rapid and robust antinociceptive effect on

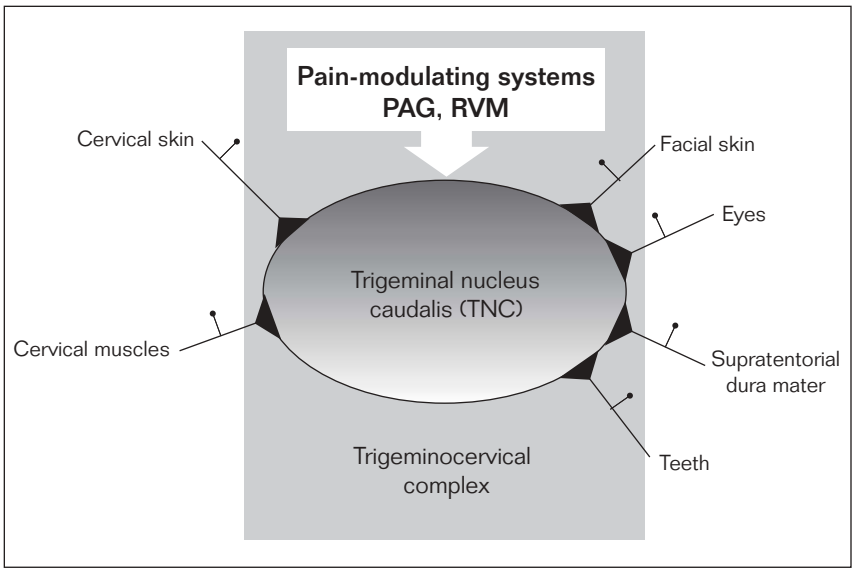

Fig 1 Trigeminal and cervical afferents converge onto nociceptive second-order neurons in the trigeminocervical complex, such as the trigeminal nucleus caudalis (TNC). Strong noxious stimuli can cause increased afferent inflow into the trigeminocervical complex, which may cause it to become sensitized. Nociceptive inflow to the second-order neurons is modulated by descending inhibitory projections from the PAG, nucleus raphe magnus, and RVM, which are located in the brainstem (Adapted from Bartsch and Goadsby[7]).

headache and orofacial pain.[4–6] The apparent effectiveness of this procedure was first recognized in 1996 by the second author and first reported in 2003.[4] The procedure has been used to treat orofacial pain and headaches in the first author's emergency department since 2002.

The mechanism of the observed antinociception following this injection is unknown. Relief of pain and associated allodynia appear to be a nonspecific effect that most likely involves convergence between the cervical nerves and the sensitized trigeminocervical complex, which contains key relay neurons for nociceptive input in the head and neck.[7,8] Additionally, descending inhibitory projections from brainstem structures, such as the periaqueductal gray (PAG), nucleus raphe magnus, and rostroventral medulla (RVM), synapse with the trigeminocervical complex and have a profound antinociceptive effect (Fig 1).[7–9] Pain relief could result from an effect on the sensitized trigeminocervical complex, and central antinociception pathways may also play a role.

Because the observed pain relief associated with the intramuscular injection of 0.5% bupivacaine bilateral to the spinous processes of the lower cervical vertebrae procedure has not previously been studied in a quantitative manner, the aim of this study was to describe the experiences of an academic emergency department over the course of a year in treating orofacial pain with intramuscular injections of 0.5% bupivacaine bilateral to the spinous processes of the lower cervical vertebrae.

Materials and Methods

The Human Assurance Committee at the Medical College of Georgia approved this study. All patients 18 years of age or older with a painful orofacial condition treated with intramuscular injections of bupivacaine at the lower cervical paraspinous muscles who presented to the emergency department of the Medical College of Georgia between June 30, 2003 and July 1, 2004 were included. A database of 2,517 patients who had a discharge diagnosis of specific orofacial pain conditions (ICD-9) was reviewed for patients who had been treated with bupivacaine injections, and a second database of 771 patients who were coded (CPT-4) as having had an anesthetic injection was also reviewed. Two trained research assistants reviewed charts from these databases to document whether lower cervical bupivacaine injections had been performed for treatment of orofacial pain. Patients were excluded if chart documentation was inadequate to determine the therapeutic outcome of the procedure.

A single reviewer, the first author, accomplished data extraction from the medical records. Data extraction rules were established prior to the onset of data collection and were based on a preliminary review of approximately 20 charts. A data extraction form was created using Microsoft Excel. All charts were reviewed twice by the reviewer to ensure accurate data extraction. The reviewer was not blinded to the study objective. Password-pro-

I. Complete Pain Relief
   A. Complete orofacial pain resolution documented (score of 0) on the NDS or 1 of the following descriptors: "orofacial pain resolved," "orofacial pain relieved," or "orofacial pain gone."
   B. Complete relief of orofacial pain condition reported (score of 0), but partial or localized return of pain reported prior to discharge.
II. Clinical Pain Relief
   A. Orofacial pain relief documented (1 to 2 of 10 on NDS); no rescue medications required prior to discharge.
   B. Reduction in orofacial pain area and/or clinical improvement documented (eg, "feeling better," "improvement," "good relief," or no numerical descriptor scale reported) and no rescue medications required prior to discharge.
III. Partial Pain Relief
   A. Reduction in orofacial pain documented by NDS, but pain not given a score less than 3 following treatment (with or without rescue medication administration prior to discharge).
   B. Reduction in orofacial pain area documented, but an area of residual orofacial pain reported, and residual pain of at least 3 on the NDS documented (with or without rescue medication administration prior to discharge).
   C. Reduction in orofacial pain area and/or clinical improvement documented, but rescue medications required prior to discharge.
IV. No Orofacial Pain Relief
   A. Patient relates no significant orofacial pain relief with bupivacaine injection.
   B. No improvement documented in record, and rescue medications provided.

Fig 2 Therapeutic response classification.

tected databases, obscuring of patient-identifying information, and locked storage with eventual destruction of chart copies used in the review were used to comply with Health Insurance Portability and Accountability Act (HIPAA) regulations.

A literature search was performed for previously validated criteria for the retrospective review of pain relief documentation. When no literature appropriate to this retrospective chart review was found, the authors developed criteria based on common clinical experience and face validity. Four orofacial pain relief categories were developed: complete relief, clinical relief, partial relief, and no relief (Fig 2). The pain relief of the 114 patients identified in the database search was reviewed with respect to these 4 orofacial pain relief categories.

The numerical descriptor scale (NDS) was the tool most commonly used in the patient record for rating pain and therefore was a significant component of the pain relief criteria. An NDS of 0 to 10 was used by the patient to rate pain, where 0 indicated "absence of pain" and 10 indicated "worst possible pain." Pain levels were documented using the NDS before and after the therapeutic intervention for 71 of the patients; the average, median, and range of pain relief of this subset of patients were also calculated.

Complete relief (a score of 0 on the NDS) was differentiated from clinical relief, but both categories were considered symptomatic relief sufficient for the patient to be discharged without further emergency department treatment. A score of 1 or 2 on the NDS (with no rescue medications required prior to discharge) was considered clinical relief. However, patients who rated their pain at 3 to 4 of 10 often reported sufficient pain relief to allow them to be discharged without further treatment. Orofacial pain relief defined as "partial" typically involved a documented reduction in the pain area (eg, decreased total area of pain and allodynia), residual orofacial pain greater than 2 of 10 on the NDS, and/or the need for additional pain medications. Since the therapeutic response to the injection was typically rapid and unambiguous, the therapeutic response was typically assessed between 5 and 20 minutes after the injection. When pain relief was reported to be inadequate or incomplete, rescue therapies were generally initiated within 20 to 30

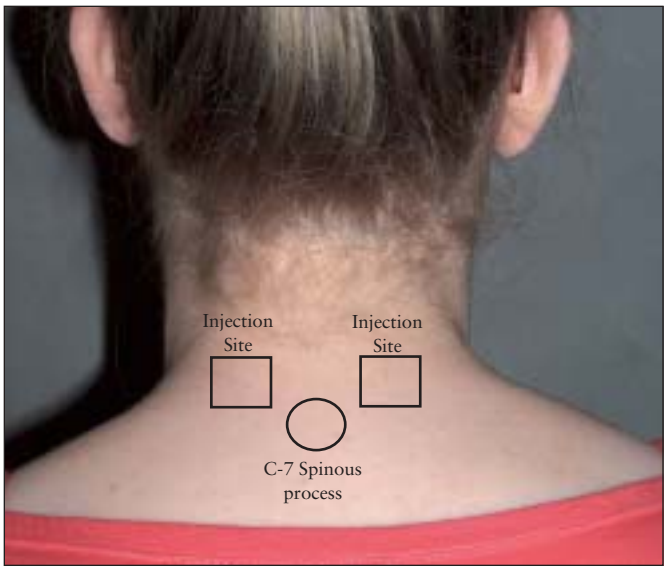

Fig 3 The recommended injection sites are located 2 to 3 cm bilateral to the spinous process of the sixth or seventh cervical vertebra.

minutes. Pain relief was also categorized as partial when chart documentation suggested complete relief but pain medication of any type or route was administered prior to discharge.

The treatment procedure entailed the slow bilateral injection of 1.5 mL of 0.5% bupivacaine HCl 2.5 to 3.5 cm into the paraspinous musculature at a distance 2 to 3 cm from the spinous process of the sixth or seventh cervical vertebra (Fig 3). A 1.5-inch (3.81 cm), 25-gauge needle attached to a 3-mL syringe was typically used. The entire amount of bupivacaine for each injection (1.5 mL) was deposited in a single location. The use of bilateral injections was based on the authors' experience that unilateral injections appear to be less effective or have a slower response time to reported benefit. Appropriate skin preparation, precautions against blood-borne pathogens, aspiration before injection, and safety measures to manage potential vasodepressor syncope were carried out. Observed complications of this procedure have included muscle soreness at the lower cervical injection site, transient weakness of posterior neck muscles, and vasodepressor-related presyncope. Other potential complications are pneumothorax secondary to downward angling of the needle toward the apex of a lung, injection-related infection, or rare allergic reaction to the anesthetic.

Clinical indications for the application of this technique include a wide spectrum of painful head and face conditions. Contraindications for this procedure include local infection at the injection site, recent neck surgery, and allergy to the anesthetic. Caution is recommended when performing intramuscular injections in patients with hemophilia or other bleeding disorders.

Statistical Analysis

The improvement obtained by the injection performed by the first author was compared statistically with that of the other health-care providers by means of a χ^2 test at a significance level of $P < .05$.

Results

During the study period (June 30, 2003 to July 1, 2004), 118 patients with orofacial pain conditions underwent the lower cervical paraspinous injections for the purpose of pain relief. Four charts were excluded because of insufficient documentation of the patient's history, physical examination, and emergency department treatment course. Thus, 114 charts were available for review and were included in this study. Fourteen different physicians (emergency medicine attending physicians and residents) and 1 physician assistant performed the injections on the 114 patients. The first author was the attending physician of record for 51 of the 114 patients (45%).

Conditions causing orofacial pain involved the teeth, eyes, ears, mandible, throat and, more broadly, the head and face. One specific eye condition, glaucoma, was tracked separately. Pharyngeal pain was most often associated with viral or bacterial pharyngitis. Painful dental conditions included dental pulpitis, periapical abscess, and postsurgical pain (endodontic surgery). Conditions causing eye pain were primarily corneal abrasions and blunt trauma. Head and facial pain conditions included temporomandibular disorders (TMD), blunt

Table 1 Pain Locations and Clinical Responses

Location of pain	Complete relief	Clinical relief	Partial relief	No relief	Total
Dental	30	12	24	6	72
Eye	4	1	1	0	6
Ear	8	2	1	0	11
Mandible	7	1	0	1	9
Glaucoma	1	2	0	0	3
Pharynx	1	0	2	0	3
Head and face	4	2	4	0	10
Total	55	20	32	7	114
Percentage relief	48%	18%	28%	6%	

trauma, or cellulitis of the head and face. Painful ear conditions included otitis externa or otitis media. Mandibular pain was most commonly due to blunt trauma and included mandibular fractures, contusions and, in 1 case, jaw dislocation.

All but 4 of the 114 charts available for review had an NDS score for pain prior to treatment, and the majority of the patients had initial pain levels of 9 (n = 13) or 10 (n = 63). The NDS was not used to document the therapeutic response following treatment for 43 of the 114 patients (38%). Descriptors other than the NDS were used for these patients. These included descriptions of pain relief over specific areas of the head and face as well as phrases such as "complete relief," "pain has resolved," "improvement," "feeling better," and "good relief" (Fig 2). In 71 of 114 cases (62%), pain levels were documented both before and after treatment. The average change in NDS score following the bilateral intramuscular injections for these 71 patients was 7.25 points (median, 8; range, 2 to 10).

The majority of pain conditions involving all anatomic locations responded to bilateral lower cervical intramuscular bupivacaine injections with relief of pain. Overall, a therapeutic response and pain improvement were documented for 107 of 114 patients (94%; Table 1). Complete relief occurred for 55 of 114 patients (48%), clinical relief was achieved in 20 cases (18%), and partial relief was documented for 32 of 114 patients (28%). Twenty-four of the patients categorized as having partial relief presented with dental pain. Seven of 114 patients (6%) met chart review criteria for failure to demonstrate any reduction in pain. No patient reported worse pain following the injection.

Of the 51 patients evaluated and treated by the first author, 38 met the criteria for complete or clinical pain relief (75%), and 12 patients had partial relief (24%).

There was no statistical difference χ^2 (1 df = 3.12; $P = .077$) between the first author's success rate and that of all other health-care providers combined. All other health-care providers combined treated a total of 63 patients and had 37 patients (59%) who met the criteria for complete or clinical pain relief. The 4 health-care providers who most frequently performed the procedure injected a total of 28 patients (range, 5 to 11 patients). Of these patients, 71% reported complete or clinical pain relief, and 25% described partial relief. Only 1 patient reported no therapeutic response. There was also no statistical difference (1 df = 0.09; $P = 0.77$; χ^2 test) between the first author's therapeutic success rate and the success rates of those who performed the procedure most frequently.

Pain relief was typically rapid, and 36 of the 75 patients (48%) with complete or clinical relief reportedly had a therapeutic response in less than 5 minutes.

Seven patients who initially had complete pain relief experienced a partial return of pain prior to discharge from the emergency department. Four of these 7 patients had recent traumatic mandibular injuries, and another patient had a corneal abrasion as well as an orbital fracture. The sixth patient had facial cellulitis, and pain returned after approximately 1.5 hours. The seventh patient presented with glaucoma, and his eye pain returned after approximately 2 hours. After a second set of lower cervical intramuscular injections with bupivacaine, this patient's pain was completely and permanently relieved. Because all 7 of these patients had experienced complete pain relief during the initial evaluation period, they were tallied as having had complete pain relief.

Even though allodynia and headache are commonly associated with orofacial pain conditions, their presence or absence were inconsistently reported in the emergency department medical records reviewed in this study.

Discussion

Millions of people experience conditions causing acute or chronic orofacial pain, and every year thousands of patients visit emergency departments for relief from debilitating pain. By the time of presentation many patients show evidence of central sensitization, with allodynia and pain extending well beyond the anatomic region of the inciting injury or inflammation.[10,11] Furthermore, associated headaches are common.[12] While current therapeutic options for pain control are generally effective, it is common for emergency physicians to manage patients with orofacial pain conditions resistant to standard pain therapies. A treatment option that relieves pain effectively, works rapidly, and has minimal drug side effects would be ideal.

The bilateral lower cervical intramuscular injection with bupivacaine appears to be an effective treatment modality for acute orofacial pain. Even though a placebo effect most assuredly occurred in a percentage of the present sample, a reported therapeutic response in 94% of the patients is much higher than could be attributed to placebo effect alone. Although the therapeutic response was partial relief in 28% of these patients, and rescue medications were sometimes required, the observed benefits from the injections were significant. The lower cervical paraspinous injection with bupivacaine was also successful as a rescue medication. A number of patients who had experienced inadequate pain relief from other interventions had resolution of their orofacial pain only after treatment with the lower cervical bupivacaine injections. The duration of pain relief following this procedure cannot be determined from this retrospective review. A limited number of patients (7 of 114) with severe pain had a documented recurrence of pain while in the emergency department.

The clinical indications for the application of this technique appear to include a wide spectrum of painful head and face conditions. The authors acknowledge that specific dental nerve blocks may more consistently and effectively manage dental pain; nevertheless, this technique appears to frequently relieve dental pain along with associated head and face pain.

The convergence of the upper cervical nerves and trigeminal sensory afferents at the trigeminocervical complex is well documented.[7,8,13–19] In 1998 Browne et al performed a comprehensive review of the basic science and empiric literature detailing evidence of neurophysiologic coupling between the craniofacial and cervical systems.[20] Bogduk recently published an extensive review of current evidence suggesting an association between headache pain and the cervical anatomy in 2004.[21] Most recently, an exhaustive critical review of the literature by Armijo Olivo et al concluded that "there are probably associations between the cervical spine and the stomatognathic system, and consequently, a link to craniofacial pain."[22]

In clinical studies, Carlson et al reported that 13 of 15 patients experienced a significant reduction in masseter region pain following ipsilateral trapezius trigger-point injection with 2% lidocaine.[23] Busch et al demonstrated a significant decrease of the ipsi- and contralateral nociceptive blink response reflex areas and an increase of the ipsi- and contralateral R2 latencies on the injection side after a unilateral occipital nerve block.[24] While the mechanism of pain relief associated with this procedure is unknown, the relief of orofacial pain, allodynia, photophobia, and associated headaches suggests that a sensitized trigeminocervical complex is quieted and/or that descending inhibitory antinociception by the PAG, nucleus raphe magnus, and RVM is facilitated.[7–9]

Finally, an alternative pain relief mechanism to be considered is diffuse noxious inhibitory controls (DNIC).[25–27] The posterior cervical injections could initially serve as noxious stimuli that activate an endogenous analgesic system within the brain, resulting in the attenuation of nociceptive signals.

Limitations

This study has several limitations. First, it involved a retrospective review and consequently lacks the scientific rigor of a placebo-controlled study. Nevertheless, as already stated, the observed therapeutic response was significantly higher than would be expected due to placebo effect alone. Additionally, although this review uniquely reports the therapeutic responses of a large number of patients, the application of the procedure is described for an assortment of conditions causing orofacial pain. Consequently, many of the disease categories studied included smaller cohorts of patients.

Another weakness of the study is the lack of validated criteria for rating pain relief. The NDS used to document pain levels at presentation for the majority of the patients has been previously validated in the emergency department setting.[28] Furthermore, the NDS has been shown to correlate well with the visual analog scale,[28,29] and several studies have shown that a minimally clinical significant difference in the NDS is approximately 1.3 units.[28–31] Unfortunately, more than one third of

the therapeutic responses to treatment (38%) were reported using only clinical response descriptions rather than the NDS. Consequently, pain relief criteria for this retrospective chart review had to be developed using a combination of elements, including clinical response descriptions as well as the NDS. Nevertheless, for the 71 patients with NDS scores documented before and after the intervention, the average score decrease was 7.25 points.

It is also possible that bias might have been introduced into this study because 1 physician, the first author, was responsible for 45% of the procedures. Orofacial pain relief occurred in 75% of the first author's patients as compared to 59% of the patients treated by all other health-care providers combined. These results were not statistically different and, as reported in the Results section, the 4 health-care providers who most frequently and independently performed the procedure had combined results almost identical to those of the first author.

Conclusions

The lower cervical paraspinous intramuscular injection with bupivacaine appears to be a useful adjunct for the management of orofacial pain in the emergency department setting. This retrospective chart review of all patients treated during a 1-year period provides evidence that this procedure may relieve orofacial pain. These results also provide additional clinical support for a convergence between the cervical nerves and the trigeminocervical complex as well as a prominent central antinociceptive effect. If these findings are subsequently confirmed, other head and neck nociceptive conditions, including chronic orofacial pain, postsurgical pain, and postinfection pain, as well as pain associated with head and neck cancers, may benefit from this procedure. Nevertheless, a methodologically rigorous double-blind, randomized controlled trial is needed before widespread application of this procedure for the treatment of orofacial pain can be recommended.

Acknowledgments

The authors would like to thank their research assistants, Davis Mellick and Selvin Jeremiadoss, for their contributions.

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