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Educational case report

Real-time ultrasound-guided infraorbital nerve block to treat trigeminal neuralgia using a high concentration of tetracaine dissolved in bupivacaine☆

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HIGHLIGHTS

- Infra-orbital blocks with tetracaine (40 mg/ml) are effective and safe for trigeminal neuralgia.
- Ultrasound imaging is useful for localizing the infraorbital foramen.
- We performed real-time ultrasound guidance for an infraorbital nerve block.
- Real-time ultrasound guidance can visualize an image of the spreading agents around the nerve.
- Real-time ultrasound guidance enables a high success rate for the block.

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ABSTRACT

Background: Trigeminal neuralgia is a neuropathic disorder characterized by episodes of intense pain in the face. Drug therapy is the first choice of treatment. However, in cases where drug therapy are contraindicated due to side effects, patients can get pain relief from lengthy neurosurgical procedures. Alternatively, a peripheral trigeminal nerve block can be easily performed in an outpatient setting. Therefore it is a useful treatment option for the acute paroxysmal period of TN in patients who cannot use drug therapy. We performed real-time ultrasound guidance for infraorbital nerve blocks in TN patients using a high concentration of tetracaine dissolved in bupivacaine. In this report, we examine the efficacy of our methods.

Patients: : As approved by the Institutional Review Board, the medical records in our hospital were queried retrospectively. Six patients with TN at the V2 area matched the study criteria. All patients could not continue drug therapy with carbamazepine due to side effects and they received an ultrasound-guided infraorbital nerve block with a high concentration of tetracaine dissolved in bupivacaine.

Methods: The patient was placed in the supine position and the patient's face was sterilized and draped. An ultrasound system with a 6–13 MHz linear probe was used with a sterile cover. The probe was inserted into the horizontal plane of the cheek just beside the nose and was slid in the cranial direction to find the dimple of the infraorbital foramen. The 25G 25 mm needle was inserted from the caudal side just across from the probe using an out-of-plane approach. To lead the needle tip to the foramen, needle direction was corrected with real-time ultrasound guidance. After the test block with lidocaine (2%, 0.5 ml), a solution of tetracaine (20 mg) dissolved in bupivacaine (0.5%, 0.5 ml) was injected. During each injection, the spread of the agent around the nerve was confirmed using ultrasound images.

Results: Ten blocks were performed for six patients. Immediately after the procedure, all 10 blocks produced analgesia and relieved the pain. In the three blocks, pain was experienced in a new trigger point outside of the infraorbital nerve region (around the back teeth) within a week after the block and pain were relieved using other treatment. Two patients developed small hematomas in the cheek but

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they disappeared in a week. All patients did not complain about other side effects including paraesthesia, hyperpathia, dysaesthesia, or double vision. Hypoaesthesia to touch and pain in the infraorbital region were observed in all blocks after 2 weeks.

Conclusions: We performed real-time ultrasound-guided infraorbital nerve block for TN with a high concentration of tetracaine dissolved in bupivacaine. Our method achieved a high success rate and there were only minor and transient side effects.

Implications: : Real-time ultrasound-guided infraorbital nerve block is one of the useful options to treat the acute paroxysmal period of TN at the infraorbital nerve area. Ultrasound-guided injections may become the standard practice for injecting peripheral trigeminal nerves. Using this high concentration of tetracaine as a neurolytic agent is effective and appears to have only minor side effects.

1. Introduction

Trigeminal neuralgia (TN) is a neuropathic disorder characterized by episodes of intense pain in the face originating from the trigeminal nerve. There are various clinical options to treat TN: anti-epileptic drugs (carbamazepine, baclofen, etc.), microvascular decompression surgery, gamma knife, nerve block using a neurolytic agent, and radiofrequency rhizotomy [1]. Drug therapy is the first choice of treatment. However, in cases where anti-epileptic drugs are contraindicated due to side effects, patients can get immediate pain relief from lengthy neurosurgical procedures. Alternatively, a peripheral trigeminal nerve block can be easily performed in an outpatient clinic setting. Therefore it is a useful treatment option for the acute paroxysmal period of TN in patients who cannot use anti-epileptic drugs. TN at the V2 area is reported to account for 37.8% of all TN, and 80% of the TN at V2 can be treated with the infra-orbital nerve block [2]. Peripheral trigeminal nerve blocks using a high concentration of tetracaine dissolved in bupivacaine are effective in treating TN [3,4]. Ultrasound imaging is useful for localizing foramina when performing a superficial trigeminal nerve block [5,6]. Cadaveric investigation suggests that ultrasound guidance can be used to inject the peripheral trigeminal nerve with a high degree of accuracy [7]. We performed real-time ultrasound guidance for infraorbital nerve blocks using a high concentration of tetracaine dissolved in bupivacaine in six patients who could not tolerate carbamazepine. In this report, we examine the efficacy of our methods.

2. Methods

As approved by the Institutional Review Board of Ehime University School of Medicine, the medical records in our hospital were queried retrospectively.

Six patients (four males, two females; mean age, 71 years; age range, 54–87 years) with TN at the V2 area matched the study criteria. In these patients, analgesic drug therapy had failed to control the pain or had produced intolerable side effects (dizziness or impairment of liver function). None of these patients requested to go directly to neurosurgical interference. Written informed consent for this nerve block was obtained from all patients. The effect of the block was evaluated using the Barrow Neurological Institute (BNI) pain scale [8].

The patient was placed in the supine position and the patient's face was sterilized and draped. An ultrasound system with a 6–13 MHz linear probe (Sonosite, Inc., Bothell, WA, USA) was used with a sterile cover. The probe was inserted into the horizontal plane of the cheek just beside the nose and was slid in the cranial direction to find the dimple of the infraorbital foramen (Fig. 1). The 25G 25 mm needle was inserted from the caudal side just across from the probe using an out-of-plane approach. The needle was introduced through the skin 10 mm lateral to the middle part of the ala of the nose and advanced in superior, posterior, and slightly lateral direction. To lead the needle tip to the foramen, needle direction was corrected with real-time ultrasound guidance. After confirming that the needle tip was at the entrance of the foramen, the needle was then advanced 3 mm within the canal (Fig. 2). Paraesthesia was not necessary. A test dose of lidocaine (2%, 0.5 ml) was injected. Five minutes later, anaesthesia of the skin innervated by the infraorbital nerve was confirmed using von Frey filaments (1.0 g bending force for touch sensation, 8.0 g bending force for pain sensation) and side effects including double vision were checked. Then a solution of tetracaine (20 mg) (crystalline tetracaine hydrochloride; Kyorin Pharmaceutical, Tokyo, Japan) dissolved in bupivacaine (0.5%, 0.5 ml) (AstraZeneca) was injected. During each injection, the spread of the agent around the nerve was confirmed using ultrasound images (Fig. 3). An aspiration test was done before each injection. The needle was pulled back and the patient applied pressure over the insertion site for 5 min for pressure haemostasis.

Pain relief for TN and sensation at the skin innervated by the infraorbital nerve were evaluated again 2 weeks after the block. Then patients were informed to feel free to return in the case of pain are recurrent. The medical records were queried for up to 6 months after the block.

3. Results

Ten blocks were performed for six patients (Table 1). Immediately after the procedure, all 10 blocks produced analgesia and relieved the pain. In one of these blocks, weak pain occurred occasionally, but no medication was needed. In two of these blocks pain recurred after 3 months, pain recurred after more than 6 months in two blocks, and pain relief continued in three blocks. In the remaining three blocks, pain was experienced in a new trigger point outside of the infraorbital nerve region (around the back teeth) within a week after the block. In two of these three pains were relieved using a maxillary nerve radiofrequency rhizotomy, and in the remaining one a low dose of carbamazepine was used. Two patients developed small hematomas in the cheek but they disappeared in a week. All patients did not complain about other side effects including paraesthesia, hyperpathia, dysaesthesia, or double vision. Hypoaesthesia to touch and pain in the infraorbital region were observed in all blocks after 2 weeks.

4. Discussion

There are several methods for neurolytic block. However, no one neurolytic agent or technique has been proven superior to another [9]. Derivatives of tetracaine such as N-alkyl tetracaine compounds were reported to have both anaesthetic and neurolytic properties [10]. In our cases, decreases in both touch and pain sensation continued over 2 weeks after the nerve block. However, no patient complained of dysaesthesia or hyperpathia. Therefore, we think that the high concentration of tetracaine dissolved in

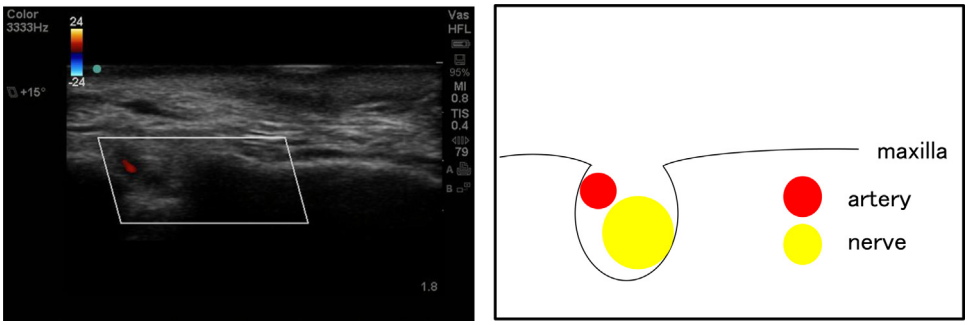

Fig. 1. Left: Ultrasound image of the infra orbital foramen with colour Doppler. Right: Illustration of the structure in ultrasound image.

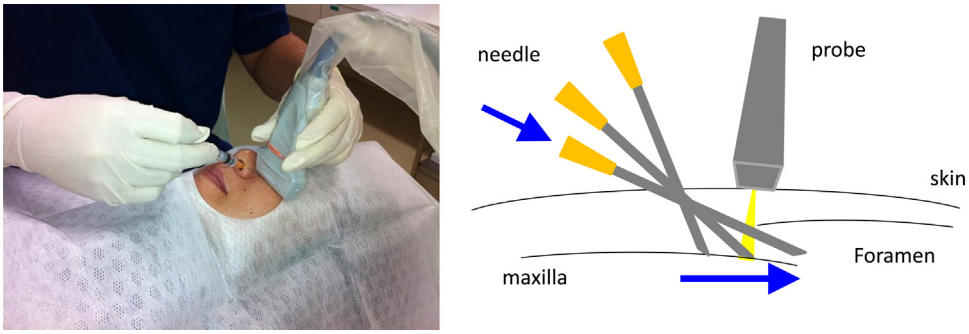

Fig. 2. Left: Transducer position and needle insertion. Right: Illustration of needle movement (walking along the maxilla towards and into the foramen).

bupivacaine has weak neurolytic effect with less discomfort and chemical neuritis.

An infraorbital nerve block is usually performed using anatomical landmarks or with palpation of the infraorbital foramen through the skin. In conventional peripheral neurolytic trigeminal nerve block with alcohol, the literature reports success rates from 80% to 91% and literature continues to be published arguing that accuracy rates for injections using a blind technique are not as high as desired [7]. In our case series, hypoaesthesia at the infraorbital region was observed in all blocks at 2 weeks after blocks,

Table 1
Summary of block.

Patient	Gender	Age	BNI pain scale			Recurrence	Other treatment after block
			Before	After block	After 2 weeks		
1	Male	70	V	I	I	Three months after block	
			V	I	I	After 3 days, expressed new trigger around back tooth	Maxillary nerve RF, microvascular decompression surgery
2	Male	87	V	I	I	Three months after block	
			V	I	I	None	Gamma knife (2 months after block)
3	Female	73	V	I	I	After 1 day, expressed new trigger around back tooth	Maxillary nerve RF
4	Male	83	V	I	I	Over 6 months after block	
			V	I	I	None	
5	Male	63	V	I	II	None	Microvascular decompression surgery (2 months after block)
6	Female	54	V	I	I	Over 6 months after block	
			V	I	III	After 1 week expressed new trigger around back tooth	Low dose of carbamazepine (100 mg/day)

Barrow Neurological Institute (BNI) pain scale.
BNI Grade I – no trigeminal pain; no medication required.
BNI Grade II – occasional pain; not requiring medication.
BNI Grade III – some pain; adequately controlled with medication.
BNI Grade IV – some pain; not adequately controlled with medication.
BNI Grade V – severe pain; not relieved with medication.

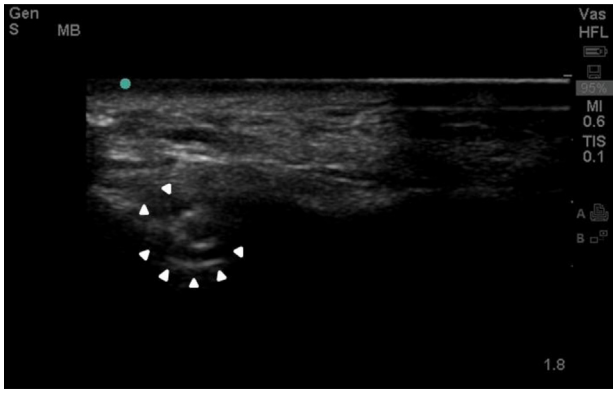

Fig. 3. Post-injection ultrasound image showing the spread of the agent around the nerve (doughnut sign).

reflecting a success rate of 100% (two cases require the consideration of the effect of maxillary nerve radiofrequency rhizotomy). In conventional infraorbital nerve blocks with neurolytic agents, we sometimes observe that although the effect of a test block using local anaesthetics is complete, the effect of the neurolytic agent used in the infraorbital block is incomplete. In these failed cases, we speculate that the needle tip is separated from the nerve after the test block. In conventional methods, paraesthesia helps to confirm that the needle tip is in contact with the nerve. Therefore, it is difficult to identify the needle position after local anaesthesia has been applied via a test block. By using ultrasound guidance, as demonstrated in our study, needle position can be identified and adjusted after a test block. Therefore, ultrasound guidance may increase the success rate of infraorbital nerve blocks. Furthermore, ultrasound is useful for infraorbital nerve blocks using more toxic neurolytic agents than those used in our case such as an alcohol or phenol.

In-plane vs. out-of-plane needle-probe alignment for ultrasound-guided peripheral nerve blocks remains controversial. The infraorbital foramen exists superficially and near to the needle-introducing site, so we chose an out-of-plane approach that requires a shorter distance than the in-plane approach. The out-of-plane approach is also advantageous when injecting the agent because it provides images showing the spread of the agent around the nerve as a doughnut sign.

Serious complications associated with the infraorbital nerve block are relatively rare. In our case, two women developed small haematoma in the cheek after the block, which may have been caused by vascular injury. Ultrasound imaging can visualize the infraorbital artery in some patients. However, even in cases where the infraorbital artery can be identified, it is difficult to avoid vascular injury. In our method, the needle tip target is inside the infraorbital foramen, which contains the nerve. Intravascular puncture within the foramen cannot be visualized with ultrasound. Therefore, aspiration testing before injection is important to avoid serious complications caused by intravascular injection.

5. Conclusions

We performed real-time ultrasound-guided infraorbital nerve block for TN with a high concentration of tetracaine dissolved in bupivacaine. Our method achieved a high success rate and there were only minor and transient side effects.

6. Implications

Real-time ultrasound-guided infraorbital nerve block is one of the useful options to treat the acute paroxysmal period of TN at the infraorbital nerve area. Ultrasound-guided injections may become the standard practice for injecting peripheral trigeminal nerves. Using this high concentration of tetracaine as a neurolytic agent is effective and appears to have only minor side effects.

Conflict of interest

None declared.

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