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Palliative Treatment of Trigeminal Neuralgia Secondary to Brain Tumor with Extracranial Radiofrequency Ablation of Trigeminal Nerve Branches: A Case Report

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1. Abstract

1.1. Background: When patients with trigeminal neuralgia secondary to tumor are unwilling to choose craniotomy as the primary tumor treatment, the most appropriate palliative analgesic treatment takes first priority.

1.2. Case Description: The patient had "trigger points" in the innervation areas of each branch of the trigeminal nerve, and 8 VAS points at the time of the attack. MRI revealed a cerebellopontine angle tumor immersed in the middle cranial fossa of the gasserian ganglion. Extracranial radiofrequency ablation of the trigeminal nerve branch was performed and the pain disappeared completely. The remaining primary pain area was numb, and no recurrence was observed at 3-months follow-up.

1.3. Conclusions: Effectiveness of extracranial radiofrequency in palliative treatment is not-limited to tumor penetration in the middle fossa and secondary trigeminal neuralgia, but in avoiding intracranial hemorrhage, infection, and metastasis, arising from radiofrequency in the gasserian ganglion or percutaneous micro-balloon compression. Testing and replication of this technique is advisable.

2. Introduction

Trigeminal neuralgia secondary to intracranial tumor needs to be treated first for the primary tumor. Because of age and economic reasons, patients refused to have craniotomy and asked for palliative analgesia. We chose radiofrequency ablation combined with the 1st:2nd and 3rd branches of extracranial trigeminal nerve,which not only achieved the purpose of analgesia, but also avoided serious complications such as tumor spread, intracranial hemorrhage and intracranial infection caused by radiofrequency or balloon compression of intracranial Gasserian ganglion.

3. Case Presentation

The patient, a 74-year-old female, was admitted to the hospital due to repeated right facial pain for 16 years, that aggravated in 1 month. The patient had experienced electric shock-like paroxysmal pain on the right side, 16 years ago with no obvious inducement or prodromal symptoms. The pain was induced whilst washing the face, speaking, and brushing teeth, lasting for several minutes each time. The intervals in-between the episodes were completely painless. In another hospital, she was diagnosed with trigeminal neuralgia. The pain could be alleviated by the oral intake of carbamazepine. As the symptoms gradually worsened over the past 13 years, even an increase of 2.4 g/day of carbamazepine failed to effectively relieve the pain or counter the side-effects such as dizziness, ataxia. When the patient revisited the hospital, magnetic resonance imaging (MRI) revealed that "the right anterior bridge pool occupied the tumor." Although surgery was recommended, it was refused. To relieve the pain, oxcarbazepine, gabapentin, pregabalin, tramadol, amitriptyline was consumed, along with acupuncture treatment. Oral medication was completely ineffective 1 month prior to presentation, and the patient experienced more frequent pain attacks (6–8 times/h). The visual analog score (VAS) of the degree of pain was more than 8 points, as the patient presented to our pain department for treatment. She was hospitalized for secondary right side trigeminal neuralgia.

Physical examination: A body temperature of 37.4 ℃, respiration rate of 18 times/min, pulse rate of 88 times/min, blood pressure

143/78 mmHg, 157 cm height, and 55 kg weight were recorded. Consciousness, normal spirit, no abnormality in the thorax, no abnormality in cardiopulmonary auscultation, no tenderness or rebound pain in the abdomen, no deformity of the limbs, or movement disorders were confirmed. Special examination: The face was symmetrical without swelling, the tongue was in the middle, vision was normal, the visual field was not damaged, and no pain was induced by swallowing. The trigeminal nerves, V1, V2, and V3, innervating the areas on the right side all had touch-induced pain, no tenderness, or hypoesthesia in the relevant areas, and the VAS score was 8 points when pain occurred. Rechecking the trigeminal nerve MRI revealed that the right anterior pontine cistern inhabited a tumor that invaded the trigeminal gasserian ganglion of the middle cranial fossa. Cranial computerized tomography (CT) examination reaved a "space occupying in the petrous apex of the right temporal bone."

The patient had no history of facial herpes zoster and was diagnosed with "secondary right trigeminal neuralgia" in combination with physical and auxiliary examinations. The organized multidisciplinary team discussion (MDT) and consultations revealed that the neurology department believed that the effect of various oral drugs used consequentially and additionally remained poor, and that conservative treatment should be abandoned. The neurosurgery department proposed craniotomy for tumor resection, while the pain department believed that if the patient resolutely refused to choose the treatment for the primary intracranial tumor, it may be treated by radiofrequency or balloon compression; however, the patient's tumor had infiltrated the gasserian ganglion. To avoid spread and metastasis of the tumor or complications of intracranial hemorrhage, we chose extracranial radiofrequency of the trigeminal nerve branches. Palliative analgesia. After communicating the opinions of the MDT to the patient and her family, the patient refused craniotomy and chose extracranial radiofrequency therapy. The preoperative routine blood examination, electrocardiogram, coagulation function, and other examinations thereon improved. After the contraindication for radiofrequency treatment was eliminated, percutaneous punctures of the foramen ovale, foramen rotundum, and supraorbital foramen were performed under CT guidance for the extracranial radiofrequency treatment of the mandibular, maxillary, and supraorbital nerves of the trigeminal nerve.

The patient fasted for 6 h, and an intravenous trocar was retained to open the intravenous infusion channel, which was sent to the CT operating room. The patient was instructed to lie on a CT (German Siemens Huanyue) table and put a thin pillow under the shoulder to tilt her head back. Vital signs were monitored and nasal catheter oxygen inhalation was performed. A positioning grid was placed on the right side of the face, and the head was fixed with a wide tape. Paranasal sinus mode CT was used to obtain the skull localization image. First, the foramen ovale and foramen rotundum (the lower boundary of the scanning RFA is the line of the external ear foramen - [the middle point of the line between the mental process and the canine], and the upper boundary reaches the lower edge of the orbit) were scanned with a thickness of 3 mm in the semi-coronal position. The obtained images were replayed, and the puncture plane was selected (V3 radiofrequency was selected to include the plane of the mandibular coronal process and foramen ovale; while for the V2 branches, the plane including the lower edge of the zygomatic arch and the outer mouth of the foramen rotundum tube was selected) to design the puncture path (pulling a straight line from the foramen ovale and foramen rotundum to avoid the bone block; the intersection point of this line and the skin being the puncture point) and the needle entry angle and depth were measured [1-5]. After an intravenous injection of 50 μg fentanyl citrate, and local infiltration anesthesia with 1 ml 2% lidocaine at each puncture point, the radiofrequency needle was punctured at the foramen ovale and foramen rotundum, according to the designed puncture path. Then, a 2 mm thick axial scan was performed on the supraorbital margin to find the plane containing the supraorbital hole (notch). The puncture path was designed which was horizontally punctured along the lower edge of the eyebrow arch to the top of the supraorbital notch [6,7] using a CT tool ruler. Electrophysiological tests were carried out on each branch: 0.5 mA low frequency (2 Hz, 1 ms) current to stimulate mandibular rhythmic shaking; a 0.5 mA high frequency (50 Hz 0.1 ms) current to stimulate the numbness and tingling sensation of the skin in the V3, V2 and V1 branches; and then, intravenous injection of 50 μg of fentanyl citrate and 70 mg of propofol were provided again. After the patient fell asleep, radiofrequency ablation (RFA) at 90 ℃ for 120 s [1,5,8] was performed on each branch.

After awakening, the right facial skin was touched using a cotton swab. The patient complained of numbness and dullness, which no longer caused pain attacks, and the treatment was terminated upon pulling the radiofrequency needle out. After 2 days of observation, the pain did not recur and the patient was discharged from the hospital. The patient was asked to undergo brain CT or MRI every 6 months. If the tumor seemed to grow rapidly, the patient was asked to visit the neurosurgery department on time. Three months after discharge, the pain did not recur.

4. Discussion

Trigeminal neuralgia can be divided into two major categories: primary and secondary. The latter is mostly secondary to tumors in the cerebellopontine angle or trigeminal herpes zoster. Trigeminal neuralgia (TN) is a common type of head and facial pain. As it has a typical lightning-like sharp pain manifestation, of sudden onset and stop, the pain is limited to the area dominated by the trigeminal nerve, has the characteristics of "trigger point" of touch-induced pain, and initial oral carbamazepine can is effective for relieving the pain. It is easy to be diagnosed clinically, but brain CT or MRI examination is required to exclude the possibility of secondary intracranial tumors. [9] This patient had no history of

herpes zoster and had typical symptoms of trigeminal neuralgia from the beginning. Oral carbamazepine was effective until drug resistance appeared during the treatment of trigeminal neuralgia with oral medicine; that is, after long-term oral administration of a drug, the curative effect declines, and even an increase in the dose cannot achieve the effect of the original small dose. Brain CT and MRI resonance imaging revealed secondary trigeminal neuralgia caused by a tumor at the right pontocerebellar angle.

The treatment principle of secondary trigeminal neuralgia is to treat the primary disease first. RFA, percutaneous microballoon compression (PBC), gamma knife irradiation, and craniotomy microvascular decompression (MVD) are alternative options for primary trigeminal neuralgia, [10] in addition to oral conservative treatment. For patients with trigeminal nerve multibranch pain who are unwilling to choose an MVD operation, PBC should be preferred over RFA. As the therapeutic target of PBC is the gasserian ganglion, there is no selectivity for the three branches during PBC treatment. The compression treatment of the gasserian ganglion can simultaneously cover the three branch innervating areas, and the damage to neurons is lighter than the traditional RFA of the gasserian ganglion, which would not cause destructive damage to the V1 branch (ophthalmic nerve), resulting in corneal denervation, perforation blindness, or other serious complications. [9] However, for the treatment principle of secondary trigeminal neuralgia, the primary disease should be treated primarily to remove the cause. The patient was definitively diagnosed with trigeminal neuralgia secondary to a tumor occupying the cerebellopontine angle. Craniotomy is the first-choice of treatment for tumor resection.

The clinical diagnosis and treatment decisions should not only follow medical principles, but also consider social factors. According to medical principles, patients with trigeminal neuralgia secondary to tumors should be treated with craniotomy as the first choice. After communicating the MDT discussion opinions with the patient and his family members, the patient and his family members clearly refused to undergo craniotomy tumor resection and asked for the simplest way to relieve the current severe pain. As the patient was from poor economic conditions with negligible conventional social standing, the risk of serious complications arising from surgery would have been high, given that the tumor had already invaded the gasserian ganglion region of the middle cranial fossa from the posterior cranial fossa. In addition, the patient was older, unwilling to undergo craniotomy, and only wanted palliative treatment for pain relief. In combination with MDT and the wishes of the patient, a clinical treatment scheme can only be selected between RFA and PBC, which are more minimally invasive than craniotomy.

RFA of extracranial non gasserian ganglion transfers the target of classic RFA from intracranial gasserian ganglion to each branch of the trigeminal nerve. Entering the skull during the puncture operation is unnecessary, and complications such as intracranial hemorrhage and intracranial infection could be avoided. The classic RFA technique for treatment trigeminal neuralgia is to puncture the gasserian ganglion (which is deep in the middle cranial fossa) through the foramen ovale; the puncture needle needs to enter the skull to reach the target, the gasserian ganglion, during the treatment operation. Hence, the risk of complications causing intracranial hemorrhage and intracranial infection is eminent. [1-8, 10, 11]. The extracranial RFA transferred the target of classic RFA from the intracranial gasserian ganglion to each branch of the trigeminal nerve out of the cranial foramen, and the needle point of extracranial RFA did not need to enter the skull during the puncture operation, which could avoid the risk of intracranial hemorrhage of the classic RFA. In addition, RFA of the V1 subbranch supraorbital hole avoids the small branches that dominate the cornea and can avoid the complications of blindness caused by corneal perforation; therefore, extracranial RFA is safer than classic RFA. The therapeutic target for PBC is the intracranial gasserian ganglion. If PBC is selected for treatment, disturbance of the gasserian ganglion area is inevitable. [12,13] In addition, the patient's tumor had invaded the trigeminal ganglion, which is likely to have serious consequences because the RF-agile tumor tissue being compressed by the balloon, even in the absence of intracranial hemorrhage. There may also be concerns about the dissemination and metastasis of tumor tissue invading the gasserian ganglion segment due to puncture or extrusion. Therefore, after repeated discussions and weighing the advantages and disadvantages, we chose extracranial non-gasserian ganglion RFA. In this case, after receiving extracranial RFA from all branches of the trigeminal nerve, the pain disappeared immediately, and there was no recurrence of pain after 3 months of follow-up. Extracranial RFA of the trigeminal nerve branch can therefore be regarded as a safe and effective palliative treatment option for trigeminal neuralgia secondary to tumors in the pontocerebellar angle involving the meniscus of the middle cranial fossa.

5. Conflict of Interest

The authors declare no conflicts of interest.

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