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Pulsed radiofrequency treatment of the Gasserian ganglion in patients with idiopathic trigeminal neuralgia

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Abstract

Pulsed radiofrequency treatment has been described as a minimal invasive alternative to radiofrequency thermocoagulation for the management of chronic pain syndromes. We present here our first five high-risk patients with idiopathic trigeminal neuralgia who were treated with pulsed radiofrequency after multidisciplinary assessment; with a mean follow-up of 19.2 months (range 10–26). These patients were at high risk due to age, co-morbidities or previous interventional and surgical treatments. An excellent long-term effect was achieved in three of the five patients, a partial effect in one patient and a short-term effect in one patient. No neurological side effects or complications were reported.

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Keywords: Trigeminal neuralgia; Pulsed radiofrequency; Gasserian ganglion

1. Introduction

Patients suffering from idiopathic trigeminal neuralgia (ITN) that is refractory to pharmacological treatment are candidates for interventional therapy. The three percutaneous procedures are balloon compression, retrogasserian glycerol injection and radiofrequency (RF) thermocoagulation. These procedures are neurodestructive and may be associated with side effects such as sensory loss, dysesthesia, anesthesia dolorosa and corneal anesthesia (Fraïoli et al., 1989; Apfelbaum, 1990; Kanpolat et al., 2001).

Conventional RF treatment, using a constant output of high-frequency electric current applied at the Gasserian ganglion, is documented as one of the most effective interventional techniques when conservative treatment fails

(Sweet and Wepsic, 1974; Jho and Lunsford, 1997; Kanpolat et al., 2001).

RF current applied to the nerve creates a friction of molecules, which in turn warms the tissue. This technique uses increasing temperatures starting at 60 °C, thus producing lesions in the ganglion. The size of the lesion will depend on the temperature obtained in the tissue, the duration of the procedure, the size of the noninsulated electrode tip and the electrode diameter. The use of pulsed radiofrequency current (PRF), whereby the high-frequency current is applied in bursts of 20 ms with a silent time of 480 ms, allowing elimination of heat, has been documented to be safe and efficacious in the management of spinal pain (Sluijter et al., 1998; Munglani, 1999).

Our study reports results from the first five high-risk patients with ITN who were treated in our hospital with PRF of the Gasserian ganglion. To our knowledge no other literature exists on the long-term effects of this new treatment option.

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113 2. Patients and methods

114 Patients presenting to our hospital with refractory
115 trigeminal neuralgia receive a multidisciplinary assessment,
116 with complete neurological evaluation and magnetic
117 resonance imaging. Within this population several patients
118 have multiple co-morbidities; some have already received
119 interventional treatment for ITN. In order to be a candidate
120 for RF or PRF treatment, the conservative, pharmacological
121 treatment options must have been tested for a sufficiently
122 long period to allow the patient to be classified as refractory.

123 All patients had previously been treated with carbama-
124 zepine, gabapentin and/or valproic acid without pain relief
125 or with intolerable side effects. PRF was performed in
126 patients who had either undergone other interventional
127 treatments or whose co-morbidity did not justify invasive
128 surgical procedures because of assumed efficacy and safety
129 issues.

130 After providing the patients with complete information
131 regarding the technique and its expected effects and side
132 effects, we obtained their verbal informed consent.

133 The patient was lightly sedated with propofol, and a
134 Sluijter–Metha thermocouple 10-cm electrode with a 4-mm
135 noninsulated tip was positioned under fluoroscopic gui-
136 dance as described by Sweet and Wepsic (1974).

137 After verifying the correct position of the needle, the
138 patient was woken up to test the sensory threshold by means
139 of electrostimulation at 50 Hz. The PRF current was then
140 applied for 120 s with a generator (Radionics, Burlington,
141 MA.) output of 45 V, not exceeding a temperature of 42 °C
142 at the tip of the electrode. Thereafter the sensitivity of the
143 face and cornea were tested. If required, a second PRF
144 treatment was carried out for a further 120 ms.

145 Patients were followed for efficacy, side effects and
146 complications on a regular basis for up to 2 months. Careful
147 neurological evaluations were performed with special
148 attention for sensory loss and dysesthesia. Long-term
149 follow-up, by an evaluator not involved in patient selection
150 and/or treatment, took place in the middle of 2001, mean
151 follow-up time being 19.2 months (range 10–26 months).

152 3. Results

153 3.1. Patient 1

154 A 69-year-old man had suffered from trigeminal
155 neuralgia in the first branch of the trigeminal nerve for 10
156 years. Previous interventional treatments consisted of
157 retrogasserian glycerol injection and thermocoagulation of
158 the first branch of the trigeminal nerve 2 years prior to PRF
159 treatment. His medical history included aortic valve repair
160 for aortic stenosis.

161 His current episode of ITN had started several months
162 earlier with a sudden flash of pain above the right eye, which
163 was resistant to pharmacological treatment. Triggers for the

164 attacks of pain were cold, wind and eating. Sensory
165 stimulation (50 Hz) resulted in tingling above the right
166 eye at 0.4 V and PRF treatment was carried out as described
167 above. Two 120-ms interventions took place during the
168 same session.

169 The onset of pain relief was reported 1 day after the
170 intervention. At long-term follow-up 20 months after the
171 procedure he was completely pain-free. No additional
172 pharmacological or other treatments were required during
173 this period, and no side effects or complications were
174 reported.

175 3.2. Patient 2

176 A 68-year-old woman had suffered from painful attacks
177 in the region of the second branch of the trigeminal nerve for
178 9 months. Her medical history included arterial hyperten-
179 sion, atrial fibrillation and implantation of a pacemaker. She
180 experienced very painful attacks in her jaw, which were
181 triggered by touch and speaking.

182 The electrode was positioned at the level of the second
183 branch of the left trigeminal nerve. Sensory stimulation (50
184 Hz) evoked sensations on the painful site at 0.04 V. A PRF
185 current was applied and resulted in pain relief after 12 days.

186 At long-term follow-up 10 months after PRF treatment,
187 she was completely pain-free. No additional pharmacologi-
188 cal or other treatments were required during this period, and
189 no side effects or complications were reported.

190 3.3. Patient 3

191 A 67-year-old woman had experienced trigeminal
192 neuralgia for the past 12 years, which was triggered by
193 touch, eating and cold, and was located in the second and
194 third branch on the right side. She had previously undergone
195 three craniotomies with microvascular decompression
196 (Janetta procedure) in another hospital, and refused to
197 undergo another severe surgical intervention.

198 An extensive pharmacological approach provided insuf-
199 ficient results and, because of sensory changes in the painful
200 area, PRF treatment was proposed. The first attempt had to
201 be interrupted because the position of the electrode in the
202 foramen ovale could not be visualized, and a hematoma
203 developed. Two weeks later a new attempt was made and
204 the electrode could now be positioned at the level of the
205 Gasserian ganglion.

206 Sensations at the painful site were obtained by sensory
207 stimulation at 0.1 V with 50 Hz. PRF treatment resulted in
208 complete analgesia after 20 days, which lasted for up to 4
209 months; thereafter, low-intensity attacks recurred.
210 Additional carbamazepine (800 mg daily) and gabapentin
211 (900 mg daily) treatment resulted in good pain relief for
212 many months. Fifteen months after the first PRF treatment a
213 second intervention was performed, which resulted in
214 complete pain relief after 27 days. At long-term follow-up
215 18 months after the first PRF treatment and 3 months after
216

the second intervention, complete pain relief had been achieved without additional pharmacological treatment. No additional sensory changes or dysesthesia were noted.

3.4. Patient 4

An 81-year-old woman had trigeminal neuralgia for 10 months in the right third branch of the trigeminal nerve. The triggers were cold and eating. Pharmacological treatment was stopped because of intolerance. An electrode was placed at the V3 portion of the Gasserian ganglion. Electrical stimulation at 0.37 V with 50 Hz resulted in sensations at the painful site and was followed by PRF treatment, which was performed without any technical difficulties. At the follow-up visit 19 days after the PRF treatment, 90% pain reduction was noted. At long-term follow-up 22 months after the procedure, she still reported 90% pain reduction. No additional pharmacological or other treatments were required during this period, and no side effects or complications were reported.

3.5. Patient 5

A 70-year-old man had suffered from trigeminal neuralgia in the left second branch of the trigeminal nerve for 20 years. In addition to pharmacological treatment he underwent surgical extraction of all his teeth, and an RF procedure had been carried out twice in another hospital.

In this patient, placement of the electrode at the left V2 portion of the Gasserian ganglion was difficult because of foramen sclerosis. Sensations in the painful region were obtained with sensory stimulation at 0.1 V. Initial pain relief was noted 10 days after the intervention. One month after PRF treatment he experienced a reduction in the number of painful attacks and a 75% decrease in pain intensity. However, 5 months after the treatment he consulted another pain center where RF thermocoagulation of the Gasserian ganglion was performed with only minimal additional pain-relieving effect.

At long-term follow-up, 26 months after the PRF intervention, the patient was referred to the neurosurgeon for microvascular decompression.

3.6. Overall results

Our small series indicates that PRF of the Gasserian ganglion can be effective in terms of pain reduction. Three patients had an excellent (90–100%) reduction in pain and required no additional pharmacological or interventional treatment. One patient had partial pain relief and needed a second treatment after 15 months to become asymptomatic. The reduction in pain intensity and/or frequency of the attacks was experienced as a major improvement in quality of life. One patient had only short-term pain relief, which was not improved after an additional conventional thermo-

coagulation treatment. No neurological or other complications were observed.

PRF of the Gasserian ganglion is a percutaneous minimal invasive procedure, which was safe and well tolerated in our high-risk patients.

4. Discussion

The treatment of patients with intractable ITN is often a challenge in clinical practice. Within a multidisciplinary pain center, different treatment options exist. The pharmacological approach remains the first step therapy. When this treatment fails, or intolerable side effects occur, a choice can be made between the interventional and surgical approach.

The microvascular decompression technique, which was first described by Jannetta (1967), is the most common performed (open) surgical treatment. It consists of opening a keyhole in the mastoid area and freeing the trigeminal nerve from the compression/pulsating artery by a piece of Teflon. The value lies in its potential treatment of the etiology rather than the symptoms of the disorder. The published results mention a high success rate, although recurrence can also occur. It is a major surgical intervention at the central nervous system with a small but definitely existing risk for serious perioperative complications including, mortality (0.5%), permanent disability (1%) and cranial nerve palsies (5%) according to a recent review (Louw and Burchiel, 2001). For those reasons physicians can start with a less invasive percutaneous intervention in their treatment algorithm.

Glycerol injection, balloon compression and conventional RF treatment are described as effective interventional treatment options for ITN. Their mode of action is based on (partial) nerve destruction. Undesired effects depend on the extent of the lesion. These side effects are well documented for conventional RF treatment. Kanpolat et al. (2001) list 1% dysesthesia, 0.8% anesthesia dolorosa and 5.7% diminished corneal reflex.

Relapse of pain depends on the chosen techniques, with the highest recurrence rate after glycerol injection, but large inter-individual differences are mentioned.

Sluijter et al. (1998) pointed out that heat destruction of the nerve could not be the only mode of action of RF treatment because the temperature is only measured at the electrode tip and is known to diminish rapidly at a distance of 1–2 mm. This is consistent with the observation that in patients treated with RF lesions adjacent to the dorsal root ganglion, the sensory loss in the relevant dermatome is only transient whereas the pain relief lasts much longer. During application of RF treatment the generation of heat is not the only event that occurs; the tissue is also exposed to the RF electric field. Such electric fields are known to have a biological effect (Archer et al., 1999) which may explain the mode of action of RF although the mechanism is still ill understood.

337 RF may therefore be used in a non- or minimally
338 destructive fashion. PRF uses a high generator output for a
339 short period of 20 ms followed by a 'silent' period of 480
340 ms. The heat generated during the active burst can be
341 eliminated during the silent period and temperature at the
342 electrode tip does not exceed 42 °C.

343 The use of conventional RF treatment in the management
344 of trigeminal neuralgia is more extensively documented.
345 However, possible side effects and complications justify the
346 use of the less invasive pulsed radiofrequency treatment
347 option. Our case reports indicate that PRF treatment for ITN
348 can be an alternative to other percutaneous techniques. It is
349 minimally invasive and we did not observe neurological
350 side effects or complications. In current clinical practice we
351 discuss both treatment options with the patients, who make
352 an informed choice. Further trials are required to define
353 criteria for the correct patient selection.

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357
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