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ORIGINAL ARTICLE

The role of percutaneous balloon compression in the treatment of trigeminal neuralgia recurring after other surgical procedures

Nicola Montano · Fabio Papacci · Beatrice Cioni · Rina Di Bonaventura · Mario Meglio

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Abstract Trigeminal neuralgia (TN) recurring after surgery can be difficult to treat. Treatment algorithms have not been standardized or universally accepted. Here we investigated the effectiveness of percutaneous balloon compression (PBC) in the treatment of patients with TN recurrence after other surgical techniques and analyzed the role of some clinical and operative factors in determining the prognosis. The records of 22 patients (13 M and 9 F) suffering recurrent TN after one (2 gamma knife surgery, 5 percutaneous radiofrequency rhizotomy, 6 percutaneous retrogasserian glycerol rhizotomy, 3 microvascular decompression) or more (6 patients) procedures and submitted to PBC at our institution from January 2003 to February 2012 were reviewed. Seven patients had TN related to multiple sclerosis (MS). Mean follow-up was 51.81 ± 26.63 months. 81.81 % of patients reported an acute pain relief. No major complication was observed after PBC. Eight patients (36.36 %) experienced pain recurrence and underwent one (five patients) or more (three patients) PBC. At the last follow-up, we obtained an excellent outcome (BNI I–II) in 16 patients out of 22 (72.72 %) and a good outcome (BNI III) in the remaining six. No patients had an uncontrolled pain. The lack of history of MS ($p = 0.0174$), the pear-like shape of the balloon at the operation ($p = 0.0234$) and a compression time <5 min ($p < 0.05$) were associated to higher pain-free survival. Considering these results PBC could be considered a useful technique for patients whose pain recurs after other procedures.

N. Montano (✉) · F. Papacci · B. Cioni · R. Di Bonaventura · M. Meglio
Institute of Neurosurgery, Catholic University, Largo Agostino Gemelli, 8, 00168 Rome, Italy
e-mail: nicolamontanomd@yahoo.it

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Introduction

A general consensus exists on the utility of percutaneous balloon compression (PBC) to treat patients with drug-resistant trigeminal neuralgia (TN) both in general population [1] and in multiple sclerosis [2, 3]. Nonetheless, some authors suggested lower efficacy of PBC after other surgical procedures [4, 5]. As a matter of fact this topic has been focused only in two papers [6, 7] and considered only marginally by other authors [8–13]. We report on the effectiveness of PBC in patients with TN recurrence after other surgical procedures. We also analyze potential prognostic factors and discuss our results and the pertinent literature.

Methods

We retrospectively analyzed 22 patients (13 M and 9 F) suffering recurrent TN after one or more procedures and submitted to PBC at our institution from January 2003 to February 2012. The mean age was 60.95 ± 13.54 years with a mean follow-up of 51.81 ± 26.63 months. Seven patients had MS-related TN. TN duration before the PBC was 13.94 ± 9.45 years and the pain was atypical in three patients. Eleven cases had a pre-operative hypoesthesia. Six patients had undergone two or more procedures before PBC. Patient's clinical data are summarized in Table 1. Patients reported their pain as the worst possible pain. The operation was performed under general anesthesia and fluoroscope image intensifier using a 14-gauge needle and

Table 1 Clinical findings of patients with previous operations submitted to PBC

Case (#)	Sex	Age (years)	MS	TN duration before procedure (years)	TN type	Affected trigeminal divisions (no)	Pre-op deficit	Previous operations	Shape	Compression time (min)	APR	Post-op deficit	Recurrence	Pain-free survival (mos)
1	M	80	No	20	Typical	2	Yes	PRGR, MVD	Pear	4	Complete	No	No	62
2	F	49	Yes	4	Typical	2	No	GKS	Pear	6	Complete	No	Yes	1
3	F	73	No	20	Typical	1	No	PRR	Pear	4	Complete	No	No	72
4	F	76	No	17	Atypical	3	Yes	PRGR	Elliptical	5	Complete	No	Yes	16
5	F	61	Yes	10	Typical	2	Yes	PRR, GKS	Pear	5	Complete	No	No	35
6	F	64	No	15	Typical	1	No	PRGR	Pear	6	Complete	No	No	85
7	M	57	Yes	7	Typical	3	Yes	PRR	Elliptical	10	Complete	Yes	Yes	20
8	M	51	No	30	Typical	2	Yes	PRR, MVD	Pear	4	Partial	No	No	92
9	M	37	No	5	Typical	1	Yes	MVD	Elliptical	1	Complete	No	Yes	20
10	F	58	Yes	4	Typical	2	No	PRR	Pear	8	Complete	No	Yes	55
11	F	51	Yes	5	Atypical	2	No	PRGR	Pear	3	Complete	No	No	52
12	F	61	No	10	Typical	2	Yes	MVD	Pear	2	Complete	Yes	No	22
13	M	77	No	27	Typical	3	No	PRGR	Elliptical	2	Complete	No	No	12
14	M	68	Yes	21	Typical	2	Yes	PRGR, GKS	Pear	4	Complete	No	Yes	1
15	M	60	No	30	Typical	1	No	PRGR, MVD, PRR	Pear	1	Complete	Yes	No	39
16	M	62	No	15	Typical	1	No	MVD	Elliptical	2	Complete	No	No	48
17	F	73	No	0.8	Typical	2	No	GKS	Pear	2	Partial	No	No	8
18	M	56	No	15	Typical	1	No	PRR	Pear	8	Partial	No	No	84
19	M	82	No	11	Typical	1	Yes	PRGR, PRR	Pear	5	Complete	No	Yes	35
20	M	69	No	2	Atypical	3	Yes	PRGR	Pear	3	Complete	No	No	9
21	M	46	Yes	8	Typical	1	No	PRGR	Elliptical	12	Complete	No	Yes	13
22	M	30	No	30	Typical	2	Yes	PRR	Pear	3	Partial	Yes	No	55

MS multiple sclerosis, *TN* trigeminal neuralgia, *PRGR* percutaneous retrogasserian glycerol rhizotomy, *GKS* gamma knife surgery, *PRR* percutaneous radiofrequency rhizotomy, *PBC* percutaneous balloon compression, *MVD* microvascular decompression, *APR* acute pain relief, *mos* months, *no* number, *min* minutes

a Fogarty balloon catheter 4-French filled with 0.75 ml of medium of contrast with a compression time ranging from 1 to 12 min (Table 1), as previously reported [14, 15]. As outcome indicators, we used the acute pain relief (APR: pain-free at hospital discharge) and pain-free survival (PFS). At follow-up, the outcome was evaluated using the Barrow Neurological Institute (BNI) pain scale [16].

Moreover, we investigated the role of sex, history of MS, TN type, number of affected trigeminal divisions, pre-operative deficit, number and type of previous operations, compression time (<5 min vs. ≥5 min), balloon shape at operation (pear-like vs elliptical) as potential prognostic factors. A comparison of categorical variables was performed by Chi-square statistic. Kaplan–Meier curves were plotted and differences in pain-free survival between groups of patients were compared using the log-rank test. p values <0.05 were considered as statistically significant.

Results

Eighteen out of twenty-two patients (81.81 %) reported an APR. No major complication was observed after the procedure. Four patients complained of mild worsening (#7, #12, #22) or onset (#15) of hypoesthesia (see Table 1). None of the considered potential prognostic factors was associated to a higher probability of APR.

Eight patients (36.36 %) experienced a recurrence of pain with a mean pain-free survival of 20.12 ± 17.87 months. All of them were further submitted to one (#2, #7, #14, #19, #21) or more (#4, #9, #10) PBC (see Table 2).

At latest follow-up (mean 51.81 ± 26.63 months), patients who did not recur after the first PBC (63.64 %) showed an excellent (BNI I–II) or good (BNI III) outcome in ten (#1, #3, #5, #6, #11, #12, #13, #15, #16, #20) and in four (#8, #17, #18, #22) cases, respectively.

Overall we obtained an excellent outcome (BNI I–II) in 16 patients out of 22 (72.72 %) and a good outcome (BNI III) in the remaining ones. No patients had an uncontrolled pain (see Table 2).

Among possible prognostic factors, the lack of history of MS ($p = 0.0174$), the pear-like shape of the balloon at the operation ($p = 0.0234$) and a compression time <5 min ($p < 0.05$) were associated to higher pain-free survival (Fig. 1).

Table 2 Follow-up of patients

Case (#)	Procedures after recurrence	BNI-grade at follow-up	Follow-up (mos)
1	n.r.	I	62
2	PBC	I	36
3	n.r.	II	72
4	PBC; PBC (after 2 mos)	III	57
5	n.r.	I	35
6	n.r.	II	85
7	PBC	I	55
8	n.r.	III	92
9	PBC; PBC (after 22 mos)	II	48
10	PBC; PBC (after 24 mos); PBC (after 14 mos)	III	108
11	n.r.	I	52
12	n.r.	II	22
13	n.r.	I	12
14	PBC	I	48
15	n.r.	I	39
16	n.r.	I	48
17	n.r.	III	8
18	n.r.	III	84
19	PBC	I	42
20	n.r.	I	9
21	PBC	II	71
22	n.r.	III	55

PBC percutaneous balloon compression, *mos* months, *n.r.* no recurrence, *BNI-grade* Barrow Neurological Institute pain scale

Discussion

TN is a facial pain syndrome characterized by paroxysmal, shock like pain attacks located in the somatosensory distribution of the trigeminal nerve whose prevalence is 0.015 % [17] in the general population and 1 % [5] to 6.3 % in MS patients [18]. From its introduction by Mullan et al. [19, 20], PBC has been extensively used to treat TN patients due to low-cost, simplicity and the advantage of being the only percutaneous procedure performed with the patient under general anesthesia. While there is a general consensus about the usefulness of PBC either in general population [1] or in MS patients [2, 3], some authors suggested [4, 5] a lower efficacy in patients previously treated with other surgical procedures. However, the results of PBC in this subset of patients have previously been reported only marginally in the literature [8–13] and only two papers [6, 7] specifically focused on this topic.

In their work Kouzounias et al. [6] studied 47 patients (42 with previous operations) and reported the follow-up after the first PBC for each patient. They observed an 85 % initial success rate with 70 % of patients experiencing pain recurrence. Similarly Omeis et al. [7] reported an 83 % immediate pain relief after PBC in a series of 29 patients with 45.5 % of recurrence rate.

In our study, we observed an APR of 81.81 % with a recurrence rate of 36.36 %. Moreover, we found that

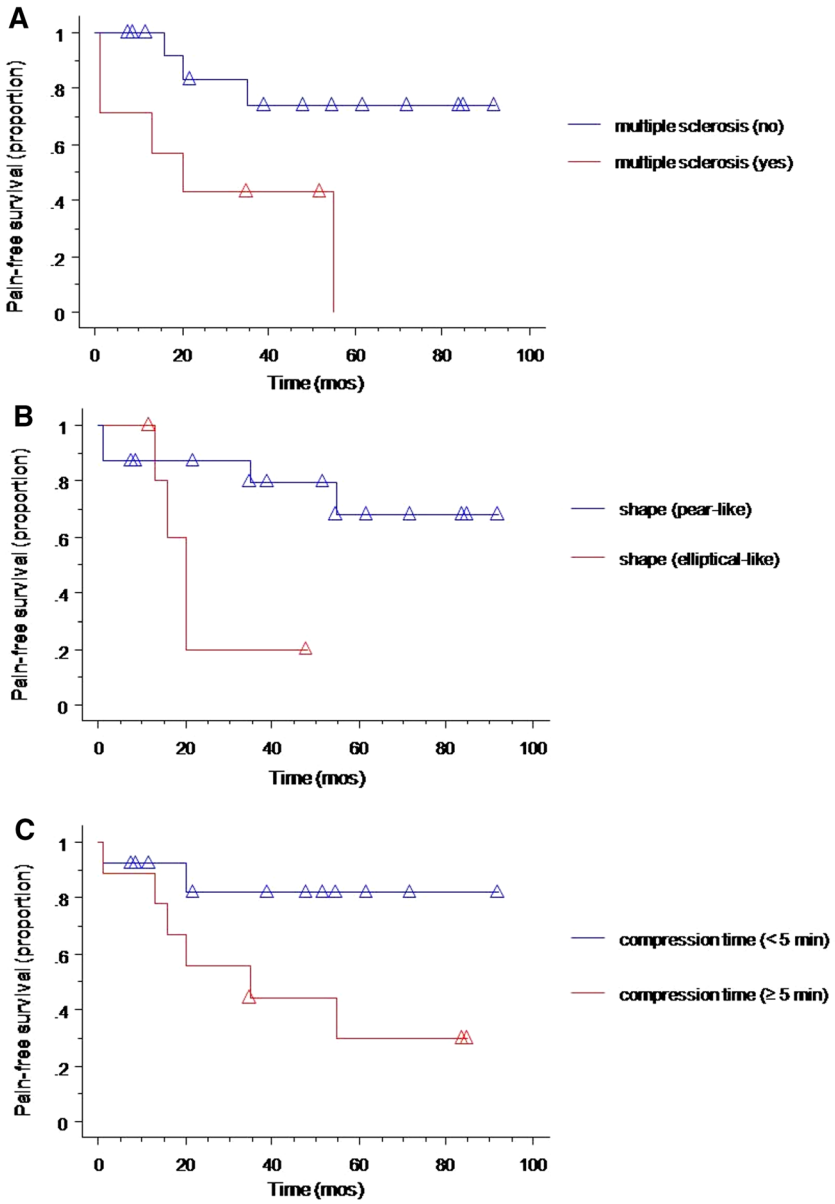

Fig. 1 Kaplan–Meier curves of patients submitted to PBC and stratified by **a** history of MS, **b** balloon shape at operation and **c** compression time. The lack of history of MS ($p = 0.0174$), the pear-like shape of the balloon at the operation ($p = 0.0234$) and a compression time <5 min ($p < 0.05$) were associated to higher pain-free survival

repeating PBC was very useful in these patients because we obtained an excellent (BNI I–II)–good (BNI III) response after a single or multiple procedures in all patients (see Table 2).

In agreement with other reports [3, 6] the pear-like shape of the balloon at the operation was found to be a good prognostic factor. These data likely reflect an engagement of the balloon within the porus trigeminus producing a better compression of the retrogasserian root.

Even if we observed that the history of MS was associated with lower pain-free survival, we obtained a control of pain with repeating the procedure also in these patients [2, 3, 6].

Moreover, we found that a compression time <5 min was associated to better pain-free survival, confirming that a longer compression time did not affect the pain relief and only increase the complication rate [9, 14, 21].

Other techniques for the treatment of recurrent TN have been proposed. Recently Zhang et al. [22] reported that radiofrequency thermocoagulation rhizotomy was effective for recurrent TN after a failed microvascular decompression (MVD). Nonetheless MVD has been advised in patient with recurrent TN if other less invasive procedures have not relieved the facial pain [23, 24]. Most of published studies on recurrent TN after a failed previous procedure are focused on the role of gamma knife radiosurgery (GKS) [25–28]. However the reported data are difficult to compare due to differences in dose [29, 30] and target location [31, 32]. Thus, evaluating the potentially prognostic factors associated to GKS is difficult. Despite these limitations, these

studies suggest that repeating GKS provides a similar rate of pain relief as the first procedure [27] and that initial failed treatment is not a factor affecting the pain control [26]. Moreover, the development of sensory loss seems to predict better long-term pain control [25, 27, 28]. These data could be explained by the mechanism of pain relief after GKS probably related to a diffuse damage of all axons of trigeminal nerve [33]. It has also been suggested that after GKS pain sensation could be not conveyed because of a raising of pain threshold rather than a selective destruction of pain transmission fibers, like percutaneous procedures [34].

PBC is well accepted by patients with mild side effects [7] and good results after one or more operations. In our opinion this makes PBC a useful technique for patients whose pain recurs after other surgical procedures [35].

Conflict of interest The authors declare no conflict of interest.

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