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CLINICAL ARTICLE

Percutaneous balloon compression for the treatment of trigeminal neuralgia in patients with multiple sclerosis. Analysis of the potentially prognostic factors

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Abstract
Background The role of different procedures for the treatment of drug-resistant trigeminal neuralgia (TN) in patients affected by multiple sclerosis (MS) is under discussion and there are no clear indications in the literature. In particular, the role of percutaneous balloon compression (PBC) has been poorly addressed so far. Moreover, to the best of our knowledge, there are no reports analysing the factors potentially related to the prognosis in these patients. We examined the role of PBC for the treatment of TN in MS patients and investigated the role of some clinical and procedure-related factors in determining the prognosis of these patients.
Method We retrospectively reviewed clinical and outcome data of 21 MS patients submitted to PBC (eight of them had already been treated with different procedures). We analysed the impact of the sex, number of affected trigeminal divisions, pre-operative deficit, previous operations, compression time and balloon shape at the operation, on acute pain relief (APR) by the chi-squared statistic and on pain-free survival (PFS) by the Kaplan-Meier method.
Findings An excellent (BNI I-II)-good (BNI III) outcome was obtained in all patients with a single or repeated procedure. The presence of a single affected trigeminal division (p=0.042), the absence of previous operations (p=0.048), the compression time ≤5 min (p=0.0067) and the pear-like shape of the balloon at the operation ($p<0.05$) were associated to higher pain-free survival.
Conclusions PBC is a safe and effective technique to treat drug-resistant TN in MS patients. Some clinical and procedure-related factors may play a role in the prognosis of these patients.

Keywords Drug-resistant trigeminal neuralgia · Multiple sclerosis · Percutaneous balloon compression

Introduction

Trigeminal neuralgia (TN) complicating the clinical course of multiple sclerosis (MS) patients has been treated with various procedures. While in the literature there are many papers on the efficacy of different techniques for the treatment of TN in MS patients [4, 12, 16, 20], the results for percutaneous balloon compression (PBC) have been reported only marginally in a small amount of patients [1, 3, 5]. Moreover, to the best of our knowledge, there are no reports analysing the potential prognostic factors of PBC in this particular population. The aim of this study was to investigate the role of PBC in the treatment of TN in MS patients and to analyse different clinical and technique-related factors in determining the prognosis.

Methods and materials

We retrospectively analysed 21 MS patients (10 male and 11 female) harbouring TN and submitted to PBC, from January 2000 to February 2011. The mean age was 52.23±11.26 years with a follow-up of 51.57±20.89 months. SM and TN duration before the procedure was 13.81±8.41 years and

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Table 1 Clinical findings of MS patients affected by TN and submitted to PBC

Case no.	Sex	Age	MS duration before procedure (years)	TN duration before procedure (years)	TN type	Trigeminal division (no)	Pre-op. deficit	Previous operation/ type	Shape	Time of compression (min)	APR	Post-op. deficit	Complication	Recurrence	PFS (months)
1	M	49	9	7	Typical	2	No	No	pear-like	5	Complete	No	No	No	40
2	M	46	13	1	Typical	2	No	No	elliptical-like	6	Complete	No	No	Yes	20
3	F	53	15	4	Typical	2	No	No	pear-like	5	Partial	No	No	Yes	40
4	F	50	0,5	3	Typical	2	No	Yes/PRGR	elliptical-like	5	Complete	Hypoestesia	No	Yes	0,5
5	F	49	22	4	Typical	2	No	Yes/GKS	pear-like	6	Complete	No	No	Yes	1
6	F	61	8	10	Typical	2	Yes	Yes/PRR + GKS	pear-like	5	Complete	No	No	No	35
7	F	53	12	10	Typical	1	Yes	No	pear-like	5	Complete	No	No	No	75
8	M	57	1	7	Typical	3	Yes	Yes/PRR	elliptical-like	10	Complete	Hypoestesia	No	Yes	20
9	M	45	13	2	Typical	3	No	No	pear-like	5	Partial	No	No	Yes	0,5
10	F	58	18	4	Typical	2	No	Yes/PRR	pear-like	8	Complete	No	No	Yes	55
11	M	42	27	0,5	Typical	1	No	No	pear-like	5	Complete	No	No	No	57
12	M	30	3	3	Atypical	1	No	No	elliptical-like	2	Partial	No	No	No	16
13	F	48	8	8	Typical	1	No	No	elliptical-like	6	Partial	No	No	Yes	2
14	F	34	11	5	Typical	1	No	No	pear-like	5	Complete	No	No	No	69
15	M	68	18	21	Typical	2	Yes	Yes/ PRGR +GKS	pear-like	4	Complete	No	No	Yes	1
16	M	55	17	3	Typical	1	No	n.a.	pear-like	5	Complete	No	No	No	71
17	F	44	17	2	Atypical	2	No	No	pear-like	7	Complete	No	No	Yes	12
18	F	64	10	3	Typical	2	Yes	No	pear-like	5	Complete	No	No	No	70
19	F	70	25	6	Typical	1	No	n.a.	pear-like	3	Complete	No	No	No	30
20	M	46	9	8	Typical	1	No	Yes/PRGR	elliptical-like	12	Complete	No	No	Yes	13
21	M	75	34	7	Typical	3	No	Yes/PBC	pear-like	6	Complete	No	No	Yes	15

MS multiple sclerosis, *TN* trigeminal neuralgia, *PRGR* percutaneous retrogasserian glycerol rhyzotomy, *GKS* gamma knife surgery, *PRR* percoutaneous radiofrequency rhizothomy, *PBC* percoutaneous balloon compression, *APR* acute pain relief, *PFS* pain-free survival, *n.a.* not available

5.61±4.51 years, respectively. The pain was atypical in two patients. Five cases had a pre-operative hypoesthesia and eight cases had undergone previous operations (Table 1). Patients reported their pain as the worst possible pain. The operation was performed under general anaesthesia and fluoroscope image intensifier using a 14-gauge needle and a 4-French Fogarty balloon catheter filled with 0.75 ml contrast medium, with a compression time ranging from 2 to 12 min (Table 1),as previously reported [7, 8]. We used, as outcome indicators, acute pain relief (APR: pain-free at hospital discharge) and pain-free survival (PFS). At follow-up, the outcome was assessed using the Barrow Neurological Institute (BNI) pain scale [14].

Furthermore, we investigated the role of sex, number of affected trigeminal divisions, pre-operative deficit, previous operations, compression time (≤5 min vs >5 min), balloon shape at operation (pear-like vs elliptical-like) as potential prognostic factors. A comparison of categorical variables was performed by chi-squared statistic. Kaplan-Meier curves were plotted and differences in pain-free survival between groups of patients were compared using the log-rank test. Those p values less than 0.05 were considered as statistically significant.

Results

Seventeen out of 21 patients (80.95%) reported an APR. No major complication was observed after the procedure. Only two patients (cases 4 and 8) complained of the onset of mild hypoesthesia (Table 1). None of the evaluated factors was associated to an higher probability of APR. Twelve patients (57.14%) experienced a recurrence of pain with a mean pain-free survival of 15.0±17.24 months. All of them required one (cases 2, 3, 5, 8, 9, 10, 15, 17, 20, 21) or more (cases 9, 10, 17) PBC (see Table 2). In two cases with a recurrence in the third branch (cases 4, 13) percutaneous radiofrequency rhizothomy was performed [7, 18].

All patients who did not recur after the first PBC (42.8%) showed an excellent outcome (BNI I-II) at latest follow-up. Globally, considering also the patients submitted to more procedures, an excellent outcome (BNI I-II) was obtained in 16 patients out of 21 (76.1%) and a good outcome (BNI III) in the remaining ones. No patients had an uncontrolled pain (Table 2).

Among potentially prognostic factors, the presence of a single affected trigeminal division (p=0.042), the absence of previous operations (p=0.048), compression time ≤5 min (p= 0.0067) and pear-like shape of the balloon at the operation (p< 0.05) were associated to higher pain-free survival (Fig. 1).

Discussion

The prevalence of TN in MS patients is high, ranging from 1% [15] to 6.3% [13]. While the results and the factors associated with the prognosis for PBC have been extensively investigated in the general population (see two recent reviews comparing different surgical modalities [6, 19]), the results of PBC and the role of different factors involved in the prognosis of MS patients have been poorly addressed so far [1, 3, 5].

Table 2 Follow-up of patients

Case no.	Procedures after recurrence	BNI-grade at follow-up	Follow-up (months)
1	NR	I	40
2	PBC	III	30
3	PBC	III	45
4	PRR	III	60
5	PBC	I	36
6	NR	I	35
7	NR	I	75
8	PBC	I	55
9	PBC, PBC (after 29 months)	II	48
10	PBC, PBC (after 24 months), PBC (after 14 months)	III	108
11	NR	II	57
12	NR	II	16
13	PRR	II	48
14	NR	I	69
15	PBC	I	48
16	NR	I	71
17	PBC, PBC (after 24 months)	I	40
18	NR	II	70
19	NR	I	30
20	PBC	II	71
21	PBC	III	31

PRR percoutaneous radiofrequency rhizothomy, *PBC* percoutaneous balloon compression, *NR* no recurrence, *BNI-grade* Barrow Neurological Institute pain scale

In our series, we obtained 100% of excellent (BNI I-II)-good (BNI III) responses with a single or repeated procedures. Only two patients out of 21 (9.5%) required other techniques than PBC to control their pain (cases 4, 13).

Considering the literature reporting on MS patients submitted to different procedures, (Supplementary Table S1), we found that, globally, the APR rate after different procedures in MS patients was high, ranging from 84.8% of gamma knife surgery to 95.4% of percutaneous radiofrequency rhizothomy. PBC and microvascular decompression (MVD) showed an APR rate of 89.6% and 90.8%, respectively. We found that percutaneous radiofrequency rhizothomy showed a better pain-free rate at follow-up (73.5%). Considering the recurrence rate (RR), this procedure showed an high RR (43.1%) as well as PBC (59.2%), as demonstrated by our results and previously reported results [1, 5]. However, taking into account the complication rate (CR), PBC was associated to lower CR (4.7%). Moreover, according to our experience (no effects or very mild side effects, not requiring any treatment) and other reported experience [10], PBC was well accepted and could be easily repeated, when needed.

The analysis of possible prognostic factors documented a statistically better prognosis in patient whose pain involved a single trigeminal division. The different pathogenesis of typical TN and MS-related TN might explain the difference between our data and those reported by Kouzounias et al. [5], who did not find any difference, considering the number of affected divisions, in patients with typical TN.

The history of previous operations has been reported to negatively influence the prognosis [14, 15], although this has not been confirmed by other authors [9, 17]. In our series, we found a worse prognosis in patients who had undergone previous operations, even if we observed a mean pain-free survival higher compared with that reported for typical TN (15.07 months in our MS population and 7.3 months in general population [10]).

The compression time is the only technically operator-modifiable parameter. It was evidenced that a longer time of compression did not improve the prognosis of patients and was associated with an increased complication rate [2, 11]. These findings are confirmed by our results. In our study population, a compression time ≤5 min was associated with a better pain-free survival, as we previously demonstrated also for the general population [7].

A recent report [5] demonstrated that the pear-like balloon shape was an important prognostic factor with a better impact on the outcome. This was true also in our MS patient series. The pear-like shape likely reflects an engagement of the balloon with the porus trigeminus and this could produce a better compression of the retro-gasserian root [5].

In summary, considering that PBC, MVD and percutaneous radiofrequency rhizothomy have the best APR rate, but PBC shows the lowest complication rate, can be easily repeated and is well accepted by patients, we consider PBC as first choice in

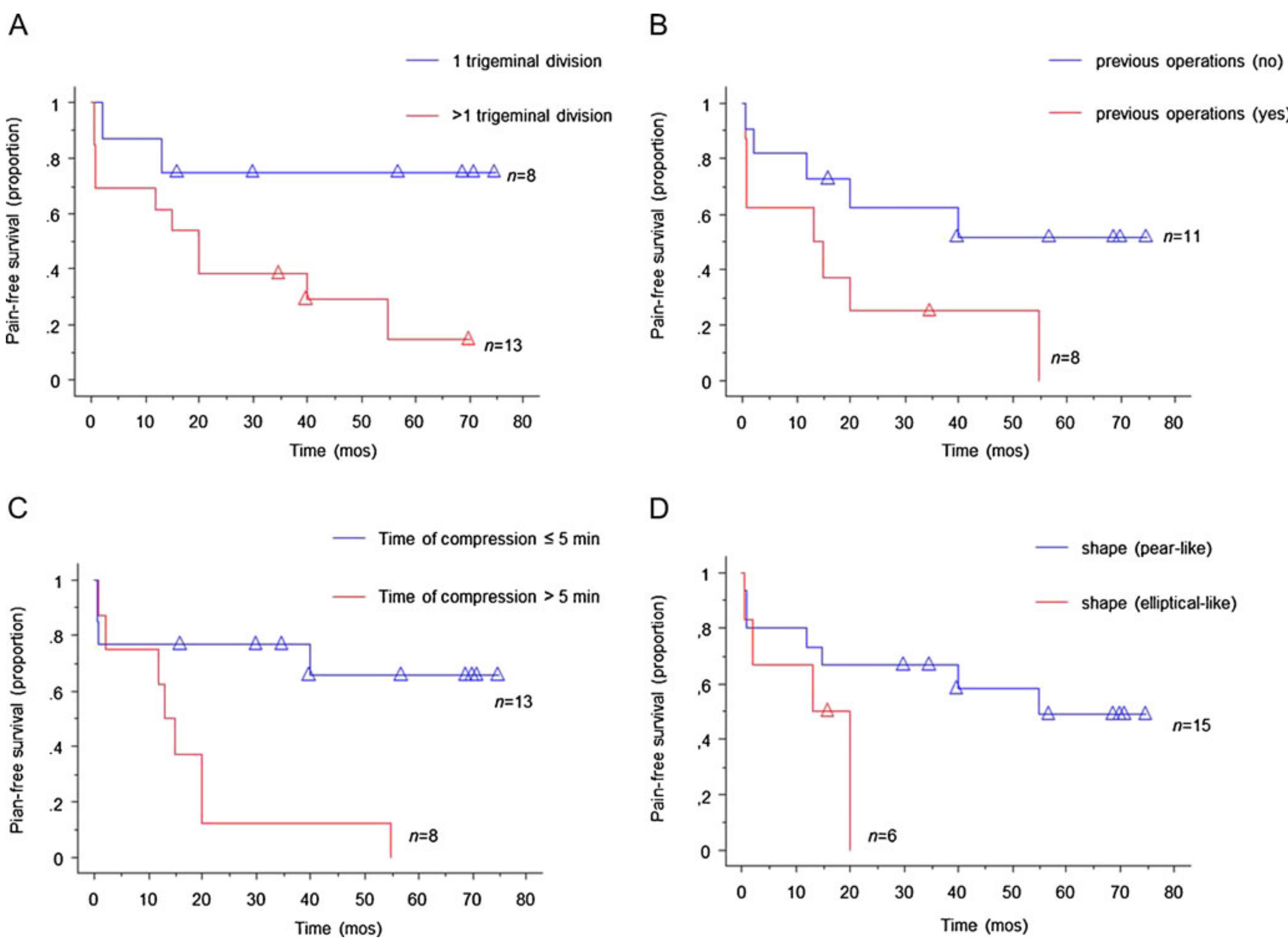

Fig. 1 Kaplan-Meier curves of MS patients submitted to PBC and stratified by (**a**) number of affected trigeminal divisions, (**b**) history of previous operations, (**c**) compression time and (**d**) balloon shape at operation. Single affected trigeminal division (p=0.042), absence of previous operations (p=0.048), time of compression ≤5 min (p=0.0067) and pear-like shape of the balloon at the operation (p<0.05) were associated with higher pain-free survival

MS patients with drug-resistant TN. Some factors, such as single affected trigeminal division, absence of previous operations, compression time ≤5 min and pear-like shape of the balloon at the operation, seem to be associated with a better prognosis in these patients.

Conflicts of Interest None

References

1. Belber CJ, Rak RA (1987) Balloon compression rhizolysis in the surgical management of trigeminal neuralgia. Neurosurgery 20:908–913
2. Brown JA, Pilitsis JG (2005) Percutaneous balloon compression for the treatment oftrigeminal neuralgia: results in 56 patients based on balloon compression pressuremonitoring. Neurosurg Focus 18(5):E10
3. Fraioli B, Esposito V, Guidetti B, Cruccu G, Manfredi M (1989) Treatment of trigeminal neuralgia by thermocoagulation, glycerolization, and percutaneous compression of the gasserian ganglion and/or retrogasserian rootlets: long-term results and therapeutic protocol. Neurosurgery 24:239–245
4. Kanpolat Y, Berk C, Savas A, Bekar A (2000) Percutaneous controlled radiofrequency rhizotomy in the management of patients with trigeminal neuralgia due to multiple sclerosis. Acta Neurochir (Wien) 142:685–689, discussion 689–690
5. Kouzounias K, Schechtmann G, Lind G, Winter J, Linderoth B (2010) Factors that influence outcome of percutaneous balloon compression in the treatment of trigeminal neuralgia. Neurosurgery 67:925–934, discussion 934
6. Lopez BC, Hamlyn PJ, Zakrzewska JM (2004) Systematic review of ablative neurosurgicaltechniques for the treatment of trigeminal neuralgia. Neurosurgery 54:973–982, discussion 982–983
7. Meglio M, Cioni B (1989) Percutaneous procedures for trigeminal neuralgia: microcompression versus radiofrequency thermocoagulation. Personal experience. Pain 38:9–16
8. Meglio M, Cioni B, Moles A, Visocchi M (1990) Microvascular decompression versus percutaneous procedures for typical trigeminal neuralgia: personal experience. Stereotact Funct Neurosurg 54–55:76–79
9. Miller JP, Acar F, Burchiel KJ (2009) Classification of trigeminal neuralgia: clinical, therapeutic, and prognostic implications in a series of 144 patients undergoing microvascular decompression. J Neurosurg 111:1231–1234
10. Omeis I, Smith D, Kim S, Murali R (2008) Percutaneous balloon compression for thetreatment of recurrent trigeminal neuralgia: long-term outcome in 29 patients. Stereotact Funct Neurosurg 86:259–265
11. Park SS, Lee MK, Kim JW, Jung JY, Kim IS, Ghang CG (2008) Percutaneous ballooncompression of trigeminal ganglion for the treatment of idiopathic trigeminalneuralgia: experience in 50 patients. J Korean Neurosurg Soc 43:186–189
12. Pickett GE, Bisnaire D, Ferguson GG (2005) Percutaneous retrogasserian glycerol rhizotomy in the treatment of tic douloureux associated with multiple sclerosis. Neurosurgery 56:537–545, discussion 537–545
13. Putzki N, Pfriem A, Limmroth V, Yaldizli O, Tettenborn B, Diener HC, Katsarava Z (2009) Prevalence of migraine, tension-type headache and trigeminal neuralgia in multiple sclerosis. Eur J Neurol 16:262–267
14. Ruge D, Brochner D, Davis L (1958) A study of the treatment of 637 patients with trigeminal neuralgia. J Neurosurg 15:528–536
15. Rogers CL, Shetter AG, Fiedler JA, Smith KA, Han PP, Speiser BL (2000) Gamma knife radiosurgery for trigeminal neuralgia: the initial experience of The Barrow Neurological Institute. Int J Radiat Oncol BiolPhys 47:1013–1019
16. Sandell T, Eide PK (2010) The effect of microvascular decompression in patients with multiple sclerosis and trigeminal neuralgia. Neurosurgery 67:749–753, discussion 753–754
17. Sheehan J, Pan HC, Stroila M, Steiner L (2005) Gamma knife surgery for trigeminal neuralgia: outcomes and prognostic factors. J Neurosurg 102:434–441
18. Siegfried J (1977) 500 Percutaneous thermocoagulations of the Gasserian ganglion for trigeminal pain. Surg Neurol 8:126–131
19. Tatli M, Satici O, Kanpolat Y, Sindou M (2008) Various surgical modalities fortrigeminal neuralgia: literature study of respective long-term outcomes. Acta Neurochir (Wien) 150:243–255
20. Zorro O, Lobato-Polo J, Kano H, Flickinger JC, Lunsford LD, Kondziolka D (2009) Gamma knife radiosurgery for multiple sclerosis-related trigeminal neuralgia. Neurology 73:1149–1154