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Cervical Medial Branch Blocks for the Diagnosis of Somatosensory Tinnitus. A Pilot study.

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Abstract

The purpose was to discover if medial branch blocks (MBBs) of the cervical spine can be used as a diagnostic tool to identify patients with somatosensory tinnitus. MBBs are a diagnostic tool to confirm the diagnosis facet joint pain in patients with neck pain. It is not known, if MBBs are also suitable for testing other symptoms than pain. However, the existence of neural connections between the auditory system and the cervical region can be assumed. Included were 22 consecutive patients presenting with tinnitus, who had received MBBs in a ten years' period. Patients were tested with a MBB with bupivacaine and triamcinolone. Injections were performed with fluoroscopic visualization using established techniques. The mean follow-up time was 6.2 weeks. Tinnitus was analyzed through the global clinical impression of the patient. Seven patients (31.8 %) experienced a significant improvement of the tinnitus. In one patient a thermal radiofrequency neurotomy was done after positive response to two MBBs. The pain relief and a significant reduction of the tinnitus sustained at the follow-up examination 20 weeks after the denervation. No statistically significant difference was found in age, gender, duration of symptoms, additional neck pain or vertigo, or side or level of the intervention. This pilot study shows the feasibility to identify patients with somatosensory tinnitus with MBBs. Further studies with the primary intention on tinnitus are necessary to prove the significance of MBBs. After a positive response to MBBs, treatment with radiofrequency neurotomy is the rational consequence.

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Running title

Cervical Medial Branch Blocks for Somatosensory Tinnitus

Keywords

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Introduction

Tinnitus is defined as the perception of sound in the absence of external auditory stimulation [1, 2]. If the tinnitus can be evoked or modulated by inputs from the somatosensory and somatomotor system, it is called "somatosensory tinnitus" (SST) [3-8]. The most important characteristic of such tinnitus is that its origin seems to be related to problems of the head and neck, rather than to problems of the ear [3]. The existence of neural connections between the auditory system and the cervical region can be assumed based on a number of animal studies [4, 5, 7, 8-13]. Aberrant cervical somatosensory information conveyed to the cochlear nucleus can cause tinnitus independent of cochlear hair cell loss or other auditory pathway pathology [1]. The cochlear nucleus also serves as a multimodal recipient of non-auditory inputs from such structures such as the cervical spinal nerves [14-16].

The diagnosis of SST is challenging and is mainly based on medical history [1]. A variety of treatments have been proposed, including physiotherapy [15, 17-19], osteopathy [15, 17, 18], chirotherpay [3] neural therapy [15, 17, 18], electro stimulation [19], acupuncture [20], transcranial magnetic stimulation [20, 21], and brain stimulation [20, 22, 23]. A case report [24] describes the treatment of the cervical facet joints with radiofrequency (RF) neurotomy. The denervation of the medial branches C2 and C3 eliminated the symptoms of tinnitus in one patient. It was believed that the sensory inputs from the upper cervical region were blocked after denervation.

Comparable to other joints, the facet joints are a possible pain source. It is the result of repetitive stress, leading to inflammation and stretching of the joint capsule [25, 26]. The joints are innervated by the medial branches of the dorsal rami [27]. The gold standard for the diagnosis of facet joint pain are MBBs [28]. The target nerve is anesthetized with a small volume of local anesthetic. If the pain is not relieved after an MBB, the target nerve cannot be regarded as mediating the pain, which means the facet joint is not the pain source. To reduce the possibility of responses being false-positives, controlled blocks are mandatory [28, 29].

It is not known, whether MBBs are also suitable for testing symptoms other than pain. SST is probably underdiagnosed due to a lack of publications of diagnostic tests and therapeutic options on this subject [19]. The purpose of this pilot study was to discover whether MBBs of the cervical spine can be used as a diagnostic tool to seek out patients with SST. The advantage of MBBs as a diagnostic tool is, that if the diagnosis is proven by controlled blocks, an evidence-based therapy option is available. The indication for thermal RF neurotomy is a positive response to controlled diagnostic MBBs [28, 30]. If MBBs are suitable as a diagnostic tool for SST, RF neurotomy might be a rational therapy.

Materials and Methods

This pilot study was designed as a retrospective practice audit. An electronic medical record system was used to identify patients in a single spine center. All consecutive patients presenting with tinnitus, who had received cervical MBBs between 2006 and 2015, were included. Neck pain of appropriate quality was the primary indication for treatment. The tinnitus was an additional complaint of the patient. Patients with cervical spine surgery in their history and patients without data regarding the alterations of the tinnitus in their follow-up were excluded.

Patients were tested for facet joint pain with an MBB with about 1 ml of bupivacaine (0.25%) and 20 mg triamcinolone. Injections were performed with fluoroscopic visualization using established techniques [28]. A lateral view of the spine was obtained. The target point is the centroid of the articular pillar with the same segmental number as the target nerve. The needle is placed straight along the x-ray beam to the medial branch (Figure). Target joints were identified by the pain pattern, local tenderness over the area, and provocation of pain with deep pressure.

For every patient, the first follow up examination was between one and four weeks after the intervention. Further examinations were arranged according to the needs of the patients. Each time a physician interview and a clinical examination was used to capture information.

A statistical analysis was performed. Chi-square-tests were used to compare patients with

favorable response to treatment and patients with negative treatment response and to investigate subgroups of patients (e.g. the different levels being treated). Welch's t-Test was used to test the hypothesis that two populations had equal means (e.g. age or duration of symptoms). $P < 0.05$ was set as the threshold to interpret the results as significant.

Figure 1. Lateral fluoroscopic view with the needle in position for a C3 medial branch block.

Results

Between January 2006 and December 2015, 22 consecutive patients with tinnitus met the inclusion criteria. The data of the patients are shown in the Table. Seven patients were women and 15 were men. The mean age was 54.5 years (between 35 and 80 years). Two medial branches were blocked with local anesthetic in 17 patients (medial branches C3 and C4 in 10 patients, medial branches C4 and C5 in 6 patients and in one patient the medial branches C5 and C6). Three medial branches (C3, C4 and C5) were blocked in five patients. Eight patients were treated on one side (six on the left, 2 on the right) and 14 patients on both sides. Eleven patients had one MBB, 8 patients two blocks and one patient there blocks. All patients had a history of neck pain and tinnitus between weeks and more than 1 year. Furthermore, 9 patients had referring pain into the head and two patients had vertigo.

All patients were invited to a follow-up examination after the intervention. The mean follow-up time was 6.2 weeks (between 1 and 20 weeks). Tinnitus was analyzed through the global clinical impression of the patient (i.e. "better", "worse", "the same"). Seven patients (31.8%) experienced a significant improvement of the tinnitus, while two patients (9.1%) reported a worsening of the tinnitus. Pain relief was achieved in 14 patients (63.6%). There was no worsening of pain. In one patient, a thermal RF neurotomy of the medial branches C3, C4 and C5 was performed after positive response to two MBBs. The pain relief and a significant reduction of the tinnitus sustained at the follow-up examination after 10 weeks.

No statistically significant difference was found between the group with an improvement of tinnitus and the group with a bad outcome (Table) for the analyzed parameters (age, gender, duration of symptoms, additional neck pain or vertigo, or side or level of the intervention).

Discussion

This pilot study is the first study to determine whether MBBs are a possible diagnostic tool with which to identify SST. Cervical MBBs are a diagnostic procedure designed to test whether a patient's pain is mediated by one or more of the medial branches of the cervical dorsal rami [28]. The results of this study show that MBBs influence not only the pain but also the tinnitus. In nearly one third of the patients presenting with neck pain and tinnitus the positive answer to the MBBs revealed SST. As expected, the duration of action of an MBB is limited. A repetition of the block for validation of the test result or to test different cervical levels is possible. If the diagnosis of facet joint pain can be confirmed, the pain can be treated with thermal RF neurotomy. Whether RF neurotomy also qualifies for the treatment of SST if previously controlled MBB showed a

Table 1. Characteristics of all treated patients.

			Response to Treatment			
	All patients		Favorable		None	
	N	%	N	%	N	%
	22		7	31.8	15	68.2
Men	15	68.2	4	57.1	11	73.3
Women	7	31.8	3	42.9	4	26.7
Age (years)						
Min--Max	35-80		38-80		35-69	
Mean ± SD	54.5 ± 12.0		53.8 ± 16.4		45.8 ± 10.1	
Level of intervention						
C3 and C4	10	45.5	3	42.9	7	46.7
C4 and C5	6	27.3	3	42.9	3	20.0
C5 and C6	1	4.5	0	0.0	1	6.7
C3, C4 and C5	5	22.7	1	14.3	4	26.7
Side						
left	6	40.9	1	14.3	5	33.3
right	3	13.6	2	14.3	0	0.0
both	10	45.5	4	28.6	10	66.7
Duration of symptoms						
Weeks	4	18.2	1	14.3	3	20.0
Months	9	40.9	2	28.6	7	46.7
> 1 year	9	40.9	4	57.1	5	33.3
Additional symptoms						
Headache	9	40.9	3	42.9	6	40.0
Vertigo	2	9.1	1	14.3	1	6.7
Follow-up time (weeks, mean ± SD)	6.2 ± 5.3					
Tinnitus						
Improved	7	31.8	7	100.0		
No change	13	59.1			13	86.7
Worse	2	9.1			2	13.3
Neck pain						
Improved	14	63.6	7	100.0	7	46.7
No change	5	22.7			5	33.3

positive influence on the tinnitus must be examined in further studies. At least one patient from this study was treated successfully with RF neurotomy.

The principles, validity and utility of MBBs for pain are well examined [28]. However, no study exists about the importance of MBBs for the diagnosis of tinnitus. Therefore, it is not possible to compare the results of this pilot study with the literature. However, one case report exists [24] about the treatment of a patient with SST with RF neurotomy. In this case report, the main intention was the treatment of neck pain; however, the denervation of the medial branches C2 and C3 eliminated the symptoms of tinnitus at the one year follow-up. This patient was tested positively with a single medial branch block before the RF procedure.

In total, 63.6% of the patients in this study were treated bilaterally, which compared well with the bilateral tinnitus level of 64% in the literature [31]. However, the duration of tinnitus was shorter in this study compared to a range from 2 to 60 years in literature [31]. The prevalence of tinnitus increases with age and seems to attain a plateau at around 60 to 80 years [4], compared to a mean age of 54.5 years in this study. The male-female ratio is 2:1 in the literature [4] and in our study. In summary the small population of this pilot study seems to be comparable to other studies in the literature.

An interesting question remains the importance of the level to choose for the MBB. Because the primarily intention was to treat neck pain, the level for the MBBs was chosen by localization of the pain according to typical pain maps [32] and by clinical examination. Therefore, the medial branch C2 was not tested. Typically, the medial branches C3 to C5 were included, because these levels are the most commonly involved levels in neck pain [28]. However, the input from the spinal nerves to the cochlear nucleus have their origin especially from C2/3 [14-16]. Therefore, in future studies, the medial branches C2 and C3 need special attention. The selection of the best level to test with MBBs will be a challenge for future studies.

Conclusion

This pilot study shows the feasibility of testing the diagnosis SST with medial branch blocks. Nearly one third of the patients with a combination of neck pain and tinnitus SST was revealed by a positive answerer to two MBBs. However, some limitations exist. It was the primary intention to treat neck pain; the assessment of tinnitus was an additional aim. Therefore, the history taken and the clinical examination were not targeted specifically to tinnitus. Further studies with the primary intention on SST are necessary to prove the significance of MBBs. A close cooperation between specialists for tinnitus and interventional pain specialists will be necessary. A clear specification what can be expected from MBBs and RF neurotomy and instruments to measure the change in outcome have to be specified. If MBBs are a useful diagnostic test for SST, a treatment study with RF neurotomy would be the rational consequence.

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