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Title

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Permalink

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Journal

Otology & neurotology : official publication of the American Otological Society, American Neurotology Society [and] European Academy of Otology and Neurotology, 38(10)

ISSN

1531-7129

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Publication Date

2017-12-01

DOI

10.1097/mao.0000000000001596

Peer reviewed

Resolution of Persistent Post-Stapedotomy Vertigo With Migraine Prophylactic Medication

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Objective: To describe persistent post-stapedotomy vertigo (PSV) and its treatment using migraine prophylaxis.

Patients: A retrospective review of all patients with persistent PSV spanning 10 years at a tertiary academic hospital was performed. Patients who experienced persistent vertigo for a minimum of 3 months after surgery were included. Those with possible perilymph fistula, long prosthesis, and benign paroxysmal positional vertigo were excluded.

Interventions: All patients received instructions on migraine dietary and lifestyle changes and Vitamin B2 and magnesium. In addition, prophylactic treatment with nortriptyline, verapamil, or a combination thereof was started.

Main Outcome Measure: Changes in vertigo frequency was the main outcome variable. The secondary outcome variables included the time period and medications necessary to achieve symptomatic resolution.

Results: Four women and one man with an average age of 53 years were identified that met criteria for persistent PSV

indicating an incidence of 0.9% at our institution. The onset of vertigo symptoms was on average 20 days postoperatively. All five patients had daily vertigo episodes and experienced complete resolution with no vertigo episodes after treatment. Symptomatic resolution was achieved over an average of 9 weeks after initiating treatments.

Conclusions: Persistent PSV beyond 3 months is a rare occurrence and its treatment can be challenging when there is no evidence of an underlying pathology. This subset of patients may be suffering from migraine, which was triggered postoperatively. Treatment with migraine prophylaxis in this cohort of patients may result in resolution of vertigo. **Key Words:** Migraine—Persistent post-stapedotomy vertigo—Stapedectomy—Stapedotomy—Vertigo.

Otol Neurotol 38:1500–1504, 2017.

Complications of stapes surgery are relatively rare and include persistent conductive hearing loss, prosthesis displacement, vertigo, dysgeusia, deafness, and facial nerve injury (1,2). Post-stapedotomy vertigo (PSV) affects 8.5 to 45% of patients following stapes surgery. PSV is typically transient and resolves within 1 week (3,4). In 0.5 to 2.6% of patients, vertigo may persist beyond 4 weeks (5,6). In these cases, long prosthesis, perilymph fistula (PLF), benign positional vertigo (BPV), and pneumolabyrinth have to be ruled out (7–9). A high-resolution CT scan of the temporal bone, Epley maneuver, and autologous blood patch comprise the work up to evaluate for these conditions (10–14).

Some patients with persistent PSV may have no apparent underlying etiology, making diagnosis and treatment challenging. In our practice, we have anecdotally noted that these patients commonly report a history of migraine. We concluded that a subset of patients with persistent PSV could be suffering from vestibular migraine and surgical stress may have triggered the vertigo. In this study, we aimed to investigate the results of treating persistent PSV with a migraine prophylaxis regimen.

METHODS

A retrospective chart review spanning 2006 to 2016 was conducted with permission from our Institutional Review Board. All post-stapedotomy patients who developed PSV persisting beyond 2 months were included. Before initiating migraine prophylaxis, all patients were evaluated for other possible etiologies according to an algorithm outlined in Figure 1. As such, all patients with possible PLF, long prosthesis, and BPV were systematically identified and excluded from the study. Once all potential etiologies were ruled out, patients began a migraine prophylactic treatment regimen (Fig. 2). The first line therapy was commonly nortriptyline, verapamil, or

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Presented at the American Otological Society Annual Spring Meeting, April 26–30, 2017; San Diego, CA.

Financial Disclosure: None.

The authors disclose no conflicts of interest.

DOI: 10.1097/MAO.0000000000001596

FIG. 1. Treatment algorithm for PSV and steps taken to rule out other etiologies. PSV indicates post-stapedotomy vertigo.

both if there was no symptomatic resolution. Second line treatment was topiramate if resolution was not achieved with first line therapy. All medications were given at escalating doses. Patients were also instructed to improve the consistency of their sleep hygiene and adhere to a strict migraine diet which avoids foods that can trigger migraine (15,16). After 3 months of symptomatic relief, the drug(s) were tapered off one at a time. Symptom resolution was confirmed with multiple follow-up appointments for at least 1 year postoperatively.

RESULTS

Between 2006 and 2015, 312 stapedotomies were performed at our institution. Of these, three patients experienced persistent PSV, resulting in an incidence of 0.9%. Additionally, two patients with persistent PSV were referred after being operated at other institutions. The average age was 53 years, with all patients

describing an episodic true rotatory vertigo (Table 1). All patients had a primary diagnosis of otosclerosis and experienced improved hearing postoperatively. Two patients (40%) had a history of episodic vertigo before stapedotomy while two (40%) had a history of migraine headaches, meeting international headache classification (IHS) criteria for migraine. None of the patients met criteria for vestibular migraine. There were no distinguishing features between patients with regards to severity of otosclerosis, age of onset, and postoperative hearing when compared with the overall otosclerosis cohort.

Postoperatively, all patients developed daily vertiginous episodes with an average postoperative onset of 20 days (range, 2–60 d). These patients were observed and treated as outlined in Figure 1 for at least 2 months following the onset of vertigo and before initiation of migraine treatment. All patients had CT scans to rule out

FIG. 2. Treatment approach to the management of post stapes vertigo.

possible superior/posterior canal dehiscence and to evaluate for long prosthesis. All patients had negative findings with no evidence of cochlear otosclerosis. Otosclerotic plaques in the fistula ante fenestrum were seen in all cases. Once the migraine prophylactic treatment was initiated, complete symptomatic relief was achieved over an average treatment course of 9 weeks (range, 3–15 wk). There was complete resolution of vertigo upon completion of migraine prophylaxis which was confirmed at a minimum of 1 year after treatment. Dose escalation was necessary in all cases. Only one patient responded to single medication therapy. Two patients required combination therapy and one patient required a trial of a third drug (topiramate) after failure with combination therapy.

Two patients had pressure induced vertigo, with eructation and elevation changes (Table 1). Both patients underwent empiric intratympanic autologous blood

TABLE 1. Defining features of subjects included in the study

Age	Sex	Air-Bone Gap After Surgery	Duration and Frequency of Vertigo Before Treatment	Time Until Post-op Symptom Development	Days of Treatment Until Complete Symptomatic Resolution	Hx of Vertigo Before Surgery	Hx of Migraine Headache Before Surgery	Medications Used to Achieve Resolution	Significant Migraine Triggers	Significant Vertigo Triggers
67	F	1.25	1–3 seconds, daily	60 days	15 weeks	No	No	75 mg nortriptyline and 240 mg verapamil	None	Eructation, yawning, change in elevation
58	M	3.75	30 minutes, three times per week	2 days	6 weeks	No	Yes	50 mg nortriptyline	Erratic eating schedule	Food triggers and when hungry
51	F	13.75	15 minutes, daily	5 days	13 weeks	Yes	Yes	75 mg nortriptyline and 180 mg verapamil	Sleep deprivation and stress	None
53	F	1.25	1–3 seconds, daily	14 days	9 weeks	Yes	No	75 mg nortriptyline	None	Eructation, yawning, change in elevation
38	F	5	30 minutes, daily	10 days	3 weeks	No	No	75 mg topiramate	None	Sleep deprivation

injection to treat a potential perilymph fistula, with no symptomatic relief. As with all patients, these two patients did not have a long prosthesis identified on temporal bone CT. They both experienced symptomatic resolution with migraine prophylactic therapy. For one patient, medication tapering (from 50 to 25 mg of nortriptyline) resulted in return of symptoms, despite symptomatic relief for 3 months before medication tapering. Symptomatic relief was resolved by increasing medication dosage (up to 50 mg of nortriptyline). No patients subjectively reported significant phonophobia or hyperacusis beyond the normal expected transient sound sensitivity after stapedotomy. In all patients, vertigo was described as episodic vertigo, as detailed in Table 1. All patients had intolerance to head and visual motion. Furthermore, two (40%) patients had a specific migraine headache trigger and one (20%) identified both a migraine headache and vertigo trigger. Two (40%) patients had a migraine trigger for their vertigo such as a dietary or sleep trigger (Table 1). The following migraine symptoms were reported in the five patients included in this cohort: otalgia (40%), allodynia (60%), aural fullness (40%), and pressure sensitivity (40%). In all patients, Dix–Hallpike examination was negative with no gaze-evoked nystagmus.

DISCUSSION

The incidence of persistent PSV in our practice was 0.9%, which is consistent with the reported incidence of 0.5 to 2.6% in literature (5,6). Resolution of persistent PSV with migraine prophylaxis treatment may suggest a possible link between PSV and an underlying undiagnosed or latent migraine. The generalizability of this conclusion, however, is limited by the small sample size in this study and the lack of a control group. Only two patients (40%) had a history of migraine headache before surgery and reported specific migraine triggers (food triggers, hunger, and sleep deprivation) which elicited their migraine headaches. Two had specific migrainous triggers for their vertigo (food or sleep deprivation). The majority of patients (60%) did not exhibit symptoms of migraine headache before the postoperative onset of PSV. This suggests that patients who develop PSV postoperatively do not necessarily have a history of migraine headaches. In our study cohort, all patients required dose escalation to achieve symptomatic control, which along with combination therapy, is usually necessary for achieving symptomatic control in classic migraine or vestibular migraine patients (17–20). One patient (Patient 1 in Table 1) had recurrence of symptoms when nortriptyline was reduced from 50 to 25 mg for 3 weeks, which resolved after increasing the dose back to 50 mg.

PSV treatment depends on symptom duration. Short-lived vertigo (6 days or less) commonly responding to conservative management with treatment necessary only after quality of life is affected (21). Vertiginous episodes are the reason for revision stapedotomy in 2.2 to 9.5% of

the cases. The most common intraoperative findings are prosthesis related (22–24). Revision surgery allows the surgeon to address anatomical issues, such as an excessively long prosthesis (23,25). One study reported that in 14% of vertigo revision cases, no intraoperative abnormalities were identified and the PSV persisted (22). Another study found 40% of the patients with suspected PLF had no abnormal findings intraoperatively (25). As such, there may be a subset of patients with unexplained, persistent PSV in which vestibular migraine is triggered by the stapes surgery and could be the etiological cause.

The relationship between PSV and migraine has not been reported in the literature previously. No definitive explanation exists linking these two seemingly independent disorders. One hypothesis is that stapedotomy can introduce a significant vestibular stimulation and result in vertigo. Intraoperative vestibular stimulation may arise from significant pressure changes in the vestibule following footplate manipulation and perforation, prosthesis placement and testing, as well as caloric stimulation from middle ear suctioning. The vertigo in turn may trigger a migraine process in the brain. In addition, the preoperative stress, overnight fasting, and lifestyle changes (e.g., they do not consume their morning caffeine on the day of surgery) can all potentially trigger a migraine episode. Of note, surgical intervention is comprised of a process that starts preoperatively, and continues during the recovery period. This can cause a change in the function of the organ—all serving as a potential migraine trigger. Loud noise has also been cited to be a common migraine trigger (26), which can occur following stimulation from the prosthesis placement and testing. All patients had normal postoperative tympanic membrane examinations when they presented, with no evidence of reparative granuloma present postoperatively. Others have demonstrated vestibular stimuli to trigger migraine following caloric testing, optokinetic stimulation, and motion sickness (27–30). In the case of caloric testing, patients experienced the onset of new migraine symptoms or developed migraine headaches following testing when there was no previous history of either (27,28). Similarly, we hypothesize that vertigo and the sounds generated by prosthesis placement and moving the piston intraoperatively can serve as migraine triggers. The PSV described in this study may potentially be of migraine origin and triggered by vertiginous or sound stimuli secondary to stapes surgery.

The pathophysiological relationship between vestibular stimuli triggering migraine is unclear and no widely accepted theory exists. One theory implicates that the activation of vestibular nuclei during migraine episodes can bidirectionally activate the trigeminal nuclei which can occur due to the interlinked neural fibers connecting the two nuclei (31,32). The trigeminal vascular reflex activated by the vestibular nuclei may additionally contribute to the migraine pathophysiology (33). As such, the link between migraine and vertigo could be bidirectional, with the activation of vestibular nuclei as a result of stapes surgery triggering the trigeminal nuclei, causing

migraine symptoms. Furthermore, secondary stimulation or potential inhibition of the vestibular nuclei may ensue, resulting in vertigo. Therefore, migraine prophylactic therapies, such as tricyclic antidepressants or calcium channel blockers, can inhibit trigeminal activation via neuroendocrine or vascular mechanisms, respectively (34,35). This may offer a possible explanation regarding why patients achieve symptomatic improvement when the underlying migraine etiology is treated.

Our study is limited due to the sample size of our observations. Only five patients with persistent PSV were identified over a 10-year period at a high volume academic tertiary care center, which highlights the rarity of this condition. Furthermore, it is entirely plausible that the patients may have improved on their own over time, and that the symptomatic resolution may not have been entirely due to migraine treatment. In one patient, reduction of medication dosage led to symptomatic recurrence. In this patient, it is more likely that migraine played a major role in their vertigo. Multi-institutional studies enrolling more patients and randomized controlled trials are warranted to further characterize this patient population and assess the effectiveness of these treatments in a controlled fashion.

CONCLUSION

Persistent PSV is a rare condition and can often be difficult to treat. In a subset of patients, no specific underlying pathology can be identified. Patients who exhibit symptoms beyond 2 months postoperatively could possibly be experiencing a concurrent diagnosis of vestibular migraine triggered by the stapes surgery. In this patient population, migraine prophylactic therapy can be curative.

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