Benign Paroxysmal Positional Vertigo After Stapedectomy

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Objective: To determine the incidence of benign paroxysmal positional vertigo (BPPV) following stapedectomy in a patient group and the efficacy of the Epley maneuver in this group. Study Design: Prospective study in a university-based tertiary referral system. Methods: The patient group comprised 63 patients who had undergone stapedectomy; a control group consisted of normal healthy individuals with no otolaryngological complaints. All individuals underwent the Dix-Hallpike maneuver for the diagnosis of BPPV. Patients who exhibited vertigo, torsional nystagmus (which reverses its direction on return to sitting position) preceded by a latent period, and the fatigability of these findings were considered to have BPPV. If the test result was positive, they underwent the Epley therapeutic maneuver. Results: Four of the patients who had undergone a stapedectomy showed characteristic findings of BPPV. No individual in the control group had BPPV. All patients responded well to the Epley maneuver. Conclusions: Stapedectomy may be regarded as an etiological factor in BPPV. Therefore, this study investigated a group of patients who had undergone stapedectomy and the efficacy of the Dix-Hallpike maneuver and criteria necessary for diagnosis of BPPV.

INTRODUCTION

There have been major developments in the understanding of the pathophysiology and therapy of benign paroxysmal positional vertigo (BPPV) during the last two decades. In 1921, Barany described paroxysmal vertigo with nystagmus following changes in head position. Later, Dix and Hallpike introduced the term “benign positional paroxysmal vertigo” and described the Dix-Hallpike maneuver and criteria necessary for diagnosis of BPPV.

Ear operations are considered to be among the etiological factors in BPPV; however, a survey of the relevant literature in English through the Internet showed a scarcity of publications on BPPV following stapedectomy. Therefore, this study investigated a group of patients who had undergone stapedectomy, to determine the incidence of BPPV after stapedectomy and the efficacy of the Epley maneuver in this patient group.

MATERIALS AND METHODS

The study was carried out in the Department of Otolaryngology—Head and Neck Surgery at Hacettepe University (Ankara, Turkey) on 63 patients who had had a stapedectomy. There were 46 female and 17 male patients, with an age range of 23 to 65 years (average age, 38.2 y). Preoperatively all patients had an air-bone gap of at least 30 dB (pure-tone average in frequencies 500 Hz and 1 and 2 kHz), and clinical otosclerosis was diagnosed.

All patients with dizziness, vertigo, or inner ear involvement were excluded from the study, but Dix-Hallpike maneuver was not performed routinely preoperatively. They had undergone uneventful stapedectomy surgery. The surgical technique in-
volves removing the stapes superstructure and making a small fenestra at the stapes footplate; the fenestra is created using a sharp needle. A Teflon piston (either 0.6 or 0.8 mm in diameter and 3.75–4.5 mm in length as determined at the time of surgery) is then used between the incus and the fenestra, and the opening around the prosthesis is closed with crushed bony pieces from the stapes superstructure.

Sixty-three adults with no otolaryngological or vestibular complaints made up the control group. In this group, there were 40 female and 23 male subjects with an age range of 20 to 63 years (average age, 41 y).

The study group patients were evaluated for vertigo after surgery; a questionnaire about the presence and characteristics of vertigo was completed by each of the patients. Because most patients demonstrate some vertigo and nystagmus during the first month after surgery, the evaluation for vertigo was not performed within this period. The evaluation period was 8 to 348 months after surgery. After an ENT examination, patients underwent a complete audiological evaluation. Patients with the findings of Meniere’s disease were excluded from the study. The Dix-Hallpike maneuver was used for all patients and control subjects to diagnose BPPV. Patients who exhibited vertigo, torsional nystagmus (which reverses its direction on return to sitting position) preceded by a latent period, and fatigability of these findings were considered to have BPPV.

The operative notes for all of the patients were reviewed; the size and position of the fenestra at the footplate and the diameter and length of the piston were noted.

Patients with BPPV were given the Epley maneuver for therapy, and their progress was followed every week for 1 month. In their control examination the Dix-Hallpike maneuver was repeated to determine whether vertigo and nystagmus still persisted.

The difference between the patient and the control groups was tested statistically using the “difference-between-the-two-proportions test.”

RESULTS

Four patients (6.3%) in the group who had had stapedectomy exhibited characteristic findings of BPPV; none of these patients had exhibited BPPV symptoms before the stapedectomy. All four patients had unilateral BPPV on the side of the operation, and the characteristics of the nystagmus were typical for posterior semicircular canal BPPV in all cases. No subject in the control group exhibited symptoms or findings of BPPV, as revealed by the Dix-Hallpike maneuver. The difference between the two groups was statistically significant (P < .05).

All 63 patients had had a small fenestra stapedectomy in the posterior part of the footplate. Their file records indicated that the average length of the piston in this group without vertigo and BPPV was 4.19 mm. The lengths of the pistons used in the four patients who exhibited symptoms of BPPV were recorded in their files as 4.5, 4.5, 4.25, and 4.25 mm, respectively.

The four patients with BPPV underwent the Epley maneuver for therapy. Their progress was followed weekly for a period of 1 month. None of them complained of vertigo, and none demonstrated vertigo or nystagmus during follow-up Dix-Hallpike testing.

DISCUSSION

This study revealed a 6.3% incidence of BPPV following stapedectomy. In the control group of healthy individuals, no case of BPPV could be demonstrated. The difference between the two groups was statistically significant (P < .05). All four patients with BPPV showed no further symptoms during 1 month of follow-up after the Epley maneuver.

According to Baloh et al., no cause could be identified in 48% of their case studies of patients with BPPV. The etiological factors include head injury, vestibular neuritis, otological infections, and prolonged bed rest. Ear surgery is another etiological factor in BPPV. Hughes and Proctor noted that in 151 cases of BPPV, 6 occurred after ear surgery. Five of the operations they described were stapedectomies and one was a tympanoplasty, but no explanation was provided by these authors to account for BPPV after stapedectomy or tympanoplasty in these cases.

Today, the pathophysiology of BPPV is generally understood to be a result of canalolithiasis in which otoconia dislodged from the maculae of the otolith organs accumulate in the long arm of the posterior semicircular canal. Cupulolithiasis, as originally proposed by Schucknecht and Ruby, cannot explain the paroxysmal nature of the disease, the brief duration of the nystagmus, the reversal of the nystagmus, or the fatigability of these findings. Further evidence of the causative role of canalolithiasis in BPPV came from Parnes and McClure, when they observed particulate material within the long arm of the posterior semicircular canal during semicircular canal occlusion operations.

The pathophysiology of BPPV after stapedectomy may be related to trauma to the otolith organs. The stapes footplate lies lateral to the utricle and saccule (Fig. 1). The distance between the footplate and the labyrinthine elements is of the magnitude of a millimeter. According to Donaldson et al., the distance from the superior surface of the footplate to the saccule, which lies anterior and medial to the footplate, varies between 1.0 and 1.4 mm (the shortest distance is 0.82 mm). The corresponding
distance for the utricle, which lies posterior and medial to the footplate, varies between 0.7 and 1.4 mm (the shortest distance is 0.38 mm). Therefore, anatomically there is a close relationship between the footplate and membranous structures in the vestibule. Ideally, the tip of the piston should be 0.25 mm below the stapes footplate. If the utricle is close to the footplate and the tip of the piston extends further than 0.25 mm within the vestibule, utricular trauma is likely. This in turn may mobilize the otoliths into the long arm of the posterior semicircular canal, which is the most dependent part of the membranous labyrinth. We think this may be the underlying pathophysiology of BPPV after stapedectomy.

Causse et al.\textsuperscript{9} indicated that the posterior part of the footplate is the only location where the piston shaft is not directly above the membranous labyrinth. As a result of this, the fenestra during stapedectomy is usually located in the posterior part of the footplate. The fenestra was located in the posterior part of the footplate in all of our patients; this leads us away from the conclusion that there was trauma to the saccule, which is located anterior and medial to the footplate. Meyerhof\textsuperscript{10} suggested that utricular trauma may be the origin and that otoliths mobilized in this way may enter the semicircular canal; this view correlates with our findings.

In our operations, a straight needle is used to perforate the footplate and, afterwards, bone spicules are removed with fine hooks; it is possible that some tiny bone fragments may enter the vestibule at this stage of the operation. A laser can also be used for this part of the surgery; bony fragments from the footplate are less likely to fall into the vestibule with lasers because there is no pushing action. It may be interesting to investigate the occurrence of BPPV after laser stapedectomy, to clarify the differences between these two methods, as well as their relative merits.

Tribukait and Bergener\textsuperscript{11} investigated the occurrence of subjective visual horizontal following stapedectomies. The authors found that in the acute stage after surgery, subjective visual horizontal was significantly tilted away from the operated side, and they pointed out that this indicated an increase in the resting activity of utricular afferents. This also supports the etiological view of utricular trauma in the immediate postoperative period.

Shei\textsuperscript{12} described the occurrence of postoperative positional giddiness when the head is turned backwards or in the direction of the operated ear, especially in the supine position. He related this symptom to injury of the utricle; if the lower end of the Teflon piston is positioned too far into the vestibule, it may injure the utricle. Therefore, Shei stressed the importance of the correct length of the piston. In our study, the average piston length in the four patients exhibiting symptoms of BPPV was 4.37 mm; in the remaining patients the length was 4.19 mm. We think this difference is not important in the production of utricular trauma. However, as pointed out by Causse et al.,\textsuperscript{9} in 2% of patients the saccule and utricle are close to the footplate; in cases of patients such as these, a long piston can produce utricular trauma.

Meyerhof\textsuperscript{10} indicated that BPPV may occur after a stapedectomy but is usually resolved without treatment. Collison and Kolberg\textsuperscript{13} reported a case of persistent BPPV after stapedectomy and its successful treatment with the Epley maneuver. Their case report indicated that the pathophysiology was most probably related to a floating footplate, which tilted on its short axis and came into contact with the membranous labyrinth at the utricle. This caused dislodgment of the otocanals into the semicircular canals. Morgenstern and Greven\textsuperscript{14} had to perform surgery to treat BPPV after a stapedectomy, but at the time of their study the Epley maneuver was not yet known. All of our four patients responded well to the Epley maneuver.

**CONCLUSION**

Stapedectomy may be considered among the etiological factors in BPPV, and the physiopathological mechanism appears to be utricular trauma. It should be kept in mind that in 2% of the patients the membranous labyrinth is close to the footplate. This indicates the importance of correctly measuring the distance between the long process of the incus and the footplate; the tip of the prosthesis should be just within the vestibule. Patients exhibiting BPPV after stapedectomy responded well to the Epley maneuver.

**BIBLIOGRAPHY**