

Clinical manifestations of barotraumatic perilymphatic fistula according to the types of trauma and the fistular site

Ji Eun Choi, MD, Il Joon Moon MD, PhD, Yang-Sun Cho MD, PhD, Sung Hwa Hong MD, PhD, Won-Ho Chung MD, PhD

Department of Otorhinolaryngology-Head and Neck Surgery, Sungkyunkwan University School of Medicine, Samsung Medical Center, Seoul, Korea

ABSTRACT

Objectives. The diagnosis of barotraumatic perilymph fistula (PLF) is controversial due to the variability in patient presentation and difficulty in pre-operative evaluation. Symptoms like hearing loss, ear fullness and dizziness can develop following minor barotrauma such as Valsalva, nose blowing and straining. The aim of this study is to investigate the clinical manifestations of barotraumatic PLF according to the fistula site and to propose the diagnostic criteria of barotraumatic PLF.

Methods. Twenty one patients (23 ears) who underwent the exploratory tympanotomy on the suspicion of perilymph fistula were retrospectively reviewed. Types of barotrauma, clinical symptoms and clinical outcomes were compared between the groups.

Results. The internal barotrauma such as nose blowing, cough, straining and altitude changes were 17 ears, and minor blunt head trauma such as head blowing and slap injury were 6 ears. OW fistula was caused by blunt head trauma (n=3) and altitude change (n=2). RW fistula was mostly caused by internal trauma; straining (n=3), nose blowing (n=2), altitude change (n=2) and blunt trauma (n=1). The symptoms of PLF were both hearing loss and dizziness. But, the time sequence of symptom presentation was different depending on the fistula site. In OW fistula, either hearing loss or dizziness was initial presenting symptoms, and both symptoms were presented simultaneously or sequentially. In RW fistula, initial presentation was hearing loss. On physical findings, positional nystagmus was found in 9 cases: OW (n=1), RW (n=3) and unknown (n=5). The pattern of positional nystagmus differed from typical BPPV in terms of bilateral positional nystagmus, longer duration, nystagmus of ampullofugal pattern. The hearing outcomes were dependent on the surgical timing after symptom onset. Hearing improved group had early surgical repair than no improved group (p<.0001, Mann-Whitney test). Hearing gain also showed strong correlation with surgical timing in Spearman analysis (rs=-0.727, p<.0001). The final improvement rate for dizziness was about 96% (22/23 ears).

Conclusion. Since outcome gets better when surgical repair perform as early as possible, clinical suspicion for the early diagnosis and repair of barotraumatic PLF is important.

METHODS AND MATERIALS

Clinical data [Table 1]

- retrospective review, from Jan 2005 through April 2015
- underwent exploratory tympanotomy on the suspicion of barotraumatic PLF which was suspected when the patients developed the symptoms of hearing loss and/or dizziness following the known history of barotrauma
- Total 23 ears and 21 subjects**

Type of barotrauma

- Internal type: implosive type: nose blowing, flying, diving & explosive type: Valsalva, straining
- External type: external trauma such as slap injury or minor blunt head trauma

Exploratory tympanotomy and surgical findings

Under the local anesthesia, the tympanomeatal flap was elevated via endaural approach. After elevating tympanomeatal flap, both round window (RW) and oval window (OW) were carefully evaluated for perilymph leak, membrane tearing or other abnormality such as fibrous mesh. After visualizing the both windows, both windows were patched with soft tissue and fibrin glue no matter what PLF was clearly confirmed or not.

Table 1 Demographics of suspected barotraumatic perilymph fistula

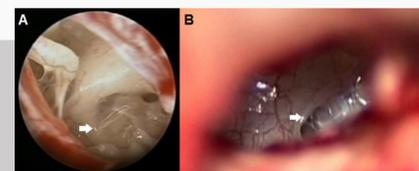
Case	Sex/Age	Type	Traumatic event	Time sequence of Sx	Operative findings	Origin
1	M/12	external trauma	trauma	HL + Dz	fluid collection	RW
2-R	F/60	implosive	nose blowing	HL + Dz	fluid collection	RW
2-L					fluid collection	RW
3	M/17	external trauma	trauma	HL + Dz	fibrous web	OW
4	M/44	explosive	straining	Dz → HL	no evidence	unknown
5	M/12	external trauma	trauma	Dz → HL	fibrous web	OW
6	F/32	explosive	straining	Dz → HL	no evidence	unknown
7	F/52	explosive	straining	HL → Dz	fluid collection	RW
8	F/40	implosive	nose blowing	Dz → HL	fluid collection	unknown
9-R	M/34	explosive	straining	HL → Dz	no evidence	unknown
9-L					no evidence	unknown
10	F/15	external trauma	trauma	HL → Dz	fibrous web	unknown
11	M/16	external trauma	trauma	HL → Dz	no evidence	unknown
12	F/64	implosive	altitude change	HL → Dz	fistula (hole)	OW
13	F/54	implosive	altitude change	HL → Dz	fistula (hole)	RW
14	F/45	explosive	straining	HL → Dz	fluid collection	RW
15	F/43	explosive	straining	HL → Dz	fluid collection	RW
16	M/56	implosive	altitude change	HL → Dz	fluid collection	RW
17	F/58	implosive	altitude change	Dz → HL	fluid collection	OW
18	M/57	explosive	cough	HL → Dz	no evidence	unknown
19	M/59	external trauma	trauma	HL → Dz	fluid collection	OW
20	M/50	implosive	nose blowing	HL → Dz	no evidence	unknown
21	M/59	explosive	straining	HL → Dz	no evidence	unknown

RESULTS

Clinical manifestations

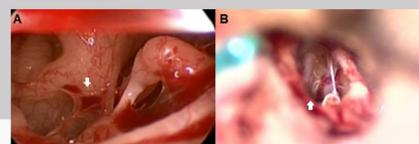
- In RW type (8 ears);** clear fluid (7 ears), fibrous mesh (one ear) [Fig 2]

- Clear fluid (arrow) in the RW niche was found
- Fibrous mesh surrounding the RW was found



- In OW type (5 ears);** clear fluid (2 ears), fibrous mesh (2 ears) and slit-like fistula (one ear) [Fig 3]

- Fibrous mesh (arrow) around the stapes was found
- Slit like hole (arrow) was found anterior to the stapes annulus



- In undetermined type (10 ears)**

Type of trauma [figure 3]

- Cause of trauma according to the fistula site. External minor trauma such as blunt head trauma and slap injury caused OW fistula more often (3/5 ears).
- Internal barotrauma such as straining, cough, nose blowing and altitude change caused RW fistula (7/8 ears) and undetermined type (8/10 ears).

Clinical manifestations according to fistula site [Figure 4]

- The main symptoms of PLF were both hearing loss and dizziness. In OW fistula, hearing loss and dizziness were presented sequentially in each 2 ears and both symptoms presented simultaneously in one ear. However, in RW type, hearing loss was always initial presenting symptom accompanying with dizziness (3 ears) or preceding to dizziness (5 ears). In undetermined type, hearing loss was preceded in 7 ears and dizziness was preceded in 3 ears.
- Nystagmus was found in OW (n=1), RW (n=3) and undetermined type (n=8)

Figure 3 location of fistula according to cause

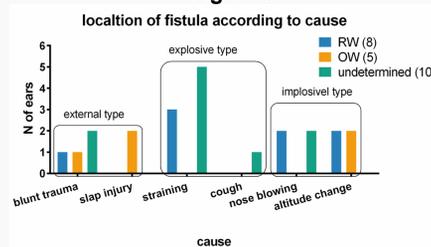
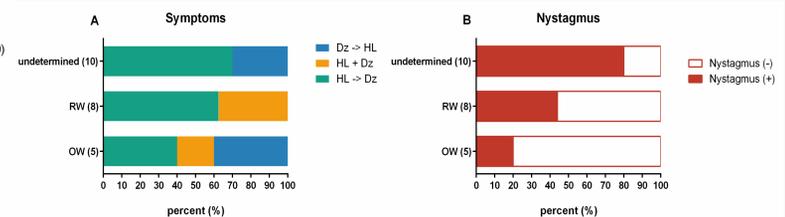


Figure 4 Clinical manifestations

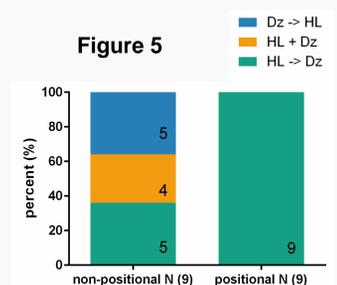


Positional Nystagmus [Table 2 & Figure 5]

- Positional nystagmus was found in 9 ears; OW (one ear), RW (3 ears) and undetermined (5 ears). Every patient who had the positional nystagmus has the clinical features that hearing loss developed first after barotrauma, and positional dizziness followed several hours later [Figure 5]
- The character of positional nystagmus was commonly bilateral. Direction of nystagmus included up-beating or down-beating which meant that each canal can be involved in ampullofugal directions, except only one patient (case 9) who showed reduced caloric response (56% weaker). The difference from typical benign paroxysmal positional vertigo (BPPV) was that there was no fatigability, no reversibility and it had longer duration.

Table 2 Character of positional nystagmus

Case	Side	Type	SN	Positional test	Dix-Hallpike test	Origin
9-R	R	Explosive	Absent	R) LB	R) LB	unknown
9-L	L	-	-	-	-	unknown
10	R	external trauma	present	R) UB, L) DB R) LB, L) RB (R > L) → R) UB, L) DB	R) RB → B) UB (R > L)	unknown
14	R	Explosive	absent	B) UB (R > L)	B) UB (R > L)	RW
15	R	Explosive	present	B) UB, L) LB	B) UB, L) LB	RW
16	R	Implosive	present	R) UB	-	unknown
18	R	Explosive	absent	B) UB → R) RB, L) LB	B) DB	OW
19	L	external trauma	present	R) RB, L) UB → R) RB	-	unknown
20	L	Implosive	absent	-	-	unknown



Hearing outcomes according to surgical timing and frequencies [Fig 6]

- Hearing improved group had early surgical repair than no improved group (p<.0001, Mann-Whitney test)
- Hearing gain was strongly correlated with surgical timing in Spearman analysis (rs=-0.727, p<.0001). The mean followed period of audiogram was 8 months and ranged from 1 month to 58 months.

Clinical outcomes after perilymph fistula repair [Fig 7]

- The final improvement rate for dizziness was about 96% (22/23 ears)
- Total three patients who showed dizziness and positional nystagmus underwent revision PLF repair and all patient resolved dizziness after the surgery

Figure 6 hearing gain according to surgical timing

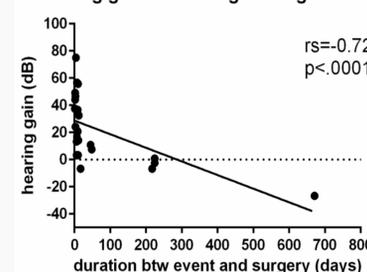
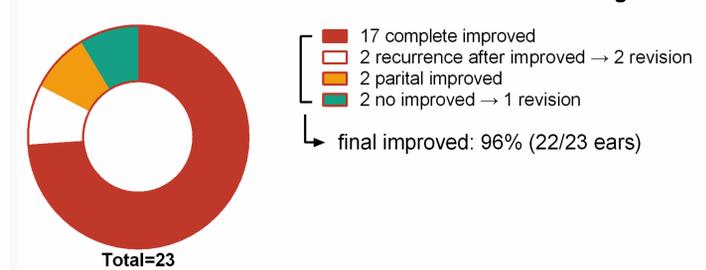


Figure 7 clinical outcome



Proposed clinical criteria of barotraumatic PLF

- Definite PLF**
 - Visual confirmation of PLF via surgical exploration
- Probable PLF**
 - Sudden hearing loss immediately after Barotrauma
 - Sudden or progressive sensorineural hearing loss followed by positional dizziness
 - Characteristic of positional nystagmus
 - Bilateral, long duration, no reversibility, no fatigability
 - Resolved after surgical repair