

Sudden Hearing Loss with Vertigo Portends Greater Stroke Risk Than Sudden Hearing Loss or Vertigo Alone

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Background: Because it is unknown whether sudden hearing loss (SHL) in acute vertigo is a “benign” sign (reflecting ear disease) or a “dangerous” sign (reflecting stroke), we sought to compare long-term stroke risk among patients with (1) “SHL with vertigo,” (2) “SHL alone,” and (3) “vertigo alone” using a large national health-care database. *Methods:* Patients with first-incident SHL (International Classification of Diseases, Ninth Edition, Clinical Modification [ICD-9-CM] 388.2) or vertigo (ICD-9-CM 386.x, 780.4) were identified from the National Health Insurance Research Database of Taiwan (2002-2009). We defined SHL with vertigo as a vertigo-related diagnosis ± 30 days from the index SHL event. SHL without a temporally proximate vertigo diagnosis was considered SHL alone. The vertigo-alone group had no SHL diagnosis. All the patients were followed up until stroke, death, withdrawal from the database, or current end of the database (December 31, 2012) for a minimum period of 3 years. The hazards of stroke were compared across groups. *Results:* We studied 218,656 patients (678 SHL with vertigo, 1998 with SHL alone, and 215,980 with vertigo alone). Stroke rates at study end were 5.5% (SHL with vertigo), 3.0% (SHL alone), and 3.9% (vertigo alone). Stroke hazards were higher in SHL with vertigo than in SHL alone (hazard ratio [HR], 1.93; 95% confidence interval [CI], 1.28-2.91) and in vertigo alone (HR, 1.63; 95% CI, 1.18-2.25). Defining a narrower window between SHL and vertigo (± 3 days) increased the hazards. *Conclusions:* The combination of SHL plus vertigo in close temporal proximity is associated with increased subsequent stroke risk over SHL alone and vertigo alone. This suggests that SHL in patients with vertigo is not necessarily a benign peripheral vestibular sign. **Key Words:** Sudden hearing loss—vertigo—dizziness—vertebrobasilar stroke—diagnosis.

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Introduction

Identifying stroke among patients presenting with vertigo is one of the most challenging issues in neurology, neuro-otology, and emergency medicine, and missed stroke in this context is frequent.¹ Most clinicians seek to differentiate stroke from peripheral vestibulopathy using the presence of focal neurological signs. Unfortunately, only 19% of patients with stroke presenting with acute vestibular syndrome have focal findings.² Among these patients, the head impulse test, nystagmus, and test of skew deviation (HINTS) battery of bedside ocular motor tests has been shown to be highly sensitive and specific for stroke.²⁻⁶

HINTS is based on key physiological differences between vestibular eye movement responses when central versus peripheral vestibular structures are injured.⁵ Not surprisingly, then, HINTS is most likely to fail when strokes affect the inner ear directly, because labyrinthine infarction is presumably physiologically indistinguishable from vestibular neuritis or labyrinthitis.⁵ As a result, infarctions affecting the anterior inferior cerebellar artery (AICA) territory, which supplies blood to the inner ear in the majority of people, are the most challenging to reliably identify.^{7,8} Among patients with AICA infarction, 60% have a combined audiovestibular loss.⁹

It has been suggested, therefore, that new hearing loss in the context of acute vertigo might be an important stroke predictor.⁴ Classical teaching, however, tells us that the comorbid presence of hearing loss indicates a peripheral-type vertigo.¹⁰ Many practitioners take acute hearing loss as a benign symptom when associated with vertigo and link it with pure inner ear disorders such as Menière disease or labyrinthitis, and, therefore, a lower risk for stroke. The underlying cause of sudden hearing loss (SHL) is also debated. Some specialists believe that SHL results from viral inner ear infection, whereas others favor a vascular origin. A large, population-based study showed that patients with SHL have a higher, long-term risk of stroke when compared with control subjects,¹¹ but the increased risk is roughly half of that in patients with vertigo presentations.¹² Among those with a proven AICA infarction, only 3% are said to initially present with an isolated SHL.⁹ In patients with SHL, 20%-60% complain of vertigo, and sometimes vertigo is their main symptom.¹³ Prior studies comparing SHL with and without vertigo found that hearing loss recovers more poorly if patients have vertigo, implying potentially different etiologies between these 2 groups.¹⁴

Thus, whether SHL is a benign symptom or a dangerous stroke predictor in patients with vertigo remains to be clarified. This specific issue has not been studied directly, largely because of a segregation between research on vertigo (without hearing loss) and research on hearing loss (without vertigo).¹⁵ In the present study, we use a population-based database to compare stroke risk

across patients with SHL alone, those with both SHL and vertigo, and those with vertigo alone. We hypothesized that the combination of SHL and vertigo would predict a higher stroke risk relative to patients with either SHL or vertigo alone.

Methods

Data Source

We used data from the National Health Insurance Research Database (NHIRD) of Taiwan. The NHIRD contains records of approximately 23 million enrollees dating back to March 1995, representing almost 99% of the total population in Taiwan. We reviewed records from the Longitudinal Health Insurance Database (LHID), which includes claims data for 1 million enrollees randomly selected from all beneficiaries of the National Health Insurance program in 2010. The medical records in the LHID include those from 1996 to 2012 for clinic visits, emergency department visits, and inpatient hospitalizations. To ensure confidentiality, the enrollees' personal information is protected using anonymous unique identification numbers. We extracted data based on the International Classification of Diseases, Ninth Edition, Clinical Modification (ICD-9-CM) codes.

Study Design

We conducted a population-based retrospective cohort study from the LHID using ICD-9-CM discharge diagnoses across clinical settings (clinic, emergency department, inpatient ward). We defined 3 cohorts for the primary analysis: (1) *SHL with vertigo* (SHL with temporally proximate vertigo), (2) *SHL alone* (SHL without temporally proximate vertigo), and (3) *vertigo alone* (vertigo without any history of SHL). Our primary outcome was a longitudinal follow-up for a first inpatient diagnosis of stroke. The study did not directly involve human subjects and so was exempt from institutional review board oversight.

Study Population

Patients with first-incident SHL (ICD-9-CM 388.2) diagnosed between January 1, 2002, and December 31, 2009, were identified from the LHID. For each member of the SHL cohort, we identified the most proximate visit for a vertigo-related diagnosis (ICD-9-CM 780.4 dizziness and giddiness, 386.x vertiginous syndromes, as used in prior works^{16,17}), if any. We defined our SHL with vertigo cohort as those with a vertigo event temporally proximate to the index SHL event (details in the next paragraph). We defined the SHL-alone cohort as those with either a nonproximate vertigo event or no vertigo event at all. We defined the vertigo-alone cohort as patients with a

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