

## Sudden bilateral hearing loss due to gastric carcinoma and its histological evidence

YAYOI SUZUKI\*, KIMITAKA KAGA\*, YURIKO SUGIUCHI†, TETSUO ISHII‡, JUN-ICHI SUZUKI\*\*, TAKASHI TAKIGUCHI\*\*\*

### Abstract

Six temporal bones and a brain tissue sample removed at autopsy from four patients with bilateral sudden hearing loss related to gastric adenocarcinoma were histologically studied. The pathological remains suggest that the sudden hearing loss of these patients may have occurred via one of two different mechanisms: (1) metastasis to the internal auditory meatus damaging the auditory nerve or (2) inner ear haemorrhage damaging Corti's organ. These two mechanisms may cause bilateral sudden deafness in patients with gastric adenocarcinoma.

**Key words:** Hearing loss, sudden sensorineural; Stomach neoplasms; Adenocarcinoma; Temporal bone

### Introduction

More than 200 cases of temporal bone metastasis have been reported in the literature (Schuknecht, 1968; Hill and Kohut, 1976; Nelson and Hinojosa, 1991; Ohira, 1993; Cumberworth *et al.*, 1994). However, bilateral sudden hearing loss due to gastric adenocarcinoma has remained rare. Only nine cases of temporal bone metastasis of gastric cancer have been reported, none accompanied by bilateral hearing loss.

Gastric adenocarcinoma is the most prevalent cancer and the prevalent cause of death in adults in Japan. We analysed histologically the pathophysiology of bilateral sudden deafness in four patients with gastric adenocarcinoma with particular refer-

ence to the relationship between bilateral sudden hearing loss and gastric adenocarcinoma.

### Materials and methods

The temporal bone collection of the department of Otolaryngology at Teikyo University, consisting of more than 500 temporal bones was reviewed. Four patients of gastric adenocarcinoma (six temporal bones from three patients and a brain tissue sample from one patient) presented with bilateral sudden hearing loss. Clinical information including audiograms and vestibular function tests was reviewed, and correlations were made with the autopsy reports and the histopathological findings.

TABLE I  
CLINICAL AND HISTOPATHOLOGICAL FINDINGS

Case	Age	Cause of death	Otologic symptoms	Site of temporal bone lesion	
				Right	Left
1	54	DMLC	Deafness (rt lt), tinnitus, nystagmus, dysgeusia, vertigo, facial paralysis (rt lt)	Massive IAC invasion	Massive IAC invasion OC preserved
2	64	DMLC	Deafness (lt rt), Tinnitus (lt), Otagia (lt), Vertigo		
3	38	Leukemoid Reaction	Deafness (lt rt), Vertigo	Massive Bleeding (PL, EL), TM, otolith missing	Bleeding (PL) OC preserved
4	46	DIC	Deafness (rt lt), Nystagmus	Bleeding OC flattened	Bleeding OC preserved

DIC = Diffuse Intravascular Coagulation; DMLC = Diffuse Metastatic Leptomeningeal Carcinomatosis; PL = Perilymphatic space; OC = the Organ of Corti; EL = Endolymphatic space; IAC = Internal auditory canal; TM = Tectorial membrane.

From the Departments of Otolaryngology, University of Tokyo\*, Tokyo Medical and Dental University†, Tokyo Women's Medical College‡, Teikyo University\*\* Tokyo, and Takiguchi Otological Clinic\*\*\*, Hiroshima, Japan.

Accepted for publication: 3 November 1997.

The temporal bones were cut into 20-micrometre sections and every 10th section was stained with haematoxylin-eosin. The brain tissue was cut using a routine procedure and stained with haematoxylin-eosin.

**Results**

A summary of the clinical and histopathological findings is presented in Table I. All the patients were male.

*Case 1*

A 54-year-old man underwent a gastrectomy for treatment of gastric adenocarcinoma. Half a year later, he lost his hearing ability bilaterally three weeks before his death (Figure 1a). He developed right facial nerve palsy two weeks before his death, and left facial nerve palsy one week before his death. He complained of headache and vertigo, and horizontal nystagmus to the left was observed. He died of diffuse leptomeningeal carcinomatosis.

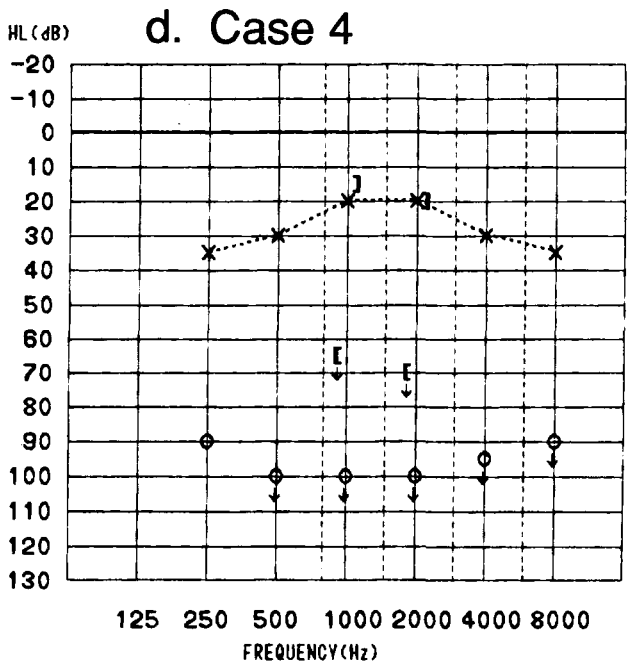
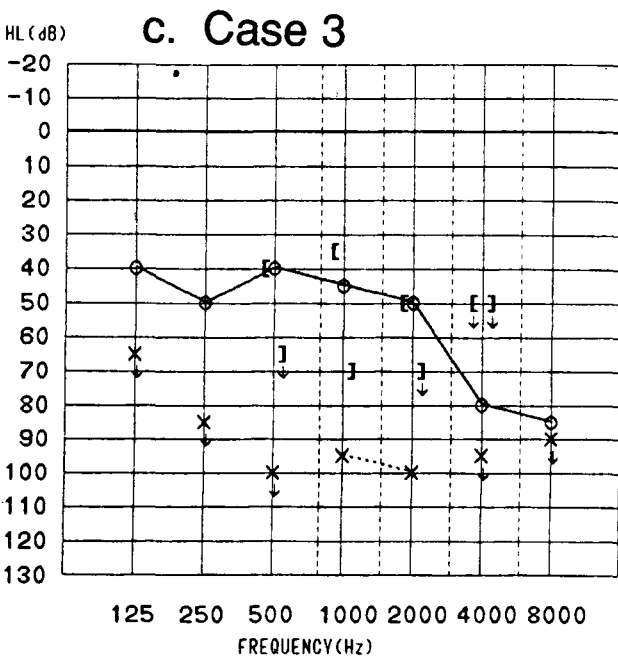
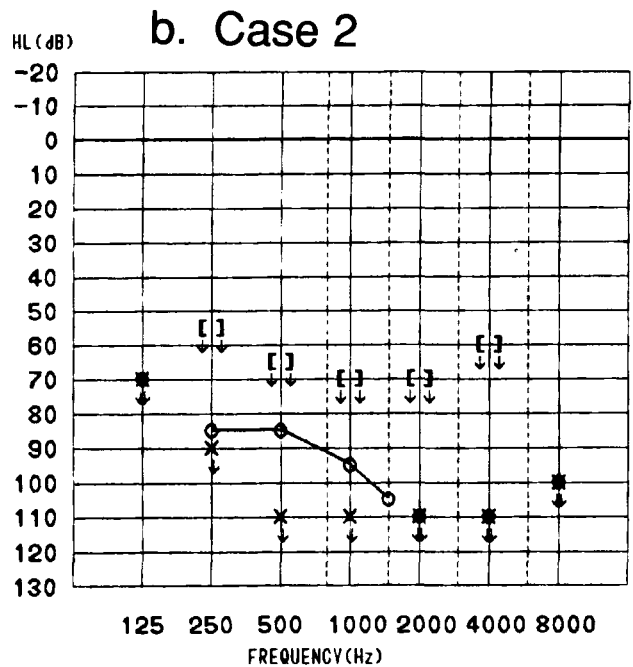
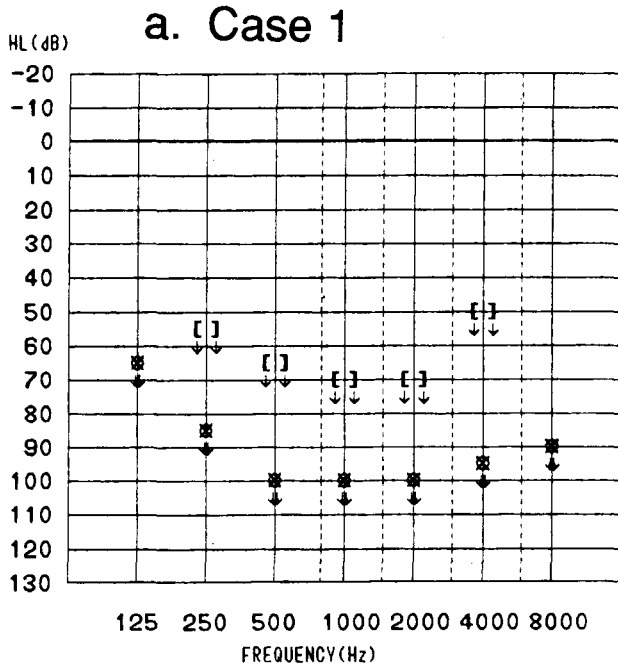


Fig. 1 a-d  
Audiogram of four cases who manifested bilateral sudden deafness.



FIG. 2  
Temporal bone pathology of *Case 1*.

#### *Temporal bone histopathological findings*

The most significant pathological finding was the massive infiltration of carcinomatous cells into the internal auditory meatus, involving the VIIth and VIIIth cranial nerves (Figure 2a). The auditory nerve was replaced by cancer cells. However, the organ of Corti, saccule and utricle were well preserved. No marked histopathological differences were found between his right and left ears. There was a small amount of blood in the scala vestibuli.

#### *Case 2*

A 64-year-old man underwent gastrectomy for treatment of Borrmann type II gastric adenocarcinoma. Eight months later, he suddenly experienced tinnitus, otalgia, hearing loss and vertigo in his left ear, and consulted an otolaryngologist. He lost his hearing ability progressively, resulting three weeks before his death, in profound bilateral hearing loss and canal paresis (Fig. 1b). Cerebrospinal fluid examination revealed dissemination of cancer cells in the subarachnoid space. Six weeks after his initial visit, he died of diffuse leptomeningeal carcinomatosis.

#### *Histopathological findings*

Temporal bone dissection was not performed on his family's request. The brain was oedematous and histopathological examination revealed diffuse invasion of the arachnoid space by signet cells (Figure 3). Metastasis to the brain parenchyma was not observed.

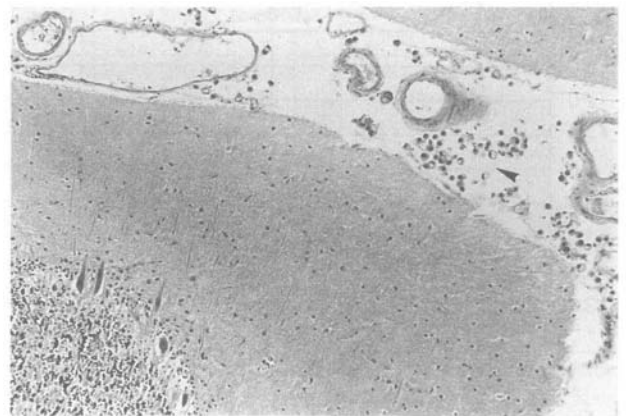


FIG. 3  
Neuropathology of cerebral cortex of *Case 2*.



*Case 3*

A 38-year-old man without any past serious illness presented suddenly with nasal bleeding and pain in his hip joint. On admission, RI scintigram revealed metastatic carcinoma of unknown origin in the left femur. His platelet count became extremely low (30,000), and he died of leukaemoid reaction three weeks later.

Thirteen days before his death, he suddenly developed severe hearing loss in the left ear, confirmed by pure tone audiometry (Figure 1c). The next day, he became completely deaf in both ears and did not recover before his death. He complained of slight vertigo, but nystagmus was not detected. No other symptoms, such as facial nerve paralysis, were observed.

Autopsy revealed the cause of the leukaemoid reaction to be bone metastases of gastric carcinoma.

*Temporal bone histopathological findings.*

Right ear: Massive bleeding was observed both in the perilymphatic and endolymphatic spaces (Figure 4). Tectorial membranes were missing in most turns. The spiral ligament and the modiolus were filled with blood. The vestibular organs were filled with blood and the otoconia were absent.

Left ear: Blood had accumulated mainly in the perilymphatic space of the cochlea. The organ of Corti, tectorial membrane and stria vascularis showed better preservation.

*Case 4*

A 46-year-old man without any particular past medical history began experiencing back pain. Three weeks later, he developed right hearing loss without vertigo over a period of 12 hours. An audiometry revealed severe sensorineural right hearing loss (Figure 1d). Four weeks later, he showed profound left hearing loss. Although he did not complain of any vestibular symptoms, horizontal nystagmus to the right was observed.

Analysis of haematological data revealed typical disseminated intravascular coagulation (DIC) syndrome. His platelet count was 32,000. He manifested haemorrhagic diathesis and died 13 days later. An autopsy confirmed the presence of gastric adenocarcinoma with metastases to the lung and to the bone marrow.

*Temporal bone histopathological findings.*

Right ear: Blood or its precipitates were found only in limited parts of the cochlear duct. Distention and collapse of Reissner's membrane and the

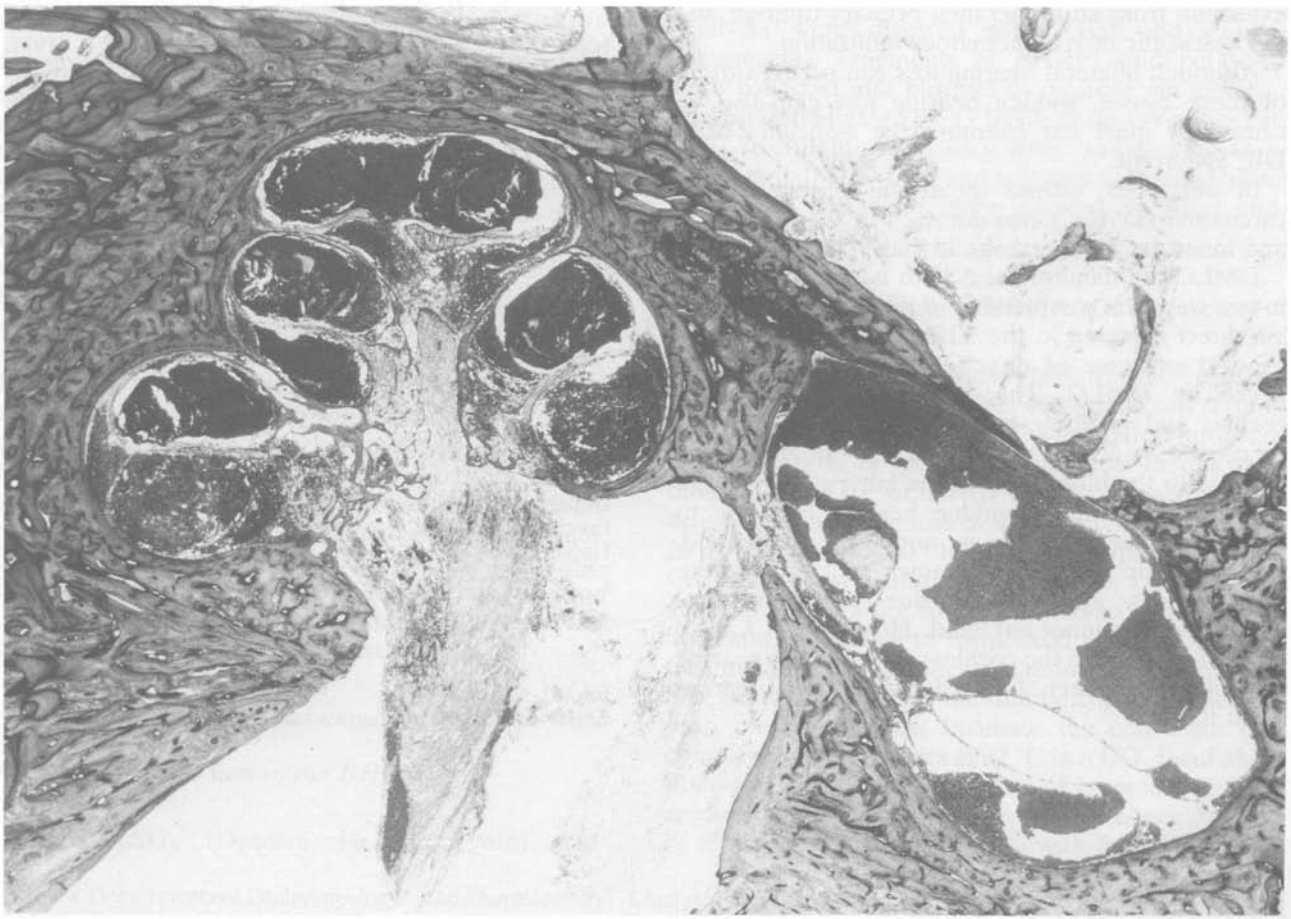


FIG. 4  
Temporal bone pathology of Case 3.

cochlear duct were noted. The organ of Corti was lost or flattened in all turns. Strial atrophy and severe loss of the spiral ganglion cells was noted. The saccule was filled with haemolysed blood.

Left ear: Blood was found in the cochlear duct of all turns, in the scala tympani of the basal turn, and in the perilymphatic spaces of the vestibule. The organ of Corti was better preserved. The stria vascularis was flattened.

## Discussion

Bilateral sudden hearing loss due to metastatic carcinoma is rare. According to Jaffe's survey (1972), among 143 cases of sudden deafness, none of 110 cases resulted from tumour metastasis (33 cases were listed as of unknown cause). Igarashi *et al.* (1979) reported a case with bilateral sudden hearing loss associated with metastatic pancreatic adenocarcinoma. Bergstrom *et al.* (1977) reported a case of bronchogenic carcinoma. To our knowledge, no case of bilateral sudden hearing loss due to metastatic gastric adenocarcinoma has been reported.

Berlinger *et al.* (1980) recognized five distinct types of temporal bone involvement in cases of metastatic carcinoma: (1) isolated metastasis from a distant primary tumour; (2) direct extension from an intracranial primary tumour; (3) direct extension from a regional primary tumour; (4) leptomeningeal extension from an intracranial primary tumour; and (5) leukaemic or lymphomatous infiltration.

Although bilateral hearing loss can occur with all of these causes, sudden hearing loss can also be caused by inner ear haemorrhage associated with DIC syndrome.

In our cases, diffuse metastatic leptomeningeal carcinoma (DMLC) was detected in *Cases 1* and *2* and inner ear haemorrhage in *Cases 3* and *4*.

DMLC can damage the VIIIth nerve and hearing in two ways, via compression of the VIIIth nerve and via direct invasion to the VIIIth nerve. Our *Case 1* showed evidence of direct invasion of the VIIIth nerve by DMLC. The relatively well-preserved cochlea and vestibule suggest that hearing loss can be caused by VIIIth nerve injury in the absence of damage to the blood flow of the labyrinth.

The mechanism of sudden hearing loss due to inner ear haemorrhage is not well understood. Perilymphatic bleeding is known to cause severe hearing loss, speculatively due to biochemical changes in the inner ear fluid. However, in *Case 4* blood was found in the cochlear duct and the hearing loss might have been due to damage to the organ of Corti itself.

Bilateral sudden deafness is not a common disease in adults. Jaffe (1972) noticed only four in his 148 sudden hearing loss cases were bilateral. However, in *Case 2*, otolaryngological problems were the only symptoms that prompted the patient to seek medical care. It took 30 days to make a final diagnosis.

## Acknowledgement

These specimens were prepared at the Department of Pathology, Teikyo University, Tokyo.

We thank Misses E. Saito, M. Baba and M. Furuya of the Department of Otolaryngology, Teikyo University for their technical assistance and H. Miyazaki of Department of Otolaryngology, University of Tokyo for typing. We should also like to thank R. Miyazawa, Division of Photo Center, University Hospital of Tokyo.

## References

- Berlinger, N. T., Koutroupas, S., Adam, G., Maisel, R. (1980) Patterns of involvement of the temporal bone in metastatic and systemic malignancy. *Laryngoscope* **90**: 619-627.
- Bergstrom, L. V., Baker, B. B., Sando, I. (1977) Sudden deafness and facial palsy from metastatic bronchogenic carcinoma. *Journal of Laryngology and Otology* **91**: 787-793.
- Cumberworth, L., Friedmann, I., Glover, G. W. (1994) Late metastasis of breast carcinoma to the external auditory meatus. *Journal of Laryngology and Otology* **108**: 808-810.
- Hill, B. A., Kohut, R. I. (1976) Metastatic adenocarcinoma of the temporal bone. *Archives of Otolaryngology* **102**: 568-571.
- Igarashi, M., Card, G. G., Johnson, P. E., Alford, B. R. (1979) Bilateral sudden hearing loss and metastatic pancreatic adenocarcinoma. *Archives of Otolaryngology* **105**: 196-200.
- Jaffe, B. F. (1972) Sudden deafness: An otologic emergency. *Archives of Otolaryngology* **86**: 697-707.
- Nelson, E. G., Hinojosa, R. (1991) Histopathology of metastatic temporal bone tumors. *Archives of Otolaryngology - Head and Neck Surgery* **117**: 189-192.
- Ohira, Y. (1993) A comparative study on otologic symptoms and pathologies of metastatic tumors of the temporal bone. *Teikyo Medical Journal* **19**: 465-480.
- Schuknecht, H. F., Allam, A. F., Murakami, Y. (1968) Pathology of secondary malignant tumors of the temporal bone. *Annals of Otology, Rhinology and Laryngology* **77**: 5-22.

Address for correspondence:

K. Kaga, M.D.,  
Department of Otolaryngology,  
Faculty of Medicine,  
University of Tokyo,  
7-3-1 Hongo, Bunkyo-ku,  
Tokyo 113,  
Japan.

Fax: 81-3-3814-9486

Email: Kimikaga-ky@umin.u-tokyo.ac.jp