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Case Report

An unprecedented case of penetrating head trauma caused by shoji (a Japanese-style paper sliding door)

Hidehiro Okura^{*}, Yuki Takaki, Kensaku Makino, Senshu Nonaka, Satoshi Tsutsumi, Hisato Ishii

Department of Neurosurgery, Juntendo Urayasu Hospital, 2-1-1 Tomioka, Urayasu-city, Chiba 279-0021, Japan

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ABSTRACT

Penetrating head trauma (PHT) includes any traumatic injury where an object pierces the skull and breaches the dural membrane surrounding the brain. PHTs are less prevalent than blunt head injuries. However, they often have more complex damage, worse prognosis, and higher rates of morbidity and mortality. An 83-year-old man fell at his home and hit his head on the right side toward a shoji (a Japanese-style paper sliding door). He reported to the emergency room the following day with his family. He had a small wound before the right ear, which was sutured in the emergency room. A CT scan demonstrated tiny pieces of bone fragments inside the brain, as well as right temporal subcortical hemorrhage and pneumocephalus. He was admitted to the hospital and received intensive prophylaxis with antibiotics. He developed life-threatening skin disease and subsequent acute kidney disease requiring hemodialysis. He fully recovered from his life-threatening condition. Here, we report an unprecedented case of a penetrating head injury of an older adult caused by a shoji.

Introduction

Penetrating head trauma (PHT) includes any traumatic injury where an object pierces the skull and breaches the dural membrane surrounding the brain. PHTs are less prevalent than blunt head injuries, and they represent approximately 0.4% of injuries; however, they often have more complex damage, worse prognosis, and higher rates of morbidity and mortality [1]. Bullets are the most common foreign bodies attributed to PHT; however, chopsticks, toothbrushes, nails, and knives have also been reported [1].

Shoji is a Japanese-style room divider consisting of translucent thin paper sheets on wooden lattice frames. It is lightweight, fragile, and usually easily broken by light impact. A broken edge of a lattice frame can pierce people after falls and cause PHT. Here, we report an unprecedented case of penetrating head trauma caused by shoji that was successfully treated, and the life-threatening comorbidities associated with intensive prophylactic antibiotics were controlled.

Case report

An 83-year-old man with hypertension fell in his home and hit his head on the right side toward a shoji (a Japanese-style paper sliding door) (Fig. 1A). The patient had a small laceration and bleeding that stopped spontaneously. He reported to the emergency

^{*} Corresponding author at: 2-1-1 Tomioka, Urayasu-city, Chiba 279-0021, Japan.
E-mail address: hokura@juntendo.ac.jp (H. Okura).

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room the following day with his family complaining of mild midline occipitalgia. He was awake and alert. He had full strength in all extremities. He did not present any other neurological manifestations. He had a small wound in front of the right ear, which was sutured in the emergency room (Fig. 1B). Computed tomography (CT) at presentation revealed tiny pieces of bone fragments inside the brain, as well as right temporal subcortical hemorrhage and pneumocephalus (Fig. 2). According to his family, the lattice frame of the shoji broke and penetrated his temple just in front of the right ear. The family lost the broken lattice frame after withdrawing it. He was admitted to the hospital for further treatment. Conservative management was initiated with intensive prophylaxis with antibiotics, including vancomycin (VCM) and ceftriaxone (CTX). He developed a skin rash seemingly caused by the antibiotics. VCM and CTX were changed to meropenem (MEPM). His skin rash significantly deteriorated. A dermatology service was also involved. He was diagnosed with acute generalized exanthematous pustulosis. MEPM had to be discontinued. However, his systemic skin rash continued to worsen. He was diagnosed with generalized pustular psoriasis (GPP) and developed a subsequent acute kidney injury. Along with steroid administration, granulocyte monocyte apheresis in combination with hemodialysis was initiated. MEPM was resumed since the GPP was considered unrelated to MEMP by the dermatology service. MEMP was continued for six weeks after the diagnosis of GPP. Periodically repeated magnetic resonance imaging (MRI) showed no evidence of abscess development during treatment (Fig. 3). He fully recovered from the life-threatening skin disease and was neurologically stable. He was transferred to a rehabilitation hospital because of disuse syndrome.

Discussion

PHT is a rare but lethal disease [1]. Foreign bodies in the brain can cause immediate complications, such as pneumocephalus, intracerebral hemorrhage, and brain contusions, which can lead to abscesses, meningitis, and encephalitis [1]. The incidence of infections, including intra- and extra-cranial infections, range from 5% to 23% [2]. In the present case, the patient pulled out a fragment of the lattice frame after the fall and threw it away. However, wooden foreign bodies are very infectious because porous organic materials provide good culture conditions for bacterial agents [3]. In addition, injection in the brain can be associated with high morbidity and mortality rates [4]. Although *Staphylococcus aureus* is the most frequently associated organism, gram-negative bacteria frequently cause intracranial infections after PHT [5]. We did not perform a culture test. Therefore, we immediately initiated broad-spectrum prophylactic intravenous antibiotics.

Cerebral abscesses have a reported incidence of 2–3%, and they are the most severe intracranial infections with a mortality rate above 50% [6]. Brain abscesses are more likely to form around retained fragments, generally developing 2–4 weeks after the initial trauma, although they may rarely develop years later [6]. While the patient no longer had a lattice frame in his brain at presentation, the potentially contaminating bony fragments were observed beneath the entry site on the initial CT scan. This may have to the development of brain abscess.

Diffusion-weighted imaging (DWI) is one of the most useful for evaluating and predicting the development of brain abscesses. DWI shows a high-intensity signal for hypoxia, edema, hemorrhage, or brain abscess. This case showed a sustained high DWI signal during

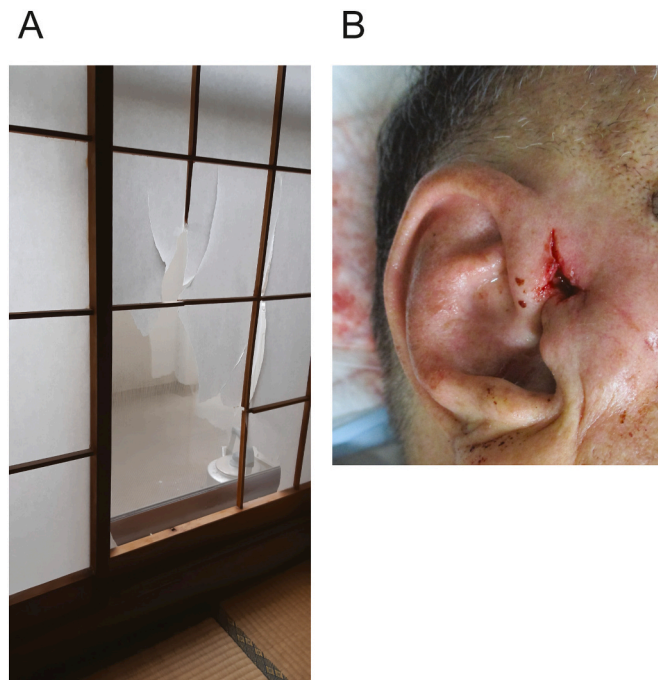


Fig. 1. (A) A broken shoji (a Japanese-style paper sliding door) missing a fragment of a lattice frame. (B) A small wound in front of the right ear.

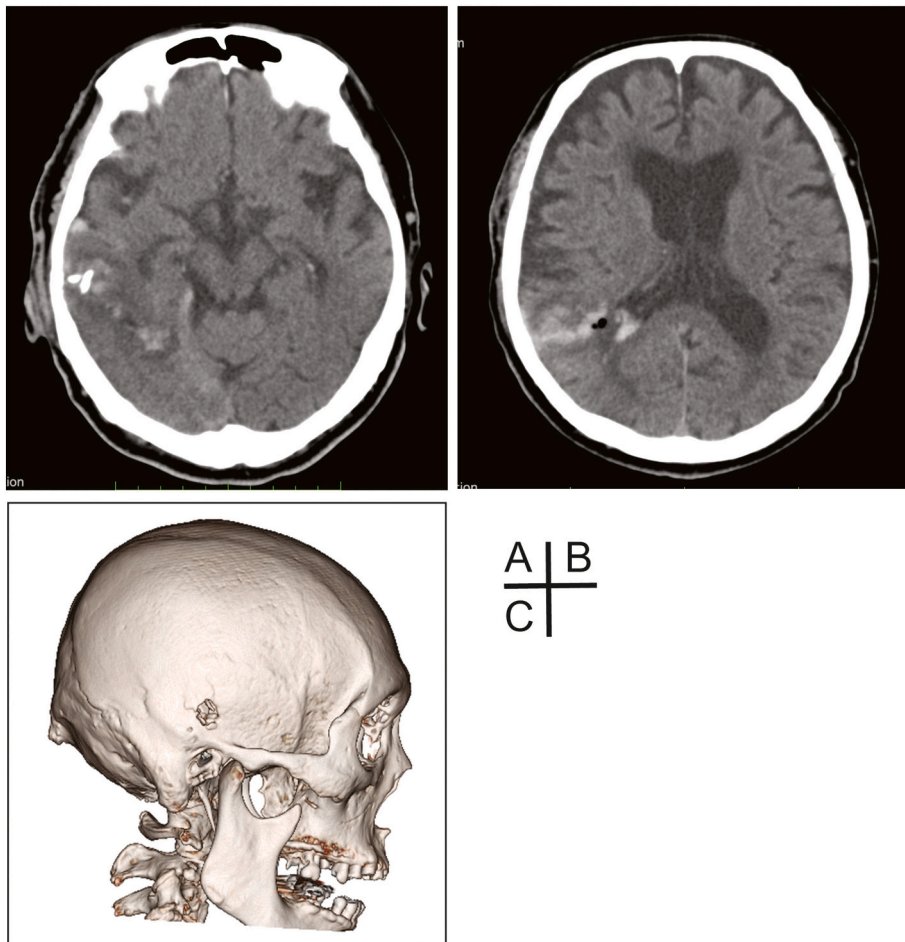


Fig. 2. (A) Head CT without contrast at presentation demonstrating tiny pieces of bone fragments inside the brain, as well as (B) right temporal subcortical hemorrhage and pneumocephalus. (C) 3D-CT bone image demonstrating penetrating bone fracture in the right temporal bone.

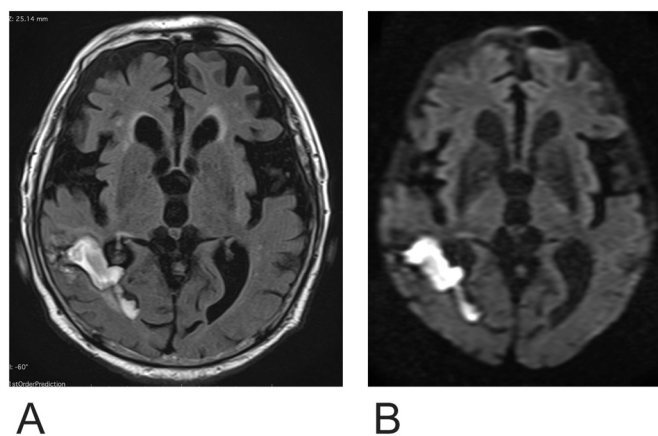


Fig. 3. Brain MRI two months after the injury. FLAIR (A) and DWI (B) showing a high-intensity signal in the right temporal lobe that remained the same during the illness.

the illness. We did not perform gadolinium (Gd)-enhanced MRI due to acute kidney failure. We needed to carefully decide on the timing of antibiotic discontinuation. There have been several previous reports on the duration of use of antibiotics in patients with PHT [7]. There is no clear consensus on the duration of the disease. Esposito and Walker recommended the use of intravenous ceftriaxone,

metronidazole, and vancomycin for a minimum of six weeks for PHT patients [8]. Kazim et al. recommended that prophylactic antibiotics should be maintained for at least 7–14 days. In this case, we temporarily interrupted the administration of antibiotics due to the skin rash. The blood tests showed continuous elevation of white blood cell (WBC) and C-reactive protein (CRP) levels. We eventually continued antibiotic treatment for six weeks after his WBC and CRP levels had returned to normal.

Several penetrating brain injuries are caused by soft and metal materials. However, we are unaware of any previous reports of PHT caused by a broken lattice frame. Older adults are likely to fall due to their wobbling gaits or feelings of faintness. Adults with PHT who are 50 or more years have higher mortality risks [5]. Older adults also generally have functional deterioration, including declines in gait and balance, increased fall risks, and loss of independence [9]. Age-related physiological changes affect drug pharmacokinetics and pharmacodynamics, meaning that older adults are sensitive to various medications [10].

This case serves as a reminder that supposedly trivial brain injuries caused by a fragile lattice frame can be complicated by life-threatening systemic reactions caused by intensive antibiotic therapy. Given the rapidly aging society, the number of older adults with wobbling gait has been on the rise. Care needs to be exercised, especially for older adults, to prevent this type of PHT.

Declaration of competing interest

All authors report no conflict of interest.

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