Brain Abscess Following Transorbital Penetrating Injury Due to Bamboo Fragments
—Case Report—

Jun MARUYA, Kiyoshi YAMAMOTO, Mikiko WAKAI*, and Uichi KANEKO**

Departments of Neurosurgery and *Ophthalmology, Niigata Prefectural Koide Hospital, Niigata; **Department of Neurosurgery, Omiya Red Cross Hospital, Saitama

Abstract

A 56-year-old female presented with transorbital penetrating injury caused by bamboo fragments, which resulted in brain abscess 2 weeks after the injury. Initial computed tomography (CT) of the head did not reveal the foreign bodies. However, follow-up CT demonstrated a well-defined hyperdense abnormality of 1.0 cm length in the left orbit and brain abscess in the left temporal lobe. The lesion corresponding to the hyperdense abnormality on CT appeared isointense on T1-weighted magnetic resonance (MR) imaging and hypointense on T2-weighted MR imaging. The bamboo fragments were surgically removed, and aspiration and continuous drainage were performed for the brain abscess. The postoperative course was uneventful and the patient was transferred to a local hospital with minor neurological deficits. Bamboo foreign bodies may show changes in properties on CT and MR imaging in the subacute stage. Careful radiological examination and follow-up monitoring are required for the correct diagnosis and treatment of such injuries.

Key words: abscess, penetrating injury, bamboo, computed tomography, magnetic resonance imaging

Introduction

Transorbital penetrating injury is relatively uncommon, but the diagnosis is straightforward when the presence of the foreign body fragment in the wound can be confirmed. However, penetrating wounds in the periorbital region may appear superficial and minor at first glance. Such injuries carry a significant risk of associated intracranial penetration because of the unique shape and thin bony roof of the orbit. Injury may be initially asymptomatic, but serious events can occur several days, months, or even years after the injury. Wooden or bamboo foreign bodies located in the orbitocranial region are difficult to detect because such objects are not always recognizable on roentgenograms. We describe a case of misdiagnosis of transorbital penetrating injury due to bamboo foreign bodies because of the unusual neuroimaging appearance at the time of injury, followed by the development of brain abscess 2 weeks after the injury. Intraorbital wooden foreign bodies are usually hypodense on computed tomography (CT) and hypointense on both T1- and T2-weighted magnetic resonance (MR) imaging, but the bamboo foreign fragments appeared as hyperdense on CT, isointense on T1-weighted MR imaging, and hypointense on T2-weighted MR imaging in the subacute stage in this case.

Case Report

A 56-year-old female tumbled into a bamboo grove while hiking in the mountains. She was transported to our hospital by helicopter and ambulance. Her eyelid was remarkably swollen and a small laceration was recognized at the lower eyelid. Her gross examination was normal. She was drowsy but her pupils were isocoric and reacted normally to light. Her motor function was normal. OphthalmoLOGICAL examination showed the eyeball and visual acuity were normal, but ocular movements were disturbed.
Laboratory studies revealed no findings of inflammation. Initial CT revealed fractures extending from the orbit to the temporal bone. Cerebral contusion and free bone fragments were recognized in the temporal lobe (Fig. 1A). Free air and hemorrhage were present in the left lateral ventricle (Fig. 1B). However, no bamboo foreign bodies could be identified in the orbit. Intravenous antibiotic therapy was initiated. Her consciousness became gradually clearer. Laboratory studies revealed a white blood cell count of 12,800/ml and elevation of the C-reactive protein level to 10.1 mg/dl on Day 3, but both of them decreased within normal range on Day 5.

MR imaging with gadolinium administration, performed on Day 9, revealed ring-like enhancement in the temporal lobe. However, CT, performed on the same day, showed only brain edema with no ring-like enhancement, which suggested cerebritis. Her consciousness was clear and neurological examination revealed no abnormal findings except diplopia. Laboratory studies could not detect any findings of inflammation on Day 12. No clinical symptoms or signs of meningitis such as stiff neck were recognized. Intravenous antibiotic therapy was continued with close observation. Follow-up CT, performed on Day 13, showed ring-like enhancement around free bone fragments obviously located in the temporal lobe, which suggested brain abscess (Fig. 2). Orbital CT was performed to confirm the relationship between the orbit and the brain abscess, which also clearly demonstrated a well-defined hyperdense abnormality of 1.0 cm length in the orbit (Fig. 3A) not detected by previous CT. Retrospective evaluation of the MR images found that the corresponding lesion appeared as isointense on $T_1$-weighted MR imaging (Fig. 3B) and hypointense on $T_2$-weighted MR imaging (Fig. 3C). Cerebral angiography revealed no abnormalities.

Removal of the free bone fragments in the temporal lobe was thought to carry a high risk for neurological deficits such as sensory aphasia. Simultaneous stereotactic surgery for the brain abscess and transcranial approach for the orbit were planned at first. However, this was thought to be difficult, because the instruments for stereotactic surgery might obstruct the craniotomy. Therefore, only the trans-
cranial approach was chosen under the diagnosis of a foreign body in the orbit, and we planned to attempt the stereotactic surgery later. Left frontotemporal craniotomy and orbitozygomatic osteotomy was performed on Day 13. The lateral wall of the orbit was drilled away with a diamond burr. Purulent discharge was found around the superior orbital fissure and evacuated. The bamboo foreign fragments were also found there and carefully removed to avoid injury to the cranial nerves (Fig. 4). A dural tear in the temporal lobe was recognized and repaired with a muscle piece.

After the operation, more intensive intravenous antibiotic therapy and closer observation were started. Postoperative CT performed on Day 16 showed increases in the ring-like enhancement and brain edema. Finally, abscess aspiration and continuous drainage were performed by stereotactic surgery on Day 17, and the abscess was irrigated via a drainage tube with antibiotic solution for 3 days. Microbial cultural examination did not show any bacterial growth.

The postoperative course was uneventful. Follow-up CT revealed disappearance of the ring-like enhancement and decreased brain edema. Antibiotics were administered for 5 weeks totally. The patient was transferred to a local hospital with only slight limitation of lateral gaze in her left eye.

**Discussion**

The orbit is shaped like a horizontal pyramid and its bony structure is very thin, especially in young children, so transorbital penetrating injury usually occurs in young children. Penetration of the object parallel to the orbital roof will enter the cranial cavity commonly via the superior orbital fissure or the optic canal, which provides direct access without bone fracture. Penetration in this direction will cause critical intracranial complications such as carotid-cavernous fistula or brain stem injury. Penetration of the object upward and across the orbital roof, which consists of thin bone and therefore offers little resistance, will easily damage the frontal lobe and result in intracerebral hematoma. This type of penetration is the most frequent transorbital penetrating injury. In our case, we speculate that a bamboo stick on the ground punctured the orbit and penetrated the temporal lobe when she tumbled into the bamboo grove, and then the bamboo stick was removed but bamboo fragments were retained in the orbit.

Immediate complications of transorbital penetrating injury include intracerebral hematoma, cerebral contusion, intraventricular hemorrhage, pneumocephalus, brain stem injury, and cerebrovascular injuries. High indexes of suspicion are essential to correctly identify and treat transorbital penetrating injury based on these findings. In our case, initial CT showed cerebral contusion, intraventricular hemorrhage, and pneumocephalus. Intracranial infections often develop in the chronic stage following transorbital penetrating injury. Wood is especially dangerous since it is porous, often grossly contaminated, easily fragmented, and provides a good medium for microbial agents. Organisms present on the wood, or skin bacteria contamination during the impact, may be transported intracranially. Therefore, a retained wooden or bamboo body in the orbit and cranium may cause severe infectious complications days to years after the initial injury. Brain abscess, which is the most frequent complication and the main cause of death, occurred in 50% of intracranial injuries following periorbital wound and 71% of cerebral injuries caused by a pencil. The mortality is 25%. Early radical debridement and removal of the retained foreign fragments are mandatory to prevent infectious complications. Antibiotic therapy is recommended, even if the signs of intracranial involvement are absent, and should be directed against Staphylococcus aureus and ubiquitous organisms such as the Bacillus and Clostridium species. Retained bone fragments after head injury may also cause infectious complications. Therefore, close clinical observation and radiological examination are very important, as in our case, since there were retained bone fragments in the temporal lobe and the possibility of retained bamboo fragments could not be excluded.

CT can detect intraorbital wooden or bamboo foreign bodies. Wooden orbital foreign bodies in the acute stage appear hypodense to orbital fat whereas intraorbital bamboo foreign bodies are isodense with orbital fat, and were initially mis-
interpreted as air bubbles in some cases.\textsuperscript{17)} Intraorbital wooden foreign bodies become isodense or hyperdense to soft tissue in the chronic stage.\textsuperscript{13)} An experimental study showed that serial CT findings were variable because wood absorbs water.\textsuperscript{7)} Dry wood may become wet wood within a few days because of the inflammatory process.\textsuperscript{17)} Therefore, it is not surprising that the bamboo foreign fragments in our case appeared hyperdense on CT performed on Day 13. Wooden bodies appear hypointense on both $T_1$- and $T_2$-weighted MR imaging in the acute stage\textsuperscript{8)} and isointense on $T_1$-weighted MR imaging and hypointense on $T_2$-weighted imaging in the chronic stage, suggesting that the fragment contained a lot of water.\textsuperscript{9)} The findings for the bamboo fragments in our case were similar.

The present case indicates that the CT and MR imaging properties of wooden or bamboo foreign bodies can change in vivo in both the chronic stage and the subacute stage. Extensive radiological examination and follow-up monitoring are particularly important to determine the exact location of wooden or bamboo foreign bodies in patients with transorbital penetrating injury.

References


Address reprint requests to: J. Maruya, M.D., Department of Neurosurgery, Akita Red Cross Hospital, 222-1 Nawashiroawa, Saruta, Kamikitate, Akita 010–1406, Japan.
e-mail: jmaruya@bri.niigata-u.ac.jp.