Radiological findings of penetrating injuries of the face and brain

Poster No.: C-0208
Congress: ECR 2011
Type: Educational Exhibit
Authors: K. Tsuchiya, M. Imai, H. Tateishi, A. Ohara, Y. Watanabe, M. Kokan, T. Nitatori; Tokyo/JP
Keywords: Trauma, Technical aspects, MR, CT, Neuroradiology brain, Head and neck, Emergency
DOI: 10.1594/ecr2011/C-0208

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

(1) To learn the spectrum of radiological findings of penetrating injuries of the face and brain.

(2) To know how to make a choice of imaging modalities and that of image reconstruction method.

Background

Penetrating injuries of the brain are caused by foreign bodies that enter into and lodge within the cranial vault. To be exact, they are differentiated from perforating injuries that have both entrance and exit wounds to the cranial vault. In this presentation, we discuss both types of injury as penetrating injuries.

During a period of last about six years, our university hospital, which is a tertiary emergency medicine center in the western part of Tokyo, experienced more than 15 patients with various penetrating injuries of the brain as well as those of the face examined by CT and/or MR imaging. Based on the experience, we present imaging findings of major types of such injuries.

Imaging findings OR Procedure details

(1) Penetration of a wooden material to the orbit:

As the wooden penetrating material to the orbit, sticks, pencils, and chopsticks (especially in Asian countries) are popular. A dry wooden material is depicted on plain CT showing the attenuation value of air in the acute phase (1, 2) (Fig. 1 on page 3) As the material absorbs water, its attenuation value increases accordingly. Multiplanar reconstruction (MPR) MDCT images and MR images obtained in an appropriate section angle are of great value to demonstrate the relation between intraorbital structures, especially the optic nerve, and the penetrating object (Fig. 2 on page 4) CT plays a great role in assessing associated orbital fracture, while MR imaging is of value for demonstrating secondary changes within the orbit that include edema, inflammation and bleeding. In addition, MR imaging may depict the wooden material when it is not well discriminated from surrounding structures on CT (3, 4).

(2) Penetration of a small metallic material to the orbit or brain:
A small metallic material can enter the orbit or the cranial vault under miscellaneous circumstances. Such a material is usually detected on radiographs and well shown on CT showing hyperdensity (Fig. 3 on page 5). CT scans can visualize changes in adjacent structures as well. However, they may be degraded due to artifacts in the case of a rather large metallic object. Although secondary changes of the optic nerve or brain are efficiently demonstrated on MR imaging, it should be kept in mind that ferromagnetic foreign bodies can cause iatrogenic injuries to adjacent structures (5).

(3) Penetration of a long metallic/wooden material to the brain:

As an object that penetrates to the brain, we have experienced an umbrella tip, a wood stick, a kitchen knife, and a drill. In patients with such an injury, CT is a modality of choice in the acute phase to evaluate lesions developed in the cranial vault. Again, MR imaging including diffusion-weighted scan sensitively demonstrates secondary lesions that include contusion, ischemia and inflammation (Fig. 4 on page 6). As vascular injury, a penetrating foreign body causes direct rupture and occlusion. In some cases, arterial dissection or carotid-cavernous fistula can develop. When there is evidence of possible vascular injury on CT or MR imaging, MR angiography or CT angiography is indicated (Fig. 5 on page 7). Conventional angiography may be required before removal of a penetrated object to assess its relationship with major vessels (Fig. 6 on page 8). Outcome usually depends on the type and degree of vascular injury. In one of our patients who had a penetrating injury to the temporal lobe caused by a high-speed rotating drill, a large subdural hematoma and possible infarct in the middle cerebral artery territory developed resulting in fatal outcome (Fig. 7 on page 9).

(4) Gunshot to the brain:

Although some minor injuries are classified as "superficial" or "tangential", most cases are related to crimes and serious. The spectrum of potential traumatic lesions and pathophysiologic sequels are essentially the same as those encountered in other closed head injury (6). In perforating injury, however, it characteristically has both entrance and exit wounds (Fig. 8 on page 9). CT usually yields sufficient information. But, it may be degraded by metallic streak artifacts. MR imaging plays a role similar to other conditions as stated above. Its value, however, is limited in cases of ferromagnetic bullets.

Images for this section:
**Fig. 1:** Orbital injury by a tip of a chopstick. (A) CT shows the material as a mass of air density (arrow). (B and C) Photographs show the small material (B) and a set of chopsticks (C). One of them lost its apical portion (circle in C).
**Fig. 2:** Orbital injury by a stick. (A) Photograph shows two tree branches sticking in the face. An inferior one is penetrating into the orbit. (B) MDCT image reconstructed in the oblique sagittal plane well demonstrates the relation between the stick showing the air attenuation and the optic nerve. An apical portion of the stick is lodged anterior to the superior orbital fissure. (C) Oblique T2-weighted MR image also shows the stick. (D) Coronal T2-weighted MR image also shows the stick (arrow) and surrounding swollen soft tissue that displace the optic nerve superomedially.
Fig. 3: Fig. 3. Orbital injury by a small metallic foreign body. (A and B) Axial and coronal CT scans show a hyperdense metallic fragment just lodged laterally to the eyeball (arrow, A and B) and surrounding soft tissue swelling containing air.
Fig. 4: Transorbital injury by an umbrella tip. (A) CT obtained after removal of the umbrella shows a lesion of mixed density in the base of the right frontal lobe (arrows). (B) T2*-weighted MR image shows hypointensity of deoxyhemoglobin representing hemorrhage (arrows). (C) Oblique FLAIR image shows a hyperintense lesion of edema extending from the frontal base to the basal ganglia (arrows).
**Fig. 5:** Injury to the middle cerebral artery by penetration of a wood stick. (A) CT shows a hematoma in the temporal lobe possibly from the injured middle cerebral artery (MCA). (B) Diffusion-weighted MR image after removal of the hematoma shows fresh infarct in the MCA territory (arrows). (C) Time-of-flight MR angiogram poorly shows branches of the MCA. (D) Mean transit time map of MR perfusion study shows hypoperfusion (elongated transit time) in the MCA area (arrows).
Fig. 6: Penetration in the temporal region by a kitchen knife. (A) Reformatted MDCT image shows the penetration by a kitchen knife. (B) Angiogram obtained before removal of the knife shows the spared MCA branches and the distance between the MCA trunk and the tip of the knife. CT and MR images after removal of the knife (not shown) demonstrated no cerebral contusion but an epidural hematoma.

Fig. 7: Penetration in the temporal region by a rotating drill. (A) CT shows a hematoma caused by drill penetration and subdural hematoma. (B) CT of a higher level shows extension of the subdural hematoma and marked swelling of the right hemisphere.
**Fig. 8:** Fig. 8. Gunshot injury developed by suicide firing in the mouth. (A) CT shows diffuse brain swelling, subarachnoid hemorrhage and pneumocephalus. (B and C) Bone-window CT scans show the entrance (B, arrows) and the exit (C, arrow) of the bullet.
Conclusion

In these situations, it is required to promptly select an appropriate modality. It is also imperative to apply an effective scanning technique or sequence as well as an image postprocessing method.

Personal Information

Kazuhiro Tsuchiya, M.D. is an associated professor of the Department of Radiology at Kyorin University Faculty of Medicine, Mitaka, Tokyo, Japan.

If you are interested in this presentation, send correspondence to

tsuchiyak-kyr@umin.ac.jp

References


