Successful Removal of Intracranial Air-Gun Bullet With Stereotaxic Apparatus

Case Report

KENICHIRO SUGITA, M.D., TERUSHIGE DOI, M.D., OSAMU SATO, M.D., YOSHIRO TAKAOKA, M.D., NAOMI MUTSUGA, M.D., AND RYUICHI TSUGANE, M.D.

Neurosurgical Division, Department of Surgery, Nagoya University, School of Medicine, Tsurumai, Showa, Nagoya, Japan

THERE have been many reports concerning the surgical treatment of an intracranial foreign body. Since the usual method of craniotomy cannot avoid some cerebral damage, deeply lodged, minimal, or asymptomatic foreign bodies have frequently been left untouched. Recently we successfully removed an intracranial air-gun bullet using a stereotaxic method through a small burr hole, without any complication.

Case Report

On December 8, 1967, a 1-year-old girl accidentally received an air-gun bullet in the back of her head from a distance of 2 meters. Plain skull x-ray films revealed a bullet deep in the left cerebral hemisphere. Three hours later, irritability, headache, vomiting, and a right-sided Jacksonian seizure appeared. The seizure was followed by loss of consciousness and progressive right hemiparesis. Anticonvulsant therapy and antibiotics were intensively administered. The impaired consciousness disappeared gradually within 1 week, and the right hemiparesis improved so that she could walk 1 month after the accident. She was admitted to our hospital on February 2, 1968.

Examination. Neurological check-up revealed traces of right hemiparesis. A tiny scar was found on the occipital area 15 mm from the midline to the left and 40 mm above the inion. Plain skull x-ray film revealed some small bone fragments in the occipital area and a deeply lodged bullet. The cerebrospinal fluid (CSF) was clear, and routine laboratory examinations showed no abnormality. The electroencephalogram, left carotid arteriogram, and pneumoencephalogram showed no pathological findings (Figs. 1 and 2). Films in the various head positions revealed that the bullet could move approximately 5 mm in all directions; the range and location were drawn on the atlas of Schaltenbrand-Bailey (Fig. 3).

Operation. On March 1, 1968, an operation was carried out using stereotaxic apparatus under general anesthesia. The patient's head was fixed, and anteroposterior and lateral x-ray pictures were taken to calculate the position of the bullet stereotaxically. A tracheal forceps modified for this purpose was inserted through a frontal burr hole close to the bullet while anteroposterior and lateral x-ray pictures were taken to verify its proximity (Fig. 4). Then, under continuous observation of the image intensifier in the lateral projection, the forceps was advanced with its tip open. Although further advancement of the forceps pushed the bullet about 5 mm in the direction of forceps insertion, the bullet could be clamped and successfully removed (Fig. 5).

Before the procedure of clamping with the forceps, we tried to suck up the bullet with a metallic tube, 4 mm in diameter, inserted toward the bullet stereotaxically. Its tip was covered with a rubber tube so as to fit snugly around the bullet. The bullet was attached to the tip of the tube with negative pressure of 50 mm Hg, and then the tube was gently pulled out. The bullet could be dragged approximately 10 mm; then it detached and snapped back to the previous position. The negative pressure 50 mm Hg delivered to the tube was sufficient to suck up a mass of 30 gm weight in a preliminary trial. During the procedure neither brain tissue nor pus was sucked out. We assume the attempted suction produced no extra damage.
to the brain because the subsequent route of insertion for the forceps was the same as that for the suction tube.

Postoperative Course. The postoperative course was uneventful. Antibiotic and anti-convulsant therapy was continued for 1 week. Two weeks after the operation the patient was discharged from the hospital. By then the right hemiparesis had almost cleared except for minimal right-sided facial paresis. A visual field examination was of course impossible because of her age. The evoked potential of photic stimulation on the EEG was observed symmetrically in both occipital areas. Four weeks postoperatively the patient was completely normal.

Comment

The treatment of penetrating cranial wounds was highly developed during World War II. A relatively large fresh intracranial foreign body is usually removed by craniotomy, with complete debridement of wounded brain tissue. It is generally agreed that the surgical removal of small or asymptomatic intracranial foreign bodies should
only be attempted in easily accessible areas. Conversely, deeply lodged foreign bodies are generally left untouched.

Papers reporting the late sequelae of retained intracranial foreign bodies are summarized below.

**Abscess Formation.** Brain abscesses due to penetrating cranial wounds usually occur within 3 to 5 weeks, with an incidence of 13% to 16%. Some authors reported a higher incidence of abscess formation in those cases with a retained foreign body and bone fragments than in those without them. The late development of an abscess around a retained foreign body has been reported from 2 to 30 years later.

**Epilepsy.** Usually epilepsy occurs secondary to abscess or cyst formation. Ascroft reported a high incidence of epilepsy (38%) among those with retained metallic fragments. Maltby denied the relation between an intracranial foreign body and epilepsy. Wedler observed 14 cases of epilepsy (23%) in 60 cases of retained shell fragments in the basal ganglia.

**Migration of the Bullet.** Jefferson reported a case of spontaneous movement of a bullet in the cerebrum, which he concluded was due to softening and abscess formation in the surrounding structure. Wood also observed a movable foreign body in 4 of 40 cases, while still others described an intraventricular migration of the foreign body.

**Tumor Development.** Two cases of tumor developing after foreign body penetration have been reported.

To avoid these complications a maximal effort should be made to remove the intracranial foreign bodies. In our case the preoperative neurological deficit was minimal; the bullet was seated deep in the left cerebral hemisphere near the optic tract, the basal ganglia, and the internal capsule. Application of the usual surgical procedure could not have avoided the risk of damaging these important structures. Therefore, we used the stereotaxic apparatus to minimize injury to the critical structures and were able to remove the bullet successfully with minimal damage to the brain tissue, namely, that caused by the track of the forceps carrying the bullet. Mundinger reported a case in which a bullet lodged intracranially was removed by the combined techniques of craniotomy and stereotaxy.

Since it is not under direct vision, a stereotaxic operation is disadvantageous in the event of hemorrhage from a vessel inadvertently clamped by the forceps when grasping the bullet. Carotid arteriography could be
Fig. 4. X-ray pictures during stereotaxic operation.

Fig. 5. Our stereotaxic apparatus, tip of the forceps, and the air-gun bullet.
used to determine whether there was any sizeable vessel around the bullet, and to select the needle track. To avoid vascular injury by forceps, sucking the bullet with a tube was attempted but failed, probably because of the firm membranous structure or gliosis around the bullet. Application of a magnet was impractical in this case because the air-gun bullet was made of pure lead. Pneumoencephalography is also helpful in identifying the location of a bullet, especially in terms of its relation to the ventricular system. Thus, it becomes possible to prevent the erroneous penetration of forceps into the ventricle, inducing fatal ventricular infection if there is abscess formation around the bullet.

**Summary**

We have described the successful removal of an intracranial air-gun bullet from the brain of a 1-year-old baby, using a stereotaxic apparatus aided by angiography and pneumoencephalography. The operative and postoperative courses were uneventful. The advantages and disadvantages of the stereotaxic method for this purpose have been discussed.

**References**