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The Early Prognosis of Craniocerebral Gunshot Wounds in Civilian Practice as an Aid to the Choice of Treatment

A Series of 56 Cases Studied by the Computerized Tomography

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Summary

The authors report a series of 56 cases of craniocerebral lesions secondary to missile injuries studied by means of CT scan. CT scans demonstrate the track of the missile, destruction of deep cerebral parenchyma, dissection of the white matter (intracerebral air) and reactive oedema. The prognostic incidence of CT is discussed. The CT scan helps to choose the best therapeutic management with respect to each particular case.

Keywords: CT scan; gunshot wounds; head injury.

Introduction

A lot of clinical or experimental work concerning craniocerebral gunshot wounds has been reported both in military and civilian practices[2–8]. The fundamental difference between military and civilian craniocerebral injury is related to the high velocity of the military missile compared with the low velocity in civilian injuries. The civilian missile, contrary to the military one, is relatively benign when embedded in the cerebral parenchyma. This fact is apparently due to the very limited area of perimissile tissue disruption[7]. The different studies tried to define the essential prognostic factors (age, time interval prior to admission to a neurosurgical centre, clinical condition on admission, type of projectile, distance of shooting, etc.) and the policy of emergent treatment.

The purpose of this study is to examine the craniocerebral injuries from relatively low velocity missiles by CT scan, which allows rapid visualization of the entire brain, can help us determine the nature of intracranial lesions precisely, and can roughly assess the prognosis of the patient. It is also particularly invaluable for the rational planning of therapeutic management.

Clinical Material

This report reviews a series of 56 cases which were admitted to the Neurosurgical Service at la Pitié (Pr. B. Pertuiset) with penetrating craniocerebral gunshot wounds from March 1, 1978 to August 31, 1983. All of the 56 cases were admitted to our Coma Intensive Care Unit within 6 hours after injury, and all of them have received an emergent CT scan investigation whatever time of the day or night. Patients with just scalp injury or linear skull fractures were excluded.

The overall average age was 35.3 years; the youngest, 5 months old, and the oldest 78 years. Sex incidence showed a male predominence with a ratio of 47:9. Two cases had associated intra-abdominal injury.

From the information available, an attempt was made to determine the circumstances surrounding the injury (Table 1). Most of our cases were suicide attempts and occurred in urban regions. The missile type and size are shown in Table 2. In evaluating the severity of injury at the time of admission, we divided the patients in this series into 4 grades (Table 3). Ophthalmological symptoms and signs caused by damage of orbital structures (no other neurological signs noted) were not encountered.

The patterns of skull fractures were examined to determine the direction of the missile, point of entry and exit from the brain, and whether the missile remained in the head. In the suicide group, the right temporal entrance sites were most common with 23, the face with 8. In 25 cases, the bullet remained intracranially without an exit orifice. In our series, neither entrance nor exit sites were found in the posterior fossa.

The plain skull films (AP and Lateral) demonstrated bone damage at the entrance and exit sites, intraparenchymal bone chips, presence of intracranial air and "ricochet phenomenon" when the bullet struck the inner table of the cranium or dural structures like the falx or tentorium and made the bullet take a curved course before lodging.

CT Scan Findings

All of these 56 cases received emergency CT scan examinations. Their findings are listed in Table 4. It allows rapid visualization of the entire head, the location and size of any intracranial lesions which include:

Cutaneous and subcutaneous lesions (subgaleal haematoma, bone debris).

Bone damage (especially at the entrance and exit sites).

The presence of intracranial air (pneumocephalus).

The presence of a traumatic subarachnoid haemorrhage demonstrated by a thin layer of high density area around the cerebral hemisphere.

The presence of subdural and/or epidural haematomas.

Damaging of ventricular system with the presence of intraventricular air and/or blood.

Table 1. *Relation Between Type of Accidents and Mortality*

Type of accident	Number	Died	% Mortality
Suicide	35	17	49%
Accident	6	2	33%
Assault	15	11	73%

Table 2. *Relation Between Missile Size and Mortality*

Type of weapons	Number	Died	% Mortality
Caliber 38	1	1	100%
Caliber 22	19	6	32%
Caliber 9	3	2	67%
Caliber 6.35	3	1	33%
Hunting rifle	6	5	83%

Table 3. *Clinical Classification on Admission*

Grade I: alert, no neurological deficit.
Grade II: drowsy, with or without a neurological deficit.
Grade III: coma, with or without localizing signs.
Grade IV: coma, with brain stem clinical impairment.

The missile track was outlined by a band or triangular zone containing high and low density areas corresponding to haemorrhage, surrounding oedema, air bubbles, bone chips and debris from projectiles.

The presence of subsequent surgical lesions, such as extensive intracerebral haematoma and/or localized brain contusion with a mass effect, causing ipsilateral ventricular compression and/or midline shifting.

The presence of deeply located diencephalic and mesencephalic lesions (this enables us to make reasonable prognostic predictions).

CT scan also showed us lesions of the skull base, air sinus and lesions of major vessels such as a carotid-cavernous fistula etc. Of course when a vascular injury is suspected clinically, angiography is necessary.

Results

Factors Determining Mortality

The overall mortality in this series was 53.6%.

The relationship between mortality and the type of accident and the type of weapons are shown in Tables 1 and 2. It is evident that the most important prognostic factor, which is the extent of injury to vital structures, is reflected by the clinical condition of the patient on admission. The relationship between clinical condition and mortality is shown in Table 5.

A very significant factor is the course and extent of the missile track. As cited by Lillard[6], single lobe injuries did much better than those cases where the missile crossed either the mid-sagittal or the mid-coronal plane, with the highest mortality when both planes were crossed (Table 6).

The severity of the patient's condition are closely related to the 4 major mechanism below:

The destruction of diencephalo-mesencephalic vital centres by the missile itself.

Diffuse hyperemic, oedematous reaction of the whole brain parenchyma causing acute intracranial hypertension.

Localized lesion (contusion, haematoma) associated with surrounding oedema causing secondary brain stem compression (uncal, tonsillar herniations).

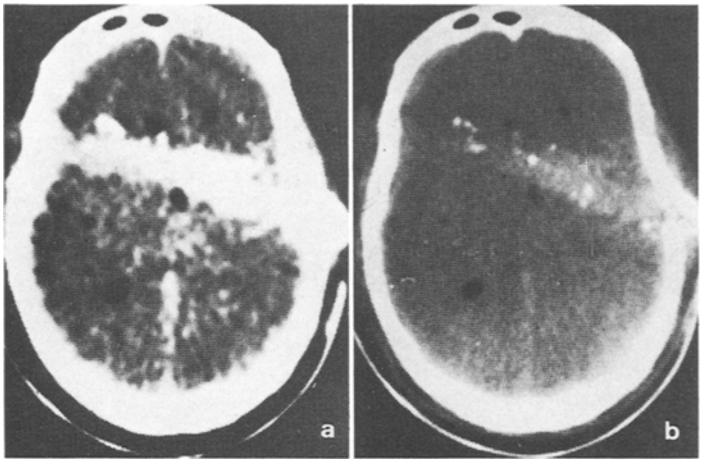
Major vessel's injury causing massive haemorrhage.

The CT scan is useful for identifying all intracranial lesions and particularly for demonstrating a localized expansive lesion, which is the only condition to be considered as a surgical candidate.

The CT scan can demonstrate an early oedematous reaction, localized or generalized with the image of the ventricular size and shape and CT signs of herniation (obliteration of basal cisterns and deformity of the brain stem). The oedematous change is usually found around the area of parenchymatous damage, however it could also reflect the "shock phenomenon" of the brain when it was penetrated by the missile.

We also found the presence of "small air bubbles" dissecting into white matter at some distance away from the missile track in 7 cases. It was usually associated with severe brain swelling, and was a sign of a very poor prognosis.

The CT scan showed deeply located lesions that usually were overlooked in the angiographic study: haemorrhage of the basal ganglia, hypothalamus or mesencephalus; which also gave us slight prognostic possibilities.



Figs. 1 a, b. CT scan of a suicide patient, who sustained a through and through bihemispheric gunshot wound. A band shaped intracerebral haematoma outlines the missile track. By utilizing bone windows (b) bone chips and metallic debris are identified along the missile track. Intracerebral air bubbles are also demonstrated

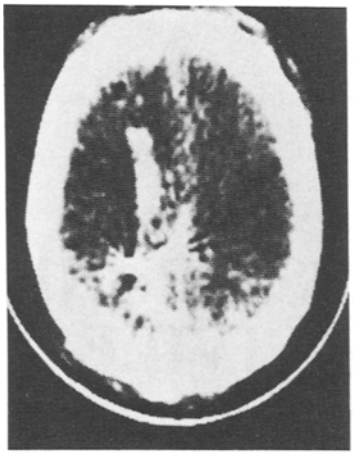


Fig. 2

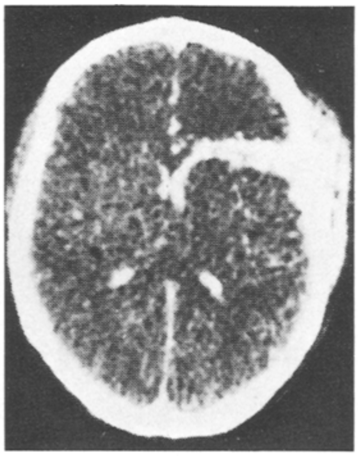


Fig. 3

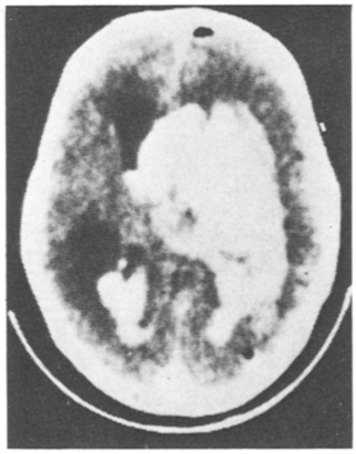


Fig. 4

Fig. 2. A CT scan showing a band shaped intracerebral haematoma extended postero-anteriorly. Lots of metallic debris is shown in the right posterior parietal region

Fig. 3. A CT scan demonstrating a left frontal subgaleal haematoma, a thin layer of subdural haematoma, a transverse band shaped intracerebral haematoma, subarachnoid haemorrhage (interhemispheric fissure), intraventricular haemorrhage and intraparenchymal pneumocephalus

Fig. 4. A CT scan showing an extensive deeply located intracerebral haematoma with rupture into the lateral ventricles

The Choice of a Treatment

When the patients' conditions were evaluated and the CT scan examinations were performed, we classified the patients into the following categories:

If patients are admitted with a decerebrate or flaccid status, we believe that they are not surgical candidates. Conservative management only is advised.

When the CT scan shows an expansive lesion (haematoma, contusion), decompressive surgery is performed as early as possible before clinical deterioration occurs.

In other cases, we avoid "exploratory surgery", which is quite unsatisfactory. A restrictive surgical approach is suggested. The operation itself consists of debridement of entrance and exit sites. Traumatized fascia, muscle and pericranium are excised. In most of the cases the dural defect needs a graft; material for a dural graft is readily available from the immediate operative area, such as pericranium, temporalis fascia, etc. We agree with Lillard[6] that a large cortical incision for exploration must be avoided and no attempt is made to retrieve missile fragments unless they are easily accessible.

Intracranial pressure monitoring and continuous external ventricular drainage are routinely used in grades III and IV cases.

Table 4. *CT Findings*

1.	Band shaped intracerebral haematoma (missile track)	
	a) crossed mid-sagittal plane	24/56
	b) crossed mid-coronal plane	5/57
	c) one lobe	15/56
2.	Extensive intracerebral haematoma	13/56
3.	Extensive extracerebral haematoma	7/56
4.	Significant subarachnoid haemorrhage	33/56
5.	Intraventricular haemorrhage	27/56
6.	Pneumocephalus	
	a) extracerebral	36/56
	b) intracerebral	24/56
	along the missile track	17/56
	dissected into white matter	7/56
	c) pneumoventricles	3/56
7.	Significant ventricular dilatation (due to intraventricular haemorrhage or infratentorial lesions)	8/56
8.	Diffuse cerebral oedema	21/56
9.	Cerebral ischaemic lesion	2/56
	Carotid-carvernous fistula	2/56
10.	Intraorbital lesion	8/56

Table 5. *Relation Between Clinical Condition and Mortality*

Clinical condition on admission	Number	Died	% Mortality
Grade I	15	2	13%
Grade II	11	3	27%
Grade III	14	9	64%
Grade IV	16	16	100%

Conclusion

From this series it can be concluded that the comparison of the CT images with the clinical condition of the patient enables us to precisely decide very early after the shooting which management is the best to consider. At the same time, this comparison is a very efficient approach to the late prognosis.

Table 6. *Relation Between Missile Track and Mortality*

Course of the missile track	Number	Died	% Mortality
One lobe	15	3	20%
Crossed mid-sagittal	24	12	50%
Crossed mid-coronal	5	4	80%
Crossed both planes	12	11	92%

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