Intracranial complications of transorbital stab wounds

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The most comprehensive series dealing with the intracranial complications of transorbital stab wounds is that of Birch-Hirschfeld (1930), who collected 169 cases from the literature and added three of his own. Smaller series have also been described (McLure and Gardner, 1949; Schneider and Henderson, 1952; Kjer, 1954; Bulluck, Baker, and Henderson, 1959; Unger and Umbach, 1962; Bard and Jarrett, 1964).

The present series of ten cases appears to be the largest individual series so far described.

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Clinical findings

No patients below the age of 20 years were encountered. Six of the ten patients were stabbed with a knife (Fig. 1) or a wire. One was stabbed with a sharpened stick, and the only female in this series was stabbed with a pointed pencil. In one case the object used by the assailant was not known but was probably a knife.

The left side was involved more frequently than the right side (6:4) possibly because the assailants were right-handed.

In six patients the eye was damaged, and in four of these the intraocular contents were grossly disorganized; three of the four died.

FIG. 1 Case 5. Transorbital stab showing blade of knife in situ. Venous phase carotid angiogram

Meningitis developed in three patients and seemed to be related to the period of delay before treatment was instituted.

Of the ten transorbital stab wounds, five were associated with injury to the carotid artery. Carotid cavernous fistula and a false aneurysm of the internal carotid each occurred twice. In one of these five patients who died, there was damage to the cavernous sinus; the track of the stabbing wire extended to the occipital lobe.

A clinical analysis of these cases is given in Tables I and II.

Discussion

From the cases recorded in the literature, it would seem that transorbital stab wounds causing intracranial complications occur more frequently in children than in adults, and more often in boys than in girls (Prideaux, 1882; Verbiest, 1954). This is probably due to the more violent type of games played by boys (Bulluck and others, 1959). Our series included no patients below the age of 20 years.

Table I Ocular complications

Case no.	Age (yrs)	Sex	Side	Instrument	Injury to globe	Visual loss
1	?	M	R	Wire	Yes	No
2	31	M	L	Knife	No	No
3	?	M	R	Stick	Yes	No
4	40	M	L	Knife	Yes	Yes
5	20	M	L	Knife <i>in situ</i>	Yes	Yes
6	30	M	R	Knife	Yes	No
7	30	M	L	Knife	No	Slight
8	25	M	L	Knife	Yes	Yes
9	23	M	R	Knife	No	Yes
10	25	F	L	Pencil <i>in situ</i>	No	No

The orbit is pyramidal in shape with a quadrangular base situated at the orbital margin. A fine-pointed instrument entering the orbit at low velocity, will tend to be directed by the converging walls towards

Table II Intracranial complications

Case no.	Delay before admission	Clinical state	Infection	Vascular injury	Result
1	Hours	Coma	o	Internal carotid artery occlusion in cavernous sinus	Died
2	2 days	Restless stupor	Meningitis	o	Completely recovered
3	Hours	Coma	o	o	Died
4	3 days	Stupor	Meningitis	o	Recovered Visual deficit
5	Hours	Right hemiplegia	o	False carotid aneurysm (intraclinoid)	Recovered Visual loss Hemiparesis
6	?	Coma	o	o	Died
7	2 years	Satisfactory	o	Carotid cavernous fistula	Completely recovered
8	Hours	(?)	o	Carotid cavernous fistula	Recovered Left eye blind
9	2 weeks	Akinetic mute	Meningitis	False aneurysm of supraclinoid carotid artery	Clinically unchanged
10	Hours	Ptosis and impaired ocular movement	o	o	Fully recovered (Extradural position of pencil)

FIG. 2 Case 8. Left carotid arteriogram (lateral view, subtraction technique), showing carotid cavernous fistula

FIG. 3 Case 8. Antero-posterior view of same arteriogram, showing bilateral filling of cavernous sinuses in arterial phase

the apex where it is most likely to damage the optic nerve, ocular nerves, and the extraocular muscles. In addition, the instrument may extend beyond the orbit and damage the carotid artery and/or the cavernous sinus (Figs 2 and 3).

The walls of the orbit, however, are thin and if the penetrating object moves with some velocity and is directed at right-angles to the wall, the latter may be penetrated. In a similar manner the superior orbital fissure may be entered, and the temporal lobe may be damaged.

An object directed vertically upwards may pierce the roof of the orbit and cause frontal lobe damage. This injury seems to occur particularly in children who fall on sharp objects carried in the hand.

The lateral wall of the orbit forms an angle of about 45° with the sagittal plane. Penetrating objects, if driven with sufficient force, follow the direction of this wall and may cross the midline, damaging structures on the opposite side, viz. the contralateral optic nerve, carotid artery, cavernous sinus, and frontal or temporal lobes. These features were exemplified in this series by Case 9. Similar cases have been described by McLure and Gardner (1949) and Gossman (1967).

The entrance wound may be apparently trivial (Fig. 4) and superficial (Guthkelch, 1960), or it may be situated in the fornix of the conjunctiva and therefore not be apparent (Colley, 1934; Copper, 1957). In addition, chemosis or subconjunctival haemorrhage may mask the entrance wound.

FIG 4 Case 2. Apparently insignificant wound of left upper lid with penetration of orbital roof and subsequent meningitis

It has been suggested (Verbiest, 1954) that the globe often escapes injury if a slender-pointed instrument is used. This is true of low-velocity stabs. In these circumstances the eyeball can move into the space afforded by the copious orbital fatty tissue which surrounds the eye. If a large knife is used, however, the eye is frequently damaged. The globe

was damaged in six of our patients and completely destroyed in four of them.

Marked proptosis may be caused by intra orbital haemorrhage, and a foreign body retained in the orbit (Colley, 1934) may cause prolonged suppuration (Neudörfer, 1949).

Penetration of the orbital walls results in damage to the paranasal sinuses, thus causing emphysema of the orbit, cerebrospinal fluid fistulae, orbital cellulitis, meningitis, cerebral abscess (Verbiest, 1954) or pneumocephalus (Bard, 1963).

Infection is particularly common in transorbital wounds, certainly more so than in stab wounds of the head at other sites. Three of our ten patients developed meningitis. The infection is due to contaminated penetrating objects or communication with the paranasal sinuses.

Patients injured by fragments of wood may develop tetanus; this is perhaps because many of these accidents occur in agricultural environments where there is a high risk of contamination with *Clostridium tetani*. Gas gangrene can also occur (Kjer, 1954).

Cerebral complications of transorbital stab wounds include ventricular damage, pneumocephalus, and subdural, subarachnoid, intracerebral, and intraventricular haemorrhage. Damage to the cavernous sinus has been described (Birch-Hirschfeld, 1930), and carotid cavernous fistulae may result (Wolff and Schmidt, 1939; McLure and Gardner, 1949; Schneider and Henderson, 1952; Walsh and Hoyt, 1969). Traumatic aneurysm of the anterior choroidal artery (Cressman and Hayes, 1966) and of the carotid artery (Bulluck and others, 1959; Goald and Ronderos, 1961) have also been reported.

In this series, carotid-cavernous fistulae occurred in two patients, internal carotid occlusion in the cavernous sinus in one, a false infraclinoid carotid aneurysm in one, and a false supraclinoid carotid aneurysm in one.

Radiology of orbital stab wounds

The standard radiological views are taken as a routine. Where, however, there is suspicion of a transorbital stab wound, these views may not demonstrate orbital fractures (Kjer, 1954). Special efforts should be made to demonstrate the orbital roof (Copper, 1957), the optic canal, and the orbital fissure.

Pneumocephalus indicates the presence of intracranial penetration or communication between brain and paranasal sinus.

Detailed radiology is essential before intracranial exploration is carried out. Repeated arteriography may be necessary to demonstrate a false aneurysm or carotid cavernous fistula. Kjer (1954) found ventriculography more useful than arteriography, but this has not been our experience.

In this series it was found that in patients who have

been stabbed in the orbit, with suspicion of intracranial damage, carotid angiography was mandatory and was more useful than ventriculography.

Management of transorbital stabs

Because of the complexity of these wounds, their treatment in certain circumstances is best accomplished by a team, comprising a neurosurgeon, ophthalmologist, otolaryngologist, and plastic surgeon.

Copper (1957) and Verbiest (1954) advised immediate exploration for intracranial complications after transorbital stab wounds.

We feel that this view should be modified for knife wounds. Within 8 hours of the accident, the knife, if it has not been extricated, should be removed under radiological control and in a neurosurgical theatre, where everything is in readiness to deal with a major vascular injury. If there is no vascular injury, antibiotics should be given as a precaution. None of this series of patients developed late infection, even when initially pneumocephalus was demonstrated. If there is evidence of compression associated with a retrogressive neurological state, arteriography is carried out to demonstrate an intracerebral haematoma. The dural defect and fracture of the orbit are dealt with at operation after the clot has been evacuated.

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With stab wounds of the orbit produced by sticks and pencils, a preliminary exploration may be made by the ophthalmologist from the orbital aspect. If there is evidence that the wall of the orbit has been perforated, immediate craniotomy appropriately sited should be performed. Foreign bodies, devitalized tissue, and bony fragments can thus be removed.

Injury to the carotid artery is dealt with according to the site and nature of the lesion present.

In this series, in the two patients with carotid cavernous fistula, the internal carotid artery was clipped intracranially, the fistula was embolized with muscle and the cervical internal carotid artery was ligated. Both the false aneurysms were trapped, the infraclinoid one between an intracranial clip and a ligature on the cervical internal carotid artery, and the other intracranially.

The absence of a true aneurysmal sac makes direct clipping impossible.

Summary

Ocular and orbital injuries due to stab wounds may mask underlying serious intracranial damage.

The correct clinical assessment and treatment of such cases require the attention of a team comprising a neurosurgeon, ophthalmologist, otolaryngologist, and plastic surgeon.