It is likely that similar problems of high malnutrition case fatality rates due to inappropriate clinical management exist in other South African hospitals, particularly at district level. It is therefore recommended that a similar process be undertaken in other provinces and regions.

None of the children was tested for HIV. Treatment in such cases remains essentially the same, although the outcomes are different. However, as the experience in Hlabisa has shown,[4] the HIV epidemic can have an important impact on outcomes for these children. The evaluation of the further impact of this intervention will have to take into account the rising number of HIV-positive children in this area.

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CRANIOCEREBRAL GUNSHOT INJURIES IN SOUTH AFRICA — A SUGGESTED MANAGEMENT STRATEGY

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Objective. To determine the outcome of craniocerebral gunshot injuries, analyse factors that affect prognosis and suggest a management protocol.

Design. A retrospective analysis of civilian craniocerebral gunshot injuries treated over a 7-year period.

Setting. Groote Schuur Hospital's neurosurgery and trauma unit service.

Patients. One hundred and eighty-one patients with craniocerebral gunshot injuries were admitted to the Department of Neurosurgery, Groote Schuur Hospital, University of Cape Town, over a 7-year period and a retrospective analysis of these patient records with regard to outcome and prognostic factors was carried out.

Results. Seventy-six patients sustained non-penetrating injuries, 8 (11%) of whom had underlying cerebral injury on computed tomography (CT) scan. The prognosis was good in the case of non-penetrating injuries. One hundred and five patients sustained penetrating injuries and 57% (62) had a poor outcome. A Glasgow Coma Score (GCS) of 5 or less following resuscitation was associated with a 98% mortality rate. CT scan evidence of transventricular injury was associated with 100% mortality, bihemispheric injury with 90% mortality, and diffuse cerebral swelling with 81% mortality.

Conclusion. Patients with non-penetrating craniocerebral gunshot injuries should all undergo a CT scan as 10% will have cerebral injury. The prognosis is normally good. In penetrating craniocerebral gunshot injuries a GCS of 5 or less, or a GCS of 8 or less with CT scan findings of transventricular or bihemispheric injury have such a poor outcome that conservative treatment is indicated.

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Craniocerebral gunshot wounds have been a prominent feature of conflict situations in the 20th century; consequently much of our understanding and management of these injuries has been learned from patients treated in these circumstances. Treatment of missile injuries has also improved with the general progress in medicine. During World War II the use of antibiotics benefited patients with bullet or shrapnel injuries of the brain.[1,2] In Korea and Vietnam survival was further improved with rapid evacuation and resuscitation as well as aggressive surgical treatment, although morbidity still remained very high.[3-6] The war in Lebanon and the conflict in Iran and Iraq witnessed a generally more conservative surgical approach, with little change in mortality but improvement in neurological sequelae.[7]

More recently, studies of civilian craniocerebral gunshot wounds have highlighted the difference in the nature of the ballistics of military and civilian handguns, and the effect this has on outcome.

In South Africa there has been an increasing number of gunshot injuries. The cost of the medical care of these severely injured patients is extremely high, and a rational approach to management therefore needs to be developed. The purpose of this study was to analyse factors important in the outcome and management of craniocerebral gunshot injuries in South Africa.

MATERIALS AND METHODS

A total of 181 victims of cranial gunshot injuries were admitted to the Department of Neurosurgery, Groote Schuur Hospital, Cape Town, over a 7-year period (1986 - 1992). The admission rate increased during the years of the study, with 52 patients being admitted in 1992.

All patients were initially resuscitated in the trauma unit; once clinically stable they were sent for computed tomography (CT) scan. Surgical treatment included debridement of the entrance and exit wound, craniectomy and removal of depressed bone fragments where it was thought that this would not cause further injury to the brain, debridement of necrotic brain and evacuation of significant intracranial haematoma followed by repair of the dura. Postoperative management of the patients was in the intensive care unit (ICU), with ventilation where necessary. All patients were placed on antibiotic therapy (cloxacillin, ceftriaxone and metronidazole) and an anticonvulsant. Routine monitoring of electrolytes and arterial blood gases was performed in all patients. We did not, however, routinely insert intracranial pressure monitors.

The patients were divided into two groups, namely those with penetrating and those with non-penetrating injury, and the results were analysed retrospectively in an attempt to determine the effect of the level of consciousness and CT scan findings on outcome. The outcome was assessed using the Glasgow Outcome Score (GOS). Surviving patients were followed up for an average of 7.2 months.

RESULTS

The victims were predominantly young males, with 155 males and 25 females admitted to the study. The median age of this group of patients was 19 years (Fig. 1). The most common cause of injury was assault (117), followed by police action (33). Suicide accounted for 18 injuries, and 13 injuries were accidental.

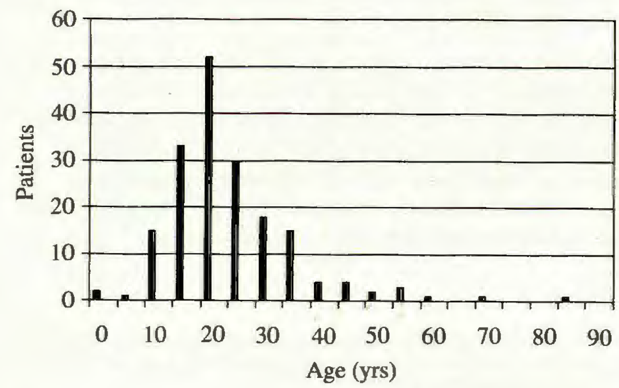

Fig. 1. Age distribution of patients with gunshot injuries treated at Groote Schuur Hospital.

Non-penetrating injury

Seventy-six patients sustained a non-penetrating injury (41%). Shotgun pellets caused 35 of these injuries, while 10 were inflicted by low-velocity and 6 by high-velocity handguns. The nature of the gun was unknown in 25 cases.

All patients with non-penetrating gunshot injuries underwent CT scanning, and significant intracranial injury was demonstrated in 11% of patients (8 cases). Five patients had intracerebral haematomas or contusions (Fig. 2), 2 had subdural haematomas and 1 patient had diffuse cerebral swelling.

Using the GOS to assess the outcome of patients who sustained a non-penetrating craniocerebral gunshot wound revealed that 93% (71) had normal neurological function, 5% (4) had residual minor neurological deficits and 1% (1) had a major neurological deficit. No patient with a non-penetrating injury died or was left in a persistent vegetative state.

Penetrating injury

Penetrating craniocerebral gunshot injuries occurred in 105 patients (59%). The weapon was unknown in the majority of cases (56). High-velocity handguns were used in 24 injuries, low-velocity handguns in 10, rifles in 2 and shotguns in 13.

Fig. 2. A cerebral contusion beneath a tangential non-penetrating gunshot injury.

Outcome

Using the GOS to assess the outcome of patients who sustained a penetrating injury revealed a mortality rate of 52% (55), while 7% of patients (7) were either in a vegetative state or had a major neurological disability. Twenty-nine per cent of patients (31) had a minor neurological deficit and 12% (12) were normal neurologically. If a poor outcome is deemed to include those patients who died, who were left in a vegetative state or who had a major neurological defect, then 57% of patients had a poor outcome and 43% a good outcome following a penetrating craniocerebral gunshot injury.

Outcome/Glasgow Coma Score

The Glasgow Coma Score (GCS) following resuscitation on admission was then compared with the outcome in terms of survival (Table I). Patients who had a GCS of 3 - 5 following resuscitation had a 98% mortality rate. Those with a GCS of 6 - 10 had a mortality rate of 31%, while only 8% of patients with a GCS of 11 - 15 died.

Table I. Outcome of patients who sustained craniocerebral gunshot injuries related to the initial GCS after resuscitation

GCS	Mortality (%)
3 - 5	98
6 - 10	31
11 - 15	8

GCS = Glasgow Coma Score.

Outcome/CT scan findings

The initial CT scan findings were compared with the survival rates of the patients (Table II). Transventricular injury was associated with non-survival in 100% of cases (Fig. 3), while bi-hemispheric injury that did not obviously involve the ventricles had a mortality rate of 90%. Diffuse cerebral swelling associated with the gunshot injury resulted in death in 81% of patients.

Table II. Outcome of patients with penetrating craniocerebral gunshot injuries related to the CT scan

CT scan findings	Mortality (%)
Bilateral hemispheric injury	99
Transventricular injury	100
Generalised swelling	81

CT = computed tomography.

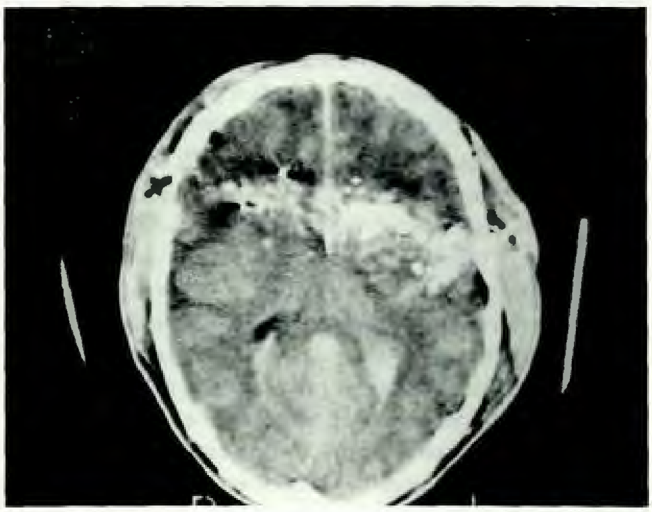

Fig. 3. Example of a fatal bihemispheric transventricular gunshot injury.

DISCUSSION

Military experience with high-velocity gunshot injuries has been well documented, mainly during the major conflicts of this century.[1,2,4-9] Experience relating to civilian gunshot injuries has been more recent, with most of the experience gathered over the last 30 years.[10-18] The majority of civilian gunshot injuries are caused by low-velocity handguns. It has been contended that civilian gunshot head injuries differ from military injuries because of the calibre of weapons involved, the shorter interval between time of injury and arrival at a neurological centre, and the better facilities available at a trauma centre.[10] While many of the principles in the surgical management of the wounds obtained in the military studies have been retained or modified, attempts have been made to identify prognostic factors and how they may be used to guide management.

The level of consciousness as measured by the GCS has uniformly been found to aid in predicting outcome.[6,11,12,14,18,19] The GCS assesses the amount and severity of cerebral damage, and it is logical that the more severe the tissue destruction, the poorer the outcome. However, what is not always clear in some reports is when the GCS was assessed. If the GCS is taken before resuscitation, then other factors such as hypoxia, hypotension and hypothermia may alter the GCS and this may result in a poorer outcome expected for the patient. Consequently, we feel that only following full resuscitation should the GCS be used for prognostic purposes. Several authors have developed their own scales for gunshot injuries,[13,20] but the lack of uniformity makes it difficult to compare patients between series; the GCS is therefore the most accurate measure. Clark *et al.*[11] found that patients with a GCS of 3 invariably died, and Grahm *et al.*[12] similarly suggested that patients with a GCS of 3 - 5 following resuscitation and in whom no intracranial haematoma could be demonstrated should be managed conservatively as the outcome was very poor. In our series none of the patients with a GCS of 5 or below survived, irrespective of the findings on the CT scan.

Radiological findings with the advent of CT scanning have been found to be of prognostic importance in cases of craniocerebral gunshot injury.[21] The findings on CT scan that are thought to be most significant have been reviewed by several authors. Kennedy *et al.*[15] found that the mortality from multilobe injuries was 5 times that for single-lobe injury in patients admitted with a GCS of 5 - 13. Grahm *et al.*[12] found that patients with ventricular penetration, even in unilateral hemispheric injury, had a very poor outcome (90% mortality), with all the survivors neurologically devastated. Bihemispheric injury has also been found to be associated with very poor survival and outcome,[11,14] particularly when associated with scattering of bone and metal fragments away from the tract.[18] Intracranial haematomas associated with gunshot head injuries tend to occur in the first 8 hours post injury,[13] and while haematomas are felt to affect patient outcome adversely,[11,13] surgical drainage is mandatory.[11-13] In our series, patients with transventricular injury had a 100% mortality rate, bihemispheric injury 90% and diffuse cerebral swelling 81%, irrespective of the GCS. All patients with a GCS of 8 or less and these radiological findings on CT scan died.

Low-calibre firearms are typically the weapons associated with civilian craniocerebral gunshot injuries as opposed to military injuries. Therefore, in a study done on civilian injuries it is not possible to draw any conclusions based on calibre of the missile.[15] Kirkpatrick and DiMaio,[16] in their study of the pathology of civilian gunshot injuries, concluded that the damage created by a low-velocity missile is not directly related to the calibre of the firearm, different size tracts being created by the same calibre weapons. The variation in size of the tracts was thought to be related to the yaw of the deformed missile and secondary bone and bullet fragments. Military weapons of high velocity, however, probably do create more extensive cerebral injury. A point of importance is that many of the modern civilian handguns are now high velocity and in South Africa there is an abundance of military firearms in civilian hands.

Gunshot victims are uniformly young and therefore it is difficult to draw any conclusions as to the effect of age on outcome.[15,22] In patients with brain extrusion there is no difference in survival if the GCS is taken into account.[15]

Tangential craniocerebral gunshot injuries may be defined as those where the projectile does not penetrate the cranium. The injury may include a scalp laceration, linear skull fracture or a gutter fracture with depressed bone fragments and underlying brain injury.[23] In our series 11% of the patients had underlying intracranial injury, which included cerebral haematomas and contusions, subdural haematomas and cerebral swelling. We feel that CT scan is mandatory in these cases. All these patients in our series had a good outcome.

CONCLUSION

Craniocerebral gunshot injuries are a relatively common cause of admission to accident units in South Africa. In an environment where resources are limited it is important to identify those patients who will benefit from therapy, and those cases where injury is so severe that meaningful survival is not possible. It makes sense to utilise the available resources in treating the patients who are likely to have a good outcome.

In non-penetrating cranial gunshot injury CT scans should be performed on all patients, as 11% of these victims will have a surgically treatable lesion. Their outcome is good.

In patients with penetrating craniocerebral gunshot injuries we propose the following guidelines:

1. All patients should be resuscitated on admission, including intubation and ventilation if necessary, after which a CT scan should be performed. A decision on management can then be made on the basis of the post-resuscitation GCS and CT scan findings.

2. Patients with a GCS of 5 or less have a poor outcome, with no survival in our series. Those patients with a GCS of 8 or less, with CT scan evidence of bilateral hemisphere injury, transventricular injury and diffuse cerebral swelling, also have a poor outcome, with the majority of the patients dying and the survivors being left in a vegetative state. Treatment of these patients should involve simple debridement and suture of the wound and no further active treatment.

3. Patients with a GCS of > 5 following resuscitation may have a good outcome (except the group with a GCS of 6 - 8 with adverse radiological features). They should be treated more vigorously, both surgically with craniectomy and by

removal of accessible bone and bullet fragments, debridement of non-viable necrotic brain tissue and dural repair. Adjuvant antibiotics and anticonvulsants should be given and ventilation should be performed where necessary.

4. Patients who have large space-occupying extra-axial haematomas should be treated with surgical drainage and medical supportive treatment.

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INTOXICATION, CRIMINAL OFFENCES AND SUICIDE ATTEMPTS IN A GROUP OF SOUTH AFRICAN PROBLEM DRINKERS

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Background. Incidence rates of crime and alcohol abuse in South Africa are unacceptably high. Research suggests a relationship between alcohol and both crime and suicide. This study aims to add to the information base on this topic in South Africa.

Methods. This is a cross-sectional record study of criminal offences and suicide attempts in 269 admissions to an alcohol rehabilitation unit in the Western Cape. Types of criminal offences and suicide attempts are described. Relationships are sought between crime, violent crime and suicide attempts on the one hand, and demographic and alcohol-related variables on the other.

Results. One hundred and four subjects (39%) had criminal convictions, the majority of which were committed while the subjects were intoxicated. The commonest alcohol-related crimes were driving-related (17% of subjects) and crimes of violence (15%). Male gender, younger age at initiation of drinking, and earlier onset of problem drinking were significantly associated with criminal behaviour. Violent crime was associated with earlier onset of initial, regular and problem drinking, and maternal alcohol abuse. Suicide attempts (24% of subjects) were associated with female gender, white racial group, not being in a marital relationship, younger current age and early age of problem drinking.

Conclusions. There was an association between intoxication and both violent crime and suicide attempts. The importance of population studies and the need for intervention programmes aimed at teenagers who are drinking, are emphasised.

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