COMPLICATIONS related to knife wounds to the cranium fall into two main groups, vascular and infective. Vascular injury may present acutely with intracranial hemorrhage (ICH) or may be delayed if a false aneurysm has developed.\(^7,8\) Two types of stabs result in a higher incidence of complications: transorbital stab wounds and injuries in which the blade passes through a mucosal surface before entering the cranium.\(^1,3,11\) Transorbital stab wounds have a high incidence of both vascular and infective complications and injuries that have breached the mucosal surface have a higher incidence of infection.

Our experience with these injuries has led us to believe that patients with retained knife blades in the cranium at the time of assessment may also have a higher incidence of complications than those patients in whom the knife has already been extracted by the assailant or someone other than medical personnel (Fig. 1).

**Clinical Material and Methods**

Sixty-six patients who presented to the Groote Schuur Hospital with a transcranial knife wound during the 2-year period between September 1994 and September 1996 were studied. Entry criteria included either a knife blade in situ or a history of a cranial knife stab plus one of the following: demonstration of a slot fracture on skull x-ray films; or pneumocranium, subarachnoid hemorrhage, or a transcerebral track seen on computerized tomography (CT) scans. The complications experienced by patients with retained knife blades (Group A) and those without (Group B), were analyzed. All patients were clinically assessed and resuscitated on admission. Radiological studies included skull x-ray films in all but two and CT scans in all patients. Immediate cerebral angiography (within 6 hours) was performed in four patients when a major vascular injury was suspected, and delayed cerebral angiograms were obtained in 25 patients.

After application of local anesthetic, uncomplicated stab wounds were treated by scalp debridement and closure. Antibiotic drugs were not administered routinely. Management of Group A was not standardized, with the knife pulled out in a number of patients and others undergoing a craniectomy prior to knife removal. Patients were observed for complications from the time of admission until they were discharged home, either from our acute care ward or the rehabilitation unit. The period of admission ranged from 2 to 54 days, with a mean of 14 days. The incidence of complications in the two groups was analyzed using the chi-square test.

**Results**

**Group A**

Thirteen of the 66 patients presented with a retained knife blade at the time of admission and of these all 13 presented within 24 hours. Eight of the 13 patients developed a major complication related to their stab injury. All eight of these patients had an ICH: six at the time of pre-
sentation and two after knife blade removal. Seven of the eight patients underwent surgical removal of their hematomas, but one who had a deep inaccessible lesion did not undergo surgery (Fig. 2). Of the patients with an ICH, four had vascular injuries visible on angiograms and only one patient developed a brain abscess. Three patients died, all of whom had an admission Glasgow Coma Scale (GCS) score of 15. Details of the complications, mortality, site and depth of the stab, and the patient’s GCS score on admission are summarized in Table 1.

**Group B**

Fifty-three patients presented with evidence of a stab wound after the knife had been removed by the assailant. The majority presented within 48 hours, but in six patients there was a delay of up to 4 weeks. Eighteen of 53 patients developed a major complication related to the stab wound.

**Infective Complications**

Seven of these 18 patients developed intracranial infection. Three of the seven with infective complications had a knife track that passed through a mucosal surface.

**Vascular Complications**

Eleven of the 18 patients with serious sequelae in Group B developed vascular complications. Six had significant ICH seen on admission CT scans and required surgical treatment, although only five lesions were evacuated (two subdural, one extradural, and three intracerebral hematomas). One of the patients with ICH exhibited a false aneurysm on angiographic studies. Of two patients who had a vascular injury that was confirmed on angiography, one had a carotid occlusion and the other a traumatic false aneurysm. Three patients were presumed to have had a vascular injury because massive subarachnoid hemorrhage was seen on CT scanning, but they died before angiography could be performed. Of the 11 patients with vascular complications in Group B, only two had penetration of the petrous bone or orbit. Four patients in Group B died; of these, three had presented with GCS scores of less than 7 and one with a GCS score of 13.

Comparison of the complications occurring in the two groups shows an increase in intracerebral hematomas and other vascular injuries in the retained blade group (p < 0.01, chi-square test); eight of 13 in Group A compared with 11 of 53 in Group B.

**Discussion**

**High-Risk Stab Wounds**

**Orbital and Mucosal.** The complications occurring after transcranial and transorbital stab wounds treated at our...
Vascular injury occurred in approximately 30% of patients and the overall mortality rate was 17%. Orbital stabs have the worst prognosis, with a mortality rate of up to 30% and serious morbidity related to optic nerve injury, vascular injury, or infection. Vascular injuries occur in up to 50% of patients with orbital stab wounds. 

Knife wounds passing through an air sinus or the oropharyngeal mucosa before entering the cranium have an increased incidence of infection. In contrast, calvarial stabs seldom result in intracranial infection and only four patients in this study who had a stab with no mucosal penetration developed infection. In these types of cases we simply perform scalp debridement for wound treatment and no antibiotic drugs are administered. Although prophylactic antibiotic drugs are advocated by some authors we have not administered them in the last 10 years and have found that this policy has not led to a higher incidence of infection in cases treated at our institution. 

Wild et al. reported on two patients with retained blades who suffered only shallow penetration and sustained no complications. These authors commented on the difficulty of assessing the depth of blade penetration on CT scans because of metal artifacts. However, no previous study has analyzed complications in patients presenting with a retained knife blade as a separate group and compared these cases with other transcranial stabs. It has been suggested by van Dellen and Lipschitz that the prognosis is worse for patients in whom the knife blade is removed by the assailant. It was postulated that under these circumstances the blade is rocked and twisted more to remove it. This may not always be the case because often the blades with shallow penetration are more easily pulled out by an assailant. The shallow penetration results in less injury even if there is blade movement during removal.

The higher incidence of vascular injury in patients presenting with a retained blade relates to two factors in our opinion. First, patients with a retained blade tend to have suffered deep intracranial penetration. This allows for exposure of more cerebral vessels to the blade and hence a greater chance of vascular injury. This contention is supported by the fact that all five patients who had a retained knife but only superficial blade penetration had no complications. Second, there is a high incidence of petrous temporal bone penetration in Group A (Table 1). A knife retained in the petrous bone remains fixed but the risk of carotid injury is greater in this situation (Fig. 3). It is also possible that a retained blade may prevent hemorrhage by tamponading an incised vessel. This may allow a patient with a severe vascular injury to seek medical care only to deteriorate when the blade is removed.

Mortality rates are higher in patients with retained knife blades. In this study the three patients in Group A who died all presented to the hospital with a GCS score of 15. Their delayed deterioration can be attributed to two causes: 1) in one patient there was an unavoidable delay in surgery; and 2) in the remaining two patients a new lesion or enlargement of an existing hematoma was precipitated by knife removal.

In Group B death was not unexpected in the three patients with a low GCS. It is unfortunate that the patient with the good GCS died as he had a temporal hematoma that was potentially treatable.

### Management of Patients With Retained Blades

Although we believe we have identified another high-risk category of patients with stab wounds of the cranium,
a strategy for their management is difficult to formulate. Emergency management is a priority even if patients are neurologically intact on admission. Clinical assessment, skull x-ray studies, and CT scans should determine if immediate angiographic studies are necessary. The importance of early angiography in stab wounds to the head has been shown by du Trevou and van Dellen.4 Their study assessed 250 patients in whom no blade was retained after transcranial stabbing, but their findings are also valid for patients with a retained blade. Vascular injury should be recognized in this early period unless there is vasospasm or vessel occlusion. Either of these findings necessitates additional delayed angiography. If the blade lies in the vicinity of any major cerebral vessel or venous sinus, angiographic studies should be performed prior to knife blade removal. If vascular injury is present a decision regarding the advisability of endovascular or surgical treatment can be made. Adequate exposure of proximal vessels in the area of injury is mandatory if surgical exploration is undertaken.

If no vascular injury is anticipated or the angiogram is normal, blade removal should take place in an operating room while the patient is receiving a general anesthetic. Whether the blade is pulled out or surgically removed depends on how fixed it is and if “in line” removal is possible. A number of maneuvers can be used to achieve in line removal. The most practical involves application of vise-grips to the protruding blade and the use of a small mallet to gently hit the vise-grips and knock the blade out in the direction of its insertion. Once the blade has been removed and while the patient is still anesthetized a CT scan should be obtained to exclude the presence of a delayed hemorrhage. If bleeding has occurred hematoma evacuation may then take place without delay. A surgical technique for retained blades has been described by van Dellen and Lipschitz,13 A D-shaped craniectomy is performed with the straight side against the blade to free it from the bone. Immediate postoperative CT studies should still be obtained rather than exploring the knife track to exclude the presence of deep hematomas.

Conclusions

Retained transcranial knife blades have a high incidence of early and late vascular complications. The greater depth of brain penetration and the higher frequency of petrous injury associated with these wounds are thought to be significant causes of these complications.

References