

Coil Embolization of the Internal Carotid Artery in Patient with Retained Transcranial Knife

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Abstract

Background

We describe endovascular coil embolization of the internal carotid artery before removing a retained knife blade partially occluding the lacerum segment of the internal carotid artery.

Case Description

A 21-year-old male presented to the emergency department with a retained transcranial knife after sustaining a stab to the left temporal scalp. He was hemodynamically stable and neurologically intact on presentation. Computed tomography angiography followed by digital subtraction angiography revealed narrowing of the lacerum segment of the left internal carotid artery by the tip of the knife blade with adequate blood flow from the contralateral internal carotid artery. Embolization and occlusion of the internal carotid artery proximal and distal to the knife tip were performed. The patient was transferred to the neurosurgical operating room for extraction of the knife. A repeat left carotid artery angiogram post knife extraction showed no displacement of the coils and no extravasation of contrast. Follow-up imaging confirmed a good outcome.

Conclusions

A staged approach of digital subtraction angiography and endovascular therapy followed by surgical treatment is a safe and effective management strategy for patients presenting with a retained transcranial knife and suspected vascular injury.

Key words: Carotid artery; Endovascular treatment; Retained knife; Vascular injury

Abbreviations and Acronyms

CT: Computed tomography

DSA: Digital subtraction angiography

ICA: Internal carotid artery

Introduction

Penetrating head injuries are uncommon in most of the world accounting for approximately 0.4% of traumatic head injuries.^{1,2} In South Africa, transcranial stab injuries are more common, with 6% of all head injuries attributed to transcranial stab injuries in 1992.³ Transcranial stab injuries with a retained knife have a higher prevalence of vascular injury compared with patients in whom the knife has been extracted before presentation.⁴ Vascular complications include arterial hemorrhage secondary to arterial laceration, ischemia secondary to arterial occlusion, formation of a pseudoaneurysm, carotid-cavernous fistula, and arterial dissection.^{1,5} Transcranial stab injuries with a retained knife should be evaluated using noncontrast computed tomography (CT) and a CT angiogram to assess arterial injury. Digital subtraction angiography (DSA) is useful to dynamically assess the degree of vascular injury and to assess collateral circulation before intervention. In the presence of an arterial injury, endovascular coil embolization may be considered if adequate collateral circulation is present, before surgical extraction of the knife.^{1,4}

Case Report

A 21-year-old male presented to the emergency department after being attacked and sustaining a stab to the left temporal scalp. He presented with a retained transcranial knife with the handle of the knife partially present. The patient reported no loss of consciousness or headache. The Glasgow Coma Scale of the patient was 15, and he was hemodynamically stable with no neurologic fallout.

A frontal skull radiograph demonstrated the trajectory and deep intracranial penetration of the knife (Figure 1). Noncontrast CT brain and CT angiogram demonstrated the knife blade penetrating the squamous part of the left temporal bone and traversing the left temporal lobe. The tip of the knife terminated in the petrous apex. Although metal streak artifact affected image quality, we were able to see narrowing of the lacerum segment of the left internal carotid artery (ICA) with no contrast extravasation and normal opacification distal to the narrowed ICA (Figure 2). We anticipated that this segment of the ICA would be prone to arterial injury and hemorrhage on removal of the knife. The CT also demonstrated a left acute subdural hematoma measuring 8 mm at its widest, minimal intraparenchymal hemorrhage, and midline shift of 3 mm to the right. No features suggestive of a cerebral infarct was noted.



Figure 1. Frontal skull radiograph demonstrating the trajectory of the retained transcranial knife.

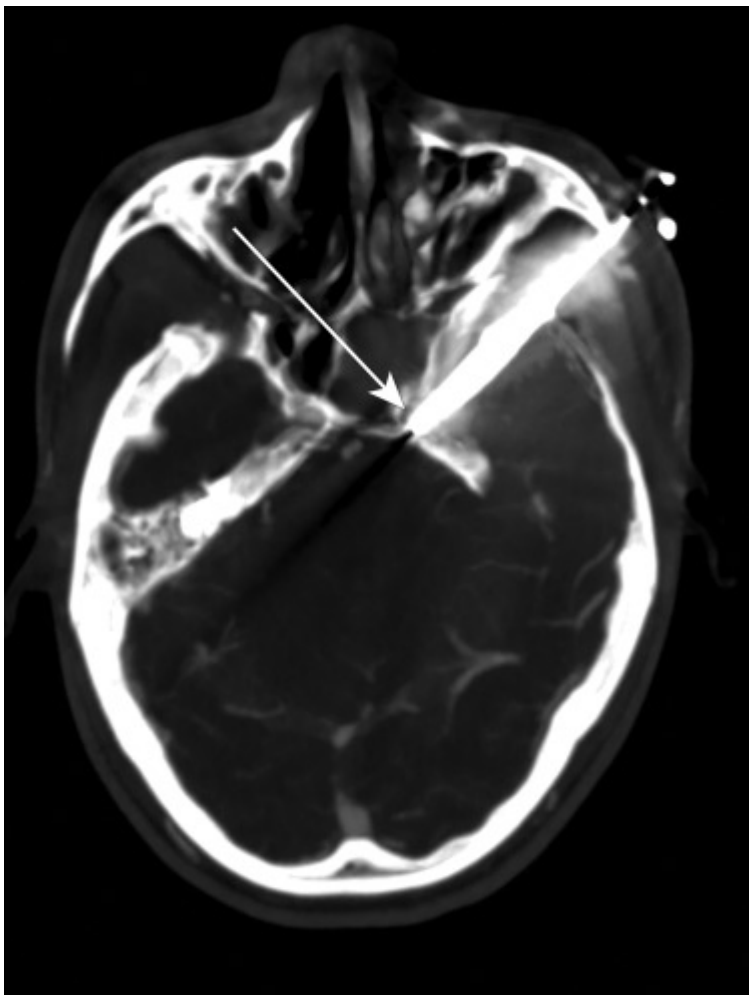


Figure 2. Axial, maximum intensity projection, computed tomography angiography image demonstrating the trajectory of the transcranial knife with the tip of the knife at the petrous apex and associated narrowing of the lacerum segment of the left internal carotid artery (*arrow*).

The patient was taken for an intracranial DSA. The left ICA demonstrated narrowing of the lacerum segment with focal irregularity of the lateral margin against the tip of the knife (Figure 3A). This finding was suggestive of either laceration of the lateral wall with tamponade from the knife blade or vasospasm secondary to compression. Flow of contrast was present distal to the region of narrowing with no extravasation of contrast. The right ICA demonstrated normal filling with adequate cross-over flow to the left with manual compression of the left common carotid artery (Figure 3B). As there was adequate collateral circulation, it was decided to embolize and occlude the left ICA using detachable coils that were deployed to span the region of narrowing extending both distally and proximally to the tip of the knife. Successful occlusion of the left ICA was achieved with the final angiogram demonstrating no flow distal to the coils (Figure 4A and B).

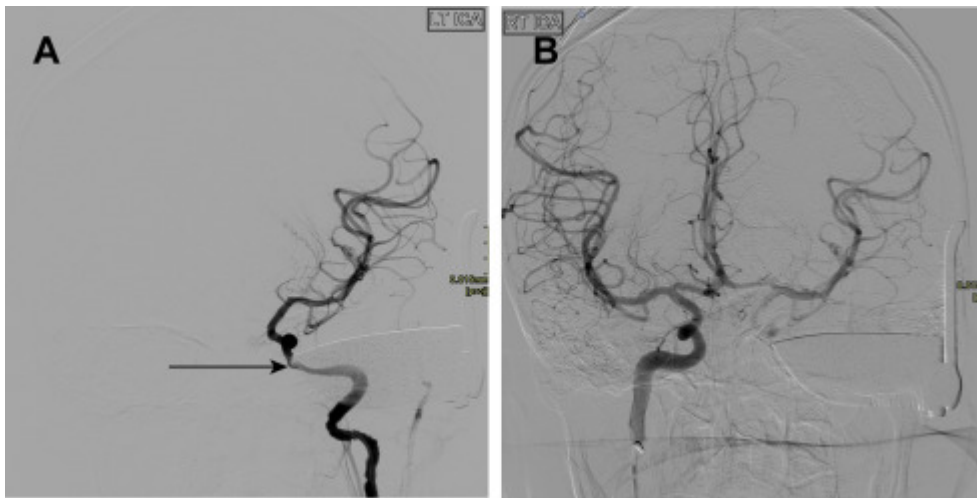


Figure 3. (A) Digital subtraction angiography (DSA), Towne view, demonstrated focal irregularity of the left internal carotid artery against the tip of the knife (*arrow*). (B) DSA, Towne view, demonstrated adequate collateral circulation from the right internal carotid artery.



Figure 4. (A) Postembolization angiogram demonstrated no flow distal to the left internal carotid artery coils, which extend proximally and distally to the tip of the knife. (B) Skull radiograph demonstrating the left internal carotid artery coils.

The patient was then transferred to the operating room. A circular craniectomy around the knife blade was performed. The knife was dislodged and extracted by applying a constant

force in the opposite direction of its trajectory (Figure 5A and B). Bleeding of the cortical vessels was cauterized and hemostasis was achieved. The defect in the dura was closed with DuraGen (collagen graft used for dural repair, Integra Lifesciences, Plainsboro Township, New Jersey, USA).



Figure 5. (A) Photograph of the patient before surgery. The head is shaved and turned to the right. The transcranial knife is noted posterior to the left eye (the left eye is marked with an *arrow*). (B) Photograph of the knife post extraction.

Postsurgical DSA of the left ICA demonstrated no displacement of coils, no extravasation of the contrast, and no flow distal to the coil. The patient was transferred to the neurosurgical intensive care unit, where he made an uneventful recovery with a Glasgow Coma Scale of 15 and no neurologic fallout. A noncontrast CT brain performed on postoperative day 1 demonstrated evacuation of the left subdural bleed and resolution of the midline shift. The left ICA coils were visualized with no delayed hemorrhage or region of infarction. At follow-up, the patient was neurologically intact.

Discussion

In this case, we used a staged approach with angiography to assess the extent of vascular damage and endovascular management before surgery. In patients where the artery is partially injured by the retained foreign body, the injured vessel can only be occluded using endovascular coils if there is adequate blood supply to the brain from the contralateral ICA. Inadequate collateral circulation will result in infarction post embolization. Embolization distal to the region of injury must be performed to prevent back bleeding after the knife is removed.^{6,7} In our patient, we embolized the segment of the ICA distal to the region of the injury because we were able to advance past the narrowed ICA segment, which was in contact with the knife blade. If the lumen is significantly narrow or occluded, the ICA segment distal to the injury may be accessed and embolized via the vertebral and posterior

communicating arteries using a retrograde approach. Endovascular stents have been used in the setting of partial vascular injury; however, stent thrombosis remains a serious complication. Stents may also result in covering of the branches of the ICA.⁶ In this case, the medical team decided against placing an endovascular stent, which requires intraoperative anticoagulation pre-stent and post-stent placement, and was contraindicated due to the need for further surgical management.

The retained transcranial knife blade can be pulled out or surgically removed depending on how impacted it is. In this case, the knife could only be pulled out after the surgical team performed a circular craniectomy, similar to previous cases.^{4, 6}

Conclusion

Transcranial stab injuries with a retained knife requires a staged management approach involving angiography and endovascular repair before surgical treatment. Endovascular coil embolization of a partially injured ICA is recommended provided there is adequate collateral blood supply.

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