

ISSN 1220-8841 (Print)
ISSN 2344-4959 (Online)

ROMANIAN
NEUROSURGERY

Vol. XXXVIII | No. 4

December 2024

A tale of the nail: post-traumatic brain
abscess from impalement injury

Eyitayo Alabi,
Afolashade Saka,
Edward Jolayemi,
Bamidele Adebayo,
Okezie Kanu

DOI: 10.33962/roneuro-2024-168



A tale of the nail: post-traumatic brain abscess from impalement injury

Eyitayo Alabi¹, Afolashade Saka², Edward Jolayemi³,
Bamidele Adebayo⁴, Okezie Kanu¹

¹ College of Medicine, University of Lagos, NIGERIA

² Cornell Health Limited, Surulere, Lagos, NIGERIA

³ General Hospital Lagos, NIGERIA

⁴ Department of Neurosurgery, University of Colorado School of Medicine, Anschutz medical Campus, USA

ABSTRACT

Impalement injuries to the head are rare but serious and potentially life-threatening. They comprise approximately 0.3% of all head injuries and require emergency surgical intervention. These injuries are mostly accidental however increasing cases arising from assault is being reported with often satisfactory outcomes.

The management of impalement injuries to the brain presents peculiar challenges due to their complexities, associated neurological disruptions and impairments, and the risk of central nervous system infection.

Cerebral abscess is a rare but potentially devastating complication of cranial impalement injuries often associated with late presentations and cases receiving suboptimal treatment.

We report a fatal case of cerebral abscess in a 33-year-old man who presented late following assault with a nail to his head. We outline the principles of management, emphasize the need for early presentation and management by qualified professionals.

INTRODUCTION

Brain abscess is a focal suppurative infection that begins in an area of cerebritis or devitalized brain tissue and develops into a collection of pus surrounded by a well-vascularized capsule.[1, 2]

Despite the development of modern neurosurgical techniques, potent antibiotics, and modern imaging technologies, suppurative central nervous system infections remain potentially fatal.[3]

The epidemiology and clinical spectrum of brain abscesses have changed in recent years due changing spectra of aetiologic agents amidst the age-long limitations in anaerobic culture techniques. Brain abscesses may arise by direct spread from an exogenous focus, endogenous source via the haematological route, or sometimes be of cryptic origin. In post-traumatic (exogenic) brain abscesses, the duration between the predisposing injury and occurrence of an abscess varies, and may initially be designated an "idiopathic brain abscess"

Keywords
impalement,
brain abscess,
nail injury,
assault,
outcome



Corresponding author:
Okezie Obasi Kanu

College of Medicine,
University of Lagos, Nigeria

drkanu@gmail.com

Copyright and usage. This is an Open Access article, distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>) which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is unaltered and is properly cited.

The written permission of the Romanian Society of Neurosurgery must be obtained for commercial re-use or in order to create a derivative work.

ISSN online 2344-4959
© Romanian Society of
Neurosurgery



First published
December 2024 by
London Academic Publishing
www.lapub.co.uk

contributing to the 15% of cases whose sources are unidentified. [4-6] This is commonly associated with mild closed head injuries.[7]

Impalement brain injuries are caused by foreign exogenous objects that penetrate the brain along any of its axes, producing a wound track corresponding to its depth of penetration. They are often accidental and constitute a neurosurgical emergency. [8] There are reported cases occurring following assault with reported outcomes being largely satisfactory [8]

The authors present a case of cerebral abscess complicating an impalement brain injury in a 33-year-old man who was assaulted with a nail.

CASE REPORT

A 33-year-old man presented to our facility with a history of recurring headache, blurry vision, impaired short-term memory, unsteady gait and frequent urination following being assaulted with a nail to his head 3-months back.

He was attacked by a group of suspected hoodlums who drove a 6-inch nail into the right side of his head once, with a hammer. The nail was forcefully pulled out by passers-by who came to his aid at the scene. He lost consciousness which he regained some minutes later. The headache was severe enough to impair activity. There was no history of seizures. He was noted to have incoherent speech afterwards and resorted treatment at home by a nurse.

At presentation, there was a healed puncture wound in the right frontal region of his scalp. He was afebrile, conscious and well oriented. His pupils were equal and reactive bilaterally. He had impaired short-term memory, mild dysarthria and left hemiparesis with power of 4/5. There were no signs of meningeal irritation.

Neuroimaging revealed an encapsulated supratentorial lesion in the right frontal lobe with leftward subfalcine brain shift and an overlying right paramedian defect in the frontal calvarium depicting the entry point of the nail. (Fig 1a-c) The lesion demonstrated a hyperintense/hyperdense capsule with hypointense/hypodense core on brain magnetic resonance imaging (MRI) and computed tomography (CT) scan images respectively. There was oedema of the surrounding uninvolved brain parenchyma. The proximity of the lesion to the frontal superior sagittal sinus (SSS) led to suspicion of an abscess involving

the SSS and an aneurysm of the SSS as a possible differential diagnosis.

Empirical broad-spectrum antibiotic therapy was instituted and patient was worked-up for emergency surgical evacuation. He had an episode of generalised tonic-clonic seizures shortly before the surgery and was administered a loading dose of intravenous phenytoin. He was noticed to be diuretic and was administered desmopressin.

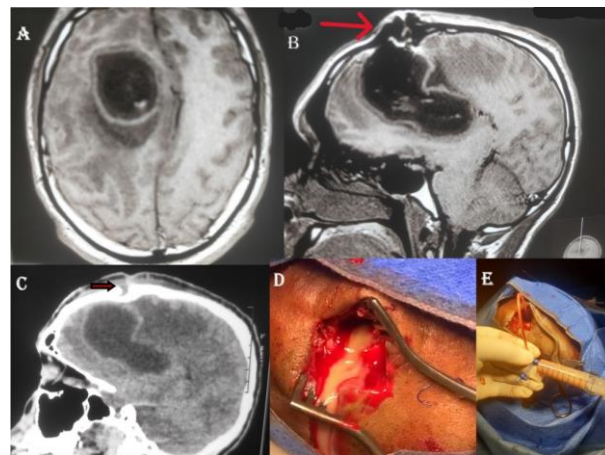


Figure 1 A-E: Cerebral abscess from impalement injury with a nail.

A: MRI Brain, axial cut of T1W sequence showing paramedian frontal abscess with significant midline shift. **B:** Sagittal view of the MRI (same sequence) showing point of entry of the impaled nail which had been extracted by non-experts before presentation (red arrow). **C:** Non-contrast sagittal CT reconstruction demonstrating a frontal bone defect and underlying abscess. **D-E:** intraoperative view of mini-craniectomy with abscess evacuation.

Surgical evacuation was done on the same day of presentation. He had a right-sided frontal paramedian mini-craniectomy under general anaesthesia. A linear incision was made incorporating the puncture wound and deepened to expose the skull defect. A paramedian burr hole was sited and widened with Kerrison rongeur to incorporate the skull fracture and expose the SSS medially. There was a dural defect with granulation tissue situated about 5mm from the SSS. Durotomy was done and directed laterally from the dural defect. There was egress of thick, yellowish, foul-smelling pus under pressure. A size-10 nasogastric tube was guided through virgin scalp into the abscess cavity and about 650mls of pus was evacuated (Fig 1d-e). Samples for microbiology analyses and sensitivity testing was taken. The

abscess cavity was gently irrigated with normal saline to which 0.32mg/ml of gentamycin was added. The wound was closed in layers with the nasogastric tube left in situ and secured as a passive drain to be removed when inactive.

Post-operatively, he was admitted to the intensive care unit (ICU) with a Glasgow Coma Score of 12 (E3V4M5). He was administered triple antibiotic therapy with Ceftriaxone, Gentamycin and Metronidazole, Phenytoin for seizure prophylaxis, antipyretics, steroids and intranasal oxygen.

Second day post-operatively, his level of consciousness dropped with Glasgow Coma Score of 9/15 necessitating intubation and ventilation. The post-operative period was turbulent.

He died on the third post-operative day. Culture and sensitivity results yielded *Staphylococcus aureus*, *Escherichia coli* Anaerobic culture was negative.

DISCUSSION

Impalement injuries to the head are rare but serious and potentially life-threatening. They constitute about 0.3% of all head injuries and require emergency surgical intervention.[9] Depending on the location, the spectrum of injury severity can range from minor to life-threatening.

The list of impaled objects reported in literature include, but are not limited to nails, knives, spears, wooden chopsticks, brush, scissors, crowbar, pitch fork prongs, door keys, fishing harpoon, rotor fan blade, grinder tool, ceramic stone, iron rod, hunting arrow and screwdrivers[8, 10-12] Most of these injuries in adults follow some form of assault while those in children are mostly accidental.[8, 12]. The rarity of impalement injuries to the cranium has been partly attributed to the relative small size of the head compared to the rest of the body and the protective reflexes in the face that allow the victim to move away from the injurious objects.[9]

The management of impalement brain injury presents peculiar challenges because of the injury complexity, associated neurological damage and functional impairment, as well as the risk of intracranial infection.[8]

Brain abscess is a rare but potentially devastating complication of cranial impalement injuries that often follow late presentation or inadequate treatment. The exact frequency is however not established due to insufficient data. Generally, brain

abscesses from penetrating traumatic brain injuries develop often from retained foreign mater and debris that were driven-in during the trauma, and in patients who neither received adequate antibiotic prophylaxis at early presentation nor appropriate intervention following late presentation to the hospital.[13]

The most common bacterial pathogens isolated following impalement injuries include *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Escherichia coli* and anaerobic organisms.[9, 13] Most patients in published series presented within hours to one-week post-injury and had the impaled object in-situ.[8, 9] Our index patient however presented 3-months post-injury after having the offending object removed by an unqualified person who did not pay attention to, nor take the necessary precautions to prevent infection.

The management of impalement brain injuries with retained object requires that retrieval of the culprit weapon or object be removed in the operating room setting, in a controlled manner, usually by a circumferential craniotomy incorporating the object. Preoperatively, brain CT scan with angiography and/or venography provides information about the depth of penetration, presence or absence of vascular injuries, associated haematomas and penetrating bone or foreign body fragments. The information garnered preoperatively may inform the surgeon of the need for vascular interventions or larger craniotomy to evacuate significant haematomas. The role of brain MRI in this setting is remote, as a brain CT scan with angiogram provides all the information needed pre-operatively, is faster and cheaper to perform. The possibility of ferromagnetic matter being present in the impaled object rules out MRI as a first imaging modality of choice also.

It is established that the anatomy of the rostral superior sagittal sinus varies, and hypoplasia does occur in about 4.3% to 7%.[14-17] In our patient, the diagnosis of cerebral abscess was made with an MRI before presentation. We entertained the possibility of a traumatic aneurysm based on the outline of the lesion though venogram could not be done for financial reasons. Patients in the low- and middle-income countries (LMICs) often pay out-of-pocket for treatment due to low health insurance coverage. The country of the authors falls within this category.[3, 18-20]. The probability that the index patient's injury

may have involved a cult clash contributed to late presentation as victims of injuries following illegal activities like robbery and cultism, in a bid to avoid the arm of the law, prefer to seek care outside formal hospital settings till major complications set in.

Intraoperatively, impalement injuries generally require a mini-craniectomy and adequate debridement under prophylactic antibiotic cover. Necrotic and devitalized brain tissue should be excised to reduce infection risk as these areas are often impregnable by antibiotics. In the event of an abscess complicating the case, or late presentations, it is recommended that broad spectrum empirical antibiotic therapy be instituted pending sensitivity results. Abscess evacuation is often required as an emergent procedure. Antibiotic therapy may subsequently be tailored to microscopy and sensitivity results and continued for 6 to 8-weeks with at least 4-weeks of parenteral administration.[3]

In our environment, cultures are often negative due to high rate of antibiotic abuse. In this scenario, we continue the broad-spectrum empirical antibiotic therapy till symptoms abate. This is administered parenterally for the first 4-weeks followed by 2 weeks of oral therapy.[19-21] The prevalence of anaerobes and difficulty in isolating them in cultures informs our routine addition of metronidazole to our broad-spectrum regimen even when the cultures are negative.[18]

The location of this lesion along the midline with involvement of the superior sagittal sinus could have led to venous stasis and formation of sinus thrombi that could dislodge and cause early post-operative death. For our patient, anticoagulation therapy was commenced two days after surgical evacuation of the cerebral abscess considering the risk of bleeding.

CONCLUSIONS

Brain abscesses complicating impalement injury to the brain are rare but potentially devastating, and require prompt medical attention. Early diagnosis and optimum treatment by qualified professionals are crucial to prevent severe or fatal neurological sequelae.

REFERENCES

1. Chen, M., Low, D.C.Y., Low, S.Y.Y., Muzumdar, D. and Seow, W.T., Management of brain abscesses: where are we now? *Childs Nerv Syst*, 2018. 34(10): p. 1871-1880.
2. Kothari, M., Goel, A. and Muzumdar, D., Brain abscess: Heuristics, principles, pathobiology, practice. *Neuro India*, 2015. 63(3): p. 329-37.
3. Kanu, O.O., Ojo, O., Esezobor, C., Bankole, O., Olatosi, J., Ogunleye, E., et al., Pediatric brain abscess - etiology, management challenges and outcome in Lagos Nigeria. *Surg Neurol Int*, 2021. 12: p. 592.
4. Arlotti, M., Grossi, P., Pea, F., Tomei, G., Vullo, V., De Rosa, F.G., et al., Consensus document on controversial issues for the treatment of infections of the central nervous system: bacterial brain abscesses. *Int J Infect Dis*, 2010. 14 Suppl 4: p. S79-92.
5. Brouwer, M.C. and van de Beek, D., Epidemiology, diagnosis, and treatment of brain abscesses. *Curr Opin Infect Dis*, 2017. 30(1): p. 129-134.
6. Na, K.Y., Jang, J.H., Sung, J.Y., Kim, Y.W. and Park, Y.K., Actinomycotic brain abscess developed 10 years after head trauma. *Korean J Pathol*, 2013. 47(1): p. 82-5.
7. Winter, A. and Shoshkes, M., Brain abscess and head trauma. *JAMA*, 1961. 176: p. 1039-41.
8. Yusuf, A.S., Mahmud, M.R., Alfin, J.D. and Adeleke, N.A., Clinical Presentation and Outcome of Impalement Craniocerebral Injuries - A CASE SERIES. *J West Afr Coll Surg*, 2017. 7(2): p. 112-123.
9. Koko, A.M. and Lasseini, A., Impalement brain injury: report of five consecutive clinical cases. *Egyptian Journal of Neurosurgery*, 2020. 35(1): p. 5.
10. Onimisi, J.A., Apollos, G.D., Mesi, M. and Sale, D., Cranial Impalement of a Falling Fence Spike in a Child: A. *Journal of Surgery*, 2016. 4(2): p. 31-34.
11. Aremu, S.K., Makusid, M.M. and Ibe, I.C., Oro-cranial penetrating pencil injury. *Annals of Saudi medicine*, 2012. 32(5): p. 534-536.
12. Damm, A., Lauritsen, A.Ø., Klemp, K. and Nielsen, R.V., Transorbital impalement by a wooden stick in a 3-year-old child. *Case Reports*, 2015. 2015: p. bcr2015211885.
13. Ganga, A., Leary, O.P., Sastry, R.A., Asaad, W.F., Svokos, K.A., Oyelese, A.A., et al., Antibiotic prophylaxis in penetrating traumatic brain injury: analysis of a single-center series and systematic review of the literature. *Acta neurochirurgica*, 2023. 165(2): p. 303-313.
14. Ruiz, D.S.M., Fasel, J. and Gailloud, P., Unilateral hypoplasia of the rostral end of the superior sagittal sinus. *American journal of neuroradiology*, 2012. 33(2): p. 286-291.
15. Koko, A. and Alyafei, T., Case report of coexistence of two variant anatomy, hypoplastic rostral superior sagittal sinus and hypoplastic right side transverse sinus and internal jugular vein. *Open J Clin Med Images*, 2022. 2(1): p. 1040.
16. Yasmin, K., Al-Qureshi, F.T., Islam, M.M., Sultana, A. and Ony, T.A., Anatomical Variations of the Superior Sagittal, Transverse and Sigmoid Dural Venous Sinuses in the Cerebral MRV Images of Adult Bangladeshis. *Sch J App Med Sci*, 2022. 4: p. 485-490.
17. Pallewatte, A., Tharmalingam, T. and Liyanage, N., Anatomic variants and artefacts in non enhanced MRV- Potential pitfalls in diagnosing cerebral venous sinus

- thrombosis (CVST). *Sri Lanka Journal of Radiology*, 2016. 2(1).
18. Kanu, O., Asoegwu, C., Adebayo, B., Ukponmwan, E., Jolayemi, E., Bamigboye, B., et al., Intracranial Complications of Otitis Media in Adult Nigerians—An Institutional Experience.
 19. Kanu, O.O., Esezobor, C.I., Ojo, O.A., Asoegwu, C.N., Nnoli, C., Dawang, Y., et al., Infantile supratentorial subdural empyema managed by percutaneous aspiration: an outcome study in a Nigerian city. *Sudanese Journal of Paediatrics*, 2019. 19(1): p. 37.
 20. Kanu, O.O., Nnoli, C., Olowoyeye, O., Ojo, O., Esezobor, C., Adeyomoye, A., et al., Infantile subdural empyema: The role of brain sonography and percutaneous subdural tapping in a resource-challenged region. *Journal of neurosciences in rural practice*, 2014. 5(4): p. 355.
 21. Jolayemi, E.O., Bankole, O.B., Ojo, O.A., Bamigboye, B., Adebayo, B.O., Arekhandia, B.J., et al., Contemporary management of intracranial subdural empyema: an institutional experience. *Journal of West African College of Surgeons*, 2022. 12(3): p. 56-63.