Pseudoaneurysms in a Penetrating Head and Neck Injury: A Case Series

Miguel Nicolai T. Victorino[1], Reynaldo Benedict V. Villamor[2], Lester Ron S. Bustamante[3]

[1]Medical Officer III, Neurological Surgery, Vicente Sotto Memorial Medical Center
[2]Section Head, Vascular Neurological Surgery, Vicente Sotto Memorial Medical Center
[3]Medical Officer III, Neurological Surgery, Vicente Sotto Memorial Medical Center

Abstract
An intricate challenge faced by neurosurgeons involves the management of cerebral vessel Pseudoaneurysms. A comprehensive understanding of their natural progression, typical symptoms, underlying pathophysiology, and the diverse spectrum of available treatment modalities is crucial. This research focuses on three atypical cases of pseudoaneurysms resulting from penetrating head and neck injuries, diagnosed through Cerebral Catheter Angiography.
The initial case involved a 14-year-old female with a metal bar penetrating the right maxillary region. A Left Frontal Craniotomy was performed, entailing the trapping of the Left Internal Frontal Artery. The second case featured an 11-year-old female with a frontal bone penetration by marble from a slingshot, necessitating a Bicoronal craniectomy and clipping of the left pericallosal Artery Pseudoaneurysm. The third case, involving a gunshot penetrating the posterior aspect of the neck with a slug at C1 lamina, was managed conservatively.
Cerebral Angiography emerged as a pivotal method for detecting vascular pathology. Radiographic images depicting the pseudoaneurysm and the implicated foreign object are presented. The research strongly advocates for Digital Subtraction Angiography as the Gold Standard Diagnostic tool for pseudoaneurysms in the context of penetrating head and neck injuries. This recommendation is grounded in the method's superior diagnostic capabilities and its potential to enhance the precision of clinical assessments and subsequent therapeutic interventions.

Keywords: Pseudoaneurysms, Penetrating Head and Neck Injury, Cerebral Catheter Angiography

Introduction

In the Philippines, the majority of head trauma cases are brought to government-owned hospitals. However, before the availability of intracranial vascular studies, surgeons were preoperatively blind to vascular pathologies in their surgical procedures for penetrating head and neck injuries. While the incidence of intracerebral Pseudoaneurysms after a head injury varies from 5 to 40% mostly arising from blunt head trauma [4], the capability of utilizing Cerebral Catheter Angiography is observed to be underperformed. Thus, the true incidence of pseudoaneurysms is underreported in the Philippine landscape.

This case series emphasizes the importance of Digital Subtraction Angiography (DSA) in detecting pseudoaneurysms in a penetrating head and neck injury. The management and characteristics of intracranial pseudoaneurysms from 2016 to 2018 recorded in Vicente Sotto Memorial Medical Center (VSMMC) are described using preoperative DSA.

Case Presentation

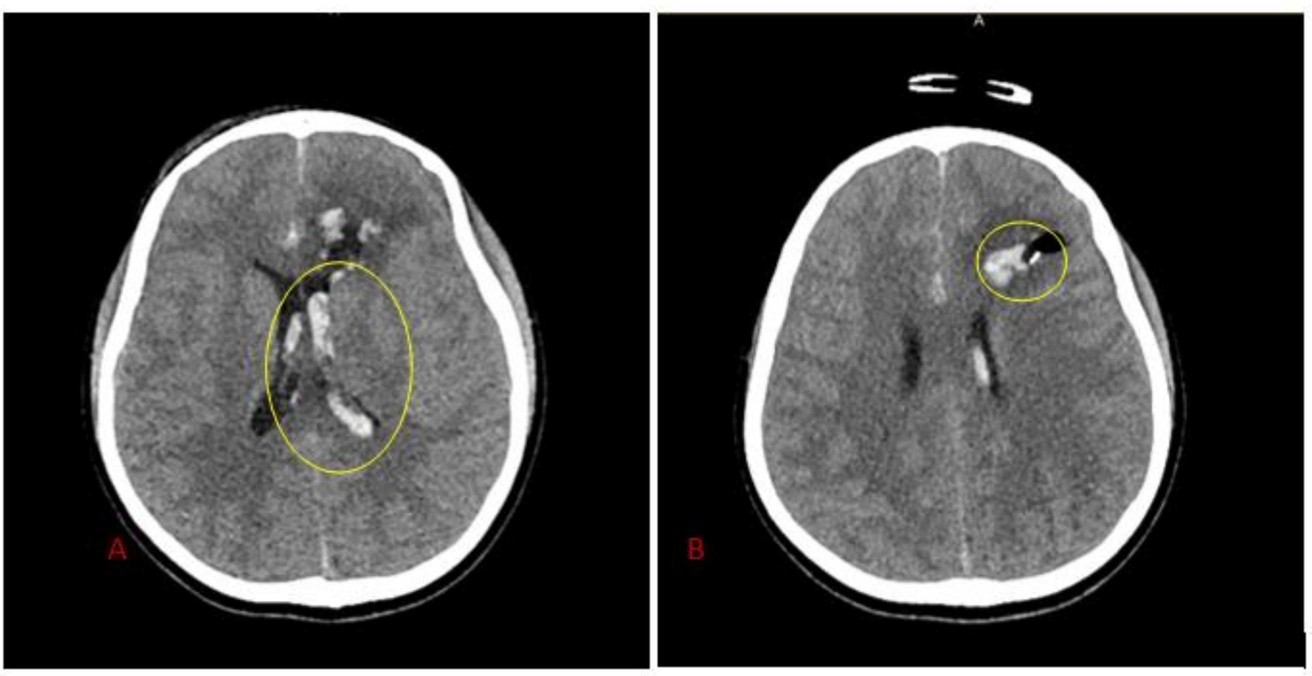
Case 1

A 14-year-old female was first admitted to another hospital after she accidentally fell from the roof of their 2-story house to the ground. Approximately 8 cm of a protruded steel bar penetrated her maxillary area and then she immediately pulled it on her own. She presented with profuse bleeding at the site of injury, vomiting, epistaxis, blurring of vision, and loss of consciousness.

Two days after she was transferred to VSMMC, a computed tomography scan was done which revealed subarachnoid hemorrhage, left medial frontal hematoma with intraventricular extension, and fracture of the supraorbital wall.

SDA was performed which further revealed a pseudoaneurysm at the left Anterior Cerebral Artery – Left Internal Frontal Artery measuring approximately 3.5 mm x 4 mm with an ill-defined neck measuring approximately 3 mm. During surgery, trapping of the left internal frontal pseudoaneurysm was done via a left frontal craniotomy. Eleven days after the operation, a follow-up DSA revealed complete obliteration of the pseudoaneurysm. The patient was then discharged awake, alert, and without visual loss.

Figure 1. Plain Cranial Computed Tomography Shows Left Mesial Frontal Hematoma (A) with Intraventricular Extensions and Pneumocephalus (B).



International Journal for Multidisciplinary Research (IJFMR)

E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Figure 1.1. DSA, Left ICA Injection AP (A) and Lateral Vew (B) Shows a 3.5 mm x 4 mm with an Ill-Defined Neck Measuring Approximately 3 mm.

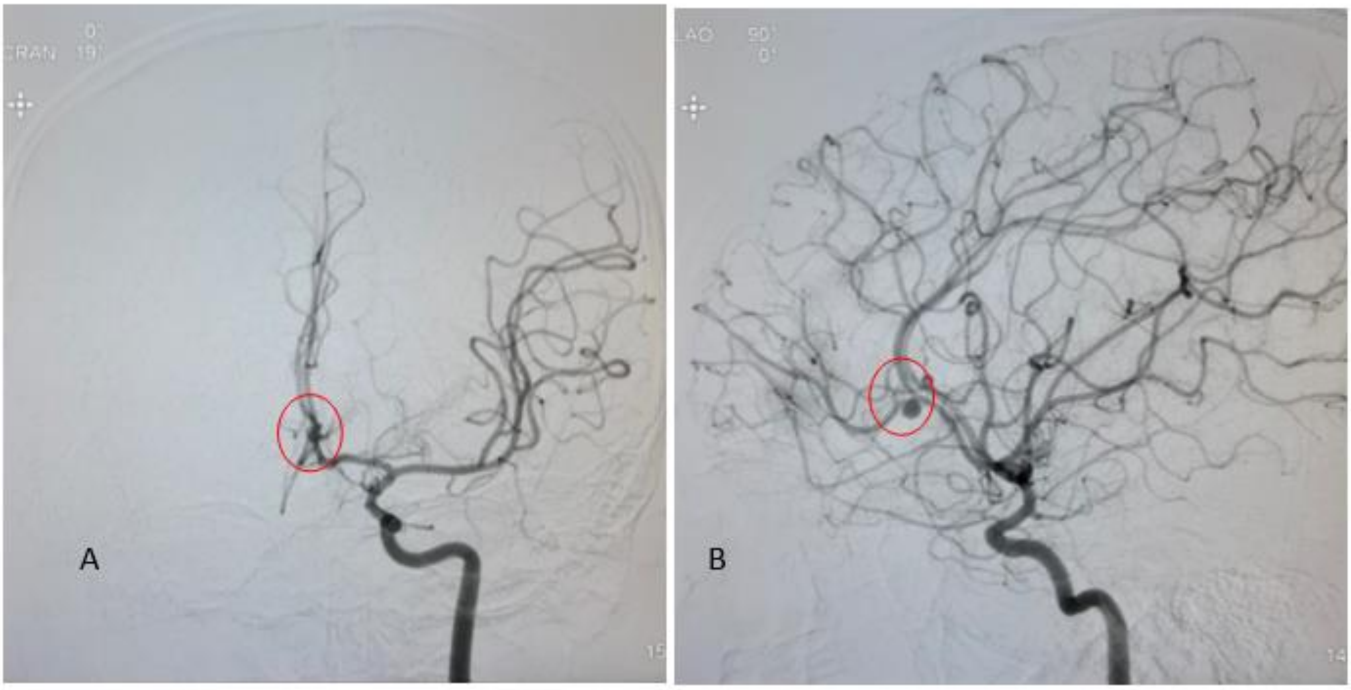


Figure 1.2. DSA, Left ICA Injection Lateral View Showing Dimension of the Pseudoaneurysm (A) Clips Applied Trapping the Pseudoaneurysm (B).

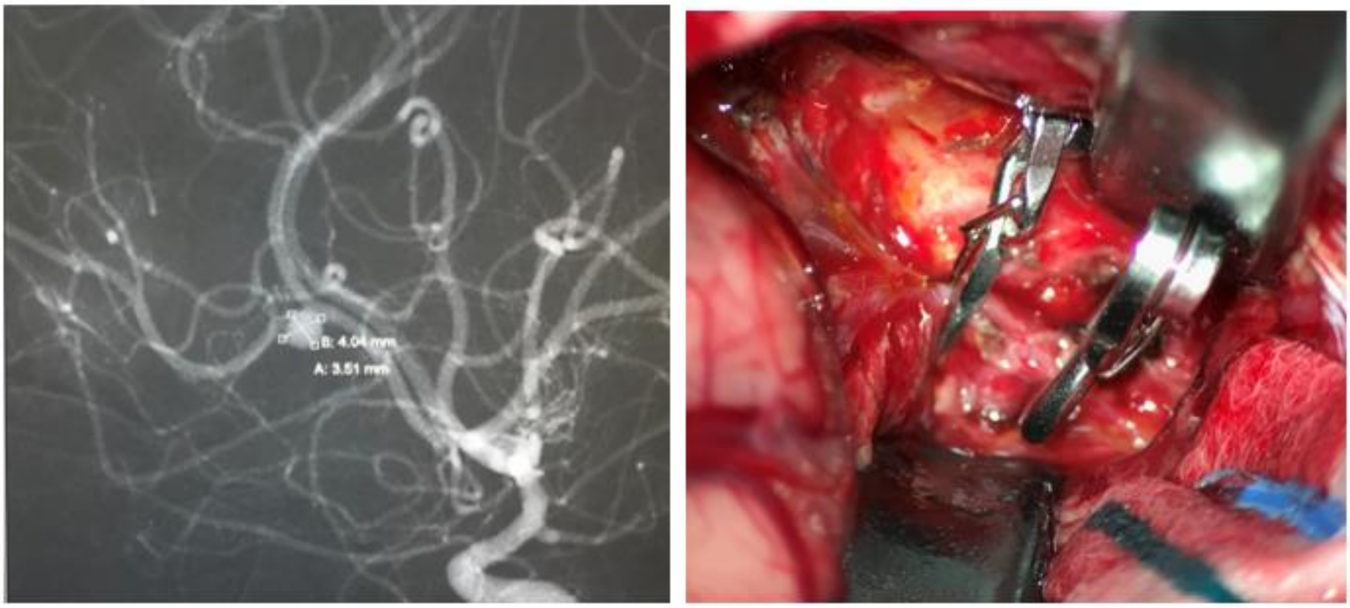


Figure 1.3. Follow-Up DSA, Left ICA Injection AP (A) and Lateral View (B) Shows Complete Obliteration of the Pseudoaneurysm.

Case 2

An 11-year-old female was admitted to VSMMC due to a marble that penetrated the frontal area of her head through a slingshot. Despite being completely awake and following commands, headache, and vomiting were present at the onset. DSA revealed a foreign body at the interior midline area and a pseudoaneurysm at the Left Anterior Cerebral Artery Distal A2 – Pericallosal Artery, which was directed superiorly, was likewise noted. The aneurysm measured approximately 3.48 mm x 3.99 mm with a neck of 2.15 mm. During bi-coronal craniectomy, the left ACA – Pericallosal Artery was clipped together with the removal of the foreign body.

Figure 2. DSA, Left ICA Injection, Lateral View, Image A Shows a Slug in Situ at the Anterior Midline Area, Image B Shows an Aneurysm Measured Approximately 3.48 mm x 3.99 mm with a Neck of 2.15 mm.

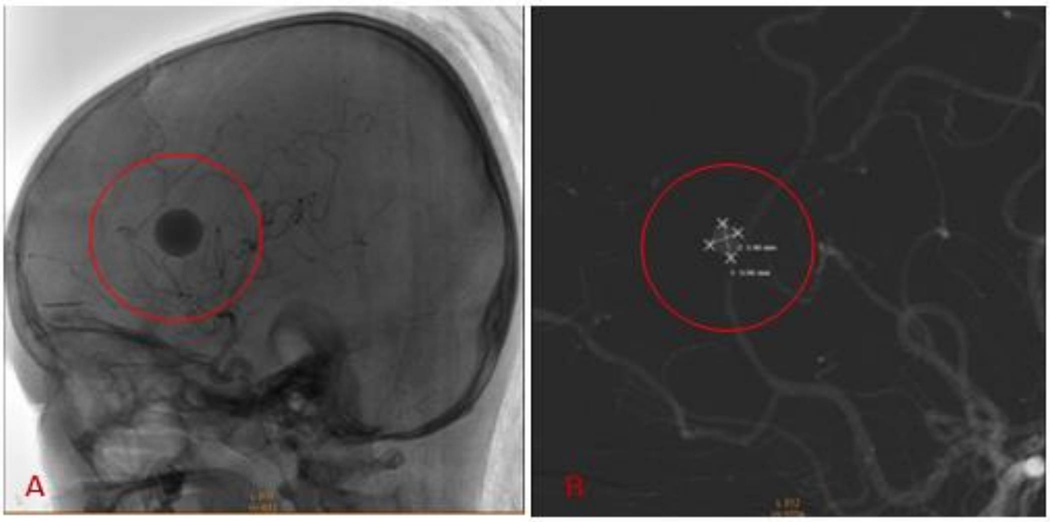


Figure 2.1. DSA, Left ICA Injection, AP (A) and Lateral (B) View Shows the Pseudoaneurysm from the Left Peri-Callosal Artery.

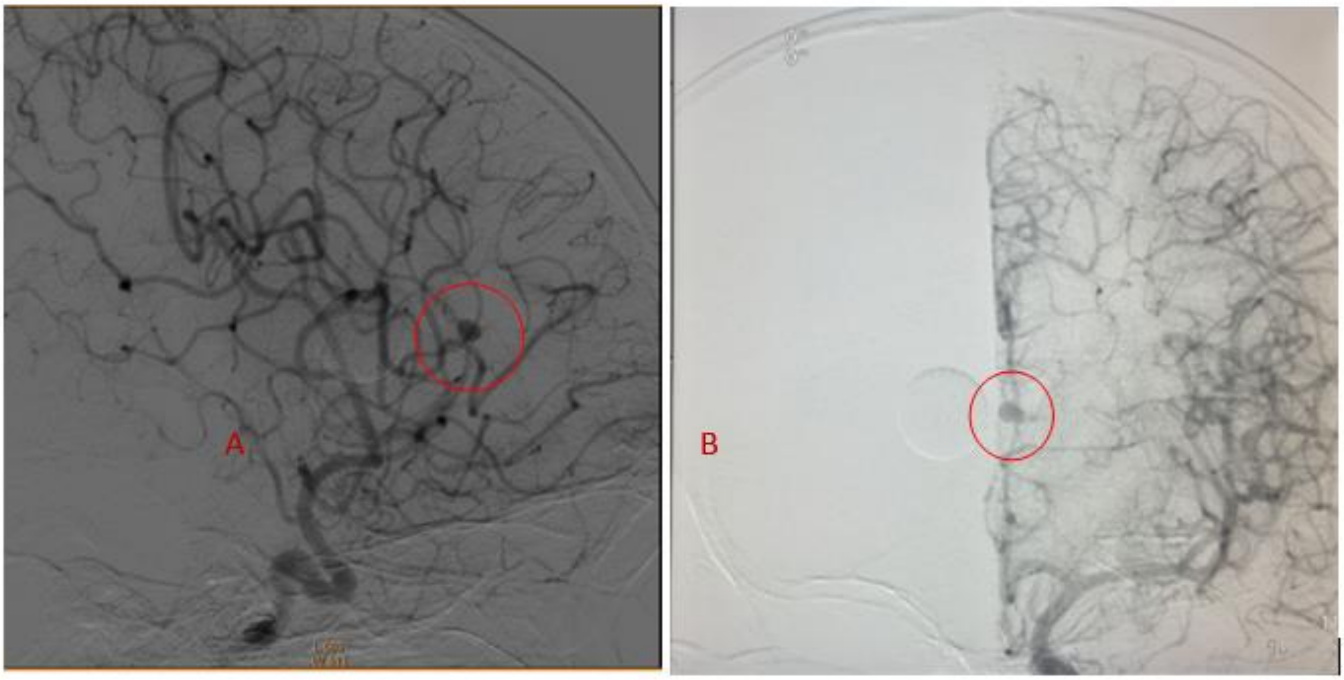
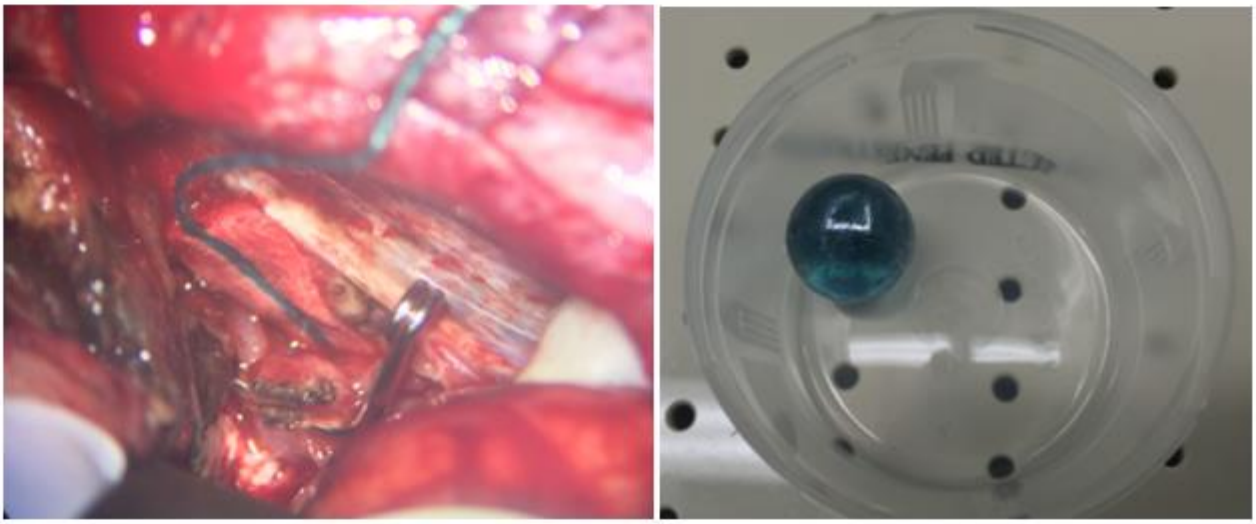


Figure 2.2. Intra-Operative Photo of the Clip Applied on the Left Peri-Callosal Pseudoaneurysm (A). The Foreign Body that was Removed During Craniectomy (B).

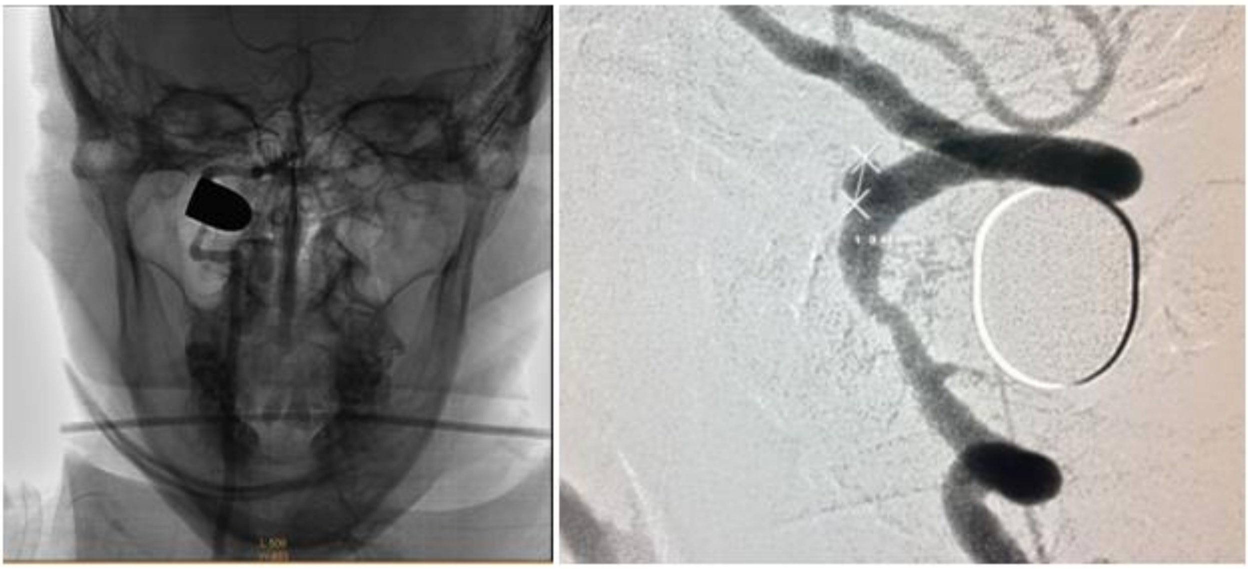


Case 3

A 43-year-old male was shot in the head. The bullet entered the posterior aspect of his neck with no point of exit. A cervical CT scan revealed a fractured posterior arc of C1 and a retained foreign object at the left aspect of the C1 lamina measuring approximately 14 mm x 12 mm. Cerebral Catheter Angiography was conducted which showed a pseudoaneurysm of the V3 segment of the vertebral artery that was directed superiorly. The aneurysm measured approximately 3.4 mm x 3.57 mm and vasospasm was also noted. No surgery was done and the patient was discharged after four days.

Figure 3. Skull Roentgenogram AP (A) and Lateral View (B) Shows a 14 mm x 12 mm Opaque Material at the Body of C1.

Figure 3.1. DSA, Right Vertebral Artery Injection, AP (A) and Lateral View Showing the Diameter of the Pseudoaneurysm (B).



Case Discussion

Traumatic aneurysms manifest in two primary forms: true aneurysms, characterized by an intact tunica adventitia, and pseudoaneurysms, arising from a cavity formed by a clotted hematoma resulting from a complete vessel wall transection [2,3]. The trajectory of traumatic pseudoaneurysms is challenging to ascertain, as they may either gradually expand and rupture over weeks or months or spontaneously contract and disappear. Notably, even if initial shrinkage occurs, re-expansion is a possibility.

The broad definition of pseudoaneurysm encompasses arterial wall defects allowing arterial blood communication with the adjacent extra-luminal space, stemming from various causes such as inflammation, iatrogenic factors, and, pertinent to our discussion, penetrating head and neck trauma. In such cases, extravasating blood is contained by surrounding soft tissues and a compressed thrombus, forming a sac or cavity [4]. Complications associated with traumatic pseudoaneurysms are unpredictable and pose a substantial risk of morbidity and mortality.

Intracranial pseudoaneurysms, often arising from post-blunt or penetrating head injuries [5], have been studied extensively. A study during the Iran-Iraq war, conducted by Aarabi, utilized Cerebral Catheter Angiography approximately 17 days post-injury, detecting aneurysms in 3% of the 255 patients examined. Neurologic symptoms, injury nature, entry point, and trajectory significantly influence the urgency for detection and intervention. Interventions for traumatic pseudoaneurysms vary based on anatomic configuration and location. Endovascular approaches are less invasive but challenging [6], while craniotomy for trapping or clipping of the aneurysm may be warranted. [8-13]

Recommendations for further diagnostic studies following penetrating head injuries target orbitofaciocraniocerebral injuries near the pterion and cases with CT scans revealing hematomas [3,7,8]. Cerebral Catheter Angiography, with its 99.3% sensitivity, is a valuable tool for detecting pseudoaneurysms in such injuries. In addition, CCA depicts the dynamic flow of intracranial blood vessels which is an instrumental arsenal in surgical planning. The angiogram results serve as a crucial guide during intracranial surgery, aiding in determining the appropriate intervention strategy for optimal patient outcomes.

Conclusion

In the context of penetrating head and neck trauma, various diagnostic and screening modalities can be employed to identify vascular lesions, with computed tomography angiography (CTA) being one such screening tool. However, it has been observed that CTA exhibits diminished sensitivity and specificity, particularly in the presence of metallic artifacts, as might occur with a retained knife blade. In situations involving such artifacts, Digital Subtraction Angiography (DSA) remains the preferred modality for detecting associated vascular injuries.

Notably, DSA's sensitivity is comparatively lower for non-traumatic intracerebral aneurysms involving the second and third-order branches of the intracranial vessels. Digital Subtraction Angiography is a computer-assisted radiographic visualization technique specifically focused on the carotids and cerebral vessels, offering minimal interference from background tissue. The process involves highlighting blood vessels, leading the researcher to posit that DSA serves as the gold standard imaging choice for patients admitted due to penetrating head and neck trauma.

References

1. Saad N.E., Saad W.E., Davies M.G., Waldman D.L., Fultz P.J. Rubens D.J. Psueudoaneurysm and the role of minimally invasive techniques in their management. Raduigraphic. 2005;25 (Suppl. 1): S173-S189.
2. Amirjamshidi A, Rahmat H, Abbassioun K. Traumatic aneurysms and arteriovenous fistulas of intracranial vessels associated with penetrating head injuries occurring during war principles and pitfalls in diagnosis and management. J Neurosurg 1996;84:769–780.

3. Aarabi B. Management of traumatic aneurysms caused by high-velocity missile head wounds. Neurosurgery clinics of North America [Internet]. 2013 [cited 2023 Dec 19];6(4). Available from: https://pubmed.ncbi.nlm.nih.gov/8527918/.
4. Kotapka M Kaila KK. Martinez AJ, Sekhar LN. Infiltration of the carotid artery by cavernous sinus meningioma. J Neuro-surg 1994;81:252-255.
5. Head injury prognosis. http://www.trialscoordinatingcentre.lshtm.ac.uk/Risk%20calculator/index.ht [Accessed 09.09.16).
6. Aarabi B. Et al. Management and prognosis of penetrating brain injury. J. Trauma. 2001;51(suppl):S1-S85.
7. 7. Cohen JE, et al. Results of endocasvular treatment of traumatic intracranial aneruerysms. Neurosurgery. 2008;63:476-485
8. Parent AD, Smith RR. Traumatic aneurysm complicating EC-IC bypass: successful surgical clipping. Surg Neurol 1981;15: 229-231.
9. Ahuja A, Guterman LR, Hopkins LN. Carotid cavernous fistula and false aneurysm of the cavernous carotid artery: complicatins of transsphenoidal surgery. Neurosurgery 1002:31:774-779.
10. Dario A. Dorizzi A, Scamoni C, Certai M, Grimaldi GB. Iatrogenic intracranial aneruysm: case report and review of literature. J Neurosurg Sci 1997:41:195-202.
11. Cosgrove GR, Villemure JG, Melancon D. Traumatic intracranial aneurysm due to arterial injury at surgery: case report. J Neurosurg 1983;58:291–294.
12. Frank G, Galassi E. Aneurysmal dilatation of ICA after tumor resection. J Neurosurg 1992;76:169–170.
13. Hudgins PA, Browning DG, Gallups J, et al. Endoscopic paranasal sinus surgery: radiographic evaluation of severe complications. AJNR Am J Neuroradiology 1992;13:1161–1167.
14. Adeel M Ikram M. Post traumatic pseudoaneurysm of internal carotid artery: a cause of intractable epistaxis BMJ Case Rep 2012: 2012 May 23 [Epub] http://dx.doi.org/10,1136/bcr.02.2012.5927.
15. Amenta PS, Starke RM, Jabbour PM, Tjoumakaris SI, Gonzales LF, Rosenwasser RH, et al/ Succesful treatment of traumatic carotid pseudoaneurysm with pipeline stent: case report and review of literature. Surg Neurol Int 3:160, 2012.