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CASE STUDY

CAROTID-JUGULAR FISTULA FOLLOWING A BOMB EXPLOSION: A CASE STUDY OF RARE FISTULA

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Abstract

Background: Traumatic arteriovenous fistula (TAVF) is a rare vascular injury, usually caused by blast trauma and is on the rise in Yemen due to the ongoing war there for 14 years. This report describes a case of TAVF that occurred 5 days before the patient sought help and presented to the hospital.
Case presentation: A 16-year-old male with unknown past medical history presented five days after a bomb blast with penetrating trauma to the second zone of the neck. Physical examination revealed a tremor over the site of injury, suggestive of vascular injury, but the patient had no active bleeding, neurologic deficit, or expansive hematoma. Computed tomography (CT) angiography findings were critical in confirming a traumatic arteriovenous fistula and guiding the surgical approach for exploration and repair. Surgical exploration identified a carotid-jugular fistula between the posterolateral common carotid artery and the medial internal jugular vein. Computed tomography angiography findings confirmed successful closure of the fistula with preservation of vascular integrity and no immediate postoperative complications.
Conclusion: This case report describes the successful surgical management of a rare carotid-jugular fistula after a bomb blast. The positive outcomes, including preservation of neurological function and vascular integrity, highlight the importance of prompt surgical intervention and the potential for excellent recovery in traumatic vascular injuries.
Keywords: Common carotid artery (CCA), Internal jugular vein (IJV), Carotid-Jugular Fistula (CJF), CT Angiogram.

INTRODUCTION

Penetrating neck trauma poses significant challenges due to the high density of vital structures, including major blood vessels, cranial nerves, and the aerodigestive tract[1,2]. The prevalence of vascular injury due to military engagements in Iraq and Afghanistan has been reported to be 12%, a five-fold increase over that found in Southeast Asia[3]. In Yemen, we have encountered more vascular cases due to war. Trauma in the Zone II area is associated with potential vascular injuries that require prompt recognition and management, including the rare traumatic common carotid artery–internal jugular vein (CJF) fistula, which, if left untreated, is likely to lead to high-output heart failure, embolism, and/or atrial fibrillation[2,4]. This case report describes the management of a rare carotid-jugular fistula in a 16-year-old male following a bomb explosion after 5 days. The case underscores the importance of thorough clinical evaluation, prompt surgical intervention, and careful postoperative management in trauma-induced vascular injuries. The two primary objectives of therapy for vascular traumatic injuries are bleeding control and perfusion restoration. The most common causes of acquired carotid-jugular fistula include central vein catheterization, gunshot wounds, and neck knife wounds. Blunt trauma is an uncommon reason[5]. These patients typically manifest as persistent neck thrills, tinnitus, and pulsatile edema. To treat these fistulas,

endovascular and surgical approaches have been employed[6].

CASE STUDY

A 16-year-old male with no past medical history presented to the hospital complaining of right neck pain. The case began 5 days prior to admission as a gunshot wound that had caused a water tank to explode, resulting in very small fragments penetrating the right side of the neck (zone 2). The wound was crusted and without significant bleeding, and the patient remained at home without medical consultation. On the second day, he developed fever at the site of injury. On arrival, the patient had a clear airway, was breathing spontaneously, and showed normal vital signs. He did not show hemoptysis, dilated hematoma, pulsatile, or neurological deficit. Physical examination revealed an old crusted wound of approximately 2 mm, and a tremor over the right side of the neck at the site of injury, but the pulses in the upper and lower extremities were intact. The patient was hemodynamically stable, with a blood pressure of 110/70 mm Hg with a pulse rate of 81 breaths/m, heart rate, and respiratory rate of 15 breaths/m, and a normal temperature of 37.1°C.

Investigations

Laboratory investigations were normal. A CT scan of the neck was performed to evaluate the vascular structures and identify any traumatic arteriovenous connections. The scan revealed a direct communication between the posterolateral wall of the common carotid artery (CCA) and the medial border of the internal jugular vein (IJV), consistent with a carotid-jugular fistula. The fistula measured approximately 3.78 mm in diameter and was located in the second zone of the neck, confirming the clinical suspicion.

Findings

No evidence of active leakage or pseudoaneurysm formation. The internal carotid artery (ICA) and external carotid artery (ECA) were intact and free of significant stenosis. The internal jugular vein (IJV) showed turbulent (congested) flow due to the fistulous connection. No significant hematoma or signs of vascular dysfunction were noted, (Figure 1).

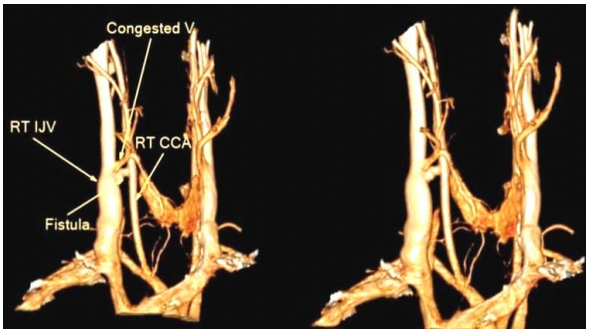

Figure 1: Direct communication between the posterolateral wall of the common carotid artery (CCA) and the medial border of the internal jugular vein (IJV), consistent with a carotid-jugular fistula.

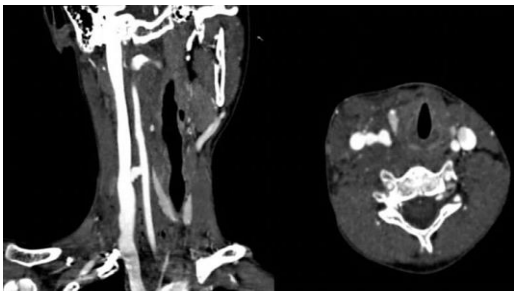

Figure 2: The internal jugular vein (IJV) showed turbulent (congested) flow due to the fistulous connection. No significant hematoma or signs of vascular dysfunction were noted.

Surgical Approach

The patient was transferred to the operating room for surgical exploration and repair of the carotid-jugular fistula. The procedure was performed within 1 hour of antibiotic administration and under general anesthesia, with the patient in the supine position and the neck slightly extended to facilitate exposure of the vascular structures. Standard sterile technique was used throughout. A standard neck incision was made parallel to the medial border of the sternocleidomastoid muscle (SCMM), followed by exploration of the carotid sheath. The common carotid artery (CCA) and internal carotid artery (ICA) were controlled with vascular loops to minimize blood loss. Systemic heparin (5000 IU) was administered prior to further dissection and the vessels were serially clamped. After further dissection, a fistula was identified between the posterior lateral central carotid artery and the medial internal jugular vein (IJV). The fistula was ligated using sutures (e.g., 7-0 Prolene) to ensure complete closure of the arteriovenous connection, and the vessels were inspected for additional injuries. Bleeding was confirmed to have stopped after ligation, with no evidence of residual bleeding or abnormal blood flow. The blood vessels remained open, and blood flow was restored with no evidence of vascular dysfunction. Mild congestion of the internal jugular vein was noted, which was expected after ligation of the fistula. After ensuring that bleeding had stopped adequately, the wound was flushed with normal saline to reduce the risk of infection. The patient was extubated and transferred to the recovery room in stable condition. Vital signs were closely monitored, and follow-up was performed daily.

Outcome and Follow-up

After the surgery, the patient remained conscious and alert, and had no neurological deficits. The common carotid artery pulse was intact bilaterally, and the internal jugular vein appeared congested, but without clinical complications. There was no residual irritation at the lesion site, confirming successful closure of the fistula. In addition, the patient did not show any changes in voice, tongue deviation, or difficulty swallowing, indicating that no cranial nerves were damaged during the surgery. However, we were unable to repeat CT angiography or any other examinations due to poor condition and fear of retaliation as a result of the civil offense, so the patient was discharged from

the hospital against medical advice to continue hospitalization for observation. The patient was discharged after only 7 days of observation, with instructions for regular follow-up. No complications were noted during follow-up visits, and the patient continued to show normal neurological and vascular function.

DISCUSSION

Penetrating neck trauma, particularly in Zone II, presents unique challenges due to the anatomical concentration of critical structures, including the carotid artery, jugular vein, cranial nerves, and the aero digestive tract[1,2]. This case involves a rare arteriovenous fistula between the common carotid artery and internal jugular vein (IJV), a condition that has an incidence of only 4-7% in vascular injuries[4]. The patient's lack of significant bleeding and the presence of a thrill at the injury site were crucial diagnostic signs, pointing toward a vascular injury despite the absence of other common symptoms such as hemoptysis or expanding hematoma[7].

Figure 3: A standard neck incision was made parallel to the medial border of the sternocleidomastoid muscle (SCMM), followed by exploration of the carotid sheath.

Various studies highlight both similarities and contrasts to the case presented in this research. For instance, Tabanında *et al.*[8], described the successful surgical management of a CJF caused by an inadvertent arterial puncture, presenting with a palpable thrill at the base of the neck. This resonates with the thrill detected in our case, reinforcing the importance of early recognition of vascular injuries through clinical signs and imaging, followed by timely surgical intervention to achieve optimal outcomes. Similarly, the study by Heo *et al.*[6], on a delayed presentation of an ascending pharyngeal artery–internal jugular vein fistula caused by blunt trauma underscores how vascular injuries can manifest days after the initial trauma. This aligns with the delayed presentation of our patient five days post-injury, emphasizing that such vascular anomalies may remain undiagnosed until later clinical symptoms arise.
The use of a CT angiogram played a pivotal role in confirming the diagnosis, as it clearly visualized the fistulous connection between the CCA and IJV, facilitating surgical planning. Siletz and Inaba[7] provide a detailed diagnostic algorithm for managing penetrating neck trauma, recommending the use of CT Angiography (CTA) as the gold standard for evaluating vascular injuries. When CTA was conducted preoperatively, it confirmed the presence of a carotid-jugular fistula, consistent with the recommendations outlined by Siletz and Inaba[7]. This diagnostic approach is crucial, as undiagnosed vascular injuries can lead to significant morbidity, including hemorrhage, stroke, or congestive heart failure, as noted in late-presenting cases like that described by Chen *et al.*[9], where delayed diagnosis of multiple fistulas resulted in severe cardiovascular complications.

Figure 4: The internal jugular vein was noted to be mildly congested, which was anticipated post-ligation of the fistula.

Further supporting the significance of prompt and accurate diagnosis, which highlights a case of an arteriovenous fistula (AVF) of the superficial temporal artery, where the combination of surgical and endovascular treatment was required. Although this case pertains to a different anatomical region, it underlines the complexity of AVF management in trauma cases and the potential for hybrid approaches to enhance patient outcomes. Our case, managed solely with surgical ligation, reflected the traditional approach in resource-limited settings, but future consideration of hybrid techniques could prove beneficial in facilities with access to advanced technologies[10].
Gomez and Abeykoon[10] describe emergency surgery for penetrating neck trauma involving the common carotid artery, with the patient presenting in shock. Although our patient was hemodynamically stable, this study parallels the urgency and critical nature of surgical intervention in severe vascular trauma cases, where any delay could result in life-threatening complications. Similarly, Puca and Pignatelli[11] discuss an idiopathic carotid-jugular fistula, which, while not trauma-related, offers insight into the treatment strategies applicable to AVFs. The preservation of neurological and vascular function in both cases following surgical intervention highlights the effectiveness of prompt surgical management.
Massara *et al.*[12], introduce a hybrid two-stage technique for treating post-traumatic CJFs, combining surgical and endovascular methods. This approach differs from our case, where surgery was the sole intervention due to limited resources. However, the success of their hybrid technique suggests that integrating minimally

invasive options could potentially reduce patient morbidity and improve outcomes, particularly in complex trauma cases. This technique could be considered for future cases if technological resources become available. Moreover, Góes Junior *et al.*[2], reaffirm the role of surgical correction in treating traumatic CJFs, with similar successful outcomes in maintaining vascular integrity. Their study, along with Nawrocki *et al.*[13], who describe a delayed presentation of a CJF caused by blunt trauma from an arrow, reinforces the importance of vigilance in detecting and managing AVFs even when symptoms are delayed. Both studies underscore the need for high clinical suspicion and comprehensive imaging to guide treatment, particularly in trauma cases where the initial presentation may be misleading.

Finally, Raherinantenaina *et al.*[14], and Patel *et al.*[15], contribute to the discussion by addressing the challenges in managing CJFs in resource-limited settings and in cases of iatrogenic causes, respectively. Raherinantenaina *et al.*[14], highlight the difficulties posed by socio-political constraints, which are mirrored in our case, where the patient was discharged against medical advice due to fears related to the ongoing conflict. Our patient's postoperative course was uneventful, with intact neurological function, a stable carotid pulse, and no residual thrill at the site of injury. This high-light the importance of timely surgical intervention in achieving favorable out-comes for penetrating vascular injuries. The follow-up period, although limited due to the patient's discharge against medical advice, indicated no major complications or signs of vascular compromise. Also our patient couldn't inability to perform follow-up imaging due to low income and a socio factor leaves some uncertainty regarding the long-term vascular and neurological prognosis.

Limitations of the study

The main limitations of this study are that it is a case report where generalizability is not possible and a causal relationship cannot be established. In addition, there may be significant biases regarding publication and retrospective study design due to the focus on rare or unusual cases.

CONCLUSIONS

The delayed diagnosis complicates the clinical course, requiring thorough investigation even days after the injury. The use of CT Angiography (CTA) as the gold standard for evaluating vascular injuries even in cases where symptoms are delayed. While endovascular options are increasingly used for fistula management, open surgical repair remains the gold standard in settings where resources for complex endovascular interventions may be limited or when immediate access to vascular structures is required for hemostasis and repair.

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AUTHOR'S CONTRIBUTIONS

Al-Madwahi NY, Al-Dailami KI: writing original draft, methodology, investigation. **Al-Moyed KA, Al-Shamahi EH:** formal analysis, data curation, conceptualization. **Al-Shamahy HA, Al-dossary OAI**: formal analysis, data curation, conceptualization. Final manuscript was checked and approved by all authors.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.,

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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