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Case Report

Management of neonatal upper limb trauma complicated by arterial injury: A case report

Man Duc Minh Phan [a], Ly Thi Thanh Nguyen [b], Tien Minh Nguyen [b], Phi Duong Nguyen [b,*]

[a] Pham Ngoc Thach University of Medicine, Ho Chi Minh City, Viet Nam
[b] City Children's Hospital, Ho Chi Minh City, Viet Nam

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ABSTRACT

This case report presents the clinical course and management of a 29-day-old female infant who presented with upper limb trauma secondary to entrapment beneath a sewing machine. Following admission, the patient exhibited clinical signs consistent with arterial injury and compartment syndrome, necessitating prompt diagnostic evaluation and surgical intervention. Despite challenges in arterial visualization via Doppler ultrasound, radiographic imaging confirmed displaced distal humerus fracture of the left upper limb, prompting further evaluation and surgical planning. Surgical decompression and stabilization were performed, followed by successful endovascular intervention utilizing digital subtraction angiography (DSA) to restore arterial perfusion. Subsequent development of compartment syndrome necessitated emergent fasciotomy, followed by wound care and skin grafting. Multidisciplinary rehabilitation facilitated optimal recovery, with the patient demonstrating improved motor function and sensory perception at six-month follow-up. This case underscores the importance of timely recognition, multidisciplinary collaboration, and prompt intervention in managing pediatric upper limb trauma complicated by arterial injury and compartment syndrome.

Introduction

Neonatal upper limb trauma is a rare but clinically significant condition that presents unique challenges in diagnosis and management [1]. While pediatric trauma cases often involve falls or accidental injuries, neonatal injuries, particularly those affecting the upper extremities, can occur in diverse settings, including at home or in healthcare environments [2]. Despite their infrequency, these injuries can have profound implications for both short-term and long-term outcomes, necessitating a thorough understanding of their presentation, diagnosis, and management strategies.

In this context, we present a case report of a 29-day-old female infant who experienced upper limb trauma secondary to a sewing machine accident. The case underscores the importance of timely recognition and intervention in neonatal trauma cases, especially when complicated by arterial injury. Through a detailed examination of the patient's clinical course and treatment, we aim to contribute to the existing body of knowledge regarding the management of neonatal upper limb trauma and highlight key considerations for clinicians faced with similar cases.

* Corresponding author at: City Children's Hospital, 15 Vo Tran Chi Street, Tan Kien ward, Binh Chanh district, Ho Chi Minh City, Viet Nam.
E-mail address: nguyenduongphi1311@gmail.com (P.D. Nguyen).

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Case presentation

A 29-day-old female infant was admitted to our hospital following upper limb trauma sustained from an incident involving a sewing machine. The patient's mother inadvertently caught the infant's arm in the sewing machine, resulting in the machine toppling over and exerting pressure on the affected limb. Upon presentation to the hospital, approximately 30 min post-injury, the infant exhibited significant swelling and discomfort in the elbow and forearm region.

Initial assessment at the primary care facility involved the application of a wooden splint and attempted Doppler ultrasound examination of the arterial flow in the affected limb. However, due to the difficulty in visualizing the arterial flow, the decision was made to transfer the patient to our institution, a tertiary pediatric hospital, for further evaluation and management.

Upon arrival at our hospital, the infant's physical examination revealed pronounced bruising and swelling in the elbow and forearm, with pallor observed in the fingertips. The affected area felt cool to the touch, and no pulsatile arterial flow could be palpated. Pulse oximetry readings were unable to detect oxygen saturation in the affected limb, and capillary refill time was prolonged, exceeding 3 s (Fig. 1).

Radiographic evaluation with X-ray imaging confirmed fractures involving displaced distal humerus in the left upper limb, specifically a trans-physeal separation (Fig. 2). Additionally, suspicion of arterial injury was raised based on the clinical presentation and imaging findings, leading to a provisional diagnosis of closed fractures with associated arterial trauma involving the left upper extremity.

Prompt surgical intervention was deemed necessary to address both the bony fractures and the suspected arterial injury. An L-shaped anteromedial approach was employed to expose, reduce, and stabilize the fracture and access the vascular structures. Surgical exploration revealed compression of the brachial artery with compromised distal flow, necessitating immediate decompression to restore vascular perfusion to the affected limb. Two Kirschner wires were placed in a crossing pattern to stabilize the fracture.

Following surgical decompression and stabilization of the fractures, the patient was closely monitored in the postoperative period. However, one hour post-surgery, signs of ischemia persisted, with the affected limb exhibiting persistent pallor, decreased temperature, and absent pulsatile arterial flow (Fig. 3). An urgent digital subtraction angiography (DSA) was performed, confirming arterial obstruction necessitating further intervention.

The nature of the vascular occlusion was identified as a thrombotic event, and endovascular intervention was successfully performed to dilate the vessel and restore flow.The occlusion was negotiated with a wire, and the vessel was dilated to restore flow (Supplementary video), resulting in improved distal perfusion to the affected limb. Subsequent clinical assessment revealed resolution of ischemic symptoms, with improved capillary refill time and restoration of oxygen saturation in the affected limb.

Despite successful vascular intervention, the patient developed signs of compartment syndrome, characterized by progressive swelling, tense compartments, and compromised tissue perfusion (Fig. 4). Prophylactic fasciotomy was performed to alleviate compartmental pressure and prevent further tissue damage (Fig. 5).

In the postoperative period, the patient underwent wound care and was closely monitored for signs of infection or vascular compromise. Six days following surgical intervention, the patient underwent skin grafting to address tissue loss and promote wound healing (Fig. 6). At four weeks post-operation, the Kirschner wires were removed following X-ray confirmation of bone healing.

Subsequent follow-up assessments revealed satisfactory wound healing and gradual improvement in motor function and sensation in the affected limb. At the six-month follow-up, the patient demonstrated a full range of motion in both the elbow and fingers, with significant recovery in limb function, including improved motor skills and sensory perception.

Throughout the course of hospitalization and subsequent rehabilitation, the patient received multidisciplinary care involving pediatric surgery, orthopedics, vascular surgery, and rehabilitation services. Physical therapy and occupational therapy interventions

Fig. 1. Pallor left limb.

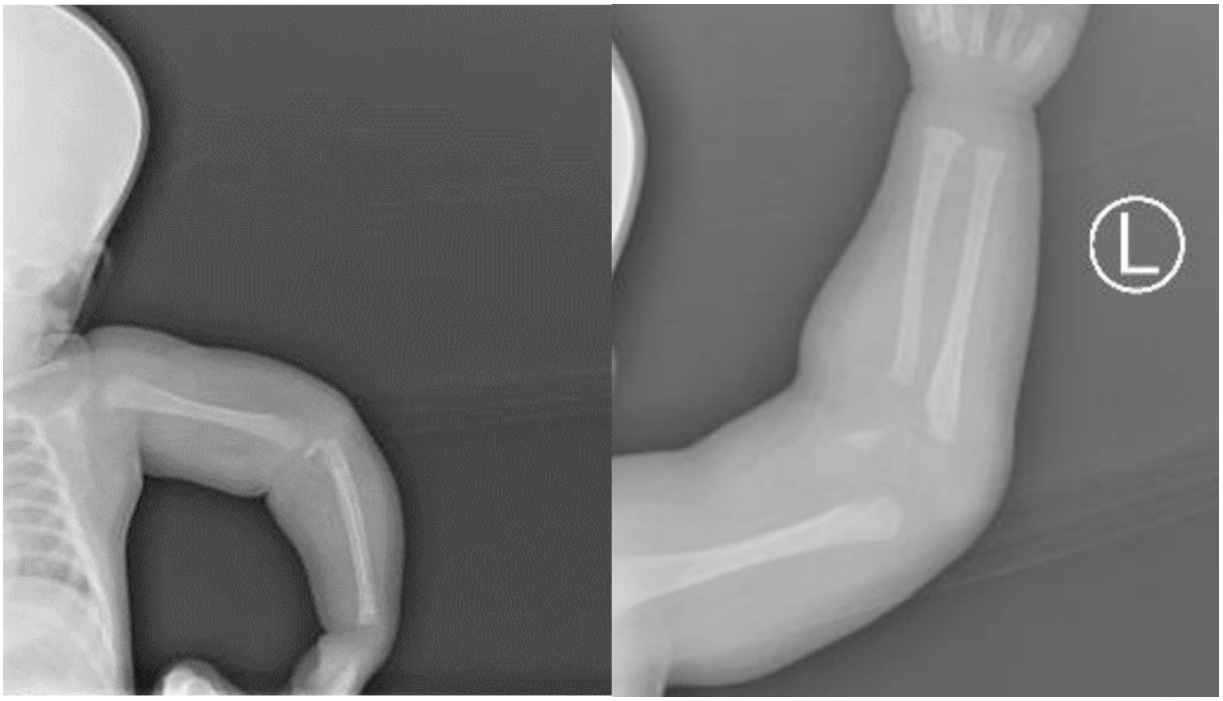

Fig. 2. X-rays of the case.

Fig. 3. Patient condition after first operation.

were initiated to facilitate optimal recovery and functional outcomes.

Overall, the case highlights the complexity and challenges associated with neonatal upper limb trauma, particularly when complicated by arterial injury and compartment syndrome. Timely recognition, multidisciplinary collaboration, and prompt intervention are essential in achieving favorable outcomes in such cases.

Discussion

The management of pediatric upper limb trauma, particularly in cases complicated by arterial injury and compartment syndrome, presents unique challenges requiring a multidisciplinary approach [3].

Arterial injuries in pediatric patients are relatively uncommon but can result in significant morbidity if not promptly recognized

Fig. 4. Swelling limb after endovascular intervention.

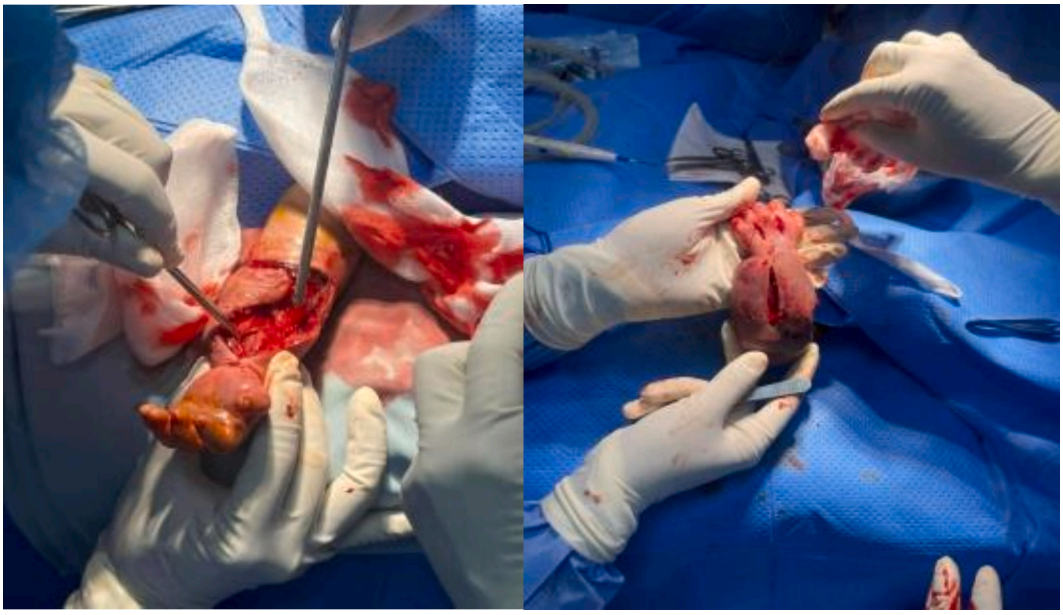

Fig. 5. Emergent surgical fasciotomy performed.

and managed [4]. In this case, the patient's presentation with upper limb trauma following entrapment beneath a sewing machine led to suspicion of arterial injury due to the presence of swelling, discoloration, and impaired perfusion. Although Doppler ultrasound, a commonly employed diagnostic modality, initially posed challenges in visualizing arterial flow, radiographic imaging confirmed distal fracture of the humerus, raising concerns for underlying arterial damage. This highlights the importance of maintaining a high index of suspicion for vascular injury in the setting of traumatic limb injuries, particularly when clinical findings are suggestive but imaging modalities are inconclusive.

Prompt surgical intervention is paramount in addressing arterial injuries to prevent ischemic complications and optimize limb salvage [5]. In this case, surgical exploration and decompression were performed, followed by endovascular intervention utilizing digital subtraction angiography (DSA) to restore arterial perfusion. DSA offers superior visualization of vascular anatomy and allows for precise localization of arterial lesions, facilitating targeted interventions such as angioplasty or stent placement. The successful restoration of arterial flow underscores the efficacy of endovascular techniques in the management of pediatric arterial injuries, with DSA serving as a valuable tool in guiding therapeutic decision-making and optimizing outcomes.

Fig. 6. Skin grafting result.

Compartment syndrome, characterized by increased tissue pressure within a confined anatomical space, represents a potential complication of traumatic limb injuries and vascular compromise [6]. Despite successful arterial revascularization, the development of compartment syndrome in this case necessitated emergent fasciotomy to prevent irreversible tissue damage and optimize limb viability. Fasciotomy involves incision and release of the fascial compartments surrounding the affected limb, relieving pressure and restoring perfusion. Timely recognition and intervention are crucial in mitigating the sequelae of compartment syndrome, emphasizing the importance of close clinical monitoring and prompt surgical consultation in high-risk cases [7].

In this case, fasciotomy was performed prophylactically due to prolonged ischemia and the high risk of developing compartment syndrome. This decision was based on clinical signs and the potential for significant morbidity associated with delayed intervention. The proactive approach of performing a prophylactic fasciotomy can be crucial in similar cases to prevent the progression of compartment syndrome, which can result in severe and permanent damage to the limb. Given the complexity and potential complications of such injuries, it is advisable to consider prophylactic fasciotomy in situations where prolonged ischemia is evident and the risk of compartment syndrome is high.

The management of pediatric upper limb trauma extends beyond acute interventions to encompass comprehensive rehabilitation and long-term follow-up. Multidisciplinary rehabilitation programs tailored to the individual needs of the patient are essential in promoting functional recovery and optimizing outcomes [8]. In this case, postoperative rehabilitation included wound care, physical therapy, and occupational therapy, aimed at improving motor function, sensory perception, and overall quality of life. The favorable outcome observed at six-month follow-up underscores the importance of coordinated, multidisciplinary care in achieving optimal recovery following complex pediatric trauma.

Conclusion

In conclusion, the presented case highlights the challenges and complexities associated with upper limb trauma in pediatric patients, particularly when complicated by arterial injury and compartment syndrome. Timely recognition, multidisciplinary collaboration, and prompt surgical intervention are essential in achieving favorable outcomes and minimizing long-term sequelae in such cases. Continued research and clinical vigilance are warranted to further enhance the management of pediatric upper limb trauma and optimize patient outcomes.

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CRediT authorship contribution statement

Man Duc Minh Phan: Writing – review & editing, Writing – original draft, Supervision, Data curation, Conceptualization. **Ly Thi Thanh Nguyen:** Visualization, Formal analysis. **Tien Minh Nguyen:** Writing – review & editing, Supervision. **Phi Duong Nguyen:** Writing – review & editing, Writing – original draft, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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