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Management of maxillofacial trauma accompanying the gunshot severe injuries of femoral arteries: A case report from Iraq

Abstract. Femoral vascular trauma is a distinctive condition for every patient that needs an individual special urgent care and management approach to reduce mortality in the golden hour. Nonetheless, the risk persists in polytrauma patients accompanied by maxillofacial injuries. This study documents life-threatening bilateral femoral injuries by a gunshot that was accompanied by maxillofacial trauma. **Methods.** In the emergency room of the field hospital at north of Iraq, a 35-year-old man was presented with a deteriorating condition due to multiple gunshot injuries. The patient was suffering from complete severance to the right and left superficial femoral arteries, left superficial femoral vein, femoral nerve, and maxillofacial injuries. Femoral blood vessels were first managed to stabilize the patient's condition. Then, intermaxillary fixation and mandibular fracture were managed with screws for emergency and temporary fixation (by elastic, then by wires). One month postoperative, the patient revealed complete healing, but the patient suffered from intermittent lameness due to left femoral nerve injury. **Conclusion.** To the author's knowledge, this is the first case report that documented the successful rescue of maxillofacial trauma associated with multiple gunshot femoral vessels severe injuries with an early return of the traumatic patient to his normal function.

Key words: femoral arteries, gunshot wound, maxillofacial injuries, polytraumas, vascular traumas

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Лечение челюстно-лицевой травмы, сопровождающейся тяжелыми огнестрельными ранениями бедренных артерий: клинический случай из Ирака

Реферат. Травма бедренных сосудов — особое состояние для пациента, требующее индивидуального подхода к оказанию неотложной помощи и лечению с целью снижения смертности в «золотой час». Тем не менее у пациентов с политравмой, сопровождающейся челюстно-лицевыми травмами, риск сохраняется. В данном исследовании описаны угрожающие жизни двусторонние повреждения бедренных артерий в результате огнестрельного ранения, сопровождавшегося челюстно-лицевой травмой. **Методы.** В отделение неотложной помощи полевого госпиталя на севере Ирака поступил 35-летний мужчина с ухудшающимся состоянием в результате множественных огнестрельных ранений. У пациента наблюдался полный разрыв правой и левой поверхностных бедренных артерий, левой поверхностной бедренной вены, бедренного нерва, а также челюстно-лицевые травмы. В первую очередь были проведены меры по стабилизации состояния пациента путем лечения бедренных кровеносных сосудов. Затем проведены межчелюстная фиксация и лечение перелома нижней челюсти с помощью винтов для экстренной и временной фиксации (сначала эластичными, затем проволочными). Через месяц после операции пациент полностью выздоровел, но страдал от периодической хромоты из-за повреждения левого бедренного нерва. **Заключение.** Насколько известно авторам, это первый случай, когда было задокументировано успешное спасение пациента с челюстно-лицевой травмой, сопровождавшейся множественными тяжелыми повреждениями бедренных сосудов в результате огнестрельного ранения, с быстрым возвращением пациента к нормальной жизнедеятельности.

Ключевые слова: бедренные артерии, огнестрельное ранение, челюстно-лицевые травмы, политравмы, сосудистые травмы

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INTRODUCTION

Violence has contributed to rising mortality and is considered a significant health problem worldwide. The estimated average of violent fatalities between 2007—2012 was 508,000, comprising approximately 70,000 related to conflict, according to a report of the small arms survey [1]. Firearms are a chief device of associated injuries from both conflict and non-conflict violence that are responsible for about 46.3% of fatalities [1]. Iraq has suffered from continuous conflicts and sectarian violence since 2003, that associated estimated 63% of violent firearm-related fatalities [2].

Previous studies have provided less information on "multiple traumas" and detailed statistics on multiple trauma-related deaths due to war and civil conflict in Iraq. However, they do provide extensive data on total deaths, violent deaths, and excess deaths attributed to the 2003—2011 war in Iraq [3]. Subsequently adjusting for forced migration, the total estimate rises to 461,000 excess deaths. The introductory death rate during the war (March 2003 — June 2011) was 4.55 per 1,000 person-years, more than 0.5 times higher than the prewar rate of 2.89 per 1,000 person-years (January 2001 — February 2003) [4]. Previous researchers mentioned that 63% of violent deaths were caused by gunshots, 12% by car bombs, and 9% by other accidents [5].

According to sibling survey, the Adult deaths were estimated to be 376,000 deaths among age 15—60 years from March 2003 to June 2011. Of these, 187,000 were excess deaths (attributable to the conflict), with 132,000 deaths directly resulting from war-related violence. The researcher also displayed gender-specific deaths; they mentioned that the risk of death among men during the peak of the war (2005—2006) was 2.9 times higher than during the prewar period. At the same time, the risk of death among women during the same period was 0.7 times higher than it was in the prewar period. The sex ratio for violent deaths was 8.5 males per female [6].

Severe morbidity and mortality occur from multiple gunshot injuries. Femoral vascular involvement with gunshot injuries is an unusual injury form that needs rapid, coordinated interdisciplinary care to achieve acceptable consequences and save the patient's life [7].

The management of maxillofacial injuries resulting from gunshot wounds, especially when accompanied by significant damage to the femoral artery, requires a multidisciplinary approach that focuses on rapid assessment, stabilization, and definitive repair of facial and vascular injuries [8—10]. The most common facial region complex injuries result from gunshots involving hard and soft tissues. Therefore, early intervention is critical to restore function and aesthetics. The management strategies included airway management; establishing a safe airway is critical, especially in cases with significant facial trauma that may compromise breathing. The techniques range from endotracheal intubation to tracheostomy, depending on the severity of the injury [11—13].

Immediate and complete debridement of necrotic tissue, followed by primary closure of intraoral wounds, helps prevent infection and promote healing. Antibiotic coverage is essential during this phase. Additionally, early stabilization of mandibular and midface fractures using open reduction and internal fixation (ORIF) techniques is advised to repair structural integrity and function. A study of 409 patients with facial gunshot wounds reported that 66.3% underwent surgery with satisfactory results [14].

Most published research mentioned that treating bone and soft tissue injuries in a single surgical session can reduce the number of operations and decrease patient morbidity. This approach has been associated with favorable outcomes in the management of facial gunshot wounds [15].

Gunshot wounds to the femoral artery are life-threatening and require immediate attention to control bleeding and restore perfusion to the affected extremity. The control of bleeding by rapidly applying direct pressure, tourniquets, or hemostatic agents is essential to control active bleeding during the initial evaluation. Classic treatment often involves surgical exploration and repair of the arterial injury. The techniques used to include end-to-end grafting depend on the size of the injury, and it is estimated that overlapping grafting is used in autogenous vein grafts or synthetic grafts. The saphenous vein used in autologous grafts is preferred in cases with significant tissue loss due to lower infection rates [16].

In specified cases, especially when the patient is hemodynamically stable and the injury is treatable, vascular techniques such as covered stent placement can be used [17]. This approach delivers a less invasive alternative with the potential to reduce recovery times. A case report demonstrated the successful use of an 8×50 mm covered stent in a firearm-related superficial femoral artery injury, resulting in satisfactory blood flow and function.

Femoral shaft fractures are effectively cured with intramedullary fixing, exclusive of proper debridement of the wound or fracture [7, 8]. Nonetheless, emergent is required for revascularization of injured vessels, which takes priority before stabilization of the fracture bone [9—11]. Gunshot polytrauma, including maxillofacial injuries, provokes extreme challenges that complicate the management and treatment of patients. The maxillofacial area is highly vascularized and complicated by the presence of the upper respiratory system, oral cavity, and cranial and cervical structures that may parallel involved [13, 14]. Consequently, attention needs to be taken during the management of face gunshots, including securing the airway [18], controlling hemorrhage, and finding the exact repair methods for

traumatic facial defects. Consequently, this study presented a case report of a patient who affected with multiple firearm injuries, including bilateral femoral artery injuries and maxillofacial area trauma, and their management methods.

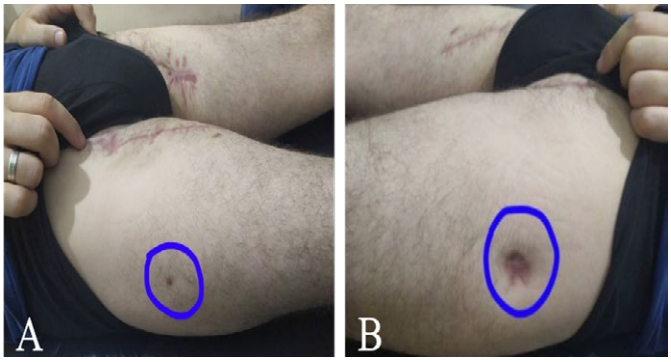

Fig. 1. A — inlet from right thigh; B — exit from left thigh 30 days after treatment

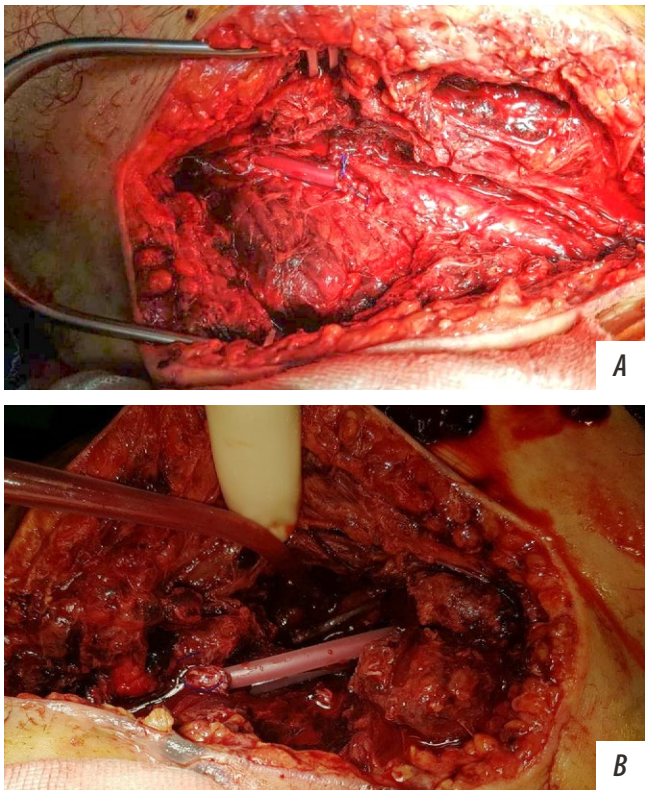

Fig. 2. The femoral artery (A) and the femoral vein after shunt placement (B)

Fig. 3. Chest X-ray at time of patient presentation

CASE REPORT

A 35-year-old man was shot by a firearm (June, 2021) at the Iraqi—Syrian borders. The patient was presented to the emergency room of Field Erbil General Hospital unconscious and in a state of hemorrhagic shock due to multiple gunshot injuries 60 minutes after sustaining the injuries. The bullet entry points were from the lateral aspect of the right upper thigh, passing through the perineum and the left thigh from medial to lateral where the exit point (fig. 1).

The patient suffered from complete severance to right and left superficial femoral arteries, left superficial femoral vein (fig. 2), and femoral nerve.

Clinical examination and management

The patient blood pressure was 60/40, pulse rate more than 120, cold extremities, & agitation with pulsatile bleeding from the left thigh controlled by manual compression in ER. The patient had absence of Doppler signals on both sides distally.

Immediately, the patient was transferred to the operative theatre for management, with maintaining compression on the bleeding left thigh. In theatre before commencing the surgery, the patient's status worsened. An expanding swelling was noticed in the right thigh and the patient then went suddenly into cardiac arrest. Immediate CPR was started and the patient regained cardiac activity after one cycle with active massive blood transfusion protocol. In the meanwhile the vascular surgeon had controlled the left femoral arterial bleeding with clamps and controlled the injured left superficial femoral vein. Then, the swollen right thigh was explored directly. Another complete cut to the right superficial femoral artery was found and controlled with clamps also. Since, the unstable patient's condition, emergency shunts with nasogastric 16-French tubes were inserted on both sides including the injured vein and the patient transported to another hospital with surgical ICU services. At that time the patient had transfusion of 9 blood units and 3 fresh frozen plasma (FFP) units with no platelets due to shortage of the patient's blood group blood. The patient continued to ooze from his wounds despite extra packing and compression and needed 7 more units of fresh blood, 5 FFP and 4 platelets.

Eight hours later the patient resuscitation, and was transferred back to theatre. A considerable size hematoma was seen upon exploring of the right side at a bleeding arterial branch. The artery was ligated and the hematoma evacuated. The surgery was terminated at this stage due to the excessive bleeding that happened during this process and the already placed shunts were left in place. The patient was returned to ICU for further stabilization. Chest X-ray was taken at day of presentation (fig. 3). Blood sample was collected and send for laboratory for blood analysis (see the Table).

A day after, the patient was re-explored and had removal of shunts on both sides. After these procedures little change

was seen in the Doppler signals bilaterally with persistent triphasic wave and good capillary refill in the feet. Both injured arteries were therefore ligated. The venous shunt was already thrombosed and it was removed and the vein ligated (fig. 4).

After that, the patient general condition was stabilized. Doppler signals bilaterally persisted and patient kept on heparin infusion 18 units/kg per 24 hours in ICU. Only mild swelling in left leg not necessitating fasciotomy was noted. The patient began ambulation day 3 post injury. He was discharged from ICU the next day and from hospital on day 7 and kept on oral anticoagulants (Rivaroxaban 15 mg ×2 daily). According to the life support principles, and after stability of the patient, the management of facial injuries was started. The posterior anterior X-ray of maxillofacial area revealed mandibular fracture only (fig. 5). Screw for intermaxillary fixation (IMF) considered as a typical device for emergency and temporary fixation (by elastic then by wires). The wires were passed between the maxillary teeth and between the mandibular teeth (fig. 6).

General investigations in different time intervals

Constituent	On ICU admission	After blood transfusion	After first operation	Condition stabilization
Glucose (mg/dL)	276	91	89	102
Urea (mg/dL)	—	27	23	24
Creatinine (mg/dL)	1.1	1.2	0.6	0.4
Hematology				
WBC (·10^9/L)	3.9	9.2	4.4	7.3
Neutro (%)	61	78	90	79
Lympho (%)	23	17	74	11
Mono (%)	23	5	21	10
Hemoglobin (g/dL)	8.3	10.0	8.4	9.0
Hematocrit (%)	26	31	26	28
Platelets (·10^9/L)	22	89	36	56
PTTK (sec)	—	90	50	40
PT (sec)	noclotting	21	15	15
INR	—	2.08	1.40	1.40
Activity, %	—	42.5	68.0	68.0
Serum electrolytes				
K$^+$ (mmol/L)	5.89	—	3.66	3.50
Na$^+$ (mmol/L)	128.56	—	138.80	134.00
Cl$^-$ (mmol/L)	101.94	—	107.40	108.00
Total Ca (mmol/L)	3.6	—	8.24	8.30
Ca^{2+} (mmol/L)	1.97	—	4.29	4.20
***p*H**	—	—	7.32	7.38
Arterial blood				
***p*H**	7.09	—	—	—
***p*CO$_2$ (mm Hg)**	46.6	—	—	—
***p*O$_2$ (mm Hg)**	98.0	—	—	—
Urine electrolytes				
K$^+$ (mmol/L)	—	—	—	14.50
Na$^+$ (mmol/L)	—	—	—	171.38
Cl$^-$ (mmol/L)	—	—	—	94.46

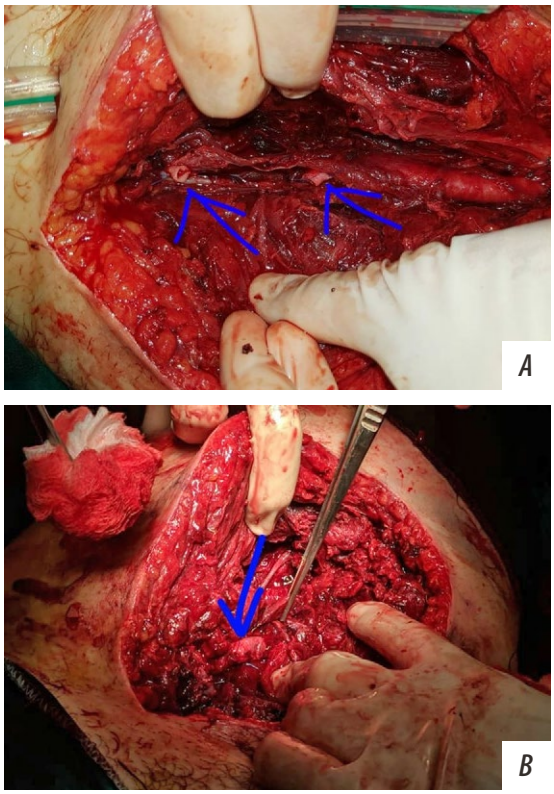

Fig. 4. A — the ends of ligated femoral artery; B — left femoral artery after ligation (arrow), femoral vein after ligation (held by Debakey forceps)

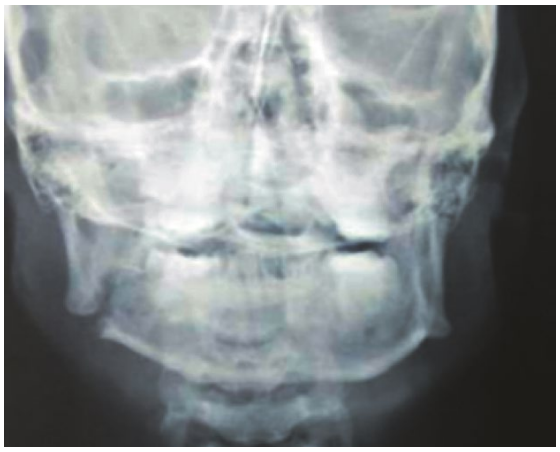

Fig. 5. Orthopantomogram showed a fracture angle of the mandible on the right

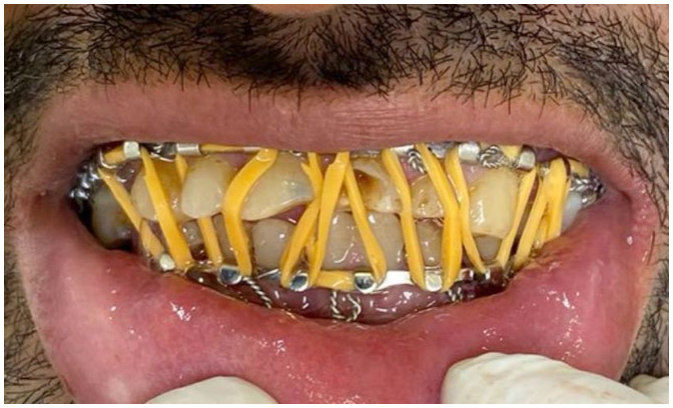

Fig. 6. The elastic IMF for occlusion reduction

DISCUSSION

Different treatment modalities used to treat patient with gunshots injuries because most studies about the treatment remain controversial and have not been designed adequately to provide satisfactory comparison [10, 19, 20]. However, there are many available publications which were documented and discussed the successful outcome and treatment of patients with gunshot of femoral vessel [8, 21] and maxillofacial injuries [22]. The management of firearm facial injuries specially the mandible continued controversies till today between the oral and maxillofacial surgeons [20, 21].

Moreover, an argument also raised about the surgical sequences of intervention [22]. Vascular intervention as well as fracture fixation need to be done first according to concept of previous researcher [17, 18]. In this current case report, the management of the vessels were done first in order to control the bleeding that aim to patients stabilization and these observations are similar to the above mentioned studies [9, 23].

Previous retrospective study presented twenty seven patients who suffered from gunshot injuries in both lower and upper extremity accompanied with fracture and vascular injury over a 10-year period [9]. The results of McHenry et al. (2003) approved that there were no cases of vascular repair disruption after fracture fixation in 22 cases. And they found that 4 of 5 patients who experienced orthopaedic fixation before revascularization needed fasciotomies while only 8 of 22 patients who were revascularized first required fasciotomies. Consequence, they established that orthopaedic fixation should be done after revascularization [9].

Most previous studies approved that most patterns of vascular injury require prompt diagnosis and treatment in order to improve the outcomes. This treatment may come in the form of definitive treatment or temporary measures intended to facilitate a safe delay in care [24].

In the current case report, the patient suffered from the total wall defects with bleeding and hematomas. This result agrees with previous observations reported by Feliciano et al. (2009), who divided the vascular injuries into 5 categories, as follows [25]:

1) intimal injuries including subintimal hematomas, flaps, disruptions;
2) total wall defects with bleeding, hematomas, or pseudoaneurysm;
3) total disruptions with bleeding and/or occlusions;
4) arteriovenous fistulas;
5) spasm.

In the current case report, the patient presented to the emergency room unconscious and in a state of hemorrhagic shock with complete severance to right and left vessels and femoral nerve. The patient also revealed cold extremities, & agitation) with pulsatile bleeding from the left thigh and absence of Doppler signals on both sides distally. Moreover, a considerable size hematoma was seen upon exploring the right side at a bleeding arterial branch. These clinical presentation are considered as hard signs of vascular injury and compatible with previous clinical evaluation reported by other researcher [26]. They divided vascular injury into hard which is characterized by rapidly expanding hematomas due to active hemorrhage, absent pulses, pallor, paresthesia, pain, paralyses, poikilothermia. While the soft signs of injury reveals arterial bleeding at the scene of injury, weakened distal unilateral pulse, small hematoma, neurological deficit, abnormal flow velocity wave on Doppler examination [26]. The investigation of hard signs in gunshot trauma during the physical examination commonly recognized the vascular injury in the anatomical area and require the urgent operation [27].

The management of the current patient was used the emergency shunts with nasogastric 16-French tubes which were inserted on both sides including the injured vein. These procedures agree with previous reported study regarding the urgent definitive vascular repair using a transitory intravascular shunt. They mentioned to use the Javid or Pruitt—Inhara vascular shunts if available, however, a sterile nasogastric or chest tube can also work with the vessel inner diameter. The functions of the shunts are to repair distal arterial circulation and encourage the venous drainage. The shunt kept temporarily in the vessel and removed when the repair occurred in the definitive vessel [28].

The current patient was suffered from multiple gunshots that included the maxillofacial area that leading to mandibular fracture. Similar observation has been reported in further studies too [25, 29]. They showed that the majority of fracture was in the mandibular region because of large surface of the mandibular body [29, 30].

Screw for IMF considered as a typical device for emergency and temporary fixation (by elastic then by wires) in this patient. Similar procedures have been used in previous studies that described the treatment of thirty-six of gunshot injury cases by MMF or external pin fixation [30].

CONCLUSIONS

This case reports approved the successful saving of a patient with severe bilateral femoral artery injuries combined with maxillofacial trauma from gunshot. The study displays the significance of prioritizing the vascular controlling to reach the patient stabilization before managing the maxillofacial injuries. The temporary fixation methods such as the intermaxillary fixation (IMF) consider as effective in the emergency management of the mandibular fractures. Outstandingly, this patient reached complete healing within one month and returned to normal function, which for the author's knowledge is the first in documented cases of such complicated trauma.

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