

Vascular Injuries Analysis by the Oldest Vascular Center in Cairo, A City that Doesn't Sleep

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ABSTRACT

Background: Kasr Alainy, Cairo university teaching hospital, one of the biggest teaching hospital in the middle east with bed capacities around 5200 beds (1) that is located at the center of Cairo. We will review the vascular cases that were served by the vascular team that was on duty one day per week, whether alone or with other teams starting from June 2014 till end of May 2015. **Patients and Method:** Clinically the patients were categorized into two main categories according to the presenting signs; soft signs and the second category was hard signs. In this study, we have reviewed our experience in dealing with 133 vascular injuries. **Results:** the most common mode of vascular injury was road traffic accidents 52.4%, the most frequently injured artery was the superficial femoral artery (21.8%), For arterial injuries, interposition autologous long saphenous vein was the most frequently employed surgical technique for treatment of our patients (73/133, 54.9%), with 2 cases had to do amputation. 12 cases (11.7%) out of 103 had postoperative surgical site infection, 8 cases (7.8%) out of 103 cases died. **Conclusion:** Clinical symptoms and signs are corner stone for surgical teams, Infection is the most common morbidity that can affect any team. Long saphenous vein is the best vascular conduit that you can depend on it with less rate of infection and high patency rate. Fasciotomy is not a routine for peripheral vascular trauma.

Key Words: Trauma, Saphenous, fasciotomy

INTRODUCTION

Kasr Alainy, Cairo university teaching hospital, one of the biggest teaching hospital in the middle east with bed capacities around 5200 beds (1) that is located at the center of Cairo. This teaching hospital is the pooling center for all kinds of causalities ranging from simple stab injury to explosive injury to gunshot injury to road traffic accident 24 hours a day, 7 days a week.

We will review the vascular cases that were served by the vascular team that was on duty one day per week, whether alone or with other teams starting from June 2014 till end of May 2015. The following article will review the basic practices and guiding principles used by Vascular surgeons managing traumatic vascular injuries in a busy civilian trauma center with basic simple facilities.

PATIENTS AND METHOD

All cases with vascular injuries admitted to the ER from June 2014 till end of May 2015 were prospectively recorded on a data sheet and

retrospectively analyzed. Patient personal demographic data was filled in, any associated medical disease was precisely monitored. Patterns of injury were documented, noting the mechanism of vascular injury, whether penetrating or blunt injury with the anatomical distribution, and the presence of associated nonvascular injuries; **figure 1** shows an example of road traffic accident causing contusion thrombosis of 2nd part left Axillary artery.

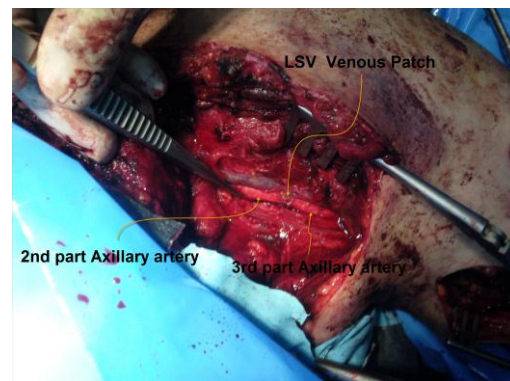


Fig. 1: Injured 2nd part axillary artery with patch repair post MCA

Vascular injuries were characterized by type (arterial, venous, or a combination of both); **figure 2 (a,b)** is one example of bullet injury of Right subclavian vein with repair by synthetic Dacron graft, while **figure (3)** demonstrate the most common used conduit for repair in our study which is the Long Saphenous Vein graft for Injured Left Brachial artery after a stab injury.

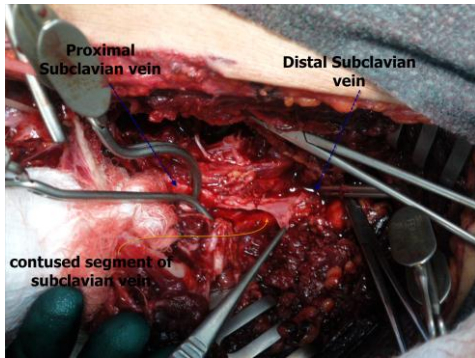


Fig. 2a: Contused segment of the Rt. Subclavian vein post gunshot with # clavicle.

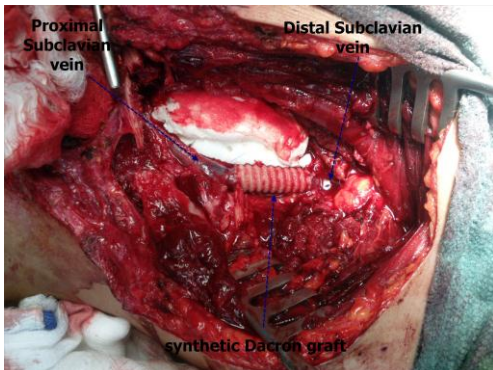


Fig. 2b: Repair of contused Subclavian vein by interposition synthetic Dacron graft

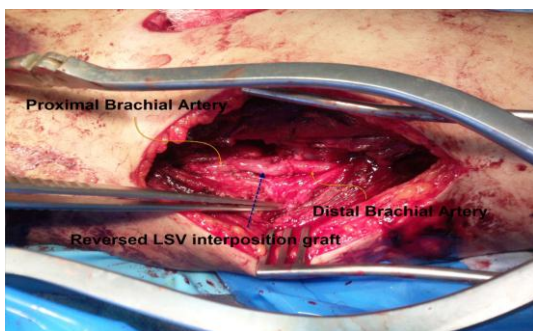


Fig. 3: Reversed LSV interposition graft to repair the Lt. Brachial artery post stab injury

All patients were examined at the Emergency Room, clinically and with hand held Doppler only as there was no constant dependent access to the traditional duplex study all the time. For any traumatic case presenting to the Emergency room, prophylactic anti-tetanic serum, and 3rd generation cephalosporin were given as a routine. Metronidazole was given to selected cases of soiled open wounds that were cleaned and washed properly at the Emergency Room before transferring the patient to the operation room. 2nd dose of 3rd generation cephalosporin is to be given to the patients at the time of induction with metronidazole in case of wound soiling. Penicillin was given to patients with cephalosporin hypersensitivity.

Blood transfusion was given to young patients (less than 40 yrs old) when the Hb reaches 7 g/dl or less, Older patients (41 or more) or young patients with associated co-morbidities were given blood transfusion when the Hb reaches 9 g/dl or less.

Clinically the patients were categorized into two main categories according to the presenting signs; the first category had soft signs (hematoma, history of hemorrhage at scene of accident, unexplained hypotension, peripheral nerve deficit) and those for close observation and duplex ultrasound, the second category had hard signs (absent pulses, bruit or palpable thrill, active hemorrhage, expanding hematoma, distal ischemia) and those were transferred to the operation room for urgent exploration and definitive treatment.

Amputated extremities were not included in our study population due to the hospital protocol between General Surgery and Vascular team, the General Surgery team was to do primary amputation for all cases with Mangled Extremity Severity Score (MESS) of 7 or more.

For abdominal vascular injuries, indications for vascular team intervention were usually based on urgent intra-operative vascular call by the general surgery team or in case of absent femoral pulse with history of abdominal trauma. Vascular team was to interfere in cases of retroperitoneal hematoma zone I, expanding pulsating hematoma at zone II, and no indication for exploring zone III as long as there is pelvic fracture, slow rate of expansion, intact groin arterial pulsations.

Intra-operative details of the Injury type (Partial tear, Complete transection, Contusion,

Pseudo aneurysm, AV fistula) were documented together with the type of vascular repair done (Simple Ligation, Direct sutures, Venous Patch, Venous interposition graft, Synthetic interposition graft).

The Long saphenous vein was the conduit of choice in both the upper and lower extremities. The contralateral vein was taken preferentially for lower extremity injuries, although the ipsilateral vein was required in few cases. In nearly all cases, vascular repair was attempted within the first 4 to 6 hours from the time of admission, according to the vacancy of the vascular team. Temporary intraluminal shunting was indicated for patients with combined arterial, venous, and soft-tissue injuries and concomitant long bone fractures when the decision was made to perform limb salvage. The standard sterile system tubing was used as a shunt. Concomitant venous injuries were repaired selectively.

Arterial reconstruction was considered successful when the pulse distal to the reconstruction was present or if there was a warm limb with no signs of acute ischemia. Limb salvage is defined as the presence of a viable limb at one month after injury, regardless of functional outcome.

Associated fasciotomy was done for cases that develop early post revascularization compartmental syndrome within the first 12 hours as the team protocol was to avoid doing prophylactic fasciotomy to minimize infection incidence in the fasciotomy wound. Cases with delayed ischaemia (more than 4 hours) and did not undergo fasciotomy were closely monitored clinically due to absence of pressure monitors.

RESULTS

Demographic data

Our study involved 103 patients with vascular trauma. As shown in **table (1)**, more than 2/3rd patients (88.2%) were 16 to 39 year old with a peak in age between 25 to 30 year. Patients of other age groups were injured infrequently, only 6 were younger than 16 (7.5%), 8 (4.3%) were between 40 and 60 year old. The youngest patient was 2 years old; the oldest patient was 57 years old patient. Male to Female ratio is 1.6 to 1, with 61.2% male patients compared to 38.8% female patients as shown in Table (1). The mean age of

the patients in the study was 34.3 years (SD \pm 47.3), ranging between 2 and 57 years.

Table (1): Demographic distribution of our study

| Age group | Gender | | Total | |
|-----------|--------|--------|-------|-------|
| | Male | Female | No. | % |
| 2 - 15 | 5 | 1 | 6 | 7.5 |
| 16-39 | 86 | 3 | 89 | 88.2 |
| 40-60 | 8 | 0 | 8 | 4.3 |
| Total | 99 | 4 | 103 | 100.0 |

Mode of injury:

As in **Figure (4)** 52.4%, are road traffic accident due to crowded capital with around 20 million population in Cairo, followed by firearm injuries being 36.9%, then comes blunt and stab injury (4.9 %), (3.9%) mostly street fights.. Explosive injury is the least mode of injury 1.9% mainly accidental in big factories.

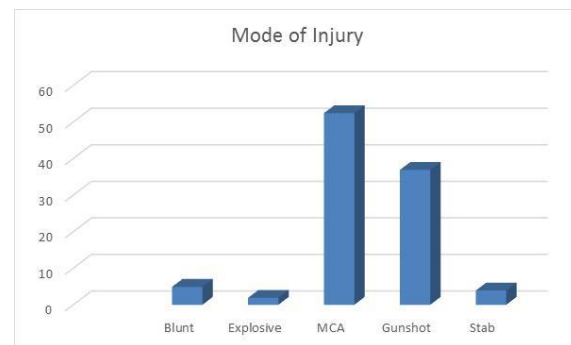


Fig. 4: Mode of Vascular Injury

Types of vessel injured:

Vascular injuries were mainly arterial, pure arterial was 63%, venous 9%, and both arterial and venous 28%, **figure 5**.

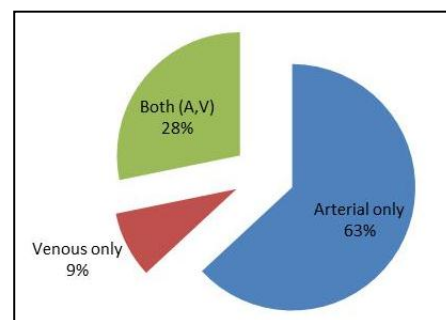


Fig. 5: Type of Injured Vessel

Site of injury:

The most frequently injured artery was the superficial femoral artery (21.8%), followed by the popliteal artery (13.5%), brachial artery (12%), axillary artery (5.3%), abdominal aorta and tibials (3.8%). Other arteries were injured less frequently as shown in **figure 6**. The most frequently injured vein was the popliteal vein

(6.8%), axillary vein (5.3%) and common iliac veins come next (4.5%). Evaluation of the data on the site of injury indicates that the superficial femoral vessels were the most commonly injured in gunshot, while the popliteal vessel injuries was the most commonly injured by road traffic accidents.

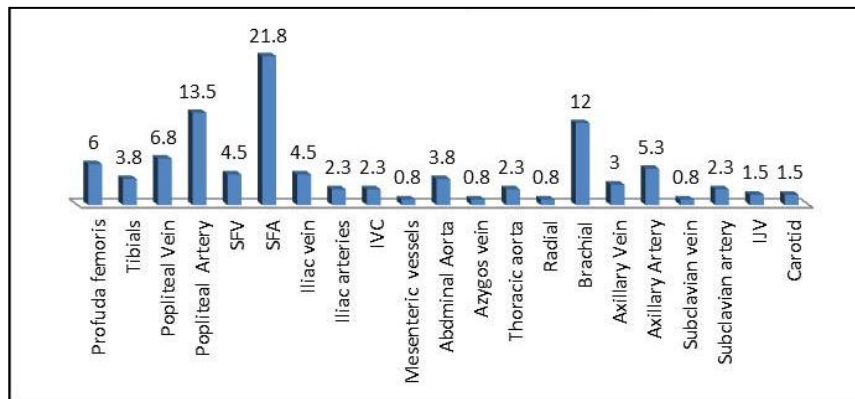


Fig. 6: Prevalence of different Vessels Injured in our study

Associated injuries:

In **figure 7**, isolated vascular injury was present in only 5.8% of cases mostly stab injury where associated injuries including bone, nerve and remote injury (affecting the head, chest, or

abdomen) were present in 94.2% of patients due to the dispersive aggressive road traffic accidents. Associated bone and nerve injury represent the majority of complex injuries (35.9%), followed by soft tissue loss and nerve injuries (12.6%).

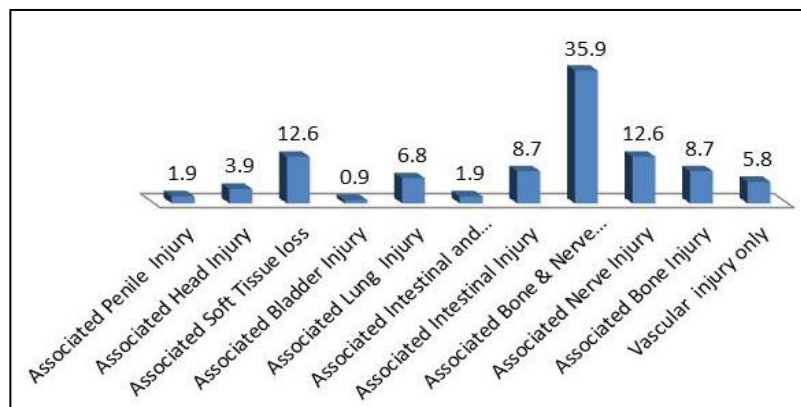


Fig. 7: Associated Soft tissue and bone injury

Clinical presentation

Absent pulse was the commonest clinical presentation in injured cases (29.5%). Distal pallor and coldness was second common presentation (27.6) followed by external bleeding

(25%), pulsatile hematoma was less common (2.2%), bruit or palpable thrill was the least (1.5%), as shown in **figure 8**.

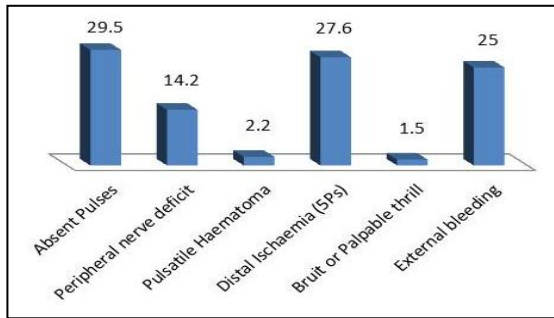


Fig. 8: Clinical presentation

Table (2) shows that the majority of the patients were admitted at the emergency room of the hospital, (76.2%) were shocked at the time of presentation, mostly road traffic accidents, explosive injury, and gunshot injury while the rest of the cases (29.8%) were stable at the presentation, mostly blunt injury.

Table (2): Stability of patient at time of presentation

| | No. | % |
|---------|-----|------|
| Stable | 74 | 70.2 |
| Shocked | 29 | 29.8 |

Diagnostic workup:

In almost all patients, the decision to operate was based on the presence of "hard signs" of vascular trauma. Although duplex scan was a

powerful tool to support clinical decision but the inconsistent availability of this facility makes the clinical team depends mainly on the clinical hard and soft signs. Two injuries were initially missed (2/133 or 1.5%) and presented later as false aneurysm and arteriovenous fistula .

Surgical technique:

Complete transection was the commonest intra-operative finding, followed by contusion thrombosis. As shown in **table (3)**, Interposition autologous long saphenous vein was the most frequently employed surgical technique for treatment of our patients (73/133, 54.9%) mostly for complete transected vessels, followed by direct repair (21/133, 15.8%) mostly for partially transected vessels. Interposition PTFE as in **figure (9)** comes next (17/133, 12.8%) for large vessels; subclavian, iliacs, and other medium sized vessels with poor sized autologous vein; 1 carotid, 4 cases of femoral vessels, and one case of brachial artery injury. Ligation (12/133, 12.0%) was done mainly for completely transected veins (profunda femoris, SFV under the level of profunda femoris, popliteal vein) and one case of 2nd part subclavian artery due to the bad general condition of the patient as a form of damage control. Venous patch was applied in (6/133, 4.5%) mainly for partially lacerated vessels.

Table (3): Intraoperative presentation and technique

| Intraoperative finding | Type of repair | | | | | Total | |
|------------------------|----------------|---------------|----------------------------|--------------------|----------|-------|-------|
| | Venous patch | Direct repair | Reversed Interposition GSV | Interposition PTFE | Ligation | No. | % |
| Partial Laceration | 4 | 2 | - | - | - | 6 | 4.5 |
| Complete Transection | - | 16 | 60 | 9 | 11 | 96 | 72.2 |
| Contusion | - | - | 13 | 8 | 4 | 25 | 18.8 |
| Pseudoaneurysm | 1 | 1 | - | - | - | 2 | 1.5 |
| AV Fistula | 1 | 2 | - | - | 1 | 4 | 3.0 |
| Total | 6 | 21 | 73 | 17 | 16 | 133 | 100.0 |



Fig. 9: Repair of Right SFA with interposition synthetic PTFE graft.

Follow up:

Cases were to be discharged 5 to 7 days postoperative with regular outpatient clinic visit on regular basis for two weeks, and once monthly for 6 months postoperatively. This short hospital stay was done mainly because of the overcrowding and insufficient hospital beds. However cases with associated chest or gut injuries were to stay longer period till the cardiothoracic or general surgery teams to decide. Absence of duplex scan makes follow up to depend mainly on the portable hand doppler and clinical signs.

77 cases (85.6%) out of 90 arterial repair had good volume distal palpable pulse, 6 cases (6.7%) out of 90 arterial repair had absent clinical pulse with audible blood flow on the hand doppler and compensated warm limbs. 4 cases (4.5%) out of 90 arterial repair had absent distal pulse with cold ischemic limb, for which re-exploration and thrombectomy was done for all 4 cases, 2 cases improved with palpable pulse, however 2 other cases had to do amputation, with 50% secondary patency rate.

12 cases (11.7%) out of 103 had postoperative surgical site infection (7-30 days postoperative), proper drainage, and repeated dressing was done for all cases. 3 cases out of 12 cases had 2ry hemorrhage and ligation; one brachial case and two femoral artery cases.

8 cases (7.8%) out of 103 cases had acute renal failure post revascularization, and were on regular dialysis. 1 case (0.9%) out of 103 cases developed left sided hemiplegia post internal carotid repair.

8 cases (7.8%) out of 103 cases died, 4 of them died intraoperatively; 2 cases of thoracic aorta injury, one case of multiple abdominal aorta injury, one case of common iliac vein injury, the

other 4 cases died postoperatively at the ICU; 2 cases with associated head injury, 1 case post abdominal aorta and IVC repair, 1 case with acute renal failure (**Figure 10**).

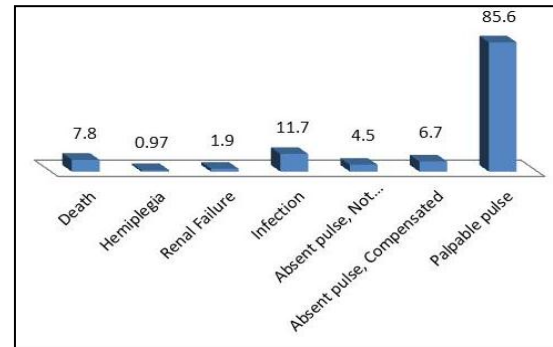


Fig. 10: Follow up study

Fasciotomy was not done routinely, only for 6 cases that develop compartmental syndrome within 24 hours post revascularization, 4 cases post femoral vessels repair, one post upper popliteal repair and one case post subclavian artery repair.

DISCUSSION

Articles from Israel^(2,3) and Beirut^(4,5) describe mass casualties of blunt trauma resulting from stone throwing,⁽⁶⁾ cut and stab wounds, firearm injuries, and tear gas inhalation^(7,8).

During the Egyptian uprising, firearms resulted in the majority of injuries (93.1%), followed by stab wounds (3.5%), blunt trauma from stone throwing (2.6%), and finally tear gas inhalation (0.4%)⁽⁹⁾.

Penetrating trauma accounts for 70-90% of vascular injuries in USA⁽¹⁰⁾ but that was not the case in our study with significant prevalence of road traffic accident 52.4%, with the Egyptian Central Agency for Public Mobilization and Statistics announcing 14,403 car accident in Egypt in 2014⁽¹¹⁾.

The most frequently injured artery was the superficial femoral artery (21.8%), followed by the popliteal artery (13.5%), compared to other studies done at London and South Africa where the most frequently injured vessel was the superficial femoral artery (37.2%), followed by the popliteal (30.7%)⁽¹²⁾, compared to the Kosovo war, the most frequently injured vessel was the superficial femoral artery (25%), while the

popliteal artery came in the 8th place with (3.3%)⁽¹³⁾. while the brachial artery was the most common injured artery (9.8) followed by the femoral (7.1%) in Iraq and Afghanistan war.⁽¹⁴⁾

The fact that associated injuries including bone, nerve and remote injury (affecting the head, chest, or abdomen) were present in 94.2% of patients due to the high speed and widespread dispersion of the very sharp, very light pieces of glass and car body parts after collisions, that permits the dispersion to long distance affecting victims in wide range with multiple injuries. Associated soft tissue and skeletal injuries accounts for 10%-70% of all extremity arterial injuries. In past years, the great majority of complex extremity injuries in the civilian sector have been caused by blunt trauma, although in some recent series penetrating trauma has caused a majority of these injuries⁽¹⁵⁾.

Due to the inconsistent presence of imaging facility, the vascular team was faced with a situation that the clinical signs and symptoms were the main tools for decision to operate, conserve or amputate. The Soft Sign, Hard sign rule was the magic tool that proves its efficacy throughout our trial, to the extent that the hand held Doppler was only used for evaluation of the patency of vascular anastomoses postoperative and was a luxury to use it preoperative for detection of pulse and that emphasizes how much important the clinical sense and signs for vascular surgeons, and among 103 cases, only 2 cases (1.9%) were missed, where 5% to 15% of patients with vascular injury can be missed by initially unimpressive clinical examination where patients in spite of having normal palpable pulse but still have vascular injury⁽¹⁶⁾. Our 2 cases presented two moths latter, one with carotid jugular fistula and the other with femoral pseudo-aneurysm and were treated with no complications.

For arterial injuries, interposition autologous long saphenous vein was the most frequently employed surgical technique for treatment of our patients (73/133, 54.9%), followed by direct repair (21/133, 15.8%), where in other studies direct repair was the most frequently employed surgical technique (70/120 or 58.3%), followed by autologous vein interposition (18/120 or 15.0%)⁽¹³⁾. That difference in results from other studies is attributed to the aggressive road traffic accident injury,

Our main fear and major complication was Infection as 12 cases (11.7%) compared to US Army Institute of Surgical Research about the incidence of infection in vascular war injuries in Iraq and Afghanistan that increased from 2.3% in 2001 to 11.9% in 2005⁽¹⁷⁾.

Due to that high risk of infection, as in Blair study, deep infection occurred at a rate of 20% in the compartment syndrome/fasciotomy patients, versus 5% and 4% to those cases without fasciotomy, so fasciotomy was not done as routine, only for 6 cases that develop compartmental syndrome within 24 hours post revascularization, and all cases were late presentation (more than 4 hours) to ER room⁽¹⁸⁾.

CONCLUSION

Vascular trauma is the third leading cause of death. Clinical symptoms and signs are corner stone for surgical teams, and the hard sign, soft sign algorithm is an accurate algorithm that our team adopted and advice other teams in similar tough situations to depend on it and trust it. Infection is the most common morbidity that can affect any team in a busy jammed public hospital, even with young patients and even with wide spectrum antibiotic availability. Long saphenous vein is the best vascular conduit that you can depend on it with less rate of infection and high patency rate. Fasciotomy is not a routine for peripheral vascular trauma, and can be saved for particular cases of delayed revascularization especially if you fear infection.

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