

Vascular Injuries in Trauma Patients with Open Lower Extremity Fractures: Are CT Angiograms Necessary for Management?

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Introduction

- The incidence of vascular injury with lower extremity trauma ranges from 0.1-16%.
- Delayed treatment of vascular injury can lead to fracture malunion, acute peripheral ischemia, reperfusion injury, tissue necrosis, and amputation.
- Computer tomography angiography (CTA) is a fast, non-invasive, and cost-effective diagnostic tool that can detect vascular injury with high sensitivity and specificity.
- Previous studies have suggested that there should be a high index of suspicion for vascular trauma in patients with open fractures as well as those with hard or soft clinical signs of vascular injury; therefore, these patients should undergo CTA testing.
- Hard signs include pulsatile bleeding, expanding hematoma, absent distal pulses, cold pale limb, palpable thrill, or audible bruit.
- Soft vascular signs include peripheral nerve deficits, history of moderate hemorrhage, reduced palpable pulse, or injury in proximity to a major artery.
- The purpose of this study was to evaluate the incidence of vascular injuries in patients with open lower extremity fractures and the utility of CTA in their management.

Methods

- A retrospective review of patients with open fractures of the tibia, fibula, and/or femur between March 2014 and March 2019 at our institution was conducted following IRB approval.
- Univariate analysis was performed to identify factors associated with surgical treatment for vascular injury.

Table 1. Demographic and Medical Data of 142 Study Patients.

Sex: Male / Female	107 (75%) / 34 (25%)
Mean Age	43.8±16.6 yrs (range: 18-93)
Mean BMI	26.4±6.2 kg/m ² (range: 18.3-57.1)
Tobacco Use	
Never Smoker	76 (53.5%)
Current Smoker	48 (33.8%)
Former Smoker	18 (12.7%)
Diabetes	12 (8.5%)
Peripheral Vascular Disease	1 (0.7%)
Surgery to the Fractured Extremity	8 (5.6%)

Results

- 142 orthopaedic trauma patients with 209 open long bone fractures of the lower extremity were included (Table 1 and 2).

Table 2. Injury Characteristics.

Variable	Number of Patients (%)
Mean Injury Severity Score	13.7±7.1 (range: 4-43)
Clinical Signs	
Hard Vascular Signs	11 (7.7%)
Soft Vascular Signs	23 (16.2%)
Evaluation with ABI	6 (4.2%)
Range of ABI	0.3-1.1

- 35 patients (25%) were evaluated with CTAs.
- 12 patients (8.5% of study population or 34.3% of patients who underwent evaluation with CTA) had positive CTA findings for acute vascular injury secondary to trauma (Table 3).
- None of the patients with positive CTA findings were evaluated with an ankle-brachial index (ABI).

Table 3. Cohort Characteristics of 12 Patients with Positive CTA Findings for Acute Vascular Injury.

Injury Characteristics	
Mean Injury Severity Score	14.8±5.1 (range=9-25)
Hard Vascular Signs	4 (33.3%)
Soft Vascular Signs	8 (66.7%)
Evaluation with ABI	0 (0%)
Diabetes	1 (8.3%)
Current/Former Smoker	6 (50%)

- 4 patients (2.8% of the total study population) underwent surgery for treatment of vascular injury (Table 4).
- Surgical indications for vascular repair included complete transection of a large blood vessel in the lower extremity with unresolvable bleeding that resulted in hematoma and poor blood supply to the leg.
- Distal pulses, which were not identifiable on Doppler exam prior to vascular intervention, were detected postoperatively.

Results

Factors associated with the Need for Vascular Repair

Demographic Variables:

- Age, gender, race, and body mass index were not associated with the need for vascular repair.

Medical Factors:

- Diabetes, peripheral vascular disease, and tobacco use were not associated with the need for vascular repair.

Injury Characteristics

- Although ISS was not associated with the need for vascular repair, the mean ISS of the surgical patients was >15, which was indicative of severe trauma.
- Hard** (p=0.003) and **soft** (p=0.02) signs of vascular injury on clinical exam were factors associated with the need for vascular repair.

Table 4. Cohort Characteristics of 4 Patients who Underwent Vascular Surgery.

Mean Injury Severity Score	16.5±5.4 (range: 11-25)
Hard Vascular Signs	4 (100%)
Soft Vascular Signs	4 (100%)
Both Hard and Soft Signs	2 (50%)
Evaluation with ABI	0 (0%)
Positive CTA Findings	4 (100%)
Mean Injury Severity Score	16.5±5.4 (range: 11-25)
Diabetes	1 (25%)
Current Smoker	2 (50%)

Conclusion

- There was a low incidence of vascular injury associated with open fractures of the lower extremity.
- The incidence of surgery for vascular repair was even less frequent, with one-third of patients with positive CTA findings requiring surgery.
- Positive CTA findings did not alter clinical management in a majority of patients in our study population.
- CTA may not be necessary for the evaluation of all trauma patients with open fractures unless hard or soft signs of vascular injury are present on clinical exam.