When Are CT Angiograms Indicated for Lower Extremity Fractures?

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Background/Purpose: Computed tomography angiography (CTA) has become a frequently used imaging modality for the detection of traumatic vascular injuries. Although there is evidence to guide the utilization of imaging modalities when "hard signs" of vascular injury are present, there are no guidelines for their use when only "soft signs" or "no signs" of vascular injury are present in the setting of an acute lower extremity injury. The purpose of this study was to review the CTAs performed at our institution and determine: (1) the presence or absence of any signs of a vascular injury; (2) which, if any, soft and/or hard signs were predictors of positive CTA findings and/or the need for treatment of the detected vascular injury; and (3) what type(s) of lower extremity fractures (open and closed) and injury mechanism(s), if any, were associated with a positive CTA findings and/or the need for treatment. Methodss: A retrospective review was conducted on 275 consecutive patients treated at a Level I trauma center from 2004-2013 who had an acute lower extremity fractures and a CTA. Their charts were reviewed for the presence or absence of the five hard signs (absent distal pulse, pulsatile bleeding, expanding hematoma, cold/pale limb, palpable thrill, audible bruit) and the five soft signs (decreased pulse, peripheral nerve deficit, small hemorrhage, wound near artery, nonpulsatile hematoma) of a vascular injury and were recorded. Each fracture was classified using the OTA classification and the status of soft tissue (open vs closed) and mechanism of injury was recorded. Every CTA radiology report was reviewed and was considered positive if there was any concern for injury to a specific vessel. Any vascular intervention or need for an amputation due to a vascular injury was recorded.

Results: 275 extremities' CTAs were reviewed and 80 (29%) reports had positive findings of a vascular injury. Only 16 (6%) of those extremities required treatment. 108 extremities had no documented soft or hard signs and none of those had a positive CTA. Extremities that had more than one hard or soft sign had an increased chance of a positive CTA finding (Table 1). When an extremity had at least one hard or soft sign, the presence of "open" soft-tissue injury and/or an injury located distal to the knee injuries increased the chances of having a positive CTA finding and an intervention for that vascular injury (Table 2). Injuries caused by a high-energy mechanism accounted for 99% of positive CTA findings but there was no difference between the specific types of high energy mechanism (Table 2). The 16 cases that required treatment of a vascular injury all had diminished or absent pulses on presentation to the emergency department and 13 of 16 had an "open" injury.

Conclusion: Based on our findings there is no evidence to support the routine use of CTAs for lower extremity fractures unless soft or hard signs of a vascular injury are present on physical examination. The presence of: (1) an open injury, (2) an injury located distal to the knee, and (3) a high-energy mechanism of injury had a higher risk of a vascular injury. However, only 6% of the cases that had positive CTA required a change in their treatment and all of those cases had either diminished or absent distal pulses present on physical examination.

Table 1. Correlation of physical exam findings, positive CTA results, and the need for vascular treatment

Physical Exam Findings	# of CTAs	# (%) of positive CTAs	# (%) requiring treatment
No soft or hard sign	108	0 (0%)	0 (0%)
One soft sign	73	29 (40%)	2 (3%)
Two soft signs	4	3 (75%)	0 (0%)
One hard sign	43	18 (42%)	4 (9%)
Two hard signs	16	11 (69%)	4 (25%)
Combinations of hard and soft signs	30	19 (63%)	6 (20%)

Table 2. The effect of fracture location, soft tissue status and mechanism of injury on CTA results.

	# of CTAs	# of positive CTAs	% positive CTAs	# requiring treatment	% requiring treatment
FRACTURE LOCATION					
Proximal femur	7	0	0%	0	0%
Midshaft Femur	5	2	40%	0	0%
Distal Femur	1	0	0%	0	0%
Proximal tibia +/- fibula	35	10	29%	2	6%
Isolated proximal fibula	8	5	63%	3	38%
Isolated midshaft fibula	2	2	100%	0	0%
Midshaft tibia +/- fibula	50	26	52%	4	8%
Distal tibia +/- fibula	8	6	75%	0	0%
Foot fractures	3	2	67%	1	33%
Multiple fractures	47	28	60%	6	13%
INJURY MECHANISM					
Gunshot Wound	23	12	52%	4	17%
Motor vehicle collision	34	18	53%	6	18%
Motor Cycle Collision	34	15	44%	1	3%
Fall from Height	12	5	42%	0	0%
Ground Level Fall	7	1	14%	0	0%
Auto versus pedestrian	48	26	54%	4	8%
Blast Injury	3	0	0%	0	0%
Crush Injury	3	2	67%	1	33%
SOFT TISSUE STATUS					
Open Injuries	96	58	60%	13	14%
Closed Injuries	70	22	31%	3	4%

All data included in this table is from patients who had at least one hard or soft sign on physical exam since no patient without at least one sign had a positive CTA

See pages 47 - 108 for financial disclosure information.