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Systemic anticoagulation in the setting of vascular extremity trauma

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ABSTRACT

Introduction: There is conflicting data regarding if patients with vascular extremity trauma who undergo surgical treatment need to be systematically anticoagulated. We hypothesized that intraoperative systemic anticoagulation (ISA) decreased the risk of repair thrombosis or limb amputation after traumatic vascular injury of the extremities.
Methods: We analyzed a composite risk of repair thrombosis and/or limb amputation (RTLA) between patients who did and did not undergo ISA during arterial injury repair. Patient data was collected in the American Association for the Surgery of Trauma PROspective Vascular Injury Treatment (PROOVIT) registry. This registry contains demographic, diagnostic, treatment, and outcome data.
Results: Between February 2013 and August 2015, 193 patients with upper or lower extremity arterial injuries who underwent open operative repair were entered into the PROOVIT registry. The majority were male (87%) with a mean age of 32.6 years (range 4–91) and 74% injured by penetrating mechanism. 63% of the injuries were described as arterial transection and 37% had concomitant venous injury. 62% of patients underwent ISA. RTLA occurred in 22 patients (11%) overall, with no significant difference in these outcomes between patients who received ISA and those that did not (10% vs. 14%, $p = 0.6$). There was, however, significantly higher total blood product use noted among patients treated with ISA versus those that did not receive ISA (median 3 units vs. 1 unit, $p = 0.002$). Patients treated with ISA also stayed longer in the ICU (median 3 days vs. 1 day, $p = 0.001$) and hospital (median 9.5 days vs. 6 days, $p = 0.01$).
Discussion: In this multicenter prospective cohort, intraoperative systemic anticoagulation was not associated with a difference in rate of repair thrombosis or limb loss; but was associated with an increase in blood product requirements and prolonged hospital stay. Our data suggest there is no significant difference in outcome to support use of ISA for repair of traumatic arterial injuries.

Background

Routine intraoperative systemic anticoagulation (ISA) is a mainstay of therapy in elective arterial reconstruction and treatment of acute limb ischemia [1]. In the setting of trauma, surgeons have been reluctant or unable to systemically anticoagulate patients when performing arterial repair due to concern for potential local and systemic bleeding [2]. It is unclear if the improved patency seen with elective vascular repair can be generalized to traumatic arterial repair, particularly in patients

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with acute traumatic coagulopathy or resuscitation-associated coagulopathy. There is limited and conflicting retrospective data in the literature correlating improved patency or limb salvage with use of ISA during traumatic arterial injury repair [3–9]. Retrospective reviews of patients who received ISA during lower extremity arterial injury repair report a limb salvage rate of 85–91% [2,5,7,8]. Other reviews, however, report lower limb salvage rates of 83–84% with similar injuries, despite routinely not giving ISA [4,10]. Comparative studies have shown no statistically significant difference in outcome between patients who are given ISA and those who are not [6,7]. Proponents, however, argue that the risks of ISA are minimal, and may decrease the risk of distal in situ thrombus or microvascular thrombosis [5,9]. We hypothesized that intraoperative systemic anticoagulation (ISA) decreased the risk of repair thrombosis or limb amputation (RTLA) after traumatic vascular injury of the extremities.

Methods

Patient data was collected from the American Association for the Surgery of Trauma (AAST) Multicenter PROspective Observational Vascular Injury Treatment (PROOVIT) registry. The details of this registry have been previously described [11]. This is a prospectively-collected database of injuries to named arterial and venous structures from fourteen Level I trauma centers across the United States. The database includes demographic, diagnostic, treatment, and outcome data for the index hospital stay. The registry is accruing data from clinic and readmission follow up.

Patients with upper or lower extremity arterial injuries who underwent open arterial revascularization between February 2013 and August 2015 were identified. Patients treated with arterial ligation, primary traumatic amputation, endovascular repair or embolization were excluded. Arterial injuries to the upper extremity utilized for analysis included individual injuries to the brachial or distal forearm arteries. The rare combined brachial and radial artery injuries were categorized as brachial artery injuries. Arterial injuries to the lower extremity included individual injuries to the femoral, popliteal or distal to the popliteal artery. Method of repair included autologous conduit, synthetic interposition or bypass graft and primary repair. Patients treated with vein interposition or bypass, vein patch or autologous artery as a conduit were included in the autologous category. ISA was defined as systemic anticoagulation with unfractionated heparin (UFH) utilized during the initial operation or vascular repair. Intraoperative regional anticoagulation was not included in this study. The total mangled extremity severity score (MESS) was calculated

Table 1
Demographics of included patients, analyzed by intraoperative anticoagulation status.

		Intraoperative Systemic Anticoagulation		
Factor	All	Received	Not Received	p-value
Mean age (SD)	32.6 (15.3)	32.2 (15.1)	33.4 (15.7)	0.6*
Male, n (%)	167/193 (87)	109/119 (92)	58/74 (78)	0.02†
Injury mechanism				0.5†
Blunt, n (%)	47/193 (24)	32/119 (27)	15/74 (20)	
Penetrating, n (%)	142/193 (74)	85/119 (71)	57/74 (77)	
Mixed blunt and penetrating, n (%)	4/193 (2)	2/119 (2)	2/74 (3)	
Specific mechanism				0.5†
Gunshot, n (%)	80/193 (42)	53/119 (45)	27/74 (37)	
Stabbing, n (%)	29/193 (15)	16/119 (13)	13/74 (18)	
Motor Vehicle Collision, n (%)	25/193 (13)	17/119 (14)	8/74 (11)	
Other, n (%)	59/193 (31)	33/119 (28)	26/74 (35)	
Injury description				0.5†
Flow limiting defect, n (%)	33/193 (17)	22/119 (19)	11/74 (15)	
Occlusion, n (%)	24/193 (12)	18/119 (15)	6/74 (8)	
Pseudoaneurysm, n (%)	6/193 (3)	3/119 (3)	3/74 (4)	
Transection, n (%)	121/193 (63)	71/119 (60)	50/74 (68)	
Other injury type, n (%)	9/193 (5)	5/119 (4)	4/74 (5)	
Median ISS (Q1, Q3)	9 (9, 16)	10 (9, 16)	9 (5, 16)	0.1§
Mean admission SBP (SD)	120.9 (28.5)	120.5 (29.8)	121.6 (26.6)	0.8*
Median GCS (Q1, Q3)	15 (15, 15)	15 (15, 15)	15 (15, 15)	0.7§
Median AIS-extremity (Q1, Q3)	3 (3, 3)	3 (3, 3)	3 (2, 3)	0.06§
Median MESS (Q1, Q3)	4 (3, 6)	4 (3, 6)	4 (3, 5)	0.08§
Median Skeletal/Soft tissue Score (Q1, Q3)	1 (1, 2)	1 (1, 2)	1 (1, 1)	0.1§
Median Limb Ischemia Score (Q1, Q3)	1 (1, 2)	2 (1, 2)	1 (1, 1)	<0.001§
Median Shock Score (Q1, Q3)	0 (0, 1)	0 (0, 1)	0 (0, 1)	0.9§
Median Age Score (Q1, Q3)	0 (0, 1)	0 (0, 1)	1 (0, 1)	0.3§
Concomitant vein injury, n (%)	71/193 (37)	44/119 (37)	27/74 (37)	0.9†
Vein repaired, n (%)	63/71 (89)	40/44 (91)	23/27 (85)	0.7†
Concomitant nerve injury, n (%)	63/193 (33)	31/119 (26)	32/74 (43)	0.02‡
Concomitant orthopedic injury, n (%)	66/193 (34)	43/119 (36)	23/74 (31)	0.6†

ISS = Injury severity score.
AIS = Abbreviated injury score.
SBP = Systolic blood pressure.
GCS = Glasgow coma score.
MESS = Mangled extremity severity score.
SD = standard deviation.
Q1 = Lower quantile (25th percentile).
Q3 = Upper quantile (75th percentile).
* Two-tailed *t*-test.
† Pearson's Chi-square.
‡ Chi-square with Yates' continuity correction.
§ Wilcoxon Rank-Sum.

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