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Incidence of Vascular Injuries in poly-traumatized Patients

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ABSTRACT
Background: Vascular injury resulting from trauma is a leading cause of morbidity and mortality worldwide. Exsanguination is perhaps the most important cause of potentially preventable death after injury. The resulting ischemic tissue damage leads to high rates of amputation in a characteristically young and active population.
Objective: To determine the incidence of vascular injuries, modes and mechanisms of trauma and their relations with regional vascular injury distribution and the outcome of vascular injuries in polytrauma patients.
Patients and methods: This is a prospective observational analytical (cohort) study that included 520 patients who were presented by multiple causes of trauma to Mansoura University Emergency Hospital, Mansoura, Egypt. A level 1-trauma center with about 250,000 visits and 25000 trauma cases admission per year. This study was conducted over the period of 1 year from January 2019 to December 2019.
Results: According to abbreviated injury scale (AIS) ≥3, patients with vascular injuries had considerable more severe injuries than other patients. The most common regions with vascular injuries were peripheral vascular injuries in 95.8% [52.6% in lower limb and 43.2% in upper limb], followed by central vascular injuries in 4.2% [1.6% in neck, 1.6% in thorax and 1 % in abdomen]. Blunt trauma was considerably more common than penetrating trauma in both groups. Moreover, blunt trauma was more common in all regional vascular injuries (66.7% of neck, 75% of lower limb, and 100% of thoracic and abdominal vascular injuries) except upper limb (in 47.8%).
Conclusion: The vascular trauma is associated with more injury severity AIS, injury severity score (ISS) and higher mortality rate than other polytrauma patients.
Keywords: Vascular injuries, Poly-traumatized patients,

INTRODUCTION
In developed countries, injury is the leading cause of mortality amongst people aged 15-44 years, and in developing countries is only exceeded by infectious disease as a cause of death [(1)]. Motor vehicle collisions (MVCs) account for the largest number of traumatic deaths in civilian practice. A strong correlation has been noted between increasing severity of injury and incidence of associated vascular injury[(2)].

Classically, vascular injury mechanisms are divided into penetrating or blunt. Following blunt trauma, tissue injury is produced by local compression, rapid deceleration, and the resulting shear forces. In penetrating trauma, the injury is produced by crushing and separation of tissues along the path of the penetrating object along with the resulting concussive shockwave [(3)]. Injury to a vessel can include vasospasm, which can be limb threatening when severe; intimal injury including a flap, dissection, or intramural hematoma; wall defect leading to pseudoaneurysm or hemorrhage; arteriovenous fistula (AVF); or partial or complete transaction [(4)].

The clinical history combined with knowledge of the anatomical target zone and a high index of suspicion should alert the experienced trauma practitioner to injury complexes most likely to have resulted in major vascular injury. Clinical signs of vascular injury may be soft signs "history of bleeding, non-pulsatile hematoma" or hard signs "pulsatile hematoma, bruit, thrill, pulse deficit" [(5)]. In some instances, vascular injury may present without any hard or soft physical examination findings and exist as an occult injury. The physical examination must be augmented with Doppler extremity pressure measurements to diagnose vascular injury [(6)].

It should be emphasized that patients with vascular injuries, like all other trauma patients, should be cared for according to the principles described in the Advanced Trauma Life Support Program. In addition, the management of vascular injuries focuses on some specific goals including early hemorrhage control, minimization of distal ischemia, restoration of perfusion, and prevention of compartment syndrome [(7)].

The purpose of this study was to determine the incidence of vascular injuries, modes and mechanisms of trauma and their relations with regional vascular injury distribution and the outcome of vascular injuries in polytrauma patients.

PATIENTS AND METHODS
This is a prospective observational analytical (cohort) study that included 520 patients who were presented by multiple causes of trauma to Mansoura University Emergency Hospital (MUEH), Mansoura, Egypt. This study was conducted over the period of 1 year from January 2019 to December 2019. The patients were classified into 2 groups according to state of vascularaffection: Group 1: with vascular injuries and

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included 190 cases, and Group 2: without vascular injury and included 330 cases.

Group 1 was further classified into 2 subgroups: (A) Central vascular injuries group: with vascular injuries in the neck, chest and abdomen; and included 8 patients. (B) Peripheral vascular injuries group: with vascular injuries in the upper and lower limbs and included 182 patients

Inclusion criteria: All polytraumatized patients.

Exclusion criteria: Old trauma more than 24 hours, patients refusing to participate in the study, history of peripheral vascular diseases and patients with minor trauma who did not need admission.

All patients were subjected to the following:

- **Resuscitation and primary survey of all patients:**

  A = Airway and cervical spine stabilization as there is risk of coexistent cervical spine injury.

  B = Breathing and ventilation: Provide high O_2 flow if the patient is not ventilated.

  C = Circulation and control of hemorrhage: Two wide bore cannulae should be inserted and blood sample should be sent to the lab to assess blood loss.

  D = Disability and rapid neurological assessment.

  E = Exposure including undressing the patient, without hypothermia.

  Adjuncts of primary survey including monitor, pulse oximetry, urinary catheter, focused assessment sonography in trauma (FAST), Chest X-ray (CXR) and x-ray pelvis were done.

- **The secondary survey:**

I. After initial resuscitation effort, all patients were subjected to full history taking including age, mode and time of trauma, time of arrival and resuscitation.

II. **Ample history taking.**

III. **Clinical examination** of the patients at the trauma room including vital signs, GCS, complete general examination: head-to-toe examination including log-roll to define the potentially life-threatening and/or occult injuries.

IV. **AIS in different body regions:**

Table (1): Abbreviated Injury Scale (AIS) [8].

Score	Injury
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Incompatible with life

V. **Assessment of state of vascular affection through limbs examination to detect:** Hard signs, soft signs and injury extremity index.

VI. **Investigations:**

A. **Laboratory tests:** CBC, INR, ABO grouping, serum creatinine.

B. **Radiological investigations:** X-ray, duplex ultrasound and CT angiography.

Ethical considerations:

An approval of the study was obtained from Mansoura University Academic and Ethical Committee. Informed written consent was obtained from the relatives of the patients sharing in the study. Confidentiality and personal privacy was respected in all levels of the study.

Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data were expressed as number and percentage. Quantitative data were expressed as median (minimum and maximum) & inter for non-parametric data and mean, standard deviation for parametric data after testing normality using Kolmogorov-Smirnov test. Significance of the obtained results was judged at the 5% level.

All tests were 2 tailed. Mean value (X) is the sum of all observations divided by the number of observation. Standard deviation (SD) is the degree of scatter of individual varieties around their mean. The paired (T) test: compares the means of two variables for a single group. It computes the differences between values of two variables for each case and tests whether the average differs from zero.

Chi-square (χ^2) test for comparison between groups as regards qualitative data. Fisher's exact test (FET) evaluates all distribution probabilities for a 2 x 2 table and produces an exact probability for a given set of observed frequencies. A significant p-value was considered when it is equal or less than 0.05.

RESULTS

520 polytrauma patients were included in the study, 190 patients (36.5%) had vascular injuries and 330 patients (63.5%) had no vascular injuries. The means of age were 29.9 ± 9.2 and 31.3 ± 10.10 in group 1 and group 2 respectively. Male gender prevails in both groups (79.5% and 76.9% respectively).

About 53.2% and 57.3% were resident in urban areas. Blunt trauma was more common than penetrating trauma in both groups (63.7% and 84.8% respectively) with high significant statistical difference ($P < 0.001$). MVC and RTA were the commonest blunt trauma, while stabbing was the commonest penetrating trauma in both groups (Table 2).

Table (2): Analysis of demographic data and modes of trauma between the two study groups

Demographic data	Group 1 With vascular injuries N=190; 36.5%	Group 2 Without vascular injuries N=330; 63.5%	Test of sig.
Age:			
Mean ± SD	29.9 ± 9.2	31.3 ± 10.10	t= 1.641 p= 0.354
Gender:			
Males	151 (79.5%)	254 (76.9%)	X^2= 1.514 P= 0.365
Females	39 (20.5 %)	76 (23.1%)	
Residence:			
Urban	101 (53.2%)	189 (57.3%)	X^2= 1.318 P= 0.262
Rural	89 (46.8 %)	141 (42.7%)	
Modes of trauma:			
A. Blunt	**121 (63.7%)**	**280 (84.8%)**	X^2=29.417 P < 0.0001**
RTA	37 (30.6%)	93 (33.2%)	
MVC	41(33.9%)	107 (38.2%)	
FFH	16 (13.2%)	36 (12.9%)	
FTG	9 (7.4%)	33 (11.8%)	
Machinery	18 (14.9%)	11 (3.9%)	
B. Penetrating	**69 (36.3%)**	**50 (15.2%)**	
Stabbing	61 (88.4%)	38 (76%)	
Gunshot	8 (11.6%)	12 (14%)	

X^2: Chi-square test P <0.01: high statistically significant

Patients with vascular injuries had more severe abbreviated injury scale (AIS ≥ 3) in various body regions than patients without vascular injuries. There were high significant statistical differences (P <0.01) between both groups in injury severity in thorax, abdomen and extremities, with significant differences (P < 0.05) in neck and pelvic injuries. While head and spine injuries were closely approximated in both groups (Table 3).

Table (3): Analysis of trauma severity (AIS ≥ 3) between the study groups

Severe injury sites (AIS ≥3)	Group 1 With vascular injuries N=190; 36.5%	Group 2 Without vascular injuries N=330; 63.5%	Test of sig. (χ^2)	P value
Head	35 (18.4%)	51 (15.5%)	0.569	0.4507
Neck	34 (17.9%)	37 (11.2%)	4.018	0.045*
Thorax	41 (21.6%)	39 (11.8%)	8.091	0.0044**
Abdomen	39 (23.2%)	36 (10.9%)	8.273	0.004**
Pelvis	28 (14.7%)	27 (8.2%)	4.807	0.0284*
Spine	24 (12.6%)	37 (11.2%)	0.118	0.7317
Upper limb	129 (67.9%)	168 (50.9%)	13.518	0.0002**
Lower limb	135 (71%)	194 (58.8%)	7.286	0.0069**

χ2: Chi-square test P>0.05: non-significant P<0.05: statistically significant
P<0.01: high statistically significant

The regional distribution of injured vessels in the studied cases were **central** [neck in 1.5%: (external jugular vein: 2 cases and external carotid artery: 1 case), thorax in 1.5% (thoracic aorta, subclavian vein and subclavian artery: each occurred in 1 case) and abdomen in 1.1% (iliac artery and renal artery: each occurred in 1 case)].

Peripheral [upper limb in 43.5% (ulnar artery in 30 cases, radial artery in 27 cases, brachial artery in 16 cases, axillary vein in 5 cases and axillary artery in 4 cases) and lower limb in 52.5% (anterior tibial artery in 32 cases, posterior tibial artery in 27 cases, popliteal artery in 24 cases, superficial femoral vein in 10 cases, superficial femoral artery in 6 cases and common femoral in 1 case)] as shown in table (4).

Table (4): Analysis of the vascular injuries in the studied cases

Group 1: vascular injuries (190 patients)		
	Frequency	**Percentage**
A. Central vascular injuries (N= 8; 4.2%)		
Neck (N= 3; 1.6 %)		
External jugular vein	2	66.6 %
External carotid artery	1	33.3 %
Thorax (N= 3; 1.6 %)		
Thoracic aorta	1	33.3 %
Subclavian artery	1	33.3 %
Subclavian vein	1	33.3 %
Abdomen (N= 2; 1%)		
Iliac artery	1	50 %
Renal artery	1	50 %
B. Peripheral vascular injuries (N= 182; 95.8%)		
Upper limb (N= 82; 43.2%)		
Axillary artery	4	4.88 %
Axillary vein	5	6.1 %
Brachial artery	16	19.5 %
Radial artery	27	33 %
Ulnar artery	30	36.6 %
Lower limb (N= 100; 52.6 %)		
Common femoral artery	1	1 %
Superficial femoral artery	6	6 %
Superficial femoral vein	10	10 %
Popliteal artery	24	24 %
Anterior tibial artery	32	32 %
Posterior tibial artery	27	27 %

Table (5) showed that the central vascular injuries (trunk, thoracic, abdominal then neck) had a wide variety of associated injuries more than peripheral vascular injuries (upper and lower limbs).

Table (5): Distribution of associated injuries in the patients with vascular injuries

Group 1: vascular injuries (190 patients)						
Associated injuries		**Central (8)**			**Peripheral (182)**	
		Neck (3)	**Thorax (3)**	**Abdomen (2)**	**Upper limb (82)**	**Lower limb (100)**
Traumatic Brain Injury		2 (66.7%)	1 (33.3%)	1 (50%)	13 (15.8%)	25 (25%)
Facial fracture		2 (66.7%)	-	1 (50%)	14 (17.1%)	22 (22%)
Thoracic	Scapular fracture	-	3 (100%)	-	1 (1.2%)	-
	Clavicle fracture	-	3 (100%)	-	5 (6.1%)	5 (5%)
	Rib fracture	-	3 (100%)	2 (100%)	7 (8.5%)	10 (10%)
	Lung contusion	1 (33.3%)	3 (100%)	2 (100%)	8 (9.7%)	10 (10%)
	Hemothorax	1 (33.3%)	3 (100%)	1 (50%)	13 (15.8%)	17 (17%)
	Pneumothorax	1 (33.3%)	3 (100%)	-	11 (13.4%)	9 (9%)
Visceral injury		-	2 (66.7%)	2 (100%)	19 (23.2%)	15 (15%)
Pelvic fracture		1 (33.3%)	1 (33.3%)	2 (100%)	14 (17.1%)	24 (24%)
Spine fracture		1 (33.3%)	1 (33.3%)	2 (100%)	11 (13.4%)	21 (21%)
Bone fracture		-	2 (66.7%)	1 (50%)	58 (70.7%)	89 (89%)
Peripheral nerve injury		-	-	1 (50%)	49 (59.7%)	83 (83%)

The patterns of vascular injuries found were intimal injury in 5.8% (11 patients), complete wall defect in 37.9% (72 patients) and complete transection in 56.3% (107 patients) as shown in table (6).

Table (6): Patterns of vascular injuries

Group 1: with vascular injuries (190 patients)		
Patterns of vascular injuries	**Frequency**	**Percentage**
Intimal injury	11	5.8%
Complete wall defect	72	37.9%
Complete transection	107	56.3%

The outcome of the studied cases was estimated according to surgical intervention, ICU admission, hospital length of stay (LOS) and mortality rate. The outcome of the studied cases was worse in patients with vascular injuries as cases with vascular injuries had more surgical intervention, more ICU admission, more prolonged hospital LOS and higher mortality rate with significant statistical differences between the 2 study groups (Table 7).

Table (7): Outcome estimation of the studied cases

	Group 1 With vascular injuries	Group 2 Without vascular injuries	Test of sig.
Surgical intervention			
Yes	136 (71.6%)	184 (55.8%)	$\chi2$= 5.189 P = 0.0227*
No	54 (28.4%)	146 (44.2%)	
ICU admission			
Yes	97 (51%)	135 (40.9%)	χ^2=4.619 P = 0.0316*
No	93 (49%)	195 (59.1%)	
Hospital LOS			
Mean ± SD	11.98 ± 2.9	9.75 ± 2.78	t= -6.140 P <0.0001**
Median (Min-Max)	6 (1-19)	5 (2-17)	
Mortality rate			
Died	49 (25.8%)	56 (17%)	χ^2=5.286 P = 0.0215 *
Survived	141 (74.2%)	274 (83%)	

$\chi2$: Chi-square test t: student t test
P<0.05: statistically significant P<0.01: high statistically significant

The outcome in the vascular injuries subgroups showed that there were significant statistical differences between the 2 subgroups in all parameters except surgical intervention. The outcome was worse in central vascular injuries: ISS (41.9 ± 12.54 vs. 30.75 ± 11.89), ICU admission in (62.5% vs. 50.5%), more mortality rate (62.5% vs. 17.1%) and hospital LOS (10.87 ± 3.11 vs. 9.91 ± 3.19). Besides, surgical intervention occurred in 6 cases (75%) with central vascular injuries and 130 cases (71.4%) with peripheral vascular injuries, respectively (Table 8).

Table (8): Analysis of outcome of vascular injuries subgroups

Group 1: vascular injuries (190 patients)			
	Central (8)	**Peripheral (182)**	**Test of significance**
ISS			
Mean ± SD	41.9 ± 12.54	30.75 ± 11.89	t= - 4.54 P < 0.0001**
Median (Min-Max)	41 (9-75)	9 (1-66)	
Surgical intervention			
Yes	6 (75%)	130 (71.4%)	$\chi2$= 0.218 P = 0.831
No	2 (25%)	52 (28.6%)	
ICU admission			
Yes	5 (62.5%)	92 (50.5%)	$\chi2$= 4.15 P = 0.0401*
No	3 (37.5%)	90 (49.5%)	
Hospital LOS			
Mean ± SD	10.87 ± 3.11	9.91 ± 3.19	t= 2.035 P= 0.045*
Median (Min-Max)	8 (1-19)	5 (1-17)	
Mortality rate			
Died	5 (62.5%)	31(17.1%)	$\chi2$= 27.049

Survived	3 (37.5%)	151 (82.9%)	P < 0.0001**

t: student t test, χ2: Chi-square test, P < 0.05: statistically significant, P < 0.01: high statistically significant

DISCUSSION

The incidence of vascular injuries in the studied cases was 36.5% (190 patients). Most of the studied cases were of middle age with approximated age means in vascular injury and non-vascular injury groups. Male gender prevails in both groups. Our results are in agreement with **Friend *et al.*** [(9)] where they included 45164 patients on the trauma database, of which 1205 patients (2.6%) sustained 1335 vascular injuries. Males of their middle age (20–29 years) were more frequently injured**.** In another study performed by **Pöyhönen *et al.*** [(10)]**,** the incidence of non-iatrogenic vascular trauma was 11.9% (143 patients). About 75.5% (108 patients) of vascular injuries were males. The mean age of the cohort was 38 ± 20 years**.** Furthermore, in a previous study achieved by **Perkins *et al.*** [(11)], 5823 trauma patients were enrolled in the study. The incidence of vascular injuries was 4.4% (256 patients). The majority of vascular trauma occurred in severely injured young males. Significant baseline demographic differences exist between patients suffering from penetrating or blunt vascular trauma**.**

The reason why the males of middle age group are involved in accidents could be explained by the fact that they tend to participate in high risk activities, over-speed and drive without wearing any protective devices and in so doing are predisposed to risks of being exposed to motorcycle crashes, which adds a serious economic loss to the community [(12)]**.** In that respect, our reports differ from these earlier papers, as it was possible to produce population-based results. These results can be undoubtedly generalized to cover the whole of Egypt, as the country is divided into multiple quite similar university hospital districts.

In the current study, injuries were more severe (according AIS ≥ 3) in patients with vascular injuries. There were high significant statistical differences (P < 0.01) between both groups in injury severity in thorax, abdomen and extremities, with significant differences (P < 0.05) in neck and pelvic injuries. While head and spine injuries were closely approximated in both groups. Our results are consistent with **Perkins *et al.*** [(11)] who clarified that vascular trauma patients were more severely injured (higher ISS), showed general trauma admissions [17 (9-29) and 9 (4-19)] with ISS > 15 in 84% and 44% respectively. In addition, vascular trauma patients had significantly greater use of hospital resources in terms of blood transfusion requirements and critical care requirements with high significant statistical difference (P < 0.01) between the 2 groups.

AIS describes the anatomic injury and sets the basis for the calculation of other trauma scores. Polytrauma was defined as AIS of 3 in ≥ body regions. The higher the score, the higher the injury severity, and, therefore, the higher the mortality. The ISS is based on an anatomic classification of injury severity of the AIS,

combining the severity levels in a single value, which is correlated with the outcomes [(13)]**.**

In the present study, the most common region with vascular injuries was peripheral vascular injuries in 95.8% [lower limb in 52.6% (100 patients) and upper limb in 43.2% (82 patients)], followed by central vascular injuries in 4.2% [neck in 1.6% (3 patients), thorax in 1.6% (3 patients) and abdomen in 1 % (2 patients)]. These are in agreement with **Friend *et al.*** [(9)] who informed that the regional vascular injuries were distributed as follows: peripheral vascular injuries in 76.2% [upper limb in 64.1% (772 patients) and lower limb in 12.1% (146 patients)], and central vascular injuries in 23.8% [abdomen in 9.2% (111 patients), neck in 8.4% (101 patients), and thorax in 6.2% (75 patients)]. As well, **Pöyhönen *et al.*** [(10)] reported that peripheral vascular injuries were much more common [upper limb in 69.9% (100 patients), and lower limb in 18.9% (27 patients)] than central vascular injuries [neck in 4.2% (6 patients), thorax 3.5% (5 patients) and abdomen 3.5% (5 patients)]. Also, **Stannard *et al.*** [(14)] informed that the regional vascular injuries distribution was as follows: 69.1% (76 patients) sustained extremity vascular injury, whereas 38.2% (42 patients) sustained (central thoracic and abdominal: 25 patients and cervical: 17 patients) injury. Eight patients sustained combination vascular injury to more than one body zone. On the contrary, **Perkins *et al.*** [(11)] found that central vascular injuries were most common (48%) then extremity (34%) and lastly junctional (20%) injuries. In cases with extremity vascular injuries, the distribution of upper and lower limb injuries was the same (47% vs. 53%). On the contrary, **Loh *et al.*** [(15)] published that central vascular injuries were more common [neck: 8% (4 patients), thorax: 10% (5 patients), and abdomen: 26% (13 patients)] than peripheral vascular injuries [upper limb: 12% (6 patients) and lower limb: 16% (8 patients)].

In the present study, blunt trauma was more common than penetrating in both groups (63.7% and 84.8%) respectively with high significant statistical difference. In addition, blunt trauma was more common in all regional vascular injuries (66.7% of neck, 75% of lower limb, 100% of thoracic and abdominal vascular injuries) except in upper limb vascular injuries where penetrating trauma was slightly more common in 52.4%. Similarly, **Friend *et***

al. **[9]** stated that blunt trauma occurred more frequently than penetrating. The extremities, particularly the upper limbs were most commonly injured. The most common causes of injury for each region were as follows: MVC and stabbing (neck, thorax, abdomen and lower limb) and piercing injuries (upper limb). Correspondingly, **Loh *et al.*** **[15]** stated that blunt trauma was the predominant mode of trauma in vascular and nonvascular trauma groups (60% and 66% respectively). RTA (pedestrian) was the main blunt trauma, while stabbing was the main penetrating trauma in both groups. In contrast, **Abdulkarim *et al.*** **[16]** stated that penetrating trauma was more common than blunt trauma [51.4% (18 patients) vs. 48.6% (17 patients)] in patients with vascular injuries. Most injuries (43%) were sustained in RTAs, 31% had differing mechanisms including domestic, industrial and agricultural accidents and 17% were caused by stabbing.

In this study, the central vascular injuries had various associated injuries [thorax (intrathoracic and visceral injuries), abdomen (intrathoracic, visceral, pelvic and spine injuries) and neck (TBI and facial fractures)], which were more common and fatal than peripheral vascular injuries [upper and lower limbs vascular injuries (bone fractures and peripheral nerve injuries)]. Correspondingly, **Friend *et al.*** **[9]** clarified that the highest number of associated injuries occurred with truncal vascular injuries [thorax (TBI and intrathoracic injuries), abdomen (pelvic, ribs and spine fractures and TBI), and neck (TBI and facial fractures)], while peripheral vascular injuries were more associated with extremity bone fractures.

The anatomical distribution of vascular injuries and mechanism of trauma can suggest associated injuries. Upper extremities are often isolated injuries with a penetrating cause. The highest number of associated injuries occurred with truncal vascular injuries because of both anatomical proximity to vital structures and extensive injuries caused by MVCs causing more dispersed trauma**[17,18]**.

In the present study, the patterns of vascular injuries found were intimal injury in 5.8% (11 patients), complete wall defect in 37.9% (72 patients) and complete transection in 56.3% (107 patients).

In this study, the outcome of the studied cases was worse in patients with vascular injuries. In addition, the central vascular injuries had worse outcome (more ISS, more surgical intervention, more ICU admission, more hospital LOS and more mortality rate: [62.5% (5 patients: 2 before and 3 after surgery) vs. 43.4% (79 patients: 72 before and 9 after surgery)] with significant statistical differences between the study groups. These results are in harmony with **Friend *et al.*** **[9]** who reported that central vascular injuries recorded higher ISS, LOS and mortality rate (thoracic (41 [9– 75]), 17 [3–73], (42.7%); abdominal (38 [9–66]), 17 [1–49], (15.3%); and neck (1.5 [2–43], 2 [1–73], (11.2%)) than peripheral vascular injuries (lower limb (9 [1–57]), 11 [2–52], (2.7%); and upper limb (9 [1–50], 6 [1–74], (0.9%)) respectively. Equally, **Perkins *et al.*****[11]** reported that vascular trauma had higher ISS, more prolonged hospital LOS and higher mortality rate than general trauma. The majority of deaths developed in cases with central or junctional vascular injuries. Univariate analysis revealed that ISS, blunt mechanism of injury and a junctional or central zone of injury were significantly accompanied with death. These results are in harmony with **Stannard *et al.*** **[14]** who stated that central vascular injuries were much more severe (ISS) than peripheral ones [23 (11–75) and 17 (13–20) respectively, P < 0.001]. In addition, the mortality rate was 90.5% of central vascular injuries [100% of torso vascular injuries (25 patients; 24 before surgery and 1 died after thoracotomy) and 76.5% of cervical vascular injuries (13 patients: 11 before surgery and 2 after surgery)], while it was 52.6% for peripheral vascular injuries (40 patients: 39 before surgery and 1 postoperative). In contrast, **Pöyhönen *et al.*** **[10]** reported that the majority (N = 110, 76.9 %) of vascular injuries were treated surgically [62.5% of central vascular injuries (2 in neck, 5 in thorax and 3 in abdomen), and 78.7% of peripheral vascular injuries (85 in upper limb and 15 in lower limb)]. The 30- day mortality was zero in both central and peripheral vascular injuries.

The vascular trauma is associated with more injury severity, more use of hospital resources (including hospital LOS, blood transfusion and surgical intervention) and higher mortality rate. In this concern, torso vascular injuries are associated with poorer outcome as they are non-compressible, with close anatomical proximity to vital organs and mainly attributed to high-speed collusions that are associated with high-energy transfer to a wide body surface area **[19]**.

CONCLUSION

- The vascular trauma patients are subjected to more injury severity (AIS, ISS) and higher mortality rate than other polytrauma patients.
- Blunt modes of trauma are predominant generally in polytrauma patients and specifically in vascular trauma except upper limb.
- Blunt vascular injury is associated with worse outcomes than penetrating ones because of extensive tissue damage associated with high impact force
- Penetrating modes of trauma are able to induce a disproportionate amount of vascular injuries as the elastic vascular tissues make them resistant to blunt trauma, but amenable to cutting
- Peripheral vascular injuries are significantly more common than central vascular injuries among

vascular injured patients

- Upper limb vascular injuries are often isolated injuries of penetrating origin. While, lower limb vascular injuries often have associated injuries of blunt origin (high-speed collusion)

- Central vascular injuries have the highest number of associated injuries and are associated with poorer outcome because of anatomical proximity to vital structures and extensive injuries caused by blunt trauma of high-speed collusion

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