Acute trauma coagulopathy: prevalence and outcome in trauma patients presenting to the Emergency Department SMBB Trauma Centre, Civil Hospital Karachi.

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Abstract

PURPOSE To determine the prevalence of Acute Trauma Coagulopathy (ATC) in severely injured patients presenting to the emergency department of SMBB Trauma Centre of Civil Hospital Karachi and to investigate its impact on these patient's outcome. Early recognition using initial coagulation profile (PT/APTT) accompanied by adequate management of ATC and prevention of bleeding may substantially reduce mortality and improve outcomes in severely injured patients in resource limited environments.

MATERIAL AND METHODS This descriptive cross sectional study was carried out in Surgical unit 4, Dr Ruth K.M. Pfau Civil hospital Karachi from 27 th July 2019 to 28 th January 2020. After approval from institutional review board, 80 patients aged between 14 to 60 years with injury severity score more than 15 were enrolled using non probability consecutive sampling technique and their coagulation profile (PT, APTT and INR) was done at presentation and followed for in hospital mortality. Data was collected and analyzed using SPSS 24.

RESULTS In our study total 80 patients were enrolled, the mean age of patients was 27.28 ± 12.18 . Trauma coagulopathy was present in 12.5% patients. In hospital mortality was found to be 16.3%. The in hospital mortality was compared in patients with coagulopathy and patients without coagulopathy and p value was significant 0.00. Data stratification was significant for age with p value 0.016. Data stratification for gender, mode of injury, mechanism of injury, amount of fluid given at presentation and injury severity score was not significant.

CONCLUSION Acute trauma coagulopathy is associated with increased risk of mortality.

Introduction

Trauma remains a leading cause of death and disability in adults in spite of advances in resuscitation, surgical management, and critical care [1]. The World Health Organization (WHO) estimates that around 5 million people die of injuries every year, accounting for 10% of global annual mortality [2]. Low- and middle income nations are severely affected with over 90% of the world's trauma mortality occurring in these nations. Young people are most commonly involved in trauma related deaths with almost 50% of those who die are between 15 and 44 years of age, with males accounting for twice as many deaths as females; death due to traumatic injury is, therefore, the leading cause of life years lost. Violence-self-inflicted, interpersonal, and war-related-accounts for half of trauma mortality. Road traffic accounts for the next largest proportion [3].

Immediately after trauma a number of physiological derangements set in a patient. Central to trauma management along with determination of the extent of injury is early recognition of these derangements and initiation of goal directed therapy. Hemorrhage is responsible for 40% of all trauma deaths [4]. A frequent complication of hemorrhage is coagulopathy that may occur in up to 25% of patients with trauma, even before hospital admission [5]. Acute traumatic coagulopathy (ATC) is an endogenous

impairment of hemostasis that occurs early after injury and is associated with increased mortality and worse outcomes in the polytrauma patients [6].

Coagulopathy associated with traumatic injury is the result of multiple independent but interacting mechanisms. Early coagulopathy is driven by shock and requires thrombin generation from tissue injury as an initiator. Initiation of coagulation occurs with activation of anticoagulant and fibrinolytic pathways. This Acute Coagulopathy of Trauma-Shock is altered by subsequent events and medical therapies, in particular acidemia, hypothermia, and dilution. There is significant interplay between all mechanisms.

Acute trauma coagulopathy is caused by tissue injury, hypo perfusion and shock. Mechanisms for this acute coagulopathy include activation of protein C, endothelial glycocalyx disruption, depletion of fibrinogen, and platelet dysfunction. Hypothermia and acidemia amplify the endogenous coagulopathy and often accompany trauma. These multifactorial processes lead to decreased clot strength, autoheparinization, and hyperfibrinolysis. Furthermore, the effects of aggressive crystalloid administration, haemodilution from inappropriate blood product transfusion, and prolonged surgical times may worsen clinical outcomes [7].

Sarah et al. in a retrospective study of combat casualties showed that mortality in those who were coagulopathic at arrival to the emergency department was 24% (32/133) versus 4% (8/214) in those not presenting with coagulopathy [8]. Mujuni et al. in a study carried out in 2012 found out the frequency of patients with acute trauma coagulopathy among major trauma patients to be 54.4% and a mortality of 29.29% in patients with ATC as compared to 10.84% in non ATC patients [2]. Sjoerd et al. in a study of 107 patients reported that early coagulopathy as diagnosed in the emergency department occurred in 24% of all patients and during the first 24 hours post-trauma it provided an independent prognostic factor for unfavorable outcome (odds ratio (OR) 3.75 (95% CI 1.07 to 12.51; P=0.04) and OR 11.61 (2.79 to 48.34); P= 0.003) [9].

The aim of this study is to determine the prevalence of Acute Trauma Coagulopathy (ATC) in severely injured patients presenting to the emergency department of Civil Hospital Karachi and to investigate its impact on these patient's outcome. Studies have reported an overall mortality among major trauma patients with acute trauma coagulopathy ranging from 15% to 24% [10]. However studies in low and middle income countries like Pakistan are lacking, which are most severely affected and contribute to over 90% of trauma related mortality. After trauma most preventable deaths occur due to bleeding [11]. Early recognition using initial coagulation profile (PT/APTT) accompanied by adequate and aggressive management of Acute Trauma Coagulopathy and prevention of bleeding may substantially reduce mortality and improve outcomes in severely injured patients in resource limited environments like ours.

Materials And Methods

STUDY DESIGN: Descriptive Case Series.

STUDY SETTING: Emergency Department of SMBB Trauma Centre and Surgical Unit 4, DR. RUTH K.M. PFAU Civil Hospital Karachi.

Duration of Study: 27th July 2019 to 28th January 2020.

Sample Size: Using WHO Calculator Statistics for Mortality in patients with ATC - 29.29% d - 10% (Sample Size n=80)

Sampling Technique: Non-probability consecutive sampling.

Inclusion Criteria:

1. All patients with injuries to head and neck, face, thorax, abdomen, extremities, external (surface) with Injury Severity Score (ISS)>15 presenting within 6 hours of initial injury.
2. Age limit: 14 - 60 years

Exclusion Criteria:

History was elicited from the patient or the para medics / care givers / relatives accompanying the patient to the Emergency Department and following patients were excluded.

- Patients who received more than 2 liters of crystalloids before admission.
- Patients who received blood transfusion before admission.
- Patients with a known bleeding diathesis.
- Patients on anticoagulant medications as elicited from history.
- Patients with a history of liver disease or renal failure.

DATA COLLECTION PROCEDURE:

After approval from CPSP and Institutional review board (d.u.h.s) 80 patients full filling the inclusion and exclusion criteria were enrolled from Emergency Department and Surgical Unit 4, Civil Hospital Karachi. Written informed consent was taken from care taker. Demographic data including age, gender, time from injury to arrival in the emergency department, mechanism of injury, fluid administration at scene; and on anatomic injury characteristics and scored using Injury severity scoring (ISS) calculated from these data. On the arrival of the patient in the emergency department, the first task of one member of the trauma team was to take a blood sample (arterial or venous) via a direct puncture, with a non-heparinized syringe. The sample was placed in a citrated tube and sent immediately to the hospital's central laboratory. Prothrombin time (PT), Activated partial thromboplastin time (APTT), and International normalized ratio (INR) was determined from this sample, and represented the coagulation state before

further resuscitation. The coagulation data was collected from the hospital's laboratory computer database. The presence of a coagulopathy was defined as an INR over 1.2 and/or an APTT over 45 seconds (1.5 times the upper limit of institute). Mortality was used as the outcome measure. Patients that were admitted to the surgical unit or intensive care unit following resuscitation and management of injuries were followed for in-hospital mortality on 0, 2nd, 6th day and finally assessed on 14th day. Patients that were discharged within 2 weeks of in hospital admission or the patients that were not admitted in hospital and discharged from the emergency department were considered as survivors.

Results

In our study 80 patients with blunt and penetrating trauma injury were enrolled. The injury was accidental as well as non-accidental. The in-hospital mortality was compared in patients with coagulopathy and patients without coagulopathy.

There were 43 males and 37 female patients [Table 1].

Accidental injury was present in 46.3% and 53.8% had non accidental injury [Table 2].

Blunt trauma was found in 32 patients and penetrating trauma was found in 48 patients [Table 3].

Trauma coagulopathy was present in 12.5% patients [Table 4].

In hospital mortality was found in 16.3% patients [Table 5].

The mean age of patients was 27.28 ± 12.18 [Table 6].

The amount of fluid given at presentation was 1200 ± 80 ml [Table 7].

The mean injury severity score was 50.2 ± 11.18 [Table 8].

Prothombin time was 13.3 ± 1.8 sec, APTT was 32.3 ± 2.1 and mean INR was 1.2 ± 0.1 [Table 9].

The inhospital mortality was compared in patients with coagulopathy and patients without coagulopathy and p value was significant 0.00 [Table 10].

Data stratification was significant for age p value 0.016 [Table 11].

Data stratification for gender, mode of injury, mechanism of injury, amount of fluid given at presentation and injury severity score was not significant [Table 12, 13, 14, 15 and 16].

Table 1: Gender distribution

		Frequency	Percent
Valid	Male	43	53.8
	Female	37	46.3
	Total	80	100.0

Table 2: Mode of injury

		Frequency	Percent
Valid	Accidental	37	46.3
	Non-accidental	43	53.8
	Total	80	100.0

Table 3: Mechanism of injury

		Frequency	Percent
Valid	Blunt	32	40.0
	Penetrating	48	60.0
	Total	80	100.0

Table 4: Frequency of trauma coagulopathy

		Frequency	Percent
Valid	Yes	10	12.5
	No	70	87.5
	Total	80	100.0

Table 5: Frequency of in hospital mortality

		Frequency	Percent
Valid	Discharge	67	83.8
	Expire	13	16.3
	Total	80	100.0

Table 6: Age distribution of sampled population

Descriptive Statistics age					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	80	15	60	27.28	12.181

Table 7: Amount of fluid given

Descriptive Statistics amount of fluid					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	80	500ml	1500ml	1200ml	80.18ml

Table 8: Injury severity score

Descriptive Statistics injury severity score					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	80	16	74	50.28	11.181

Table 9: PT, APTT, INR

Descriptive Statistics PT, APTT, INR					
	N	Minimum	Maximum	Mean	Std. Deviation
PT	80	11	21	13.3	1.81
APTT	80	26	40	32.3	2.1
INR	80	1	1.6	1.2	0.1

Table 10: Comparison of in hospital mortality in patients with coagulopathy and without coagulopathy

Cross tabulation inhospital mortality and Trauma coagulopathy					
			Trauma coagulopathy		Total
			Yes	No	
Inhospital mortality	Discharge	Count	3	64	67
		% within inhospital mortality	4.5%	95.5%	100.0%
	Expire	Count	7	6	13
		% within inhospital mortality	53.8%	46.2%	100.0%
Total		Count	10	70	80
		% within inhospital mortality	12.5%	87.5%	100.0%
p-value=0.000 significant					

Table 11: Data stratification for age

Cross tabulation Age, inhospital mortality and Trauma coagulopathy						
Trauma coagulopathy				Inhospital mortality		Total
				Discharge	Expire	
Yes	Age	13-40 years	Count	1	7	8
			% within Age	12.5%	87.5%	100.0%
		41-65 years	Count	2	0	2
			% within Age	100.0%	0.0%	100.0%
	Total		Count	3	7	10
			% within Age	30.0%	70.0%	100.0%
No	Age	13-40 years	Count	49	6	55
			% within Age	89.1%	10.9%	100.0%
		41-65 years	Count	15	0	15
			% within Age	100.0%	0.0%	100.0%
	Total		Count	64	6	70
			% within Age	91.4%	8.6%	100.0%
Total	Age	13-40 years	Count	50	13	63
			% within Age	79.4%	20.6%	100.0%
		41-65 years	Count	17	0	17
			% within Age	100.0%	0.0%	100.0%
	Total		Count	67	13	80
			% within Age	83.8%	16.2%	100.0%
p-value= 0.016 significant						

Table 12: Data stratification for gender

Cross tabulation Gender , inhospital mortality and Trauma coagulopathy						
Trauma coagulopathy				Inhospital mortality		Total
				Discharge	Expire	
Yes	Gender	Male	Count	2	2	4
			% within Gender	50.0%	50.0%	100.0%
		Female	Count	1	5	6
			% within Gender	16.7%	83.3%	100.0%
	Total		Count	3	7	10
			% within Gender	30.0%	70.0%	100.0%
No	Gender	Male	Count	35	4	39
			% within Gender	89.7%	10.3%	100.0%
		Female	Count	29	2	31
			% within Gender	93.5%	6.5%	100.0%
	Total		Count	64	6	70
			% within Gender	91.4%	8.6%	100.0%
Total	Gender	Male	Count	37	6	43
			% within Gender	86.0%	14.0%	100.0%
		Female	Count	30	7	37
			% within Gender	81.1%	18.9%	100.0%
	Total		Count	67	13	80
			% within Gender	83.8%	16.2%	100.0%
p-value 0.26 not significant						

Table 13: Data stratification for mode of injury

Cross tabulation Mode of Injury , inhospital mortality and Trauma coagulopathy						
Trauma coagulopathy				Inhospital mortality	Total	
				Discharge	Expire	
Yes	Mode of Injury	Accidental	Count	0	2	2
			Percentage	0.0%	100.0%	100.0%
		Non-accidental	Count	3	5	8
			Percentage	37.5%	62.5%	100.0%
	Total	Count	3	7	10	
		Percentage	30.0%	70.0%	100.0%	
No	Mode of Injury	Accidental	Count	32	3	35
			Percentage	91.4%	8.6%	100.0%
		Non-accidental	Count	32	3	35
			Percentage	91.4%	8.6%	100.0%
	Total	Count	64	6	70	
		Percentage	91.4%	8.6%	100.0%	
Total	Mode of Injury	Accidental	Count	32	5	37
			Percentage	86.5%	13.5%	100.0%
		Non-accidental	Count	35	8	43
			Percentage	81.4%	18.6%	100.0%
	Total	Count	67	13	80	
		Percentage	83.8%	16.2%	100.0%	
p-value= 0.301 not significant						

Table 14: Data stratification for mechanism of injury

Cross tabulation Mechanism of Injury , inhospital mortality and Trauma coagulopathy						
Trauma coagulopathy				Inhospital mortality		Total
				Discharge	Expire	
Yes	Mechanism of Injury	Blunt	Count	2	4	6
			Percentage	33.3%	66.7%	100.0%
		Penetrating	Count	1	3	4
			Percentage	25.0%	75.0%	100.0%
	Total		Count	3	7	10
			Percentage	30.0%	70.0%	100.0%
No	Mechanism of Injury	Blunt	Count	23	3	26
			Percentage	88.5%	11.5%	100.0%
		Penetrating	Count	41	3	44
			Percentage	93.2%	6.8%	100.0%
	Total		Count	64	6	70
			Percentage	91.4%	8.6%	100.0%
Total	Mechanism of Injury	Blunt	Count	25	7	32
			Percentage	78.1%	21.9%	100.0%
		Penetrating	Count	42	6	48
			Percentage	87.5%	12.5%	100.0%
	Total		Count	67	13	80
			Percentage	83.8%	16.2%	100.0%
p-value= 0.778 not significant						

Table 15: Data stratification for amount of fluid

Cross tabulation Amount of fluid , inhospital mortality and Trauma coagulopathy						
Trauma coagulopathy				Inhospital mortality		Total
				Discharge	Expire	
Yes	Amount of fluid	Less than 1000ml	Count	1	2	3
			Percentage	33.3%	66.7%	100.0%
		More than 1000 ml	Count	2	5	7
			Percentage	28.6%	71.4%	100.0%
	Total		Count	3	7	10
			Percentage	30.0%	70.0%	100.0%
No	Amount of fluid	Less than 1000ml	Count	42	3	45
			Percentage	93.3%	6.7%	100.0%
		More than 1000 ml	Count	22	3	25
			Percentage	88.0%	12.0%	100.0%
	Total		Count	64	6	70
			Percentage	91.4%	8.6%	100.0%
Total	Amount of fluid	Less than 1000ml	Count	43	5	48
			Percentage	89.6%	10.4%	100.0%
		More than 1000 ml	Count	24	8	32
			Percentage	75.0%	25.0%	100.0%
	Total		Count	67	13	80
			Percentage	83.8%	16.2%	100.0%
p-value= 0.880 not significant						

Table 16: Data stratification for injury severity score

Cross tabulation Injury severity score , inhospital mortality and Trauma coagulopathy						
Trauma coagulopathy				Inhospital mortality		Total
				Discharge	Expire	
Yes	Injury severity score	serious 16-24	Count	2	2	4
			Percentage	50.0%	50.0%	100.0%
		severe 25-49	Count	1	4	5
			Percentage	20.0%	80.0%	100.0%
		critical 50-74	Count	0	1	1
			Percentage	0.0%	100.0%	100.0%
	Total		Count	3	7	10
			Percentage	30.0%	70.0%	100.0%
No	Injury severity score	serious 16-24	Count	28	0	28
			Percentage	100.0%	0.0%	100.0%
		severe 25-49	Count	23	3	26
			Percentage	88.5%	11.5%	100.0%
		critical 50-74	Count	13	3	16
			Percentage	81.2%	18.8%	100.0%
	Total		Count	64	6	70
			Percentage	91.4%	8.6%	100.0%
Total	Injury severity score	serious 16-24	Count	30	2	32
			Percentage	93.8%	6.2%	100.0%
		severe 25-49	Count	24	7	31
			Percentage	77.4%	22.6%	100.0%
		critical 50-74	Count	13	4	17
			Percentage	76.5%	23.5%	100.0%
	Total		Count	67	13	80
			Percentage	83.8%	16.2%	100.0%
p-value= 0.490 not significant						

Discussion

For decades, the art of medically managing the trauma patient was just that, an art. A paucity of scientific information existed until the beginning of Operation Desert Shield in 1990 when the problem of massive trauma, coagulopathy, and transfusion was thrust prominently into the global spotlight. The United States Centers for Disease Control and Prevention in 2014 ranked unintentional injury as the leading cause of death among ages 1-44 [12]. Trauma coagulopathy is an early, primary post-injury coagulopathy. It is associated with an increase in mortality, even when controlling for crystalloids, vital signs, injury severity and head injury. In our study the mean age of patients was 27.28 ± 12.18 , there were 43 males and 37 female patients. Accidental injury was present in 46.3% and 53.8% had non accidental injury. Blunt trauma was found in 32 patients and penetrating trauma was found in 48 patients. Trauma coagulopathy was present in 12.5% patients. In hospital mortality was found in 16.3% patients. The mean injury severity score was 50.2 ± 11.18 . The inhospital mortality was compared in patients with coagulopathy and patients without coagulopathy and p value was significant 0.00. Data stratification was significant for age p value 0.016. Data stratification for gender, mode of injury, mechanism of injury, amount of fluid given at presentation and injury severity score was not significant.

Our results were comparable to other international studies. A high prevalence of ATC has been reported in Uganda with 54% [13], while an Australian study found that only 9.0% of their traumatic patients met the definition of traumatic coagulopathy [14]. Two studies from Europe have reported the prevalence of ATC in the range of 24% to 34% [15, 16].

Mitra stated that Acute traumatic coagulopathy is observed in 10-25% of patients post major trauma and its management forms an integral part of haemostatic resuscitation. There were 772 patients included in this study with a median ISS of 29 (19-41), with 91.7% blunt trauma. All-cause in-hospital mortality was 17.5%, while 77 (9.7%) patients died early. Increasing age (OR 1.04), a GCS of 3-8 (OR 5.05), and the presence of acute coagulopathy (OR 8.77) were significant independent variables associated with early death [17].

A study by MacLeoab et al [18] on 701 patients gave similar results. There was 75.3% male, 25.7% penetrating, with a mean age of 39 years. The overall mortality was 7.3%. ATC occurred in 114 patients (16.3%) and was found to be independently associated with death (odds of death (per 0.10 s increase in PT): 1.10, $p = 0.001$) However, even mildly injured patients, who had an ISS < 16, normal RTS score, and no fluid resuscitation, had an ETIC prevalence of 11.7% (11/94).

Hojjat [19] conducted a study on 246 patients with the mean age of 36.57 ± 17.11 years were included (88.2% male). The mean injury severity score (ISS) was 21.83 ± 7.37 (16 – 54). Patients were resuscitated with 676.83 ± 452.02 (0 – 1500) ml intravenous fluid before arriving at the ED. The maximum and minimum frequencies of ATC were 31.3% based on PTT > 36s and 2.4% based on PT > 18s, respectively. There was a significant association between the occurrence of ATC (PT ratio > 1.2) and ISS > 23 ($p = 0.001$), abdominal abbreviated injury score (AIS) > 3 ($p = 0.003$), base deficit > 4 ($p = 0.019$), pulse rate > 90/minute ($p = 0.041$), and pH < 7.30 ($p = 0.043$).

Conclusion

Acute traumatic coagulopathy (ATC) occurs after severe injury and shock and is associated with increased bleeding, morbidity, and mortality. Our study concludes that a significant proportion of major trauma patients were coagulopathic. Initial coagulation profile is useful in predicting outcomes for major trauma patients. A high proportion of patients arrive in the emergency department with an established clotting disorder, we suggest that a coagulation profile is an important laboratory investigation that should be performed early in the workup of trauma patients even in resource limited environments in order to provide directed and aggressive management to the patients at high risk and to reduce morbidity and improve survival.

Declarations

FUNDING: Not applicable

CONFLICTS OF INTEREST: Author has no conflicts of interest to declare.

ETHIC APPROVAL: Study was conducted after taking approval from College of Physicians and Surgeons Pakistan (CPSP) and Institutional Review Board of Dow University of Health Sciences (D.U.H.S).

CONSENT TO PARTICIPATE: Written and informed consent was taken from the care taker of the patients.

AVAILABILITY OF DATA AND MATERIAL: Data available within the article.

CODE AVAILABILITY: Not applicable

AUTHORS' CONTRIBUTIONS:

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