INTRODUCTION

Trauma is part of anesthesia practices but the specialty of few anesthesiologists' clinical practice focused on trauma can yield experience and insights that contribute to better patient outcomes. **(Richard P Dutton M.D.M.B.A the American Society of Anesthesiologist, 2008)**.

Injures are estimated to become the number one cause of death for men and women under the age 45 by the year 2020.Trauma patient present unique challenges to anesthesiologist. Acute injures require resource intensive care and complex cases especially when coupled with underlying medical condition **(Charles Smith: Western Reserve University Ohio, 2008).**

Acute blood loss is a very common problem following injury rapid recognition and restoration of homeostasis is the corner stone of the initial care of any badly injured patient **(ThomasM. Scalea. MD International Trauma Care Unit, 2008).**

The primary survey (PS) is designed to recognize and treat immediately life-threatening conditions within the first few minutes of the patient’s arrival. The secondary survey (SS) is described as a head-to-toe examination, including tubes and fingers in every orifice, and is intended to diagnose all injuries before formulating a definitive management strategy. A tertiary survey should also occur and is typically conducted in the surgical intensive care unit (SICU), after the patient returns from surgery or the resuscitation suite , and serves as an additional screen to decrease the risk of missed injuries(**Beverly J, Newhouse and Carla St. Laurent (2007).**

Aim of the Work

Goal of this work is throw light on management of trauma patient and to decrease morbidity and mortality due to trauma.

Epidemiology of Trauma

Injury is a global public health problem and the Dominant cause of morbidity and mortality among the young, particularly in industrialized countries. According to the World Health Organization (WHO), there were 5.8 million fatalities due to injury in 2000 .Injury is the seventh cause of death worldwide and the number one cause of death in the young (ages 1–44) years in the United States **(William et al., 2007).**

The leading causes of trauma in industrialized countries are motor vehicle collisions (MVCs), whereas in developing countries, interpersonal violence and war account for most injuries **(Bruce et al.,2007).**

Trauma care Systems:-

A trauma care system is an organized regional approach to the care of the acutely injured patient. The trauma system provides a continuum from prehospital care, to hospital care, and subsequently to rehabilitation care. The optimal system triages for injured patients based on severity of injury and predetermined criteria to different levels of trauma institutions. However, the system also has to provide an interfacility transfer mechanism for those who are mistriaged **(Ronald et al.,2008).**

Major components of a trauma system:-

A.Prehospital care:

1. Discovery of injury.
2. Access and activation of prehospital care.
3. Life saving prehospital medical care ,including basic and advanced Injury support measures.
4. Transport of these critically injured patients by the most expeditious and efficient means

(Denetriades et al., 2005).

Table (1): Leading causes of the global burden of trauma

Cause of death	Individuals killed
Road traffic injuries	1,260,000 (25%)
Other injuries	856,800 (17%)
Suicide	815,000 (16%)
Homicide	520,000 (10%)
Drowning	450,000 (9%)
Poisoning	315,000 (6%)
War	310,000 (6%)
Falls	283,000 (6%)
Burns due to fire	238,000 (5%)

(Daniela L et al.,2007)

Triage:

Triage is derived from the French word trier which means "to sort'' **(Daniela L et al.,2007).**

Triage is a dynamic process, with reclassification of status possible after the transport and definitive treatment of the victim has occurred. The initial triage categorization should be seen as a temporary classification of the victims' condition, which is easily changed and affected by both victim- and nonvictim-related factors **(Debacker, 2001).**

The main goals of triage procedures are to:

(i) Prevent avoidable deaths.
(ii) Ensure proper initial medical treatment within a minimal time frame.
(iii) Avoid misusing assets on hopeless cases

(Daniela et al., 2007).

Triage should be applied whenever the number of patients exceeds the capabilities of the available resources during mass casualty incidents, triage officers must quickly determine which victims need immediate medical treatment and which can wait; which victims require emergency surgery and which are not endangered. The assembly, triage and transport areas must be situated in safe locations, where the rescue personnel and victims will not be further endangered by the incident Each victim is issued a color-coded triage card, when available, which contains a limited amount of medical information regarding the status of the victim, as well as identification **(Ronald et al., 2008)**.

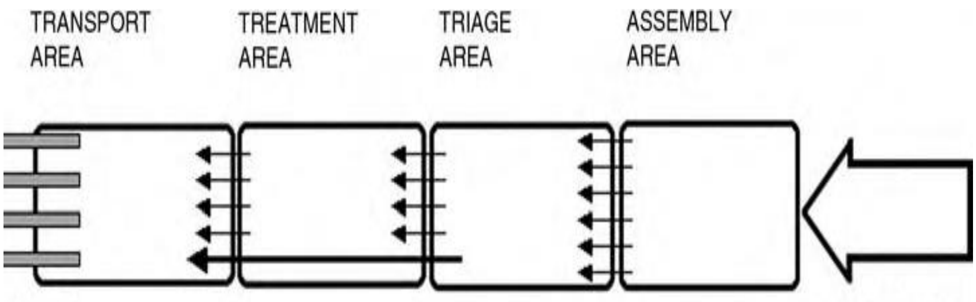

Fig. (1): Pt flow from the incident area to hospitals after triage

Prehospital:

Emergency medical services (EMS), in relation to trauma, refer to prehospital care of the acutely injured at the scene and transport to a hospital. The first goal of EMS is to provide trained personnel with appropriate equipment rapidly available to critical injured patients. The second goal of EMS is to transport patients safely and quickly to the closest, most appropriate medical facility. To do this effectively, a reliable communication network is essential for success. In urban communities, EMS response time is expected to be 4 to 6 minutes. In rural communities, delays are more common **(Ronald et al., 2008).**

Trauma Centers:

The trauma center serves to integrate the trauma care system by providing local and regional leadership. A network of trauma care facilities can function to provide a complete range of care for injured patients based on severity of injury and resources available. Trauma centers are categorized by levels I through IV, with level I referring to those facilities with the greatest resources.

Comprehensive regional trauma care centers have been shown to have a significantly lower in-hospital mortality **(Ronald et al., 2008).**

Table (2): Trauma center level designation role within trauma system , staffing and volume requirement levels of care.

Category	Relative designation (more resources available to the right)				
ACS-COT Trauma Center	Level V	Level IV	Level III	Level II	Level I
Role within a coordinated trauma system	Not formally recognized by the ACS[a]	Provides ATLS® (resusc. and stabilization) then transfer to nearest appropriate-level trauma center	Provides prompt assessment, resusc., emergency surgery, and stabilization with transfer to a level I or II as appropriate	Initial management capabilities generally similar to level I, but often located in less population-dense locations	Regional resource. Full capability of management from prevention to rehab., including research
Immediate 24 hrs staffing requirements	None	No specific in-house MD req. In-house nurses and resuscitation equipment	Trauma surgeon and anesthesiologist must be avail ≤20 min. No req. for neurosurgical coverage In-house nurses and resuscitation equipment	Trauma surgeons and neurosurgeons can be out of house but avail. ≤20 min. Anesthesiologists "must be in the OR by the time the patient arrives" In-house nurses and resuscitation equipment	In-house trauma surgeons, anesthesiologists, and physician specialists (e.g., neurosurgeons, and orthopedic surgeons), nurses, and resuscitation equipment. Includes pediatric cases
Volume and experience requirements	None	None	None	Same criteria as level I except volume standards and research are not required	1200 admissions a year or 240 major trauma patients per year, or an average of 35 major trauma patients per surgeon

Abbreviation (ACS-COT) American college of surgeons –committee on trauma (ATLS) advanced trauma life support (MD) medical doctors **(Erika et al., 2007).**

Trauma scorings

Trauma scoring was introduced just over 30 years ago, when the automobile insurance industry and trauma physicians simultaneously created methods of assigning numeric values to describe the anatomical physiological, and other consequences of injury. The aim of both groups was to reduce morbidity and mortality through the process of quality improvement. Trauma scoring is a useful tool for:

1.Epidemiology
2.Research
3.Triage
4.Outcome prediction
5.Anatomical and physiological evaluations of injury severity
6.Intra and inter-hospital evaluation of trauma care
7.Trauma registers
8.Planning and resource allocation within trauma systems

(Marcin and Pollack, 2002).

Table (3): Trauma scores, scales, and triage acronyms

Year[a]	Abbreviations	Names
1970	AIS	Abbreviated injury scale
1971	TI	Trauma index
1974	GCS	Glasgow Coma Scale
1974	TISS	Therapeutic intervention scoring system
1974	ISS	Injury severity score
1980	TI	Triage index
1980	TRISS	Trauma-injury and severity score
1981	TS	Trauma score
1981	APACHE	Acute physiological and chronic health evaluation
1982	PGCS	Pediatric GCS
1987	PTS	Pediatric trauma score
1987	OIS	Organ injury scale (AAST)
1988	PRISM	Pediatric risk of mortality score
1989	AP	Anatomical profile
1989	RTS	Revised trauma score
1989	T-RTS	Triage version of RTS
1990	ASCOT	A severity characterization of trauma
1994	UST	Uniform scoring system for trauma (Utstein style)
1994	APSC	Acute physiology score for children
1996	ICD-9-CM	ICD-9 clinical modification based on AIS and ISS
1996	TOXALS™	Toxic Advanced Life Support™
1997	NISS	New ISS
2001	ASPTS	Age-specific pediatric trauma score
2002	PAAT	Pediatric age-adjusted TRISS
2003	START	Simple triage and rapid treatment
2003	JUMP-START	Pediatric version of START

Abbreviation (AAST) American association for the surgery of trauma (ICD-9) international classification revision **(Ronald et al., 2008)**.

A. Physiological scoring systems:

1.Glasgow coma score(GCS):

The GCS was first introduced in 1974,it is used to assess the level of consciousness following head trauma in the secondary survey **(Sternbach, 2000).**

Generally, a GCS of 13 or higher is associated with mild brain injury,9 to 12 is associated with moderate injury, and 8 or less is associated with severe brain injury . The reliability of the GCS can be variable, depending on whether a patient is able to speak (e.g.,an infant) or whether a patient is intubated. Analyses have found that the admission GCS is more predictive of injury severity than the field GCS and the motor component is the most reliable and strongest predictor of outcome **(Ross et al.,1998).**

Trauma Score and Revised Trauma:

Revised trauma score(RTS) was developed in 1981 as a modification of the trauma index, first described in 1980. found that a combination of five physiological parameters (eye-opening, verbal response, motor response, capillary refill, and respiratory response) showed a good correlation with mortality resulting from blunt trauma. Systolic blood pressure (SBP) and respiratory rate (RR) were added and the TS were created as a reliable tool for both field triage and patient outcome determinations. It indicates the severity of injury through physiological response as a numerical assessment of cerebral and cardiopulmonary system function. Revised trauma score is a good outcome predictor when the coded values are multiplied by weighted coefficients (derived from the Major Trauma Outcome Study), according to the following equation:

$$RTS = 0.9368\ GCSc + 0.7326\ SBPc + 0.2908\ RRc$$

The coefficient values assigned reflect the ability of each parameter to affect the outcome, with the highest assigned weight given to the GCS, which indicates that head injuries impact the outcome more than the initial SBP or RR. The RTS values range from 0 to 7.8408, with a higher value indicating increase propapilty of survival.

Table (4): Revised trauma score **(Daniela L et al., 2007)**

GCS	SBP	RR	RTS coded value
13–15	>89	10–29	4
9–12	76–89	>29	3
6–8	50–75	6–9	2
4–5	1–49	1–5	1
3	0	0	0

The Organ Injury Scale (OIS):

The Organ Injury Scale Was developed by the American Association for the Surgery of Trauma (AAST) in 1987 (to facilitate clinical research. The resultant classification scheme is fundamentally an anatomical description, scaled from one to six, with one representing the least severe injury, five the most severe that is salvageable, and six, non salvageable (in the case of a liver injury, also essentially lethal). The first version covered liver, spleen, and kidney injuries. Since 1987, several revisions have occurred and other organs added. Currently, there are OIS characterizations for lung, heart, chest wall, diaphragm, abdomen, blood vessels, ureter, bladder, and urethra, in addition to the original three organs. These OIS schemes continue to be updated periodically for each organ **(Daniela et al., 2007).**

Anatomical scorings systems:

Abbreviated Injury Scale (AIS):

The AIS is an anatomically based global scoring system that classifies each injury in various body regions according to its relative importance on a six-point ordinal scale It is not defined by physiological change, except for limited clarification purposes.

1. Mild
2. Moderate
3. Serious (non- life threatening)
4. Sever (life threatening)
5. Critical
6. Fatal **(Kobusingye et al., 2005)**

Injury severity score (ISS):

Each injury is assigned an AIS code and classified in one of six body regions, as follows: (i) head/neck, (ii) face (iii) thorax, (iv) abdomen, (v) extremities (including pelvis) and (vi) external. The highest scores from the three most severely injured regions are squared and then added together to provide the ISS score (i.e., ISS ¼ a^2 b^2 c^2). Any injury assigned the AIS score 6 is automatically given the maximal score 75. ISS values are from 0 (no injuries)to 75 incompatible with life), with the higher scores indicating increased severity (**Daniela et al., 2007).**

Pediatric Scoring:

The pediatric trauma score (PTS) is useful and accurate for the physiological and anatomical differences unique to pediatric patients. Pediatric trauma patients present specific problems related to their differences from adults in terms of physiology and injury mechanism. They are especially susceptible to head trauma, and often have multiple injuries that are not immediately apparent. The PTS (Table), first introduced in 1987 by Tepaset al. Is the most frequently used trauma scoring system in the pediatric trauma population. The PTS can identify critical pediatric patients more accurately than other scoring systems because it incorporates six parameters specific to injured children. During the initial assessment, each parameter is evaluated and given the numeric score +2,+ 1, or -1 **(Daniela et al., 2007).**

Table (5): pediatric trauma score

component	category		
	+2	+1	-1
Child weight (kg)	More than 20	10-20	Less than 20
Airway	normal	maintainable	unmaintainable
Systolic blood pressure (mmHg	More than 90	90-50	Less than 50
Centeral nervous system	awake	Obtunded	Coma/decerebrate
Open wound	none	minor	Major/penetrating
Skeletal fractures	none	Closed fractures	Open/multiple

C. The combined system:

Combined scoring systems combines the advantages of both physiological systems and anatomical systems, but it is difficult to calculate and need experienced personnel to perform it, Trauma score Injury Severity Score (TRISS) is example of the combined systems **(Kauffmann et al.,1990).**

Trauma score Injury Severity Score (TRISS):

Is the combination of the physiological data in RTS and anatomical data in ISS. It calculate survival probability (Ps) in trauma patients by using combined initial admission ISS and RTS scores, along with the age of the patient.

The Ps is calculated as follows:

$$Ps = 1/(1 + e\ -b)$$

The coefficient b is calculated by the following equation:

$$b = b0 + b1(RTS) + b2(ISS) + b3(age)$$

e = 2:718282, the base of Napierian logarithms The TRISS coefficients b0 and b3 are weighted values derived from the multiple trauma outcome study (MTOS) database with differing values obtained for blunt and penetrating trauma

(Kauffmann et al.,1990).

Prehospital and interhospital transport:

The movement of critically injured patients is potentially hazardous. However, significant improvements in transport safety and efficiency have occurred over the last decade chiefly because of the advances in resuscitation algorithms training, and monitoring technology. Onboard resuscitation capabilities and transport logistics have also progressed. Because each phase of trauma management is improving, transport teams are being tasked with the transport of increasingly severe injuries In civilian trauma settings, the focus is centered upon situations, rotary-wing aircraft are often used for initial evacuation and transport to a receiving hospital. In civilian practice, ground ambulance is most commonly used. For interhospital transport, all three modes (ground ambulance, rotary-wing aircraft, and fixed-wing aircraft) are used **(Jose et al., 2007).**

Transportation guidelines:

Guidelines for transport within the hospital (intrahospital) and between hospitals (interhospital) have been formally developed by the American Society of Anaesthesia Committee on Trauma, and the Society of Critical Care Medicine. common items emerge with all of these guidelines:

(i) Patient transport always involves some degree of risk.
(ii) The benefits to be realized must outweigh these potential risks.
(iii) During transport, the standards of care (especially monitoring) should be at he same level or higher than that provided in the setting from which the patient is being transported **(Warren et al.,2004)**.
(iv) During transport support the neck of the patient ,move the patient as one mass on a board and control any external bleeding by tourniquet.

In emergency transport from combat zones, resuscitation and stabilization may not be possible before evacuation and, by necessity, must occur en route. In civilian practice, the relative emphasis on pretransport resuscitation and stabilization is dictated by local practice and the severity of injuries, where as interhospital transport should only occur after adequate resuscitation and stabilization has been achieved .

Early transport is the critical goal of prehospital care because the major causes of early morbidity and mortality are exsanguinations and neurological injuries. Interhospital transport should only occur after the patient is stabilized (as above), all life-threatening injuries are diagnosed, and the patient is at least provisionally treated in elective settings, “early transport” means to do so before secondary problems occur **(Ronald et al., 2008).**

Table (6):Methods for transportation

Mode	Advantages	Disadvantages
Ground ambulance	Simple to operate and maintain, and generally available Best for short distances (5– 10 miles), quicker to and from the scene	Unable to cross geographical barriers (i.e., mountain ranges, flooded roadways Slower for travel of long distances. Less safe in hostile territory
Rotary-wing aircraft	Short range, runway not required Airport not required Can land in hostile territory, or difficult terrain Best for 50 to 150 miles Useful in search and rescue, some models can be refueled in midair	High cost and complex to operate Inefficient for disasters with large number of casualties (only small number of patients transported at a time)
Fixed-wing aircraft (small)	Faster runway to runway travel Uses shorter, unimproved runways Best for 150 to 300 miles	High cost and complexity Aircraft may be better utilized in the disaster area for other purposes
Fixed-wing aircraft (large)	Advanced en route care is facilitated Carries more patients Long range missions possible (e.g., >20 hr with aerial refueling) More efficient medical crew can manage multiple patients Best for >300 miles	Very high cost and complexity Longer, improved runways required Requires detailed planning and coordination between sending, evacuation, and receiving medical teams
Military fixed-wing In-theatre Medevac patient transport: C-130 (unrefueled range 1500 nautical miles)	Rugged design Capable of landing and takeoff on dirt runways Best for intratheater transport of multiple casualties 75 to 750 miles	Noisy, bumpy Often very tight quarters Although the plane often survives in hostile territory, the patients and passengers can “experience violent conditions”
Military fixed-wing transcontinental Medevac patient transport: C-17 (unrefueled range 5200 nautical miles)	Capable of steep take-off and landings Requires relatively short runway (3000 feet) Best for intercontinental medevac and patients transport	Few disadvantages when used for intended purpose If forced into action for short distances (<150 miles) may not be fuel efficient

(Daniela L et al .2007)

Pathophysiology of trauma

Human physiologic response to injury is uniform enough to justify the term “traumatic disease” despite the several causes of trauma. However, the mechanism of injury is important ,because it determines the pattern of injury, and this knowledge focuses the treatment priorities for the patient **(Doreen et al.,1999).**

For example, penetrating thoracic trauma requires immediate placement of a chest tube to drain extrapulmonary pleural air and blood while blunt chest trauma requires immediate attention to gas exchange because of widespread pulmonary contusion that complicates the instability of chest wall **(Grande.,1993).**

The physiological response to trauma:

The central nervous system initiates the response to injury. Afferent neural pathways are activated by pain, hypovolemia, hypoxia and acidosis. This neural input is processed in the brain, and efferent pathways mediate changes to affect the host response **(Hill, 2000).**

The host response to injury(stress response),is biphasic, with a hypodynamic (ebb phase) followed by a hyperdynamic (flow phase),the flow phase is followed by a convalescence phase that gradually returns to the pre-injury baseline **(Patrick and Clifford, 2000).**

The hypodynamic phase(ebb phase):

The hypodynamic (ebb) phase, is typically caused by hypovolemia secondary to hemorrhage, and the initial host response to hypovolemia is directed toward preserving existing blood volume and maintaining perfusion to the brain and the heart at the expense of the skin, muscle, viscera, and adipose tissue **(Watts et al., 1998).**

Clinical findings during the ebb phase include; low core temperature, poor tissue perfusion, and cold clammy skin. Energy expenditure and cardiac output are decreased, whereas systemic vascular resistance is increased **(Deitch,1992).**

Norepinephrine is the primary mediator of the ebb phase. It is released from peripheral nerves causing increase in myocardial contractility and heart rate vasoconstriction of arterioles, and venulo-constriction. In combination, these effects lead to restoration of blood volume, increased cardiac performance and maximal venous return in the face of hemorrhage **(Patrick and Clifford, 2000).**

The hyperdynamic (flow) phase:

The flow phase of response, predominates when adequate blood volume has been restored. This phase is characterized by hypermetabolism, and, inparticular, profound protein metabolism. The degree of hypermetabolism varies with the magnitude of injury and its goal is to repair tissue damage **(Schlag and Redal, 1995).**

Clinical characteristics of the flow phase include warm pink skin, elevated core temperature and increased energy expenditure **(Guiro and Lowry, 1996).**

This phase is characterized by a unique cascade of events that can be summarized as; inflammatory cell activation, hormonal release and mediator modulation **(Patrick and Clifford, 2000).**

A. The main inlfammatory cells which are activated in response to stress are macrophages; which are stimulated by cytokines and their main function is to remove necrotic tissues and release different types of cytokines; and polymorph nuclear cells (PNLs) which release oxidizing molecules, proteolytic enzymes and vaso-active substances **(Kim and Deutschman, 2000).**

Oxidizing molecules (e.g. oxygen free radicles and hydrogen peroxide) are proinflammatory molecules which cause lipid