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THEME

PREDICTIVE PROGNOSTIC VALUE OF REVERSE SHOCK INDEX MULTIPLIED BY GLASGOW SCALE rSIG in trauma patients

Presented and publicly defended on

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- *LOUASSEF Fatima Amat Elrahmen.*
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To the man who teach me how to be strong, my dear father "OMAR" who dedicate his life to me, thank u for earing an honest living for us and for supporting and encouraging me to believe in myself. I am forever grateful to have you in my life.

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List of tables:

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List of abbreviations:

AAAM: Association of the advancements of automotive medicine.

AHT: Arterial hypertension.

AIS: Abbreviated injury scale.

AP: Anatomic Profile.

ARDS: Acute respiratory distress syndrome.

ASCOT: A Severity Characterization of Trauma

ATC: Acute traumatic coagulopathy.

DALY: Disability adjusted life years.

DCR: Damage control resuscitation

DCS: Damage control surgery.

DM: Diabetes mellitus.

ED: Emergency department.

ER: Emergency room.

E: Eye-opening.

FDPs: Fibrin degradation products.

GCS: Glasgow Coma Scale.

HB: Hemoglobin.

HR: Heart rate.

ICU: Intensive care unit.

ISC: International scaling committee.

ISS: Injury severity score.

JTDB: Japan trauma data bank.

LIMCs: Low and Middle-Income Countries.

M: Motor responses.

MOF: Multi-organ failure.

MOI: Mechanism of injury.

MT: Massive transfusion.

MVC: Motor vehicle collisions.

PATOS: Pan-Asian trauma outcomes study.

qSOFA: Quick sepsis related organ failure assessment.

RBCs: Red blood cells.

RR: Respiratory rate.

rSI: Reverse shock index.

rSIG: Reverse Shock Index multiplied by Glasgow Scale.

RTA: Road traffic accidents.

RTCs: Road traffic crashes.

TRISS: Trauma and injury severity score.

RTS: Revised Trauma Score.

SBP: Systolic blood pressure.

SI: Shock index.

SIPA: Pediatric age-adjusted shock index.

TBI: Trauma brain injury.

TXA: Tranexamic acid.

V: Verbal responses.

WHO: World Health Organization.

AI: Artificial intelligence

Table of contents:

<u>Introduction:</u>

I. Introduction:

I.1. Background:

Trauma, the sixth leading cause of death worldwide and is also the leading cause of death and disability in people under the age of 40 years(1,2). Trauma causes 10% of global mortality and it is responsible for 90% of mortality in Low and Middle-Income Countries (LIMCs)(2). Trauma also decreases the disability adjusted life years (DALY) in different communities(1,2), emphasizing the urgent need for comprehensive strategies to mitigate its toll. The sheer magnitude of trauma-related incidents underscores its status as a critical area requiring focused attention and intervention.

Today, trauma is one of the important issues in public health that should be given more attention in the health care system, because not only thousands of deaths and millions of injuries occur due to various trauma annually, but also it imposes direct and indirect socio-economic costs on the health care system of communities and individuals. These costs include treatment costs, reduced productivity, stopping activities, and loss of family income during hospitalization(2,3).

I.1. Rationale for the study:

Many studies have investigated and published prognostic predictive models for patients with trauma. Presently, the Reverse Shock Index multiplied by Glasgow Scale (RSIG) holds promise as a potential prognostic tool for trauma patients. However, there is limited research examining its predictive efficacy in real-world clinical settings, particularly within the context of Colonel Lotfi Hospital. A comprehensive assessment of RSIG as a prognostic indicator for trauma patients upon admission to the emergency department is conspicuously absent. Understanding the predictive capacity of RSIG in this environment could substantially influence clinical decision-making, resource allocation, and patient care, ultimately culminating in enhanced trauma management and superior patient outcomes. Consequently, this study aims to rectify the current dearth of evidence and furnish valuable insights into the predictive prognostic utility of RSIG in trauma patients at Colonel Lotfi Hospital.

I.2. Research questions:

Is the reverse shock index multiplied by Glasgow scales (RSIG) efficient as a predictor of prognostic in trauma patients at Colonel Lotfi Mixed Hospital?

I.3. . OBJECTIVES:

I.3.1. Main Objective:

- Evaluate the predictive prognostic value of the Reverse Shock Index multiplied by Glasgow Scale (RSIGS) in trauma patients upon admission to the emergency department of Colonel Lotfi Hospital.
- Assess the potential of RSIGS as a prognostic indicator in the context of trauma management at our hospital.

I.3.2. Secondary objectives:

- Evaluate the ability of reverse shock index multiplied by Glasgow scales (rSIGs) to predict massive blood transfusion in trauma patients.
- Assess how effectively RSIGS can forecast mortality in trauma patients.
- Evaluate the ability of RSIGs to predict emergency surgical procedure in trauma patients.

Theoretical section:

II. General framework on major trauma:

II.1. Definition of major trauma:

trauma is defined by any injury that has the potential to cause long-term disability or death(4). It defined by the World Health Organization (WHO) as physical damage suffered by a human body when it is suddenly subjected to external forces(5)(mechanical, thermal, chemical, radiated) that exceed the threshold of physiological tolerance or deprived of one or more vital elements (oxygen, heat)(6).

Trauma result from road traffic crashes, falls, drowning, burns, poisoning and acts of violence against oneself or others, among other causes(7).

II.2. Epidemiology of trauma:

Trauma is the sixth leading cause of death and disability around the world and the fifth leading cause of significant disability. It is also the first leading cause of death and disability under the age of 40 years and the highest proportion of injury-related burden falls on males between the ages of 15 and 24(1). For people age 5-29 years, road traffic injuries is one of the top 5 causes of death(7).

the leading causes of injury-related deaths include road traffic crashes (RTCs), suicide, and falls(7,8).

Trauma constitutes a significant public health concern, with the World Health Organization (WHO) estimating that more than 5 million people die annually from injuries, accounting for 9% of all deaths(5,9). For both sexes, one in every ten deaths result from injury(1,5).

In 2010, 68% of injuries occur in males and death from trauma is twice as common in males as it is in females, this is believed to be because males are much more willing to engage in risk-taking activities(9).

Tens of millions more people suffer non-fatal injuries each year which lead to emergency department and acute care visits, hospitalizations or treatment by general practitioners and often result in temporary or permanent disability and the need for long-term physical and mental health care and rehabilitation(7).

Injuries and violence place a massive burden on national economies, costing countries billions of US dollars each year in health care, lost productivity and law enforcement(2,3,7).

Table 1: Deaths from Cause-Specific Injuries in 2010.

Table 1. Deaths from Cause-Specific Injuries in 2010.*

Cause of Death	No. of Deaths/ 100,000 Persons	% of All Deaths	% of Injury-Related Deaths	% Involving Males
All causes	52,770	100.0	—	54.8
All injuries	5,073	9.6	100.0	68.2
Unintentional injuries	3,520	6.7	69.4	67.4
Transportation-related injuries	1,397	2.6	27.5	75.1
Falls	541	1.0	10.7	59.0
Drowning	349	0.7	6.9	70.5
Injuries from fires, heat, and hot substances	338	0.6	6.7	47.5
Poisonings	180	0.3	3.5	65.6
Other	715	1.4	14.1	66.9
Intentional injuries	1,340	2.5	26.4	70.7
Self-harm	884	1.7	17.4	65.5
Interpersonal violence	456	0.9	9.0	80.7
Forces of nature, war, and legal intervention†	214	0.4	4.2	65.4
Exposure to forces of nature	196	0.4	3.9	65.3
Collective violence and legal interventions	18	<0.1	0.4	63.9

* Data are from Lozano et al.[3]
† Deaths from legal intervention include, among others, those that result from death penalties imposed by governments.

II.3. Pathophysiology:

II.3.1. mechanism of injury (MOI):

The mechanism of injury (MOI) specifically refers to how trauma and its associated forces directly or indirectly impact the human body(10). MOI implies a transfer of energy from one source (the environment) to another (the human body)(10).

- ***Penetrating Trauma:***

Penetrating injuries result from an object entering the body and sometimes exiting the body causing damage along the path. The object may not penetrate the fascia resulting in an external injury only. More commonly the object penetrates the fascia and injures underlying structures resulting in “open” injuries. On occasion the implement may still be present in the body(11).

penetrating injuries are commonly caused by gunshots and stabbings(11). Other penetrating injuries can occur from tools and machinery and other objects with a sharp edge.

Figure 1: thoracic penetrating trauma.

- ***Blunt trauma:***

Blunt trauma is classified as a force striking the body(12),it occurs when the force applied to the body is not sharp in nature(11), and its consequences are dependent on the location of the trauma. The most common cause and location of blunt force trauma in adults are motor vehicle collisions (MVC)(10,12) and falls.

The human body can be transported by multiple means. Other than MVC, the most common conveyances resulting in blunt injury are bicycles and animals being ridden, such as horses and bull riding(11).

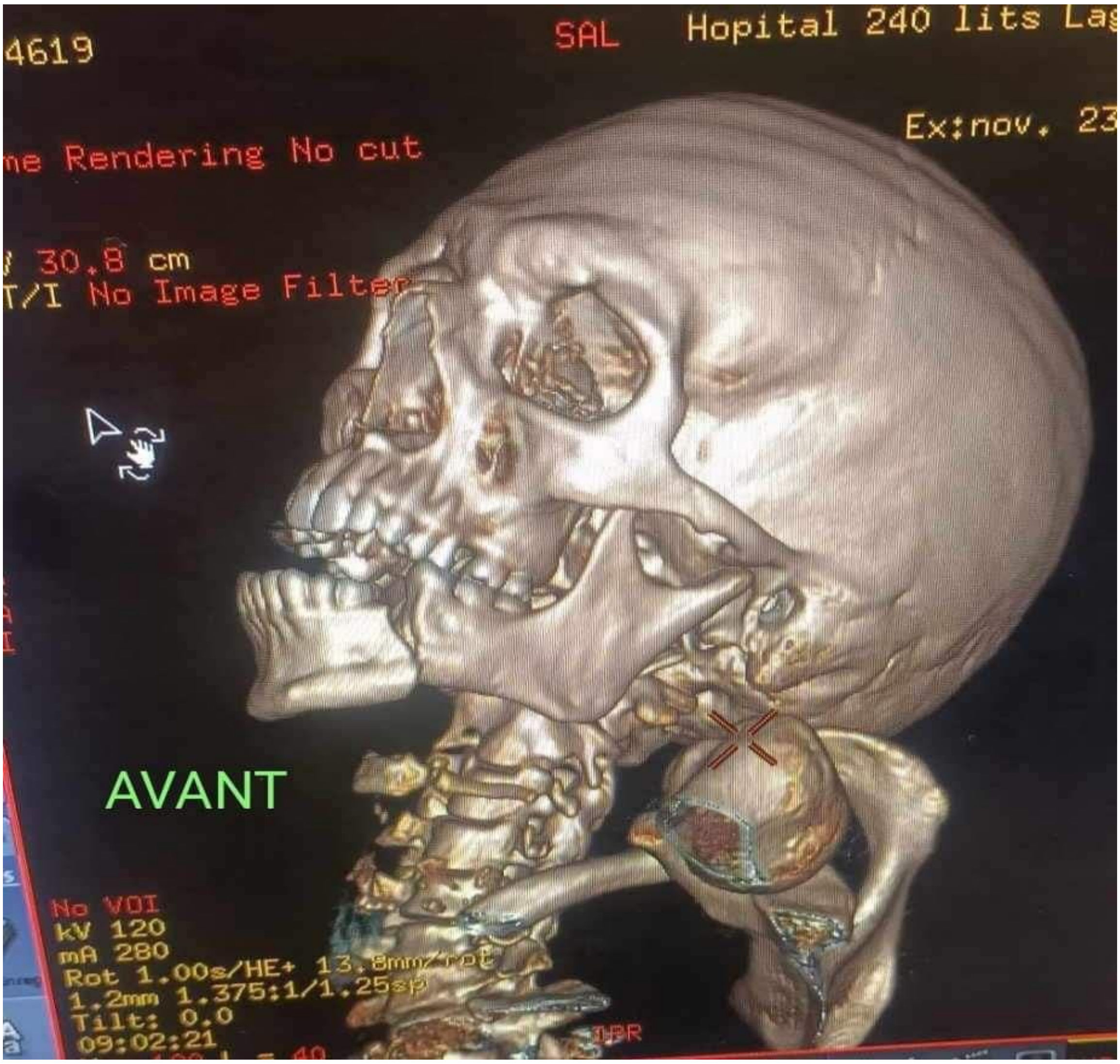

Figure 2: facial trauma due to road traffic accident.

- ***Deceleration Trauma:***

Deceleration trauma is an injury caused by a sudden stop in motion(12). Like the two previously discussed categories of trauma, deceleration trauma also affects different organ systems. Acceleration-deceleration injury to the brain resulting from the motion of the brain hitting one area of the skull and bouncing back, hitting the direct opposite side of the brain on the other side of the skull(13). This movement can result from both direct forces like direct head impact on the steering wheel in a motor vehicle accident or by non-contact forces like the shaken baby.

The aorta is also a potential site for deceleration injury, causing a traumatic aortic rupture.

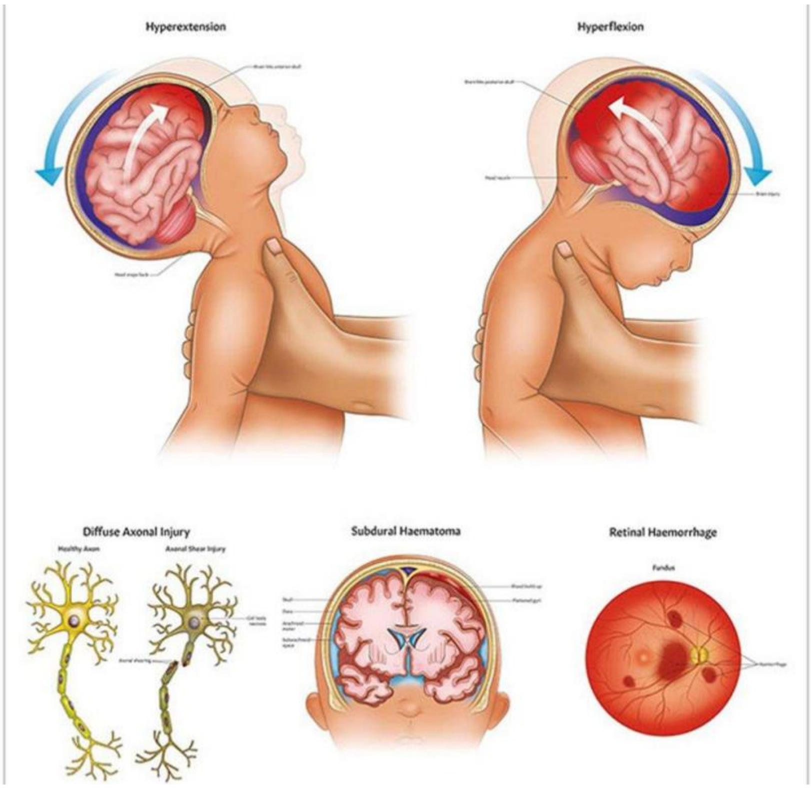

Figure 3: shaken baby syndrome.

II.3.2. Pathophysiological consequences:

- ***respiratory distress:***

Acute respiratory distress syndrome (ARDS) is an acute diffuse lung injury that occurs within a short period of time and can cause severe hypoxemia leading to hypoxic damage to various organs throughout the body, and is the most common complication in patients with severe trauma(14). ARDS is essentially a local inflammatory response of the capillary –alveolar membrane to systemic inflammatory up-regulation. It affects the endothelial layer of the circulatory system and the epithelial layers of the bronchoalveolar system. This is accompanied by failure of the hemostatic and immunologic barrier functions of the capillary –alveolar membrane and the gas exchange functions(15).

The origin of acute respiratory distress (ARDS) can be central or peripheral. The peripheral origin reflects an impairment of ventilatory mechanics during Some anatomical lesions (hemothorax, pneumothorax, pulmonary compression by hiatal hernia, etc.) induce a state of pulmonary collapse, leading to a 'shunt effect' (perfusion of a non-ventilated part of the lung)(16).It can be a disorder of alveolar-capillary diffusion within the context of pulmonary contusion or inhalation pneumonia(17).

The central origin may be related to coma due to brain injury and intracranial hypertension, repeated seizures, or upper spinal cord injury due to trauma to the cervical spine(17).

High-flow oxygenation and/or mechanical ventilation aim to combat this organ failure and establish satisfactory oxygenation.

- ***Neurological effects:***

It is the direct consequence of anatomical lesions that fall within the framework of trauma brain injury (TBI) and/or spinal trauma, but it also results from processes at the origin of circulatory and/or respiratory disorders(16).

The neurological assessment of the trauma patient is a major step in their management. Disorders of consciousness are assessed using the Glasgow Coma Scale (GCS)This score allows for an initial assessment and, due to its reproducibility, monitoring of the evolution. Examination of the pupils (diameter, symmetry, photomotor reflex) provides information on the possibility of an expansive lesion. Examination and palpation of the skull should reveal hemorrhagic wounds, anomalies in relief, otorrhagia, otorrhea, rhinorrhea, or rhinorrhagia.

- ***Circulatory system disease:***

In the initial phase, arterial hypotension reflects hypovolemia of externalized hemorrhagic origin, retroperitoneal hemorrhage, or multifocal diaphyseal fractures (femur) and/or endothoracic compression of the cardiac cavities in most cases(17).

The state of hypovolemic shock is evident in the paleness of the injured, discolored conjunctivas, tachycardia, loss of consciousness, drop in blood pressure, narrowing of the pulse pressure, and a rapid, thready pulse(18).

Hypovolemia as well as the anemia caused by blood loss will further worsen hypoxia, leading to a detrimental impact on vital organs, namely the brainstem, the heart, and then the kidneys(15,16).

Hypovolemia induces a low cardiac output with the appearance of free radicals in the circulation, leading to inflammatory processes, a decrease in microcirculation due to platelet aggregation, resulting in local tissue and vascular damage. This is the cause of hemorrhagic shock(15).

30 to 40% of these patients die from hemorrhagic shock or one of its consequences. Patients with a systolic blood pressure (SBP) below 90 mmHg at the time of initial care at the scene will have a very high mortality rate.

III. Post-traumatic hemorrhage and hemorrhagic shock:

III.1. Definition:

Hemorrhagic shock is the major preventable cause of morbidity and mortality in patients suffering major trauma, it represents a major cause of mortality with a percentage of 50%, which is the biggest avoidable cause of death in severe trauma patients.

Hemorrhagic shock is defined as a form of hypovolemic shock in which severe traumatic blood loss leads to inadequate oxygen delivery to tissues(19).

The loss of circulating volume, due to hemorrhage, results in acute anemia, leading to a decrease in arterial oxygen content. Simultaneously, the reduction in venous return to the heart results in a decrease in systolic ejection volume and cardiac output, consequently reducing oxygen transport in the systemic circulation. This creates an imbalance between oxygen needs and supply to tissues, leading to tissue hypoperfusion and cellular hypoxia, responsible for multiorgan failure(20).

Compensatory mechanisms exist and include:

- Peripheral arterial vasoconstriction (increase in peripheral vascular resistance) leading to a redistribution of regional blood flows to "vital" organs (brain, heart).
- Venous vasoconstriction resulting in a decrease in venous capacitance to maintain venous return and, therefore, cardiac preload.
- An increase in heart rate.
- These mechanisms initially maintain a satisfactory cardiac output, but they are quickly overwhelmed when blood loss exceeds 30 to 40% of the total blood volume; this is then referred to as an irreversible or refractory state of shock.

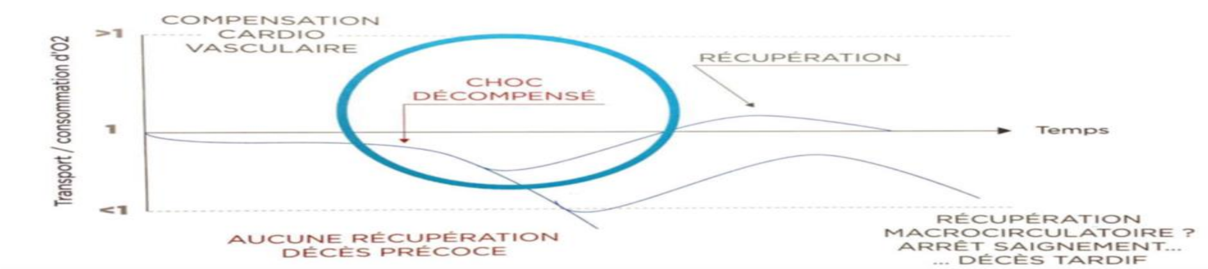

Figure 4: illustrates the pathway of hypovolemic shock development

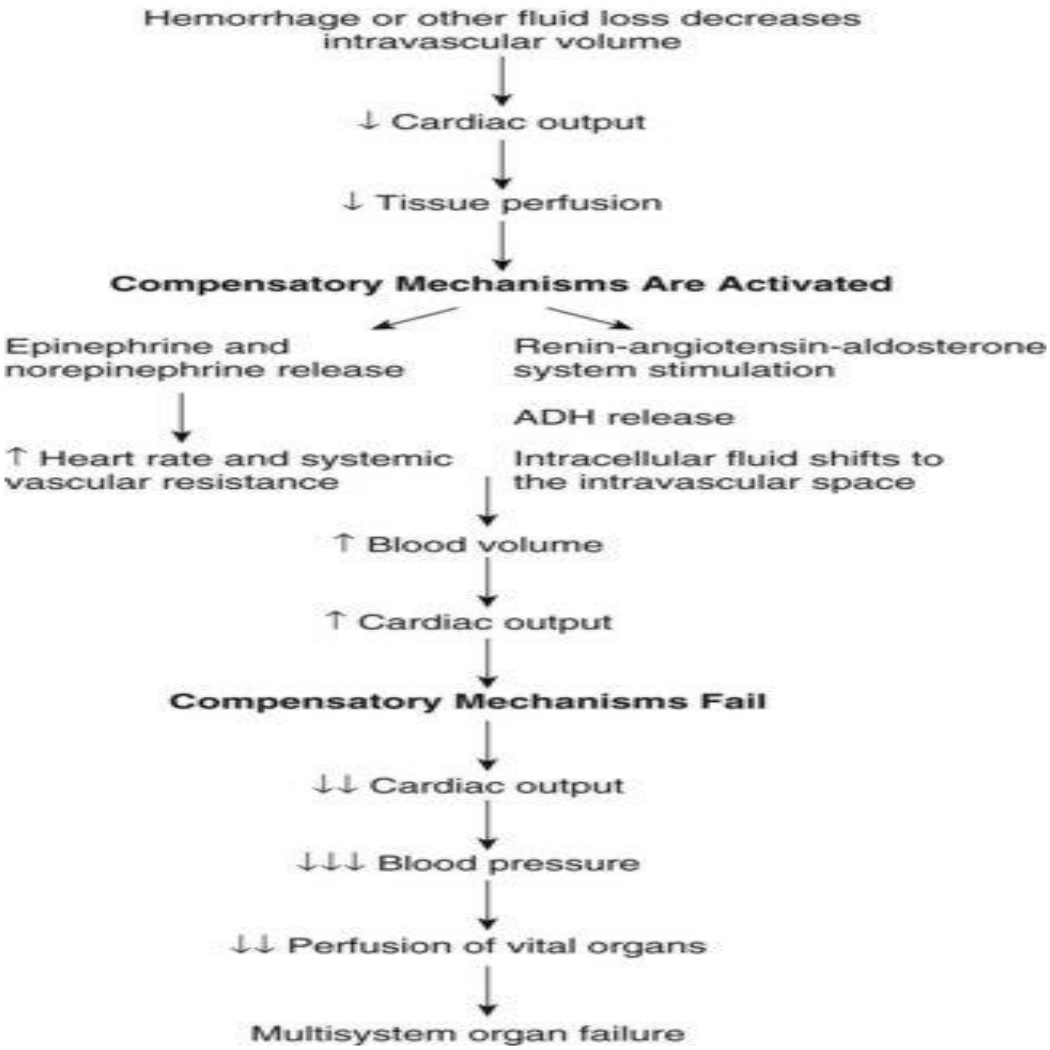

Figure 5: the development of hypovolemic shock.

III.2. Physiopathological reminders of the coagulation cascade:

Haemostasis, defined as arrest of bleeding, is the process that allows for maintaining the integrity of a closed circulatory system under high pressure after vascular injury.

Haemostasis achieved by several stages namely:

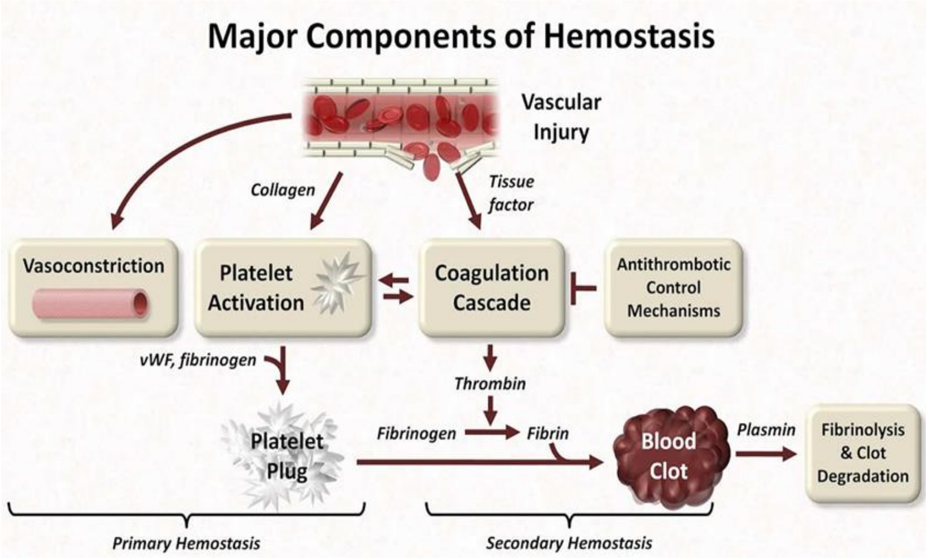

Figure 6: major components of hemostasis.

III.2.1. Primary haemostasis:

Primary haemostasis results from complex interactions between platelets, vessel wall and adhesive proteins leading to the formation of initial platelet plug that provides a surface for the assembly of activated coagulation factors leading to the formation of fibrin stabilized platelet aggregates and subsequent clot retraction(21).

III.2.2. Coagulation:

Once the platelet plug has been formed by the platelets, the clotting factors are activated in a sequence of events known as 'coagulation cascade' which leads to the formation of Fibrin from inactive fibrinogen plasma protein.

Coagulation consists of three pathways: intrinsic, extrinsic, and common. The intrinsic pathway is activated by factors in the blood, while extrinsic is activated by tissue factor. Both pathways result in activation of factor X leading into the common pathway, which ends with converting fibrinogen into fibrin to form a stabilized blood clot.

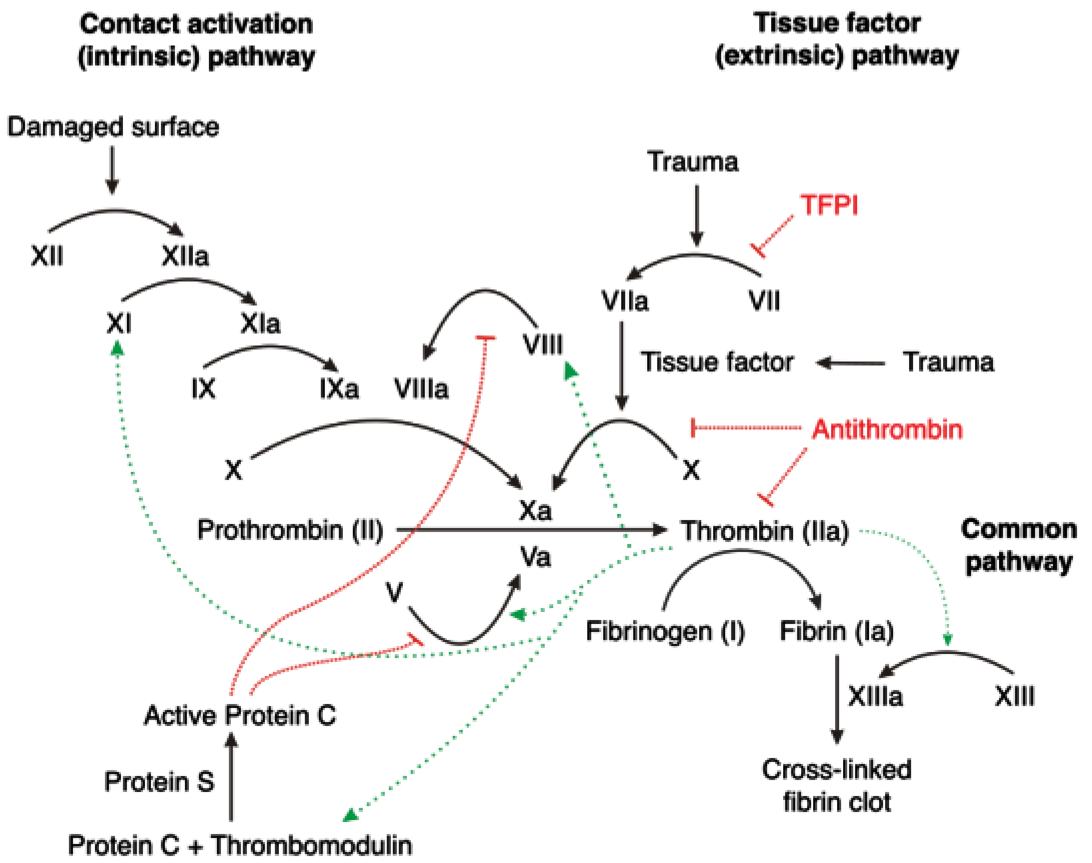

Figure 7: coagulation cascade.

III.2.3.Fibrinolytic system:

Fibrinolytic system is a parallel system which is activated along with activation of coagulation cascade and serves to limit the size of clot. Fibrinolysis is an enzymatic process that dissolves the fibrin clot into fibrin degradation products (FDPs)(21)**.**

III.3. Coagulopathy of trauma and triad of death:

Coagulopathy is one of the most preventable causes of death in trauma and has been implicated as the cause of almost half of hemorrhagic deaths in trauma patients(22).

Coagulopathy is present at the time of admission to the emergency department in up to 25–35% of trauma patients(22).

III.3.1. Acute traumatic coagulopathy (ATC):

Acute traumatic coagulopathy (ATC) is an early endogenous process occurs immediately after trauma, driven by the combination of shock, hypoperfusion, and vascular damage(23).

Mechanisms for this acute coagulopathy include activation of protein C, endothelial glycocalyx disruption, depletion of fibrinogen, and platelet dysfunction(23).

Vascular injuries cause a massive release of tissue factor, which activates the coagulation cascade via the extrinsic pathway, leading to the production of thrombin necessary for fibrin formation. During this pro-coagulant phase, thrombin activates several coagulation factors, resulting in an amplification loop that produces a large amount of thrombin, leading to the consumption of coagulation factors. This is followed by a pro-fibrinolytic phase, which, combined with the consumption of coagulation factors, results in a phenomenon maintaining bleeding, corresponding to the endogenous coagulopathy of the trauma patient and hypoperfusion(20).

ATC can be amplified by hypothermia and acidosis as well as the induction of iatrogenic dilution related to vascular filling(20,23).

III.3.2. Trauma's triad of death:

The trinity of hypothermia, acidosis and endogenous coagulopathy, known as the lethal triad, in trauma setting is a well-known risk factor associated with high risk of death. These three can develop quickly in the hypovolemic trauma patient and once sets in, it forms a vicious circle that may be difficult to surmount(24).

- ***Hypothermia:***

Hypothermia is defined as a temperature less than 35°C, it is secondary to massive blood loss, and it would be the cause of impaired platelet aggregation, a decrease in enzymatic reactions in the coagulation cascade, and endothelial dysfunction. This hypothermia and its effects on haemostasis are exacerbated and sustained by the infusion of room-temperature resuscitation fluids during the resuscitative management(20).

- ***Acidosis:***

Acidosis is defined as a PH of less than 7.2, it is favoured by the activation of anaerobic metabolism due to tissue hypoxia in the case of shock. It would be responsible for impairing the activation of factors V and X, and thus the conversion of prothrombin to thrombin. It would also lead to an increase in thrombomodulin, which binds to thrombin and triggers the activation of protein C, resulting in fibrinolysis and inhibition of the coagulation cascade(20).

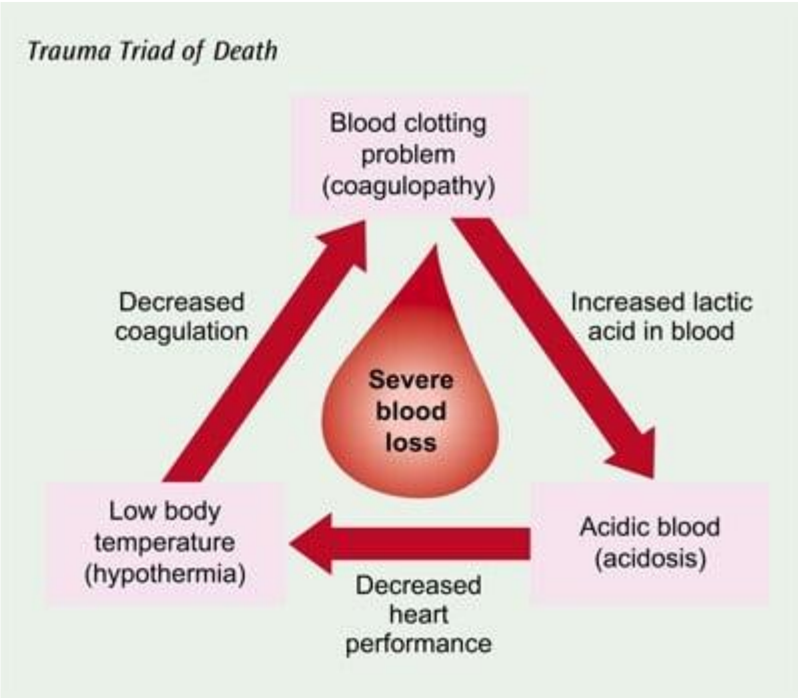

Figure 8: The deadly triad in trauma.

- ***Dilutional coagulopathy:***

Dilutional coagulopathy results from the administration of resuscitation fluids as well as packed red blood cells and fresh frozen plasma and is responsible for platelet dysfunction and dilution of coagulation factors(25).

However, this haemodilution can be limited by tolerating a so-called permissive hypotension, achieved through small-volume vascular filling combined with the administration of a vasopressor support using catecholamines.

IV. Damage control resuscitation (DCR):

Damage control is a concept that is used to describe emergency control without definitive repair of a situation that is a threat to a ship and its ability to carry out its mission(26).

The concept of damage control resuscitation (DCR) recognizes that surgical control of bleeding and resuscitation must happen simultaneously to get the best results. DCR attempts to prevent, rather than treat coagulopathy as the most “treatable” arm of the lethal triad(27).

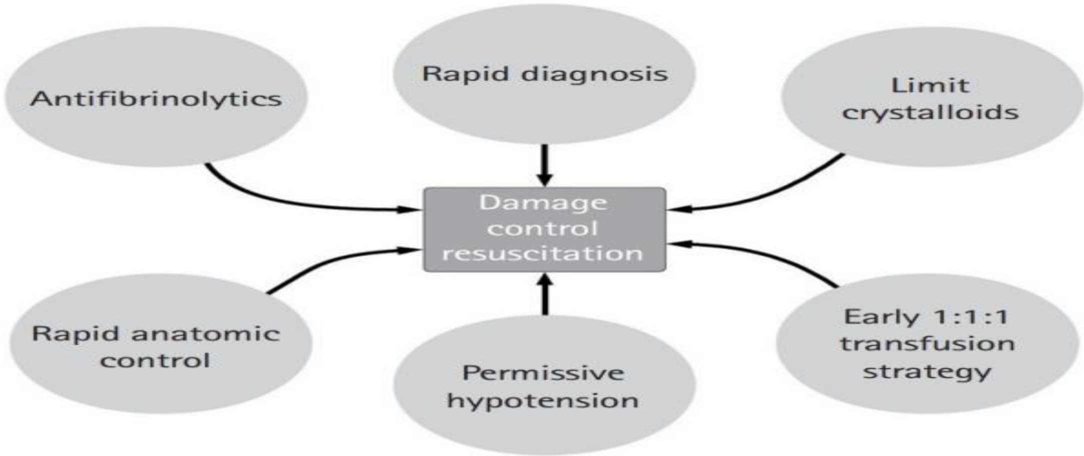

Figure 9:Tenets of damage control resuscitation.

IV.1. Controlling the bleeding:

Haemostasis is the first step in managing a trauma patient with bleeding. During the primary survey any ongoing bleeding should trigger rapid intervention to stem further haemorrhage. Where necessary tourniquets, pelvic binders and distraction/splinting of long bone injuries should be instigated. Prompt decisions to move to the operating theatre or radiology suite should be made for severe ongoing haemorrhage; if not then multi-slice computed tomography can provide essential information which often guides intervention(20,27).

Figure 10: Tourniquet

Figure 11: Pelvic binder.

Figure 12: application of tourniquet in an open trauma of lower limb.

IV.2. Damage control surgery (DCS):

Damage control surgery is defined as rapid termination of an operation after control of life-threatening bleeding and contamination followed by correction of physiologic abnormalities and definitive management(28).This modern strategy involves a staged approach to multiply injured patients designed to avoid or correct the lethal triad of hypothermia, acidosis, and coagulopathy before definitive management of injuries(26).

DCS should be time limited and applicable to most anatomical zones including maxillofacial, neck, abdomen, thoracic cavity, pelvic, and major extremities. This initial short intervention is at the expense of providing definitive repair, which is delayed until the patient is physiologically stable(27).Techniques such as abdominal packing, the use of hemostatic agents, vascular shunting, and use of endovascular stenting and embolization may help, the return to the operating room can be planned for between 6 and 48 hours. Changing patient conditions may require earlier re-exploration. The return operating room visit will be for definitive repair and closure(26).

IV.3. Hypotensive resuscitation:

Hypotensive resuscitation describes targeting a lower blood pressure until definitive haemostasis is achieved. It restricts the use of crystalloid fluids allowing blood pressure to remain lower than normal, limiting secondary blood loss until initial haemostasis can be accomplished. This approach is a trade-off between adequacy of tissue perfusion, versus normalizing coagulopathy and gaining haemostasis. Reduced crystalloid volumes are less likely to create dilutional coagulopathy, and reduced pressures are less likely to dislodge formed clots. Tissue oxygen delivery and clearance of metabolic waste must, however, be maintained at a level compatible with life(27).

While the optimal blood pressure target has yet to be defined, based on the currently available data, a SBP of 90 to 100 mmHg is likely safe for most patients. For patients with traumatic brain injury or spinal cord injuries, higher blood pressures are recommended and hypotensive resuscitation should not be used in these patients(26,27).

IV.4. Massive transfusion protocols and haemostatic resuscitation:

massive transfusion has been defined as the transfusion of 10 or more units of red blood cells (RBCs) within 24 hours of injury. The primary objective of a massive transfusion is to prevent fatal outcomes resulting from critical hypoperfusion-related complications while striving to attain haemostasis. Early prediction of MT is useful to anticipate the process of blood product preparation. Thus, MT protocols improve patients' outcome and minimized blood product wastage.

IV.5. Tranexamic acid (TXA):

Tranexamic acid (TXA) is a antifibrinolytic synthetic analog of amino acid lysine, serves that works by inhibiting the formation of plasmin, which is necessary for the degradation of fibrin(26).

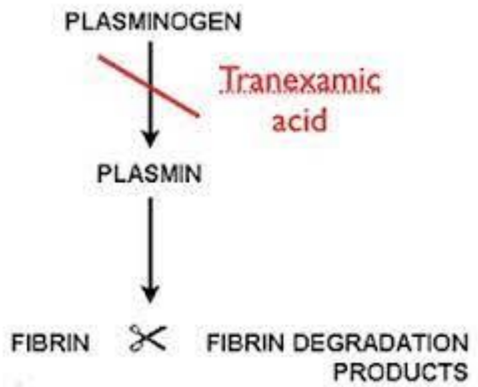

Figure 13: mechanism of action of TXA.

The CRASH-2 trial, a large, randomized controlled trial, provided that early administration of tranexamic acid (TXA) reduced the risk of death in bleeding trauma patients by approximately one-third. The protocol was 1 g over 10 minutes as a loading dose, then a further 1 g as an infusion over 8 hours. Administration of TXA should ideally be started within 1 hour of injury, and within 3 hours to avoid harmful effects, however, beyond the third hour, there is no benefit, and an increased mortality tends to occur(29).

V. Trauma scoring systems:

V.1. Introduction:

In the field of emergency medicine, a careful evaluation of trauma severity is essential to steer clinical interventions and enhance patient outcomes. Trauma scoring systems, advanced instruments crafted to measure the severity of injuries suffered by individuals, play a central role in this crucial undertaking. This introduction aims to illuminate the domain of trauma scoring systems, providing insights into their historical development, widespread application, and significant contribution to clinical practice.

V.2. historical perspective:

The concepts of trauma scoring system is relatively new, it began about 50 years ago. In 1971, a group of researchers known as association of the advancements of automotive medicine (AAAM) developed the abbreviated injury scale (AIS), with was modified in 2005 by the international scaling committee (ISC) to grade the severity of individual injuries.

In 1974, Baker and Al introduced the injury severity score (ISS) using AIS as a basis. Since then, multiple scoring systems have been proposed each with its own problems and limitations.

V.3. Classification of Trauma Scoring Systems:

Many studies by healthcare professionals have investigated and published to objectively assess and categorize the severity of injuries of patients with trauma. In principle(30), scoring systems can be divided into:

- Anatomical Scoring Systems.
- Physiological Scoring Systems.
- Combination of anatomic and physiological scoring systems.

V.3.1. anatomical scoring systems:

- ***Abbreviated Injury Scale (AIS):***

The Abbreviated Injury Scale (AIS) is an anatomical-based coding system created to classify and describe the severity of injuries. The score describes three aspects of the injury: type, location, and severity(31). The AIS score individual injuries and classifies them into one of six categories:

Table 2: AIS score and their associated injury.

AIS score	Injury severity
0	Uninjured
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Fatal (unsurvivable)

There are nine AIS chapters corresponding to nine body regions:

Table 3: AIS body regions.

AIS code	Region
1	Head
2	Face
3	Neck
4	Thorax
5	Abdomen
6	Spine
7	Upper extremity
8	Lower extremity
9	Unspecified

The assignment of AIS scores can be subjective because it relies on the interpretation of healthcare professionals. This subjectivity introduces variability in scoring, which can potentially affect the consistency and reliability of injury severity assessments. However, the Abbreviated Injury Scale (AIS) may lack the level of detail needed to differentiate between minor differences in injury severity. This means that the scale may not be sensitive enough to accurately distinguish subtle variations in the severity of injuries, particularly when the injuries fall within a narrow range of severity. As a result, minor differences in the extent of injury may not be accurately represented, potentially limiting the precision of the AIS in capturing nuanced differences in trauma severity.

- ***Injury Severity Score (ISS):***

The Injury Severity Score (ISS) is an established medical score to assess trauma severity. It provides an overall score for patients with multiple injuries(32,33). Each injury is assigned an abbreviated injury scale (AIS) score and is allocated to one of six body regions.

Table 4: ISS body regions.

Number	**Region**
1.	Head & Neck
2.	Face
3.	Thorax
4.	Abdomen
5.	Extremities
6.	External

The highest AIS score in each body region is used. The three most severely injured body regions have their score squared and added together to produce the ISS score.

The ISS score ranges from 01 to 75. A major trauma is defined as ISS greater than 15. If any of the three AIS scores is 6 (unrevivable), the score is automatically set at 75.

- ISS from 1 to 8: minor.
- ISS from 9 to 15: moderate.
- ISS from 16 to 24: serious.
- ISS from 25 to 49: severe.

- ISS from 50 to 74: critical.
- ISS 75: maximum.

The Injury Severity Score (ISS) may not capture the complexity of multi-system trauma due to its focus on the three most severe injuries in distinct body regions. This limitation can lead to overlooking additional injuries that, although individually less severe, collectively contribute to the overall complexity and impact on patient outcomes in cases of widespread trauma.

- ***Anatomic profile (AP):***

The Anatomic Profile (AP) was introduced in 1990 to overcome some of the limitations of the ISS(34). The AP score is the square root of the sum of the squares of all the AIS scores in a region. It uses 4 categories (variables):

Table 5: Anatomic profile components.

Categories	AIS regions	AIS severity
A	Head and brain Spinale cord	3-6
B	Thorax Anterior neck	3-6
C	All remaining serious injuries	3-6
D	All none serious injuries	1-2

Each component is calculated by taking the square root of the sum of the squares of all injuries defined by each region. A region with no injury received a score of zero.

The AP has been proven to be superior to the ISS in discriminating survivors from none survivors. However, its complex computational model has restricted its applications and limited its use.

V.3.2. Physiological Scoring Systems:

- ***Glasgow coma scale (GCs):***

The Glasgow Coma Scale (GCS); was first published in 1974; is used to objectively describe the extent of impaired consciousness in all types of acute medical and trauma patients. The scale assesses patients according to three aspects of responsiveness: eye-opening (E), motor (M), and verbal responses (V). Reporting each of these separately provides a clear, communicable picture of a patient's state. It provides a quantitative measure of neurological function, crucial for understanding the impact of traumatic injuries on the central nervous system(35).

The score is the sum of the three parameters: eye-opening (E), motor response (M), and verbal response (V):

Table 6: The Glasgow coma scale.

Parameter	Response	Score
Eye opening	None	1
	To pain	2
	To speech	3
	Spontaneously	4
Motor response	None	1
	Extending	2
	Flexing	3
	Withdrawal	4
	Localizing	5
	Obeys command	6
	None	1

Verbal response	Incomprehensible	2
	Inappropriate	3
	Confused	4
	Orientated	5

A GCS of:

- 13 to 15 correspond to mild head injury.
- 9 to 12 correspond to moderate head injury.
- 8 or less correspond to severe head injury.

While GCS provides valuable information about the level of consciousness, it may not always predict the long-term functional outcome of patients, particularly in cases of severe traumatic brain injuries where additional factors come into play. Also, it is sensitive to sedative medications administered to patients, this sensitivity may result in a lower GCS score that does not accurately reflect the patient's underlying neurological status.

- ***Revised Trauma Score (RTS):***

The revised Trauma Score (RTS) is a physiologic scoring system based on the initial vital signs of a patient. A lower score indicates a higher severity of injury. is made up of three categories: Glasgow Coma Scale (GCS), systolic blood pressure (SBP), and respiratory rate (RR)(30).

Table 7: Trauma Score (RTS). The values for the three parameters are summed to give the Triage-RTS. Weighted values are summed for the RTS.

Clinical Parameter	Category	Score	x weight

Respiratory rate (Breaths per minute)	10-29	4	0.2908
	>29	3	
	6-9	2	
	1-5	1	
	0	0	
Systolic blood Pressure	>89	4	0.7326
	76-89	3	
	50-75	2	
	1-49	1	
	0	0	
Glasgow Coma Scale	13-15	4	0.9368
	9-12	3	
	6-8	2	
	4-5	1	
	3	0	

These three scores (GCS; RR and SBP) are then used to take the sum by

RTS=0,9368 GCS+0.7326 SBP+0.2908 RR.

The RTS is difficult to calculate due to an intervention that makes it impossible to determine the Glasgow Coma Scale (GCS) score and respiratory rate (RR) upon hospital admission, which are necessary for the calculation of the RTS.

Due to the subjective nature of the Glasgow Coma Scale (GCS), the Revised Trauma Score (RTS) has limitations in relying on assessments that may involve some subjectivity. Additionally, the scoring system may not fully capture subtle changes or variations in neurological or respiratory status, which can be overlooked. This highlights the importance of considering additional objective measures to ensure a more comprehensive assessment of trauma patients.

V.3.3. combination of anatomic and physiological score systems:

- ***Trauma and Injury Severity Score (TRISS):***

Trauma and injury severity score (TRISS), introduced in 1981, is a combination index based on Trauma Score (RTS), Injury Severity Score (ISS), and patient's age(33,34). It showed that the physiological index in combination with anatomic index and age is a powerful predictor of outcome in trauma patients. They combined the trauma score and injury severity score with age to give a new index called TRISS (RTS, ISS, Age combination index).

The Trauma and Injury Severity Score (TRISS) may face challenges in accurately addressing the unique physiological responses observed in specific patient populations. This can lead to potential inaccuracies in assessing the severity of trauma. This limitation implies that the generalization of TRISS across diverse patient groups may not fully capture variations in how different individuals or demographics physiologically respond to trauma. Consequently, there is a risk of imprecise prognostication and potential inaccuracies in predicting outcomes for specific subpopulations within the broader spectrum of trauma patients.

- ***A severity characterization of trauma using (ASCOT):***

A Severity Characterization of Trauma (ASCOT), introduced by Champion et al in 1990. ASCOT is a physiologic and anatomic characterization of injury severity which combines RTS and anatomic profile (AP) and patient's age in more efficient way then TRISS(36). The advantage of ASCOT was the use of AP instead of ISS, which better reflected the cumulative anatomic injury load of the patient.

The ASCOT performs much better on outcome prediction than TRISS. However, its complexity has limited its use.

VI. Reverse shock index multiplied by Glasgow scale (RSIG):

VI.1. Definition of RSIG and its components:

VI.1.1. shock index (SI):

The shock index (SI) was introduced by Allgower and Burri in 1967 and calculated by the triage heart rate (HR) and systolic blood pressure (SBP) using the following formula: SI = HR/SBP(37),offering greater sensitivity compared to conventional vital signs alone. SI proves valuable in recognizing significant injury, especially when HR and SBP appear normal, as SBP is a delayed indicator of shock post-trauma. Easily computed at the bedside without additional tools, SI aids in assessing mortality risk and the need for massive transfusion(37,38).

The shock index (SI) had been developed to identify trauma patients in a hypovolemic shock. it is deemed indicative of shock in patients when it exceeds 0.8–1.0. Higher SI values (SI of ≥1)is highly indicative of hemodynamic instability and mortality upon arrival at the ED and generally indicates an uncompensated shock state of the patient and resuscitation may be necessary(39).However, SI can underestimate the severity of underlying shock in older injured patients, because older patients tend to have higher baseline SBP even after injury, Overall, SI carries poor sensitivity in predicting mortality. It should never be used to diagnose or rule out critical illness in isolation(40).

VI.1.2. Reverse shock index (rSI):

A research group in Taiwan introduced the concept of reverse (or inverse) shock index (rSI) as a preferable alternative to SI(41), defined as the ratio of SBP to HR. This preference arises from the common perception among practitioners that unstable hemodynamic status involves SBP lower than HR, rather than HR higher than SBP as indicated by SI. Consequently, rSI < 1 indicates that the SBP is lower than the HR, implying that the patient is probably in shock.

Moreover, the rSI could be used upon the arrival of first responders at the site of injury without any additional calculation or equipment. rSI <1 was associated with poor outcome and may help identify trauma patients at high risk of mortality even without hypotension(42).

VI.1.3. Reverse shock index multiplied by Glasgow scale (rSIG):

a Japanese research group has proposed a new scoring tool, the reverse shock index multiplied by the Glasgow Coma Scale (rSIG)(43), which is calculated as follows: rSIG = Glasgow Coma Scale (GCS)multiplied by rSI (SBP/HR).

The rSIG score combines both hemodynamic (shock index) and neurologic status (GCS score) to improve the accuracy of prediction(38). In admission, rSIG is very easy to calculate in emergency departments without the need for additional information, blood tests, or hard-to-remember coding systems(43).

VI.2. The interest of rSIG in predicting mortality:

among trauma patients occur in one of the three phases(44):

- immediate death occurring due to overwhelming injury, usually due to apnea.
- Early death occurring within hours after trauma.
- Delayed death occurring days to weeks after trauma as a result of treatable infections, multi-organ failure (MOF) or other late complications.

Identifying patients highly at risk of mortality is very important in managing the trauma patients, rSIG was originally developed to predict in-hospital mortality in trauma patients using the Japan trauma data bank (JTDB) data for 2006–2015 and has a better discriminant ability than the traditional measures of vital signs(43), and there are many other studies investigate the use of rSIG to predict mortality in trauma patients. One study demonstrated that low rSIG is associated with an increase in-hospital mortality in adult patients trauma(45), another study found that rSIG < 14 is a simple and prompt tool to predict mortality in adult severe trauma patients with head injury(46). also, a PATOS retrospective cohort study revealed that rSIG showed a superior discriminant power than SI in short-term mortality(39).

Another found that it was useful to use rSIG for predicting mortality in austere environment(47), because of its ease of calculation and its increased ability to predict mortality.

The usefulness of rSIG for prediction of mortality has been validated also in cohort study which found that rSIG more accurately identifies pediatric patients at highest risk of death when compared with SIPA(48).

In contrast, a single-center retrospective study examined 18 750 trauma patients realised in Taiwan revealed that rSIG had a significantly higher predictive accuracy of mortality than SI but a lower predictive accuracy of mortality than RTS in all adult trauma patients and in adult patients with isolated head injury(49).

Table 8: description of the main data from the literature on the interest of rSIG in predicting mortality.

Author and reference	Year	Type of study	Number of patients	Results
Kimura and Tanaka. (43)	2018	retrospective, multicenter study	168,517 patients	rSIG is easy to calculate without the need for additional information. A higher rSIG means lower in-hospital mortality
Jung, Ryu and Heo.(45)	2023	Prospective cohort study		Low rSIG was significantly associated with an increase in in-hospital mortality in patients' post-trauma with and without TBI
Wan-ting and al.(46)	2020	retrospective case control study	438 patients	rSIG < 14 is a simple and prompt tool to predict mortality in adult severe trauma patients with head injury
Chen and al.(39)	2023	retrospective cohort analysis	103 935 patients	rSIG consistently showed a superior discriminant power than SI and MSI in short-term mortality
Lammers and al.(47)	2020	Retrospective review	22,218 patients	TRISS and rSIG proved to be most predictive of mortality. However, rSIG may be optimal scoring tool because of its ease of calculation and its increased ability to predict mortality.
Lammers and al.(48)	2021	Retrospective review	2,007 pediatric patients	rSIG more accurately identifies pediatric patients at highest risk of death when compared with SIPA alone

Sc and al.(49)	2018	retrospective cohort study	18,750 patients	rSIG had a significantly higher predictive accuracy of mortality than SI, but a lower predictive accuracy of mortality than RTS in all adult trauma patients and in adult patients with isolated head injury.

VI.3. The interest of rSIG in predicting massive transfusion (MT):

Time is a major prognostic factor in the management of a trauma patient in haemorrhagic shock, especially in prehospital settings. Approximately 85% of deaths related to haemorrhagic shock would occur within 6 hours after hospital admission(50). Therefore, early identification of patients with massive haemorrhage is crucial(51).

Early prediction of MT is useful to anticipate the process of blood product preparation. Thus, MT protocols improve patients' outcome and minimized blood product wastage(52). Several scores to predict MT have been proposed(53), but they may not be always simple to be calculated in the field MT is accompanied most frequently with significant blood loss or shock, although, the volume of blood transfused may lead to a variety of potentially serious problems(52).

In literature, many studies Investigate the Correlation between RSIG and Massive Transfusion. A few studies have compared the utility of rSIG for prediction of blood transfusion with that of other trauma indices witch a retrospective single-centre study in South Korea in 2021 suggested that the prognostic performance of rSIG for MT was significantly higher than SI, SIA, and qSOFA(51). A new retrospective study using data from the Japan Trauma Data Bank (JTDB) revealed that rSIG was superior to the ABC score and the FASILA score(54). Another study found that TRISS and rSIG demonstrated a higher AUROCs than for SI, Reverse SI or RTS(47). Similarly, the findings of a cohort study in the paediatric trauma setting suggested that RSIG proved to be more effective than SI and SIPA in identifying paediatric patients who were at risk of requiring early interventions like blood transfusion within 4 hours or intubation(55)…

Therefore, rSIG could be used specifically for prediction of the need for massive transfusion. Clinicians can use RSIG to identify individuals at high risk of requiring early transfusion due to severe injury and haemorrhagic shock, this approach allows for minimizing transfusion-related complications and improving overall patient outcomes in critical situations.

Table 9: description of the main data from the literature on the interest of rSIG in predicting massive transfusion.

Author and reference	Year	Type of study	Number of patients	Results
Lee and al.(51)	2021	Retrospective, observational study	1627 patients	rSIG is a useful, rapid, and accurate predictor for MT, coagulopathy, in-hospital mortality, and 24- h mortality in trauma patients.
Uemura and al.(54)	2023	Retrospective validation study	32,201 patients	rSIG is a simple and effective predictor of emergent interventions, especially massive transfusion.
Lammers and al.(47)	2020	Retrospective review	22,218 patients	TRISS and rSIG demonstrated a higher AUROCs than for SI, Reverse SI or RTS in predicting transfusion.
Ml and al.(55)	2022	Retrospective cohort study	604,931 patients	rSIG outperformed SI and SIPA in the early identification of traumatically injured children at risk for early interventions, such as blood transfusion within 4 hours, intubation, intracranial pressure monitoring, and intensive care unit admission.

VI.4. The interest of rSIG in predicting surgical procedure:

In literature, a few studies discuss the ability of rSIG to predict the need for surgical procedures. A retrospective validation study assessed the utility of rSIG as a tool for predicting surgical procedure using data of 44,778 patients were entered into the Japan Trauma Data Bank (JTDB) revealed that rSIG has superior ability then SI, GCS, T-RT. Similarly, a cohort study showed that rSIG was the optimal tool for prospective prediction of an emergent surgical procedure when compared with SI, rSI, SIG, SIA, and RTS in civilians and military personnel in a combat region(47).

Practical section:

VII. MATERIALS AND METHODS:

VII.1. Study population:

Patients included in this study were admitted to the emergency departments of Colonel Lotfi Mixed Hospital and Hmida Benadjila Hospital in Laghouat for severe trauma between January 2018 and December 2022.

VII.2. Study Type:

This research is a retrospective, comparative, analytical cohort study.

VII.3. Data Collection:

Data were collected from the medical records of hospitalized patients and operative protocols.

A questionnaire was used to collect this Data, providing patient information, circumstances of the trauma, vital signs (SBP, DBP, HR, RR) at ED presentation, GCS and hemoglobin levels at ED presentation, the need of transfusion and the need of surgical intervention, and the in-hospital mortality (appendix 01).

We calculated rSIG using the following formulae:

rSIG=(SBP/HR) *GCS

VII.4. Selection Criteria:

VII.4.1. Inclusion criteria:

Our study included all patients aged between 18 and 80 years who were hospitalized for severe trauma or polytrauma.

VII.4.2. Exclusion Criteria:

Patients whose medical records lacked information on blood pressure, heart rate, Glasgow Coma Scale score, and hemoglobin levels were excluded from our study.

VII.5. Statistical analysis:

All statistical analysis were performed using SPSS software version 27.0.1(IBM Corp., Chicago, IL, USA).

Data analysing will be conducted at:

- **Descriptive analysis:** All the continuous variables are reported as mean ± standard deviation (SD), while categorical variables are presented as numbers and percentages.
- **Univariate analysis:** All continuous data were analysed with Student's t-test for differences between groups. Nominal variables were compared using Pearson $\chi 2$ test or Fisher's exact test, depending on the sample size.

All the tests were 2-sided, and p values < 0.05 were considered statistically significant.

The 95% confidence intervals for means and percentages will be provided.

VII.6. Description of the different stages of the work and their probable duration:

- Total planned duration and schedule: 07 months.
- Literature review: 20 days.
  - The bibliographic sources mainly consist of specialized periodicals, books, original articles, internet sites, as well as theses and recommendations from learned societies.
  - Documentary synthesis and critical report on the subject (03 months).
- Study initiation: (01 month)
  - Patient reception.
  - Data collection.
- Analysis and discussion of results: (01 month)
- Writing (01 month).

VII.7. Tasks performed by the intern:

- Study different documents such as articles, theses, and books to choose the theme.
- Establish questionnaire cards and organize the collected data to facilitate their analysis.
- Create a detailed outline to plan the theoretical part of the work.

VIII. Expected results:

In this comprehensive study, we anticipate that the utilization of the rSIG will yield substantial insights into the prognostic capabilities of this combined metric for trauma patients. Preliminary analyses of the gathered data indicate a promising potential for rSIG as a prognostic tool, with a clear correlation between its values and clinical outcomes. Specifically, we expect that trauma patients presenting with lower rSI × GCS scores will exhibit a heightened risk of adverse events, including complications related to shock, increased mortality rates, and prolonged hospital stays. Conversely, higher rSIG scores are likely to be associated with more favourable outcomes, including reduced risks of severe complications and shorter hospital stays. These expected results hold significant implications for clinical decision-making, allowing for more accurate risk stratification and timely interventions, ultimately leading to improved patient outcomes in trauma care settings. Furthermore, the incorporation of this combined metric may pave the way for more refined and personalized treatment approaches tailored to the specific needs of each trauma patient.

IX. results:

IX.1. Descriptive analyses:

IX.1.1. General characters of the population:

During the study period, 78 patients were admitted to the emergency department for severe trauma, of which 67.9% were from Laghouat. The average age of our study population was around 40 years old, and with a predominance of males (80.8%), The results is mentioned in the table10 & the diagram I below:

Table 10: general characters of the population:

Parameters	Value	±SD
Age (mean)	**40.3**	**17.5**
Gender		
male n (%)	**63(80.8)**	
female n (%)	**15(19.2)**	
Origin		
From Laghouat n (%)	**53(67.9)**	
Outside of Laghouat n (%)	**25(32.1)**	
Diabetes n (%)		
Yes	**12(15.4)**	
No	**66(84.6)**	
Hypertension n (%)		
Yes	**11(14.1)**	
NO	**67(85.9)**	
Cardiopathy n (%)		
Yes	**3(3.8)**	
No	**65(96.2)**	

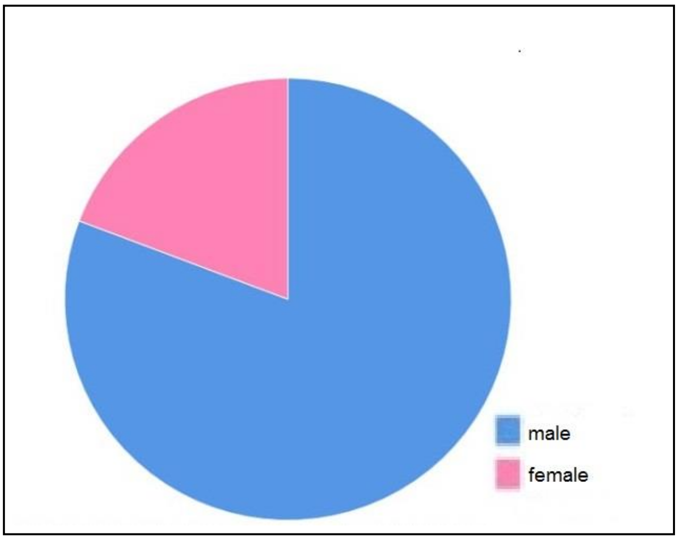

diagram I: diagram of distribution of the population by gender.

IX.1.1. Type & site of injury:

In this study, Blunt trauma was the most frequent type of injury among our population with (94.9%) while penetrating injuries has a 34.6% frequency, our analysis has chest and abdominal traumas as the most sites of injury received in the ER (emergency room) with (78.2%) and (51.3%) respectively, the rest of the results is mentioned is the table 11 below:

Table 11: type and site of injury.

Parameters		Value
Type of injury		
Blunt trauma	**n (%)**	**74(94.9)**
Penetrating trauma	**n (%)**	**27(34.6)**
Site of injury		
Chest trauma	**n (%)**	**61(78.2)**
Abdominal trauma	**n (%)**	**40(51.3)**
Facial trauma	**n (%)**	**38(48.7)**
Upper limb injuries	**n (%)**	**35(44.9)**
Traumatic brain injury	**n (%)**	**34(43.6)**
Lower limb injuries	**n (%)**	**30(38.5)**
Pelvic trauma	**n (%)**	**20(25.6)**
Cervical trauma	**n (%)**	**13(16.7)**
Spinal trauma	**n (%)**	**10(12.8)**
Vascular trauma	**n (%)**	**9(11.5)**

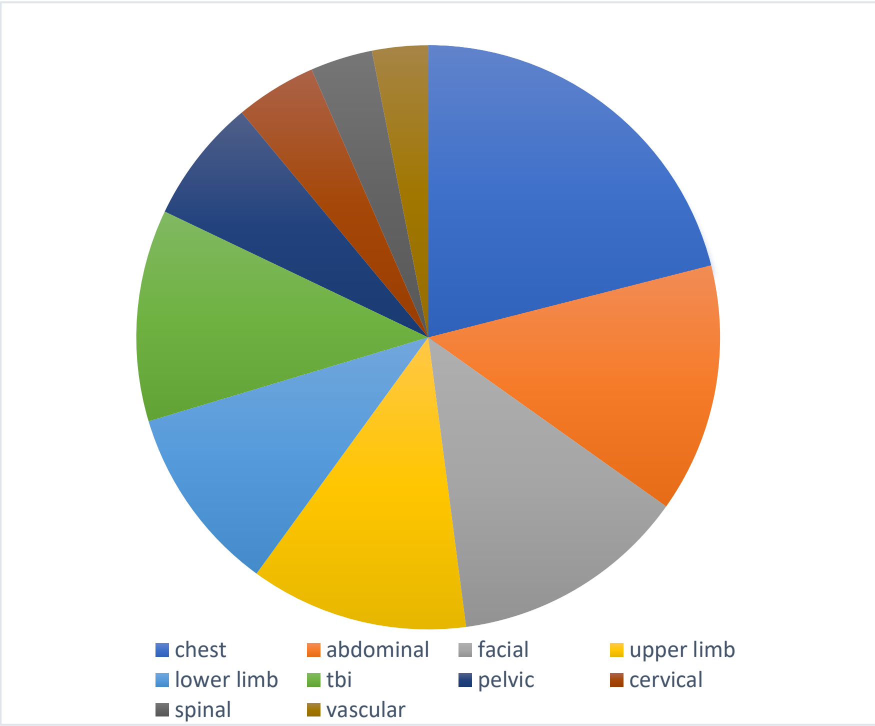

diagram II: diagram of repartition of site of injury.

IX.1.1. Circumstances of the trauma:

The results related to the circumstances of the trauma are summarized in the table below, we noticed that car accidents are what often encountered has 34.6% frequency, we received 12.8% of the accidents are work accidents while 7.7 % represents home accidents, 2.6% only for sports accidents; another road traffic accidents (RTA) with its frequencies, voluntary assaults and injuries are account by 7.7%, the rest of results is mentioned in the table 12 below:

Table 12: Mechanism and circumstances of trauma.

Parameters		Value
Pedestrian accidents	**n (%)**	**8(10.3)**
Car accidents	**n (%)**	**27(34.6)**
Bicycle accidents	**n (%)**	**18(23.1)**
Work accidents	**n (%)**	**10(12.8)**
Home accidents	**n (%)**	**6(7.7)**
Sports accidents	**n (%)**	**2(2.6)**
Voluntary assault and injuries	**n (%)**	**6(7.7)**
Driver seats	**n (%)**	**25(32.1)**
Passengers' seats	**n (%)**	**6(7.7)**
Front bus seats	**n (%)**	**6(7.7)**
Back bus seats	**n (%)**	**2(2.6)**
Security belt	**n (%)**	**15(19.2)**
Helmet	**n (%)**	**5(6.4)**
Sleeping	**n (%)**	**7(9.0)**

IX.1.1. Vital parameters of the traumatized population:

The main parameter of our study is the rSIG which has the average of 14.7 among our studied population, rSIG parameter is also related to the other vital parameters and their means sitting below in the table 13:

Table 13: vital parameters of the population.

Parameters	Value	±SD
SBP (mean)	107.1	26.9
DBP (mean)	67.0	18.5
HR (mean)	97.7	17.4
RR (mean)	26.8	4.4
Spo2 (mean)	94.3	4.9
GCS (mean)	12.1	2.4

HB (mean)	11.2	2.0
rSIG (mean)	14.7	7.4

SBP: systolic blood pression, DBP: diastolic blood pression, HR: heart ratio, RR: respiratory rate, GCS: Glasgow coma scale, HB: hemoglobin, rSIG: reverse shock index multiplied by Glasgow scale.

IX.1.2. Transfusion and the surgical intervention need among the population:

The frequency of transfused patients is approximately 53 % among the population otherwise almost half of it had operated; 24.4% of them had damage control.

Table 14: Transfusion and the surgical intervention need among the population:

Parameters		**Value**
Transfused patients	**n (%)**	41(52.6)
Operated patients	**n (%)**	45(57.7)
Re-operated patients	**n (%)**	9(11.5)
Patients had damage control	**n (%)**	19(24.4)

IX.2. Inferential analyses:

IX.2.1. Comparison between Group 01(the survivals) & Group 02(the dead):

In these inferential analyses we compare two groups with many parameters in order to find which parameters have significant effect on the two groups, we found that rSIG, HB, need for transfusion, Damage control, some sites of injury like: traumatic brain injury, facial injury, cervical and pelvic injuries have significant impact on the mortality rate, we also found that the type of injury that has a significant impact on mortality is the penetrating trauma. Our results assume that the average of rSIG score among survivals (group 01) was around 17.4 (rSIG > 15) and its average among dead (group 02) was 7.9 (rSIG < 15) with a (P < 0.00*), The average HB quantity was 11.7 among the survivals and 10 among the dead with a significant association (P<0.00*) ,we also found 81.8% among the dead (02) needed transfusion compared to only 18.2% dead patients had no need to transfusion Therefore around the half of the survivors (01) needed transfusion in addition of that .40.9% among the dead (02) needed Damage control compared to only 59.1% dead patients had no need to Damage control in the other group around 82.1% of the survivors (01) hadn't needed any damage control while 17.9% needed it, Damage control has a strong significant impact when it comes to mortality with (P = 0.03**) . Another results we got ; Among the survivals ,we had 58.9% had operated and 12.5% had re operated while 41.1% had no surgical intervention and 87.5% had no re intervention .In the other group , Among the dead , we had 54.5% had operated and 9.1% had re operated while 45.5% had no surgical intervention and 90.9% had no re intervention .Surgical interventions had no significant impact on mortality .The site of injury that has the most significant impact on mortality is TBI that are present in 43.6% of cases of this series; the frequency of TBI is significantly higher in the second group (dead patients) when compared with the first group (survival patients) [86.4% versus 26.8%; P=0.00***] , The type of the injury which is more frequent is the blunt trauma with a 94.9% but the type that has more significant association with the mortality is the penetrating trauma with (P = 0.02**) ,the results are sited in the table 15 below:

Table 15: comparison between the 02 groups: group 01 (the survivals), group 02 (the dead).

Parameters (n)	Survivals (56)	Dead (22)	P	±SD	CI at 95%
Age (mean)	**39.1**	**43.5**	**0.31***	**4.42**	**[-13.27 , 4.34]**
Gender n (%)					
Male	**43(76.8)**	**20(90.9)**	**0.21*****		
Female	**13(23.2)**	**02(09.1)**			
Diabetes n (%)					
Yes	**06(10.7)**	**06(27.3)**	**0.06****		
No	**50(99.3)**	**16(72.7)**			
Hypertension n (%)					
Yes	**09(16.1)**	**02(09.1)**	**0.71*****		
No	**47(83.9)**	**20(90.9)**			
Cardiopathy n (%)					
Yes	**01(01.8)**	**02(09.1)**	**0.19*****		
No	**55(98.2)**	**20(90.9)**			
DAA (mean)	**47.4**	**38.4**	**0.31***	**8.84**	**[-8.61 , 26.61]**
rSIG (mean)	**17.4**	**7.9**	**<0.00***	**1.53**	**[6.44 , 12.56]**
HB (mean)	**11.7**	**10.0**	**<0.00***	**0.48**	**[0.72 , 2.66]**
Need for transfusion n (%)	**23(41.9)**	**18(81.8)**	**0.00*****		
Yes	**33(58.9)**	**04(18.2)**			
No					

TBQ (mean)	**1145.8**	**1333.3**	**0.35***	**198.67**	**[-589 , 214]**
Damage control n					
(%)	**10(17.9)**	**09(40.9)**	**0.03****		
Yes	**46(82.1)**	**13(59.1)**			
No					
Operated patients n					
(%)	**33(58.9)**	**12(54.5)**	**0.72****		
Yes	**23(41.1)**	**10(45.5)**			
No					
Re-operated patients n					
(%)	**07(12.5)**	**02(09.1)**	**1.00*****		
Yes	**49(87.5)**	**20(90.9)**			
No					
Site of injury n (%)					
Traumatic brain injury	**15(26.8)**	**19(86.4)**	**<0.00*****		
Facial trauma	**20(35.7)**	**18(81.8)**	**<0.01*****		
Spinal trauma	**06(10.7)**	**04(18.2)**	**<0.45*****		
Cervical trauma	**04(07.1)**	**09(40.9)**	**<0.00*****		
Chest trauma	**46(82.1)**	**15(68.2)**	**0.17****		
Abdominal trauma	**29(51.8)**	**11(50.0)**	**0.88****		
Pelvic trauma	**11(19.6)**	**09(40.9)**	**0.05****		
Upper limb injuries	**24(42.9)**	**11(50.0)**	**0.56****		
Lower limb injuries	**21(37.5)**	**09(40.9)**	**0.78****		
Vascular trauma	**04(07.1)**	**05(22.7)**	**0.10*****		
Type of injury n (%)					
Blunt trauma					
Penetrating trauma	**53(94.6)**	**21(95.5)**	**1.00*****		
	15(26.8)	**12(54.5)**	**0.02****		

*: Student's t-test, **: Pearson's chi-squared test, ***: Fisher's exact test, CI: Confidence interval, SD: Standard deviation, n: effective, DAA: Duration between accident and arrival, rSIG: reverse shock index multiplied by Glasgow scale, HB: Hemoglobin, TBQ: transfused blood quantity, P: significant value.

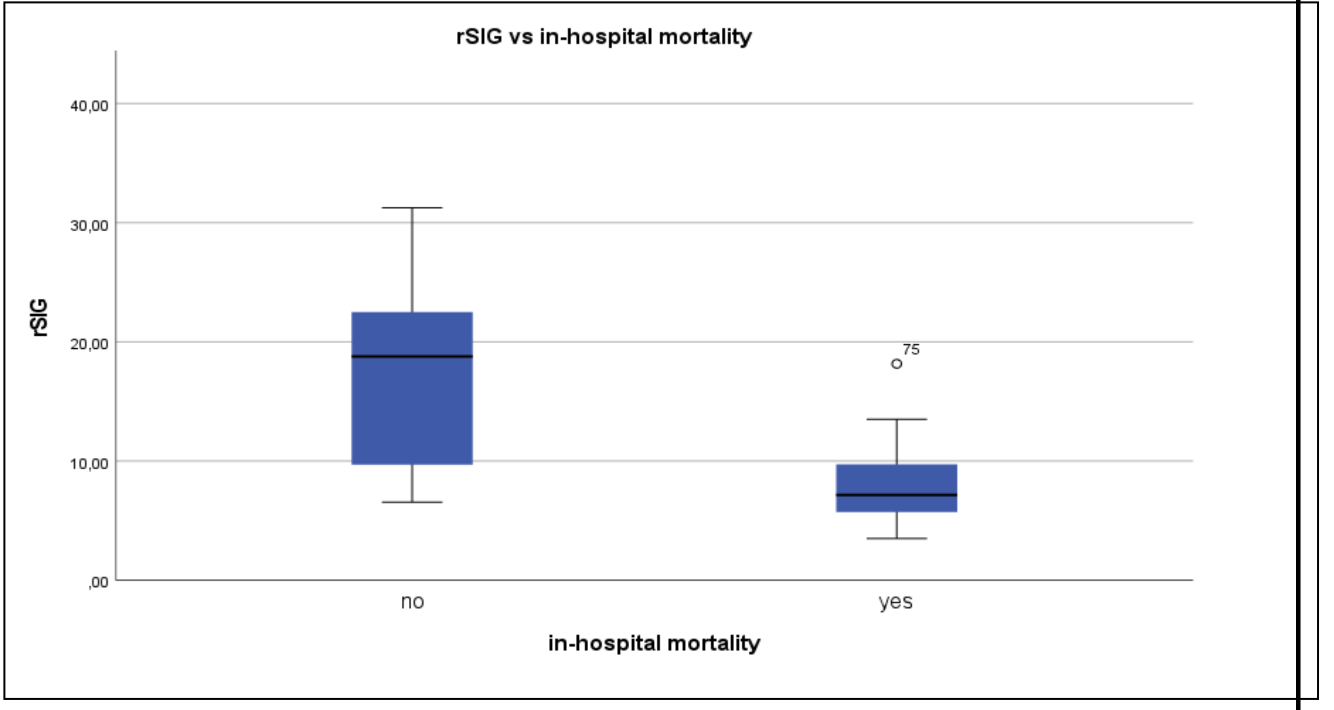

diagram III: boxplot of rSIG vs in-hospital mortality.

IX.2.1. Comparison between Group A (rSIG < 15) & Group B (rSIG > 15):

Inferential analysis below in table 16 compares two groups A & B with different parameters that tend to have significant results which are * Dead in hospital, need for transfusion, damage control, operated patients and re-operated patients *, around 21 patients among 37(with rSIG less than 15) have died in the hospital with a percentage of 51.2% in contrast of that only one patient from 41 (with rSIG more than 15) has died with less than 3% with a significant impact on mortality (P < 0.00***) .In addition , Around 80.5% from A group needed blood transfusion and only 21.6% from B group with a significant association (P <0.00**). Around 43.9% from A group had damage control and only 02.7% from B group with a significant association (P <0.00***). Therefore, around 70.7% had operated from A group whereas 43.2% only from B group with a significant association (P =0.01**) thus 19.5% had re operated from A group and only 02.7% from B group with a significant association (P =0.03***). The results are shown in table 16:

Table 16: comparison between group A (rSIG<15) and group B (rSIG>15).

Parameters	n	rSIG < 15 (37)	rSIG > 15 (41)	P
Dead in hospital (%)	n	21(51.2)	01(02.7)	<0.00***
Need for transfusion (%)	n	33(80.5)	08(21.6)	<0.00**
Damage control (%)	n	18(43.9)	01(02.7)	<0.00***
Operated patients (%)	n	29(70.7)	16(43.2)	0.01**
Re operated patients (%)	n	08(19.5)	01(02.7)	0.03***

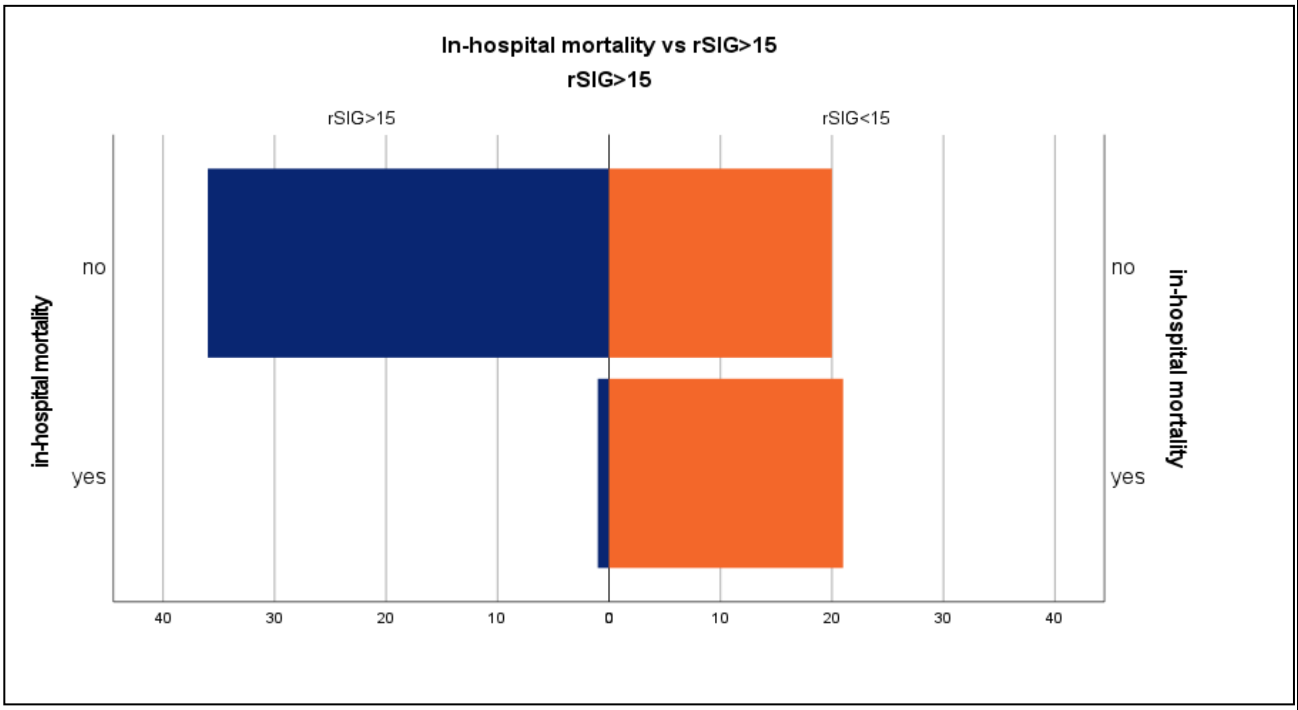

diagram IV: diagram of in-hospital mortality vs rSIG>15.

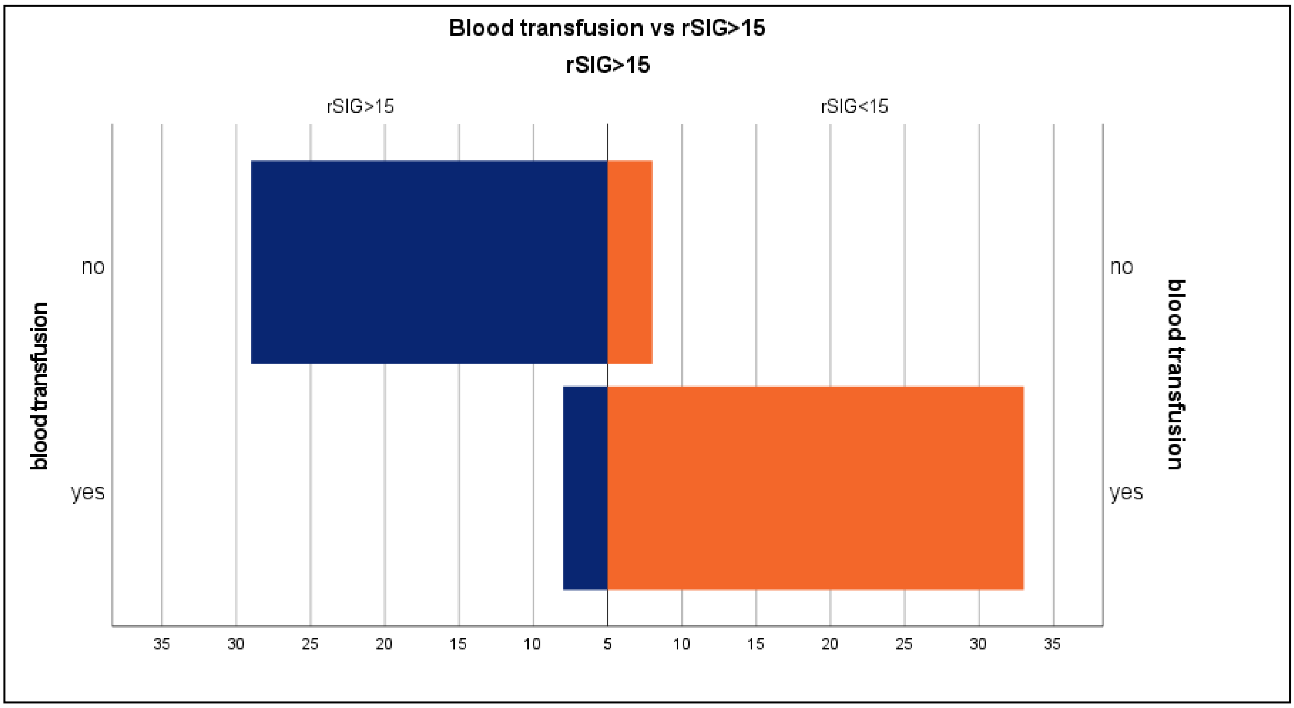

diagram V: diagram of blood transfusion vs rSIG>15.

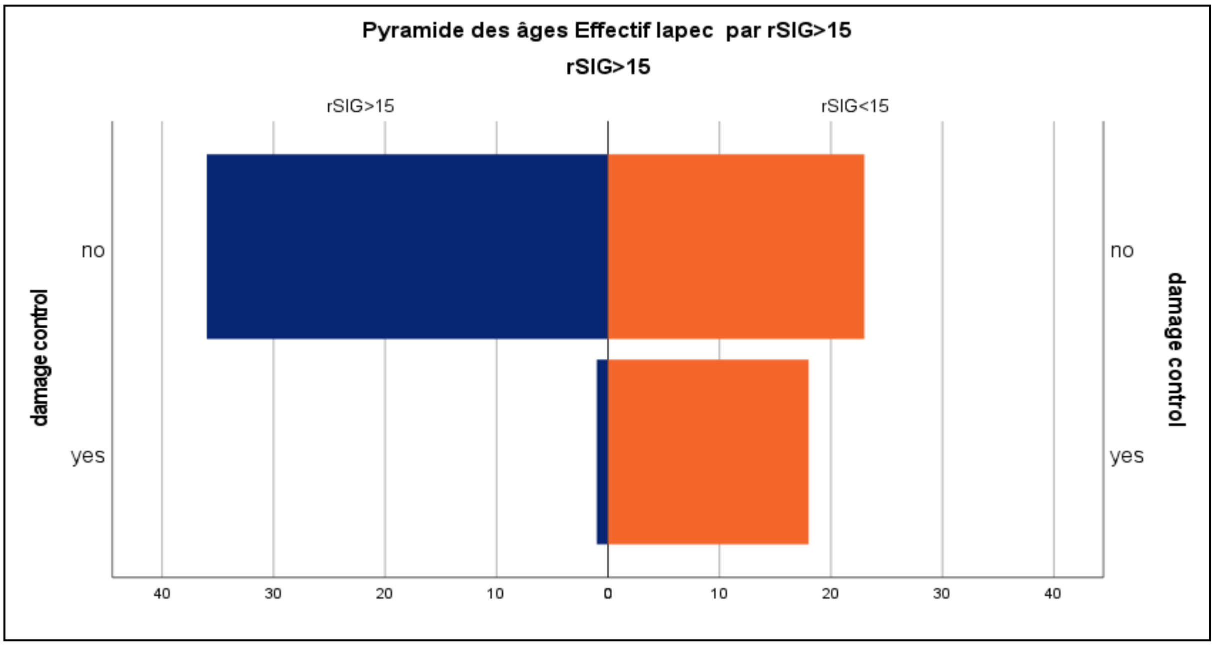

diagram VI: damage control vs rSIG>15

X. Discussion:

X.1. Age:

The average age of our study population was around 40 years old, this result is explained, on one hand by the predominance of young individuals (15 to 64 years), which represents approximately 60% of the total population in Algeria(56); and in the other hand, by the activity of young population, because they are often physically active and participate in sports activities that carry a higher risk of serious injuries, also, they engage in risky behaviours such as fast driving, alcohol or drug consumption, making them more vulnerable to accidents.

A French study found that the average age of traumatized patients is 40 years old(57), while the average age found in another Norwegian study is 45.8 years old(58).

We notice that there is no statistically significant difference in the average age between the two groups studied (dead and survivals) with a $P>0.05$.

X.1. Gender:

Men accounted for (63/78) or 80.8%, while women accounted for (15/78) or 19.2%, with a male-to-female sex ratio of 4.2. This sex ratio is comparable to the one found in a Malian study, which was equal to 4.8(16), Other studies have pointed to this in Iran and Korea(59,60).

This male predominance can be attributed to the their higher exposure to high-risk occupational sectors, such as construction, industry, or manual trades, where work accidents are more common, additionally, Men are more inclined to participate in risky activities(16), such as reckless driving, which increases their likelihood of experiencing severe trauma. Research done in Saoudi Arabia about the epidemiology of adult trauma found that male gender is the predominant. It should be noted that females were not allowed to drive in Saudi Arabia as a major part of the study period. Similarly, in the conservative Muslim countries, women may have limited involvement in risky activities or driving compared to men (61).

This difference is less pronounced in developed countries due to increased involvement of women across various domains of professional activities, hobbies, and sports(16,62).in another hand other investigators found that in the suburban routes (roads) because of men driving skills and having greater ability to react in dangerous situation, men were less likely to be killed than women(63).

We notice that gender does not have a significant impact on mortality (P>0.05) in our study.

X.1. Underlying diseases:

In our study, the percentage of patients with diabetes (DM) is 15.4% only, this frequency can be explained by The barometer Algerie's research that was done in Algeria which account increase of a 14.4% of the population between 18 and 69 years old in 2018(64). Also, patients with arterial hypertension (AHT) around 14.1% and 3.8% of patients with heart disease. This is justified by the fact that severe trauma primarily affects young population, and diabetes (especially type 2 DM, which is the most common),AHT and heart disease are usually associated with old age(65,66). It was observed that diabetes did not influence mortality (P>0.05) as well as AHT and heart disease (P>0.05), A He et al study shows that diabetes could be an independent risk factor for adverse outcomes in trauma, notably, DM patients with severe injury defined as ISS >15 had no statistically significant differences in mortality as compared to non-diabetic patients (67), which is consistent to our report.

He et al study also found that increased mortality in diabetic patients was only seen in patients with ISS<15(67), this research depends on different parameter than ours, the ISS (injury severity score) not the rSIG parameter ,different parameter has different results.

X.1. Mechanisms of trauma:

Globally, around 5.8 million people is estimated die annually as result of injuries, which causes 10% of all deaths and 16% of disability adjusted life years lost worldwide(60).

Car accidents were the most frequent cause of trauma in our series, representing 34.6% of all incidences in our data , followed by bicycle accidents (23.1%) with a small difference in frequency, It is logical since Algeria ranks 98th in the world ranking of road traffic crashes and 42nd in Africa, and holds the 12th position among Arab countries(68). In the literature, road traffic crashes (RTC) represent the primary cause of injuries(1,69). This finding is consistent with previous studies(60,70).

This high percentage may be related to many reasons like human errors, poor safety, or unsafe vehicles and roads that among these, the most common cause of RTA are the human errors(63),as violation of road safety rules, speeding and consuming drugs, poor driving skills, fatigue, and talking on the phone while driving(63,71);not to mention the infrastructure deficiencies at the road level, as in most low- and middle-income countries (LMICs). A WHO data show that during 2002 year there have been recorded 1.2 million deaths and nearly 20 million injured or disabled people a result of road traffic crushes, most of them are reported by low and middle-income countries(72).

work accidents represent 12.8% of mechanisms of trauma in our series, in Algeria, the number of workplace accidents was 42,946 in 2022(73).

X.1. Type and site of injuries:

X.1.1. Type of injury:

Most of the trauma mechanisms in our data were classified as blunt trauma with a percentage of 94.9% this finding is consistent in another study(59). The frequency of blunt trauma in the two studied groups is nearly equal (94.6% in the group of survivals, while in the group of dead patients, it is 95.5%). We noticed that blunt trauma does not have a significant impact in mortality ($P>0.05$). Another study shows that Blunt abdominal trauma who requires laparotomy include: hemodynamic instability as an indication for laparotomy, presence of solid organ injury has higher mortality (74). Our study population is not based only on Blunt abdominal trauma patients, it has also patients with penetrative trauma included, that can lead to indifferences in results.

The percentage of patients with penetrating trauma is 34.6% among them around 54.5% of dead patients and only 26.8% of survivals patients, and therefore, the difference is statistically significant (P= 0.02**).

This could be explained by the fact that Penetrating trauma can lead to significant damage to internal organs and rapid bleeding, which can result in hypovolemic shock and rapid deterioration of the patient's condition; also, it can increase the risk of infection, particularly serious bacterial infections, due to direct tissue contamination by pathogens. Other investigators have reported consistent results; mortality was significantly higher with penetrating trauma patients than with blunt trauma associated with conditions such length of interval between injury and medical intervention, presence of shock at admission, presence of cranial injury, and high penetrating abdominal trauma index were all predictors of mortality in penetrating abdominal trauma cases(75).

Another analysis has shown that Patients with penetrating injuries died more frequently within the first 60 minutes (died immediately), while blunt trauma patients rarely died on scene or within a few hours(76).That could explain the significance of penetrating trauma on the mortality.

X.1.1. Site of injuries:

- ***Traumatic brain injury (TBI):***

Traumatic brain injuries (TBI) are the leading cause of death in children and young adults and represent a major cause of psychomotor disability(77). TBI remains a frequent killer, as is the predominance of traffic-related accidents(58).In spite of concomitant injuries in other areas such as the thorax , TBI was reported to be associated with greater morbidity(78).

TBI are present in 43.6% of cases of this series; the frequency of TBI is significantly higher in the second group (dead patients) when compared with the first group (survival patients) [86.4% versus 26.8%; P=0.00***] in results, our report claims that TBI has a higher association with mortality, in another research, they found that Brain injury is still the leading cause of death after multiple traumas. Especially early deaths (up to 24 hours) and first week deaths are more often due to brain injury(76).

This significant difference between the two groups can be explained by the exposure of the head and its vulnerability during traumatic events, also because of its predominance in traffic-related accidents(58); also,non-compliance with safety measures such as wearing a helmet and security belt increases the likelihood of TBI and enhances the severity of the injury; we can notice that only 6.4% of patients were wearing hamlet and only 19.2% were wearing security belt.

In laghouat, among the young generation there is a majority don’t wear helmet while driving a motorcycle which can lead to TBI due to RTA (road traffic accidents). We recommend more educational events in our region about the safety rules while driving motorcycles.

- ***Facial trauma:***

We noticed that 81.8% of patients from the second group (dead patients) had facial trauma while only 35.7 % of the first group had it, this difference was statistically significant (P=0.00).

These results can be explained by: facial trauma is often associated to traumatic brain injuries, this trauma can lead to significant bleeding, which can result in hypovolemic shock and be fatal if not controlled promptly, additionally, it can also damage and obstruct the upper airways, which can cause respiratory distress that is fatal if not treated promptly.

- ***Cervical and spinal traumas:***

Cervical spine trauma is known to be a significant contributor to severe long-term disability(79),16.7% of patients had a cervical trauma and 12.8% had a spinal trauma.

the percentage of spinal trauma in the first the second group was 10.7% and 18.2%, respectively; and it doesn't have an impact on the mortality of the patients (P=0.45***).

Cervical trauma was observed in 04 patients (07.1%) in the first group, whereas it was observed in 09 patients (40.9%) of the second group. This difference was statistically significant (P=0.00***).

This result can be explained by Poor application of prehospital care such as immobilization and cervical collar placement; additionally, cervical spine trauma can cause a neurogenic shock, which is a type of distributive shock caused by the disruption of autonomic nervous system regulation of vascular tone(80). The dysregulation occurs because of the lack of sympathetic tone and an unopposed parasympathetic response. Neurogenic shock manifests as hypotension due to decreased systemic vascular resistance resulting from loss of sympathetic tone; and a bradycardia results from a vagal response(80).

- ***Chest trauma:***

The most frequently found trauma in our study was chest trauma, which accounted 78.2% of patients, and this is because of the existence of one single thoracic surgery department in Laghouat as it receives patients from most of the border villages .A research made in Korea found thoracic injury was the least common injury but with the high ISS score among the no survivals thus holding significance and requiring a high degree of attention in patients with major thoracic injuries(59).

The percentage of chest trauma in the first group is 82.1% while 68.2% of the second group have it. We noticed that chest trauma does not have a significant impact on mortality (P=0.17**). Excluding trauma deaths, many thoracic injuries are of moderate severity due to the stiffness of the thoracic cage and few solid organs. This can be also explained by the fact that complications associated with chest trauma can be quickly diagnosed by chest X-ray or CT scan, and can be more easily managed by emergency medical interventions, most thoracic trauma is treated conservatively with drains and rarely requires surgical intervention thus reducing the risk of death.

- ***Abdominal trauma:***

In our series, abdominal trauma was discovered in 40/78 or 51.3% of patients. We notice that there is no statistically significant difference in the frequency of abdominal trauma between the two groups studied [51.8% for the first group versus 50% for the second group; P=0.88**].

although there was a high rate of abdominal injuries due to the soft abdominal wall and the susceptibility of solid organs to undergo sudden acceleration and deceleration(59), due to preventive strategies and legislation, such as obligatory use of seatbelts ,the development of damage control surgery, advanced resuscitation, swift angiography, and less invasive techniques like abdominal drains have lowered the mortality rate of abdominal injury.

- ***Pelvic trauma:***

Pelvic traumas are important in critical care because they are the result of high energy trauma, and it is frequently associated with additional injuries, and prolonged rehabilitation. In this study, 20/78 or 25.6% of patients present a pelvic trauma. In

Giannoudis and al study, pelvic traumas are observed in 10% of severe trauma patients(81).

The frequency of pelvic trauma was significantly higher in the second group when compared with the first group (40.9% for group 02 versus 19.6% for group 01) with a P=0.05**.

The seriousness of pelvic trauma comes from the potential for haemorrhagic shock; the pelvis is anatomically associated with a number of vascular structures and a pelvic fracture can damage this structures and cause haemorrhage that have a difficult diagnosis and therapeutic challenge for trauma team. Also, pelvic trauma can be associated with other injuries and that will worsen the situation. In literature, the risk of death from isolated pelvic trauma is about 0.8%(82) , This explanation reveals why pelvic trauma could be significant when it comes to mortality rates.

- ***Limb injuries:***

Limbs injuries Are known to be one of the most likely to result in severe long-term morbidity(79),like amputation. In this series, 44.9% of patients present an upper limb trauma.

We found that 30/78 patients present a lower limb trauma in our series (38.5%), 21 patients of them are in the first group (37.5%) while 9 patients are in the second group (40.9%).

We noticed that upper and lower limbs traumas do not have an impact on mortality, with a P=0.56** for upper limb trauma and P=0.78** for lower limb trauma.

This can be explained by the fact that they pose a lower risk of vital organ injuries, and are also less likely to cause serious systemic complications that could lead to death compared to other types of traumas.

X.1.1. The predictive accuracy of rSIG in trauma patients:

Trauma is identified like a public health problem, and care of trauma patients is a matter of global concern, furthermore, initial treatment of severe trauma patients often requires large amounts of human and material resources, like massive blood transfusions, resuscitative procedures, and surgical procedures. Many studies have investigated and published prognostic predictive models for patients with trauma, including the Injury Severity Score (ISS), Revised Trauma Score (RTS), Trauma and Injury Severity Score (TRISS), and New Injury Severity Score (NISS)(33).Although these scoring systems are effective in predicting survival probability, their application in prehospital or emergency departments is constrained as they require information on all injured organs, typically available at discharge.

TRISS, NISS, ISS, and RTS involve complex calculations, making them less suitable for real-time patient conditions(38), additionally, , these scoring systems are challenging to memorize and apply in prehospital settings.

The Shock Index (SI), calculated as the heart rate (HR) divided by systolic blood pressure (SBP), was developed to identify trauma patients in hypovolemic shock(37). SI is Easily computed at the bedside without additional tools to determine mortality, regardless, SI can underestimate the severity of underlying shock in older injured patients. A research group in Taiwan introduced the reverse shock index rSI, as a preferable alternative to SI(41). Glasgow coma scale (GCS) is an instrument used to objectively describe the extent of impaired consciousness in all types of acute medical and trauma patients(35).

The reverse shock index multiplied by Glasgow scale (rSIG) is a novel tool developed by Japanese researchers in 2018(43), which is calculated by multiplying the rSI (SBP/ HR) by the GCS.

Recently, a Japanese research group Akio et al has proposed a new scoring tool, the reverse shock index multiplied by the Glasgow Coma Scale (rSIG)(43), which is calculated as follows: rSIG = Glasgow Coma Scale (GCS)multiplied by rSI (SBP/HR).

The rSIG score combines both hemodynamic (shock index) and neurologic status (GCS score) to improve the accuracy of prediction(38). In admission, rSIG is very easy to calculate in emergency departments without the need for additional information, blood tests, or hard-to-remember coding systems(43).

This study aimed to determine the predictive value of rSIG for predicting outcome of traumatic patients referring to the emergency department (ED) of Colonel Lotfi Mixed

Hospital and Hmida Benadjila Hospital in Laghouat between January 2018 and December 2022.

- ***Role of rSIG in predicting mortality:***

We found in our series the average of rSIG score among survivals (group 01) was around 17.4 (rSIG > 15) and its average among dead (group 02) was 7.9 (rSIG < 15) with a (P < 0.00*) , our findings indicate that the scoring system of rSIG has a significant Impact on the mortality rate and to the best of our knowledge, The first report done in Japan has shown the utility of rSIG and rSIG/A to identify high-risk trauma patients suggesting it as an easy go to tool to begin with in the emergency room , A higher rSIG means lower in-hospital mortality(43).

Our statistics shows that around 21 patients among 37 (with rSIG less than 15) have died in the hospital with a percentage of 51.2% in contrast of that only one patient from 41 (with rSIG more than 15) has died with less than 3%, with a significant impact on mortality (P < 0.00***) ,which we suggest based on this ; rSIG scoring tool as a predictor of mortality among patients with severe traumas with a cutoff point was 15 in our population. Therefore, an easy and a quick tool for real-time risk stratification due to the dynamic change during management of these patients is needed. The rSIG uses easily obtainable physiological variables (SBP, HR, and GCS) and is simple to calculate(46).

More recent studies have examined the association of rSIG score and the mortality ;A retrospective review was performed for pediatric patients with war zone injuries has found rSIG score to be superior to SIPA (pediatric age-adjusted shock index) as an independent predictor of early mortality that validate its accuracy in predicting early mortality(48);they suggest more studies to be done to validate its applicability to the civilian population.

Our series count on younger population, the average age of our study population is around 40 years old, our findings could support more other studies in the applicability of Reverse shock index multiplied by GCS as a predictor of morality.

In our study, rSIG cutoff point was 15 for severe trauma patients not focusing only on head injuries but our study population has different sites of injuries that can affect GCS differently study conducted in Taiwan was the first to report about the utility of rSIG score for mortality prediction among severe adult trauma patients with head injury but with a different cutoff point than ours (was 14) due to the significantly lower GCS score (6.28 ± 4.25) in their mortality group than in their survivor group (12.70 ± 5.19)(46). Another study by SC Wu *et al*. showed the best rSIG cutoff point was 14.8 for trauma patients with head injury, with 86.8% sensitivity and 70.7% specificity(49).

Other investigators propose a cutoff rSIG of 16.5 or below. However, in patients with TBI and high rSIG values, these higher rSIG values were also associated with in-hospital mortality(83).

- **Role of rSIG in predicting massive transfusion:**

Around 80.5% from A group (rSIG <15) needed blood transfusion and only 21.6% from B group (rSIG>15) with a significant association (P <0.00**). With our findings, we have confirmed the ability of rSIG as a tool to predict the need of blood transfusion among the population with rSIG < 15.
In our statistics, we compared a group of survivals (01) with a group of dead (02) in term of the need to be transfused, we found 81.8% among the dead (02) needed transfusion compared to only 18.2% dead patients had no need to transfusion Therefore around the half of the survivors (01) needed transfusion.

Due to the massive bleeding caused by the severe trauma, the need to transfusion is crucial and it has a significant impact on mortality (P < 0.00***) and it also related to the decay of rSIG scale which can lead us to conclusion ;the rSIG score could be used as a predictor of the need to transfusion because hypoxemia and hypotension may remain important causes of mortality, as they are complications of massive hemorrhage which can be detected by the parameters used in rSIG tool.

We also found a significant association of rSIG score system with the quantity of HB (p <0.00*), the average HB quantity in the survivals group (01) was about 11.7 while in the dead group (02) was 10. the difference was slightly close due to rapidity of the bleeding that cannot be measured every minute, internal bleeding can be tricky too.

Another study was performed to evaluate the ability of rSIG to predict MT in severe trauma patients has found that rSIG is a useful indicator for predicting massive transfusion in severe trauma patients and more accurate than IS in predicting in-hospital mortality(51).

the findings of a cohort study in the pediatric trauma setting suggested that RSIG proved to be more effective than SI and SIPA (pediatric age-adjusted shock index [SIPA]) in identifying pediatric patients who were at risk of requiring early interventions like blood transfusion within 4 hours or intubation (55).

Therefore, rSIG could be used specifically for prediction of the need for massive transfusion. Clinicians can use RSIG to identify individuals at high risk of requiring early transfusion due to severe injury and hemorrhagic shock, this approach allows for minimizing transfusion-related complications and improving overall patient outcomes in critical situations.

- ***Role of rSIG in predicting the need of damage control and surgical procedure:***

We compared in our study two groups ; The survivals group (01) and the dead group (02) with the need to Damage control and the need for the surgical interventions among our study population, we found 40.9% among the dead (02) needed Damage control compared to only 59.1% dead patients had no need to Damage control, in the other group around 82.1% of the survivors (01)hadn't needed any damage control while 17.9% had needed it, Damage control has a strong significant impact when it comes to mortality with (P = 0.03**). Another results we got; Among the survivals, we had 58.9% had operated and 12.5% had re operated while 41.1% had no surgical intervention and 87.5% had no re intervention. In the other group, Among the dead , we had 54.5% had operated and 9.1% had re operated while 45.5% had no surgical intervention and 90.9% had no re intervention .Surgical interventions had no significant impact on mortality while damage control has a signification, these results can be explained by the instant severe trauma with its possible complications that can lead to dead among the patients in need of Damage control which is the first step before any surgical intervention and after an intensive care unit resuscitation.

- Around 43.9% from A group had damage control and only 02.7% from B group with a significant association (P <0.00***).
- Around 70.7% had operated from A group whereas 43.2% only from B group with a significant association (P =0.01**).
- Around 19.5% had re operated from A group and only 02.7% from B group with a significant association (P =0.03***).

The complexity of injuries represents a challenge for all surgeons in addition the physiological instability of the patient in his admission to hospital. This instability includes profound hypovolemic shock, metabolic acidosis as a consequence of the failure of oxygen transportation for cellular metabolism and hypothermia, which further aggravates the acidosis (triad of death).

In the case of a patient with these characteristics, the care and the definitive treatment of their injuries would take time and this would further deplete the patients already depleted physiological reserve, making the mortality rate even higher.

In the case of patients with bleeding sites were plugged, larger vessels were closed by temporary ligatures or suture then these patients were sent to the intensive care unit (ICU) and under control they could be re operated for definitive treatment of the injuries, these patients had lower rate of mortality and based on these observations, in 1993, Rotondo et al. introduced the concept of "Damage Control" which was defined as "initial control of hemorrhage and contamination followed by correction of physiologic abnormalities and definitive management, the damage control trilogy, abbreviated operation, intensive care unit resuscitation, and definitive operation.

In our series, Damage control has a significant impact on mortality with P = 0.03** which can be a prognostic indicator of mortality because of its association with complex injuries in patients .Moreover, some studies confirm its utility and assume that damage control as a promising approach for increased survival in exsanguinating patients with major vascular and multiple visceral penetrating abdominal injuries(84).

We found that 82.1% did no damage control were survivals, and only 17.9% who did damage control were alive in contrast of that among the dead proximately half of them had damage control, we also found that rSIG scoring system can predict the need of damage control that could explain the significant association with rSIG (P < 0.00***).

This could be explained by the fact that the goal of damage control is to avoid the lethal triad comprises the vicious cycle of hypothermia, acidosis, and coagulopathy which can affect mainly the hemodynamic of the patient, rSIG scale could be helpful in detecting these changes in the primal care units and to start the damage control protocol on these with rSIG < 15, our analytics lack references as there's no studies on the predictability of rSIG scoring system on patients in need of damage control.

It has also known well that scales for assessing the severity of patients such as the rSIG score could independently predict the odds of death in patients of severe trauma .According to the our research, that takes into account two groups (survivors group 01/non-survivors group 02) compared to those who had operated and re operated and we found that these chirurgical interventions had significantly no impact on the mortality rate unlike damage control , other factors could intervene like their initial states , age and the severity of the injuries .However in this study , rSIG scale has a significant correlation with the operated and re operated patients with (P =0.01** and P =0.03***)respectively, the analytics shows that 70.7% had operated among A group (rSIG < 15) whereas 43.2% only from B group (rSIG > 15)

And around 19.5% had re operated among A group and only 02.7% from B group, we may assume that rSIG scale could be a predictor for the need to surgical procedures.

A few studies discuss the ability of rSIG to predict the need for surgical procedures , one of them a cohort study showed that rSIG was the optimal tool for prospective prediction of an emergent surgical procedure when compared with SI, rSI, SIG, SIA, and RTS in civilians and military personnel in a combat region (47).

Considering these findings, it may be worthwhile using rSIG as tool in the emergency department of colonel lotfi hospital to predict mortality, the need for transfusion, damage control and surgical procedures, Further researches should be conducted to validate the result of this study.

XI. Limitations and inconvenient of rSIG :

The Reverse Shock Index multiplied by the Glasgow Coma Scale (RSIG) is a composite measure used to predict mortality in trauma patients. However, Despite its usefulness, rSIG may have some limitations and drawbacks:

-rSIG combine the Reverse Shock Index (RSI) and the Glasgow Coma Scale (GCS) into a single measure which can be complex to use.

- The limitation of GCS and RSI can be also the limitations of rSIG: GCS is sensitive to sedative medications administered to patients, this sensitivity may result in a lower GCS score that does not accurately reflect the patient's underlying neurological. RSI depends on heart rate and systolic blood pressure, which can fluctuate due to various factors like pain, anxiety, or medication.

XII. -Limitations and strengths of the study

- Limitations of the study:

This review has several limitations that might be potential sources of bias.

- First, this was a retrospective study, and so prospective corroboration will be needed for validation.
- Second, the results were confirmed using only Colonel lotfi hospital data, and thus international validation, especially in LMICs, will be required for worldwide use in the future.
- Third, the cutoff values may differ among countries and various trauma systems, it may reflect the quality of the trauma system.
- Fourth, 94.9% of cases involve civilian blunt trauma, so the results of this study may not be applicable to patients with penetrating and open injuries, and also the complexity of trauma patients may be different in other healthcare centres.
- Fifth, the study was generalized to many trauma centres, and the information obtained may lack specificity to each trauma centre, the results of this study of rSIG would not be generalized to all the patients like patients that have only isolated head injury or head injury that could be associated with other injuries (while considering that some patients may have additional lethal injury into the other body region). thus, the result may not be applicable to other settings and further validations in other patient populations in different settings are required.

- Sixth our Data contained only 78 patients, the patients who were declared to be dead at the accident scene or upon arrival at the ER were not included in the registered database and also patients whose medical records lacked information on blood pressure, heart rate, Glasgow Coma Scale score, and hemoglobin levels were excluded from our study, and this might have resulted in selection bias in calculating the mortality rate in our study, more analytic reviews are needed with large population.
- Seventh the vital signs and GCS scores that were used in this study were those recorded upon patient's arrival at the ER; some bias in the calculation may happen because such measurement is dynamic and it may be interfered by the resuscitation performed at prehospital scenario and in some cases the initial sets of vital signs is no further available.
- Eighth, the confidence interval of the rSIG < 15 odds ratio was wide, which indicate a larger sample sized study is warranted to validate the result of this review.

- strengths of the study :

- well-defined sample size.

- The use of parametric statistical tests.

- The medical impact of the study, which will serve as a scientific document for practitioners."

XIII. Outlook:

Artificial intelligence (AI) is a branch of computer science capable of analyzing complex medical data. Their potential to exploit meaningful relationship with in a data set can be used in the diagnosis, predicting outcome in many clinical scenarios, treatment and also to gather data easily, there is compelling evidence that medical AI can play a vital role in assisting the clinician to deliver health care efficiently in the 21st century. Artificial intelligence has the potential to be applied in almost every field of medicine. There is need for further clinical trials which are appropriately designed before these emergent techniques find application in the real clinical setting(85). Also, an ever-increasing amount of medical data is being recorded by monitoring patient care devices, enabling big data analysis in health care(86).

While a balance between the increasing amount of documented data on the one hand and the demographic change and aging populations on the other hand challenges our health care systems, big data and artificial intelligence (AI) in medicine offer a huge potential to relieve physicians from the increasing complexity of today's health care and information overload when treating patients(86). Today, the widespread practical implementation of AI into hospital care has not yet become reality to all hospitals around the world(87).

AI will play a significant role in future hospital health care systems, there is a real opportunity its application to become a reality in the near future, but there is still a lot of work ahead of us. We encourage our healthcare structures in Algeria for its implementation in the processing and analysis of large amounts of data to enhance deep learning in almost any field of medicines, ongoing research will be needed to develop new AI algorithms for medical applications and to improve upon existing ones.

XIV. Recommendation:

we propose rSIG score and recommend using it in our hospital and others healthcare structures.

we also suggest to provide advance diagnostic tools in the hospital structures of Laghouat to prevent errors in the vital parameters, as well as the documentation of all the vital signs to the admitted patients thus to help the future retrospective studies to prevent excluding patients with messing parameters .

XV. Conclusion:

Due to the increased mortality rate in adult trauma patients, several prediction models have been developed for mortality prediction as TRISS, ISS and RTS. All these models

require coded scoring systems that are difficult to remember which is impractical for real time management of trauma patients in the ED. our results indicate that the rSIG ((SBP/HR) × GCS score) is easy to calculate without the need for additional information to remember charts, or equipment, we propose rSIG score as a predictor for high-risk trauma patients and a prognostic indicator to scale patient quickly and easily and to take optimal decisions especially in overcrowded emergency rooms (ER), and might have more value in resource-constrained settings such as LMICs , more studies is needed for that concept .

As our study has proved its utility among patients with severe trauma to predict mortality, the need for transfusion, damage control and surgical procedures. Reverse shock index multiplied by GCS score is more accurately identifies patients with severe trauma at highest risk of death. These findings may help further refine early risk assessments for patient management.

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XVI. Appendix:

Appendix (01):

People's Democratic Republic of Algeria

Ministry of Higher Education and Scientific Research
Amar Telidji' University – Laghouat

وزارة التعليم العالي والبحث العلمي
جامعة عمار ثليجي الأغواط

كلية الطب Faculty of Medicine

<u>Data collection sheet :</u>

<u>The Predictive prognostic value of rSIG in trauma patients:</u>

Number : /…./ date of questionnaire:/__/__/____/

<u>Identification :</u>

- Nom and first name:
- Age:
- Gender: ☐ Male. ☐ Female.
- Underlying disease: ☐ diabetes.
  ☐ AHT.
  ☐ Heart disease

- Blood group:
- Duration between accident and arrival to hospital:

- Cause: ☐ Pedestrian accident. ☐ Car accident. ☐Bicycle accident. ☐ work accident. ☐ Home accident.
  ☐ Sport accident. ☐ Voluntary assaults and injuries.
- If it was car accident; Seat: ☐driver. ☐ Passenger. ☐ Back.
  ☐ Bus front seat. ☐ Bus middle seat. ☐Bus back seat.
- Wear of hamlet: ☐ Yes. ☐ No.
- Security belt: ☐ Yes. ☐ No.
- speed: Km/h.
- Death at the scene: ☐ Yes. ☐ No.
- Sleep while accident: ☐ Yes. ☐ No.
- Accident Pickup: ☐ Yes. ☐ No.
- Thermal blanket: ☐ Yes. ☐ No.

Vital parameters:

- SBP/DBP:
- Heart rate:
- Respiratory rate:
- Oxygen saturation:
- Glasgow scale score:
- Hb:
- Transfusion: ☐ Yes. ☐ No.

- If yes, number of packed red blood cells PRBC:

- Compatibility: ☐ YES. ☐ No.
- Site of injury: ☐ Traumatic brain injury.
  ☐ facial trauma.
  ☐ cervical trauma.
  ☐ Spinal trauma.
  ☐ Abdominal trauma.
  ☐ Chest trauma.
  ☐ Pelvic trauma.
  ☐Upper limb injury.
  ☐ Lower limb injury.
  ☐ vascular trauma.

- Type of trauma: ☐ Penetrating trauma.
  ☐Blunt trauma.

- Surgical intervention: ☐ Yes. ☐ No.
- Reintervention: ☐ Yes. ☐ No.
- Lapec: ☐ Yes. ☐ No.
- In-hospital mortality: ☐ Yes. ☐ No.
- Time of death:
- Nosocomial infection: ☐Yes. ☐ No.

Appendix (02): List of figures.

Figure 1: thoracic penetrating trauma.

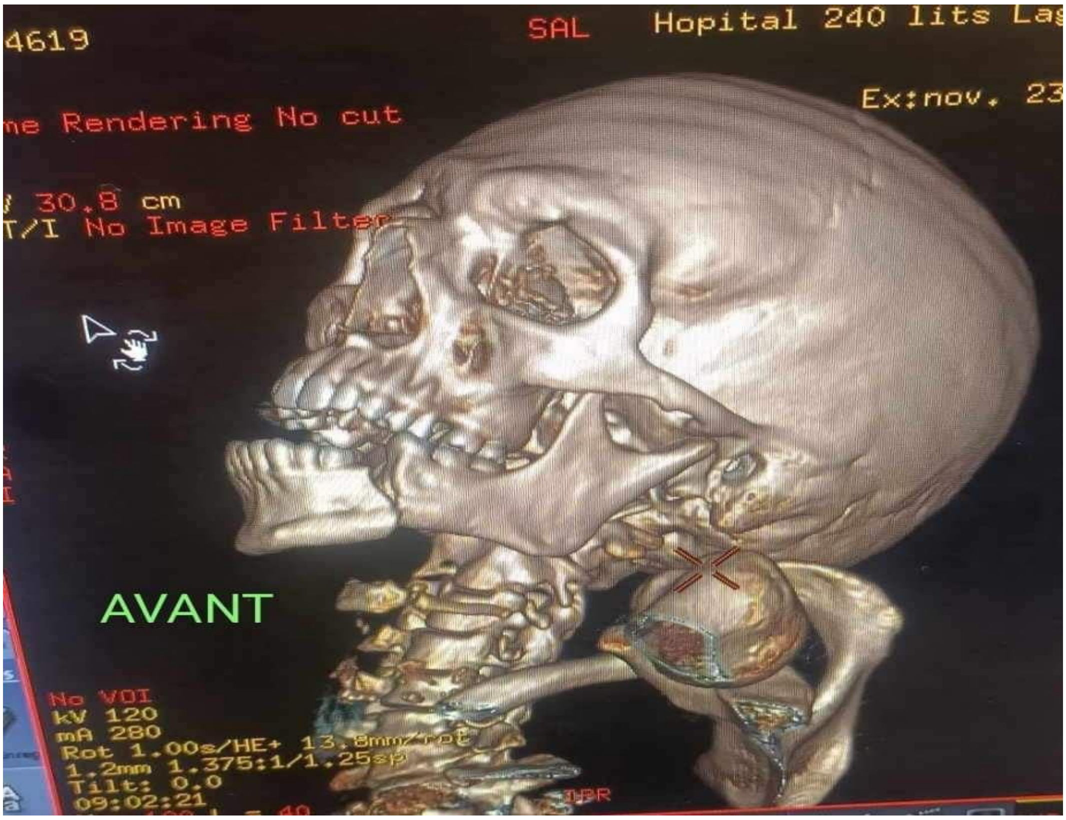

Figure 2: facial trauma due to road traffic accident.

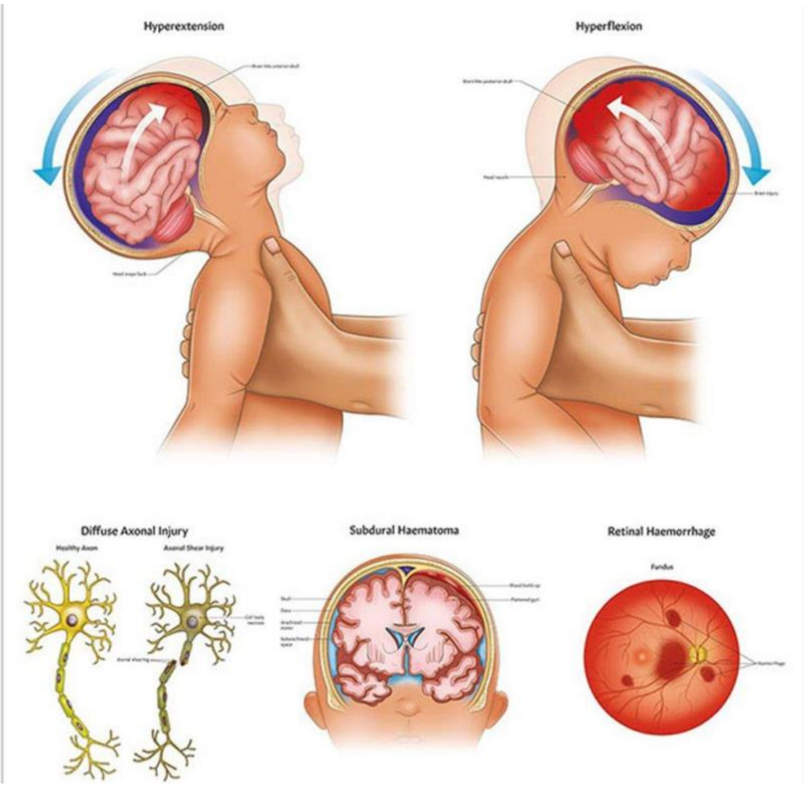

Figure 3: shaken baby syndrome.

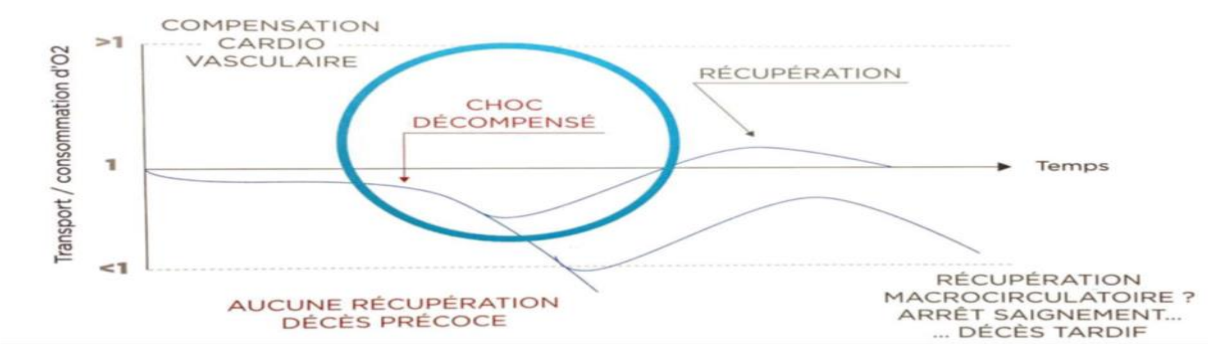

Figure 4: illustrates the pathway of hypovolemic shock development.

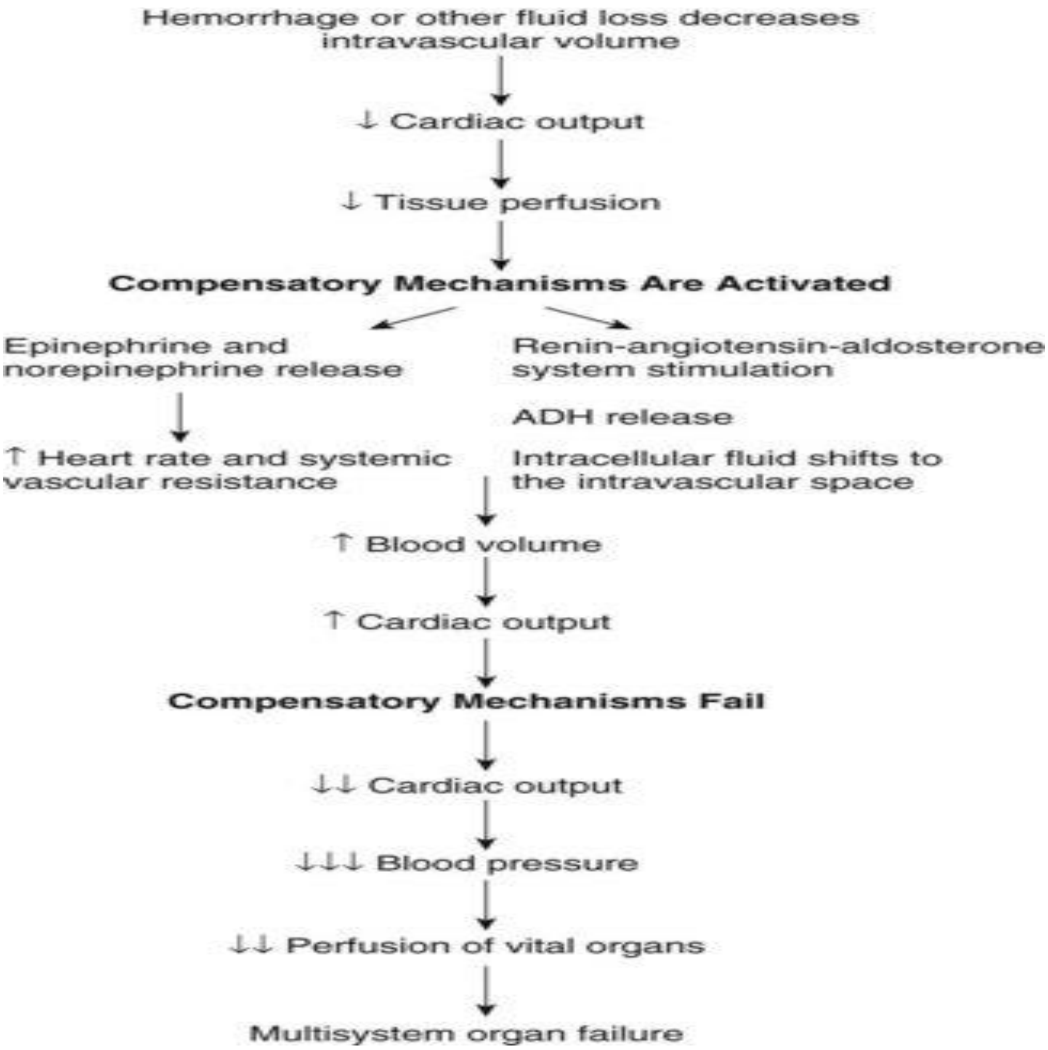

Figure 5: the development of hypovolemic shock.

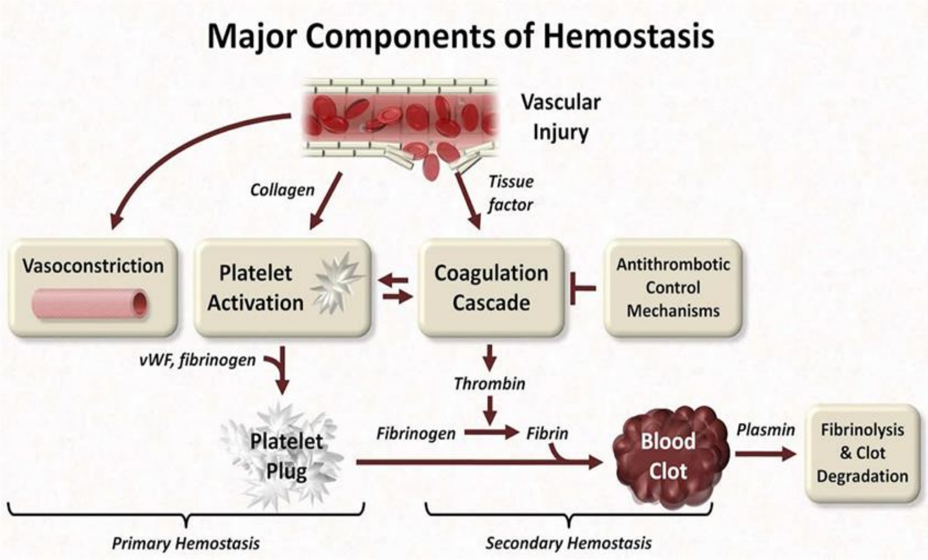

Figure 6: major components of hemostasis.

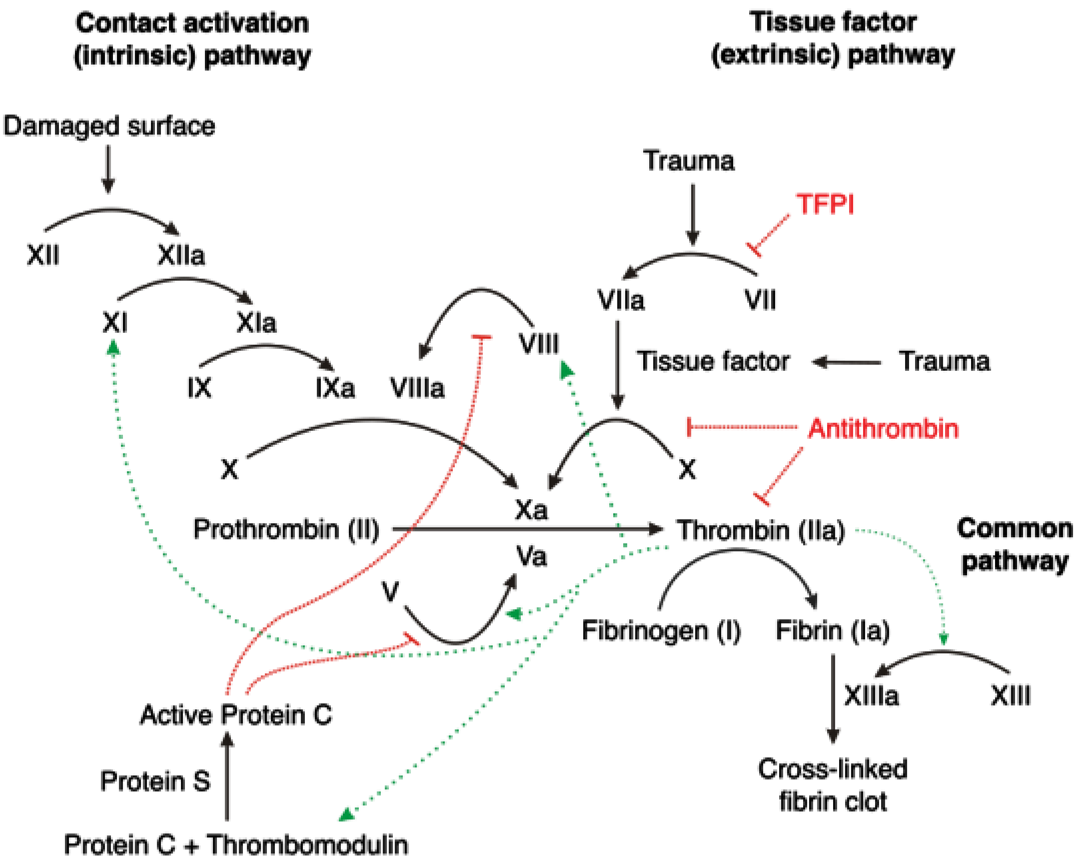

Figure 7: coagulation cascade.

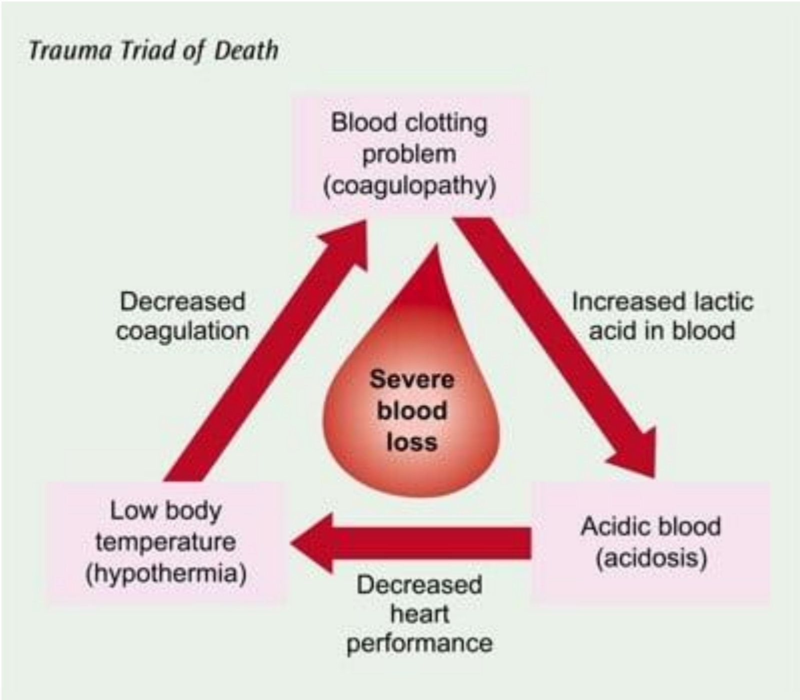

Figure 8: The deadly triad in trauma.

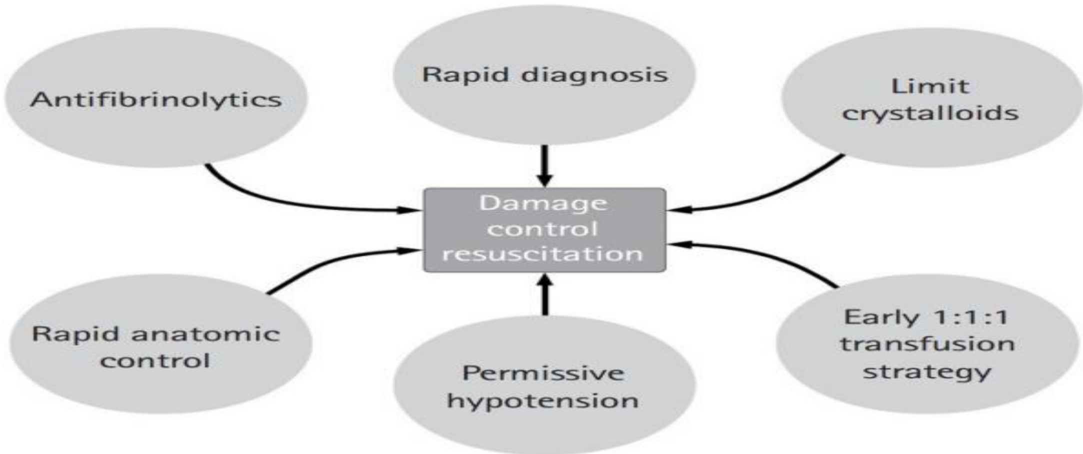

Figure 9:Tenets of damage control resuscitation.

Figure 10: Tourniquet.

Figure 11: Pelvic binder.

Figure 12: application of tourniquet in an open trauma of lower limb.

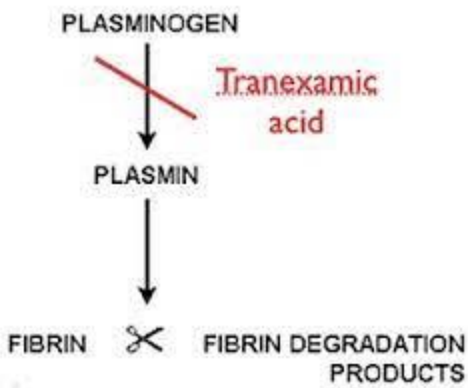

Figure 13: mechanism of action of TXA.

Appendix (03): List of tables.

Table 1: Deaths from Cause-Specific Injuries in 2010.

Table 1. Deaths from Cause-Specific Injuries in 2010.*

Cause of Death	No. of Deaths/ 100,000 Persons	% of All Deaths	% of Injury-Related Deaths	% Involving Males
All causes	52,770	100.0	—	54.8
All injuries	5,073	9.6	100.0	68.2
Unintentional injuries	3,520	6.7	69.4	67.4
Transportation-related injuries	1,397	2.6	27.5	75.1
Falls	541	1.0	10.7	59.0
Drowning	349	0.7	6.9	70.5
Injuries from fires, heat, and hot substances	338	0.6	6.7	47.5
Poisonings	180	0.3	3.5	65.6
Other	715	1.4	14.1	66.9
Intentional injuries	1,340	2.5	26.4	70.7
Self-harm	884	1.7	17.4	65.5
Interpersonal violence	456	0.9	9.0	80.7
Forces of nature, war, and legal intervention†	214	0.4	4.2	65.4
Exposure to forces of nature	196	0.4	3.9	65.3
Collective violence and legal interventions	18	<0.1	0.4	63.9

* Data are from Lozano et al.[3]
† Deaths from legal intervention include, among others, those that result from death penalties imposed by governments.

Table 2: AIS score and their associated injury.

AIS score	Injury severity
0	Uninjured
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Fatal (unsurvivable)

Table 3: AIS body regions.

AIS code	Region
1	Head
2	Face
3	Neck
4	Thorax
5	Abdomen
6	Spine
7	Upper extremity
8	Lower extremity
9	Unspecified

Table 4: ISS body regions.

Number	**Region**
1.	Head & Neck
2.	Face
3.	Thorax
4.	Abdomen
5.	Extremities
6.	External

Table 5: Anatomic profile components.

Categories	AIS regions	AIS severity
A	Head and brain Spinale cord	3-6

B	Thorax Anterior neck	3-6
C	All remaining serious injuries	3-6
D	All none serious injuries	1-2

Table 6: The Glasgow coma scale.

Parameter	Response	Score
Eye opening	None	1
	To pain	2
	To speech	3
	Spontaneously	4
Motor response	None	1
	Extending	2
	Flexing	3
	Withdrawal	4
	Localizing	5
	Obeys command	6
Verbal response	None	1
	Incomprehensible	2
	Inappropriate	3
	Confused	4
	Orientated	5

Table 7: Trauma Score (RTS). The values for the three parameters are summed to give the Triage-RTS. Weighted values are summed for the RTS.

Clinical Parameter	Category	Score	x weight
Respiratory rate (Breaths per minute)	10-29	4	0.2908
	>29	3	
	6-9	2	
	1-5	1	
	0	0	
Systolic blood Pressure	>89	4	0.7326
	76-89	3	
	50-75	2	
	1-49	1	
	0	0	
Glasgow Coma Scale	13-15	4	0.9368
	9-12	3	
	6-8	2	
	4-5	1	
	3	0	

Table 8: description of the main data from the literature on the interest of rSIG in predicting mortality.

Author and reference	Year	Type of study	Number of patients	Results
Kimura and Tanaka. (43)	2018	retrospective, multicenter study	168,517 patients	rSIG is easy to calculate without the need for additional information. A higher rSIG means lower in-hospital mortality
Jung, Ryu and Heo.(45)	2023	Prospective cohort study		Low rSIG was significantly associated with an increase in in-hospital mortality in patients' post-trauma with and without TBI

Wan-ting and al.(46)	2020	retrospective case control study	438 patients	rSIG < 14 is a simple and prompt tool to predict mortality in adult severe trauma patients with head injury
Chen and al.(39)	2023	retrospective cohort analysis	103 935 patients	rSIG consistently showed a superior discriminant power than SI and MSI in short-term mortality
Lammers and al.(47)	2020	Retrospective review	22,218 patients	TRISS and rSIG proved to be most predictive of mortality. However, rSIG may be optimal scoring tool because of its ease of calculation and its increased ability to predict mortality.
Lammers and al.(48)	2021	Retrospective review	2,007 pediatric patients	rSIG more accurately identifies pediatric patients at highest risk of death when compared with SIPA alone
Sc and al.(49)	2018	retrospective cohort study	18,750 patients	rSIG had a significantly higher predictive accuracy of mortality than SI, but a lower predictive accuracy of mortality than RTS in all adult trauma patients and in adult patients with isolated head injury.

Table 9: description of the main data from the literature on the interest of rSIG in predicting massive transfusion.

Author and reference	Year	Type of study	Number of patients	Results
Lee and al.(51)	2021	Retrospective, observational study	1627 patients	rSIG is a useful, rapid, and accurate predictor for MT, coagulopathy, in-hospital mortality, and 24- h mortality in trauma patients.
Uemura and al.(54)	2023	Retrospective validation study	32,201 patients	rSIG is a simple and effective predictor of emergent interventions, especially massive transfusion.
Lammers and al.(47)	2020	Retrospective review	22,218 patients	TRISS and rSIG demonstrated a higher AUROCs than for SI, Reverse SI or RTS in predicting transfusion.
Ml and al.(55)	2022	Retrospective cohort study	604,931 patients	rSIG outperformed SI and SIPA in the early identification of traumatically injured children at risk for early interventions, such as blood transfusion within 4 hours, intubation, intracranial

				pressure monitoring, and intensive care unit admission.

Table 10: general characters of the population:

Parameters	Value	±SD
Age (mean)	**40.3**	**17.5**
Gender		
male n (%)	**63(80.8)**	
female n (%)	**15(19.2)**	
Origin		
From Laghouat n (%)	**53(67.9)**	
Outside of Laghouat n (%)	**25(32.1)**	
Diabetes n (%)		
Yes	**12(15.4)**	
No	**66(84.6)**	
Hypertension n (%)		
Yes	**11(14.1)**	
NO	**67(85.9)**	
Cardiopathy n (%)		
Yes	**3(3.8)**	
No	**65(96.2)**	

Table 11: type and site of injury.

Parameters		Value
Type of injury		
Blunt trauma	**n (%)**	**74(94.9)**
Penetrating trauma	**n (%)**	**27(34.6)**
Site of injury		
Chest trauma	**n (%)**	**61(78.2)**
Abdominal trauma	**n (%)**	**40(51.3)**
Facial trauma	**n (%)**	**38(48.7)**
Upper limb injuries	**n (%)**	**35(44.9)**
Traumatic brain injury	**n (%)**	**34(43.6)**
Lower limb injuries	**n (%)**	**30(38.5)**
Pelvic trauma	**n (%)**	**20(25.6)**
Cervical trauma	**n (%)**	**13(16.7)**
Spinal trauma	**n (%)**	**10(12.8)**
Vascular trauma	**n (%)**	**9(11.5)**

Table 12: Mechanism and circumstances of trauma.

Parameters		Value
Pedestrian accidents	**n (%)**	**8(10.3)**
Car accidents	**n (%)**	**27(34.6)**
Bicycle accidents	**n (%)**	**18(23.1)**
Work accidents	**n (%)**	**10(12.8)**
Home accidents	**n (%)**	**6(7.7)**
Sports accidents	**n (%)**	**2(2.6)**
Voluntary assault and injuries	**n (%)**	**6(7.7)**
Driver seats	**n (%)**	**25(32.1)**
Passengers' seats	**n (%)**	**6(7.7)**
Front bus seats	**n (%)**	**6(7.7)**
Back bus seats	**n (%)**	**2(2.6)**
Security belt	**n (%)**	**15(19.2)**
Helmet	**n (%)**	**5(6.4)**
Sleeping	**n (%)**	**7(9.0)**

Table 13: vital parameters of the population.

Parameters	Value	±SD
SBP (mean)	107.1	26.9
DBP (mean)	67.0	18.5
HR (mean)	97.7	17.4
RR (mean)	26.8	4.4
Spo2 (mean)	94.3	4.9
GCS (mean)	12.1	2.4
HB (mean)	11.2	2.0
rSIG (mean)	14.7	7.4

SBP: systolic blood pression, DBP: diastolic blood pression, HR: heart ratio, RR: respiratory rate, GCS: Glasgow coma scale, HB: hemoglobin, rSIG: reverse shock index multiplied by Glasgow scale

Table 14: Transfusion and the surgical intervention need among the population:

Parameters		Value
Transfused patients	**n (%)**	41(52.6)
Operated patients	**n (%)**	45(57.7)
Re-operated patients	**n (%)**	9(11.5)
Patients had damage control	**n (%)**	19(24.4)

Table 15: comparison between the 02 groups: group 01 (the survivals), group 02 (the dead).

Parameters (n)	Survivals (56)	Dead (22)	P	±SD	CI at 95%
Age (mean)	**39.1**	**43.5**	**0.31***	**4.42**	**[-13.27 , 4.34]**
Gender n (%)					
Male	**43(76.8)**	**20(90.9)**			
Female	**13(23.2)**	**02(09.1)**	**0.21*****		

Diabetes n (%)					
Yes	**06(10.7)**	**06(27.3)**	**0.06****		
No	**50(99.3)**	**16(72.7)**			
Hypertension n (%)					
Yes	**09(16.1)**	**02(09.1)**	**0.71*****		
No	**47(83.9)**	**20(90.9)**			
Cardiopathy n (%)					
Yes	**01(01.8)**	**02(09.1)**	**0.19*****		
No	**55(98.2)**	**20(90.9)**			
DAA (mean)	**47.4**	**38.4**	**0.31***	**8.84**	**[-8.61 , 26.61]**
rSIG (mean)	**17.4**	**7.9**	**<0.00***	**1.53**	**[6.44 , 12.56]**
HB (mean)	**11.7**	**10.0**	**<0.00***	**0.48**	**[0.72 , 2.66]**
Need for transfusion n					
(%)	**23(41.9)**	**18(81.8)**	**0.00*****		
Yes	**33(58.9)**	**04(18.2)**			
No					
TBQ (mean)	**1145.8**	**1333.3**	**0.35***	**198.67**	**[-589 , 214]**
Damage control n					
(%)	**10(17.9)**	**09(40.9)**	**0.03****		
Yes	**46(82.1)**	**13(59.1)**			
No					
Operated patients n					
(%)	**33(58.9)**	**12(54.5)**	**0.72****		
Yes	**23(41.1)**	**10(45.5)**			
No					
Re-operated patients n					
(%)	**07(12.5)**	**02(09.1)**	**1.00*****		
Yes	**49(87.5)**	**20(90.9)**			
No					
Site of injury n (%)					
Traumatic brain injury	**15(26.8)**	**19(86.4)**	**<0.00*****		
Facial trauma	**20(35.7)**	**18(81.8)**	**<0.01*****		
Spinal trauma	**06(10.7)**	**04(18.2)**	**<0.45*****		
Cervical trauma	**04(07.1)**	**09(40.9)**	**<0.00*****		
Chest trauma	**46(82.1)**	**15(68.2)**	**0.17****		
Abdominal trauma	**29(51.8)**	**11(50.0)**	**0.88****		
Pelvic trauma	**11(19.6)**	**09(40.9)**	**0.05****		
Upper limb injuries	**24(42.9)**	**11(50.0)**	**0.56****		
Lower limb injuries	**21(37.5)**	**09(40.9)**	**0.78****		
Vascular trauma	**04(07.1)**	**05(22.7)**	**0.10*****		
Type of injury n (%)					
Blunt trauma					
Penetrating trauma	**53(94.6)**	**21(95.5)**	**1.00*****		
	15(26.8)	**12(54.5)**	**0.02****		

: Student's t-test, **: Pearson's chi-squared test, *: Fisher's exact test, CI: Confidence interval, SD: Standard deviation, n: effective, DAA: Duration between accident and arrival, rSIG: reverse shock index multiplied by Glasgow scale, HB: Hemoglobin, TBQ: transfused blood quantity, P: significant value.*

Table 16: comparison between group A (rSIG<15) and group B (rSIG>15).

Parameters	n	rSIG < 15 (37)	rSIG > 15 (41)	P
Dead in hospital (%)	n	21(51.2)	01(02.7)	<0.00***
Need for transfusion (%)	n	33(80.5)	08(21.6)	<0.00**
Damage control (%)	n	18(43.9)	01(02.7)	<0.00***
Operated patients (%)	n	29(70.7)	16(43.2)	0.01**
Re operated patients (%)	n	08(19.5)	01(02.7)	0.03***

Appendix (04): list of diagrams:

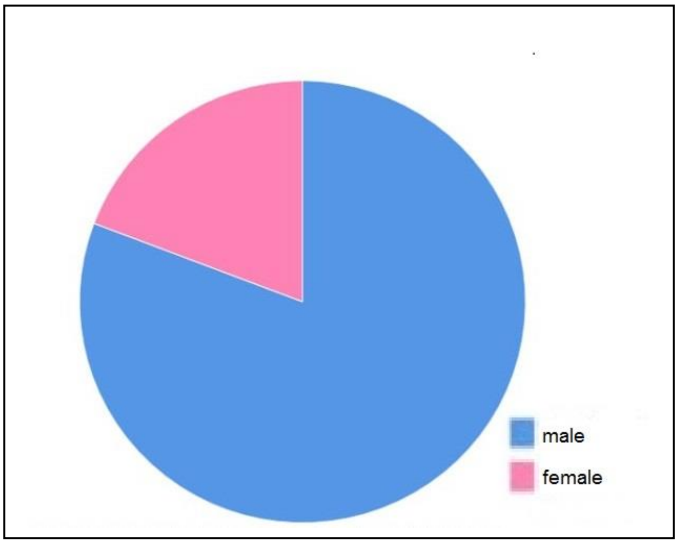

diagram I: diagram of distribution of the population by gender.

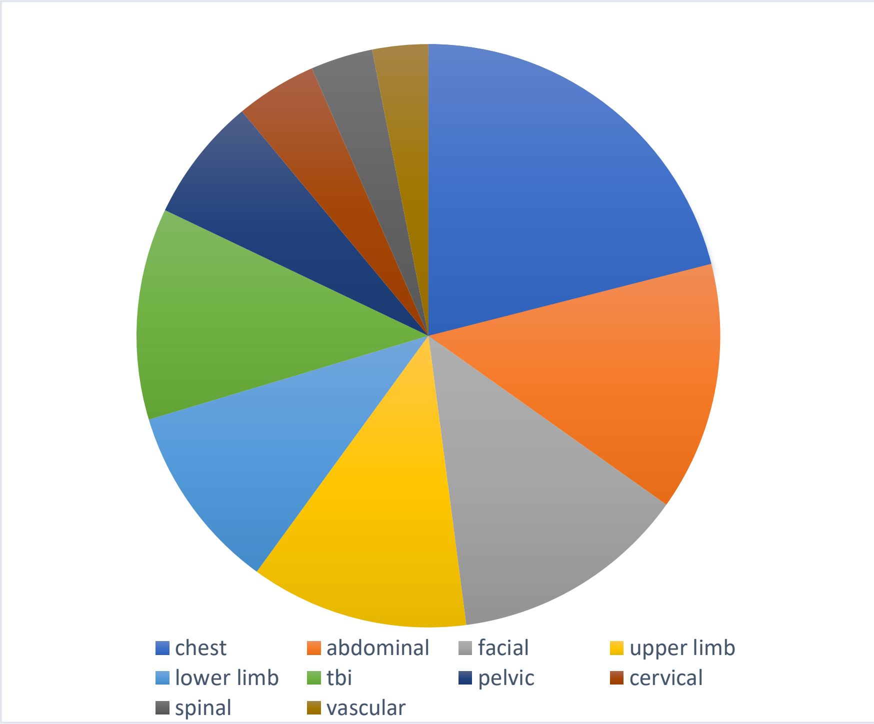

diagram II: diagram of repartition of site of injury.

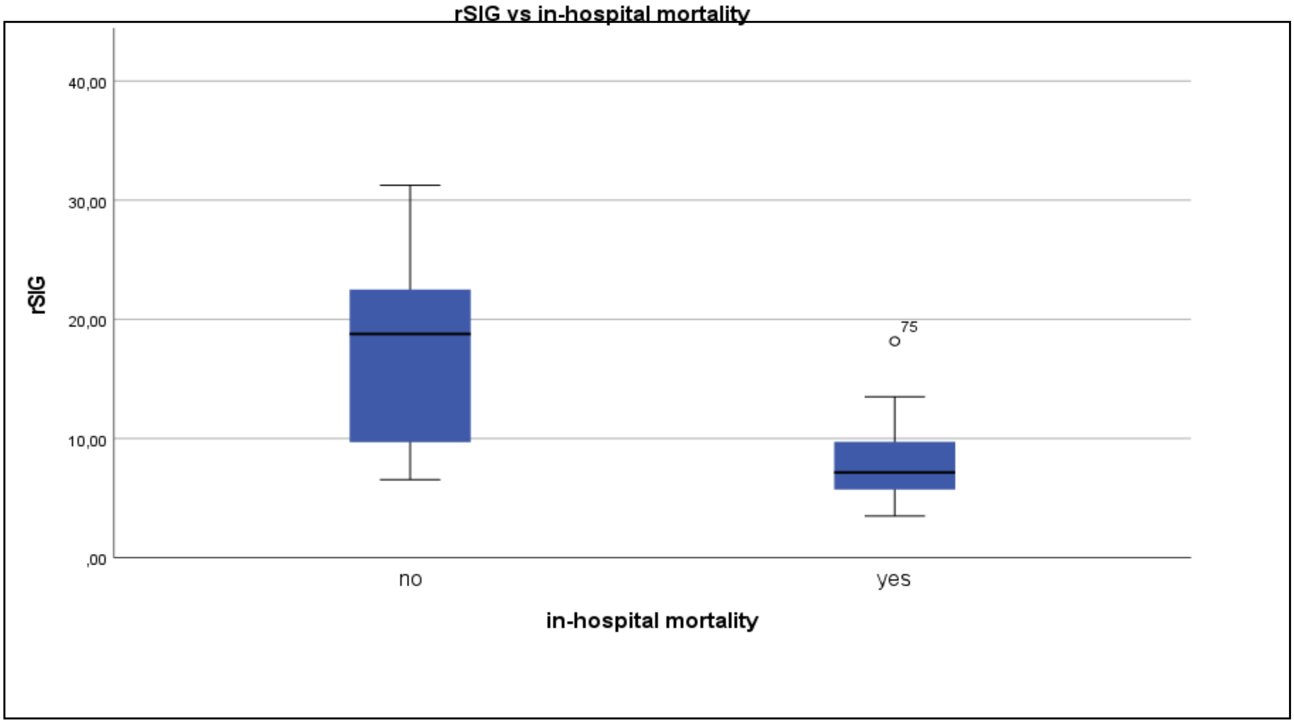

diagram III: boxplot of rSIG vs in-hospital mortality.

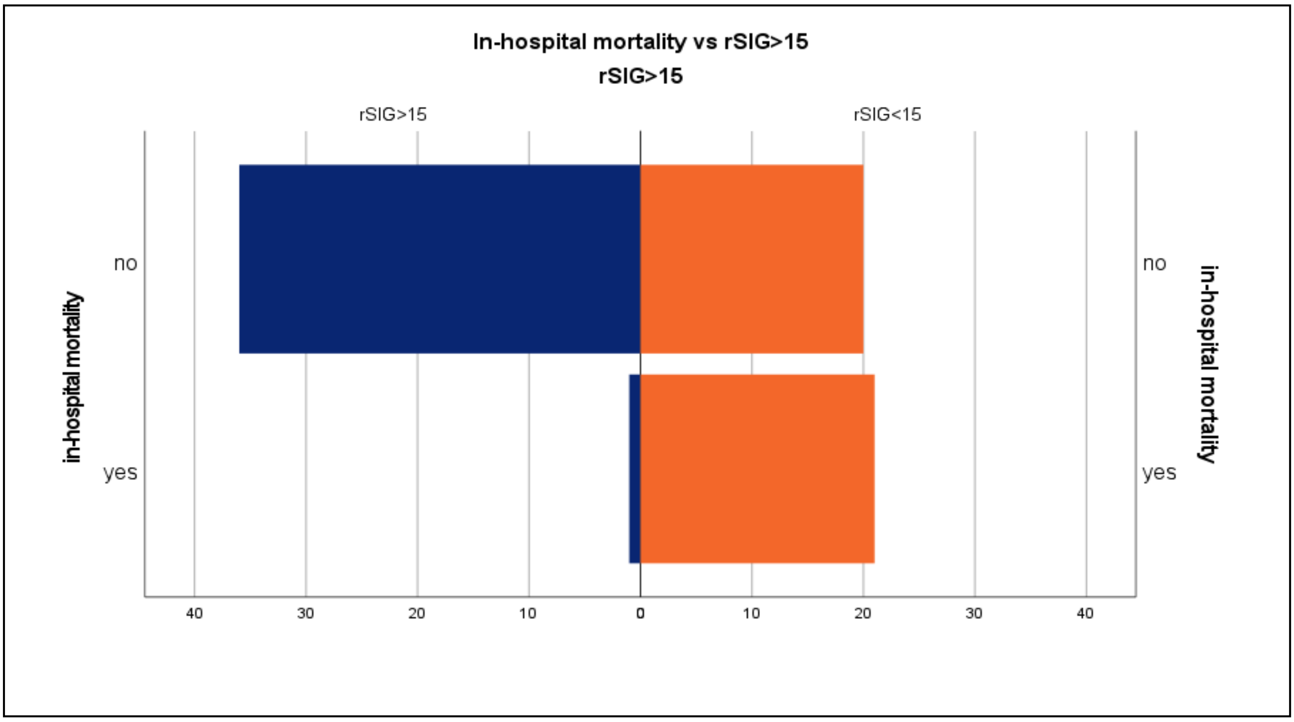

diagram IV: diagram of in-hospital mortality vs rSIG>15.

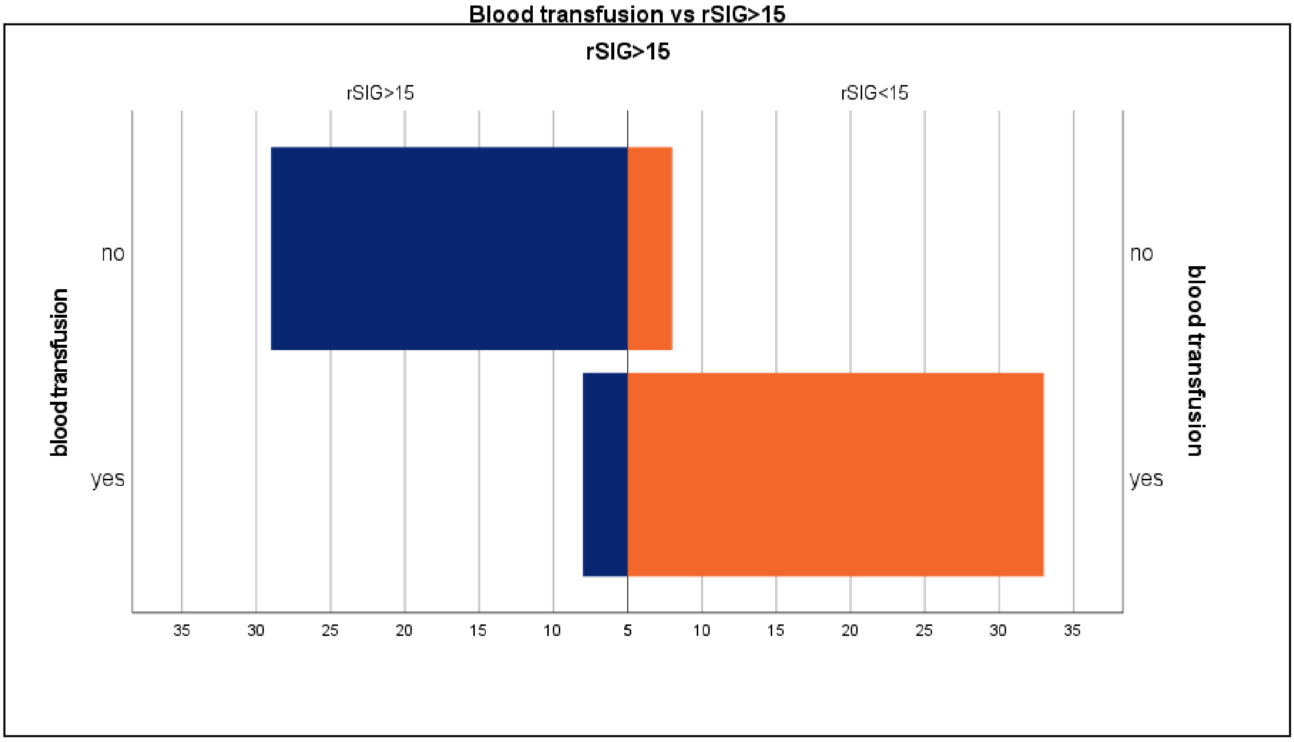

diagram V: diagram of blood transfusion vs rSIG>15.

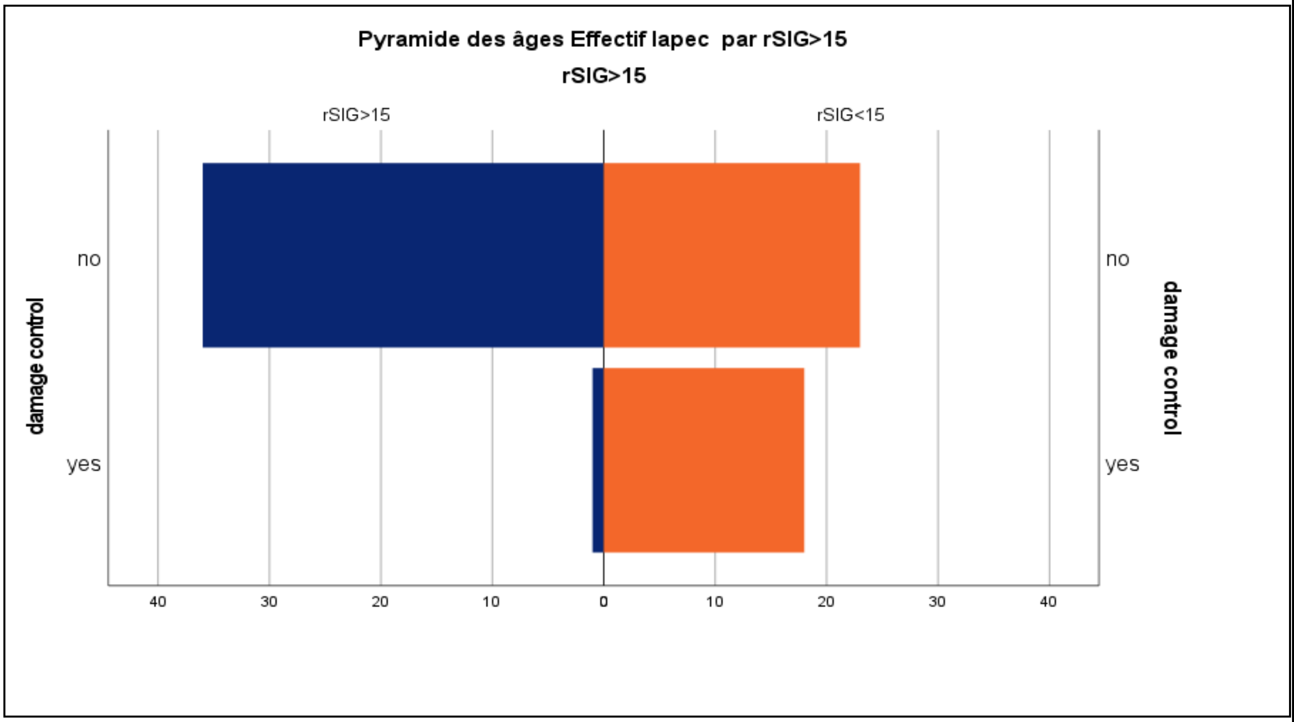

diagram VI: damage control vs rSIG>15.

Abstract:

Background: Trauma is one of the leading causes of death and disability around the world and it is one of the important issues in public health. In the field of emergency medicine, a careful evaluation of trauma severity is essential to steer clinical interventions and enhance patient outcomes. The Reverse Shock Index multiplied by Glasgow Scale (RSIG) holds promise as a potential prognostic tool for trauma patients. However, there is limited research examining its predictive efficacy in real-world clinical settings, particularly within the context of Colonel Lotfi Hospital. This study aims to externally validate the accuracy of the rSIG in the prediction of mortality, need for transfusion and need for surgical procedure

Materials and methods: This is a retrospective, comparative, analytical cohort study, Data were collected from the medical records of hospitalized patients and operative protocols of Colonel Lotfi Mixed Hospital and Hmida Benadjila Hospital in Laghouat for severe trauma between January 2018 and December 2022, where the series focused on patients aged between 18 and 80 years who were hospitalized for severe trauma or polytrauma. The outcomes were circumstances of the trauma, vital signs (SBP, DBP, HR, RR) at ED presentation, GCS and hemoglobin levels at ED presentation, the need of transfusion and the need of surgical intervention, and the in-hospital mortality.

Results:78 patients were admitted to the emergency department for severe trauma, the average age of our study population was close to 40 years old, with a male predominance (80.8%). Blunt trauma was the most frequent type of injury among our population with (94.9%) while chest trauma was the most site of injuries received in the emergency department (78.2%). The main mechanism of trauma was car accidents with a frequency of 34.6%.

In these inferential analyses we compare two groups with many parameters in order to find which parameters have significant effect on the two groups, we found that rSIG, HB, need for transfusion, Damage control, some sites of injury like: traumatic brain injury, facial injury, cervical and pelvic injuries have significant impact on the mortality rate, we also found that the type of injury that has a significant impact on mortality is the penetrating trauma. the average of rSIG score among survivals was around 17.4, and its average among dead was 7.9 with a (P < 0.00*), another inferential analysis comparing group A (rSIG<15) and group B (rSIG>15) with different parameters that tend to have significant results which are Dead in hospital, need for transfusion, damage control, operated patients and re-operated patients. The frequency of in-hospital mortality was significantly higher in group A when compared to group B [51.2% versus 02.7%; P<0.00***]; in addition, around 80.5% from A group needed blood transfusion and only 21.6% from B group with a significant association (P <0.00**). 43.9% from A group had damage control and only 02.7% from B group with a significant association (P <0.00***).

Conclusion: The Reverse shock index multiplied by GCS score is more accurately identifies patients with severe trauma at highest risk of death, massive transfusion and surgical procedure. These findings may help further refine early risk assessments for patient management, we recommend using it in our hospital and others healthcare structures, we also suggest to provide advance diagnostic tools in the hospital structures of Laghouat to prevent errors in the vital parameters.

Résumé :

Introduction : Le traumatisme est l'une des principales causes de décès et d'invalidité dans le monde et constitue l'un des problèmes importants en santé publique et dans le domaine de la médecine d'urgence, une évaluation minutieuse de la gravité des traumatismes est essentielle pour orienter les interventions cliniques et améliorer le pronostic vital des patients.

L'indice de choc inversé multiplié par l'échelle de Glasgow (RSIG) présente un potentiel comme outil pronostique pour les patients traumatisés. Cependant, il existe peu de recherches examinant son efficacité prédictive dans des environnements cliniques réels, en particulier dans le contexte de l'Hôpital Colonel Lotfi. Cette étude permet d'évaluer la valeur prédictive du rSIG dans la prédiction de la mortalité, du besoin de transfusion et du besoin d'intervention chirurgicale.

Matériaux et méthodes : Il s'agit d'une étude de cohorte rétrospective, comparative et analytique. Les données ont été collectées à partir des dossiers médicaux des patients hospitalisés et des protocoles opératoires de l'Hôpital Mixte Colonel Lotfi et de l'Hôpital Hmida Benadjila à Laghouat pour les traumatismes graves entre janvier 2018 et décembre 2022. Les variables étudiées étaient les circonstances du traumatisme, les signes vitaux (PAS, PAD, FC, FR) à la présentation aux urgences, le score de Glasgow et les taux d'hémoglobine à la présentation aux urgences, le besoin de transfusion et le besoin d'intervention chirurgicale, et la mortalité à l'hôpital.

Résultats : 78 patients ont été admis aux urgences pour traumatisme grave, l'âge moyen de notre population d'étude était proche de 40 ans, avec une prédominance masculine (80,8 %). Le traumatisme contondant était le type de traumatisme le plus fréquent parmi notre population (94,9 %), tandis que le traumatisme thoracique était le site de traumatisme le plus fréquent aux urgences (78,2 %). Le principal mécanisme de traumatisme était les accidents de voiture avec une fréquence de 34,6 %.

L'analyse inférentielle comparant deux groupes (survivants et décédés) a révélé que le rSIG, l'Hb, le besoin de transfusion, le contrôle des dommages, certains sites de traumatisme comme les traumatismes crâniens et autres ont un impact significatif sur le taux de mortalité. La moyenne du score rSIG chez les survivants était d'environ 17,4, et sa moyenne chez les décédés était de 7,9 avec un (P < 0,00*), une autre analyse inférentielle comparant le groupe A (rSIG < 15) et le groupe B (rSIG > 15) avec différents paramètres qui tendent à avoir des résultats significatifs, comme les décès à l'hôpital, le besoin de transfusion, le LAPEC les intervention et réintervention chirurgicale. La fréquence de la mortalité à l'hôpital était significativement plus élevée dans le groupe A par rapport au groupe B [51,2 % versus 02,7 % ; P<0,00*] ; de plus, environ 80,5 % du groupe A ont eu besoin de transfusion sanguine et seulement 21,6 % du groupe B avec une association significative (P <0,00). 43,9 % du groupe A ont eu besoin de LAPEC et seulement 02,7 % du groupe B avec une association significative (P <0,00***).

Conclusion : L'indice de choc inversé multiplié par le score de GCS (rSIG) peut être un outil efficace pour la prédiction de la mortalité, du besoin de transfusion et du besoin d'intervention chirurgicale chez les patients traumatisés graves. Ces résultats peuvent aider à affiner davantage les évaluations précoces des risques pour la prise en charge des patients. Nous recommandons de l'utiliser dans notre hôpital et dans d'autres structures de santé, et nous suggérons également de fournir des outils de diagnostic avancés dans les structures hospitalières de Laghouat pour prévenir les erreurs dans les paramètres vitaux.

الملخص :

المقدمة: يعد الصدمة من أبرز الأسباب الرئيسية للوفاة والإعاقة حول العالم، وهو من أحد القضايا المهمة في مجال الصحة العامة. في مجال طب الطوارئ, يعتبر التقييم الدقيق لحدة الإصابة أمر أساسي لتوجيه التدخلات السريرية وتحسين نتائج المرضى. يعتبر مؤشر الصدمة العكسي مضروبًا بمقياس غلاسكوrSIG كأداة تنبؤية محتملة للمرضى المصابين بالصدمات الشديدة. ومع ذلك، هناك أبحاث محدودة تدرس فعالية هذه الأداة في التنبأ بالحاجة الى التدخلات السريرية, لا سيما في سياق مستشفى العقيد لطفي. يهدف هذا البحث إلى التحقق من دقة rSIG في التنبأ بالوفيات, الحاجة الى نقل الدم, والحاجة الى التدخل الجراحي لدى المضي ذوي الإصابات البليغة.

المواد والطرق: هذه دراسة استعادية, مقارنة وتحليلية على مجموعة من المرضى, حيث تم جمع البيانات من السجلات الطبية للمرضى الماكثين في مستشفى العقيد لطفي المختلط ومستشفى حميدة بن عجيلة في الأغواط للصدمات الشديدة بين يناير 2018 وديسمبر 2022، حيث ركزت السلسلة على المرضى الذين تتراوح أعمارهم بين 18 و80 عامًا الذين تم ادخالهم إلى المستشفى بسبب صدمة شديدة أو متعددة. كانت نتائج الدراسة تشمل ظروف الإصابة، وعلامات الحيوية (ضغط الدم الانقباضي، ضغط الدم الانبساطي، معدل ضربات القلب، معدل التنفس) عند الوصول الى قسم الطوارئ، ومقياس غلاسكو ومستويات الهيموغلوبين عند الوصول الى قسم الطوارئ، والحاجة إلى نقل الدم والحاجة إلى التدخل الجراحي، ومعدل الوفيات داخل المستشفى.

النتائج: تم ادخال 78 مريضًا إلى قسم الطوارئ بسبب صدمات شديدة، وكان متوسط عمر سكان الدراسة قريبًا من 40 عامًا، مع سيادة للذكور (80.8%). كانت الإصابة الكليلة هي النوع الأكثر شيوعًا من الإصابات بين مرضانا بنسبة (94.9%) بينما كانت الصدمة في الصدر هي الموقع الأكثر تلقيا للإصابات في قسم الطوارئ (78.2%). وكان السبب الرئيسي للصدمة هو حوادث السيارات بتردد .34.6%

وجد تحليل الاستدلال المقارن بين مجموعتين (الناجون والمتوفون) أن نقاط مؤشر rSIG وقيمة الهيموغلوبين وحاجة لنقل الدم وجراحة الحد من الضرر وبعض مواقع الإصابة مثل إصابة الدماغ والباطنية وغيرها لها تأثير كبير على معدل الوفيات. كان متوسط مؤشر الصدمة العكسي المضروب بمقياس غلاسكو rSIG بين الناجين حوالي 17.4 ومتوسطه بين المتوفين كان 7.9 مع بقيمة (P <0.00) .تحليل استدلالي اخر يقارن المجموعة A (rSIG< 15) والمجموعة B (rSIG> 15) مع اعدادات آخرى تظهر نتائج هامة مثل الوفاة في المستشفى, الحاجة الى نقل الدم, جراحة الحد من الضرر, اجراء العمليات الجراحية واعادة اجراء العمليات الجراحية. كان تردد الوفيات داخل المستشفى أعلى بشكل كبير في المجموعة A (rSIG< 15) مقارنة بالمجموعة B (rSIG> 15) [51.2% مقابل 02.7%;* P<0.00]. بالإضافة إلى ذلك، كان حوالي 80.5% من المجموعةA بحاجة إلى نقل الدم مقابل 21.6% فقط من المجموعة B مع ارتباط هام (P <0.00). 43.9% من المجموعة A خضعوا لجراحة التحكم بالضرر مقابل 02.7% فقط من المجموعة B مع وجود ارتباط هام(***P<0.00).

الاستنتاج: مؤشر الصدمة العكسي مضروبًا بمقياس غلاسكو rSIG يمكن ان يكون أداة دقيقة وفعالة للتنبؤ بالوفيات داخل المستشفى, التنبؤ بالحاجة الى نقل الدم وكذا الحاجة الى العمليات الجراحية للمرضى المصابون بصدمات شديدة. قد تساعد هذه النتائج في تحسين التقييمات المبكرة للمخاطر لعلاج المرضى، نوصي باستخدامه في مستشفانا وهياكل الرعاية الصحية الأخرى، كما نقترح توفير أدوات التشخيص المتقدمة في هياكل المستشفى المجموعة في الأغواط لتجنب الأخطاء في المعايير الحيوية.