



# **DAMAGE CONTROL MANAGEMENT OF COMBINED SPINAL AND ABDOMINAL INJURIES DUE TO HIGH VELOCITY ROAD TRAFFIC ACCIDENTS**

**ESSAY**

*Submitted for fulfillment of the Master Degree in  
General Surgery*

**By**

***Alaa Samir Abdelwakil Mohamed Montaser***

***M.B., B.Ch.***

***Faculty of Medicine – Ain Shams University***

***Under Supervision of***

**Prof. Dr. Alaa Abdallah Farrag**

***Professor of General Surgery***

***Faculty of Medicine - Ain Shams University***

**Ass. Prof. Dr. Hamdy Ibrahim Khalil**

***Assistant Professor of Neurourgery***

***Faculty of Medicine - Ain Shams University***

**Dr. Mohamed Magdy Abdel-Aziz**

***Lecturer of General Surgery***

***Faculty of Medicine - Ain Shams University***

***Faculty of Medicine***

***Ain Shams University***

***2011***

# Acknowledgment

*First of all, I would like to raise my deepest thanks to Allah, the most kind and the most merciful, for helping me to accomplish this work.*

*I would like to express my deepest thanks and supreme gratitude to Prof. Dr. Alaa Abdallah Farrag, Professor of General Surgery Faculty of Medicine, Ain Shams University for his close supervision, valuable instructions, generous flow of support and constructive remarks throughout the preparation of this essay.*

*I am deeply grateful to Prof. Dr. Hamdy Ibrahim Khalil, Assistant Professor of neurosurgery Ain Shams University, for his kind assistance, helpful advice and great supports during the progress of this work.*

*I am deeply grateful to Dr. Mohamed Magdy Abdel-aziz, Lecturer of General Surgery Ain Shams University, for his kind assistance, helpful advice and great supports during the progress of this work.*

***Alaa Samir Abdelwakil Mohamed Montaser***



# التحكم بالضرر في إدارة مجموع الإصابات الشوكية وإصابات البطن الناتجة عن حوادث المرور عالية السرعة

رسالة

توطئة للحصول على درجة الماجستير في  
الجراحة العامة

مقدمة من

**الطبيب/ علاء سمير عبدالوكيل محمد منتصر**

بكالوريوس الطب والجراحة  
كلية الطب - جامعة عين شمس

تحت إشراف

**الأستاذ الدكتور/ علاء عبدالله فرج**

أستاذ الجراحة العامة  
كلية الطب - جامعة عين شمس

**الأستاذ الدكتور/ حمدي إبراهيم خليل**

أستاذ مساعد جراحة المخ والأعصاب  
كلية الطب - جامعة عين شمس

**الدكتور/ محمد مجدي عبدالعزيز**

مدرس الجراحة العامة  
كلية الطب - جامعة عين شمس

كلية الطب  
جامعة عين شمس

٢٠١١

## **SUMMARY**

Trauma, specially high velocity road traffic accidents, is one of the most common causes of death worldwide.

The combination of abdominal trauma and spinal trauma is most frequently caused by car accidents with restrained passengers. Association of Chance fractures and abdominal trauma in the presence of an abdominal wall contusion is well documented.

Liver & spleen are the most common injured intra-abdominal organs in blunt abdominal trauma. Hollow viscus injury is most commonly resulting from penetrating abdominal trauma. It is relatively infrequent in blunt abdominal trauma .

Mortality occurring early after injury is due to "first hits", including severe organ injury, hypoxia, hypovolaemia or head trauma. Massive injury leads to activation of the immune system and the early inflammatory immune response after trauma has been defined as systemic inflammatory response syndrome (SIRS). "Second hits" such as infections, ischaemia/reperfusion or operations can further augment the pro-inflammatory immune response and have been correlated with the high morbidity and mortality in the latter times after trauma.

The initial evaluation of a person who is injured critically from multiple traumas follows a protocol of primary survey, resuscitation, secondary survey, and either definitive treatment or transfer to an appropriate trauma center for definitive care. This approach is the heart of the ATLS system, which is designed to identify life-threatening injuries and to initiate stabilizing treatment in a rapidly efficient manner.

Diagnosis of thoracolumbar injury includes brief history, physical examination and neurologic evaluation then radiological

assessment by plain X-ray, CT and MRI which provide data for classification and prognosis.

Classification systems have evolved considerably during the last 75 years and this helps neurosurgeons for decision making.

The thoracolumbar injury severity score (TLISS) system (2006) is a novel classification scheme for describing and treating thoracolumbar injuries. It allows the simple classification of an injury by describing the mechanism of the injury, integrity of the PLC, and neurologic status. A point system is then assigned in a logical manner to these categories to arrive at a final score, which assists in injury treatment and decision making.

Combination of abdominal trauma and spinal trauma is a complex injury pattern, in which damage control management is effective. Intra- abdominal injuries are operated prior to vertebral injuries, and control of bleeding, and decontamination have the highest priority.

The optimal timing for surgical intervention has not been conclusively demonstrated. However, there is likely some neurological benefit to early decompression for patients with incomplete injuries or for those with neurological deterioration. It also assists in mobilizing patients, thereby preventing medical complications.

The evolution of the abbreviated laparotomy or “Damage Control” for trauma has improved patient survival by decreasing the operative stress on patients in physiologic exhaustion. This technique requires rapid control of bleeding and contamination, temporary abdominal closure, and then intensive care resuscitation of physiology with return to the operating room for eventual definitive operative repair. This sequence should be utilized in patients with coagulopathy, acidosis, and hypothermia.

---

# CONTENTS

	Page
LIST OF ABBREVIATIONS.....	
LIST OF TABLES .....	
LIST OF FIGURES .....	
INTRODUCTION & AIM OF THE WORK .....	
REVIEW OF LITERATURE .....	
Pathophysiology of road traffic accidents related trauma.....	
Evaluation and resuscitation of polytraumatised patient .....	
Diagnosis of spinal and abdominal injuries.....	
Damage control management of combined spinal and abdominal injuries .....	
SUMMARY.....	
REFERENCES .....	
ARABIC SUMMARY.....	-

---

## LIST OF ABBREVIATIONS

<b>AAST</b>	American Association for the Surgery of Trauma
<b>ACS</b>	Abdominal Compartment Syndrome
<b>ACTH</b>	Adrenocorticotrophic Hormone
<b>ADP</b>	Adenosine Diphosphate
<b>AIS</b>	Abbreviated Injury Score
<b>ALL</b>	Anterior Longitudinal Ligament
<b>AMP</b>	Adenosine Monophosphate
<b>AO/ASIF</b>	Arbeitsgemeinschaft für Osteosynthesefragen/Association for the Study of Internal Fixation
<b>AP</b>	Anatomic Profile
<b>APACHE</b>	Acute Physiology and Chronic Health Evaluation
<b>APP</b>	Acute Phase Proteins
<b>APS</b>	Acute Physiology Score
<b>ARDS</b>	Adult Respiratory Distress Syndrome
<b>ATIII</b>	Antithrombin III
<b>ATLS</b>	Advanced Trauma Life Support
<b>ATP</b>	Adenosine Triphosphate
<b>BAT</b>	Blunt abdominal trauma
<b>CARS</b>	Compensatory Anti-inflammatory Response Syndrome
<b>CL</b>	Capsular Ligament
<b>CPR</b>	Cardiopulmonary Resuscitation
<b>CRH</b>	Corticotropin-Releasing Hormone
<b>CRP</b>	C-Reactive Proteins
<b>CT</b>	Computed Tomography
<b>DCS</b>	Damage Control Surgery
<b>DPL</b>	Diagnostic Peritoneal Lavage
<b>EAF</b>	Entero-Atmospheric Fistula
<b>ECG</b>	Electrocardiogram
<b>ERCP</b>	Endoscopic Retrograde Cholangiography
<b>FAST</b>	Focused Abdominal Sonogram of Trauma
<b>FIG.</b>	Figure
<b>GCS</b>	Glasgow Coma Scale
<b>GIT</b>	Gastrointestinal Tract
<b>IAR</b>	Instantaneous Axis of Rotation
<b>ICD-9</b>	International Classification of Disease, Ninth Edition
<b>ICISS</b>	ICD-based Injury Severity Score
<b>ICU</b>	Intensive Care Unit
<b>IL</b>	Interleukin

---

---

<b>ISL</b>	Interspinous Ligament
<b>ISS</b>	Injury Severity Score
<b>IVU</b>	Intravenous Urography
<b>LF</b>	Ligamentum Flavum
<b>LTB4</b>	Leucotriene B4
<b>MARS</b>	Mixed Antagonistic Response Syndrome
<b>MODS</b>	Multiple Organ Dysfunction Syndrome
<b>MOF</b>	Multiple Organ Failure
<b>MRCP</b>	Magnetic Resonance Cholangiopancreatography
<b>MRI</b>	Magnetic Resonance Imaging
<b>NISS</b>	New Injury Severity Score
<b>NO</b>	Nitric Oxide
<b>PAF</b>	Platelet Activating Factor
<b>PATI</b>	Penetrating Abdominal Trauma Index
<b>PGE2</b>	Prostaglandine E2
<b>PLA2</b>	Phospholipase A2
<b>PLC</b>	Phospholipase C
<b>PLC</b>	Posterior Ligamentous Complex
<b>PLL</b>	Posterior Longitudinal Ligament
<b>PMNL</b>	Polymorphonuclear Leucocyte
<b>RBC</b>	Red Blood Cells
<b>RNS</b>	Reactive Nitrogen Species
<b>ROS</b>	Reactive Oxygen Species
<b>RTS</b>	Revised Trauma Score
<b>SCIWORA</b>	Spinal Cord Injury Without Radiological Abnormality
<b>SIRS</b>	Systemic Inflammatory Response Syndrome
<b>SMA</b>	Superior Mesenteric Artery
<b>SOFA</b>	Sequential Organ Failure Assessment
<b>SRRs</b>	Survival Risk Ratios
<b>TLICS</b>	Thoracolumbar Injury Classification and Severity Score
<b>TLISS</b>	Thoracolumbar Injury Severity Score
<b>TNF</b>	Tumor Necrosis Factor
<b>t-PA</b>	Tissue-Plasminogen Activator
<b>TRISS</b>	Trauma and Injury Severity Score
<b>TXA2</b>	Thromboxane A2
<b>u-PA</b>	Urokinase-like Plasminogen Activator
<b>WBC</b>	White Blood Cells
<b>WHO</b>	World Health Organisation

---



---

## LIST OF TABLES

---

Table No.	Title	Page
1	Clinical parameters systemic inflammatory response syndrome (SIRS) .....	32
2	The triage sort .....	51
3	Abbreviated Injury score .....	52
4	ISS Calculation .....	53
5	Glasgow coma scale in adults .....	58
6	GCS in children .....	58
7	Revised trauma score .....	59
8	Representative APACHE II Calculation for Hypothetical Patient .....	61
9	AO classification system .....	89
10	The thoracolumbar injury severity score (TLISS) .....	91
11	The thoracolumbar injury classification and severity score (TLICS) .....	93
12	Key muscle group used in Asia motor source evaluation of spinal cord injury .....	97
13	Muscle grading chart .....	98
14	American Association for the Surgery of Trauma (AAST) organ injury scale, spleen .....	143

---

## LIST OF FIGURES

---

Fig. No.	Title	Page
1	Vertebral column .....	14
2	Anatomy of typical vertebra .....	14
3	Uncinate process .....	18
4	Vertebral body shape .....	19
5	Diagrammatic axial section of the spinal cord .....	21
6	Transverse pedicle width and angle versus spinal level .....	22
7	Eccentrically borne load on intervertebral disc .....	23
8	Ligaments and their effective moment arms .....	25
9	Ischemia/reperfusion injury .....	40
10	Survival probability by Revised Trauma Score .....	60
11	Seat belt mark in combined spinal trauma and abdominal trauma.....	74
12	Intra-abdominal free air .....	74
13	The components of the three columns of the thoracolumbar spine.....	77
14	Subtypes of burst fracture.....	81
15	Seat-belt injury.....	83
16	Chance Fracture .....	83
17	Flexion- rotation injury.....	85
18	AO classification system .....	88
19	Subtypes of Type A: compression injuries.....	88
20	Algorithm for AO fracture type classification.....	90
21	Dermatome distributions .....	98
22	Examination of perianal skin for sensation in cervical cord injury.....	99
23	Bulbocavernosus reflex .....	99
24	Anal wink.....	99

---

---

<b>25</b>	<b>Radiographic fracture assessment.....</b>	<b>102</b>
<b>26</b>	<b>CT scan of Chance burst fracture .....</b>	<b>107</b>
<b>27</b>	<b>CT scan with "double margin" sign at T8-9 .....</b>	<b>107</b>
<b>28</b>	<b>Helical CT of lumbar spine burst fracture .....</b>	<b>108</b>
<b>29</b>	<b>MRI assessment of thoracolumbar fracture .....</b>	<b>110</b>
<b>30</b>	<b>Helical CT of liver and right kidney injury .....</b>	<b>118</b>
<b>31</b>	<b>Helical CT of splenic fracture and left renal trauma .....</b>	<b>118</b>
<b>32</b>	<b>Helical CT of mesenteric injury and Chance fracture .....</b>	<b>119</b>
<b>33</b>	<b>Incisions used in damage control surgery.....</b>	<b>136</b>
<b>34</b>	<b>The Pringle maneuver.....</b>	<b>139</b>
<b>35</b>	<b>Traumatic small bowel rupture .....</b>	<b>146</b>
<b>36</b>	<b>The zones of the retroperitoneum .....</b>	<b>149</b>

## INTRODUCTION

Every day around the world, almost 16,000 people die from all types of injuries. Injuries represent 12% of the global burden of disease, the third most important cause of overall mortality and the main cause of death among 1–40-year-olds traffic injuries account for around 25% of all deaths from injury. The category of injuries worldwide is dominated by those incurred in road crashes. According to WHO data, deaths from road **(Peden et al., 2004)**

Mortality occurring early after injury is due to "first hits", including severe organ injury, hypoxia, hypovolaemia or head trauma. Massive injury leads to activation of the immune system and the early inflammatory immune response after trauma has been defined as systemic inflammatory response syndrome (SIRS).

"Second hits" such as infections, ischaemia/reperfusion or operations can further augment the pro-inflammatory immune response and have been correlated with the high morbidity and mortality in the latter times after trauma. The purpose of this review is therefore to describe the immunological events after trauma and to introduce important mediators and pathways of the inflammatory immune response. **(Lenz A et al., 2007)**

The initial evaluation of a person who is injured critically from multiple traumas follows a protocol of primary survey, resuscitation, secondary survey, and either definitive treatment or transfer to an appropriate trauma center for definitive care. This approach is the heart of the ATLS system, which is designed to

identify life-threatening injuries and to initiate stabilizing treatment in a rapidly efficient manner. Absolute diagnostic certainty is not required to treat critical clinical conditions identified early in the process. **(Parks SN, 2004)**

The combination of abdominal trauma and spinal trauma is most frequently caused by car accidents with restrained passengers. Association of Chance fractures and abdominal trauma in the presence of an abdominal wall contusion is well documented. Thus, abdominal trauma is diagnosed in 50% of seat belt fastened patients with a Chance fracture. The combined abdominal trauma and spinal trauma is therefore a key example of high energy flexion-distraction injury and multiple trauma management.

Combination of abdominal trauma and spinal trauma is a complex injury pattern, in which damage control management is effective. Intra-abdominal injuries are operated prior to vertebral injuries, and control of bleeding, and decontamination have the highest priority. Anterior stabilization of cervical spine injuries and posterior stabilization of thoracolumbar injuries have proven effective. Operative reconstructions are performed in postponed procedures. **(Woltmann et al., 2007)**

The evolution of the abbreviated laparotomy or “Damage Control” for trauma has improved patient survival by decreasing the operative stress on patients in physiologic exhaustion. This technique requires rapid control of bleeding and contamination, temporary abdominal closure, and then intensive care resuscitation of physiology with return to the operating room for eventual

definitive operative repair. This sequence should be utilized in patients with coagulopathy, acidosis, and hypothermia. while mortality in a subset of critically ill trauma patients has decreased with this modality, these patients have a very high incidence of morbidity and frequently require prolonged hospitalization and multiple operative procedures. The success of Damage Control in management of abdominal pathology has led to the expansion of the concept into orthopedic and vascular trauma, and into general surgical care. **(Pape et al., 2010)**

## **AIM OF THE WORK**

The aim of this work is to review and clarify the impact of high velocity road traffic accidents and damage control management of combined Spinal and Abdominal injuries.