Orthopaedic Trauma:

A Systematic Approach
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edited by

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This book is intended to cover the basics of the management of common orthopaedic and musculoskeletal injuries for medical students, junior doctors and paramedical staff. The book has been kept at a basic and practical level in order to aid those involved in the initial assessment and management of these patients, to enable them to make the fundamental and critical decisions necessary in a primary and secondary setting and to perform the interventions that are required with appropriate guidance.

This book cannot be comprehensive and exhaustive in terms of orthopaedic trauma nor is it designed to be a bible of accident and emergency surgery. It is a concise summary of basic orthopaedic facts, of common presentations and of injuries and procedures that need to be in the armamentarium of the junior doctor.

The impetus for this book has been the change in medical training with the arrival of modernising medical careers and the foundation curriculum. The editors felt that it was important to outline a series of orthopaedic/musculoskeletal/trauma competencies in a simple, easily digested way for medical students, junior doctors and paramedics.

This project is specifically aimed at juniors. To that end each chapter has been written by a junior doctor who has recently been exposed to the stresses, traumas and difficulties that medical students and junior doctors face but in each case the chapter has been supervised by a more senior colleague with expertise in the subject. Many of the chapters have been modified from a series that was first published in the British Journal of Hospital Medicine and the book will of course not have been possible without the foresight of Rebecca Linssen and her colleagues who saw the potential for these topics to be included in both the foundation supplement of Hospital Medicine and also amalgamated into this tome. At a practical level, Helena Raeside and Maria Anguita have provided invaluable assistance.

In every project there are a number of significant contributors. I personally owe a massive debt to Sam Oussedik and Rahul Patel. They were involved right at the outset with the development of this idea. They have undertaken primary editing for most of the chapters and have been tireless workers and good friends throughout the process. There are times when they have undoubtedly become tired of my nagging emails yet they have never failed to deliver excellent quality material on time and with good humour.

This book is designed to introduce the reader to basic trauma management and to whet the appetite for further study. It is hoped that it will help you and your patients.

Fares Haddad
Introduction

Trauma is a leading cause of morbidity and mortality in the developed world. Once an individual has been injured, it falls to the medical professionals to firstly preserve life and secondly, and perhaps just as importantly, preserve function. Often a patient’s first contact with a medical professional following an injury will be in the accident and emergency department. It is at this juncture that rapid and accurate assessment and initiation of appropriate treatment will ensure an optimal outcome is achieved.

The following chapters have been written with health care professionals in mind. They seek to provide the basic scientific and clinical information necessary to the clinician in providing excellent trauma care. The chapters have been drawn up along anatomical lines and the structure is such that having studied each chapter readers should be able to:

- Understand the significance of injuries to the region.
- Know the clinically relevant anatomy of the region.
- Recognise the common mechanisms of injury.
- Understand how patients commonly present.
- Be able to assess injuries.
- Understand the classification of injuries.
- Recognise which patients require referral to a trauma surgeon.
- Know what can be done in the accident and emergency department to treat each injury.
- Have an insight into how the trauma surgeon might treat the injury.

In this way it is hoped that readers, particularly those encountering trauma cases for the first time, will feel better equipped to accurately assess injured patients and provide initial treatment. Readers should also feel more confident in discussing cases with their senior colleagues and trauma surgeons, improving the referral process.

Each of the chapters could have been written with the same introductory paragraph outlining the initial assessment and treatment of the injured patient. For the sake of brevity this has not been included. It should be stressed that initial treatment steps in all cases should follow the guidelines provided by the Advanced Trauma and Life Support framework. Thus regional trauma is only assessed once the patient has been adequately resuscitated and stabilised.

The first section outlines the principles of trauma care, dealing with adult and paediatric trauma, and discussing the approach to open fractures. These
chapters are meant as a brief introduction to the topics and should also point the reader towards other sources of information.

The second section deals with regional trauma. This should provide enough information to allow the reader to feel well informed on each injury. It is not meant as an exhaustive discussion of trauma surgery, and so examples of definitive care are provided to inform the uninitiated rather than guide the expert.

The third section gives guidance in carrying out those practical procedures which are commonly encountered in the accident and emergency department. These should provide a starting point and framework for gaining practical experience. Such procedures are best taught in the clinical setting by senior colleagues, but it is hoped that gaining a little knowledge prior to this should speed the learning process and perhaps make it less painful for patient and clinician alike.

Finally, this book is meant as a reference guide, to be dipped into when required rather than read in one sitting. It is hoped that it will become a valuable resource for all emergency clinicians and perhaps ease the transition from medical student to specialist trainee.

Sam Oussedik
Section One:

Systematic approach to trauma
Introduction

Polytraumatised patients represent a significant challenge to the emergency department team. Preserving life and function in such patients can be daunting to the uninitiated. The application of a systematic approach to both assessment and treatment provides the clinician with a framework within which to operate, allowing injuries to be diagnosed and treated with optimal efficiency. The guidelines set out by the Advanced Trauma and Life Support (ATLS) programme of the American College of Surgeons (1997) provide such a framework, and completion of an ATLS course is strongly recommended to all healthcare professionals encountering trauma patients on a regular basis.

The trauma team

The majority of emergency departments will have access to a designated trauma team. The make-up of this team may vary from hospital to hospital, but usually includes, in addition to the emergency department clinician:

- Anaesthetist – assesses airway and ventilation and provides support when necessary.
- General surgeon – assesses the abdomen for signs of haemorrhage, hollow viscous or solid organ damage; may also assess urinary tract injuries.
- Trauma surgeon – assesses pelvic and long bone injuries; may also carry out secondary survey.
- Nursing staff – support; intravenous fluids.
- Support staff – radiographer, laboratory staff.

The trauma team may be led by any of the above staff, this task usually falling to the clinician most experienced in trauma care. The actual make up of the team is less important than the adherence to the principles of trauma care.

Initial patient assessment

Traumatised patients present to the emergency department in a number of
Table 1.1. The Revised Trauma Score

<table>
<thead>
<tr>
<th>Variables</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Respiratory rate (Breaths/min)</td>
<td></td>
</tr>
<tr>
<td>10–29</td>
<td>4</td>
</tr>
<tr>
<td>&gt;29</td>
<td>3</td>
</tr>
<tr>
<td>6–9</td>
<td>2</td>
</tr>
<tr>
<td>1–5</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B: Systolic blood pressure (mmHg)</td>
<td></td>
</tr>
<tr>
<td>&gt;89</td>
<td>4</td>
</tr>
<tr>
<td>76–89</td>
<td>3</td>
</tr>
<tr>
<td>50–75</td>
<td>2</td>
</tr>
<tr>
<td>1–49</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C: Glasgow Coma Scale</td>
<td></td>
</tr>
<tr>
<td>13–15</td>
<td>4</td>
</tr>
<tr>
<td>9–12</td>
<td>3</td>
</tr>
<tr>
<td>6–8</td>
<td>2</td>
</tr>
<tr>
<td>4–5</td>
<td>1</td>
</tr>
<tr>
<td>&lt;4</td>
<td>0</td>
</tr>
</tbody>
</table>

Revised Trauma Score = A + B + C (Champion et al, 1989).

While the Revised Trauma Score has been shown to be a poor predictor of outcome, it does act as a useful triage tool to ensure variables are measured.

different ways. Whether brought in by ambulance or self-presenting, a rapid and reliable way of triaging patients is necessary. This is usually carried out by the first healthcare provider to encounter the patient, be this the ambulance crew or the specially trained emergency department nursing staff, who will assess:

- Vital signs – blood pressure, heart rate, respiratory rate, conscious level (Revised Trauma Score – Table 1.1).
- Injury pattern – head injury, chest injury, abdominal injury, long bone fracture.
- Injury energy – high speed road traffic accident, fall from a height, fall from standing.
- Patient reserve – elderly, pregnant, pre-existing cardiac/respiratory/renal disease, diabetes.

A rapid assessment of which patients might require urgent care can therefore be made.
The primary survey

The next phase of trauma care is the primary survey. This follows a defined sequence:

A: Airway maintenance and cervical spine control
B: Breathing and ventilation
C: Circulation and haemorrhage control
D: Disability
E: Exposure and environmental control

The underlying principle to this assessment is that life-threatening conditions are diagnosed and treated as they are encountered. In the presence of a trauma team it is not unusual for all of the above phases to be carried out simultaneously by different team members. The allocation of roles to team members prior to commencement facilitates this process.

Airway maintenance and cervical spine control

The airway is assessed to ensure patency. In the presence of a speaking patient this can often be a rapid process. However, complications may arise with head and facial injuries or with altered conscious level. A Glasgow Coma Scale (GCS, Table 1.2) score of less than 8 is a relative indication to definitive airway placement. It is while assessing the airway and during manoeuvres to protect it that the cervical spine is at its most vulnerable, hence the inclusion of cervical spine control at this early juncture. Cervical spine injury should be suspected in all patients with a history of significant energy trauma, and steps taken to protect the cervical spine until such injuries are ruled out.

Breathing and ventilation

Having ensured airway patency, it is now imperative to ensure adequate ventilation and gas exchange. Oxygen saturations and respiratory rate measurement are useful adjuncts to this process but do not remove the necessity of chest auscultation and examination of excursion. Injuries to the chest wall, diaphragm and/or lungs may impede gas exchange. Life-threatening injuries include tension pneumothorax, massive pneumothorax, open pneumothorax and haemothorax. These should be actively excluded before moving on.

Circulation and haemorrhage control

Tissue oxygenation is dependent on the gases exchanged within the lungs being
transported to and from the organs. This requires the circulation of a sufficient concentration of haemoglobin at an adequate pressure. The important factors can be summarised in the following manner:

\[
\text{Cardiac output (CO) = stroke volume (SV) x heart rate (HR)}
\]

\[
\text{Blood pressure (BP) = CO x systemic vascular resistance (SVR)}
\]

Therefore: \( BP = SV \times HR \times SVR \)

In the absence of cardiac injury or a history of significant cardiac disease, cardiac output is therefore dependent on the stroke volume and the heart rate. Stroke volume is in turn dependent on the filling pressure of the left ventricle, while heart rate and systemic vascular resistance in trauma patients is often raised in the presence of a catecholamine response. The single most modifiable value is therefore that of stroke volume, which will in turn control blood pressure. Stroke volume can be increased by preventing external haemorrhage by means of compression, treating internal haemorrhage when encountered by operative means if necessary, and volume repletion by intravenous infusion. Long bone fractures are also sources of haemorrhage, and initial splinting of such injuries can help to reduce the volume lost.

**Disability**

The patient’s response to stimuli is assessed by means of the Glasgow Coma Scale (*Table 1.2*). The patient’s pupil reactivity is also assessed.

<table>
<thead>
<tr>
<th>Eye opening</th>
<th>Spontaneous</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To speech</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>To pain</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Best motor response</td>
<td>Obeys commands</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Localises pain</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Withdrawal</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Flexion</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Extension</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Verbal response</td>
<td>Orientated</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Confused</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Inappropriate</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Incomprehensible</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>
Conscious level can be impaired in the presence of increased intracranial pressure, alcohol, drugs, hypoxia and hypotension. If these last two factors are excluded then decreased conscious level should be attributed to head injury until proven otherwise.

**Exposure and environmental control**

The patient is fully exposed such that any potential injuries can be seen. It is important however to ensure that the patient remains warm following this, by the application of warming blankets when necessary.

Having completed the primary survey, the process is then repeated to ensure no deterioration has occurred. Only once life-threatening injuries have been excluded or diagnosed and treated can the secondary survey be carried out.

**The secondary survey**

This is a top-to-toe examination of the patient, assessing the presence of further, non-life-threatening injuries. A full history may be taken at this point. Skeletal trauma is assessed as set out in the following chapters. Having preserved life during the primary survey, it is now imperative to preserve function by diagnosing and treating all injuries.

**Conclusion**

Adult trauma care is best undertaken by implementing a systematic approach based on sound anatomical and physiological principles. Treating life-threatening injuries as soon as they are identified before moving on to life-altering injuries represents the best approach. Adherence to these principles allows the clinician to begin gaining the practical experience on which good trauma care is based.

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**Key points**

- Trauma patients are initially triaged to identify those who may be at immediate risk.
- The primary survey follows the approach laid out by the ATLS guidelines, evaluating injuries in the order in which they may prove fatal.
- Life-threatening conditions are diagnosed and treated as they are encountered.
- A secondary survey of non-life-threatening injuries is only carried out once the primary survey and resulting treatment is complete.
References
