26 Introduction to trauma

ASSESSMENT AND RESPONSE

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CONCLUSION

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Trauma can a ff ect all patient age groups. The severity of injury depends on the type and nature of the mechanical force applied. The formula ‘patient + mechanism = injury’ should be kept in mind when dealing with trauma patients. There is a connection among the three components of the formula, all of which should fit together in a coherent way . When no relationship can be made, examine for pre-existing pathology and hidden injuries or consider whether the history given by the patient is at fault (including deliberate attempts to mislead). Be aware of the timeline concept because there is a mini mum response time to initiate and complete treatment in order to deal with a specific condition successfully . In patients with multiple injuries early assessment and management is performed using the ATLS protocol and other guidelines developed either locally or at a national le vel. In the early clinical pathway of the patient the objective is to restore James Parkinson , 1755–1824, general practitioner of Shoreditch, London, UK, published bleeding and death) and minimise the risk of developing sub - sequent complications. Surgical interventions should be short and part of the resuscitation process, ex ecuted in a timely man - ner. Afterwards, treatment for definitive stabilisation can be per sonalised for optimum outcomes. Existing specific criteria can aid the clinician to make the right decision for the right patient at the right time. Di ff erent groups of patients, such as older patients and children, have di ff erent demands and should be managed accordingly . While clinicians are focused - on treating the injury sustained, they have other responsibil - ities, including active involvement in preventive measures. Preventive measures should be commissioned when particular mechanisms can be identified as being common or important causes of injury . - Summary box 26.12 Conclusion /uni25CF /uni25CF /uni25CF /uni25CF

Look for hidden injuries Remember the timeline concept Different treatment strategies exist, complementing each other Speci /f_i c criteria will decide the /f_i xation strategy: ETC or DCO

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DEFINITION OF TRAUMA

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Trauma can be defined as an injury to any part of the human body as the result of energy transfer from an inflicting source. The forces that can lead to injury include chemical, thermal, ionising radiation and mechanical. The extent and severity of the trauma sustained depends upon the magnitude, nature and duration of the inflicting cause. Major trauma denotes injuries to more than one body region or organ system. In Part 4, trauma will be examined from a variety of viewpoints, interconnected to di ff erent specialties . In this chapter we will examine the facets that bind the whole topic together. DEFINITION OF TRAUMA

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FURTHER READING

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Learning objectives

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Become familiar with the timeline concept in trauma • management Understand how to assess a trauma problem • Learning objectives

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Planning an individual operation

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Operative procedures in a multiply injured patient in a crit ical physiological state can be essential for their survival. It is vital to make the right decision the first time. This can be successfully done by studying in detail the history , the patient’s condition and any interventions made, followed by appropria planning and execution of treatment. For example, analysing the biochemical markers, overall physiological state and frac ture pattern and deciding factors such as patient positioning, the surgical approach to be used to gain adequate access to a bone for reduction, the type of implant to be used, the correct positioning of the implant, soft-tissue handling and the type of rehabilitation are just some of the parameters f or consid eration. Summary box 26.8 The response to trauma /uni25CF /uni25CF /uni25CF The surgeon should ask themselves (and ensure that they have answered) questions such as: Is it the optimum time to carry out the procedure? Am I the most appropriate person should the procedure become di ffi cult to complete? What is my plan A, B and C so I am able to successfully finish the procedure? Recording all the important issues on a piece of paper, or suitable alternative, will ensure that no parameter of importance is left out of the planning. In order that the pro - cedure runs smoothly in theatre, the plan can be documented on the whiteboard. Such a practice will allow every member of the surgical team to be aware of the potential issues to be addressed and the plan of action that has been decided. The appropria te surgical equipment for plans A, B and C can be clearly identified and kept in close proximity to the operating theatre. The above strategy will eliminate unnecessary detail and ensure that there will be no surprises, for instance essential equipment being unavailable.

Rationalise patient management with the development of protocols and guidelines Avoid unnecessary delays Observe trends and promptly identify evolving conditions

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THE MAGNITUDE OF THE PROBLEM

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In western industrialised countries, trauma accounts for the largest number of deaths and disability in children and young adults. According to the World Health Organization, there are an estimated 5 million injury fatalities worldwide, representing about 9% of global deaths. This rate is 1.7 times higher than deaths caused by malaria, tuberculosis and human immuno deficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS). Road tra ffi c accidents (RTAs), falls and intentional violence continue to be the most prevalent causes of trauma fatalities, with a combined rate of 64%. Of note, the major burden of injury is increasing in low- and middle-income countries sec ondary to industrialisation and increasing motorised transpor tation. Interestingly , the annual incidence and trends over time show that there is variation from country to country . Infor mation is usually obtained from na tional statistics organisa tions that use the International Classification of Diseases, a system that can be limited in providing accurate descriptions of injury severity . In contrast, the Ab breviated Injury Scale dictio nary consists of a greater level of detail (including more than 2000 injury codes) and assigns to every injury a severity score between 1 (mild) and 6 (maximum). This can be summated into the so-called injury severity score (ISS), which provides an indication of the anatomical severity of injury su ff ered by the individual patient. Major trauma is defined as an ISS greater than 15. The majority of patients admitted to hospital with injury have low ISS values, ranging between 4 and 9, with injuries such as an isolated limb fracture and/or isolated mild head injury . Overall, major trauma a ff ects approximately 15% of all injured patients. According to the UK Department of Transport, in 2019, the overall number of casualties following an RTA reported to the police, including all severities, was 153 158, of whom 25 945 had sustained severe injuries. Overall, 1752 individuals died as a result of their injuries. Across Europe, according to the data presented by the European Transport Safety Council’s Performance Index (PIN) report, it appears that the overall number of fatalities was reduced by 3% compared with 2018, and was estimated to be 22 /uni00A0 660. In 16 countries, the death rate decreased whereas in 12 it increased, with the four remaining countries registering no change. As countries do not use the same definition of serious injury , international comparisons are based on road deaths per - million inhabitants. In the 27 Member States of the European Union (EU27), the overall level of road mortality was 42 dea ths per million inhabitants in 2020 compared with 67 per million in 2010 (Figure 26.1). The EU road mortality rate was 51 per million in 2019; the unprecedented drop in mortality between 2019 and 2020 was mainly due to the tra ffi c restrictions to - contain the pandemic. - Norway remains the leader among PIN countries with 17 road deaths per million inhabitants, followed by Sweden with - 20 deaths per million inhabitants in 2020. In Malta, the UK, - Switzerland and Denmark, road mortality is below 27 per mil - lion. T he highest road mortality is in Romania and Latvia, with 85 and 73 road deaths per million inhabitants, respectively . - A large proportion of severely injured survivors experi - ence long-ter m or permanent disability as a result of their injuries. Approximately one-third of severely injured survivors sustained life-changing injuries and were unable to r eturn to

Appreciate the importance of observing trends for • identi /f_i cation of evolving conditions Recognise that speci /f_i c criteria exist for implementation of • different treatment strategies

their previous level of function and occupation, undergoing profound lifestyle changes including long-term pain and su ff er ing. It should be emphasised that an injury a ff ects not only the injured person but also everyone who is involved in the injured per son's life. The impact of the modern epidemic of RTAs on the universal epidemic of violent injury cannot be overstated. The annual direct medical cost of injuries treated in hospi tals and additional care facilities is estimated to be somewhere between £3.5 billion and £4 billion. Moreover, additional indirect costs, due to loss of earnings, loss of productivity and a reduced quality of life, increase the total sum significantly . Multiple injuries are often thought to occur primarily in younger patients who are involved in incidents with a high energy transfer. Lately , multiple injuries are also seen in the older population as patients live longer , are more active and we have better diagnostics. The last point is particularly important as older adult patients were often underinvestigated, so the full extent of injury was not appreciated. Recent data published by the UK's National Institute for Health and Care Excellence (NICE) revealed that there are an estimated 500 /uni00A0 000 new patients with fragility fractures per year in the UK; approximately 70 /uni00A0 000 of these are admitted with proximal femoral fractures, among whom 6.7% of those aged >65 years will die within 30 days of the incident, as reported by the National Hip Fracture Database. Most of the remaining patients with proximal femoral fractures will have diminished independence and functional capacity . It is therefore unsur prising that this particular cohort of patients, the number of whom will increase in coming years owing to the anticipated - increase in life expectancy , is thought to represent a huge bur - den on healthcare services and society in general. In summary , the overwhelming majority of trauma is not life- or limb-threatening and full recovery with return to preinjur y status is usually expected. However, it remains of - paramount importance that injuries are detected early in order to properly intervene and therefore achieve a favourable out - come. For instance, one must be vigilant not to miss paediatric non-accidental injury (NAI) (see Chapter 44) or injuries sec - ondary to a chronic underlying disease process rather than the injury itself, for example pathological fractures in older age g roups. Of note, it has been shown that, in 66% of cases when children die as a r esult of abuse, there has been some previous interaction with a health professional or with social services, but the seriousness of the situation was not fully appreciated. Summary box 26.1 Trauma: the magnitude of the problem /uni25CF /uni25CF /uni25CF /uni25CF -

100 80 EU27 average 2010: 68 60 EU27 average 2020: 42 40 20 0 NO SE MT UK** CH DK* ES* IE* DE* IL NL SI AT FR FI* IT* SK LU BE* EE HU CZ PT* EL* CY HR Mortality 2010 Mortality 2020 Mortality 2020 Mortality 2020 EU mortality 2020 EU mortality 2010 <20 23–33 Figure 26.1 Mortality (road deaths per million inhabitants) in 2020 (coloured bars) with mortality in 2010 for comparison (white bars) (courtesy of the European Transport Council). *National provisional estimates used for 2020. The annual number of deaths in LU and MT are particularly small and, therefore, subject to substantial annual /f_l uctuations. **UK data for 2020 are the provisional total for Great Britain for the year ending June 2020 combined with the total for Northern Ireland for the calendar year 2020. LT PL BG RS LV RO Mortality 2020 Mortality 2020 35–42 45–63

> 66 The vast majority of trauma is not life- or limb-threatening Severe trauma continues to be a major cause of death in young patients Older adult patients with fragility fractures are a special group posing a further burden to a healthcare system Promptly identifying important features of injuries could in /f_l uence the outcome

As soon as a severe injury occurs, every second counts, and all aspects of decision making and management are critical for a patient’s long-term quality of life and even their survival. The concepts of initial assessment and management have specific goals that are based on practice over a long period of time. In the modern era, new protocols have been formulated that are centred on a profound understanding of the physiology of the host response to an acute threat to homeostasis; these protocols allow clinicians to use standardised measures and to speak a common language. They also reduce delays and expedite patient care, especially when clinicians are under pressure to make a critical decision. However, an understanding of the reasoning behind them remains crucial. As in other acute conditions, the patient is particularly reliant upon the clinician when trauma occurs. A patient with a chronic condition is familiar with the nature of their problem and the way in which it is progressing. The surgeon may o ff er a remedy and the patient may consider the potential benefits and choose appropriately whether to accept the remedy . The injured patient does not know what will happen without treat ment and so relies on the surgeon to inform them of both the natural history and the potential benefits of any intervention. The implication is that, as surgeons, we have a duty to be aware of both. THE MAGNITUDE OF THE PROBLEM

In western industrialised countries, trauma accounts for the largest number of deaths and disability in children and young adults. According to the World Health Organization, there are an estimated 5 million injury fatalities worldwide, representing about 9% of global deaths. This rate is 1.7 times higher than deaths caused by malaria, tuberculosis and human immuno deficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS). Road tra ffi c accidents (RTAs), falls and intentional violence continue to be the most prevalent causes of trauma fatalities, with a combined rate of 64%. Of note, the major burden of injury is increasing in low- and middle-income countries sec ondary to industrialisation and increasing motorised transpor tation. Interestingly , the annual incidence and trends over time show that there is variation from country to country . Infor mation is usually obtained from na tional statistics organisa tions that use the International Classification of Diseases, a system that can be limited in providing accurate descriptions of injury severity . In contrast, the Ab breviated Injury Scale dictio nary consists of a greater level of detail (including more than 2000 injury codes) and assigns to every injury a severity score between 1 (mild) and 6 (maximum). This can be summated into the so-called injury severity score (ISS), which provides an indication of the anatomical severity of injury su ff ered by the individual patient. Major trauma is defined as an ISS greater than 15. The majority of patients admitted to hospital with injury have low ISS values, ranging between 4 and 9, with injuries such as an isolated limb fracture and/or isolated mild head injury . Overall, major trauma a ff ects approximately 15% of all injured patients. According to the UK Department of Transport, in 2019, the overall number of casualties following an RTA reported to the police, including all severities, was 153 158, of whom 25 945 had sustained severe injuries. Overall, 1752 individuals died as a result of their injuries. Across Europe, according to the data presented by the European Transport Safety Council’s Performance Index (PIN) report, it appears that the overall number of fatalities was reduced by 3% compared with 2018, and was estimated to be 22 /uni00A0 660. In 16 countries, the death rate decreased whereas in 12 it increased, with the four remaining countries registering no change. As countries do not use the same definition of serious injury , international comparisons are based on road deaths per - million inhabitants. In the 27 Member States of the European Union (EU27), the overall level of road mortality was 42 dea ths per million inhabitants in 2020 compared with 67 per million in 2010 (Figure 26.1). The EU road mortality rate was 51 per million in 2019; the unprecedented drop in mortality between 2019 and 2020 was mainly due to the tra ffi c restrictions to - contain the pandemic. - Norway remains the leader among PIN countries with 17 road deaths per million inhabitants, followed by Sweden with - 20 deaths per million inhabitants in 2020. In Malta, the UK, - Switzerland and Denmark, road mortality is below 27 per mil - lion. T he highest road mortality is in Romania and Latvia, with 85 and 73 road deaths per million inhabitants, respectively . - A large proportion of severely injured survivors experi - ence long-ter m or permanent disability as a result of their injuries. Approximately one-third of severely injured survivors sustained life-changing injuries and were unable to r eturn to

Appreciate the importance of observing trends for • identi /f_i cation of evolving conditions
Recognise that speci /f_i c criteria exist for implementation of • different treatment strategies

their previous level of function and occupation, undergoing profound lifestyle changes including long-term pain and su ff er ing. It should be emphasised that an injury a ff ects not only the injured person but also everyone who is involved in the injured per son’s life. The impact of the modern epidemic of RTAs on the universal epidemic of violent injury cannot be overstated. The annual direct medical cost of injuries treated in hospi tals and additional care facilities is estimated to be somewhere between £3.5 billion and £4 billion. Moreover, additional indirect costs, due to loss of earnings, loss of productivity and a reduced quality of life, increase the total sum significantly . Multiple injuries are often thought to occur primarily in younger patients who are involved in incidents with a high energy transfer. Lately , multiple injuries are also seen in the older population as patients live longer , are more active and we have better diagnostics. The last point is particularly important as older adult patients were often underinvestigated, so the full extent of injury was not appreciated. Recent data published by the UK’s National Institute for Health and Care Excellence (NICE) revealed that there are an estimated 500 /uni00A0 000 new patients with fragility fractures per year in the UK; approximately 70 /uni00A0 000 of these are admitted with proximal femoral fractures, among whom 6.7% of those aged >65 years will die within 30 days of the incident, as reported by the National Hip Fracture Database. Most of the remaining patients with proximal femoral fractures will have diminished independence and functional capacity . It is therefore unsur prising that this particular cohort of patients, the number of whom will increase in coming years owing to the anticipated - increase in life expectancy , is thought to represent a huge bur - den on healthcare services and society in general. In summary , the overwhelming majority of trauma is not life- or limb-threatening and full recovery with return to preinjur y status is usually expected. However, it remains of - paramount importance that injuries are detected early in order to properly intervene and therefore achieve a favourable out - come. For instance, one must be vigilant not to miss paediatric non-accidental injury (NAI) (see Chapter 44) or injuries sec - ondary to a chronic underlying disease process rather than the injury itself, for example pathological fractures in older age g roups. Of note, it has been shown that, in 66% of cases when children die as a r esult of abuse, there has been some previous interaction with a health professional or with social services, but the seriousness of the situation was not fully appreciated. Summary box 26.1 Trauma: the magnitude of the problem /uni25CF /uni25CF /uni25CF /uni25CF -

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THE RESPONSE TO TRAUMA

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Completion of the initial patient evaluation according to the formula (patient + mechanism = injury) should provide the necessary information to formulate and implement a ‘response’ (treatment). During this stage of management, the response to injury will continue to evolve and decompensation may occur - unexpectedly . Vigilance is required throughout treatment to identify the potential exhaustion of biological reserve mech - anisms. THE RESPONSE TO TRAUMA

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The assessment of trauma

The assessment of trauma

Traditionally , and especially when learning the theory of the various component parts of the assessment of the injured patient, this is done in a sequential linear fashion. However, opriate when dealing with a severely injured patient in practice, time is of the essence and when resources allow several things may be happening simultaneously – this is so-called horizontal management; while there may be a number of practical activ - ities occurring simultaneously , the coordination, assessment - and control of the situation remains as a mental exercise for the ‘hands-o ff ’ team leader. In particular, acquiring very - early definitive diagnoses with CT is increasingly important. To pr ovide such a level of care generally needs a systematic approach to concentrating resources and to preferably bringing the severely injured patient to that resource – a major trauma - system. the best understanding possible of the injuries sustained and their consequences. Forming that whole picture is a challeng ing process. The clinician must make the best use of what they know of the mechanism of injury , pre-existing patient factors and the injuries already found. Synthesising the associations of these thr ee factors will help direct attention to finding other less obvious problems. Sometimes, the pieces of the puzzle do not ‘add up’; at that point, the clinician should attempt to think ‘outside of the box’ as there may be something unexpected, such as an unknown underlying pathology leading to a patho logical fracture, or deliberately concealed, such as in NAI. For instance, a 50-year-old male restrained passenger in a car involved in a head-on collision with another vehicle may sustain rib fractures, a sternal fracture and a thoracic spine fracture but there may also be cardiac contusion and abdominal injuries. V ery ear ly CT and echocardiography may decrease the need for clinical acumen, but in many centres it is not available. The clinician then needs to use their knowledge of the mechanism of injury and the obvious rib and sternal fractures to direct their attention to excluding the less obvious but potentially life-threatening abdominal or cardiac injuries. Similarly , when sophisticated investigations and techniques are available, the clinician should not be over-reliant on them and neglect the important logical thought processes required to piece together the information that is available. It remains of value to consider how a clinician can make best use of the available information for the benefit of the patient. Summary box 26.3 The assessment of trauma /uni25CF /uni25CF /uni25CF Mechanisms Mechanisms may be broadly classified as blunt, penetrating or even of a combined nature. Table 26.1 shows examples of how knowledge of the mechanism may help detect more covert injuries. Early definitive imaging may be thought to reduce the need for such considerations, but the clinician can help the radiologist by directing their attention to potential diagnoses. The adage that ‘unless you are very fortunate you only find what you look for’ is apt. The most common mechanism involves blunt trauma, which may be either direct or indirect. In a direct mechanism, the damage is localised to the initial site of that mechanism. In contrast, in an indirect mechanism the damage occurs at a distant site after transmission of the force exerted. For example, a direct kick to the medial aspect of the mid-shaft of the tibia in a footballer by an opponent may induce an isolated transverse tibial fracture. There will be localised bruising and ecchymosis where the force was applied. - - On the other hand, a fall from a height of 1 metre with a twisting moment as the foot hits the ground can lead to a spiral fracture of the distal tibia. In this situation the force is transmit - ted through the body's tissues to a location some distance away from its original point of application. In this case, other injuries may have occurred along that line of transmission and should also be sought, such as a remote fibular fracture. Similarly , a motor vehicle crash associated with a point of impact of the knee joint of the driver on the dashboard of the car could induce a fracture dislocation of the acetabulum and hip joint (transmission of force from the knee joint to the hip socket – an indirect blunt mechanism) (Figure 26.5). /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF The 'timeline concept' previously discussed should not be taken to imply that every injury needs urgent treatment or that every injury of a similar type is of equal urgency . For instance, a tibial fracture that a footballer has sustained may be treated satisfactorily for some time after the moment of injury but, in

Appreciate the factors in the relationship: mechanism + patient factors = injuries sustained Use this to allow obvious features to lead to the discovery of less obvious injuries When the features do not appear to 'add up' this should be an alert for the clinician to think 'outside the box' and connect the /uni00A0 dots Figure 26.5 The injury force in a car accident can be transmitted from the dashboard to the knee and then to the hip, which is the site of injury. TABLE 26.1 Examples of patterns of injury. Mechanism Obvious features Covert injuries Left-sided Lateral Splenic rupture impact from compression of the Extradural road traf /f_i c pelvis haematoma accident Left-sided pneumothorax Flexion Chance fracture of Duodenal rupture distraction (lap the lumbar spine Popliteal artery belt) disruption Dislocated knee Head injury Cervical spine fracture Electrocution Burn on hand and Posterior dislocation collapse of the shoulder Dashboard Knee wound Posterior dislocation impact of the hip

(as described above) represents an emergency owing to the potential development of neurovascular complications (dam age to the sciatic nerve; avascular necrosis of the femoral head). Therefore, the clinician's decision-making process should be informed by the peculiarities of the type of injury sustained and the anatomical location in volved. Moreover, it should be appreciated that the conduction of energy in an indirect mechanism, which is transferred via the soft tissues or fluid, can be di ffi cult both to understand and to diagnose (accurately and promptly). For example, the rise in pressure secondary to a lower abdominal force could be passed to the vascular tree (aorta), leading to unexpected haemorrhage and death. Therefore, one can argue that the e ff ects of direct mechanisms are easier to comprehend than those of indirect ones. Penetrating injuries are caused either by sharp objects or by firearms (see Chapter 34). When dealing with sharp objects, it is necessary to take into account their length, surface area the size of the entry point. For example, a pair of scissors will cause damage to the underlying tissues that they contact (skin, subcutaneous fat, fascia, etc.). Local examination will confirm the extent of the injury and the need for wound exploration. It is critical to be familiar with the relevant anatomy of the area involved to accurately assess peripheral nerve function and ten don and muscle integrity . Here again the 'timeline concept' of prompt assessment and response (treatment) can be crucial in cases where there is vascular injury , a compartment syndrome due to internal bleeding or even joint penetration that could lead to septic arthritis. Knowledge of the anatomical structures at risk is essential to making the right decision in a timely fash ion. This is particularly critical for penetrating wounds over the torso (see Chapter 29) because it is not always easy to establish the track that the sharp object has followed. In this context, it should not be forgotten that the abdominal structures extend higher than anticipa ted, and as high as the level of the fifth rib in expiration. Summary box 26.4 Sharp object injuries /uni25CF /uni25CF /uni25CF Penetrating injuries caused by firearms are more di ffi cult to understand than incisional injuries caused by sharp objects. A low-velocity projectile may cause similar injuries to a knife, whereas a high-velocity projectile (bullet) causes extensive damage to the tissues as it travels, inducing lateral acceleration far from the point of impact and producing either a permanent or a temporary cavity (see Chapter 34). The importance of the temporary cavity is that it lasts for only milliseconds and is usu ally not evident during the clinical examination. It is import ant to be aware that this temporary cavity usually extends far from the boundaries of the apparent injury and there may be will ensure that the sur geon carries out su ffi cient exploration and wound excision. - Summary box 26.5 Firearm injuries /uni25CF /uni25CF /uni25CF Patient factors Every patient is di ff erent: each possesses a unique profile and medical history and so will respond di ff erently to a given trau - and matic incident. Of note, age plays an important role in this regard. Children and adults of di ff erent ages will sustain di ff er - ent injuries as a result of the same mechanism. For instance, a car hitting a pedestrian will induce di ff erent injuries in an adult from those in a child (Figure 26.6). It is important to consider the other aspects of the pa tient's history: past medical history , - medication and allergy risk will direct not only the clinical assessment but also the treatment. Obvious injuries Some injuries are very obvious and can be identified before details of the mechanism or patient are known. One can take - advantage of this, as the presence of an obvious injury can inform and lead to the identification of another that is less obvious. Obvious injuries are usually visible externally . It is therefore unsurprising that at the end of the ABCD protocol there is also an E, referring to exposure and the need to look for other signs of injury . Bruising to the scrotum of a motor - cyclist following a collision with a car suggests a pelvic fracture. Contusion over the greater trochanter of the proximal femur in an older patient experiencing di ffi culty with straight leg raise points to a fracture of the neck of the fem ur. Finger-shaped bruises on a child's arms or thighs suggest NAI. The presence of a seat belt mark on the lower abdomen of a patient involved in a car crash and who has substantial abdominal pain points to damage inside the abdomen. Thus, exposure of the trauma patient should be routine practice in order to avoid missing the 'obvious'. Hidden factors Mechanisms Sometimes, the formula 'mechanism + patient = injury' does not seem to 'add up'. If this is the case, the clinician should look further as hidden information may be contained in the mecha - nism. Occasionally , there is a deliberate attempt to misinform. While the majority of alert and orientated patients tell the truth, other patients, in order to protect themselves or others , - may fabricate a mechanism. This may mislead the clinician - and guide them to look for the wrong pattern of injuries. For instance, a patient in their twenties with a calcaneal fracture

Length of the sharp object involved is important Familiarity with local anatomy is essential Crucial point: abdominal structures at risk of injury extend high into the chest Passage of high-velocity bullets induces permanent and temporary cavitation Temporary cavitation can contain foreign material, but disappears after a few seconds and is less evident to the clinician Low-velocity bullets induce similar damage to knives

may report that this was the result of a fall into a pothole in the road, when in fact it had occurred during a burglary following a fall from a height of 10 metres. This can delay the accurate diagnosis of the specific injury and may prevent the diagnosis of other important injuries, such as a lumbar spine fracture. Although the patient should be given the chance to tell their story , it should not always be believed, particularly if there are inconsistencies. A similar situation may arise when a patient is unable to give their history of events, for instance patients who are unconscious. In this scenario, the mechanism of injury is missing. The ph ysically and mentally vulnerable include older patients, perhaps with dementia, and very young children. The di ffi culty or inability to report the injury is compounded by the fact that it might relate to criminal activity (e.g. NAI). Param eters that should alert the clinician and raise suspicion of NAI include: /uni25CF external signs of injuries not consistent with the mecha nism reported; /uni25CF long bone fractures in a preambulatory child; /uni25CF inconsistent or changing history; /uni25CF aggressive or unusual behaviour of carers at interview; /uni25CF posterior rib injuries. Summary box 26.6 Hidden mechanisms /uni25CF /uni25CF /uni25CF /uni25CF It is absolutely paramount to make a rapid diagnosis and treat the injuries, but most importantly to protect the patient from further harm, particularly vulnerable individuals (chil - - dren and older adults). An early sign of abuse that is neglected may lead to further episodes and the potential of serious harm. For these reasons, procedures are usually in place and can be - followed by passing on the problem to the appropria te team and professionals (see Chapter 44). Another important issue is the fact that any obvious injuries may provide important evidence regarding the mechanism, which may be important to a criminal investigation. The cli - nician m ust endeavour, without compromising treatment, not

Adult 15 years 10 years Figure 26.6 Body proportions at various ages and the anatomical location of injuries when hit by a car. 19.0 cm (9 in) (9 in) 17.8 cm 16.5 cm 15.2 cm (7.5 in) (7 in) (6.5 in) (6 in) Adult 15 y 10 y 5 y 3 y 1 y 5 years 3 years 1 year The vast majority of conscious patients will tell the truth Patients involved in criminal activity may not tell the truth Fear of abuse may prevent vulnerable patients from telling the truth Clinicians have the responsibility to take action when NAI is suspected

mind that forensic evidence may be needed for a conviction at a later stage. Furthermore, the importance of this is made more apparent if we consider that the victim of an attack may subsequently be a murder victim. Patients Apart from the deliberate circumstances outlined above, where the injury and mechanism are inconsistent, the clinician should consider the possibility that the patient may have an unknown pre-existing condition. For example, when a fracture occurs following what seems to have been an insu ffi cient mechanism, the clinician should suspect that the bone was already suscep tible to fracture. Such pathological fractures may be second ary to underlying problems such as metastatic or primary tumour, osteoporosis or congenital disease. One example is the preambulatory child with multiple fractures secondary to osteogenesis imperfecta, which may mimic NAI. F to identify a pathological fracture through a primary tumour will lead to inappropriate initial management compromising appropriate cancer treatment. An initial osteoporotic or herald fracture should signal the need for appropriate investigation and, potentially , treatment to prevent further or secondary fractures. Similarly , fractures may be secondary to an undiag nosed or poorly controlled medical condition. For example, a patient presenting with a scalp laceration and a wrist fracture may have fallen as a result of a transient ischaemic attack (a /uni00A0 hidden patient factor). In this situation, it is essential to include a medical secondary survey to identify the real cause of the injuries sustained and prevent further trauma. Injuries When analysis of the formula ‘mechanism + patient = injury’ has failed to identify hidden injury , there are two other approaches: 1 the look everywhere approach; 2 the focused exclusion approach. This represents the second ary and tertiary elements of the ATLS system and involves a detailed secondary survey , from top to bottom and at di ff erent time points: soon after the initial treatment phase when measures relating to saving the patient’s life ha ve been completed, the day after injury , e.g. during a ward round, or several days after injury , e.g. when the patient first wakes up in the intensive care unit (ICU). The implementation of whole-body CT (WBCT) (scanning the whole body) in all major trauma centres has allowed the clinical team to pick up injuries early . Such injuries would have been missed in the past when reliance was placed on the initial radiographs of the chest, pelvis and cervical spine. The threshold for using more WBCT has been lowered substantially . There is no doubt that WBCT scan algorithms have been shown to accelerate diagnostic work-up, but their e ff ect on survival is controversial. Moreover, concerns have been voiced about the overexposure of patients to radiation with the increasing and often uncritical use of this type of scan. The e ff ective radiation dose to all organs from a single full-body CT is 12–16 millisieverts (mSv). the range 5–100 /uni00A0 mSv had a statistically significant increase in the risk of solid cancers. Overall, the risks associated with one scan are relatively modest, approximately 1 in 1250 or 0.08%. How ever, it has been reported that widespread liberal use of CT is responsible for 1.5–2.0% of all cancers in the USA. Of interest, WBCT equates to 76 chest radiographs or 6 months of background radiation. It has been suggested that it should be requested wisely and that developing a triaging protocol can minimise the criticism of its overuse. This is based on the knowl - edge that some specific injuries are missed on a remarkably - regular basis. Such injury patterns include metatarsal and - metacarpal fractures, scaphoid fractures, perilunate disloca - tions and posterior shoulder dislocations . When such injuries are suspected, a detailed focused history , clinical examination and appropriate investigations should be carried out to either ailure confirm or exclude them. A high le vel of alertness and a high index of suspicion are always required to think beyond the obvious. Summary box 26.7 - Trauma assessment /uni25CF /uni25CF /uni25CF

Look everywhere approach. Focused exclusion approach. Knowledge of timelines for important diagnoses is essential Initial assessment should focus on what kills /f_i rst Screen high-risk patients before clinical signs become apparent, as it may be too late to intervene once signs develop

The assessment of trauma

Traditionally , and especially when learning the theory of the various component parts of the assessment of the injured patient, this is done in a sequential linear fashion. However, opriate when dealing with a severely injured patient in practice, time is of the essence and when resources allow several things may be happening simultaneously – this is so-called horizontal management; while there may be a number of practical activ - ities occurring simultaneously , the coordination, assessment - and control of the situation remains as a mental exercise for the ‘hands-o ff ’ team leader. In particular, acquiring very - early definitive diagnoses with CT is increasingly important. To pr ovide such a level of care generally needs a systematic approach to concentrating resources and to preferably bringing the severely injured patient to that resource – a major trauma - system. the best understanding possible of the injuries sustained and their consequences. Forming that whole picture is a challeng ing process. The clinician must make the best use of what they know of the mechanism of injury , pre-existing patient factors and the injuries already found. Synthesising the associations of these thr ee factors will help direct attention to finding other less obvious problems. Sometimes, the pieces of the puzzle do not ‘add up’; at that point, the clinician should attempt to think ‘outside of the box’ as there may be something unexpected, such as an unknown underlying pathology leading to a patho logical fracture, or deliberately concealed, such as in NAI. For instance, a 50-year-old male restrained passenger in a car involved in a head-on collision with another vehicle may sustain rib fractures, a sternal fracture and a thoracic spine fracture but there may also be cardiac contusion and abdominal injuries. V ery ear ly CT and echocardiography may decrease the need for clinical acumen, but in many centres it is not available. The clinician then needs to use their knowledge of the mechanism of injury and the obvious rib and sternal fractures to direct their attention to excluding the less obvious but potentially life-threatening abdominal or cardiac injuries. Similarly , when sophisticated investigations and techniques are available, the clinician should not be over-reliant on them and neglect the important logical thought processes required to piece together the information that is available. It remains of value to consider how a clinician can make best use of the available information for the benefit of the patient. Summary box 26.3 The assessment of trauma /uni25CF /uni25CF /uni25CF Mechanisms Mechanisms may be broadly classified as blunt, penetrating or even of a combined nature. Table 26.1 shows examples of how knowledge of the mechanism may help detect more covert injuries. Early definitive imaging may be thought to reduce the need for such considerations, but the clinician can help the radiologist by directing their attention to potential diagnoses. The adage that ‘unless you are very fortunate you only find what you look for’ is apt. The most common mechanism involves blunt trauma, which may be either direct or indirect. In a direct mechanism, the damage is localised to the initial site of that mechanism. In contrast, in an indirect mechanism the damage occurs at a distant site after transmission of the force exerted. For example, a direct kick to the medial aspect of the mid-shaft of the tibia in a footballer by an opponent may induce an isolated transverse tibial fracture. There will be localised bruising and ecchymosis where the force was applied. - - On the other hand, a fall from a height of 1 metre with a twisting moment as the foot hits the ground can lead to a spiral fracture of the distal tibia. In this situation the force is transmit - ted through the body’s tissues to a location some distance away from its original point of application. In this case, other injuries may have occurred along that line of transmission and should also be sought, such as a remote fibular fracture. Similarly , a motor vehicle crash associated with a point of impact of the knee joint of the driver on the dashboard of the car could induce a fracture dislocation of the acetabulum and hip joint (transmission of force from the knee joint to the hip socket – an indirect blunt mechanism) (Figure 26.5). /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF The ‘timeline concept’ previously discussed should not be taken to imply that every injury needs urgent treatment or that every injury of a similar type is of equal urgency . For instance, a tibial fracture that a footballer has sustained may be treated satisfactorily for some time after the moment of injury but, in

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When dealing with sharp objects, it is necessary to take into account their length, surface area the size of the entry point. For example, a pair of scissors will cause damage to the underlying tissues that they contact (skin, subcutaneous fat, fascia, etc.). Local examination will confirm the extent of the injury and the need for wound exploration. It is critical to be familiar with the relevant anatomy of the area involved to accurately assess peripheral nerve function and ten don and muscle integrity . Here again the 'timeline concept' of prompt assessment and response (treatment) can be crucial in cases where there is vascular injury , a compartment syndrome due to internal bleeding or even joint penetration that could lead to septic arthritis. Knowledge of the anatomical structures at risk is essential to making the right decision in a timely fash ion. This is particularly critical for penetrating wounds over the torso (see Chapter 29) because it is not always easy to establish the track that the sharp object has followed. In this context, it should not be forgotten that the abdominal structures extend higher than anticipa ted, and as high as the level of the fifth rib in expiration. Summary box 26.4 Sharp object injuries /uni25CF /uni25CF /uni25CF Penetrating injuries caused by firearms are more di ffi cult to understand than incisional injuries caused by sharp objects. A low-velocity projectile may cause similar injuries to a knife, whereas a high-velocity projectile (bullet) causes extensive damage to the tissues as it travels, inducing lateral acceleration far from the point of impact and producing either a permanent or a temporary cavity (see Chapter 34). The importance of the temporary cavity is that it lasts for only milliseconds and is usu ally not evident during the clinical examination. 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Obvious injuries Some injuries are very obvious and can be identified before details of the mechanism or patient are known. One can take - advantage of this, as the presence of an obvious injury can inform and lead to the identification of another that is less obvious. Obvious injuries are usually visible externally . It is therefore unsurprising that at the end of the ABCD protocol there is also an E, referring to exposure and the need to look for other signs of injury . Bruising to the scrotum of a motor - cyclist following a collision with a car suggests a pelvic fracture. Contusion over the greater trochanter of the proximal femur in an older patient experiencing di ffi culty with straight leg raise points to a fracture of the neck of the fem ur. Finger-shaped bruises on a child's arms or thighs suggest NAI. The presence of a seat belt mark on the lower abdomen of a patient involved in a car crash and who has substantial abdominal pain points to damage inside the abdomen. Thus, exposure of the trauma patient should be routine practice in order to avoid missing the ‘obvious’. Hidden factors Mechanisms Sometimes, the formula ‘mechanism + patient = injury’ does not seem to ‘add up’. If this is the case, the clinician should look further as hidden information may be contained in the mecha - nism. Occasionally , there is a deliberate attempt to misinform. While the majority of alert and orientated patients tell the truth, other patients, in order to protect themselves or others , - may fabricate a mechanism. This may mislead the clinician - and guide them to look for the wrong pattern of injuries. For instance, a patient in their twenties with a calcaneal fracture

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may report that this was the result of a fall into a pothole in the road, when in fact it had occurred during a burglary following a fall from a height of 10 metres. This can delay the accurate diagnosis of the specific injury and may prevent the diagnosis of other important injuries, such as a lumbar spine fracture. Although the patient should be given the chance to tell their story , it should not always be believed, particularly if there are inconsistencies. A similar situation may arise when a patient is unable to give their history of events, for instance patients who are unconscious. In this scenario, the mechanism of injury is missing. The ph ysically and mentally vulnerable include older patients, perhaps with dementia, and very young children. The di ffi culty or inability to report the injury is compounded by the fact that it might relate to criminal activity (e.g. NAI). Param eters that should alert the clinician and raise suspicion of NAI include: /uni25CF external signs of injuries not consistent with the mecha nism reported; /uni25CF long bone fractures in a preambulatory child; /uni25CF inconsistent or changing history; /uni25CF aggressive or unusual behaviour of carers at interview; /uni25CF posterior rib injuries. Summary box 26.6 Hidden mechanisms /uni25CF /uni25CF /uni25CF /uni25CF It is absolutely paramount to make a rapid diagnosis and treat the injuries, but most importantly to protect the patient from further harm, particularly vulnerable individuals (chil - - dren and older adults). An early sign of abuse that is neglected may lead to further episodes and the potential of serious harm. For these reasons, procedures are usually in place and can be - followed by passing on the problem to the appropria te team and professionals (see Chapter 44). Another important issue is the fact that any obvious injuries may provide important evidence regarding the mechanism, which may be important to a criminal investigation. The cli - nician m ust endeavour, without compromising treatment, not

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mind that forensic evidence may be needed for a conviction at a later stage. Furthermore, the importance of this is made more apparent if we consider that the victim of an attack may subsequently be a murder victim. Patients Apart from the deliberate circumstances outlined above, where the injury and mechanism are inconsistent, the clinician should consider the possibility that the patient may have an unknown pre-existing condition. For example, when a fracture occurs following what seems to have been an insu ffi cient mechanism, the clinician should suspect that the bone was already suscep tible to fracture. Such pathological fractures may be second ary to underlying problems such as metastatic or primary tumour, osteoporosis or congenital disease. One example is the preambulatory child with multiple fractures secondary to osteogenesis imperfecta, which may mimic NAI. F to identify a pathological fracture through a primary tumour will lead to inappropriate initial management compromising appropriate cancer treatment. An initial osteoporotic or herald fracture should signal the need for appropriate investigation and, potentially , treatment to prevent further or secondary fractures. Similarly , fractures may be secondary to an undiag nosed or poorly controlled medical condition. For example, a patient presenting with a scalp laceration and a wrist fracture may have fallen as a result of a transient ischaemic attack (a /uni00A0 hidden patient factor). In this situation, it is essential to include a medical secondary survey to identify the real cause of the injuries sustained and prevent further trauma. Injuries When analysis of the formula 'mechanism + patient = injury' has failed to identify hidden injury , there are two other approaches: 1 the look everywhere approach; 2 the focused exclusion approach. This represents the second ary and tertiary elements of the ATLS system and involves a detailed secondary survey , from top to bottom and at di ff erent time points: soon after the initial treatment phase when measures relating to saving the patient's life ha ve been completed, the day after injury , e.g. during a ward round, or several days after injury , e.g. when the patient first wakes up in the intensive care unit (ICU). The implementation of whole-body CT (WBCT) (scanning the whole body) in all major trauma centres has allowed the clinical team to pick up injuries early . Such injuries would have been missed in the past when reliance was placed on the initial radiographs of the chest, pelvis and cervical spine. The threshold for using more WBCT has been lowered substantially . There is no doubt that WBCT scan algorithms have been shown to accelerate diagnostic work-up, but their e ff ect on survival is controversial. Moreover, concerns have been voiced about the overexposure of patients to radiation with the increasing and often uncritical use of this type of scan. The e ff ective radiation dose to all organs from a single full-body CT is 12–16 millisieverts (mSv). the range 5–100 /uni00A0 mSv had a statistically significant increase in the risk of solid cancers. Overall, the risks associated with one scan are relatively modest, approximately 1 in 1250 or 0.08%. How ever, it has been reported that widespread liberal use of CT is responsible for 1.5–2.0% of all cancers in the USA. Of interest, WBCT equates to 76 chest radiographs or 6 months of background radiation. It has been suggested that it should be requested wisely and that developing a triaging protocol can minimise the criticism of its overuse. This is based on the knowl - edge that some specific injuries are missed on a remarkably - regular basis. Such injury patterns include metatarsal and - metacarpal fractures, scaphoid fractures, perilunate disloca - tions and posterior shoulder dislocations . When such injuries are suspected, a detailed focused history , clinical examination and appropriate investigations should be carried out to either ailure confirm or exclude them. A high le vel of alertness and a high index of suspicion are always required to think beyond the obvious. Summary box 26.7 - Trauma assessment /uni25CF /uni25CF /uni25CF

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Initial management After initial assessment of the patient's condition at the scene of an accident, paramedics communicate with the nearest hospital, triggering activation of 'the trauma team on call' and allowing personnel to expect the patient's arrival in the resuscitation room. The team leader, according to the ATLS protocol, will assign trained nurses and doctors to specific duties. Protective clothing, such as gloves and lead aprons, is required to protect the personnel from fluids and radiation exposure. Optimum coordination of the trauma team throughout the resuscitation process is essential to avoid careless delays, which may compromise the response time and the patient's condition. Timely involvement of di ff erent disciplines in assessing and planning treatment of injuries in di ff erent body areas is crucial and may lead to issues around priority in terms of planning and interventions. This situation could lead to confusion and uncertainty: 'Who should go first?' or 'What investigation should be next?' It is the role of the team leader to ensure that this is avoided and that decisions which may be critical for the patient's well-being are executed smoothly . In situations where the system operates according to locally developed protocols, someone should have the responsibility of over ruling the protocol if this is in the best interests of the patient, in order to keep the process moving along. Following common pathways to manage patients can save time and reduce errors. In this respect the development of the NICE guidelines for the initial assessment and treatment of standards documents , such as BOAST (British Orthopaedic Association Standards for Trauma), can be downloaded and - printed for display in hospitals and so can support planning and decision making. The development of local pr otocols, NICE guidelines and BOAST documents has contributed to the establishment of specific treatment pathways and to improved patient care and outcomes. Nonetheless, caution should prevail as, once a diag - nosis (label) has been made, the pathway is set and it may not - be in the patient's best interests if the diagnosis is misleading and troublesome. For instance, an older male patient fell in his - garden and sustained a wrist fracture. He was given the label of 'accidental fall and wrist fracture', placed in a plaster of Paris back slab and arrangements were made for him to be admit - ted for fracture stabilisation. However, this patient had a num - ber of medical comorbidities (heart failure, epilepsy , previous - myocardial infarction and high blood pressure). Consequently , - the label given as 'accidental fall and wrist fracture' may be associated with mor e severe underlying pathology and injuries. - The wrong label may disguise the seriousness of the injuries sustained and the patient's condition may rapidly deteriorate, putting their life at risk. Thus, the first clinician in the diagnos - tic chain has disproportionate responsibility . Early inappropri - ate assessment and incorrect labelling could place the patient on the wrong treatment care pathway . This can be avoided by conducting appropriate physiological triage with senior input. Beyond the first hour The objective of the first (golden) hour is to reach the end points of resuscitation and completion of the diagnostic procedures identifying the injuries sustained.

However, in polytraumatised patients, further interventions are necessary . For example, a spleen laceration, a lung contusion, a vertical shear pelvic fracture, an open right tibial fracture, a left femoral fracture or a distal humerus fracture are injuries necessitating treatment. The spleen laceration may be managed non-operatively or with embolisation, depending on its severity . The timing and priority of fixation of the other skeletal injuries and the type of fixation have been points of much discussion during the past decade. Two treatment strategies have prevailed: early total care (ETC) and damage control orthopaedic (DCO) surgery . Since the late 1990s the ETC approach (fix all fractures early within 24 hours) revolutionised the management of pa tients with mul - tiple injuries. This practice became the gold standard of treat - ment for polytrauma patients. Nonetheless, in specific groups of patients, for example those with severe chest and/or head injuries or those in an extreme physiological state (with ongo - ing bleeding from di ff er ent sources such as the abdomen, pelvis and chest), it was observed that the ETC concept led to early complications and mortality . With the advances made in the fields of molecular medi - cine, biology , intensive car e and immunology the physiological response to injury was better understood. It was appreciated that the trauma sustained at the scene of an accident (first hit) induces an immune–inflammatory reaction tha t evolves with time and can prime the patient to reach an uncontrolled physiological state. Subsequently , surgical interventions can exhausting the biological reserve of the patient and leading to the development of adult respiratory distress syndrome (ARDS), multiple organ dysfunction syndrome (MODS) and mortality . These observations led to the acceptance of the so-called DCO philosophy , which is also called damage control surgery (DCS) in more generalised settings (see later chapters). The stages of DCO are: /uni25CF resuscitation; /uni25CF haemorrhage control; /uni25CF decompression; /uni25CF decontamination; /uni25CF fracture splintage. Application of the DCO concept includes temporary stabi lisation of long bone fractures and pelvis with external fixators. This approach allows rapid procedures to stabilise the a ff ected bones as part of the resuscitation process. Definitive fixation of the fractures (conversion of the external fixators to intramed ullary nailing for the femur and plating of the pelvis) would usually take place 4 days later, when the physiological state of the patient has been normalised, or even later if necessary . The two stra tegies of fracture fixation – the ETC and DCS – are currently practised on the basis of some specific criteria. 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The patient’s response to injury

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Immediately after the traumatic event, physiological reactions are initiated as part of the body’s homeostasis mechanisms to preserve vital organ functions and to maintain survival. Initial responses represented by the so-called acute-phase response may be altered as the insult of injury evolves and deterioration of the patient’s condition may occur. It is essential therefore that the timing and nature of inter - ventions should be altered accordingly . Reversal of haemody - namic instability due to ongoing bleeding must be carried out promptly in order to avoid the development of coagulopathy and secondary damage to vital org ans (i.e. the brain) due to hypoxia. It is important to monitor the patient’s physiological state, including body temperature, degree of oxygenation and organ perfusion. Low body temperature is commonly present the patient with appropriate blankets during transportation, resuscitation and surgery will reduce the risk of hypothermia, coagulation disturbances and ongoing bleeding. Administra tion of inspired oxygen or ventilation, if required, will improve the patient’s degree of oxygenation. Ongoing blood loss is associated with low blood pressure, reduced perfusion of the extremities (skin discoloration), tachycardia and an altered level of consciousness. Normally , vasoconstriction and endogenous clotting factors are activated to stop the bleeding in order to maintain adequate circula tory volume. A further consideration is that traumatised lung parenchyma cannot tolerate surplus fluid. Therefore, the lat est resuscitation guidelines advocate a r eduction in crystalloid administration and the early transfusion of blood products. Furthermore, there is a need to quickly identify the source of bleeding and stop loss of blood. Another important part of the response to injur y is activa tion of the immune–inflammatory system. Acute-phase medi ators are released systemically , stimulating polymorphonuclear leukocytes to interact with the endothelium via the expres sion of surface receptors (integrins). If certain conditions are met extravasation of leukocytes may take place , particularly into the lung parenchyma, causing autodestruction. Clinical decisions should aim to minimise the risk of an exaggerated immune–inflamma tory reaction. Surgical procedures, which can act as a second insult, where injury is considered the first, should be carefully timed and selected. The patient’s response to injury

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The response to patient factors

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Injuries presenting with increased frequency in an individual patient require special attention. Older patients, perhaps with multiple medical problems, can represent such a vulnerable group. The reduced bone mineral density making their Response to the mechanism of injury /uni25CF /uni25CF /uni25CF skeletons ‘fragile’ is associated with an increased risk of frac ture. Hip fractures, wrist fractures, spinal fractures and pelvic fractures are just some of the many results following minimal trauma. The risk of fracture is increased with the presence of comorbidities such as visual impairment, Par kinsonism or transient ischaemic heart attacks. Consequently , knowing the parameters associated with a particular group of patients, attempts can be made to reduce the number of patients requir ing treatment. For instance, prescription of bone protection therapy and addressing medical comorbidities early (e.g. cataract surgery) may help to reduce the number and severity of injuries sustained. Development of specific guidelines and protocols can facilitate the much-needed implementation of unified measures allowing easy patient access and treatment. Summary box 26.11 Response to patient factors /uni25CF /uni25CF /uni25CF

Be alert to identifying frequent patterns of injury Many stakeholders, including clinicians, should engage in injury prevention Legislation and education are essential Older patients may be vulnerable to injury, owing to poor bone stock and other comorbidities Bone protection treatment is essential Development of local and national guidelines to respond to patient factors is desirable

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Injuries presenting with increased frequency in an individual patient require special attention. Older patients, perhaps with multiple medical problems, can represent such a vulnerable group. The reduced bone mineral density making their Response to the mechanism of injury /uni25CF /uni25CF /uni25CF skeletons ‘fragile’ is associated with an increased risk of frac ture. Hip fractures, wrist fractures, spinal fractures and pelvic fractures are just some of the many results following minimal trauma. The risk of fracture is increased with the presence of comorbidities such as visual impairment, Par kinsonism or transient ischaemic heart attacks. Consequently , knowing the parameters associated with a particular group of patients, attempts can be made to reduce the number of patients requir ing treatment. For instance, prescription of bone protection therapy and addressing medical comorbidities early (e.g. cataract surgery) may help to reduce the number and severity of injuries sustained. Development of specific guidelines and protocols can facilitate the much-needed implementation of unified measures allowing easy patient access and treatment. Summary box 26.11 Response to patient factors /uni25CF /uni25CF /uni25CF

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The significance of time in the outcome

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Injuries can happen at lightning speed. Time point 0 (time 0) is defined as literally the seconds prior to the event, when the patient is at their normal baseline. All subsequent events, including the acute physiological response to injury , the body's internal mechanisms to maintain homeostasis (to compensate for the sequelae of trauma), the healing processes and the actions instigated by health professionals, are associated with a 'timeline'. This 'timeline principle' is crucial to a deeper understanding of how to prioritise assessment, investigation and treatment in what may be a rapidly evolving situation following injury . There is an optimal time window during which an intervention can have a radically positive e ff ect on treatment outcome. Based on this timeline, interventions may be grossly categorised as emergent (life-saving), acute (restoring and maintaining physiological and physical stability) and delayed or semielective (focusing on the treatment of post-fracture fixation complications [non-union, infection and malunion from the orthopaedic trauma point of view]). In the immediate aftermath of a major trauma, the physiological crisis continues to evolve, the risk of death is increased and less appropriate and prompt interventions are carried out. Potentially rapidly ev olving situations, such as airway obstruction, tension haemothorax and haemopericardium, if left untreated, will inevitably have catastrophic consequences and therefore should be given priority in terms of the initial medical response to an injured patient. Thus, the seriousness and the immediate impact of a specific clinical condition should dictate its prioritisation, leading to a systematic approach ('what kills first should be managed first') (Figure 26.2). - The Advanced Trauma Life Support (ATLS) system delineates an order of priorities defined by ABCD; that is, airway , breathing, circulation and disability (neurology). This hierarchy of priorities is based on the 'time dependence' prin - ciple. In other words, the time taken to manage an individual problem is the sum of the time taken to identify it and to execute e ff ective treatment (Figure 26.3). In such settings, time is crit - ical, so the normal history and physical in vestigations are not performed during the ATLS primary survey , but the primary focus is on detecting and identifying individual problems, rank - ing them in order of priority and dealing with them e ff ectiv ely and e ffi ciently in their appropriate timeframes. The clinician should take into consideration the mechanism of injury and initial clinical findings then promptly request and carry out specific investigations, f or e xample computed tomography (CT) scans. This is to allow rapid and precise iden - tification of injuries that may benefit from early therapeutic intervention and that otherwise might be clinically challenging as the initial signs may be subtle or non-specific. This pro - active approach is critical, as the e valuation and diagnosis of an important injury may be di ffi cult before the full-blown and potentially life-threatening presentation of that injury . A typical example would be an RT A victim with a scalp laceration and a reduced Glasgow Coma Scale (GCS) score of 13/15; such a dr op in the GCS could be explained by head

Airway obstruction Intra-abdominal bleeding External haematoma Ischaemic limb 0 Time Figure 26.2 Estimated time from incident to death or irretrievable damage for various conditions. Overall timeline for generic injury Death Assessment time Response time 0 Time Figure 26.3 Diagrammatic representation of the relationship between assessment and response times. In this example, there is time to assess and respond effectively before death.

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