
Mechanism of Injury

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INTRODUCTION

Information about the Mechanism of Injury (MOI) can help identify up to 90% of a patient's injuries¹ and give the trauma team an accurate picture of what injuries the patient may have sustained. For the traumatised patient, the importance of such knowledge cannot be underestimated, as an accurate MOI can reduce morbidity and mortality.

Information about the MOI can be gained from the patient where appropriate, from witnesses or from the Emergency Services. However although determining the MOI is an integral part of the initial patient assessment, if the information is not available this should never delay the primary survey and the detection of life-threatening injuries.

The aim of this chapter is to identify the common MOIs that cause traumatic injury and how knowledge of this can assist in the assessment and resuscitation of the trauma patient.

LEARNING OBJECTIVES

At the end of this chapter the reader will be able to:

- Understand the principles of energy transmission
- Understand the difference between blunt, penetrating and blast trauma
- Demonstrate how to relate specific MOIs to certain injury patterns
- Understand the importance of MOI in the assessment, management and ongoing evaluation of the trauma patient
- Identify trauma scoring systems.

MECHANISM OF INJURY – AN OVERVIEW

Trauma is the leading cause of death in this country under the age of 40 and its effects on society are huge.² Disabilities caused by traumatic injuries lead to huge costs for the NHS, through the need to treat and rehabilitate patients, and to employers, who lose working hours and may then need to support an individual's return to work.

In addition there is usually a huge emotional and physical burden placed on the patients themselves, their families and friends, which can be devastating and far-reaching.

Mechanism of injury can be divided into four kinds:²

- Blunt
- Penetrating
- Blast
- Thermal.

98% of the trauma in the UK is blunt injury, and other mechanisms make up the rest. Thermal trauma is covered in chapter on burns (see Chapter 9).

The injury that a patient sustains is dependent on several factors: most importantly, it depends on the amount of *energy transmission* that has taken place. Surface area and tissue elasticity are also factors to take into consideration and these will be discussed later in this chapter.

The transmission of energy is sometimes known as velocity or impact energy.

Energy transmission can be considered as a shock wave that moves at various speeds. Energy is carried at the front of the wave and is concentrated in a small space.¹ Energy cannot suddenly disappear, it has to decrease, usually by being absorbed by something else.

Consider a car accident: a car travelling at 40 mph contains a considerable amount of energy. If the car stops suddenly, during a collision with another vehicle for example, the energy will dissipate through the car, and some of this may be transferred to the occupants, potentially causing injury to tissues, organs and bones.

Alternatively think of a bullet: when it is fired from a gun it leaves the barrel at a very high speed. As it travels through the air it will lose energy but if it enters a body there may still be sufficient energy to cause damage, as the body absorbs the rest of the energy.

Injuries caused as a result of energy exchange do not always manifest themselves immediately, so it is important that evaluation is ongoing, so injuries which may appear more slowly can be anticipated and dealt with.

PRE-HOSPITAL INFORMATION

The Emergency Services can be invaluable in providing information about the MOI and about any physical evidence at the scene. A summary of information which may be helpful for the assessment of the patient can be found in Table 1.1.

Occasionally there may be no obvious injury to the patient which can make assessment difficult. However, if the Emergency Services have said there is strong evidence of significant transfer of energy, the patient should always undergo a detailed assessment.

As this chapter will illustrate, certain MOIs can be predictive of serious injury and for pre-hospital personnel there are criteria for alerting the receiving hospital.² These criteria can also be used by the emergency department (ED) if a patient arrives via means other than the Emergency Services and a typical list of this type of criteria can be seen in Box 1.1.

BLUNT TRAUMA

Blunt trauma is the most common MOI in most parts of the UK² and is the result of energy transfer leading to tissue compression.³ Blunt trauma is sustained through the following types of incidents:

1. Road Traffic Accidents (RTAs) with the patient in the vehicle
2. Pedestrian impact
3. Cycle and motorcycle accidents

Table 1.1 Pre-hospital information required

Type of event, e.g. RTA with frontal impact, fall, penetrating injury	To understand the basic mechanism
Estimation of energy exchange, e.g. speed of vehicle, distance of fall	To consider the potential for significant injury
What was involved in the impact, e.g. car, tree, concrete, knife	To understand the type of injuries present, e.g. a knife will produce low impact injuries but a gun will produce medium–high impact injuries. A fall onto concrete can produce significant high impact musculoskeletal and organ injury
Were there any clues at the scene?	Some information can be very helpful, e.g. a deformed steering wheel can indicate chest impact, and a bulls-eye break in the windscreen can suggest a head or cervical spine injury. Both suggest significant energy transfer
If drugs or alcohol were known to be involved	To be aware that the patient may still be under the influence of these, which can make assessment more difficult
Past medical history (PMH) and events immediately before the accident	To determine if there was a medical event prior to the incident
Treatment at scene	To help inform ongoing management in the ED
Patient status since incident	To understand how the patient responded to any treatment given and if there is any improvement or deterioration in their condition

4. Assaults

5. Falls.

1. Road Traffic Accidents (RTAs)

When a car comes to a stop, the energy from the moving vehicle will be transferred to the vehicle itself, and then in turn to the occupants. If deceleration (slowing down) takes place slowly, such as over a longer distance, injuries can be less severe. However, deceleration forces, and therefore significant injury, can be much greater if the vehicle comes to a sudden

Box 1.1 Mechanisms of injury which suggest the potential for serious injury

- Fall of >6 m
- Pedestrian or cyclist hit by a car
- Death of other occupant in the same vehicle
- Ejection from the vehicle/bike
- Major vehicle deformity or significant intrusion into the passenger space
- Extrication time >20 min
- Vehicle rollover
- Penetrating injury to head or torso
- All shotgun wounds

stop.³ This is because the energy level, or velocity, exceeds the tolerance level of the tissue. This leads to tissue disruption and injury.¹

The nature of the materials involved in the collision and the way in which the energy is dispersed is significant.³ Modern vehicles are fitted with impact or 'crumple' zones at the front and back which collapse progressively, to absorb as much impact as possible and keep the energy away from the occupants.³ Larger vehicles tend to be safer than smaller ones. However, regardless of safety features, any significant transfer of energy puts the occupant at risk of serious injury.

RTAs can be categorised according to the type of impact (Box 1.2). The sub-category refers to the nature of the injury that the patient sustains, i.e. *occupant collision* indicates a collision between the occupant and the inside of the vehicle, or outside if they are ejected; and *organ collision* indicates the impact between the patient's organs and the internal framework of the body. Some patients can suffer both.

Occupant collision: frontal impact

A frontal impact is a collision with an object in front of the vehicle, which suddenly reduces its speed.¹ It accounts for the majority of injuries and deaths sustained in RTAs. As the

Box 1.2 Categories of road traffic accident**Occupant collision**

Frontal
Lateral
Rear
Rollover
Ejection

Organ collision

Compression injury
Declaration injury
Restraint injury

vehicle comes to a stop the occupant(s) continue to move forward with the same speed as the vehicle, until something stops them.¹ This could be the steering wheel, dashboard, windscreen, or ground if the occupant is ejected. Frontal impacts cause shortening of the car as the bonnet caves in and the engine and dashboard are forced backwards into the passenger compartment.² Any such deformity of the passenger compartment indicates a significant impact.³

In this type of impact, lower limb injuries are common as they get trapped by the engine and dashboard, or impact against pedals.² The occupant hitting the steering wheel can result in blunt torso injuries to structures such as the liver, spleen and stomach, as well as fractured ribs, sternum and flail chest. Finally head, face and cervical spine injuries can result from impact against the steering wheel or windscreen.

The occupant can also follow a *down and under* pathway, whereby they slide under the dashboard.¹ This can lead to fractures and dislocations of the ankle, knee, femur and femoral head.^{1,3}

Rear passengers can sustain injuries as well, especially if unrestrained. Any unrestrained passenger can sustain severe

facial injuries from being thrown forward. In addition front seat passengers are at risk of being injured by unrestrained rear passengers who are thrust forward.

Occupant collision: lateral impact

A lateral impact occurs when a vehicle is hit from the side and the occupant is accelerated away from the point of impact. Lateral impact RTAs are second only to frontal impacts in terms of injury and death,¹ and 75% of victims of lateral impacts are over the age of 50.

Case study 1.1 Lateral impact injuries

A 75-year-old man is pulling out of a side street in his car and is hit on the driver's side by a car estimated to be travelling at 35 mph. According to witnesses he was unconscious for a period of 2–3 minutes. At the scene it is noted that there is a crack through the window on the driver's door.

On arrival to the ED the Emergency Services report that he was conscious on their arrival but complaining of right-sided abdominal and chest pain, as well as neck pain and right upper arm pain. He has a large boggy wound on the right side of his head, an increased respiratory rate (RR) and tenderness on the right side of his chest. His right upper arm is bruised and swollen.

Injuries will relate to which side the force was applied, so a lateral impact to the driver's side could potentially result in injuries to the right side of the body, such as a liver laceration, whereas a left-sided impact may result in a passenger sustaining a ruptured spleen.

Victims can also sustain lateral flail chest injuries, pulmonary contusion and kidney injury. If the force is significant enough the occupant may be pushed from one side of the car

to another, leading to injuries on both sides. The head can also be injured if the victim strikes another occupant of the vehicle or hits their head on the window the same side as the collision.³

A lateral impact may also cause upper and lower musculoskeletal injuries, typically fractures to the pelvis, ribs and upper arm, with associated internal injuries.² Neck injuries can occur in addition, as a result of a lateral impact.

Occupant collision: rear impact

These impacts differ from frontal and lateral impacts, as they often occur when the vehicle involved is already stationary, and is struck from behind. However, like a lateral impact, the occupant is accelerated forward due to the energy transfer from behind.¹ This may subsequently lead to the vehicle being propelled forward leading to an additional frontal impact.

Injuries that occur in this type of impact are predominantly whiplash injuries, caused by hyperextension of the neck and often exacerbated by a poorly functioning head-rest.^{1,4} Fractures of the cervical spine can also occur.

Occupant collision: rollover

When a car rolls over the energy can be dissipated over a long distance, which can sometimes minimise injury to the occupants, particularly if they are restrained.^{3,4} However, the chaotic and multiple movements sustained in a rollover can and do cause significant injury and these should always be excluded.

During a rollover, injury severity can depend on whether the occupant was restrained or unrestrained. An unrestrained occupant can impact on any part of the vehicle interior¹ or could be ejected.⁴ Musculoskeletal injuries to any part of the body may occur, with associated internal organ damage.

Roof collapse can lead to significant head injury⁴ and compression fractures of the spine are common. Figure 1.1 illustrates a rollover with extensive roof damage.



Fig. 1.1 Vehicle rollover RTA. (Permission given by K Brohi. Source www.trauma.org)

Occupant collision: ejection

If the patient is ejected from the vehicle, the likelihood of serious injury increases by 300%^{1,4} as there has been sufficient energy transfer to force them from the vehicle and they will have hit the ground at considerable speed.² Anyone else in the vehicle that has not been ejected may still have been subjected to severe energy force.

Organ collision: compression injury

Compression injuries occur when the anterior (front) part of the torso stops moving forwards and the posterior (back) portion of the torso and internal organs continue to move forward. This leads to compression of the organs from the posterior part of the internal chest and abdomen,¹ but can also occur inside the skull causing brain injury.³

Examples of compression injuries include:

- Blunt myocardial injury
- Lung contusion
- Flail chest

- Pneumothorax
- Bowel injury.

Organ collision: deceleration injury

These injuries occur when a vehicle or person comes to a sudden halt, after moving at speed.³ When the body stops moving forwards the stabilising part of an organ also stops moving, but the organ itself continues to do so. This can lead to a shearing force which can detach the stabilising structure from its organ.

Examples of this type of injury are to the kidney and spleen, which both shear away from their respective pedicles. In the brain, the posterior part of the brain separates from the skull, tearing vessels in the process,¹ leading to cerebral contusion.³ The aorta can rupture in a high speed RTA, where deceleration leads to the aortic arch shearing off from the descending aorta, an injury which is usually fatal in seconds.²

Organ collision: restraint injury

The use of three-point restraint seat belts has been shown to reduce death in RTAs by up to 70%.¹ However, if used incorrectly, and sometimes when used correctly, injuries can occur.

To function correctly the lap portion of the seat belt must be below the anterior/superior iliac spines and above the femur,¹ and must be tight enough to remain in place during any impact.

If it is worn incorrectly, such as too high, then the forward motion of the posterior abdominal wall and spine can trap organs such as liver, pancreas, spleen or kidney against the belt at the front. This can result in burst injuries and lacerations to these organs¹ such as duodenal rupture.² The shoulder portion of a seat belt can cause neck injury if worn too high.³

Even when a belt is applied correctly the energy exchange can be sufficient to lead to injuries such as:



Fig. 1.2 Restraint injury. (Permission given by K Brohi. Source www.trauma.org)

- Fractures of the clavicle
- Cardiac contusions
- Pneumothorax
- Rib and sternal fractures.

Pattern bruising over the abdomen or chest from a seat belt suggests significant energy exchange and the trauma team should be suspicious of associated internal injury² (Figure 1.2).

Availability of airbags in vehicles may reduce injuries in frontal impacts, and side impacts.^{1,4} They work by spreading the deceleration forces over a large area and so reduce forward movement and impact.³ However, they provide no protection in rollovers or rear impact and can actually cause injury to patients who are not in the usual position, such as facing backwards when the airbag is set off.⁴ Once activated airbags can cause friction and heat burns.³

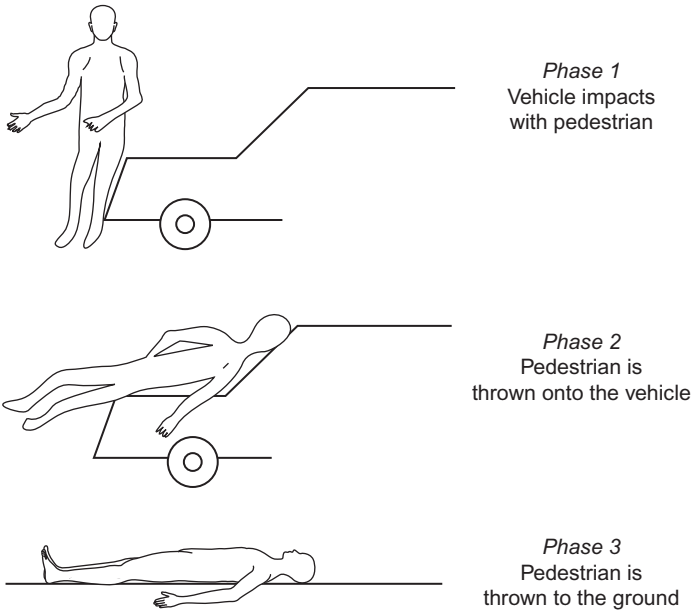


Fig. 1.3 Three phases of injury

2. Pedestrian impact

Pedestrian injuries are primarily urban in nature and children make up a large proportion of those killed or injured every year.¹ The type of injuries seen in pedestrian impact are predominantly thoracic, head and lower extremity, due to the three-phase nature of the impact involved in a pedestrian incident (Figure 1.3).

These three phases consist of:

1. The *vehicle-bumper* impact
2. The *vehicle bonnet and/or windscreen* impact
3. The *ground* impact.

Injuries sustained during the vehicle-bumper impact will vary with the height of the victim; in an adult the impact would

normally be against the legs and pelvis¹ whereas a child may sustain blunt chest and abdominal injuries. Different types of vehicles, such as lower riding sports cars, or higher four wheel drive vehicles, will also alter the impact point. Information about the type of vehicle is helpful in determining probable injury patterns. If a patient is hit by a bus or lorry, they may either be thrown to the side of the vehicle or dragged under.² This can result in any part of the body being run over or dragged along beneath a vehicle.

After the victim has hit the bumper, they may then be thrown onto the bonnet and can impact with the windscreen as well.^{1,4} Occasionally patients may be thrown over the roof of the car, if the impact is great enough.² Types of injuries sustained during this phase will be dependent on which part of the body impacts with the car, and at what speed the incident occurred at.

Finally the victim will fall from the bonnet (or roof if the speed was great enough), and impact with the ground. This will typically cause head and neck injuries as the victim falls to the ground. Organ compression can also occur as the patient comes to a stop.¹ At this point the patient may also be at risk from being run over by other vehicles in the road.

Running-over injuries occur when the vehicle, or part of the vehicle, goes over the victim or may even drag them along the road. Severe injuries can occur to any part of the body³ and these are often immediately life threatening.

Due to the lower point of impact, children may be prone to being thrown to the side or under the vehicle,² although they too can be forced onto the bonnet if conditions are right. Children will often turn to face the car before impact, thereby turning the impact into a frontal one,² whereas adults tend to turn away.³

3. Cycle and motorcycle accidents

Cyclists and motorcyclists (and their passengers) may sustain compression, acceleration and deceleration, and shearing injuries.¹ Motorcyclists are afforded some protection if they

are wearing appropriate clothing, such as leathers, boots and gloves, and there is a legal requirement for motorcyclists to wear a helmet. Despite this most motorcycle deaths are as a result of head injuries.³ Tight leather trousers, such as those worn by motorcyclists, can help to reduce blood loss in lower limb fractures.³

Cyclists however may have a lot less protection and despite the evidence showing that helmets reduce the incidence of head injury by 85%,¹ there is no legal requirement to wear one.

For cyclists and motorcyclists, there are common MOIs which can predict injury patterns, although injuries can be more severe for motorcyclists due to the speeds involved.²

In a frontal impact the front wheel of the cycle/motorcycle collides with an object and stops. The rider, however, will continue to move forward until something stops this momentum, such as the ground or another stationary object.¹ During this event, the head, chest or abdomen can impact with the handlebars leading to blunt trauma to these areas, such as pelvic fractures and injuries to the organs contained within.

If the cyclist is ejected from the bike, femoral injuries may occur as a result of impact with the handlebars.¹ The final impact, with the ground, can result in other injuries such as spinal fractures.

If the cyclist is hit from the side, they may sustain open or closed fractures, or crush injuries, to the lower limbs¹ as well as ejection and ground-impact injuries as described above. Ejection from the bike may also lead to the patient being involved in a further incident with another vehicle. Friction burns may occur as the victim slides along the ground.³

Another common MOI with cyclists is known as 'laying the bike down': to avoid being trapped between their cycle/motorcycle and another object, the cyclist may turn the bike sideways and drop the bike and inside leg onto the ground,¹ in order to slow themselves down. This can lead to significant fractures and/or soft tissue injury to the lower limbs.

4. Assaults

Victims of assaults are most commonly young males⁴ and alcohol is often involved. Injuries sustained during an assault will vary according to the force and instruments used. A minor blow to the head can produce a scalp haematoma or wound, whereas a harder blow can lead to a skull fracture, cerebral contusions and extra- or subdural haematomas.²

Commonly defensive injuries may be present, such as trauma to the limbs, hands and back,² where the person has tried to protect themselves. Head and facial injuries are also common and a victim that has been kicked or stamped on whilst on the ground may also sustain significant injuries to their torso.⁴

5. Falls

Falls predominantly affect the under-5 and over-60 age groups. They produce injury through deceleration and the severity of injuries depends on several factors:

- The *height* of the fall and therefore the speed of impact
- The contact *surface* that the victim lands on
- The *position* on impact.

The greater the height, the greater the velocity and so the greater the deceleration when the victim comes to a stop.³ As a general guide, falls from three times the height of the victim result in serious injury such as those described in the deceleration section above.

If the surface that stops the fall is hard, such as concrete, the injuries can be more severe as the rate of deceleration is increased¹ and all the energy is transferred to the body.⁴ This can result in compression injuries as described earlier.

Although the information is not always available, the position of the body on impact can also help to determine the nature of injuries that the patient may sustain. In a fall if someone lands on their feet, energy will be transferred via the bones of the lower limbs to the pelvis and then the spine, resulting in calcaneal and femoral neck fractures and injuries

to the vertebra.¹ If the person lands on their back, energy transfer takes place over a wider area and so tissue damage may be less severe.

In the older person co-morbid conditions should be considered, such as heart disease or chronic respiratory problems, which may have contributed to the fall.⁴

PENETRATING INJURIES

Penetrating injuries constitute gunshot wounds, stab wounds and impalements.

The severity of injury will depend on the velocity of the penetrating force:

- Stab wounds are low velocity
- Handguns are medium velocity
- Military rifles and shotguns are high velocity.

The velocity of an impalement injury will depend on how it was caused, but are usually low to medium energy.

The same principles of energy transmission occur with penetrating wounds, as with all other types of trauma. However, in penetrating wounds it is discussed in terms of cavitation.

Cavitation

Cavitation occurs when an object, such as a bullet or knife, collides with tissues. At the point of collision the tissues move away from the object causing a cavity. The amount of cavitation produced is directly proportional to the amount of energy transferred and will also depend on the density of the tissues, the size of the front aspect of the penetrating object and the elasticity of the tissues.³ In penetrating trauma there is both temporary and permanent cavitation.

Gunshot wounds

Gunshot wounds are medium or high velocity and the severity of the injury largely depends on what the velocity is, as this dictates how much energy is transferred to the tissues.² In a penetrating injury, this energy will form a cavity, as

described above, and the characteristics of this cavity will influence any subsequent injury.⁵

High energy weapons such as hunting rifles and assault weapons generally cause much greater damage because they create much larger cavities,³ extending far beyond the track of the bullet. These blasts can carry clothing and debris into the wound, by creating a temporary vacuum which sucks detritus into the wound.² This can result in infection if the debris is not removed.¹

High velocity wounds can be lethal at close range although injury becomes less severe as the distance between the gun and victim increases.¹ Information about how close the firearm was when it was discharged can therefore be helpful. However, the majority of shootings take place at close range with handguns, and so the potential for severe injury is significant.³

Medium velocity wounds such as those from handguns do not usually produce extensive cavitation.²

The amount of tissue damage will also be influenced by the density and elasticity of the tissues involved. A bullet from a firearm will dissipate a huge amount of energy to the tissues and in general the denser the tissue the greater amount of energy transferred, and the greater degree of damage.⁵

Solid organs such as the brain and liver are surrounded by a rigid or semi-rigid casing and have very little elasticity and so absorb a lot of energy² leading to devastating injuries. Bones, which also have no elastic recoil may shatter on impact whereas the lungs, which are less dense and more elastic, are less likely to be affected by cavitation as they absorb less energy.²

Some bullets are designed to increase the amount of damage they cause¹ by flattening, fragmenting or exploding on impact, to increase the amount of cavitation and tissue damage.² If the velocity is high enough, the resulting cavity can be up to 30 times the diameter of the bullet.¹

As well as an entrance wound, there may also be an exit wound. Depending on the velocity and site of entry, the missile will follow the path of least resistance and may exit

the body.¹ Entrance wounds may have powder burns or tattooing around the edges and exit wounds tend to be ragged.¹ There can be multiple exit wounds.³

The presence of two wounds however does not always indicate an entrance and exit, but may in fact be two entrance wounds, with bullets still in situ.¹ Estimating the path of the bullet should not take precedence over assessing and stabilising the patient.

Stab wounds

These low energy wounds cause direct tissue damage along a straight track² and knives are the commonest instrument used. If a weapon remains in the body it should be left until it can be safely removed by a senior surgeon. This should be carried out in a resuscitation setting or theatres as removal may cause haemorrhage to occur.²

Case study 1.2 Penetrating injury

A man in his early twenties is brought to the ED by a group of friends. He has been involved in a fight and has blood on his face and shirt. He is taken to the resuscitation room for assessment. The nurse notes that he has a number of slash wounds to his face, hands and wrists, although these are not actively bleeding. After getting the patient undressed a small stab wound is located beneath his right armpit measuring 1 cm in length. Despite this seemingly small injury the nurse notes that the patient looks pale, has difficulty in taking deep breaths and is tachycardic with a pulse of 118. The trauma team is immediately summoned.

A patient who has been stabbed may only appear to have a small wound but this will initially be of unknown length and so should be subject to careful assessment.⁵ 25% of penetrating abdominal injuries also involve the thorax as well and should

be assessed to exclude such injuries.³ Wounds to the chest below the nipple line may also involve the abdomen.

If the information is available, it can be useful to know if the assailant was male or female, as men tend to stab upwards and women tend to stab downwards. This can be useful in trying to determine the path of the knife and the possible injuries.

Impalements

These are predominantly accidental and often involve a larger object than a knife,⁵ such as machinery, a fence post or railings. Victims of impalements may need to be assessed with the object still in situ. Like stab wounds, if the impaling object is still in situ it should only be removed after careful assessment: more often than not this is in an operating theatre.

BLAST INJURIES

Explosions have the potential to cause multi-system, life-threatening injuries in one or more victims and need careful assessment and management.⁶ More recently the need to also screen for signs of radiation and/or chemical contamination of the patient has been highlighted. Such patients may require specialist decontamination at the scene of the blast or on arrival at the ED.

In a blast there is a huge release of energy, known as a shock front or blast front, which spreads out rapidly and will cause damage to whatever is in its path, whether this is people or buildings. The further away from the centre of the explosion the shock front travels, the less energy it carries with it.²

Blast injuries are classified as:

- Primary
- Secondary
- Tertiary.

Primary blast injuries

These injuries result from the direct effects of the pressure wave and are most damaging to air-containing organs such as

the eardrum (tympanum), lungs and gut.¹ Bruising, oedema and rupture of lung tissue, sometimes leading to pneumothorax, can occur^{1,2} and the alveoli and pulmonary veins may also be ruptured, leading to potential air embolism. Intraocular haemorrhage, as well as retinal disruption, may be present and intestinal rupture can also occur.¹

The tympanic membranes may rupture and presence of this injury suggests that significant exposure has occurred,² and although serious injury may not be present, it should nevertheless be excluded. Evidence of tympanic membrane rupture should lead to the patient having a chest x-ray to exclude chest injury such as pulmonary contusion.

It should also be remembered that absence of this injury does not preclude the presence of other serious injuries. Patients with these injuries are usually suffering from temporary hearing loss and so communication can be difficult.

Secondary blast injuries

These result from flying objects, disturbed as a result of the blast, hitting the patient. Depending on the nature, location and force of the blast, these may be a combination of blunt and penetrating injuries to any part of the body.

Tertiary blast injuries

These occur when the patient is lifted and thrown by the force of the blast, and are sustained when they impact against something, such as a wall or the ground. Again this may cause both blunt and penetrating injuries depending on the nature of the blast. They are characteristic of high energy explosions⁶ and traumatic amputations are common.

INJURY SCORING SYSTEMS

Injury scoring systems are used to determine the potential for someone having sustained a serious injury.^{7,8} They are useful in situations where there is more than one casualty, as they allow Emergency Services and ED personnel to prioritise the

Box 1.3 Injury scoring systems

The Injury Severity Score (ISS) is one of the most widely used and is an anatomical system which provides an overall score for each patient. Patients are given a score for each injury related to one of six body regions:

- Head
- Face
- Chest
- Abdomen
- Extremities
- External

The highest score for each region is squared and added together to produce the ISS score

The Revised Trauma Score (RTS) is a scoring system based on the physiological signs of the patient. Scores are given for the first set of readings of:

- Glasgow Coma Scale (GCS)
- Systolic BP
- Respiratory rate

The totals are added together and the lower the score, the more seriously injured the patient is

The Abbreviated Injury Score (AIS) scores injuries from 1 (minor) to 6 (fatal)

more severely injured patients.⁷⁻⁹ Commonly used scoring systems include (Box 1.3):

- The Injury Severity Score (ISS)
- The Abbreviated Injury Score (AIS)
- The Revised Trauma Score (RTS).

To assist in calculations of the scores, the Trauma Injury Severity Score (TRISS) calculator determines the probability of survival from the ISS, RTS and the patient's age.¹⁰

CONCLUSION

Mechanism of traumatic injury can be categorised as blunt, penetrating and blast and each will produce distinct injury patterns. An awareness of the mechanism of injury a patient may have sustained, as well as detailed assessment in the ED, can be invaluable in helping to predict the nature and severity of their injuries. This in turn can reduce morbidity and mortality.

KEY INFORMATION BOX

- Pre-hospital information about the scene of the incident can indicate potential injuries
- A significant mechanism of injury should cause a high index of suspicion
- Injury can be caused by force from outside of and within the body
- A fatality at the scene is predictive of severe force
- Penetrating injuries may seem innocuous but there may be significant damage beneath the wound
- Primary blast injuries may cause deafness due to ruptured tympanic membranes – this can be indicative of lung and gut injuries
- Injury scoring systems can help predict injury severity, morbidity and mortality in a single or group of patients.

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