Emergency care of patients with gunshot wounds


Summary
This article provides an overview of the mechanism of ballistic injuries. It also explores the management of patients with gunshot wounds in the emergency department.

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Aims and intended learning outcomes
THIS ARTICLE AIMS to increase your knowledge and awareness of the skills needed to care for patients who present to the emergency department with wounds sustained as a result of gun and firearm injuries. It explores the mechanisms of ballistic injuries and the effects on the body’s systems, as well as examining the care and management of patients with gunshot injuries. After reading this article you should be able to:
• Outline the prevalence of gunshot injuries and their impact on nursing.
• Understand the principles of ballistics and factors affecting the type and severity of firearm injuries.
• Explain the legal considerations when caring for patients with gunshot wounds.
• List the possible injuries that can be caused by gunshot wounds and describe gunshot wound classification.
• Discuss the assessment and immediate care of patients with gunshot injuries.

Introduction
Gun crime and firearm injuries are part of everyday life in some regions of the world, such as parts of South Africa, Iraq and South America. There are relatively few firearm injuries in the UK. However, nurses in emergency departments are expected to be able to care for people who have been subjects of gun crime, and to manage what are often serious injuries and patients who are likely to be experiencing a high degree of fear.
Gun crime and its effects have been prevalent in UK news bulletins recently, with the tragic consequences of the injuries sustained from shootings being reported. Much debate has taken place in the media about the perceived increased use and ease of obtaining firearms. The Greater Manchester Police stated that half of the weapons its officers seized in 2007 can be bought easily over the counter without a licence in many countries (Little 2007).
Figures from the Metropolitan Police show that from March 2008 to March 2009 there were 2,168 incidents of gun-related crime in London. This refers to all offences involving a firearm and includes offences in which a firearm has been seen or discharged/used; real and fake firearms and air weapons are included. The figures represent a 25.8% decrease on the previous year. This appears to be a significant reduction but the figures relate to all gun-related crime and do not give a
breakdown of how many injuries were sustained (Metropolitan Police 2009). The chance of patients who have been injured by guns presenting to emergency departments remains real. Figures provided by the Home Office for England and Wales show that in 2007/08 there were 455 serious or fatal injuries as a result of gun crime, a drop of 3% on the previous year. Gun crime is recorded as 0-3% of all reported crime (Home Office 2007). Figures collated by the King’s Fund, London, show that in 2008 in England and Wales there were 0.15 gun-related deaths per 100,000 of the population. This compares to 3.98 in the United States (BBC News 2008).

Although the incidence of gun-related incidents is fairly low, emergency nurses need a basic knowledge of the principles of ballistic injuries to appreciate and manage effectively patients with gunshot wounds. Lister (2003) argued that, while in the UK other causes of trauma are more common causes of emergency admissions, gun violence is a growing concern for clinical staff.

**Principles of ballistics**
Firearms or guns are weapons that require a source of energy to fire a projectile, usually a bullet. Firearms have historically been divided into four groups (Mukhtar and Jones 2003):

- **Rifles** – this includes handguns, pistols and revolvers, in which the barrel of the gun is grooved, causing the bullet to twist or ‘tumble’ when fired.
- **Smooth bore** – the shotgun is typical of this type, the barrel being a simple tube. The gun releases a large number of pellets, with the number varying depending on the type of gun.
- **Homemade guns** – these are becoming less common due to the increasing availability of other types of weapons.
- **Modified** – this includes weapons that can release other substances, such as gas and rubber bullets.

Bullets comprise a casing mostly made of lead in which is enclosed a charge of powder explosive, that on contact forces the projectile out at speeds of approximately 1.5km/second depending on the type of gun and ammunition. The wounding capacity of a bullet is related to the kinetic energy transferred from the bullet to the body, the flight and type of bullet, and the tissues injured.

A fired bullet gains kinetic energy, which depends on the mass (or size) of the bullet and the velocity of the weapon. Guns are classified as low, medium or high velocity; most bullets are fired from low to medium velocity weapons.

**Factors affecting firearm injuries**
Velocity is the speed at which the bullet travels and is the most significant factor influencing the extent of the wound (Mukhtar and Jones 2003). Laceration is generated by the bullet displacing the tissue on impact and is recognised as the primary wounding mechanism caused by handguns (Ross 1995). Cavitation is the result of the energy exchange between the moving object and the body tissues (American College of Surgeons 2004). This is caused by the shockwaves generated by the bullet, in turn causing compression of the tissue ahead of the bullet. The extent of the cavitation or hole is determined by the shape and size of the bullet. Bullets with large fronts spread or ‘mushroom’ on impact, causing more injury or greater cavitation. As the bullet enters the body a ripple effect of transmitted energy is created. This rippling produces shearing and stretching, causing further damage to surrounding structures (Johnson 1998). This effect has the potential to cause damage up to 30 times the size of the bullet. The pressure in the cavity will cause debris and organisms to enter the cavity. Bullets that hit bone are slowed down but the bone fragments that are produced can act as secondary missiles and cause further damage and increase tissue disruption.

Another factor that influences the extent of firearm injuries is the angle of the bullet at impact, or ‘yaw’. Yaw is the deviation of the bullet from the horizontal line and the main aspect to be aware of is that the later the bullet begins to yaw after impact, generally the greater and deeper the damage will be. ‘Tumble’ is the rotation of the bullet, sometimes described as somersaulting (Dickinson 2004), which also increases tissue damage.

In summary, the speed of the bullet has the greatest impact on the extent of injury, but this is also influenced by the bullet’s tumble and yaw, and the size of the bullet front.

**Legal considerations**
Injuries that result from gunshots are classed as serious crimes and, as such, nurses need to be
aware of the legal, ethical and professional issues involved in caring for these patients. Many staff will be unsure of whether it is permissible to report a patient who presents with a gunshot injury to the police.

The Crime and Disorder Act (1998) is clear that the NHS is a statutory partner in crime prevention, and that sharing information between hospital staff and the police is a way of preventing further crime. Shepherd (2007) writes that this act and the Police Reform Act (2002), as well as data protection and human rights legislation, promote data sharing in the context of prevention, detection and investigation of serious crime.

Gunshot injuries are serious crimes and healthcare professionals have a duty not only to patients, but also to the public at large. The Nursing and Midwifery Council (NMC) (2009) states: ‘You must disclose information if you believe someone may be at risk of harm, in line with the law of the country in which you are practising.’ The NMC also points out that:

‘Under common law, staff are permitted to disclose personal information in order to prevent and support detection, investigation and punishment of serious crime and/or to prevent abuse or serious harm to others. Each case must be judged on its merits. Examples could include disclosing information in relation to crimes against the person e.g. rape, child abuse, murder, kidnapping, or as a result of injuries sustained from knife or gun shot wounds.’ These decisions are complex and must take account of both the public interest in ensuring confidentiality against the public interest in disclosure. Disclosures should be proportionate and limited to relevant details.

‘Nurses and midwives should be aware that it may be necessary to justify disclosures to the courts or to the NMC and must keep a clear record of the decision making process and advice sought. Courts tend to require disclosure in the public interest where the information concerns misconduct, illegality and gross immorality.’

The General Medical Council (2003) produced guidelines in conjunction with the Association of Chief Police Officers that are supported by the British Association of Accident and Emergency Medicine. The guidelines state that police should be told whenever a patient arrives at hospital with a gunshot wound and that this is justified in the public’s interest where:

› A failure to disclose information would put the patient, or someone else, at risk of death or serious harm.
› A disclosure may assist in the prevention, detection or prosecution of a serious crime.

The guidelines go on to clarify circumstances where information may be disclosed if the patient is unable to give or refuses consent. However, if the patient cannot give consent, or says ‘no’, information can still be disclosed if there are grounds for believing that this is in the public interest or disclosure is required by law.

If there is any doubt about whether disclosure is justified, the decision to disclose information without consent should be made by, or with the agreement of, the consultant in charge, or the NHS organisation’s Caldicott Guardian.

Wherever practical, patients should be told that a disclosure will be or has been made. The reasons for disclosure should be recorded in the patient’s notes. With regards to recordkeeping, it is important to note that:

› Documentation by nursing staff is of extreme importance in caring for people injured through gunshot.
› All notes made in patients’ records are legal documents and may be requested by police, lawyers or patients at a later date.
› Documentation should be confined to charting the nature of the wound(s) and not making assumptions or judgements about entry and exit wounds, as these can be challenging and difficult to assess (Johnson 1998).

Police will treat items such as clothing and belongings as evidence and staff should not wash around the wound area or wash the patient’s hands because the police will want to screen the areas for gunpowder. This is something the police would usually request.

It should be stressed that the patient’s condition takes precedence over evidence collection. Due care should be taken with the patient’s clothing and belongings because these may be required by the police as evidence, and nurses should be clear of local procedures and policies.

**Time out 2**

Look at the abdominal area illustrated in Figure 1 and, taking into consideration the mechanisms discussed previously, list the structures that have the potential to be damaged by a bullet from a high velocity weapon fired at close range into the centre of the abdomen.

**Types of injury sustained by guns**

Bullet wounds can kill instantly or can have devastating effects on the body due to blood loss and damage to affected organs. Bullets entering the skull and the abdomen have a high degree of fatality (Johnson 1998). Gunshot wounds are
Learning zone emergency care

Described as penetrating when the bullet enters but does not exit the body, and perforating when there is an entry and exit site.

Table 1 lists possible injuries caused by gunshot wounds to different parts of the body.

Categories of firearm wounds

Contact wounds are sustained when the muzzle of the gun is in contact with the body. Contact wounds will show scorching around the edges and soot will appear in the wound (Figure 2). Near contact wounds are sustained when the muzzle of the gun is not in contact with the skin. The entry site will show charred skin surrounded by an area of soot. Soot will appear in the wound tract and will be imbedded in the skin. Intermediate range wounds are caused when the muzzle is held away from the body when the gun is fired. Grains of soot and powder produce a tattooing effect to the skin and can appear as small puncture wounds. Distant wounds are made when the muzzle is far from the body and there will be no signs of soot or tattooing. The only marks on the body will be where the bullet has penetrated.

Entry and exit wounds (Figure 3) are different in appearance depending on whether the bullet has penetrated skin or bone. An entry wound does not mean an exit wound will also be present. Exit wounds can be far away from the exit wound and in a different part of the body. Entry wounds over skin will appear as a reddish area of skin known as an abrasion ring (Cohen 2003), and the wound will be regular or oval in shape. Exit wounds over skin will usually be larger and more irregular than the entry wound due to the tumble and yaw of the bullet. There will be no abrasion ring. Entry wounds over bone will show an inward indentation while the exit wound will show an outward indentation.

Gunshot wound classification

Wounds can be classified and graded using the Red Cross gunshot wound classification tool (Table 2). Coupland (1999) advises its use in a clinical setting to establish the size of wounds inflicted by conventional weapons.

Using Table 2 the formulae below are then applied to grade the wound. Wounds are graded from the scores at entry, exit and cavity to denote size, and this reflects energy transfer. The V and M scores are not factors in grading the wound.

Grade 1 – skin wounds of less than 10cm (E+X <10) without a cavity (C = 0) and without a comminuted fracture (F = 0 or 1).
Grade 2 – skin wounds of less than 10cm (E+X <10) with a cavity (C = 1) or comminuted fracture (F = 2).

Grade 3 – skin wounds of more than 10cm (E+X >10) with a cavity (C = 1) or comminuted fracture (F = 2).

Caring for patients with gunshot wounds

As with all aspects of emergency care there is a correlation between optimum outcomes and good preparation, and this should start with the area in which the patient is going to be treated. In most cases this will be the resuscitation area of the emergency department. The nurse allocated to this area should ensure that the area is stocked routinely, and that all equipment is functioning at the start of each shift and after each patient has left the area. The resuscitation room should be well lit, warm and free from unnecessary distractions. Only staff essential to the care of the patient should be present.

Documentation should be easily accessible to record the events accurately. There should be a visible, accurate wall clock to record times, as such details have forensic as well as clinical importance and may be needed by a court at a later date.

The safety of the team and the department is paramount, bearing in mind the patient might be armed. A frightened, shocked and armed patient poses a significant risk, in addition to the possibility that the perpetrator may still be at large and seeking to cause further injury. It is advisable to alert hospital security staff to the situation without breaching the confidentiality of the patient, requesting that they are discreet in their presence.

Gunshot injuries present unique challenges to emergency department staff. The patient has experienced an extremely frightening event and is likely to be anxious. The atmosphere can often be highly charged with upset and angry relatives needing reassurance. For this reason it is essential that an experienced nurse be allocated solely to support and reassure them. This nurse should accompany relatives in the resuscitation room and keep them informed of the process.

Most emergency departments adopt the trauma team approach, which involves a specialised team being assembled when a trauma patient arrives or is expected. The size and make-up of the team will depend on the resources available and the services provided at the hospital. The most important factor of the trauma team is that there is a good team leader and that each individual is aware of his or her roles and responsibilities. Personal protection should be readily available to the team and include gloves, aprons, eye protection and lead aprons.

Clinical care In caring for patients with gunshot wounds advanced trauma life support (ATLS) guidelines apply (American College of Surgeons 2004). These advocate a sequence of events in the care of trauma patients:

- Preparation.
- Primary survey.
- Resuscitation.
- Secondary survey.
- Monitoring and evaluation.
- Definitive care.

### TABLE 2

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Entry wound (cm)</td>
</tr>
<tr>
<td>X</td>
<td>Exit wound (cm)</td>
</tr>
</tbody>
</table>
| C | 0 – No cavity
1 – Cavity present                          |
| F | 0 – No fracture
1 – Simple fracture
2 – Complex fracture                          |
| V | 0 – No involvement of vital organ
1 – Vital organ involvement                    |
| M | 0 – No metal on X-ray
1 – Single fragment
2 – Multiple fragments                        |

(Time out 3

You are the nurse allocated to the resuscitation room. A priority call is received that a patient with a gunshot wound to the abdomen is expected in ten minutes. How would you prepare the area to receive the patient?)
TABLE 3

<table>
<thead>
<tr>
<th>Grade of shock</th>
<th>Blood loss</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>15% blood volume</td>
<td>Tachycardia</td>
</tr>
<tr>
<td>Grade 2</td>
<td>15-30% blood volume</td>
<td>Tachycardia, delayed capillary refill, fall in pulse pressure</td>
</tr>
<tr>
<td>Grade 3</td>
<td>30-40% blood volume</td>
<td>Tachycardia, hypotension, reduced urine output</td>
</tr>
<tr>
<td>Grade 4</td>
<td>40-50% blood volume</td>
<td>As above but severe hypotension</td>
</tr>
</tbody>
</table>

It is important to remember that a significant proportion of patients with gunshot wounds are young and fit and that they will compensate initially for any hypovolaemia. Tintinalli et al. (2006) state that, in general, a loss of up to 750ml of circulating blood is tolerated well in healthy patients. This confirms the need for very close monitoring in the early stages as the patient may deteriorate at any time. The types and classification of shock are widely discussed in the literature. The American College of Surgeons (2004) classifies shock in relation to the severity of haemorrhage and this is summarised in Table 3.

At this stage vital signs should be recorded every five minutes, including pulse, blood pressure, respirations and oxygen saturation so that shock is detected and remedied immediately. Most patients presenting with gunshot wounds will require two wide bore cannulae and fluid resuscitation to aim for a systolic blood pressure of 100-110mmHg (Mukhtar and Jones 2003).

Routine blood investigations will also include group and save, and cross match. Best practice advocates the use of a major haemorrhage protocol and nurses should familiarise themselves with this before using it. An example from the UK Blood Transfusion and Tissue Transplant Services (2007) is shown in Figure 4 but many NHS organisations will have their own operational policy.

With abdominal wounds, urine output may need to be monitored to help assess the success of fluid resuscitation. A urinary catheter should only be inserted once a genitourinary injury has been excluded. Any bleeding from the urethra, vagina or rectum should raise suspicion of a pelvic injury.

Patients who have sustained chest injuries can deteriorate rapidly. Penetrating chest injuries can damage the lungs, heart, diaphragm and the abdominal cavity. The most common type of injury is a haemopneumothorax, which is caused by damage to the lungs and the chest wall, and is a collection of blood in the pleural cavity in association with a pneumothorax (Wyatt et al. 1999). Wyatt et al. (1999) also discussed the complications of open wounds to the chest where there is open communication between the pleural cavity and the outside, when respiratory insufficiency, lung collapse and hypoxia may arise.

Sucking chest wounds occur when the air moves directly through the chest wall into the pleural cavity. These wounds must be covered by a three-sided dressing to prevent a tension

The AVPU principle (see below), often used in the pre-hospital setting, can be used to assess rapidly the critically ill patient. Jevon (2008) advocates its use along with an examination of the pupils, and also recommends that the Glasgow Coma Scale should be used in the full assessment:

- A – alert.
- V – responding verbally.
- P – responding to pain.
- U – unresponsive.

Other factors, such as whether the patient has taken any alcohol or drugs, should also be taken into consideration. This may have an effect on his or her overall Glasgow Coma Scale. Patients with gunshot wounds, regardless of how young and fit they are, can deteriorate rapidly and close observation is of utmost importance.

The clinical care of patients with gunshot wounds should follow the ABCDE approach (Box 1). Clinical priorities in caring for a gunshot victim are: maintaining an airway, assisting ventilation, controlling haemorrhage and preventing hypothermia. Bleeding can lead to hypovolaemic shock. Dretzke et al. (2004) describe shock as circulatory failure leading to inadequate perfusion and oxygenation of the tissues. This can cause permanent damage to essential organs and can result in multiple organ failure leading to death.

**Time out 4**

Describe how you would recognise when a patient is going into shock.

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pneumothorax and a chest drain should be inserted.

Cardiac tamponade is caused by haemorrhage into the pericardial sac, which compromises cardiac output and ultimately leads to cardiac arrest if immediate action is not taken. This may be in the form of pericardiocentesis, which is the use of a large needle to drain blood from the pericardium. Aspiration of a small amount of blood (20–40ml) may improve cardiac output until a thoracotomy can be performed (Wyatt et al 1999). This is ideally done in the operating theatre but there are occasions when it is necessary to open the chest in the emergency department, such as in cardiac arrest due to penetrating chest injury.

After the initial resuscitation a series of investigations will be necessary. X-rays will be undertaken to detect foreign bodies, fractures and damage to the pulmonary system. Ultrasound and computed tomography scans may then be required to detect further internal damage. The nurse

**FIGURE 4**

An example of a major haemorrhage protocol

<table>
<thead>
<tr>
<th>Make two telephone calls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Call 1 – Hospital switchboard</strong></td>
</tr>
<tr>
<td>Ask them to take details:</td>
</tr>
<tr>
<td>• There is a major haemorrhage</td>
</tr>
<tr>
<td>• Name and location of patient</td>
</tr>
<tr>
<td>• Contact name and telephone number for doctor in charge</td>
</tr>
<tr>
<td>Ask them to inform:*</td>
</tr>
<tr>
<td>Blood bank</td>
</tr>
<tr>
<td>Haematology laboratory</td>
</tr>
<tr>
<td>Duty haematologist</td>
</tr>
<tr>
<td>Porter</td>
</tr>
<tr>
<td><strong>Call 2 – Blood bank</strong></td>
</tr>
<tr>
<td>Tell them:</td>
</tr>
<tr>
<td>• How urgent is the need for blood</td>
</tr>
<tr>
<td>• Patient information</td>
</tr>
<tr>
<td>• Name</td>
</tr>
<tr>
<td>• Hospital number</td>
</tr>
<tr>
<td>• Medical incident number</td>
</tr>
<tr>
<td>• Sex and date of birth</td>
</tr>
<tr>
<td>• ABO and Rh (Rh) blood group, if known</td>
</tr>
<tr>
<td>• What blood component and how much blood is requested</td>
</tr>
<tr>
<td>• Where the blood is to be sent</td>
</tr>
<tr>
<td>• Name and contact telephone number for doctor in charge</td>
</tr>
</tbody>
</table>

- The nurse

*$ Enter all the relevant extension numbers for your hospital in the spaces provided

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Red cells needed immediately

Use emergency O negative red cells in designated fridge

Send patient sample and request form urgently to blood bank

OR

Use emergency O negative red cells from blood bank

Send patient sample and request form urgently to blood bank

Red cells needed in 15 minutes

Send patient sample and request form urgently to blood bank

ABO and RhD group specific red cells available for collection at blood bank

Blood available 15 minutes after sample received in laboratory

Red cells needed in 45 minutes

Send patient sample and request form urgently to blood bank

ABO and rhesus group, antibody screen and crossmatch will be carried out

Blood available 45 minutes after sample received in laboratory

Are platelets, fresh frozen plasma (FFP) or cryoprecipitate needed?

Allow time for preparation and collection or delivery

An antibody screen and crossmatch will be carried out on the released units within 30 minutes

If patient has a historic record and a group and screen on a clinical sample, blood can be made available immediately by electronic release

If uncontrolled bleeding continues, consider antifibrinolytic or recombinant factor Vlla

* If there is a local protocol for your hospital, that should be used
looking after the patient is responsible for ensuring that equipment needed for patient transfer for investigations is available and working.

**Infection control** It is important to remember that all gunshot wounds are especially prone to infection. The wound will be contaminated by soot, other particles and fragments of clothing that can be distributed along the tract of the wound. Extensive surgical debridement and delayed primary closure of wounds is often required to remove particles and devitalised tissue. These wounds are highly susceptible to anaerobic infections such as tetanus and gas gangrene.

Leaper (2006) states that the wound ischaemia and deposits in the wound create an ideal medium for anaerobic organisms such as *Clostridium perfringens*. Tetanus and antibiotic prophylaxis will most likely be given in the early stages of treatment, although Evans and Burke (2000) state that antibiotics are no substitute for aggressive, early management of the initial wound. Consider also the need for tetanus immunoglobulin in patients who may not have a reliable immunisation record.

**Conclusion**

Caring for patients who have been shot presents challenges to emergency nurses and a basic knowledge of ballistics can help when providing care, which should always follow the ABCDE principles and advanced trauma life support guidelines. Emergency nurses should remain professional and non-judgemental when caring for patients injured by gun crime.

Effective treatment of these patients requires a whole system and team approach, and nurses play a vital role in this. An understanding of the principles of gun-related injuries will allow nurses to function as skilled and competent members of the emergency department team NS

### References