Hunterian Lecture

Aide memoire for the management of gunshot wounds

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The hospitals in Johannesburg deal with about 4000 gunshot wounds a year. Although most are from hand guns, a number are from high velocity, military-type weapons. Extensive experience has been built up and many lessons learned. Attention is directed to the actual damage inflicted rather than on theoretical predictions based on presumed velocity of the bullets involved, as this can often be misleading. Some patients are delayed in their presentation to emergency departments, in other cases several gunshot wound patients arrive at the same time, requiring appropriate triage and urgent management.

Key words: Gunshot wounds – Resuscitation – Management

Lessons learned include the primacy of clinical assessment in initial management, and the necessity for rapid decision-making and urgent surgery in threatened patients, particularly those in whom it is necessary to stop bleeding. The importance of avoiding over infusion of fluids and of preventing, recognising and treating hypothermia has also been recognised. As a result of the large numbers of patients seen, it has been possible, in view of the experience of the staff involved, to develop the practice of selective non-operative management of certain gunshot wounds of the abdomen and limbs. Appropriate criteria have been developed for primary closure of certain gunshot wounds of the colon. 'Damage control' emergency surgery has been embraced for some very unstable patients who will not tolerate lengthy initial surgery. In these patients, initial surgery is limited to haemostasis and other life-saving procedures, along with temporary measures such as packing, drains, temporary clamping and stapling. The patient is then further resuscitated, physiological abnormalities corrected, and returned for further surgery when in a more stable state. Recognition of the 'abdominal compartment syndrome' has been emphasised. The increased intra-

abdominal pressure from bleeding, packing, oedema having serious effects on the respiratory, vascular, renal systems. This may mandate urgent decompression.

The following point-by-point aide-memoire, based on the Johannesburg experience, has been compiled to assist in the management of gunshot wounds, and may be particularly useful for those not regularly dealing with such cases. Suitable references have been included, amplifying the points made.

Receiving area management

- Manage on ATLS® principles
- Rapid assessment
- Avoid fluid overload
- Prevent or correct hypothermia
- Minimal initial investigation
- Early decision on emergency surgery, usually to stop bleeding

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Head wounds

- If, after on-scene oxygenation, fixed dilated pupils or GCS < 5, aggressive management constitutes futile care
- Primary surgical procedure is excision and closure of scalp. Routine exploration and debridement not embarked upon
- Retained bullets and fragments have not resulted in increased infection or other complications¹
- Injury explored for complications, *e.g.* haematoma
- Respiratory, supportive and antibiotic therapy given

Neck wounds

- Mandatory exploration abandoned²
- Full clinical assessment is the key
- Exploration for 'hard' signs, *e.g.* active bleeding, shock, bruit, diminished radial pulse³
- Foley catheter in wound may control carotid, jugular, subclavian bleeding⁴
- If immediate operation not necessary, utilise angiography, colour Doppler, oesophagography, endoscopy
- A significant number can be dealt with non-operatively^{5,6}
- In through and through transcervical wounds – same principles, but higher index of suspicion. Helical CT angiography useful⁷

Spine wounds

- Sometimes element of spinal shock: some recovery possible
- Most injuries mechanically stable
- Exploration seldom necessary
- Retained bullets usually not a problem⁸
- Occasional exploration if fragment pressing on cord
- Operative stabilisation seldom needed
- No evidence that steroids are of value in this situation^{9,10}

Chest wounds

- Tube drainage adequate for majority
- If profuse bleeding, immediate operation, sometimes in emergency department if patient close to demise (profuse ≥ 1.5 l) when tube inserted and general signs

of blood loss

- Less urgent thoracotomy considered if drainage 300 ml/h for 3–4 h
- Only small number require lobectomy or pneumonectomy
- In simple suture of exit and entry wounds of lung, there is danger of air embolism from absorption of air along the tract. Advise staple along each side of track, open track, roll over, suture
- Remember possibility of penetration into abdomen

Transmediastinal

- In transmediastinal wounds, operate immediately if patient unstable¹¹
- If stable, assess by means of angiography, oesophageal studies, response to resuscitation, spiral CT
- If surgery necessary, speed to operation is a determinant factor
- A substantial number of stable patients do not require operation¹²

Abdominal wounds

- Clinical assessment paramount
- If positive signs (*e.g.* tenderness, guarding, rebound), systemic signs (*e.g.* shock), inability to assess due to lowered sensorium or necessary for anaesthesia – proceed to exploration
- If patient stable and signs are only of some local tenderness in wound, consider selective non-operative management.^{13,14} This requires regular, repeated, careful assessment. If signs appear, submit to laparotomy
- The selective, non-operative method is reliable, safe and cost effective. A significant number do not require operation, as the bullet has not penetrated or has not inflicted damage serious enough to require surgery
- **Warning!!** Requires experience and confidence
- Now internationally accepted^{15,16}

Damage control

- In selected unstable patients who will not stand lengthy surgical procedures consider 'damage control'
- First priority is to control bleeding (clamp, tie, suture, packing)

- Perform minimal other procedures (*e.g.* staple holes and intestines, tie off bowel, insert drains, cannulae)
- Effect temporary closure or dress and leave open
- Continue resuscitation, correct haematological and biochemical disorder, correct hypothermia
- Re-operate when patient more stable or when specialist surgical care available (when assessed as being necessary at first operation)

Definitive surgery

- Full inspection of abdominal contents
- Exploration of midline and paracolic haematomata, being prepared for injury to major vessels
- Perirenal haematomata explored if enlarging
- Liver injury challenging. **Utilise!:**
 - » Suture
 - » Finger fracture to expose large vessels
 - » If severe utilise packing, Pringle manoeuvre, vascular isolation
 - » If retrohepatic inferior vena cava exposure vital, attempt repair
 - » Atrio caval shunt considered if unable to repair or control
- Primary repair of stomach and small intestines

Primary repair of gunshot wound of colon can be considered if:¹⁷

- » Minimal delay to surgery
- » Minimal contamination
- » Penetrating abdominal trauma index < 25
- » Surrounding bowel wall healthy
- » Colon bleeds satisfactorily
- » Patient not shocked
- » Major transfusion not required
- » Otherwise protect with colostomy, rarely exteriorise
- Primary repair excellent in selected cases, and no need for further operation¹⁸⁻²¹

*Abdominal compartment syndrome*²²

- Increased pressure due to bleeding, packing, oedema
- Affects venous return, cardiac output, renal and respiratory function, intestinal blood flow
- Assess clinically or by measuring bladder pressure via catheter

- May need surgical decompression, possibly leaving abdomen open

Limb wounds

- Priority – recognition of vascular injury
- Clinical assessment most important²³
- If in doubt – Doppler or emergency room arteriography, which can be performed without interruptive resuscitation or relocating patient²⁴
- Immediate operation for vascular injuries
- Temporary shunts in unstable patients
- PTFE grafts can be used safely in proximal vessels if no suitable vein²⁵
- Repair large veins if possible
- Liberal use of fasciotomy
- Wound excision with delayed primary suture
- Low energy wounds of limbs with minimal clinical signs can be managed non-operatively as out-patients after period of observation. Experience necessary

Removal of bullets

- Bullets removed if easily accessible or encountered at operation
- Injudicious exploration to remove all bullets, especially if fragmented, can cause more damage than bullets themselves have caused
- Most retained bullets cause no problems

Final comment

There has been significant evolution in the management of gunshot wounds in the last decade. However, policies such as the selective non-operative management of gunshot wounds of the abdomen and of the limbs are best reserved for institutions seeing enough patients to ensure confidence in the clinical assessment of such cases. Utilising the quoted criteria, surgeons can now confidently primarily close certain gunshot wounds of the colon. Diagnostic modalities have improved greatly, and much use is made of, for example, CT scanning, yet clinical assessment remains the primary diagnostic tool. This is particularly relevant in making one of the most important decisions – whether or not to operate immediately to stop bleeding. The concept of ‘damage control’ can be life saving when used in appropriate cases, and the existence of ‘abdominal compartment syndrome’, long present, is only now attaining recognition.

In the management of gunshot wounds, it is easy to become confused by complex ballistics. Surgeons are urged to treat the wound, not the weapon, dealing appropriately with the wound as they find it.

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