Original article

A review of 187 gunshot wound admissions to a teaching hospital over a 54-month period: training and service implications

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Background: Violence involving the use of firearms has increased in the UK over the past decade. This study assesses the implications of such injuries for service provision and training by reviewing the experience at one hospital.

Methods: Accident and emergency triage data were searched for patients presenting with gunshot wounds over a 54-month period. Case notes were reviewed and patterns of care established. The resources required for clinical management were ascertained, and the financial consequences determined at contemporary full cost.

Results: There were 187 attendances with 247 wounds. Mean age was 21 years (range, 8–63 years). Of the attendances, 69% were out of normal working hours. Of the 187 cases, 97 patients were admitted to one hospital (83 of whom required surgery) and 10 patients were transferred to other hospitals (6 for plastic surgery not available at the Manchester Royal Infirmary and 4 due to lack of beds). Of the 80 patients who were not admitted, 4 died in accident and emergency, the rest were either air gun wounds or relatively simple higher calibre injuries. A wide range of surgical specialties was involved (limb injury, 53; thoraco-abdominal and vascular, 28; head and neck, 5; and orbit, 2), and combinations of injuries transgressed specialty and sub-specialty boundaries. The total cost of patient care was £267,000.

Conclusions: Gunshot wounds present a heavy demand on the clinical and financial resources of the receiving hospital, and surgeons responsible for unselected acute admissions in 'general surgery' should be capable of dealing with these indiscriminate injuries. Current training and service trends towards increasing sub-specialisation may mitigate against them achieving or retaining this capability.

Key words: Gunshot wounds – Training – Service

Violent crime, including that involving firearms, has increased in the UK over the last decade.^{1,2} Although the management of ballistic injuries is included in syllabuses of surgical training³ and contemporary texts, individual experience of such injuries is limited. The

nature of a ballistic injury is indiscriminate, and tissue damage, which crosses speciality and sub-specialty borders, is common. The nature of training in the UK has changed with specialisation introduced much earlier than has been traditional hitherto. There is an apparent

imbalance between the experience and training of surgeons, and the demands of indiscriminate injuries. This may be particularly relevant in the speciality of general surgery, where trainees and consultants are encouraged to sub-specialise into upper or lower gastrointestinal tract, hepatopancreaticobiliary surgery, breast surgery, *etc.* These surgeons' expertise in surgery within their chosen field may not equip them for an intra-abdominal catastrophe.

Purchasers of healthcare incorporate the management of patients with gunshot wounds within block funding for non-elective admissions. Such patients may place heavy demands upon limited resources in an unpredictable pattern. If ballistic injuries continue to increase, the cost of management will place an added burden upon healthcare resources.

The Manchester Royal Infirmary (MRI), serving an inner city population, has experienced an increase in numbers of patients who have sustained gunshot wounds. We report on this experience with reference to the clinical needs of these patients and the implications for both funding and training.

Patients and Methods

Patients

The medical records of all patients who attended the MRI accident and emergency department between 1 January

1995 and 20 May 2000 (1967 days) in which one of the words 'gun', 'shot' or 'shooting' appeared in the triage details were reviewed. These included gunshot wounds associated with intent to harm as well as accidental injuries. From the records, clinical data and details of investigations were obtained.

Methods

The cost of management was based on the B plan costing system for the Central Manchester Healthcare Trust for the period April 1999 to March 2000 (personal communication). The cost and services provided were divided into five parts: (i) accident and emergency; (ii) in-patient care; (iii) operations; (iv) investigations (blood and radiological); and (v) out-patient follow-up. In-patient costs included both direct and indirect costs encompassing medical and nursing staff, pharmacy, physiotherapy, radiology, laboratory, administration, catering, maintenance and service charges. Operative costs varied between specialities and were calculated from arrival in theatre to departure on a cost-per-minute basis. For example, the cost of one minute in a general surgical theatre in 2000 was £6.60 (thus one hour costs £396).

Results

There were 187 attendances to accident and emergency with gunshot wounds involving 181 patients. There were 162 males and 25 females. The number of wounds in each patient ranged between 1 and 9 and the total number of wounds was 247 (Fig. 1). In all, 97 patients required admission to the MRI spending a total of 715 days (range, 1–52 days; mean, 7 days) in hospital; 83 of these patients required surgery for their injuries. Ten patients were transferred to other units. The remaining 80 patients were managed in accident and emergency (four of whom died). Five of those patients admitted died in hospital.

The mean age of patients was 21 years (range, 8–63 years), 66% were less than 25 years of age. There was no pattern to the day of attendance, but 69% attended outside normal working hours (9 a.m. to 8 p.m., Monday to Friday). Due to lack of documentation, it was not possible to determine the distribution of weapons involved but there was evidence that handguns, rifles, shotguns and machine guns were all used. A wide variety of specialities were involved and five cases required joint care (Fig. 2). Of the 187 patients who attended accident and emergency, 90 sustained superficial trauma requiring simple cleaning and dressing of wounds; 12 of these required admission. In addition, 53 patients required orthopaedic surgery (three as joint cases), ranging from wound debridement and bullet removal to internal

Figure 1 Distribution of gunshot wounds. Values shown are a percentage of the total wounds ($n = 247$).

Table 1 General surgical operations (including urology)

Total No.	General surgical operation			
6	Exploration and debridement of wounds not breaching peritoneum			
16	Laparotomies Injuries found, repaired where possible (numbers reflect each case with that organ damaged. Multiple organs were injured in many cases)			
	Small bowel	10	Pancreas	1
	Large bowel	3	Aorta	1
	Hepato-biliary	6	IVC	1
	Spleen	3	Kidney	1
	Stomach	5	Bladder	1
3	Vessel reconstructions			
	Superficial femoral arteries		2	
	Popliteal artery		1	

fixation of fractures as well as procedures involving vessel and nerve repair. Also, 25 patients required a general/vascular surgeon (four as joint cases), 16 of whom required a laparotomy with one or more of 10 internal organs having been damaged; in many cases, more than one organ was involved reflecting the variety of expertise required by the surgeons involved (Table 1). A further 10 operations were performed by a number of other specialities (three as joint cases) including maxillofacial, cardiothoracics, ophthalmology, neurosurgery and ENT.

The total calculated cost of gunshot wounds over the period studied was £267,000 (mean, £1428). The 90 patients who were not admitted to the MRI accounted for only £5260 (range, £16–£449; mean, £58), whereas the 97 patients admitted totalled £261,745 (range, £142–£40,325; mean, £2698). In-patient costs represented 69% and

operative costs accounted for 18% of the total cost for those admitted.

Discussion

Of the 187 patients who attended with gunshot wounds, a large proportion (41%) were injured by air rifles, and management was usually relatively simple and within the normal spectrum of clinical and financial resources. The cost of intentional violent gunfire was approximately £262,750 over the study period, an average of £134 a day, the equivalent cost of 56 coronary artery bypasses, 126 knee replacements or 1745 hernia repairs (personal communication).

The numbers reported here are relatively small compared to other countries. In the US, 562,870 firearm-associated offences were reported in 1999 and 65% of the 633 murders in that year were caused by gunfire.⁴ However, there is clear evidence that gunshots produce a variety of trauma that is not confined to single specialities or sub-specialities. This is of importance when considering provision of services and the training of surgeons. The management of bone and soft tissue trauma to a certain degree follows a common pathway regardless of site or cause and thus the immediate management of their injuries should be within the realms of all orthopaedic consultants including those in contemporary (Calman) training.⁵ Intra-abdominal trauma, though, is more complex and management requires a greater diversity of surgical experience, which often crosses the boundaries of sub-specialities. The principles of management as with all poly-trauma begins with ATLS® and surgeons should be aware that injury is proportional to the weapon and the kinetic energy transferred by the bullet.⁶ Following resuscitation, if an exploratory laparotomy is indicated, general operative principles include the need for a senior anaesthetist, a competent assistant and an experienced scrub nurse. Following a long midline incision, a full intra-abdominal inspection should be carried out and definitive management tailored to the specific injuries. The senior surgeon must be prepared to face, and deal with, a variety of intra-abdominal injuries. Bowel injuries will require debridement of dead tissue, possible excision of the damaged segment. Consideration must be given to the need for stoma formation or primary repair,^{7,8} all in the possible setting of gross contamination, severe blood loss and multiple colonic wounds. Liver injuries are usually ragged and blood loss can be massive making them a challenge to deal with; the liver will require digital exploration, packing should be around the liver rather than in it and suture/ligation may be needed. Pringle's manoeuvre and argon beam may be required. If the spleen is injured and bleeding cannot be stopped,

Figure 2 Distribution of specialties responsible for management.

resection maybe required.⁹ The surgeon may also be faced with a stomach, small bowel and pancreatic injuries, renal trauma, caval or aortic injuries as well as the possibility of abdominal compartment syndrome.¹⁰ In addition to this, in many smaller centres, the general surgical consultant may be the first port of call for chest and peripheral vascular injuries. In general, intra-abdominal injuries are associated with a high mortality¹¹ and the general rule is to get to them early and control any haemorrhage. Current consultants may well have sufficient experience to deal with such diverse pathology, but the question is – are consultants produced by the current Calman training regimen competent to deal with such cases, due to the desire to specialise so early? Thus, it is becoming more likely that poly-trauma associated with gunshot wounds will, in the future, require several surgeons for each patient from different sub-specialties within general surgery. Vascular surgery is already well on the way to separate on-call rotas in many hospitals. However, the likelihood of a hospital being able to provide a separate on-call upper gastrointestinal surgeon, colorectal surgeon and vascular surgeon is currently remote. The concern is that early sub-specialisation may reduce the ability of the Calman-trained surgeon to deal effectively with all intra-abdominal injuries.

Most of the gunshot injuries in our study presented out of ordinary working hours (69%). Hospitals accepting these patients will need to be able to provide a wide range of services in addition to a multidisciplinary surgical team. The debate over sub-specialisation of hospitals mitigates against the provision of complete care for the victims of poly-trauma, including gunshot wounds. Our experience suggests that serious consideration should be given to the document recently produced by The Royal College of Surgeons of England for trauma centres that will be resourced to meet all eventualities. This would include separate on-call rotas for upper and lower gastrointestinal surgeons, closely working together on those cases which cross this artificial boundary (from a medicolegal point of view, both surgeons may well have to be responsible for the cases). This type of on-call provision would only be possible in larger regional 'level 3' trauma centres with sufficient consultant numbers.

Conclusions

Management of gunshot wounds is expensive and requires a variety of surgical skills. This has both financial and clinical implications. As surgeons continue to specialise and concentrate their skills, there must be consideration to the provision of trauma management. An increase in the number of surgeons is required if such a service is to be provided effectively. This, in turn, will add further to the financial demands of such injuries.

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