Ann R Coll Surg Engl 1994; 76: 407–411

War injuries during the Gulf War: experience of a teaching hospital in Kuwait

Abdulla Behbehani FRCS
Chairman

Nahidh Hasaniya MB ChB
Assistant Registrar

Fikri Abu-Zidan FRCS*
Acting Senior Registrar

Jamal Merei FRCS
Registrar

Department of Surgery, Mubarek Al-Kabeer Teaching Hospital, Kuwait

Key words: War; Trauma; Injuries; Ballistics; Wounds

The war injuries of 361 patients admitted to Mubarak Al-Kabeer Teaching Hospital, during the Gulf War are reported. More abdominal and chest injuries were seen in this series in comparison with other conflicts owing to the short evacuation time. Of the injuries, 54% were caused by gunshots, 34% were fragment injuries and 5.5% were glass and stab injuries. Civilians accounted for 50% of the injured. Wound infection rate was 7%, average hospital stay was 8.8 days and hospital mortality was 5.5%. We advocate radical wound excision, exploration of penetrating wounds of neck and abdomen, and mainly conservative management of chest injuries that do not involve the mediastinum.

Military surgery involves the management of injuries resulting from the weapons of war. Ideally, the wounded should be treated by military surgeons but in reality civilian surgeons find themselves trapped in war conditions practising military surgery without previous experience in that field. In civil practice such cases present a different problem to that facing the military surgeons in war. Although the military surgeons experienced a short sharp offensive war, on the other side of the battle *(1)*, the surgeons of Mubarak Hospital carried most of the burden of medical care during and after the Kuwait invasion in very difficult circumstances.

Mubarak Al-Kabeer Hospital is a 400-bed university hospital located in the centre of Kuwait. Before the invasion the hospital was fully staffed and well equipped. The occupation lasted for 7 months. During that period the staff of the hospital were under many pressures and threats; there were nearly 60% medical staff losses and 70% nurse losses as many left the country for safety reasons. Resources gradually diminished with lack of spare parts making maintenance of equipment difficult. During the withdrawal of the Iraqi army the electrical generators and water installations were destroyed. The hospital continued to work by its own electrical generator at 90% of its capacity for 6 weeks. There was lack of water and food. Water shortage led to difficulties in the laundry and the steam sterilisation of surgical instruments. This article describes the experience of Mubarak Al-Kabeer Hospital during the Gulf War.

Patients and treatment

During the period 2 August 1990 to September 1991, Mubarak Al-Kabeer Hospital received more than 1100 war injured patients at its Accident and Emergency Department. There were 164 patients who arrived dead or died in the resuscitation room. Patients with minor injuries were treated and sent home; their files were lost and therefore it is difficult to follow up these patients. There were 361 patients admitted with serious injuries and their files were retrieved and fully studied; 332 were males (92%) and 29 were females (8%). Of these, 179 (50%) were civilians and 182 were soldiers. Their ages ranged from 1 year to 71 years with an average of 28 years. There were 130 Kuwaitis (36%), 104 Iraqis (29%) and 127 (35%) other nationalities.

The most common cause of injury was gunshot (54%) followed by fragment injuries (34%) (Table I).

The distribution of injuries to the body are shown in

*Present appointment: Trauma Research Fellow, Department of Surgery, University Hospital, Linköping, Sweden

Correspondence to: Dr Abdulla Behbehani, Chairman, Department of Surgery, Faculty of Medicine, Kuwait University, PO Box 24923, 13110, Safat, Kuwait

Table I. Cause of injuries

Type	*Number of patients*	*%*
Gunshot	195	54
Fragments	122	34
Stab and glass	20	5.5
Blunt	9	2
Burns	5	1.5
Mines	5	1.5
Unknown	5	1.5
Total	361	100

Table II. The extremities were principally involved, followed by the abdomen and chest.

The average hospital stay was 8.8 days. In all, 20/361 patients died, a hospital mortality of 5.5%.

Wound management

All patients were assessed and given tetanus toxoid on arrival. Minor wounds were treated under local anaesthesia while large wounds were explored under general anaesthesia. All dead and necrotic tissue was excised and the wounds were left open. Easily accessible foreign bodies were removed but inaccessible fragments and bullets were left undisturbed. Patients were given antibiotics of the surgeon's choice as there was no shortage of drugs. Wounds were dressed daily by a surgeon and re-excision was performed if necessary. The patient was discharged on oral antibiotics when it was decided that the wound had become clean.

Head injuries

Most of the isolated penetrating injuries of the head were resuscitated in the surgical receiving area and sent to a neurosurgical department in another hospital if they were fit to be transferred. Four penetrating wounds to the head were operated upon urgently by general surgeons as the patients were not fit to be moved. All four had a craniectomy. Two were discharged conscious but with neurological deficit, and the other two remained unconscious. One patient with an acute subdural haematoma from blunt trauma had burr holes performed and died 4 days later. Another patient with a severe bullet injury to the brain died in the intensive care unit without operation. Two patients had brain concussion only and recovered. Three patients had penetrating wounds to the eyes, and one had burns of both eyes.

Five patients were operated on for faciomaxillary injuries with fixation of the mandible in one, removal of a bullet from the submandibular region in another and repair of soft tissues in the other three.

Neck injuries

All patients with penetrating wounds to the neck with profuse bleeding or difficulty in breathing were intubated and taken directly to theatre to be explored. Two patients with carotid artery injuries died on the table from uncontrollable bleeding, one patient had a successful repair of a subclavian artery injury using a venous graft. Two had a tracheostomy for tracheal injury.

Wounds of the head and neck were closed primarily with no subsequent infection.

Thoracic injuries

A total of 78 patients had chest injuries and chest radiographs were taken in all cases. Of these patients 31 were observed without operation (39.5%) and 31 were treated by chest tube drainage for haemo- or pneumothorax (39.5%). One patient with chest tube drainage and paraplegia died in the ward from pulmonary oedema possibly from blast injury to the lungs.

Ten patients (13%) had a thoracotomy for continued bleeding of more than 300 ml/h through the chest tube. One of them died on the table from severe haemorrhage as the right pulmonary pedicle and the superior vena cava had been transected by the bullet. Six patients had a thoracolaparotomy and three died of hypovolaemic shock in the theatre.

Table II. Distribution of injuries to the body in comparison with other series

	Brismar et al. (9) Bologna explosion 1980	*Jackson et al. (15) Falkland War 1983*	*Rautio et al. (4) Afghan War*	*Spalding et al. (1) Gulf War 1991*	*Behbehani et al. (this article) Gulf War 1991*
No. of patients	107	233	200	63	361
Head	9%	14%	12%	6%	12%
Thorax	19%	7%	3%	12%	22%
Abdomen	7%	11.5%	12%	11%	27%
Upper limb	19%	26.5%	26%	44%	31%
Lower limb	17%	41%	43%	75%	44%
Spine	7%	?	4%	?	2%
Back	7%	?	?	6%	5%

Abdominal injuries

In all, 66 patients had penetrating wounds of the abdomen; as a rule these patients were explored. Of these, 55 had a laparotomy, three being referred from other hospitals after initial surgery and five had a thoracolaparotomy (one having been referred from another hospital for haemodialysis). There was one negative laparotomy. One patient had a diagnostic laparoscopy with removal of an intra-abdominal bullet and was discharged well after 3 days. Only four patients were observed, three of them with stab wounds and the fourth with a penetrating bullet wound to the right hypochondrium. He had no signs of bleeding or peritonitis and was discharged well on the 4th day.

The most common organs injured were large bowel, small bowel, liver and stomach (Table III).

Large bowel injuries were treated by resection and defunctioning colostomy; small bowel injuries by resection and anastomosis; liver injuries by débridement and haemostasis, and stomach injuries by débridement and simple closure. Five patients had a splenectomy and one a splenorrhaphy.

Four patients underwent reoperation, two for missed ureteric injury, one of which had a ureteric reimplantation into the bladder and the other a ureteric reanastomosis. A third patient had missed bleeding from the stomach which was sutured and a fourth had a small leak from the lower end of the common bile duct which was treated with T-tube drainage. One patient had a missed colonic injury which formed a fistula and closed with conservative management and one patient had an abdominal collection which resolved. Two patients had a burst abdomen.

Eight patients having undergone a laparotomy and three a thoracolaparotomy died; six from massive bleeding on the operating table, three from sepsis and multi-organ failure, and two from sudden unexplained reasons where no post-mortem examination was carried out.

Upper limbs

A total of 120 upper limbs were injured in 111 patients. In all, 48 fractures were treated; 12 were of the humerus and 12 were in the forearm. Four had delayed internal fixation while the others were treated by a plaster cast. No osteomyelitis occurred. Five brachial arteries were repaired with one failure that ended with an above-elbow amputation.

Table III. Abdominal organ injuries in patients who had laparotomy (each patient may have more than one injury)

Large intestine	19	Kidney	10
Small intestine	17	Ureter	2
Liver	15	U. bladder	3
Stomach	12	Urethra	3
Spleen	6	Prostate	1
Pancreas	6	Retroperitoneal haematoma	3
Duodenum	4		
Rectum	3		

Lower limbs

There were 186 lower limbs injured in 158 patients with 72 fractures. Seventeen were of the femur; two of them were treated by external fixation and the others by traction. There were 34 fractures of lower leg bones, five of them treated by external fixation and the others by a plaster cast. Three patients developed osteomyelitis of the tibia.

Three external iliac arteries and six superficial femoral arteries were repaired. One patient had delayed management of a common femoral artery injury for 3 days and this resulted in a below-knee amputation. Four popliteal arteries were repaired; two failed, one undergoing a below-knee and the other an above-knee amputation.

In total there were five above-knee amputations, eleven below-knee amputations and one Syme's amputation.

Spine

Nine patients had a spinal injury; two to the cervical spine with quadriplegia, six with paraplegia and one with a fracture of a lumbar transverse process without neurological deficit. Two patients died of pulmonary complications, one from infection and the other from blast lung injury.

Complications

In all, 25 patients developed wound infections and three had osteomyelitis. Ten patients had pulmonary complications and two developed deep vein thrombosis. Abdominal surgery complications have been detailed under the heading Abdominal injuries.

Mortality

Overall, mortality was 16.7% (184/1100). The mortality of hospitalised patients was 5.5%. The operative mortality is shown in Table IV. Ten patients died in the theatre from massive bleeding and shock, four died from sepsis and multi-organ failure and two from pulmonary insufficiency. One died with an acute subdural haematoma and one with 100% burns. There were two deaths in the ward which were unexplained.

Two patients who died were considered salvageable: one patient with bleeding from a fractured femur, and the

Table IV. Operative mortality of injured patients

Procedure	*Number of patients*	*Mortality*	*Operative mortality*
Craniectomy	5	1	20%
Faciomaxillary surgery	5	0	0%
Neck exploration	5	2	40%
Thoracotomy	10	1	10%
Thoracolaparotomy	6	3	50%
Laparotomy	55	8	15%

other who had a fractured spine with chest injury and who developed unnoticed pulmonary insufficiency.

Discussion

In all wars the terrain, climate, evacuation time and medical resources will affect the results of the surgical management of injuries *(2)*. Mubarak Al-Kabeer Hospital, is located in the middle of Kuwait City. During the Iraqi invasion of Kuwait, fighting occurred close to the hospital and the evacuation time was very short. This was also the case in the Lebanon war *(3)*. In Korea and Vietnam rapid evacuation of the injured reduced the mortality *(2)* but, in contrast, the mortality rate in Afghanistan was high because evacuation took several days *(4)*.

It is important to emphasise that wounds in war and in peacetime differ in their nature and incidence of infection, and should be treated in different ways. In our case it was unusual to practise war surgery in a relatively clean environment.

The principles of the surgery of war wounds are well-established. The weapons of war have tremendous wounding power, either by the destructive effects of high-energy transfer causing massive soft tissue or organ damage, or by the multiplicity of fragment wounds caused by bombs, shells, rockets and grenades. A large amount of dead tissue mixed with bacteria and debris sucked into the body constitutes the typical war wound *(5,6)*. Compressive stress waves may injure the spinal cord indirectly if the wound track is near to the spine, or may even cause indirect bone fracture *(7,8)*. Six out of eight paraplegic or quadriplegic patients did not have evidence of injury to the bony spine. Explosive blast pressure from shells and bombs may cause lung injuries that may manifest up to 24 h after admission, perforated tympanic membranes and, occasionally, perforation of the colon *(5,9)*.

We observed that the size of the entry and exit wound did not reflect the amount of internal destruction, which was usually extensive. We advocated radical excision of dead and contaminated tissue *(7,8)*, and usually followed the standard guidelines of managing wounds caused by the weapons of war. We did not adopt wound closure with drains *(10)*, as the patients were kept in hospital under observation by the operating surgeon.

Wound excision and delayed primary closure is essential in war as there may be delay in treatment, multiple heavily contaminated wounds, large numbers of casualties and poor operating conditions *(1,11)*.

Antibiotics play a supportive role to the surgical excision of wounds; the treatment of war wounds is principally surgical not chemotherapeutic *(1)*.

Although wound infection was not a major problem in some other series *(2)* our infection rate was 7% of the admitted patients explained by the hygiene conditions becoming very bad at the end of the occupation period owing to poor water supply. Cleaning of laundry and vapour sterilisation thus became very difficult.

War, of course, does not distinguish between citizens of one political persuasion and another. In the Lebanon war *(3)*, 70% of the injured patients were civilians, while it was 50% in our case.

A selective approach to bullet injuries of the neck can be accepted in civil injuries and in centres with full investigative facilities. Ordog *et al.* (12) reported a mortality of 2.7% using such an approach but this was not feasible in our conditions and quick decisions had to be taken. Penetrating wounds to the neck with bleeding or difficulty in breathing were explored without delay.

It is increasingly appreciated that chest injuries that do not involve the mediastinum should not be subjected to thoracotomy unless tube drainage reveals a continuing significant leak of air or blood *(3,13)*. This is borne out by our experience with a low mortality in the observed only group (0%) and the drainage group (3%) in comparison with the thoracotomy group (10%) and the thoracolaparotomy group (50%). Patients with gunshot wounds of the chest with normal physical examination and a normal chest radiograph can be treated as outpatients after a period of observation *(14)*.

As a rule, all penetrating missile wounds of the abdomen should have a laparotomy even though one of our patients was observed, and another had a laparoscopy to remove a bullet and both did well. We tried to resucitate all patients who had abdominal missile injuries, only one patient being considered unsalvageable as he had evisceration of most of the organs of the abdomen and all theatres were occupied at the time. This is different from some other series *(3)*, where they selected the patients to operate on and achieved low mortality (4%) in comparison with our 15% mortality.

The technique of external fixation has been the most significant advance in the management of open fractures caused by missiles. Fixation can be applied at the time of initial operation *(1)* or 4 to 5 days later *(11)*. We had very limited use of external fixators, although we were aware of their benefit, because Iraqi soldiers were evacuated to Iraq with fixators applied to them and our supplies thus became depleted.

When evacuation to hospital is prolonged the overall mortality rate rises, but the hospital mortality rate is lessened owing to less severely injured patients arriving at the hospital. In the Falklands war, the British army surgical team saved all but three of the 233 patients who reached them through difficult battle conditions *(15)*. Many of the severely wounded in Afghanistan died during the long evacuation to hospital, with typical mortality rates in the hospital in Quetta of 2.5% *(4)*. Our overall mortality was 16.7%, which is comparable with the figure from Vietnam and Northern Ireland. Our hospital mortality was 5.5%.

References

1 Spalding TJW, Stewart MPM, Tulloch DN, Stephens KM. Penetrating missile injuries in the Gulf War, 1991. *Br J Surg* 1991; **78**: 1102–4.

2 Scott R. British military surgery. *J Trauma* 1988; **28**: S83–S85.

3 Fosse E, Husum H, Giannou C. The siege of Tripoli 1983. War Surgery of Lebanon. *J Trauma* 1988; **28**: 660–63.
4 Rautio J, Paavolainen P. Afghan war wounded: experience with 200 cases. *J Trauma* 1988; **28**: 523–5.
5 Owen-Smith MS. *High-velocity Missile Wounds*. 1st Edition. London: Edward Arnold, 1981.
6 Dufour D, Jensen SK, Owen-Smith M, Salmela J, Stening GF, Zetterström B, eds. *Surgery for Victims of War*. Geneva: ICRC, 1988.
7 Cooper GJ, Ryan JM. Interaction of penetrating missiles with tissue: some common misapprehensions and implications of wound management. *Br J Surg* 1990; **77**: 606–10.
8 Fackler ML, Malinowski JA. The wound profile: a visual method for quantifying gunshot wound components. *J Trauma* 1985; **25**: 522–9.
9 Brismar B, Bergenwald L. The terrorist bomb explosion in Bologna, Italy, 1980: an analysis of the effects and injuries sustained. *J Trauma* 1982; **22**: 216–20.
10 Broome G, Butler-Manuel A, Budd J, Carter PG, Warlow TA. The Hungerford shooting incident. *Injury* 1988; **19**: 313–17.
11 Coupland RM. Technical aspects of war wound excision. *Br J Surg* 1989; **76**: 663–7.
12 Ordog GJ, Albin D, Wasserberger J, Schlater TL, Balasubramaniam S. 110 bullet wounds to the neck. *J Trauma* 1985; **25**: 238–46.
13 Suleman ND, Abdul Rasoul H. War injuries of the chest. *Injury* 1985; **16**: 382–4.
14 Ordog GJ, Balasubramanium S, Wasserberger J. Outpatient management of 357 gunshot wounds to the chest. *J Trauma* 1983; **23**: 832–5.
15 Jackson DB, Batty CG, Ryan FM, McGregor WSP. The Falklands war: Army field surgical experience. *Ann R Coll Surg Engl* 1983; **65**: 281–5.

Received 11 April 1994