

Health support in the Iraq War

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OPERATION IRAQI FREEDOM was a history-making campaign which resulted in the occupation of Iraq by United States and United Kingdom forces in 3 weeks in 2003 and the eventual capture of Saddam Hussein.¹ This war continues and has resulted in considerable numbers of severely injured US and Coalition troops, Iraqi military personnel and security forces, Iraqi civilians, enemy combatants and insurgents. We review the military health system set up to treat and evacuate the injured US and Coalition personnel out of Iraq. The organisation and capability of the civilian health system is not discussed.

The population of Iraq is 25 million. In late 2004, about 150 000 troops were in Iraq, of which 135 000 were from the US. As of 18 October 2004, there were 920 Australian military personnel in the Middle East Area of Operations. This contingent was augmented by 450 personnel in April 2005. Twenty-nine countries were contributing to the

Abstract

- ◆ In the ongoing war in Iraq, Defence Health Service personnel are embedded within a United States military medical facility. US military medical support in Iraq has many similarities to the Australian system.
- ◆ Casualties are treated initially at the battle lines by medics trained in Advanced Trauma Life Support. They are then transferred to Forward Operating Bases for further resuscitation and initial surgery, then to field hospitals for stabilisation. Stable patients are evacuated to Germany and then to hospitals in the US.
- ◆ Field hospitals are equivalent to trauma centres in the US and Australia, equipped with an emergency department, operating rooms, intensive care unit, laboratory and radiology facilities, and other ancillary services.
- ◆ Blast injuries, penetrating injuries and burns are most common in Iraq, and often require multiple aggressive debridement procedures. Amputations are often required.
- ◆ Mortality is lower than in previous wars, because of better training for “buddies”, better staffed and equipped medical facilities, and more rapid evacuation to facilities in the US.

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Coalition in the “War Against Terror”. The Iraqi security forces and army comprised about 100 000 personnel.

Defence Health Service personnel have worked closely with US health service personnel since World War II. Australian personnel were assigned to the USS *Comfort* hospital ship in the first Gulf War, and are again “embedded” within a US military medical facility in Iraq. This close liaison has enhanced and validated the interoperability of the military health services of these two countries, and should encourage further conjoint deployment. Although the host unit was staffed mainly by US Air Force personnel, the US Army, Navy and Marines and the three Australian Services were represented.

The Americans graciously accepted the Australians as their colleagues, which resulted in a cooperative and productive working relationship. Australian personnel gained knowledge and experience from working within the US military system, and the Americans were accepting of Australian medical and nursing practice, and incorporated elements of this into their own clinical practice. The Australian personnel supplemented the US staff and filled particular clinical niches.



The 332nd Expeditionary Medical Group US Air Force Theatre Hospital at Camp Anaconda, Balad, Iraq. The helipad alongside the tented facility can receive up to four helicopters simultaneously.

The trauma system in Iraq

The doctrine, organisation and development of the medical support in the Iraq War by the US military has many similarities to the trauma system and the levels of medical care of the Australian Defence Force.

At the battle lines, the medics use Advanced Trauma Life Support (ATLS) skills to treat casualties, who are then transferred rapidly by helicopter or road ambulance to Forward Operating Bases (FOBs), where further resuscitation is undertaken and Forward Surgical Teams may perform damage control surgery. These teams consist of a core of two general surgeons and an anaesthetist (or nurse anaesthetist),² which is similar to the Australian Forward Surgical Troop or Fly Away Surgical Team, except that we do not have nurse anaesthetists. They are able to perform lifesaving surgery to stop haemorrhage and further stabilise patients. The holding time at the FOBs is up to 6 hours of postoperative intensive care, and an FOB is able to operate and stabilise up to 30 wounded soldiers.² Resuscitation and treatment of penetrating injuries in this environment includes surgical control of haemorrhage.

The casualties are then rapidly transported by dedicated aeromedical evacuation helicopters to field hospitals. The field hospitals could become primary receiving centres for casualties if an incident overwhelmed the FOBs. In Baghdad, the field hospital is the 31st Combat Support Hospital. This is a US Army unit set up in the Ibn Sina Hospital, which is a pre-existing hardstanding facility and includes computed tomography (CT), magnetic resonance imaging (MRI) and angiography equipment. Another field hospital is the US Air Force 332nd Expeditionary Medical Group Hospital (EDMG) at the Anaconda Air Force Base in Balad, about 60 km north of Baghdad. There is also a US Army field hospital at the Abu Ghraib Prison and a UK field hospital covering the south of

Iraq, based at Basra. This provides orthopaedic and general surgery. Severely injured patients are reassessed and further stabilised in the 332nd EDMG hospital before handover to the Critical Care Air Transport Teams for evacuation.

Stable patients are evacuated via the 332nd Contingency Aeromedical Staging Facility to Landstuhl Medical Centre in Ramstein, Germany, and then to the main military hospitals in the US. Two of these are the Walter Reed Army Medical Center, Washington, DC, and the Brooke Army Medical Center, Fort Sam Houston, Texas, which has an advanced burns unit.

The field hospitals are equivalent to trauma centres in the US and Australia. These hospitals have an emergency department, multiple operating rooms, and an intensive care unit. The ancillary services comprise full laboratory facilities, pharmacy, radiology departments (including CT, mobile image intensifiers, plain x-ray and ultrasound), and physiotherapy and occupational therapy, providing inpatient and outpatient services. Specialty outpatient clinics are also available.

The field hospitals in Iraq treat injured US troops and other Coalition troops, Iraqi military and security personnel, and some civilian casualties. The Iraqi wounded are treated at the field hospitals, and transferred to Iraqi civilian hospitals when stable. US and Coalition troops are evacuated on dedicated fixed wing flights with Critical Care Air Transport Teams to Germany (6-hour flight), where they are further treated, and then are evacuated to the US. Further surgery and stabilisation may be required at each of these stages. Follow-up surgery was urgently or emergently required in 43% of admitted battlefield casualties from Iraq on transfer to advanced hospitals in the US.³

Families of critically injured troops may also be flown across from the US to meet the injured soldier at Landstuhl Medical Centre. This service is provided by the US military and is greatly appreciated by the families of seriously injured troops.

Staff

The 332nd EDMG has a full range of specialty surgeons. In 2004, there were five general surgeons, including a cardiovascular and a liver transplant surgeon, three to four orthopaedic surgeons, a urologist and an obstetrician/gynaecologist. The general surgeons also perform vascular surgery. A plastic surgeon serving elsewhere on the base was also available. The medical staff also included a head and neck team, consisting of an ear, nose and throat surgeon, ophthalmologist, two neurosurgeons and a faciomaxillary surgeon. The head and neck team proved invaluable for the management of complex penetrating craniofacial and cervical trauma. There was an adequate complement of intensive care physicians and anaesthetists, and two consultant radiologists.

There were initially 20 members of the Australian medical detachment at the 332nd EDMG, consisting in the first



A patient in the intensive care unit of the 332nd Expeditionary Medical Group US Air Force Theatre Hospital at Camp Anaconda, Balad, Iraq being treated by Squadron Leader Belinda Ball, Senior Nursing Officer in the Royal Australian Air Force, and First Lieutenant Johnson, a US Military Nurse, illustrating the close cooperation of Australian and US personnel.

rotation of two intensivists, one neurosurgeon, one emergency department physician, 11 intensive care and emergency department nurses, and four medics. The Officer-In-Charge (OIC) was Wing Commander Michael Paterson. The rotations were initially 3 months for the medical specialists and 6 months for the nurses and medics. The neurosurgeon was followed by an orthopaedic surgeon and a general surgeon. Lieutenant Colonel David Collins became the OIC for the second rotation. Both OICs are Senior Nursing Officers. The size and makeup of the Australian medical detachment has changed beyond the first two rotations.

Injuries, assessment and management

The pattern of injury

The personal threats to military personnel serving in Iraq are indirect fire from mortars and rockets, bomb blasts (which are most frequently from improvised explosive devices), direct fire from snipers, and small arms fire. Medical threats are malaria, leishmaniasis (which is transmitted by sand flies), diseases from mice and rats, scorpion stings and spider bites, gastroenteritis, dust pollutants and possible chemical agent attack or exposure. The effects of psychological stress should not be underestimated.

Blast injuries, penetrating injuries and burns resulting from explosions are the commonest source of injury for the patients admitted to 332nd EDMG. Gunshot wounds are also common. Injuries from mine explosions are less common. Blunt trauma from motor vehicle accidents and falls is also seen.

When the patients arrive for resuscitation and surgery in a level three (surgical) facility, they are frequently shocked, anaemic, hypothermic, hypotensive and acidotic, often with

pulmonary compromise, brain injury and multiple wounds. In the one patient there are often multiple (often complex) injuries with multisystem involvement and metabolic and physiological compromise.

The wounds from bomb blasts are often heavily contaminated and are often penetrated with foreign bodies of various sizes, including metallic fragments, nails, bolts, glass, bone and skin fragments, dirt and fragments of clothing. The typical fragment injuries from bomb blast are relatively small entry wounds with gross internal damage, gross contamination, and extensive devitalised tissue.⁴ Limb, craniofacial and neck injuries predominate; penetrating chest injuries are uncommon in Coalition troops because of body armour. However, chest and abdominal trauma were commonly seen in Iraqi patients.

Compound fractures of the limbs and associated neurovascular injury are common. These injuries require urgent debridement, vascular repair and external fixation of the fractures. Vascular shunts were sometimes placed by the general surgeon at the FOB and definitive vascular repair completed in the 332nd EDMG. Mangled limbs are common, and usually require amputation. Burns are common, including respiratory burns. Abdominal and extremity compartment syndrome is also very common. The blast causes pulmonary damage including contusion, haemorrhage and oedema (“blast lung”), “blast abdomen”, including ruptured bowel and solid organs, and “blast brain”, causing cerebral oedema and raised intracranial pressure, often with cerebral haemorrhages. The blast commonly injures the eyes and ruptures the tympanic membranes.⁴

Assessment and resuscitation

In the emergency room, many aspects of the trauma assessment and resuscitation are performed simultaneously by members of the trauma team and the trauma surgeons, who are in the emergency room at an early stage.

A rapid assessment of the patient is performed, including examination of the back. A chest x-ray is performed and blood is taken at an early stage, particularly for cross-matching and measuring haemoglobin and electrolytes. Hypothermia is corrected with warming blankets. FAST ultrasound is often performed by the trauma surgeons to detect intra-abdominal haemorrhage. Cross-matched blood is obtained quickly and, if necessary, defence personnel on the base are brought in to donate fresh warm blood of a known blood group. Peripheral intravenous access was effective even with smaller bore cannulas (18G), which is contrary to the teaching of the ATLS courses.

The patient is then transferred rapidly to the operating room, via the CT scanner if there is a significant head injury present. As cervical, facial trauma, complex airway problems and blast burns to the face and respiratory tract are common, there is a low threshold for undertaking tracheostomy.

Management

The principles of surgery on bomb blast penetrating wounds include damage control surgery^{5,6} and aggressive debridement of wounds, often with fasciotomy, and always with delayed primary closure of extremity wounds. Open fractures are externally fixed. Amputations are often required for severe extremity injuries. Venous and arterial injuries are common and require emergency repair from vascular or general surgeons.

The abdomen and chest are reopened if the first operation was done by a Forward Surgical Team because there is a significant incidence of missed injury and new problems requiring further surgery. There is a liberal use of broad spectrum antibiotics. Prophylaxis for deep venous thrombosis is usually commenced at the time of surgery, but may be delayed if there is coagulopathy or brain injury. Multiple debridement procedures are often required every 24–48 hours, until the wounds have been cleared of foreign body and devitalised tissue. There is a low threshold for second and third look laparotomy. The abdominal wall is usually left open with laparotomy packs and adhesive tape covering the bowel and the defect. Vacuum drains are placed over the open abdominal wall and over open extremity wounds following debridement.

Penetrating brain injury is managed with exploration, generous craniectomy and vigorous control of intracranial pressure, including ventriculostomy. Evacuation of intracranial haematomas and devitalised brain is performed and lobectomy may be required to relieve brain stem compression and shift. Deep foreign body and bony fragments embedded in the brain are not usually pursued.

Some blast victims require up to 20–50L of resuscitation with crystalloid colloid, cryoprecipitate, stored and fresh blood. Expert anaesthetic and intensive care management is required to correct coagulopathy and manage the fluid balance of patients with blast and penetrating trauma. Blast lung usually requires prolonged positive pressure ventilation and careful fluid management to maintain adequate gas exchange.⁴ Enteric feeding is commenced early in the intensive care unit — usually within 24 hours of the injury. Nasogastric feeding is frequently converted to gastrostomy feeding if a prolonged convalescence is expected, especially if the patient is likely to be on a ventilator for more than a few days.

Late complications may occur once the casualties have returned to US hospitals, and include unusual organisms such as *Acinetobacter* and secondly, deep venous thrombosis and pulmonary embolism. There is a 5% rate of pulmonary embolus in the returnees from the Iraq War at the Walter Reid Army Medical Center. Despite the 332nd EDMG being a tented facility, the wound infection rate is less than 1%. Ongoing cognitive, behavioural, neurological and psychiatric disorders are common after severe blast and penetrating brain injury, and many troops with these problems require long-term rehabilitation and therapy.⁷

Reasons for lower mortality rates

The mortality from war wounds in US troops has progressively fallen from 30% in World War II to 21% in the Korean War, 24% in the Vietnam War, 24% in the Persian Gulf War in 1990–1991, and is down to 10% in the current Iraq/Afghanistan War (2003–2005). By 16 November 2004, 10726 US service members had war injuries. Of these, 1361 died, 1004 of them were killed in action, 5174 were injured and unable to return to duty, and 4179 were injured and did return to duty.² The limb amputation rate for American troops in Iraq is roughly 6%, compared with 3% for previous wars.

There are many factors which explain this reduction in mortality for US (and Coalition) personnel. There has been improved primary care training for “buddies” and medics, and improved resuscitation and stabilisation based on ATLS principles, involving standardised protocols for the management of trauma which have been developed since the Vietnam War. The development of Forward Surgical Teams has provided earlier surgery, expert resuscitation and damage control surgery concepts^{5,6} with the abbreviated laparotomy, early control of haemorrhage, and the early reversal of physiological derangements.

Close liaison of emergency physicians with surgical and anaesthetic staff results in a seamless transit from arrival and triage through to surgery and the intensive care unit. Advances in intensive care and anaesthetic management have also helped to reverse the physiological derangements, and the Critical Care Air Transport teams provide expert medical and nursing care to casualties during long flights to advanced medical facilities.

The provision of CT scanning at the US field hospitals in Iraq provides rapid and accurate diagnostic capability, particularly for neurotrauma and chest and abdominal trauma. Consultant radiologists provide advanced diagnostic capability in the field hospitals.

Severe head and neck trauma is common in Iraq and is associated with a high morbidity and mortality. The availability of emergency neurosurgery, ear, nose and throat, and faciomaxillary surgery is an important component of damage control surgery in Iraq. The establishment of a head and neck team provides comprehensive specialist care for complex injuries to the neck, face, skull base, and cranial cavity. The aggressive control of intracranial pressure and cerebral perfusion pressure is crucial if outcomes from bomb blast and penetrating cranial trauma are to be optimised. This is achieved through early neurosurgery, vigorous resuscitation and maintenance of blood pressure, and the use of ventriculostomy and craniectomy.

Well-equipped and staffed field hospitals in Iraq are similar to trauma centres in the US or Australia. The deployment of senior experienced specialist doctors and nurses covering a wide range of specialties in these military facilities improves the management of severe trauma and saves lives. There have also been many advances in emergency medicine, anaesthet-



Critical Care Air Transport Team preparing a patient for evacuation. Note the monitoring equipment attached to the frame over the patient.

ics, intensive care and trauma surgery, which improve the outcome from severe trauma.

Wearing body armour, helmets, and ballistic eye wear has prevented many serious injuries; however, penetrating injuries still occur to other body parts. The addition of neck, shoulder, axilla, pelvis, and groin protectors to the standard body armour may prevent many of these injuries.

Reduced holding times and rapid evacuation to more advanced facilities with reassessment and sometimes re-operation at each stage also reduce the chance of missed injuries and reduce the effects of secondary injury and other complications. The maximum holding policy for US troops in Iraq is 6 hours in an FOB, up to 3 days in a combat support or field hospital, and up to 30 days in the Landstuhl Medical Centre. These limits are not often reached, as patients are evacuated at the earliest opportunity. The time to reach a hospital in the US is usually less than 4 days from the time of injury, which has improved from 8 days at the start of the Iraq War.^{2,3} In Vietnam, it was often up to 45 days to reach the US. It is probable that infection, pulmonary embolism and complication rates would increase the longer an injured patient is kept in a tented field hospital environment. These complex infections and other complications are best dealt with in an advanced tertiary/quaternary facility in the US (or in Australia).

The management of mass casualties

We experienced frequent mass casualty events, and several important principles of management emerged. The most important is that an experienced triage officer is vital in deciding which patients need surgery and intensive management, versus those who can wait and those who are not suitable for active treatment (ie, where negative triage will be

the recommended course). An experienced triage officer is essential because the use of human and materiel resources in the emergency room, radiology, pathology, blood bank and operating theatres must be appreciated at any moment.

There must be a well-developed hospital-wide plan to manage the mass casualty situation. The teams and their leaders must be identified. The system should be tested before a mass casualty event, with everyone involved called in at an unexpected time. The equipment and systems must be checked regularly. The paperwork should be available and there should be a readily available patient identification system. The identification number must be indelibly marked on the forehead or chest of each casualty at the point of triage and correlated with the paperwork. Coloured pegs for triage category attached to the clothing of the casualties were more reliable than paper records of triage. A whiteboard served as an excellent system for tracking the casualties in the emergency department, wards and operating rooms. The evacuation plan must be well developed so that hospital beds are emptied and/or expanded, and a blood drive is initiated. The personal effects of the victims must be collected and catalogued. Security must be maintained, and an officer should be allocated to undertake media liaison and others to undertake relative and family liaison. Stress management with debriefings should be provided for staff and visitors.

Ideally, at least one doctor, one nurse and one technician should be with each patient and be able to carry out the initial resuscitation and investigation. The patients must be warmed up at an early stage. The traffic of patients is always unidirectional through the hospital. Rapid access to the operating room is essential. It should be possible to open multiple operating rooms and be able to have two operating tables in each room. Often simultaneous surgery is required with two or more teams operating, and damage control surgery is carried out. A morgue must be set up and personnel selected to care for the dead.

The Fallujah assault on 10 November 2004 resulted in 58 casualties admitted to the 332nd EDMG Air Force Theatre Hospital, requiring 38 procedures over 16 hours. The injuries were mainly to extremities, head and neck, neurotrauma, and eyes. Between 9 and 16 November 2004, 429 patients were brought to the emergency department, 304 were admitted (266 from Fallujah), and 400 surgical procedures were performed. Twenty-nine Critical Care Air Transport patients who had come from Baghdad were also managed in the intensive care unit before evacuation. Almost all of these patients were evacuated to Germany within 24 hours, which allowed the hospital to continue to take more casualties.

During the Fallujah assault, there were 23.5 surgical cases per day and 50.67 procedures per day. Total operating room case time was 482.3 hours, not including anaesthesia time, for 282 patients and 608 procedures. It should be noted that the general work of the hospital, including medical admissions, continued during this time.

The lessons for the DHS

In a combat casualty environment, there should be rapid evacuation of patients from level one (resuscitation) through to level four (advanced care), including transport to Australia. There should be well-trained and balanced trauma teams at each level. Staff should be prepared for the rigours of war surgery. All medical and nursing staff should be well prepared to treat casualties with severe blast and penetrating injuries. Surgeons must be trained in modern concepts of trauma and war surgery.⁸

An advanced trauma system for the military operation may require CT scanning, particularly at a level three/four field hospital setting. A head and neck team is a vital asset if there is a long distance to Australia. Tele-radiology and tele-health become important where various specialties are not represented in the field hospital setting, so advice can be received from remote practitioners.

Reliable communication systems are a vital component of any military operation and must allow the operational medical commander to establish efficient links with all the outlying units so that there is an efficient use of the available beds and facilities in theatre, and information regarding the injuries is passed on to those facilities accepting the casualties.

Good data collection is vital, with review of quality of care, morbidity and mortality,⁹ and rapid policy change when required.

The ready availability of pastoral care, psychological debriefing and means of contacting the families by phone and video/web link are all vital for the health, wellbeing and morale of ADF personnel on operation. Senior staff should be prepared to recognise psychological stress in their staff and patients. Staff must also be prepared to cope with the deaths of injured troops and civilians, including children, despite providing excellent care.¹⁰

Conclusion

Service in the Iraq War has been a privilege. Being able to serve alongside our US allies has been a rewarding and mutually beneficial experience, and we hope there will be further opportunities for such cooperation in the future. We have gained extensive experience in caring for battle casualties and soldiers with bomb blast injuries, and managing mass casualty events. This experience and knowledge will benefit military and civilian health professionals in Australia through further education and training and will affect future health policy and doctrine in the ADF and the Australian health system. Australians will then be better prepared to manage terrorist attacks and mass casualties on our soil, although we fervently hope the need never arises.

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Wing Commander Bill Griggs, AM,
who was nominated by
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