The Islamic Republic of Afghanistan (Fig. 1) is a landlocked country in an important geostrategic location in Central Asia, connecting the East and the West or the Middle East. It is surrounded by Pakistan, Iran, several former Soviet republics and the People’s Republic of China. Since the late 1970s Afghanistan has been suffering from a continuous state of civil war, which gave rise to foreign occupation in the form of the Soviet invasion in December 1979 followed by the US-led invasion (OEF-A) in October 2001.

During the Soviet occupation (1979–1989) anticommunist guerrilla groups (Mujahideen) formed and, heavily supported by the US, Saudi Arabia, and other countries, started fighting against the Soviet occupants. After the withdrawal of Soviet troops, the Afghan procommunist government gradually lost power and finally collapsed in 1992. Afghanistan was divided into several territories ruled by rival Mujahideen warlords, who were unable to cooperate and form a stable Afghan government. Finally the devout Taliban, also a Mujahideen group, stood up in 1994 to remove the corrupt and brutal warlords from power, and in 1996 they finally took over control of the whole of Afghanistan. In the Northern Provinces a group of Mujahideen refused to legally accept the Taliban regime and formed the Northern Alliance, or United Islamic Front for the Salvation of Afghanistan, which continued to fight the Taliban.

Consequent to the al-Qaeda terror attacks on New York and Washington in September 2001, the US and its allies started the OEF-A—based on Article 51 of the Charter of the United Nations—as part of their Global War on Terror, removing the Taliban regime from power and decimating al-Qaeda militants. In December 2001 the ISAF, composed of troops from the countries of the NATO alliance, was created and authorized by United Nations Security Council Resolution 1386 and successive resolutions. Its objectives were to assist the Afghan Authority in creating and maintaining a safe, secure, and stable environment while dealing with a strong insurgency. The two military operations of OEF-A and ISAF run in parallel, and although their merging has been intended for some time, this has not yet happened.

The Allied Joint Force Command Brunssum carries out NATO’s prime mission to ensure that the ISAF can sustain its task over the coming years. The ISAF’s multinational headquarters is located in Kabul where operations are planned in close cooperation and coordination with the Combined Forces Command-Afghanistan (OEF-A) and Afghan authorities. Assisted by the Afghan National Security Forces, the ISAF is conducting security and stability operations throughout Afghanistan to secure areas where reconstruction and humanitarian assistance efforts are performed by Afghan governmental organizations, UN missions, and other international or nongovernmental organizations. The ISAF’s Provincial Reconstruction Teams are endorsing the provincial Afghan authorities in strengthening their institutions, which are required to fully establish good governance, the rule of law, and human rights.

Starting in 2001 and increasing with tactical demands, an extensive network of forward operating bases and CSHs with attached medical evacuation assets has been established across Afghanistan, providing early...
medical facility with specialist services and major surgical capabilities, where virtually all traumatic injuries can be treated. It is located on the edge of the airstrip and, as are many other CSHs, is composed of a series of tents, containers, and plywood huts. The hospital generates its own power, is air-conditioned, and has a pharmacy, laboratory, and blood bank as well as radiological capabilities including a CT scanner. Three hard-sided, air-conditioned, and sterile operating rooms are available for emergency interventions. On a regular basis 8 patients can be treated in the intensive care ward and approximately 18 in an intermediate-care ward, with possible expansion in case of mass casualties. The medical staff of the hospital is made up of military and civilian contingents from Australia, UK, Canada, Denmark, Germany, the Netherlands, New Zealand, and the US. Specialties vary according to availability but usually include 2 teams of general and orthopedic surgeons, 2 teams of anesthetists, several emergency physicians, 1 intensivist, 1 internal medicine physician, 1 radiologist, 1 plastic/maxillofacial surgeon, and 1 neurosurgeon. After almost 4 years of Canadian control under the auspices of ISAF, the command is currently assumed by the US Navy (since October 2009). A new, larger hospital made of concrete is presently under construction close to the existing hospital.

No military neurosurgeon was available in Afghanistan until 2007. Up until that time combat casualties received treatment from general, orthopedic, and plastic/maxillofacial surgeons who had undergone some predeployment training in neurosurgery. Some concern arose following a review of several cases managed in the theater, which subsequently led to the deployment of a UK neurosurgeon to Camp Bastion (Lashkar Gar) in May 2007. Since January 2008 a neurosurgeon has been based at the Role 3 Multinational Medical Unit at the KAF. The neurosurgeon, either a military person or a civilian contractor, is supplied through NATO and provides 24/7 coverage for the duration of his or her deployment (6 weeks to 3 months). The neurosurgeons deployed so far came from the UK, Scotland, and Germany.

This Role 3 facility has the only neurosurgeon and plastic/maxillofacial surgeon in southern Afghanistan. Although the precise number of patients admitted and treated at the Role 3 hospital remains classified, we can state that approximately 90% of these trauma cases require primarily orthopedic and/or general surgery, and the majority of wounds are the direct result of blast or pen-
Battlefield neurosurgical care

To demonstrate the workload and spectrum of neurosurgical cases treated at KAF, data on a representative 1-month time span (August 1–30, 2009) and 6 typical clinical cases will be presented in this paper.

The majority of neurosurgical patients treated at the KAF Role 3 hospital during this period were Afghan security forces personnel (24 patients) and Afghan civilians (42 patients). The ISAF troops (11 patients) accounted for only 14% of all cases. Civilian patients admitted to the Role 3 hospital were mostly injured by IED blasts, and only 16% were injured during motor vehicle accidents or from other causes. Space-occupying intracranial hemorrhages and penetrating head injuries are the most frequent pathologies in head-injured patients (40 patients). The impacting force usually causes depressed compound skull fractures or the penetration of bone fragments or foreign material (metallic fragments, gravel, or dirt) into the cerebrum associated with extensive, hemorrhagic, transformed cerebral contusions and cerebral edema. Concomitant damage to the unprotected and vulnerable facial/orbital region in the form of large soft-tissue facial and scalp injuries is frequent. In 21 cases a closed-head injury with or without cerebral contusions of varying extent was the reason for admission. Only a small number of diffuse blast and burn injuries as well as cervical vascular lesions were seen.

The majority of these head and spinal injuries (48 patients) are generated by explosive devices (IED and RPG) and high-velocity gunshots (11 patients). Few lesions are caused during bomb or rocket attacks (6 patients) or motor vehicle accidents (8 patients).

Spinal injuries are not frequent (13 patients) and are usually caused either directly by the impact of high-velocity projectiles to the spine or spinal canal (5 patients) or indirectly by compressive flexion/extension forces during blasts (8 patients). Spinal injuries are often associated with extensive damage to the abdominal or thoracic structures along the bullet’s path.

The majority of injured persons reached the Role 3 hospital in time for emergency neurosurgical intervention (44 patients). Eleven patients died in the hospital from severe brain injury; all had devastating intracranial injuries and were considered not likely to survive.

A limited number of patients (8) were treated for degenerative disc disease, peripheral nerve injury, or severe head or spinal injuries unrelated to the conflict situation (for example, motor vehicle accident, fall, and so forth) as a form of humanitarian aid when resources were available.

Illustrative Cases

Case 1: Penetrating Head Injury. This 35-year-old Afghan man was injured during an IED blast and admit-

![Fig. 2. Case 1. Axial CT scans showing cerebral contusions, a large left-sided temporoparietal epidural hematoma, and a compound depressed skull fracture.](image)

![Fig. 3. Case 2. A: Axial CT scan demonstrating intracranial hemorrhage and cerebral contusion along the fragment’s path. B–D: Axial CT scans showing penetration of the skull by 2 RPG metallic fragments, 1 crossing midline structures.](image)
Case 1: Penetrating Head Injury. A 29-year-old soldier of the Afghan National Army was injured during an IED blast and transferred to the Role 3 hospital with a GCS score of 9 and a large galea laceration, right-sided hemiparesis, and unequal but reactive pupils. Computed tomography studies showed a compound depressed skull fracture, cerebral contusions, and a large left-sided temporoparietal epidural hematoma. An emergency hematoma evacuation was performed, and the patient was sent to the Kandahar Regional Afghan Military Hospital for further care on postoperative Day 5 (Fig. 2).

Case 2: Penetrating Head Injury. This 25-year-old soldier of the Afghan National Army was struck by the explosion of an RPG. On admission he showed a depressed level of consciousness (GCS Score 8), galea and facial soft-tissue injury, and severe abdominal damage. A CT study showed 2 penetrating RPG metallic fragments, one crossing the midline structures and causing hemorrhage along the fragment’s intraparenchymal path before rebounding off the inner table of the skull opposite the entry point. He died as a result of his abdominal injuries (Fig. 3).

Case 3: Penetrating Head Injury. This 30-year-old soldier of the Afghan National Army was hit by fragments of an IED. On admission he had a GCS score of 8 and had suffered severe injury to his face and orbital and frontal region with laceration of the galea, penetrating head injury, and bifrontal cerebral contusions with bifrontally incorporated multiple bone fragments. He died despite emergency neurosurgical intervention (Fig. 4).

Case 4: Penetrating Spinal Injury. This 32-year-old Afghan man was injured during an IED blast. He was admitted awake and alert with both paraplegia from L-4 without rectal tone and associated significant abdominal injury. A CT study showed an L-5 burst fracture with intra- and paraspinal metallic fragments, air entrapment within the spinal canal, penetrating abdominal injury, and retroperitoneal hematoma. Initially, the patient underwent surgery for his abdominal injuries. Exploration and debridement of the bullet path revealed the expected CSF leak. The patient underwent neurosurgical decompression and debridement of the cauda equina and dural sac closure. Unfortunately, no spinal instrumentation was available in the hospital at this time. The patient remained paraplegic but survived in good clinical condition and was sent to an external hospital for further care (Fig. 5).

Case 5: Vascular Injury. This 40-year-old soldier of the Afghan National Army was injured during an IED blast. Along with a GCS score of 13 on admission, he had a closed-head injury as well as penetrating cervical and facial injuries without focal neurological signs or symptoms. Computed tomography studies revealed subtotal occlusion of the left vertebral artery by metallic fragments at C-1. After local debridement for his soft-tissue injuries and antithrombotic medical treatment, he was transferred
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Fig. 6. Case 5. Axial contrast-enhanced CT scans showing subtotal occlusion of the left vertebral artery by metallic fragments at C-1.

Fig. 7. Case 6. Axial (left) and sagittal (right) CT scans demonstrating severe cervical soft-tissue injury with penetration of the left jugular vein and fractures of the transverse processes of C5–7 by the bullet.

to Kandahar Regional Afghan Military Hospital without neurological deficits (Fig. 6).

Case 6: Vascular Injury. This 19-year-old Afghan woman suffered a gunshot wound to her right neck and severe blood loss at the scene. Computed tomography scans showed severe cervical soft-tissue injury with penetration of the left jugular vein and fractures of the transverse processes of C5–7 by the bullet. She underwent surgery with ligation of the left jugular vein, nerve root decompression, and removal of the incorporated bullet. No injuries to other vital structures like the carotid artery, trachea, or esophagus were found intraoperatively. The patient survived with slight numbness in the left C-6 dermatome and mild weakness of the left biceps muscle and was discharged home on postoperative Day 5 (Fig. 7).

Lessons Learned

Based on our experience we would like to stress: 1) the need to attempt to meticulously debride the bone chips, shrapnel, and devitalized brain to minimize the risks of epilepsy and intracranial infection; 2) strict dural repair and closure with dural grafts (pericranium or fascia lata) to restore the best barrier against intracranial infection; 3) generous craniotomy where suitable supplemented by duraplasty as a decompressive measure to counteract the development of the inevitable brain swelling that accompanies high-velocity penetrating brain injury; and 4) strict record keeping to create a pool of knowledge that can be used for further study and discussion at a later stage, like we are doing now.

Conclusions

Even 9 years after toppling the Taliban regime the allied forces must still deal with a strong insurgency, and war in Afghanistan is now bloodier than ever. With the recent arrival of new troops, the balance of military power has shifted south. Presently only 1 neurosurgeon is based in southern Afghanistan. Few ISAF troops have required urgent neurosurgical care, and the majority of treated patients were Afghan Security Forces personnel and civilians injured as a result of military activity. To provide the best neurosurgical care to ISAF troops and their allies, the continuance of this service in southern Afghanistan should be mandatory. The limitation of resources and the possibility of endangering critically ill patients by long flights to a centralized neurosurgical service within the war zone, with the associated tactical limitations and delays, must be balanced. Skilled emergency surgeons should be encouraged to undergo extra training in emergency neurological techniques (bur holes, intracranial pressure monitoring, decompressive craniotomies, and so forth) before their deployment. In close cooperation with the Afghan government the establishment of an Afghan neurosurgical service in the years
to come should be considered as a long-term objective. The experience gained in Afghanistan can significantly contribute to the improvement of the neurosurgical techniques used in civilian trauma surgery and in the overall medical management of civilian catastrophic events.

**Disclosure**

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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