

# Utilization profile of the trauma intensive care unit at the Role 3 Multinational Medical Unit at Kandahar Airfield between May 1 and Oct. 15, 2009

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**Background:** In the war against the Taliban, Canada was the lead North Atlantic Treaty Organization (NATO) nation to provide medical and surgical care to NATO soldiers, Afghanistan National Army soldiers, Afghanistan Nation Police, civilians working in and outside Kandahar Airfield and Afghanistan civilians at the Role 3 Multinational Medical Unit (R3MMU) from February 2006 to October 2009.

**Methods:** We obtained data from the Joint Theatre Trauma Registry between May 1 and Oct. 15, 2009; 188 patients were admitted to the R3MMU intensive care unit (ICU). We analyzed the ICU data according to types and causes of trauma, mechanical ventilation prevalence, ICU medical and surgical complications, blood products utilization, length of stay in the ICU and mortality.

**Results:** The admitting services were general surgery (35%), neurosurgery (29%), orthopedic surgery (18%) and internal medicine (3%). Improvised explosive devices (46%) and gunshot wounds (26%) were the main causes of ICU admissions. The mean injury severity score for all patients admitted to the ICU was 37, and 81% of ICU patients required mechanical ventilation for a mean duration of 3 days. The main ICU complications were coagulopathy (6.4%), aspiration pneumonia (4.3%), pneumothorax (3.7%) and wound infection (2.7%). The following blood products were most used: packed red blood cells (55%), fresh frozen plasma (54%), platelets (29%) and cryoprecipitate (23%). The average length of stay in the ICU was 4.3 days, and the survival rate was 93%.

**Conclusion:** The high survival rate suggests that ICU care is a necessary and vital resource for a trauma hospital in a war zone.

**Contexte :** Au cours de la guerre contre les Talibans, le Canada a été le principal pays de l'OTAN à fournir des soins médicaux aux soldats de l'Organisation du Traité de l'Atlantique Nord (OTAN), aux militaires de l'Armée nationale de l'Afghanistan, aux membres de la Police nationale de l'Afghanistan, aux civils travaillant au Terrain d'aviation de Kandahar et à l'extérieur, ainsi qu'aux civils afghans, à partir de l'Unité médicale multinationale de rôle 3 (UMMR3), de février 2006 à octobre 2009.

**Méthodes :** Nous avons extrait des données du Registre des traumatismes sur le théâtre d'opérations en commun pour la période du 1 mai au 15 octobre 1999 : 188 patients ont été admis aux soins intensifs (SI) de l'UMMR3. Nous avons analysé les données des SI en fonction des types et des causes des traumatismes, de la prévalence de la ventilation mécanique, des complications médicales et chirurgicales aux SI, de l'utilisation des produits sanguins, de la durée du séjour aux SI et de la mortalité.

**Résultats :** La chirurgie générale (35 %), la neurochirurgie (29 %), la chirurgie orthopédique (18 %) et la médecine interne (3 %) ont été les services d'admission. Les principales causes d'admission aux SI étaient les engins explosifs improvisés (46 %) et les blessures par balle (26 %). Le score moyen de l'indice de gravité de la blessure pour tous les patients admis aux SI s'est établi à 37, et 81 % des patients des SI ont eu besoin de ventilation mécanique pendant 3 jours en moyenne. La coagulopathie (6,4 %), la pneumonie par aspiration (4,3 %), le pneumothorax (3,7 %) et l'infection des plaies (2,7 %) ont constitué les principales complications aux SI. Les produits sanguins suivants ont été les plus utilisés : culot globulaire (55 %), plasma congelé frais (54 %), plaquettes (29 %) et cryoprécipité (23 %). La durée moyenne du séjour aux SI s'est établie à 4,3 jours et le taux de survie, à 93 %.

**Conclusion :** Le taux de survie élevé indique que les soins aux SI constituent une ressource nécessaire et vitale pour un hôpital de traumatologie en zone de guerre.

Located in the austere environment of southern Afghanistan, the Role 3 Multinational Medical Unit (R3MMU) at Kandahar Airfield provides medical care to wounded multinational soldiers as well as Afghan civilians and military (Fig. 1). In military parlance, there are several levels of medical care that are graded from Role 1 through Role 5. Role 1 is typically basic first aid provided in the field. The next level is Role 2, which is able to provide resuscitation and treat shock to a higher level than Role 1. For example, a Role 2 facility has field surgical capability, radiographic imaging and basic laboratory and transfusion capabilities, but the wounded need to be transferred to the nearest Role 3 facility for care as soon as possible. Role 3 facilities are able to provide hospitalization, including surgical care at a primary surgery level; an intensive care unit (ICU); nursed beds; diagnostic imaging, such as computed tomography (CT); and laboratory support. Role 4 facilities are hospitals in the home country, and Role 5 sites are rehabilitation facilities.

In early February 2006, Canada established the



**Fig. 1.** The Role 3 Multinational Medical Unit facility in Kandahar, Afghanistan.

R3MMU at Kandahar Airfield, taking over the US Army Medical Corp Role 2 facility that had been providing health care to American, coalition and Afghan patients since October 2002. Canada was the lead nation at the R3MMU until October 2009, when the lead nation role was transferred to the US Navy Medical Corp (USNMC). Over the course of the mission, the R3MMU expanded the existing Role 2 facilities to include a CT scanner, blood bank and laboratory without microbiology support. The R3MMU facility had an 8-bed ICU, 10–16 ward beds, 2 operating room (OR) theatres, 10 trauma bays and a radiology unit with ultrasonography and plain film capabilities. The clinical workforce in the facility over the period of the mission included general, orthopedic and oral/maxillofacial surgeons, anesthesiologists, internists, radiologists, family physicians and ICU and OR nurses. Canada received assistance from the Netherlands, who provided nurses and a general/vascular surgeon; Denmark, who provided general and orthopedic surgeons, nurses and medical paramedics; and the United States and Britain, who both provided family-emergency physicians and nurses. The civilian contribution from Canada included general surgeons, orthopedic surgeons, oral/maxillofacial surgeons, internist-intensivists, a radiologist and nurses.

We obtained retrospective data on ICU admissions at the R3MMU from the Joint Theatre Trauma Registry (JTTR) over a single rotation spanning 6 months, from May 1, 2009, to Oct. 15, 2009, before the transfer of command to the USNMC. Our aim was to examine the experience of the ICU with respect to injury patterns, resource utilization and mortality data over a period of time when Canada had the lead nation responsibility. We then discuss the experiences of the R3MMU ICU and 48th US Combat Support Hospital (CSH) in Afghanistan. It is our hope that such an analysis will highlight our strengths as well as areas for improvement in the provision of trauma medical care for future missions.

## METHODS

### *Data collection*

We obtained data from the JTTR, which is a repository that collects trauma-related data on care and outcomes of military and civilian trauma patients. One of the limitations of the JTTR is that the data collection improved over the course of the mission. As a result, the data on complications recorded during the time of the 48th US CSH are less comprehensive than those for the R3MMU at Kandahar Airfield, which was established later. The complications reported for the R3MMU were defined as per the JTTR guidelines.<sup>1</sup> Each day, 2 nurses present at the R3MMU reviewed patient charts and spoke to the ICU physician to record the complications. We obtained data regarding patient demographics, mortality, injury

patterns and length of stay in the ICU directly from the JTTR.

**RESULTS**

*Profile of trauma patients*

During this 6-month period, there were 188 admissions to the R3MMU ICU. The mean age of the patients was 25 years, and about 16% were pediatric patients under the age of 16 years. In all, 95% of patients were male, and most were Afghan civilians. Of the total admissions, 44% were Afghan civilians, 36% were multinational soldiers, 16% were Afghan police/army and 4% were non-Afghan civilians. The mean injury severity score (ISS) for all admissions to the ICU was 37. The average prehospital transport time of admitted patients was 60–90 minutes.

Improvised explosive devices (IEDs) were responsible for injury in 46% of the patients, and gunshot wounds (GSWs) were responsible for 26% of admissions (Table 1). The rest of the admissions had a variety of causes from motor vehicle crashes to drowning.

*Resource utilization*

The primary specialists involved in the care of the patients were the general/trauma surgeon (35%), neurosurgeon (29%), orthopedic surgeon (18%), oral/maxillofacial surgeon (10%) and internist (4%).

There were a large number of blood products being used at the R3MMU. Packed red blood cells (PRBC) and fresh frozen plasma (FFP) were transfused in 54% and 53% of patients, respectively, at an average of 9 units per patient. Platelets were transfused in 29% of patients, cryoprecipitate in 18% and Factor VII in 17% of patients. Notably, 4% of patients in the ICU received fresh whole blood (FWB), which is a blood product that would not be used in a civilian ICU, but is used in an austere combat environment. The FWB was obtained from soldiers at Kandahar Airfield who donated their own blood.

*Complications*

Complications that occurred in patients in the ICU were coagulopathy (6.4%), aspiration pneumonia (4.3%), pneumothorax (3.7%) and wound infection (2.7%). The remainder of the complications occurred in less than 2% of patients and included acute respiratory distress syndrome, hypothermia, acute renal failure, blood transfusion reaction, decubitus ulcers, pleural effusion, pulmonary edema, anemia, wound dehiscence, hyperkalemia, hypovolemia, ileus, pneumonia and progression of the original neurologic insult. About 0.5% of patients experienced complications such as acute arterial occlusion, adverse drug reaction, cardiac arrest, deep vein thrombosis, pan-

creatitis, seizures and sepsis. On average, 81% of patients required mechanical ventilation for a mean duration of 3 days, and ventilator-associated pneumonia developed in 2 patients (1.0%).

*Quality of care*

Of the 188 patients admitted to the R3MMU ICU, 175 (93.1%) survived. Of those who died, 9 (69.2%) were Afghan nationals and the remainder were International Security Assistance Forces (ISAF). The mean length of stay in the ICU for all patients was 4.3 days, that for ISAF patients was 2 days, that for Afghan patients was 6 days. It is highly likely that our inability to access an appropriate medical facility to transfer Afghan patients may have negatively affected their chances of survival.

**DISCUSSION**

The data gathered from the R3MMU ICU provide information on injury patterns, resource utilization and indicators of quality of care — information that is useful in guiding future missions. It is also of benefit to examine the experiences of the R3MMU ICU and the 48th US CSH, which were similar facilities operating during different time periods in Afghanistan. The 48th US CSH was active from December 2002 to February 2006, when it was replaced by the Canadian-led R3MMU at Kandahar Airfield.

The 48th US CSH published data on 204 trauma admissions over an 18-month period from December 2002 to June 2003.<sup>2</sup> This facility had similar patient demographics and injury patterns to the R3MMU ICU. At the 48th US CSH, the mean age of the patients was 25 years, and the most common causes of injury were IEDs (36%) and GSWs (20%).<sup>2</sup> In comparison, at the R3MMU, the mean age of the patients was also 25 years, and the most common causes of injury were IEDs (46%) and GSWs (26%; Table 1). The patient demographics, injury patterns and facilities of the 48th US CSH and the R3MMU were similar, allowing for a

**Table 1. Demographic and clinical characteristics of patients at 2 combat support hospitals in Afghanistan**

Characteristic	48th US CSH	KAF R3MMU
Mean age, yr	25	25
Mean length of stay, d	8	4
Injury, % of patients		
Improvised explosive device	36	46
Gunshot wound	20	26
Motor vehicle crash	10	5
Grenade	5	< 1
Burns	8	1
Other	20	21

48th US CSH = 48th United States Combat Support Hospital; KAF R3MMU = Kandahar Airfield Role 3 Multinational Medical Unit.

fair comparison of their experiences. Mortality at the 48th US CSH was 6.6% for all trauma patients compared with 7.0% at the R3MMU ICU.

Blood products utilization is an area in which there was a significant difference between the 48th US CSH and the R3MMU ICU. Overall, the 48th US CSH used fewer blood products. At the 48th US CSH, 26% of trauma patients received PRBC transfusion at an average of 4 units per patient and 3.5% received FFP transfusion at an average of 4 units per patient. In contrast, the R3MMU transfused PRBC and FFP in 54% and 53% of patients, respectively, at an average of 9 units per patient.

In ICU trauma care, the “lethal triad” comprises acidosis, hypothermia and coagulopathy; these factors increase trauma patients’ risk of death. A massive transfusion is defined as a transfusion of more than 4 units of PRBCs in 1 hour and ongoing need for transfusions. Given the nature of the injuries sustained, 18% of patients admitted to the R3MMU ICU received a massive transfusion to minimize complications from blood loss. The utilization of PRBCs and FFP was almost equal at the R3MMU because published data from the war in Iraq demonstrated decreased mortality associated with a resuscitation protocol using a 1:1 ratio of FFP to PRBC units versus the previously used 3:1 ratio of saline to PRBC.<sup>3</sup> Previous publications have suggested that using a 1:1 blood products resuscitation protocol decreases mortality by decreasing coagulopathy complications, such as hemorrhage.<sup>4</sup> This may explain the increased use of blood products in the R3MMU compared with the 48th US CSH.

There were 112 complications observed at the R3MMU ICU compared with 63 complications at the 48th US CSH. The larger number observed at the R3MMU ICU may be related to improved documentation with the JTTR, which was under development when the 48th US CSH was collecting its data. Furthermore, the 48th US CSH had a higher incidence of wound infections than the R3MMU ICU. This could be a result of the primitive conditions under which the 48th US CSH was operating during the early part of the war.

### Limitations

Although the R3MMU was active for 3 years, data were only collected over a period of 6 months to cover a single rotation of the deployment and personnel. However, a previous study by Tien<sup>5</sup> shows that patient demographics and injury patterns of the R3MMU from February to July 2006 were similar to that found in our study.

When comparing the experiences of the 48th US CSH and R3MMU, it would be useful to know the mean ISS for each hospital; however, the 48th US CSH did not report the ISS scores in their publication,<sup>2</sup> which limits the utility of the comparison of mortality rates as an indicator of quality of care.

### Areas for improvement

Health care in combat zones consists of both injury treatment and promoting practices for injury prevention. Based on our experiences at the R3MMU ICU, the consistent use of personal protective equipment, field combat casualty care and improved armoured protection vehicles in the field will reduce the severity of injuries sustained on the battlefield and thus decrease the severity of injuries to be treated in the CSH.

### Future direction

The R3MMU ICU included an intensivist who provided supportive care to the trauma patients. Of the intensivists who worked at the R3MMU ICU, 40% were certified by the Royal College of Physicians and Surgeons of Canada (RCPSC), and most worked in an ICU at a university-affiliated teaching hospital. The remaining intensivists, who were not certified by the RCPSC, practised in a community ICU setting in Canada. It has been shown that an intensivist-directed multidisciplinary team is additive to surgeons who are often occupied in the OR in a combat zone and leads to improved patient outcomes. Grathwohl and Venticinque<sup>6</sup> examined the mortality outcomes in the 31st and 86th CSHs in Iraq that had the following ICU organizational structures: no intensivist in the ICU, intensivist consultation only to the ICU and an intensivist-directed team (IDT) in the ICU. The mortality outcomes were 25.8% for no intensivist in the ICU, 14.4% with intensivist consultation only and 10.1% with IDT. The IDT had the lowest mortality rate, emphasizing the importance of an IDT approach to ICU care in a combat zone hospital.

The critical care air transport team (CCAT) program is a component of the US Air Force aeromedical evacuation system, which Canada uses for its own wounded soldiers in Afghanistan. A CCAT consists of a critical care physician, critical care nurse and respiratory therapist along with supplies and equipment to operate a portable ICU within a cargo aircraft.<sup>7</sup>

This capability was developed to provide the US Air Force’s air evacuation system with the intrinsic capability to transport and stabilize critically ill and injured patients. This permits the surgical team in theatre to remain small and mobile enough to keep pace with the military operation they support and still provide advanced resuscitation, but limited postresuscitation care. The effectiveness of the system was validated in a *New England Journal of Medicine* article in December 2004, which reported the highest survival rate in the history of war and illustrated the concept that the mobile patient can be transported back to the United States in fewer than 4 days, compared with 45 days in Vietnam.<sup>8</sup>

### CONCLUSION

On Oct. 15, 2009, the lead-nation role for the R3MMU in

Afghanistan was transferred from Canada to the USNMC. This was Canada's first combat role since the Korean War, and for 3 and a half years Canada had the responsibility of being the lead nation to care for the soldiers and civilians in Afghanistan. The data presented in this paper show that Canada performed well in this capacity, as revealed by the low mortality rate of 7.0%, which is comparable to published mortality rates of the 48th US CSH. Based on our experiences at the R3MMU at Kandahar Airfield, an intensivist (certified or noncertified)-directed approach and robust CCAT capabilities were cornerstones in providing high-quality trauma medical care to wounded soldiers and civilians alike.

**Competing interests:** None declared.

**Contributors:** Mr. Pirie and Drs. McAlister and Kao designed the study. Ms. Compton, Mr. Pirie and Drs. McAlister and Kao acquired the data, which Ms. Shah and Drs. McAlister, Church and Kao analyzed. All authors wrote and reviewed the article and approved the final version for publication.

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