

Combat casualty care: Partnering for preparedness

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The theme for this year's supplement, "Partnering for Preparedness," serves notice to the nation regarding the urgency to maintain our investment in combat casualty care research, both to benefit our US military service members and to best prepare our nation on the home front. Department of Defense funding primarily seeks to optimize combat casualty care for US service members injured in conflict. In the face of military budget cuts, we must seek increased partnerships to stay ahead of the curve in combat casualty care research and to maintain our lessons learned to sustain readiness. Similarly, we are all compelled to improve care for injured American citizens. This shared goal is especially relevant and timely, given the increasing number of intentional mass casualty events on the home front.

We don't need another "history repeats itself" lesson to prove to us the importance of military and civilian collaboration in trauma care. We already know that during war research is stimulated by large casualty volumes leading to advances in combat casualty care. Our society then indirectly benefits from these advances through the adaptation of combat casualty care lessons to the care of injured citizens. We also know that between wars we seek to sustain and improve our trauma knowledge by leveraging the expertise in research and training at our nation's civilian trauma centers.

Unfortunately, our national and military leadership has the tendency to quickly forget the importance of advances made through a dedicated and focused investment in operationally relevant, gap-driven trauma research. In addition, the skills of combat casualty care experienced physicians, nurses, medics, and ancillary staff rapidly fade because of attrition to civilian life and because of a lack of dedicated sustainment of trauma skills as these military medical personnel return to a military facility practices not involving routine trauma care.

In an unsettling way, we are told that we have reached the conclusion of military conflicts in Iraq (2012) and in Afghanistan (2014), yet we remain involved with a significant number of US Military service members deployed in harm's way in both locations. In addition to Afghanistan and Iraq, we are also engaged globally with small military teams working in dispersed and remote locations such as in Africa and Asia without the benefit of a robust Joint Trauma System, which has given us the lowest case fatality rate in military history.

Equally concerning, we are experiencing an increase in the frequency and number of intentional mass casualty events from active shooter and intentional bombings on the home front. Almost daily, we see news reports of events involving multiple casualty scenarios right here on our home soil. We face an onslaught of intentional harm events with increasing complexity and are compelled to act with urgency to ensure that investment is commensurate to the importance of supporting ongoing military operations and civilian mass casualty preparedness. Increased funding for trauma research and partnership between military and civilian trauma communities are essential to meet this threat.

Internationally, we must also partner for preparedness. Part of our success in providing a Joint Trauma System for two theaters of operation for over a decade has been the result of a mutually beneficial investment in preparedness in combat casualty care across multiple nations. Our ability to work together to provide trauma care has fostered international medical partnerships in trauma care that would not otherwise have been possible. The fruits of this international investment are

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demonstrated by five deployed theater trauma system conferences culminating in the last collaborative meeting in the summer of 2014 in Afghanistan.¹

The Combat Casualty Care Research Program has already faced significant budget cuts forcing difficult choices regarding what are the most important combat casualty care research efforts that will lead to decreased morbidity and mortality for our deployed service members. In the context of national preparedness, an obvious lack of a plan and an intentional investment in trauma research for our nation only magnifies the importance of these cuts. Given a presidential directive to ensure national preparedness for mass casualty events on the home front² and the publication of a report by the National Academy of Medicine titled "A National Trauma Care System: Integrating Military and Civilian Trauma Care Systems to Achieve Zero Preventable Deaths After Injury,"³ we should be laser focused on the urgent need for an intentionally planned and programmed national trauma research action plan. The time is now for us to redouble our investment in combat casualty care research, to finally carve out funding for civilian trauma research in the national budget, and to unite to create a national trauma research action plan as part of our efforts to bolster national preparedness and security. As we "partner for preparedness," this should be among the highest of our nation's priorities.

As a learning health system, we must continuously adapt to current needs while maintaining a vision and the foresight to plan for future contingencies. In conjunction with the theme for this supplement, we have included several key special articles to highlight "partnerships for preparedness." In the first, Dr. Eric Elster, professor and chairman of the Department of Surgery at the Uniformed Services University of the Health Sciences and Walter Reed National Military Medical Center, the US Military's center for academic military medicine, examines the Military Health System Strategic Partnership with the American College of Surgeons and current trauma training partnerships with civilian trauma organizations. Next Drs. Don Jenkins and Jeff Bailey, both prior deployed Joint Theater Trauma System directors, highlight the origins and importance of the Joint Trauma System to our recent success in battlefield care. Partnering for national preparedness for active shooter and intentional mass casualty events on the home front is explored by Dr. Alex Eastman, medical director and chief of the Rees-Jones Trauma Center at Parkland in Dallas. The final special article is by Dr. Carolyn Laurencot from the US Army Medical Materiel Development Activity. She focuses on transitioning combat casualty care research through sometimes difficult regulatory pathways to successful product development.

The main body of this supplement emphasizes the importance of trauma research across the full spectrum of a trauma system of care. The issue is led by three articles related to military trauma systems. The first by Antebi, et al. represents the importance of the US-Israeli military partnership. In it, our two military deployed trauma systems of care are compared and contrasted to convey lessons to be learned on both sides. Next, Orman et al. describe their early findings from the Trauma Outcomes and Urogenital Health (TOUGH) Project. The TOUGH project reviewed data from Iraq and Afghanistan to describe the

epidemiology of genitourinary injury associated with extremity amputation. Finally, Rivera et al. conducted a quality assurance survey of the newly formed Military Orthopedic Trauma Registry and found that it contained data useful and relevant for future efforts to improve military orthopedic casualty care.

The next three articles discuss aspects of combat casualty care during medical evacuation. Maddry et al. reviewed medical evacuation records to characterize provider types and interventions performed during helicopter evacuations from point of injury during combat operations from 2011 to 2014. Liu, et al. reviewed the civilian medical evacuation literature for advances in monitoring and early hemorrhage detection techniques that could be useful for the military evacuation environment. Blakeman et al. studied several pressure monitors with closed-loop control of endotracheal tube cuff pressures to determine their performance at simulated altitude.

The next five articles relate to initial resuscitation and damage control of trauma patients on the battlefield. The first by Mann-Salinas et al. is a US-UK collaboration to evaluate newly available information from Role 2 forward surgical teams. The study analyzed types and mechanisms of injury, as well as outcomes, with a goal to ultimately determine appropriate utilization of these assets on the battlefield. Next, Joseph et al. examined deaths after resuscitative thoracotomy to determine if resuscitative endovascular balloon occlusion of the aorta (REBOA) would have had potential benefit in those patients. They hope to shed light on the need for better defined indications for REBOA use. This is followed by Johnson et al., who describe a novel technique of partial REBOA (P-REBOA). The purpose of P-REBOA is to minimize distal perfusion-reperfusion injury while extending the time REBOA can be inflated prior to surgical hemorrhage control. The next article describes a novel technique of Direct Site Endovascular Repair (DSER) by Davidson et al. DSER utilizes existing endovascular repair devices placed using an open technique. They describe three cases of initial application of this technique. Finally, Liu and colleagues investigated the effect of percentage of full thickness among total body surface area burns on resuscitation. They learned that increasing surface area and percent full thickness increased required resuscitation.

This supplement contains four articles focusing on trauma critical care. The first by Park et al. studied the epidemiology of acute respiratory distress syndrome (ARDS) with recent data from combat casualty care. Among other findings, ARDS was not found to be associated with explosion injury. Next Glaser et al. described a Focused Rapid Echocardiographic Evaluation (FREE) meant for evaluation of critically ill patients in remote environments with limited other resources. They found results of FREE to be comparable to standard transthoracic echocardiography. Galvagno et al. studied respiratory volume monitoring and found decreased volumes provide early warning prior to true oxygen desaturation in postoperative patients. Lastly, a basic science article by Peng et al. noted that lung function is not affected when resuscitating mice with human versus mouse plasma in a hemorrhage and laparotomy model.

The final two articles in this supplement describe novel areas of reconstruction inspired by dismantled blast injuries. In the first, Bamba et al. used a novel polyethylene glycol therapy in conjunction with neurotaphy in humans with digital nerve

injuries. When compared with a retrospective cohort, the results were promising for decreased nerve healing times. Finally, Pollot et al. studied volumetric muscle loss and bone healing in rats with and without the use of a small intestinal mucosa extracellular matrix and found that it impaired fracture healing and did not improve muscle strength.

DISCLOSURE

The authors declare no conflicts of interest.

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