RDCR Symposium fifth-year anniversary edition: global prehospital care rooted in a history of military innovation

Approximately a decade ago, an anesthesiologist well versed in the challenges of treating military personnel because of his position as a senior medical officer for the Norwegian Naval Special Operation Commando was looking for ways to provide blood products to critically injured service personnel in austere environments. The literature regarding the use of low-titer group O whole blood collected onsite to treat severely bleeding patients hit him like a bolt from the blue. After initiating a "walking blood bank" aboard a frigate in the Gulf of Aden, he realized that this was the answer he was looking for, but wanted to push boundaries and compare notes with others implementing similar strategies. He reached out to a pediatric intensivist, formerly of the US Army, who had authored some of the initial reports regarding resuscitative strategies for traumatic hemorrhagic shock in Iraq. The two physicians discussed the development a whole blood research program, and in early 2011, Drs Philip Spinella and Geir Strandenes met in an Irish bar while at a conference in Innsbruck, Austria, to further discuss how they could work together. They wanted to advance and disseminate the lessons of Iraq, which were in turn based on lessons learned on the battlefield dating back to Vietnam, Korea, and even World War II. As the night wore on, the discussion, fueled by great beer and a common purpose, gave rise to the "blood far forward" concept of bringing blood products as near as possible to the point of injury. An ambitious plan was born to bring this concept to prehospital providers around the globe, both military and civilian. There were many steps from that conversation to the full fruition of the idea. In addition, many others joined Strandenes and Spinella in the effort to form the fledgling organization, including Dr. Tor Hervig, a Norwegian Transfusion Medicine expert, and Hakon Skogrand, a Norwegian Navy Seal Medic. The result is the Traumatic Hemostasis and Oxygenation Research (THOR) Network, which organizes a yearly international meeting in Norway now called the Remote Damage Control Resuscitation (RDCR) Symposium. The meeting has a multidisciplinary approach that embraces input from a broad spectrum of partners all along the continuum of care and beyond. The addition of influential hematologists like Drs. Paul Ness and Andre Cap have enriched understanding of blood as an organ and brought new ideas regarding potential therapies. In keeping with its origins, late-night conversations around a table in the bar (now affectionately dubbed "the table of knowledge") continue to fuel creative networking that has led to research projects, manuscripts, practice guidelines, and opinion pieces.

The summer of 2015 marked the fifth anniversary of the symposium and so in this edition of the conference supplement, we review the impact the meeting has had, the reasons why it "punches above its weight," some of the issues that were addressed during the 2015 meeting and are covered in this supplement, and we highlight some of the topics to be tackled in the future. After the conference in 2015, we informally polled some of the RDCR "regulars" about the impact this results-oriented meeting born in an Austrian Irish pub has had over the previous 5 years. The answers were both inspiring and illuminating. In country after country, both military and civilian participants stated that this intimate forum, which brings together "tip-of-the-spear" prehospital providers, prominent researchers, influential physicians, and important operational decision makers, has changed practice at their respective institutions. In a collaborative effort between the trauma and the transfusion medicine departments, the Mayo Clinic in Rochester, Minnesota, implemented clinical use of both cold-stored (4°C) platelet (PLT) and low-titer group O whole blood for patients with severe traumatic bleeding in both prehospital and hospital settings. The Haukeland Hospital in Bergen, Norway, is testing refrigerated PLTs in PLT additive solution after hearing results from the Coagulation and Blood Research group at the US Army Institute of Surgical Research in San Antonio, Texas. In Lund, Sweden, increased point-of-care testing to assess coagulopathy and orthogonal spectroscopy to evaluate perfusion was introduced in emergency room settings as a result of contacts formed at one of the RDCR conferences. In 2009, well before the RDCR Symposium was created, the Royal Caribbean Cruise Lines (RCCL) implemented a "walking blood bank" transfusion program using fresh whole blood (FWB) from pre-vetted donors to treat cases of acute bleeding. Having found like-minded practitioners and researchers at the RDCR Symposium, the RCCL medical director writes that it is his "most important clinical meeting of the year" and that the RCCL has "developed and amended [its] protocol

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multiple times as the result of information gained during the conference sessions, or in the extensive networking that takes place at the meeting."

Given the origins of the conference, it is not surprising that militaries around the world have tuned into RDCR and are reporting significant impact on their policies and practices over the course of the past 5 years. The Norwegian special forces and others have implemented a blood far forward program that makes whole blood available to critically injured personnel even in very remote, austere locations. In the SOF command structure of the Nordic countries (Norway, Sweden, Denmark, and Finland) there is general agreement to follow the TCCC guidelines. This now includes the guideline that specifies whole blood as the preferred fluid for resuscitation of hemorrhagic shock. The French army implemented a FWB storage program and modified their massive transfusion policy to include earlier transfusion of PLTs. In the United Kingdom, cold storage of PLTs is being considered for the treatment of acute bleeding, and the Canadian, Finnish, Australian, and Czech military are exploring implementation of a whole blood program, including use of low-titer, group O FWB to treat severe hemorrhage. The Canadian Armed Forces further report that the Symposium has influenced their far forward blood program, resulting in the adoption of fibrinogen components in prehospital environments and in exploring the possible use of an experimental therapy, resuscitative endovascular balloon occlusion of the aorta (REBOA), as an adjunct to control massive prehospital bleeding.

As these stories illustrate, this small gathering of subject matter experts in hemorrhagic shock resuscitation has been able to influence care around the world in both prehospital and acute hospital settings, and the key to its success lies in the collective enthusiasm and dedication of its current 232 members from more than 18 countries. Engagement and collaboration with other societies and organizations such as the European Shock Society, AABB, the US FDA, US Military Committee of Tactical Combat Casualty Care, and the NATO Blood Panel has been extremely helpful in advancing the mission of the THOR Network. The THOR Network unabashedly acknowledges that it has not developed anything "new." In fact it relishes in the notion that it is recycling old concepts for a specific need, reflected in the Network's call to arms, namely, to move "forward to the past." The advancements in prehospital trauma resuscitation over the past 10 years have been due to the work of many individuals and the THOR Network has been just one place where these experts share their ideas and work together in a global manner to improve outcomes for those with severe traumatic hemorrhage. At the same time, the RDCR Symposium is unique. Due to its small size, the program is more fluid and ad hoc discussions often lead to crystallization of concepts needing further exploration and research. Given that participants comprise leading basic science researchers, eminent clinical faculty, and prehospital providers in the same room with those who decide the allocation of resources for militaries, acquisition programs, clinical trials, and hospitals, the impromptu debates arising during the conference have led to concrete action. Discussions regarding refrigeration of PLTs stimulated by Dr. Cap's research directly led to the Mayo Clinic and Haukeland Hospital efforts described and to PLT refrigeration being adopted as a program of record within the US military. These efforts in turn indirectly contributed to PLT refrigeration being a major topic at the National Institutes of Health (NIH) State of the Science in Transfusion Medicine meeting in 2015 and resulted in a decision by the US FDA to issue an exemption for 3-day cold storage of apheresis PLTs (whole blood–derived refrigerated PLT components are already allowed by the FDA's Code of Federal Regulations, but essentially have not been used in 30 years). The conference has led to other interactions whose impact is difficult to assess. Research teams around the world have sent members to work with top THOR Network investigators in other countries as a result of interactions initiated in this forum, leading to further exchange of ideas, and the long-term effect of these interactions may never be quantified.

During the fifth RDCR meeting in 2015 covered by this supplement, conversations evolved very much in this tradition of spontaneous discussions leading to exploration of unexpected topics after the planned presentations. This supplement reflects that fluidity in that it covers not just the meeting program, but also explores themes that were brought up during those discussions. New this year is the inclusion of point–counterpoint discussions that reflect the diverging opinions highlighted by these conversations. Dr Moore and colleagues engage Dr Roberts in a discussion regarding the merits of using tranexamic acid in the prehospital setting and debate whether this therapy should be used in a targeted manner[1] or more broadly applied.[2] Drs Yonge and Schreiber discuss the implications of the PROPPR trial[3] while Dr Maegele contributes a European perspective regarding the use of coagulation factor concentrates.[4] Preconference whole blood donation exercises stimulated the paper by Dr Doughty and coworkers proposing a new field emergency donor panel questionnaire and triage tool that could greatly facilitate implementation of "walking blood banks".[5] Dr Stubbs of the Mayo Clinic offers lessons learned while attempting to implement a FWB transfusion program,[6] and Dr Spinella provides a

comprehensive review of the work supporting the use of FWB in the treatment of severe hemorrhage that promises to be the "go-to" reference in the upcoming years.[7]

Our fifth anniversary editorial highlights what the collective group has accomplished to date, but there is still more work to do. Current projects include making refrigerated PLTs and freeze-dried plasma (FDP) more widely available in prehospital environments (while the French and Germans both manufacture FDP, to date a commercially available product for broad implementation does not yet exist). Advanced formulations of lyophylizable nanoparticle-based oxygen carriers are under investigation. It is our hope that potential therapies currently under discussion will be joined by others evolving from the learned, creative, and innovative discussions yet to come. As mentioned in our title and on the cover, this conference is rooted in military innovation, but its aspirations are focused on global progress of prehospital and acute care for military and civilian patients alike.

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