Fresh whole blood transfusion capability for Special Operations Forces

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SUMMARY

Fresh whole blood (FWB) transfusion is an option for providing volume and oxygen carrying capacity to bleeding Special Operations soldiers who are injured in an austere environment and who are far from a regular blood bank. Retrospective data from recent conflicts in Iraq and Afghanistan show an association between the use of FWB and survival. We reviewed the literature to document the issues surrounding FWB transfusion to Special Operations soldiers in the austere environment and surveyed the literature regarding best practice guidelines for and patient outcomes after FWB transfusions. Most literature regarding FWB transfusion is retrospective or historical. There is limited prospective evidence currently to change transfusion practice in tertiary care facilities, but FWB remains an option in the austere setting.

Members of the Canadian Armed Forces (CAF), particularly members of is Special Operations Forces, may deploy on combat missions to austere locations, far from tertiary-level medical and surgical support. Hemorrhage from combat injuries remains the leading cause of preventable death on the battlefield, and transfusing blood products remains a cornerstone in its treatment. However, providing blood component therapy to small groups of Special Operations soldiers in the far-forward, austere environment is a tremendous logistical challenge. Fresh whole blood (FWB) transfusions may provide a solution to this problem.

HISTORY

The CAF has a long history of providing FWB transfusions in combat settings. Robertson, serving in the Canadian Army Medical Corps during the Great War, transfused FWB to injured soldiers at the Second Battle of Ypres in 1915.[1] In 1937, during the Spanish Civil War, Norman Bethune organized one of the first mobile battlefield transfusion services, collecting and transfusing FWB.[2]

In recent years, the Canadian Forces Health Services (CFHS), in conjunction with Canadian Blood Services, organized a Walking Blood Bank to provide an FWB transfusion capability at its Role 3 Multinational Medical Unit (R3-MMU), located at Kandahar Airfield in Afghanistan.[3] Select volunteers were screened as per Canadian Blood Services donor standards before deployment. Upon activation of the Walking Blood Bank protocol at the R3-MMU, these same screened donors were rescreened before collection and transfusion of their blood. In 2010, 162 units of FWB were transfused at the R3-MMU at Kandahar Airfield by the CAF.[4]

Fresh whole blood and Special Operations Forces

Blood products from a regulated and approved source are always preferable. However, in austere environments, logistical constraints may lead to

circumstances where Special Operations Forces may have no access to approved component blood. There are now also case reports in the literature about the successful use of FWB in the Special Forces environment.[5] Other North Atlantic Treaty Organization (NATO) countries, such as Norway, have developed an aggressive research and training program pertaining to FWB in Special Operations settings and have created a program called Blood Far Forward (BFF) to look at aspects of this practice.[6,7] In particular, the Norwegian group has created a training program and protocol for collection and administration of FWB by Special Operations Forces medics.[7]

Benefits of FWB in Special Operations environments

There are advantages to transfusing FWB. Special Operations Forces usually need to walk to wherever they are going. Maintaining an FWB capability requires minimal extra equipment to carry. Also, there are biological advantages to FWB transfusions: FWB has been reported to have increased clotting factor activity and is already warm, thereby making fluid warmers unnecessary.[6,7] Finally, FWB is a source of fresh platelets; platelets are otherwise difficult, if not impossible, to transport and use in the far forward environment.[6]

Risks of FWB in Special Operations environments

Risk to donors

Immediate risks to Special Operations FWB donors may include hypotension during collection, and decreased exercise tolerance after donation. Work done by the Norwegian group has shown that donation of 1 unit of blood has no effect on their Special Operations operators in terms of shooting and heavy physical exertion;[8] however, they did note that this experiment took place under non-combat conditions, where intense physical stressors, hunger and dehydration may become factors. They did not consider the impact if the donor is wounded after donation. As well, most patients who require damage control resuscitation (DCR) will require large amounts of products, and so the temptation of soldiers to donate more than 1 unit of FWB may be intense.

Late risks of FWB donation by Special Operations soldiers are mostly administrative and ethical. If prescreening precludes a Special Operations soldier from FWB donation before a mission, there may be administrative repercussions for that soldier. This may lead to many issues with confidentiality and/or stigmatization. In addition, this may cause issues with obtaining health care insurance in the future.

Risks to recipients

Early risks to FWB include all the risks of receiving blood products, including bacterial contamination, transfusion-associated overload, transfusion-related acute lung injury, acute transfusion reaction with hemolysis (from ABO mismatch or otherwise).[9] The risk for anaphylaxis from transfusion is 1 in 18 017 and the risk for acute hemolytic reaction is 1 in 50 917 per units transfused using component therapy in Canada.[9] The risks for acute transfusion reactions from FWB would likely be higher, but still much lower than the risk of death from hemorrhage in this population.

Late risk to recipients of FWB transfusions include exposure to transfusion-transmitted infections and possible seroconversion. From the recent conflicts, 761 FWB transfusions were reviewed in recipients who were available for follow-up. Only 1 case of recipient seroconversion to hepatitis C virus was found. Results of prescreening serology in 500 patients revealed 4 cases of hepatitis C, no cases of HIV and 2 cases of chronic hepatitis B infection.[10] Fatal graft versus host disease has also occurred post-FWB transfusion in patients injured in combat.[11]

Supporting evidence

A recent, small randomized trial compared "modified" whole blood transfusions (cold) with standard component therapy. After excluding enrolled patients with severe brain injury, the authors of this trial suggested that modified whole blood transfusions were associated with a decrease in transfusion requirements, with no difference in mortality.[12] Furthermore, several retrospective studies have shown an association with improved survival using FWB in forward damage control surgical facilities and larger combat hospital environments.[13,14]

Alternatives to FWB in Special Forces environments

Recent technological advances have allowed Special Operations Forces to bring packed red blood cells far forward for a prolonged period of time, without the need for a deployed blood refrigerator.[15] Fresh whole blood should be given only if component therapy is not available.

Decision to give FWB in Special Operations Forces

The injured Special Operations soldier should first be cared for as per tactical combat casualty care principles, which include control of compressible hemorrhage, securing an airway, treatment of tension pneumothoraces, administration of tranexamic acid, avoidance of hypothermia and utilization of permissive hypotension.[16]

The risks and benefits of administering FWB must then be weighed. The risk of death from hemorrhage should outweigh the above risks of FWB transfusion. It should be kept in mind that many combat casualties will need multiple units of blood during the course of their resuscitation.

Casualties should be triaged to avoid wasting FWB on nonsalvageable casualties in the context of the limited resources of the Special Forces environment. The decision to initiate FWB transfusion by the Special Operations medic must be taken in context of transport times to a surgical facility.

Best practice guidelines

Strandenes and colleagues[17] from the Norwegian group have recently published their set of protocols and guidelines. The U.S. Special Forces have also put in place and published guidelines on their FWB programs in tactical settings.[18] The following sections on training and donor screening describe their general principles.

Training

Special Forces medics must undergo specific training under physician supervision and be certified to be able to conduct FWB collections and transfusions.[7] They must demonstrate that they know when to initiate FWB transfusion, understand the risks and benefits of FWB transfusion and manage acute transfusion reactions. They must also demonstrate in a clinical training setting that they have technical skills to safely perform the collection and transfusion of FWB.[18]

Donor screening

Donation of blood should be voluntary. Predeployment screening should take place using standard regulatory screening and interview forms, ABO and RhD blood grouping and serology for syphilis, hepatitis B and C, human T–Cell lymphoma virus, *Trypanosoma cruzi*, and nucleic amplification for hepatitis B and C, HIV and West Nile virus. Potential type O donors with "low" anti-A, anti B titres (the definition of low titres varies from country to country), should be identified as preferential donors.[7]

During long deployments, previously approved donors should be rescreened at 3-month intervals. In the situation where an FWB transfusion will be conducted by a Special Operations medic, FWB collection by the medic should be done in a standard fashion into commercially available citrated bags specifically designed for the purpose of far forward or buddy blood transfusion. Ideally, the medic should also conduct screening and perform a crossmatch and rapid serology testing on the donor blood before transfusion. However, time and logistical concerns may prevent these processes. Furthermore, if the transfusion is life-saving and no other option is available, the question arises as to whether the blood should be transfused anyway, even if the donor is tested and tests positive on any criteria.

The ABO and RhD compatible donors should be used first.[17] The next best choice should be universal donors (O negative, low titre donors). Only 1 unit (500 mL) per Special Forces donor should be collected, as further donation may compromise operational capability.[17] An intravenous blood tubing set should always be used during FWB transfusion.[4] Patients should be resuscitated with FWB to a palpable radial pulse or evidence of end organ perfusion, such as urinary output or increased consciousness.[16]

The amount of FWB given and the donors should be recorded, if the situation permits.

The FWB recipients who survive to forward surgical facilities should be monitored continuously for transfusion reactions. Blood products at more advanced facilities should be component type resuscitation wherever possible; however, banked FWB may be the only product available.[17] In this setting, a rapid crossmatch (Eldoncard, Craig Medical) and rapid serology for transfusion-transmitted infections must be done to limit the exposure of the casualty to untested blood. Recipients of FWB who have survived their injuries should be followed with serology at baseline, at 6 and 12 weeks and at 6 months and referred to an infectious disease specialist should they seroconvert. This was the practice of the CAF for casualties who received FWB during the period 2006–11. If a recipient seroconverts after FWB, an aggressive search must be made for the donors and offer them serology testing.

It is unclear whether testing donors who have given FWB during their deployment offers any further benefit to recipients, as no data exist. However, it may relieve some anxiety on the part of the recipient, so may be worthwhile. Medical confidentiality needs to be preserved for both the donor and recipient in this situation.

Conclusion

There may be a role for establishing an FWB transfusion capability for Special Operations soldiers who deploy on high-risk missions to austere locations. The evidence for FWB outcomes is weak, consisting mostly of historical accounts, case reports, retrospective data and 1 small randomized trial. However, FWB may be lifesaving for the unstable bleeding Special Operations soldier when regular blood component therapy is not available. Fresh whole blood should be considered only when there is reasonable hope of obtaining quick hemorrhage control. Donor autonomy and safety should also be respected throughout this practice.

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