Development and Implementation of a Standard Operating Procedure for Military Working Dog Blood Collection, Storage, and Transport

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ABSTRACT

Military working canines are critical assets and force multipliers for the Joint Force. Most often deployed forward of Role 2 assets, they are reliant on non-veterinary resources when wounded, ill, or injured in an operational environment. Hemorrhagic shock is the most prevalent form of shock seen in battlefield injuries and is most effectively treated with whole blood transfusion. Dogs cannot be transfused with human blood and there is no formal Department of Defense (DoD) canine blood product distribution system to operational settings. A walking blood bank is helpful when multiple dogs are geographically co-located and the resource can be provided to an injured patient quickly. In areas as widely dispersed as the Horn of Africa, the likelihood of co-location is slim and delaying this vital resource can mean the difference between life and death. Therefore, personnel at the Role 2 facility in Camp Lemonnier, Djibouti, filled a critical capability gap for the operational area by producing a local canine whole blood bank with distribution to multiple countries. This protocol can be replicated by other locations to improve medical readiness for the working canines who serve to maintain DoD Force Protection.

KEYWORDS: *military working dogs; whole blood transfusion; transfusion medicine; veterinary medicine*

Introduction

Military working dogs (MWDs) and multipurpose canines (MPCs)** are critical assets and force multipliers for the Joint Force. Wounded, ill, or injured MWDs require combat casualty care in the operational environment, many of which are forward deployed from a Role 2 facility. When veterinary personnel are not available, this care may be provided by a nonveterinary healthcare provider to preserve life, limb, or eyesight or stabilize the animal for transport to a veterinary treatment facility.[1] In these battlefield injuries, shock, if present, is most commonly hemorrhagic.[2] Hemorrhagic shock management in dogs is similar to treatment in humans: targeted fluid administration in conjunction with control of hemorrhage. While treatment with crystalloid solutions and colloids can be helpful, aggressive use leads to coagulopathy and increased bleeding in humans.[3]

Efforts to advance transfusion medicine are continuously ongoing, evidenced by historical shifts in treatment protocols.[4] Fifty years ago, studies evaluating blood components (plasma, platelets, and packed red blood cells [pRBCs]) demonstrated improved hemostasis and fewer deaths due to hemorrhage with administration of balanced blood components (1:1:1 plasma:platelets:pRBCs). This approach, combined with the fact that components can be stored longer than whole blood, resulted in a shift to component therapy.[3] However, over the past two decades, civilian trauma centers have been re-implementing whole blood transfusion protocols (specifically low anti-A/B titer type O whole blood), sparking an interest in military research into this approach. Preliminary studies show equivalent or improved resuscitation and hemostatic markers along with decreased processing and equipment needs from using whole blood instead of component therapy. Plus, improvements in whole blood storage make these products more readily available than before.[5] Because much of the literature on trauma in dogs has followed human medicine, the transition to whole blood has been adopted by veterinary medicine.

The Unique Nature of Canine Trauma Resuscitation in Austere Environments

Dogs cannot be transfused with human blood or blood products because of the risk of severe allergic reactions.[6] Additionally, canine blood products are often limited in operational settings, and there is no formal Department of Defense program in place for canine blood products disbursement.[7] To bridge the notable capability gap and continue to improve access to battlefield care for working dogs, a source of rapidly accessible canine blood products located near high-risk missions involving MWDs is needed.

Role 2 veterinary assets with robust canine populations generally include a walking blood bank. This panel of viable blood donors is prepared for emergencies where whole blood is needed. The value of a canine walking blood bank program is valid as it provides blood products when needed, without wasting resources. However, it cannot be the sole solution for a widely dispersed area of operation such as the Horn of Africa (HOA). The low number of MWDs stationed together makes this effort unrealistic. Following blood collection, expert guidance dictates that the donor must be maintained on a harness, with no neck leads, and cannot work or travel by aircraft for a minimum of 24 hours.[8] Solo canines or those in theater for only a short duration cannot be removed from the fight because of the time it takes for donation prior to an operation. Plus, having properly trained personnel, appropriate equipment and supplies, and the time and planning needed

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**For the purposes of this article, the term MWD includes MPCs.

to collect canine blood may be challenging in an operational environment.

Development of Blood Collection, Storage, and Transport Protocols in Austere Environments

The isolation of active working dogs indicates that the most effective way to source canine blood is to collect it at a larger facility and transport it to more austere locations for storage and potential use. This concept is new to the HOA, so we sought to develop a local standard operating procedure (SOP) to fill this gap in canine casualty care. This initiative started as a request from canine handlers in preparation for high-risk operations and has transitioned to regularly scheduled collection at a central location with a large repository of MWDs, followed by distribution to all outstations housing MWDs.

For routine canine whole blood (CWB) collections, donors are selected from those assigned to HOA units and residing at Camp Lemonnier, Djibouti (CLDJ), either long-term or transiently. Most MWDs are great candidates for this program because of consistent veterinary health screenings and disease prevention measures. Donors are screened using the current guidelines.[9] An extensive history is taken to ensure no lapses in monthly parasite prevention as well as awareness of current medications, travel history, date of last donation, and previous transfusions. Physical examination and lab diagnostics are performed to screen for vector- and nonvector-borne infectious diseases; tests include blood smear, fecal examination, urinalysis, complete blood count, and blood chemistry analysis. Immediate disqualifying characteristics include canines that do not have a temperament suitable for blood donation, are positive for infectious diseases, receive regular medications other than for monthly prevention, or have previously received a blood transfusion. Figure 1 shows how collection of blood is completed.

Obstacles Encountered in Program Implementation

Multiple obstacles were encountered in the implementation of this program. The main challenges included scarcity of veterinary-specific collection sets in the deployed environment, transportation of collected units, communication regarding the distribution of units, and development of a tracking system for canine blood (including transportation, storage, use, and expiration).

The authors devised all protocols for collection, processing, and storage from the Joint Trauma System guidelines for MWD transfusion, the standard of practice for MWD blood collections or transfusions in a deployed environment.[10] Research performed and draft procedures written by the previous CLDJ Veterinary Services (VS) Officer-In-Charge (OIC), CPT Brent Von Schaumburg, greatly contributed to the initial development of this program.

Although veterinary-specific collection supplies exist, it is difficult to acquire such items in a forward deployed environment without advanced planning. Human supplies are authorized for use as they utilize the same anticoagulants: citrate phosphate dextrose adenine (CPDA-1) with a 28-day storage time and citrate phosphate dextrose (CPD) with a 21-day storage time. After sedation with an opioid (butorphanol or hydromorphone), 430–450 grams of CWB is collected

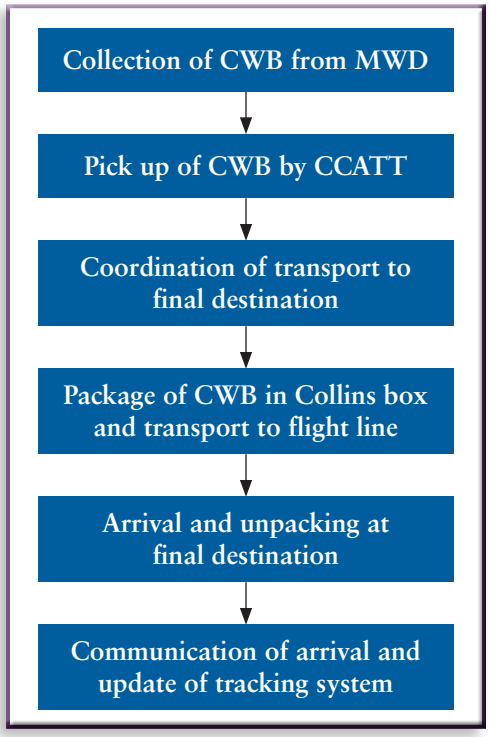
FIGURE 1 *Collection of military working dog whole blood unit.*

via aseptic jugular venipuncture using standard sterile techniques. Midazolam and ketamine are used for additional sedation if necessary. Dexmedetomidine may cause decreased mean arterial pressure and therefore it is avoided if possible. Acepromazine is also contraindicated because of a potential transient reduction in platelet count and function. If signs of hypovolemia or hypotension present following collection, administration of an isotonic crystalloid through a peripheral intravenous catheter is indicated to replace lost volume. Bland treats and a bowl of water are offered once the donor has recovered from sedation.[8] The collection of canine blood is almost identical to that of human blood. The principles, storage, and equipment used are identical. The main difference lies in the donor as many dogs must be sedated for the procedure.

Timely transport of canine blood units to various outstations proved to be another obstacle. With flight schedules constantly shifting due to operational concerns, ensuring that donated canine blood makes it to the flight line and onto the aircraft requires coordination. Because of these logistical challenges, developing a sustainable process with steady communication is essential. In this situation, the United States Air Force Critical Care Air Transport Team (CCATT) serves as an intermediary between collection by the veterinarian and delivery to the flight line for transport. The CCATT team transports blood to their storage facility via a Golden Hour box. Then it is packaged in an insulated, cooled, flight-approved box (Collins box) for transportation to its final destination. On arrival to the outstation, the blood is unpacked and confirmation of arrival is communicated to the veterinarian. Storage and transportation requirements were formulated based on local human blood program protocols. This includes strict temperature control (storage at 3°C–5°C) to reduce the chance of bacterial growth and adherence to expiration dates (depending on anticoagulant used).

It was necessary to develop a tracking system for the canine blood. Owing to the small quantity of units collected in this initial endeavor, locally tracked identification numbers are provided for each unit. These unit numbers, along with other information, including collection date, transfer date, date of arrival at destination, unit location, donor name, donor tattoo (4-character code specific to each MWD printed on the inside of the ear pinna), donor blood type, donor hematocrit, donor total protein, total bag weight, and expiration date, are placed into a web-based tracker available on a shared drive accessible via a secure network at all outstations. This tracker also includes a section for comments regarding the disposition of units (transfused, discarded, etc.). Each bag is physically labeled with collection and expiration dates, unit number, total weight, donor name and tattoo, and donor hematocrit as well as a "Veterinary Use Only" sticker. Each unit is transported in a biohazard bag with an additional identifying veterinary sticker. The overall workflow from collection to tracking CWB is depicted in Figure 2.

FIGURE 2 *Flow diagram of military working dog (MWD) blood collection, transport, and storage.*



CWB = canine whole blood; CCATT = Critical Care Air Transport Team.

Conclusion

Creating a program with minimal impact on the CLDJ and Combined Joint Task Force – Horn of Africa (CJTF-HOA) security missions require collaboration and effective communication among VS personnel, MWD kennel masters, and handlers. To minimize mission impact, we preferentially use transient canines as often as possible with the caveat that they pass the screening process and are present at the CLDJ for at least 72 hours. This also reserves resident canines for walking blood bank donations if an emergency requiring CWB presents at Camp Lemonnier. We routinely provide one unit of CWB at a time to each forward-deployed location with only one to two working canines with operational missions. CPDA-1 anticoagulant bags are prioritized so donations are collected less frequently; however, CPD anticoagulant bags are maintained as a secondary option. Stations with three or more working canines are set up and prepared to perform as walking blood bank collection and administration points in an emergency and thus not provided routine deliveries of CWB.

Future advances in canine transfusion medicine include hemoglobin-based oxygen carriers and canine freeze-dried plasma, but more research is warranted to elucidate their efficacy and safety.[11] These technologies may eventually augment or even substitute CWB collection and distribution, especially in austere environments. In the meantime, there is a critical capability gap in medical readiness for dogs, which leaves them vulnerable to death from massive hemorrhage caused by traumatic battlefield injuries. Through collaboration and determination, successful neutralization of this gap will decrease the risk of mortality for MWDs across the HOA Area of Operations. This gap is not unique to the HOA Area of Operations and this procedure can be translated to future locations and operations to improve the care we provide our MWD.

Author Contributions

All authors were involved in the concept and implementation of the endeavor discussed in the paper. EE wrote the first draft and all authors read and approved the final manuscript. The authors have no financial relationships relevant to this article to disclose. The authors have no conflicts of interest to disclose. This work was not supported by any funding.

Disclosures

The authors have no financial conflicts of interest to disclose.

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