Lessons Learned: Large-Scale Perfused Cadaver Training in Three Different Curricular Environments

Alex Y. Koo, MD[*,†]; *CPT David K. Rodgers, PA-C*[‡]; *LTC Marc H. Hohman, MD*[†,§]; *CPT Jason R. Muise, BSN*[‡]; *Kyle S. Couperus, BSN, MBA, MD*[‡]; *LTC Jillian F. Phelps, MD*[†,‡]

ABSTRACT

Background:
Perfused cadavers are viable training models for operating room surgical skills, increasing fidelity of vascular anatomy, dissection, and tissue handling. In addition, perfused cadavers may have benefits in military medical training environments with a focus on hemorrhage control and vascular access.

Objectives:
We created a large-scale training exercise with perfused cadavers in three different environments and aim to share the curricular design and feedback from the exercise.

Methods:
We conducted a 4-day simulation training exercise with 13 perfused cadavers in 3 different environments: hospital environment, the austere echelons of care environment, and a controlled-settings tent for hemorrhage control and needle decompression training. Through an anonymous online survey and an after-action review (AAR), we elicited feedback on advantages, disadvantages, costs, and comparison to models of porcine and fresh cadavers for procedures and existing courses.

Results:
A total of 324 participants were trained with 13 perfused cadavers for over 4 days from a variety of specialties and on different procedures and surgical skills. Based on 130 respondents to the survey and the AAR, perfused cadavers were rated to have realistic arterial bleeding and bleeding control training. In addition, perfused cadavers provided increased realism and fidelity for surgical skills. There were disadvantages of logistical requirements, cleanup, costs, and mobility.

Conclusion:
Perfused cadavers can be implemented effectively for hemorrhage control training, surgical and procedure skills, and even exercises in austere environments, but require significant logistical and planning considerations. The training value is maximized with a progressive curriculum from hemorrhage control iterations to more invasive surgical procedures, such as thoracotomy and exploratory laparotomy.

INTRODUCTION

While there are a variety of methods and equipment to "perfuse" cadavers, the general concepts involve cannulating a large vessel, "flushing" the stagnant blood vessels, and then using a pump to infuse simulated blood products.[1–4] Perfused cadavers have been shown to be viable training models for operating room (OR) surgical skills, increasing fidelity of vascular anatomy, dissection, and tissue handling.[1,5]

During Operation Iraqi Freedom and Operation Enduring Freedom, most of the potentially survivable deaths were from uncontrolled hemorrhage. This led to initiatives to focus on early and effective hemorrhage control as with courses like Tactical Combat Casualty Care (TCCC).[6,7] Perfused cadavers have been shown to be beneficial to train military medical personnel in hemorrhage control and vascular access.[8,9]

We created a large-scale training exercise with perfused cadavers in 3 different environments and aim to share the curricular design and feedback from the exercise. We will review the advantages and disadvantages of perfused cadavers compared to other training models based on an informal after-action review (AAR), participant survey, and discussion of existing literature. Our aim is to improve future iterations of training with perfused cadavers for combat medics, surgeons, and emergency physicians.

[*]Department of Emergency Medicine, Georgetown University, Washington, DC 20010, USA
[†]Charles A. Andersen Simulation Center, Madigan Army Medical Center, JBLM, WA 98431, USA
[‡]Department of Emergency Medicine, Madigan Army Medical Center, JBLM, WA 98431, USA
[§]Department of Otolaryngology, Madigan Army Medical Center, JBLM, WA 98431, USA

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The views expressed are those of the author(s) and do not reflect the official policy of Georgetown University, MedStar Health, the Department of the Army, the DoD, or the U.S. Government.

Corresponding author: Alex Y. Koo, MD, USA (alex.y.koo@medstar.net).

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METHODS

We conducted a simulation training exercise with TruBodies perfused cadavers, supplied by SafeGuard Medical, at Joint Base Lewis McChord, WA from December 7, 2020 to December 10, 2020.

Objectives

The objectives to maximize perfused cadaver training were 4-fold: (1) Train medical personnel on individual critical task lists (ICTLs) using high-fidelity models; (2) Train advanced surgical and procedural tasks for physicians, nurses, and medics across hospital, prolonged field care (PFC), and austere settings; (3) rain logistical and evacuation platforms across different echelons of care; and (4) provide feedback on the feasibility of perfused cadaver use for future medical training.

Participants

As a joint forces exercise, participants were all members of the military and came from 15 different units across the U.S. Army, Army Reserve, Navy, Navy Reserve, and Army National Guard. Both conventional and special operations units participated. Participants varied in medical training from physicians/surgeons, nurses, and medics to infantrymen and medical logistics/supply.

Before the exercise, leadership briefed unit participants. Soldiers and sailors were offered alternative training or duties if they did not wish to participate. On the days of events, all participants were briefed at each setting by the medical and SafeGuard Medical™ teams. Briefings included procedures for maintaining psychological safety, fire safety, and respect for the cadavers. No photography of the cadavers were allowed and participants were informed on what to do with needlestick injuries.

Each unit maintained rosters of their participating personnel, which were reviewed before and after the exercise.

Setting and Curricular Design

The simulation exercise took place in 3 settings: a simulated hospital environment, the austere echelons of care environment, and a controlled-setting tent, over the course of 4 days.

ICTLs were reviewed by subject-matter experts in medical and surgical fields for their appropriateness for training using perfused cadavers. Scenarios and procedures were developed based on ICTLs across a variety of medical and surgical military occupational specialties (MOSs).

The hospital environment was established at Charles A. Andersen Simulation Center (ASC), which is the base's medical simulation complex, housing 4 simulated ORs and an emergency department. The participants were 24 emergency medicine (EM) residents and emergency medicine physician assistant (EMPA) residents with 8 EM attendings and EMPA instructors. Participants progressed through EM-specific procedures (Fig. 1) on 5 perfused cadavers, which culminated in a clam-shell thoracotomy and Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA). A suggested progression of EM procedures for instructors

1) Hemorrhage
Injury: Traumatic Amputation, Vessel Injury
Tourniquet Application
Wound Packing/Bandaging
CombatGauze
Foley Balloon
Emergency Trauma Bandage (ETB)

2) Airway
Nasopharyngeal Airway (NPA) Oropharyngeal Airway (OPAs)
Supraglottic Airway
Bag Valve Mask with Ventilation
Endotracheal Intubation
Cricothyroidotomy
Glidescope
Retrograde Intubation

3) Respiratory/ Breathing
NCDs
Thoracostomy

4) Circulation
IV
IO
Rapid Infusion Catheter (RIC)
9 Fr Sheath Introducer
Central Venous Access
US-guided IVs

5) EM Procedures
Pericardiocentesis
Radial Arterial Line Placement
Lateral Canthotomy
Nerve Blocks
Suturing
Arthrocentesis
REBOA
ED Thoracotomy

FIGURE 1. Emergency medicine procedure progression.

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followed the "MARCH" algorithm in TCCC. Ultrasound-trained EM attendings and fellows practiced nerve blocks and taught musculoskeletal anatomy as well.

The austere echelons of care setting took place at the Medical Simulation and Training Center (MSTC) parking lot and surrounding wooded area (Supplementary Material). Medical assets from conventional units, 2-2 Stryker Brigade Combat Team (SBCT) and 62nd Medical Brigade, established their Role I and a split Forward Resuscitative Surgical Detachment (FRSD) with their associated medical evacuation platforms (i.e., Strykers, ambulances, communications). Special operations units as 1st Special Forces, 19th Special Forces, and 2nd Ranger Regiment patrolled the wooded area. Five iterations were performed with 5 perfused cadavers, which had 4 distinct injury patterns (Fig. 2). Each cadaver progressed from point-of-injury care to Prolonged Field Care (PFC) to Role I and finally, the FRSD split for damage control resuscitation and surgery. Medical evacuation platforms transported and provided en route evaluation and care to the cadavers from each echelon of care. Facilitators and instructors were senior medical personnel from their respective units that were briefed on injury patterns and expected interventions. Special operations units had senior enlisted medical sergeants facilitating scenarios for their units with radio consultation from

Mechanism of Injury: Improvised Explosive Device (IED) Blast

Injuries:

1. Mangled face
2. Bilateral pneumothoraxes
3. Abdomen: Left upper quadrant penetrating wound
4. RIGHT mangled lower extremity

TCCC/PFC/Role I:

1. Hasty tourniquet to right lower extremity
2. Deliberate tourniquet
3. Cricothyroidotomy
4. Bilateral needle decompression
5. Bilateral thoracostomy
6. Large bore intravenous catheters x 2
7. Humeral intraosseous line
8. Give "blood" (permissive hypotension)
9. Tranexamic acid
10. Calcium
11. Antibiotics
12. Hypothermia Prevention and Management Kit (HPMK) with warmers
13. Documentation

FRSD ATLS:

1. Ensure appropriate access
2. Urinary catheter
3. Orogastric tube
4. Resus with blood
5. + FAST Ultrasound (Left upper quadrant especially)
6. Chest tubes with minimal output
7. Remove tourniquet and pack wound
8. Operating room for laparotomy
9. Documentation

OR

1. Exlap with persistent hypotension/lost pulses requiring supraceliac aortic clamp
2. Injuries: spleen, stomach x2, diaphragm, small bowel injury
3. Damage control closure
4. Documentation

ICU

1. Troubleshoot chest tubes/ventilator
2. Vitals
3. Ins/Out
4. Tranexamic acid
5. Cardiac monitoring
6. Wound dressing
7. Patient positioning
8. Deep Venous Thrombosis (DVT) prophylaxis
9. Oral care/suction
10. Documentation

FIGURE 2. Perfused cadaver injury pattern and procedure progression example.

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the FRSD emergency medicine physician during the PFC phase. At the Role I, two battalion physician assistants provided instruction to their combat medics. At the split FRSD, one emergency medicine physician provided scenario facilitation and instruction for emergency medicine residents, combat medics, emergency nurses, intensive care unit nurses in the resuscitation and intensive care unit sections. In the FRSD OR, the senior surgeon instructor varied based on the cadaver injury. For example, a neurosurgeon facilitated and instructed on the perfused cadaver with traumatic brain injury and signs of herniation, while the cardiothoracic surgeon facilitated and instructed on the hemodynamically unstable cadaver with gunshot wounds to the chest. OR participants included OR technicians, surgical residents, and the certified nurse anesthetist. For medical evacuation, the senior enlisted combat medic facilitated and instructed junior combat medics during transport.

The controlled-settings tent had 3 perfused cadavers for participants to practice hemorrhage control and needle decompressions. Each cadaver had a traumatic amputation and a common femoral artery injury. Two senior medics, physician assistants, or physicians were at each cadaver to guide, teach, and assess rotating participants on appropriate tourniquet application, wound packing, and needle decompression of the chest (NDC). Participants were typically junior medics and infantrymen. Each iteration was 30-min long for instructors to review procedures and then participants applied tourniquets, packed the common femoral artery injury until bleeding was controlled, and placed needle decompression of the chests. After the controlled-settings tent, the 3 cadavers were then transported by special operations units for prolonged field care training and finally, to the FRSD for thoracotomy and exploratory laparotomy training.

Perfused Cadavers

Cadaveric preparation used envivoPC™ pre-perfusion solution to limit extravascular extravasation of the perfusion fluid.[10] Vascular access is achieved through a single-site cannulation of a large artery or vein. The cannula is connected to a proprietary mobile pulsatile-flow perfusion circuit allowing for controlled variations in hemodynamic parameters such as blood pressure, stroke volume, and pulse rate. The mobile pulsatile-flow perfusion circuit is equipped with an integrated heat exchanger and reservoir. Perfusion was achieved with either oxygenated, cryopreserved bovine whole blood or envivoPC™. Both options reacted with hemostatic agents in a realistic manner, and when combined with the active warming, provide a more natural tissue texture.

Impact/Effectiveness

After the exercise, an AAR was performed with the medical, simulation, and SafeGuard Medical™ exercise controllers, team leaders, as well as the subject-matter experts. Categories of discussion included the realism and fidelity of perfused cadavers, logistical setup of perfused cadavers, ideal training models, costs, specific procedures with perfused cadavers, and future training options with perfused cadavers.

A convenience sample survey of participants was obtained using Google Forms (Google; Mountain View, CA). The survey was created by an emergency medicine physician and reviewed by another EM physician and surgeon prior to distribution (Supplementary Material). After instruction and at each echelon of care, instructors and leadership encouraged participants to complete the survey electronically via quick response (QR) codes posted on the exits and walls of the hospital setting, austere environment tents, and the controlled-settings tent. In addition, the survey was distributed by email to unit leadership with a collection end date a week after the exercise. No paper surveys were used for ease of compilation and concern for contamination with tissue. The survey asked basic demographic questions as well as Likert scale questions on realism, durability, and mobility of the perfused cadavers. In addition, questions were asked how the perfused cadavers compared for performing procedures and against formal courses using live porcine models and fresh-frozen cadavers. Courses for comparisons were PFC, Basic Endovascular Skills in Trauma (BEST®), Advanced Trauma Operative Management (ATOM®), and Advanced Surgical Skills for Exposure in Trauma (ASSET®). To determine this "relative value," respondents were asked how they would divide up $100 into perfused cadavers vs. live porcine or fresh-frozen cadavers for funding hypothetical future educational courses. Responses were exported from Google Forms to Microsoft Excel for analysis.

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The local institution's IRB and Public Affairs reviewed the manuscript and determined it appropriate for publication.

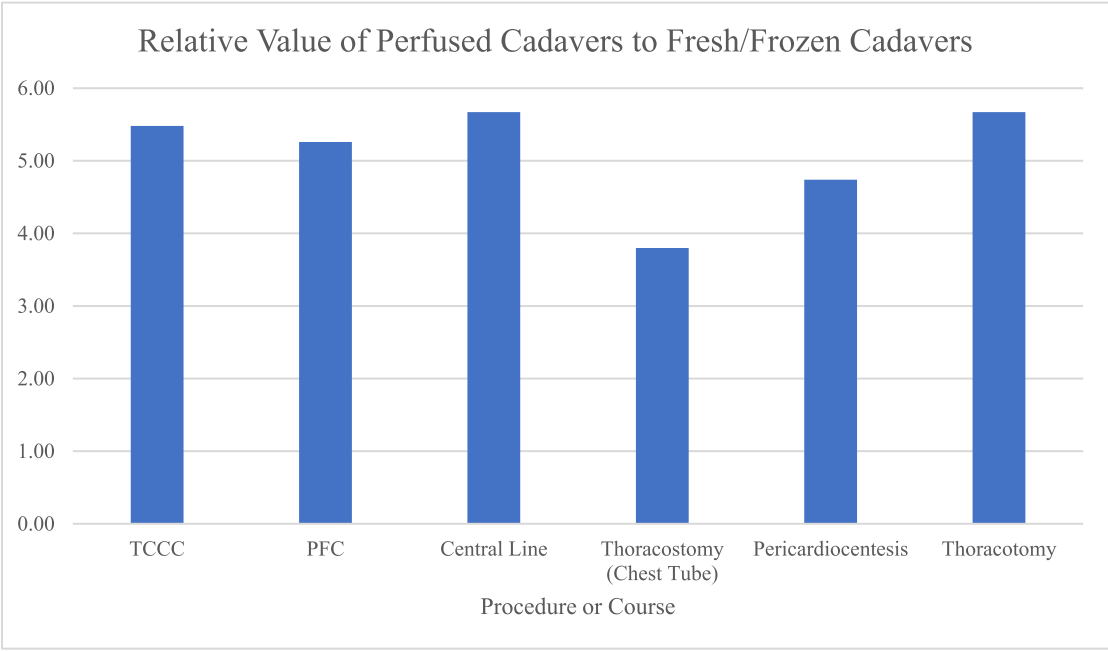
RESULTS

Over four days, 13 perfused cadavers were trained on with 324 participants, based on unit rosters. Service members with 24 different MOS participated, with the majority being combat medics (68W). Over 200 ICTL procedures were trained, from tourniquet application to neurosurgical procedures, such as trepanning.

The AAR was helpful to discuss logistical and training optimization with the perfused cadavers. For example, cleanup was labor-intensive requiring hours to clean tissue and fluids from equipment and the environment. A suggested improvement was to lay larger disposable tarps on the floor. Also, equipment such as the warming pumps for the perfusion proved to be unwieldy to transport in Strykers or ambulances. Future options were suggested, including pre-positioned pumps at each echelon of care. Cost was also discussed, with estimates being about $10,000 to $12,000 per cadaver, not including costs to hire technologists and refrigerator trucks for perfusion and transportation; however, exact costs were not available because the exercise was a vendor

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TABLE I. Relative Value of Procedures/Courses in Perfused Cadavers vs. Live Porcine Models



demonstration. For higher fidelity training, it was recommended that a facilitator who is familiar with the bleeding capabilities of the perfused cadavers increase scenario realism by asking the technologist to adjust bleeding pressures and/or switch to venous vs. arterial bleeding depending upon the progress of the clinical scenario. Lastly, vascular procedures (i.e., REBOA, central lines) need extra preparation and time with the cadavers before the events to ensure that there is minimal intravascular clotting and adequate distal perfusion.

The AAR also summarized subject-matter expert opinions. Arterial bleeding was realistic and very beneficial to help train tourniquet and wound packing, but venous procedures, such as a central line placement, proved to be challenging due to clotting and variable anatomy among the cadavers. For surgery, bleeding was realistic during incisions and intra-abdominal packing. The consensus was that surgical courses, such as ASSET®, ATOM®, and BEST® would benefit from perfused cadavers vs. current training models. For certain procedures, the team felt that perfusion did not add benefit and fresh-frozen cadavers offered similar training fidelity for musculoskeletal ultrasound anatomy, thoracostomies, and airway procedures.

For the survey, there were 130 respondents with a response rate of 58%. The respondents were 96% ($n = 125$) active duty and 4% ($n = 5$) reservists. Fifty-two percent ($n = 68$) of respondents were combat medics and most respondents had 1 to 5 years of medical experience (41%) and no combat deployments (59%). Ninety-seven percent ($n = 127$) of respondents had not previously trained with perfused cadavers. Forty-nine percent ($n = 63$) of respondents had never trained on live porcine or fresh-frozen cadavers, while 38% ($n = 49$) of respondents had trained on both live porcine and fresh-frozen cadavers.

Compared to live porcine models (Table I), the relative value of the perfused cadavers was highest for thoracostomy (RV = 4.07). The lowest procedural relative value was with hemorrhage control (RV = 1.98).

Compared to fresh-frozen cadavers (Table II), the relative value of the perfused cadavers was greater for central line placement (RV = 5.67) and thoracotomy (RV = 5.67). Thoracostomy was the lowest procedural relative value (RV = 3.8).

The median cost estimated by respondents for each perfused cadaver and support (i.e., technologist, equipment) was $10,000, whereas the average was $36,501.

On a Likert scale of 1 to 5 with 5 being "very realistic," 122 respondents rated the "blood realism" and "arterial bleeding" with highest averages at 4.4. The lowest average was for "mobility" of the perfused cadaver, rated at 3.7 by 115 respondents.

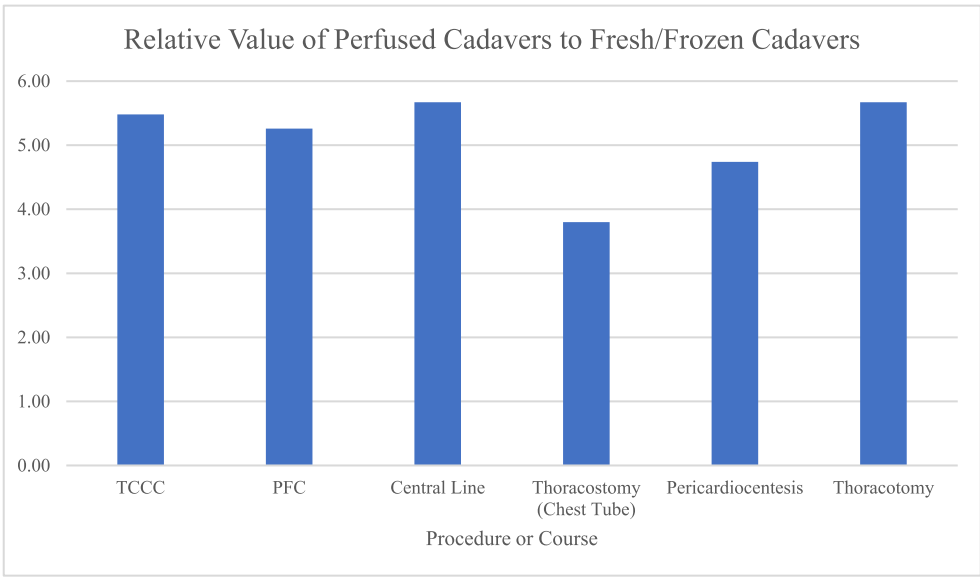
For the ASSET®, ATOM®, and BEST® courses, surgeons were asked if there was no, minimal, moderate, or significant (1 = no, 4 = significant) effect on knowledge and skills attainment when using a perfused cadaver over fresh-fresh frozen cadaver. Of the 7 surgeons who responded, averages of the scores were 3.1 for ASSET®, 3.2 for ATOM®, and 3.2 for BEST®.

DISCUSSION

Perfused cadavers supplied by different vendors are prepared differently, with significant variability regarding vascular

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TABLE II. Relative Value of Procedures/Course in Perfused Cadavers vs. Fresh/Frozen Cadavers



access points, perfusion fluid composition, and equipment.[1–4] This may affect the reproducibility of our findings, and unfortunately, there is no standardized technique or even definition of a "perfused cadaver."[11] Future standardization of a protocol would be beneficial for optimal simulation study and training.

From our experience, perfused cadavers provide 3 areas of training augmentation compared to nonperfused fresh-frozen cadavers: bleeding control training, surgical realism, and ability to perform percutaneous vascular procedures.

In our exercise, bleeding control with a common femoral arterial injury and traumatic amputation was considered realistic based on subject-matter expert feedback and survey results. Many iterations with different trainees practiced tourniquet application and wound packing without significant degradation of the perfused cadavers in all 3 settings. Particularly, the controlled-setting tent had over a 100 trainees rotating to practice effective hemorrhage control on 3 cadavers. This modality permits many participants to obtain multiple iterations with high-fidelity simulation and hemorrhage control skills attainment. The realism, fidelity, and training benefit we encountered are consistent with other studies on perfused cadavers for hemorrhage control. Reihsen et al. tested hemorrhage control procedures including tourniquet placement and wound packing of an external iliac artery injury in 13 scenarios per cadaver with consistent training outcomes.[12] Other studies implemented different tourniquets for traumatic amputations and junctional hemorrhage with high fidelity and rates of bleeding up to 700 mL min^{-1}.[9,13,14] Given high fidelity to realistic bleeding and bleeding control, an important question to ask is whether practice on perfused cadaver translates to more effective bleeding control. Grabo et al. attempted to answer this question with a study of 53 Navy corpsmen.[15] In the control arm of their study, participants received traditional didactics, videos, and tourniquet practice on their training partners while the other arm received traditional training with tourniquet practice on regionally perfused cadavers. The participants that practiced on regionally perfused cadavers had statistically significant faster control of hemorrhage and blood loss when tested on regionally perfused cadavers than the traditional training arm, indicating that simulation of arterial bleeding in cadavers can teach participants how much pressure is required for bleeding control, tactile internalization of "direct pressure," and add a layer of realism and urgency. There are other current models, such as the TraumaFX® Multiple Amputation Trauma trainer that simulate wound packing and traumatic amputation bleeding rates, but no comparison studies with perfused cadavers for these modalities have been published to date.

In our study, there were only 7 surgeons who responded to the survey, although there were more than 20 surgeons who participated. Based on qualitative feedback from surgical subject-matter experts and the survey, there was "moderate" benefit of perfused cadavers over traditional cadavers in formalized courses such as ASSET®, ATOM®, and BEST®. With damage control surgery, enhancing surgical realism through tissue and vascular bleeding can add authenticity through microvascular dermal perfusion, while adding the benefit of training critical vascular hemorrhage control.[1,2,16] Grabo et al. performed a pilot study with 16 general surgery residents and found confidence in trauma surgical skills, such as thoracotomy and abdominal vascular injury, increased after training with perfused cadavers; this confidence was maintained at 6-month follow-up.[5] Our exercise included neurosurgical, abdominal, and thoracic procedures for military trauma patients by an FRSD with case-based scenarios. While

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some surgical procedures, such as exposure, do not necessarily have to be done with perfusion, the added realism of microvascular bleeding requiring cautery contributes to increased fidelity. Other surgical procedures, such as vascular shunts, supraceliac aortic clamping, and others, are more effectively trained in perfused cadavers when compared to fresh-frozen cadavers.[17]

Percutaneous vascular access procedures, such as central line placement and REBOA, are feasible in perfused cadavers and in prior studies, useful in training.[2,18] However, in our exercise, it was sometimes difficult to obtain percutaneous venous and arterial access due to intravascular clotting. While participants could visualize vessels on ultrasound and access them percutaneously, clotting prevented "flash" in the syringe and feeding the guidewire. While the perfused cadaver models could be prepared and "flushed" for both venous and arterial systems to prevent clotting, only the arterial system was prepared. Preparation of both venous and arterial systems requires more time than arterial systems alone. Nevertheless, our survey had the greatest relative value for central lines compared to fresh-frozen cadavers because of the lack of intravascular volume in fresh-frozen cadavers. However, from a logistical standpoint, perfused cadavers require much preparation prior to training. For percutaneous vascular procedures alone, perfused cadavers may not be the ideal training model, given logistical and cost concerns compared to current training models, but vascular access training on perfused cadavers may still be combined with other procedures.[19,20]

The quality of training in hemorrhage control and surgical procedures that perfused cadavers affords participants is clearly evident; however, there are financial and logistical costs that attenuate these benefits. With over 300 participants for 13 cadavers, cost estimates were around $500/participant, with variable benefit for each participant. Interestingly, the survey median of $10,000 was close to the cost estimates of each perfused cadaver, although the much higher average suggests high variability of ranges. Other studies on perfused cadavers report ranges of $3,611 to $9,399 per cadaver with perfusion costs that can be up to $1,263 per cadaver.[1,12,21] We found that the economy and utilization of the perfused cadavers can be maximized by using them in stages, such as in the austere echelons of care environment and controlled-settings tent. Basic hemorrhage control can be repeated for participants before progressing to terminal surgical and more invasive procedures. Other logistical considerations with perfused cadavers are the challenges of mobilizing perfusion equipment, cleanup, preparation time, and storage that require extensive planning. While perfused cadavers can offer a level of realism and fidelity for training higher than many other modalities, training objectives, planning considerations, timing, and alternative training models must always be considered as well.

Participants at the austere echelons of care environment and controlled-settings tent were successful in utilizing the perfused cadavers to train on basic hemostatic techniques, evacuation care, and surgical stabilization. The hospital environment with emergency medicine physicians had valuable training in hemorrhage control and realism for procedures, but the addition of perfusion to a fresh-frozen cadaver may not have as large of a benefit for EM physicians. Many EM procedures can be performed on fresh-frozen cadavers, including airway techniques, thoracostomies, and ultrasound scanning. Percutaneous vascular procedures requiring significant cadaver preparation for adequate perfusion may be most beneficial if linked with another training or surgical exercise.

Limitations

There are significant limitations to the reproducibility of the results of the AAR and survey. The main objectives of this exercise were for training purposes rather than research, thus strict controls were not implemented. The survey could have been improved with more rigorous development procedures as focus group discussion, cognitive interviewing, and pilot testing. Variation in cadaver body habitus, age, underlying vascular disease, and perfusion technique were not controlled, which could affect fidelity and applicability to bleeding and anatomy of a young, healthy soldier. The curriculum and environments were conceived loosely and depended upon ad hoc training by the instructors/subject-matter experts. Nor was there any instructor training session or didactic plan to standardize teaching. No control group of blinding was possible. The survey did not have a 100% response rate, and as a convenience sample, is subject to sampling bias that respondents may be more favorable toward the perfused cadavers. Also, response bias where respondents may not actually answer the way they feel is possible due to the rank disparity between participants and instructors. The survey is long, as evidenced by the fact that some respondents did not answer all questions or finish the survey. The AAR did not have in-depth thematic or statistical analysis, but was rather an informal discussion between the planning teams.

Future directions may be to compare hemorrhage control proficiency on perfused cadaver vs. bleeding manikins vs. live tissue models. Also, studies on comparison of current formalized courses, as ATOM® and ASSET®, with cadavers vs. perfused cadavers in skills attainment may be beneficial. Lastly, military application of perfused cadavers in prolonged field care and FRSD environment training as Army Trauma Training Center should be studied.

CONCLUSION

Perfused cadavers can be implemented effectively for hemorrhage control training, surgical and procedure skills, and even exercises in austere environments, but require significant logistical and planning considerations. The training value is maximized with a progressive curriculum from hemorrhage control iterations to more invasive surgical procedures, such as thoracotomy and exploratory laparotomy.

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CLINICAL TRIAL REGISTRATION

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INSTITUTIONAL REVIEW BOARD (HUMAN SUBJECTS)

Not applicable.

EXEMPT STUDIES

Exempt after review as QI and in the setting of normal execution of job duties.

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC)

Not applicable.

INDIVIDUAL AUTHOR CONTRIBUTION

A.Y.K. collected and analyzed the data and drafted the original manuscript. A.Y.K., D.K.R., M.H.H., J.R.M., J.F.P. designed this research, reviewed and edited the manuscript. All authors read and approved the final manuscript.

INSTITUTIONAL CLEARANCE

Institutional clearance approved.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Military Medicine* online.

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CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author. All data are freely accessible. (A sample list of data availability statements from Oxford University Press can be found here.)

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