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| <b>REPORT DOCUMENTATION PAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |             |                       |                                       |                                    | <i>Form Approved<br/>OMB No. 0704-0188</i>          |  |
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| <b>1. REPORT DATE (DD-MM-YYYY)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |             | <b>2. REPORT TYPE</b> |                                       |                                    | <b>3. DATES COVERED (From - To)</b>                 |  |
| <b>4. TITLE AND SUBTITLE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                       |                                       | <b>5a. CONTRACT NUMBER</b>         |                                                     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                       |                                       | <b>5b. GRANT NUMBER</b>            |                                                     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                       |                                       | <b>5c. PROGRAM ELEMENT NUMBER</b>  |                                                     |  |
| <b>6. AUTHOR(S)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |                       |                                       | <b>5d. PROJECT NUMBER</b>          |                                                     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                       |                                       | <b>5e. TASK NUMBER</b>             |                                                     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                       |                                       | <b>5f. WORK UNIT NUMBER</b>        |                                                     |  |
| <b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                       |                                       |                                    | <b>8. PERFORMING ORGANIZATION<br/>REPORT NUMBER</b> |  |
| <b>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                       |                                       |                                    | <b>10. SPONSOR/MONITOR'S ACRONYM(S)</b>             |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |             |                       |                                       |                                    | <b>11. SPONSOR/MONITOR'S REPORT<br/>NUMBER(S)</b>   |  |
| <b>12. DISTRIBUTION/AVAILABILITY STATEMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                       |                                       |                                    |                                                     |  |
| <b>13. SUPPLEMENTARY NOTES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                       |                                       |                                    |                                                     |  |
| <b>14. ABSTRACT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |             |                       |                                       |                                    |                                                     |  |
| <b>15. SUBJECT TERMS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |             |                       |                                       |                                    |                                                     |  |
| <b>16. SECURITY CLASSIFICATION OF:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |             |                       | <b>17. LIMITATION OF<br/>ABSTRACT</b> | <b>18. NUMBER<br/>OF<br/>PAGES</b> | <b>19a. NAME OF RESPONSIBLE PERSON</b>              |  |
| a. REPORT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | b. ABSTRACT | c. THIS PAGE          |                                       |                                    | <b>19b. TELEPHONE NUMBER (Include area code)</b>    |  |

**1. Protocol Number:** FWH200140094A

**2. Type of Research:** Animal Research

**3. Title:** Assessing the hemodynamic effects of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) in traumatic cardiac arrest when closed chest compressions are augmented by directing the area of maximal compression over the left ventricle in a swine model (sus scrofa)

**4. Principal Investigator (PI):**

| Name           | Rank | Date of IACUC Training | Branch of Service / Corps | Staff Resident Fellow Civilian | Department / Office Symbol | Email (if other than WHASC Outlook)                        | Phone                         | Pager |
|----------------|------|------------------------|---------------------------|--------------------------------|----------------------------|------------------------------------------------------------|-------------------------------|-------|
| Jeffrey Morgan | O-3  | July 2014              | USAF                      | Fellow                         | 959 IPTS                   | <a href="mailto:jdm224@hotmail.com">jdm224@hotmail.com</a> | WP: 916-0808<br>FAX: 292-7649 |       |

**5. Purpose:** The primary objective was to assess whether the increase in return of spontaneous circulation (ROSC) and short-term survival (to 60 minutes), when performing chest compressions (CC) directly over the left ventricle, are maintained if REBOA is added to the resuscitation protocol.

Secondary outcomes included additional indicators for quality of CPR including hemodynamic variables (aortic systolic and diastolic blood pressure, right atrial systolic and diastolic blood pressure, coronary perfusion pressure, mean arterial blood pressure, end-tidal carbon dioxide), laboratory variables (pH, lactate, base excess, nitric oxide (NO), and near-infrared spectroscopy (NIRS) for measuring cerebral perfusion.

**6. Results:**

ROSC increased among standard CC animals with REBOA (33%) compared to standard CC animals without REBOA (0.0%) ( $p=0.04$ ). Among standard CC animals, aortic systolic blood pressure, right atrial systolic blood pressure and end tidal CO<sub>2</sub> (ETCO<sub>2</sub>) increased during all time intervals of BLS ( $p<0.005$ ) with REBOA. ETCO<sub>2</sub> also increased during BLS among LV CC animals with REBOA compared to LV CC animals without REBOA ( $p=0.0001$ ), however, ROSC and other hemodynamics were not significantly different. There was no difference in ROSC or hemodynamics between the LV CC and standard CC groups with REBOA.

**7. How may your findings benefit the Air Force?**

Survival of military traumatic cardiopulmonary arrest (TCPA) victims is low, but remains higher than survival in the civilian population. Small but incremental improvements in CPR could dramatically increase the survival rate. Our group has demonstrated that LV CCs improve ROSC and short-term survival in an animal model of TCPA. REBOA has been shown by other investigators to improve hemodynamics in hemorrhagic shock. Our group has now shown that REBOA improves hemodynamics, ROSC and short-term survival when added to standard chest compressions in an animal model of TCPA. The addition of REBOA also shows a trend toward improved ROSC and short-term survival in LV CC animals. Our study was adequately powered, based on preliminary estimates of an effect size of 0.57 and an expected mortality of 75%. The current study yielded mortality rates of 70% and 40% for the ROSC and LV groups respectively. Post hoc power based on our sample size was computed to determine that an expected effect size of 0.62 (arcsine transformation used) is needed to achieve 80% power to detect a significant difference. Although a statistically significant difference was not determined in this study, the trend of increased survival definitely warrants further study. These results suggest that LV CCs may significantly increase

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**For Protocol Office Use Only:**

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Copy to Budget? Yes No BIRDS Agenda Who Signed? PI Co-PI Auth AI

**For Review Purposes Only**

Eligible for Expedited Approval? Yes No Signature \_\_\_\_\_ Date: \_\_\_\_\_

the survival of military TCPA patients, REBOA may increase survival if standard CCs are used instead. Human studies are now needed to translate our animal findings to human outcomes.

## **8. Number of Animals**

Projected Enrollment of Animals at the Beginning of Study: 36

Actual Number of Animals Enrolled: 35

**9. Status of Animals Entered Into the Protocol:** The animals entered into the study were in general good health. All animals were euthanized at the end of the study per protocol.

**10. Status of Funds:** Our study was funded by the AF SGR. We had no budget deviations and all funds have been allocated for.

**11. Reason for Closure:** Objectives of the study were met

**12. Specific Problems:** The study went well; we did not encounter any specific problems.

## **13. Publications and Presentations:**

### **Presentations:**

Lightning oral presentation at American Heart Association (AHA) Scientific Sessions, Orlando, FL, November 2015

These Presentations and Publications have been cleared by 59 CRD and Public Affairs.

### **Publications:**

The manuscript is being prepared and has not yet been published.

These Presentations and Publications **have/have not (choose one)** been cleared by 59 CRD and Public Affairs. **(Do not delete this sentence.)**

**14. Exceptional Achievements:** None

**15. Signature of Principal Investigator:**

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Jeffrey Morgan, Capt, USAF, MC  
Fellow, Emergency Ultrasound  
Department of Emergency Medicine – JBSA  
[jeffrey.d.morgan30.mil@mail.mil](mailto:jeffrey.d.morgan30.mil@mail.mil)

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