Training Simulation Models

Working Prototype Simulators for Combat Surgery Procedures: Damage Control Laparotomy and Resuscitative Endovascular Balloon Occlusion of the Aorta

Combat surgery training is an essential mission of the U.S. Armed Forces. Courses such as Emergency War Surgery and Advanced Trauma Operative Management have been developed to meet this requirement; however, these courses do not cover all relevant procedures and rely on animals and cadavers which limits their utility. The Department of Defense Small Business Innovation Research (SBIR) program funded one Phase 2 project in response to the FY15 topic "Medical Simulation-Based Training System for Rapid Trauma Skills Training" (OSD08-H11). The current project, being conducted by Operative Experience, Inc., (North East, Maryland), seeks to develop training systems for two new critical surgical procedures, Damage Control Laparotomy (DCL) and Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA). This project requires an anatomic model of high complexity in which thoracic, abdominal, and ilio-femoral vascular architecture containing a programmable pumping system and a sensor array must be integrated into an infrastructure that also contains the abdominal organs. The first phase of this project has involved the design, modeling, and development of the simulator infrastructure and research into the sensors, pumps, and electrical systems that will be required.

The prototypes of the DCL and the REBOA simulator have been completed. The models include a lacerated liver, ruptured spleen, a nick to the inferior vena cava, various perforations to the bowels, integrated sensor arrays, and a tablet controller.

The researchers plan to demonstrate the prototypes within the government corral at the 2018 International Meeting on Simulation in Healthcare, January 14-17, 2018, in Los Angeles, California. The final training systems developed during this effort will be physical simulation-based systems, of high anatomical and surgical fidelity, that will be used to rapidly train surgeons and medics in critical combat trauma skills (Figures 1, 2, and 3).

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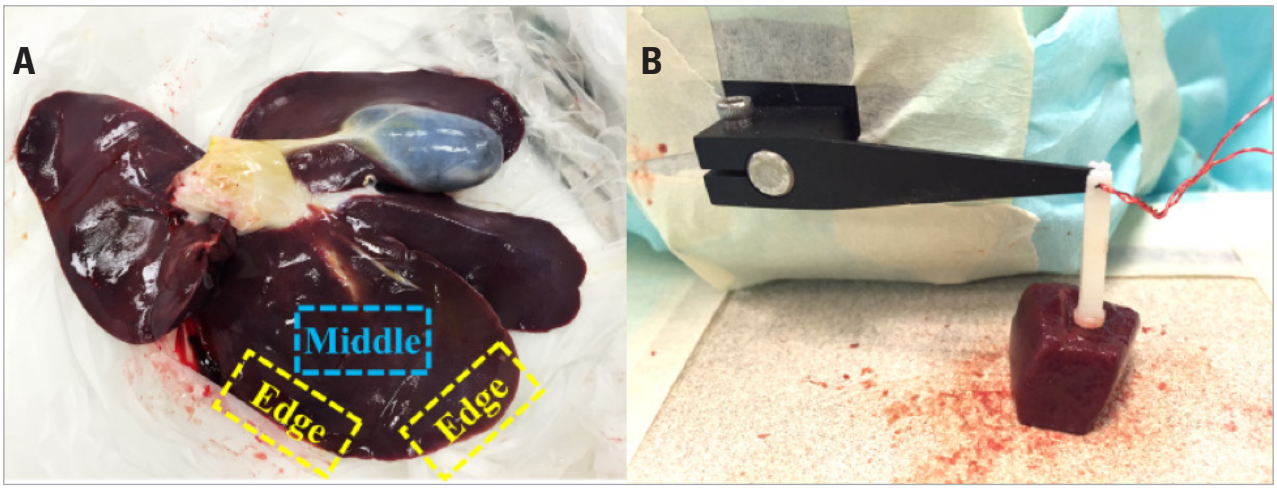

FIGURE 1: (A) Porcine Liver (B) Compression test to determine tissue mechanical properties. (Figure used with permission from the authors)

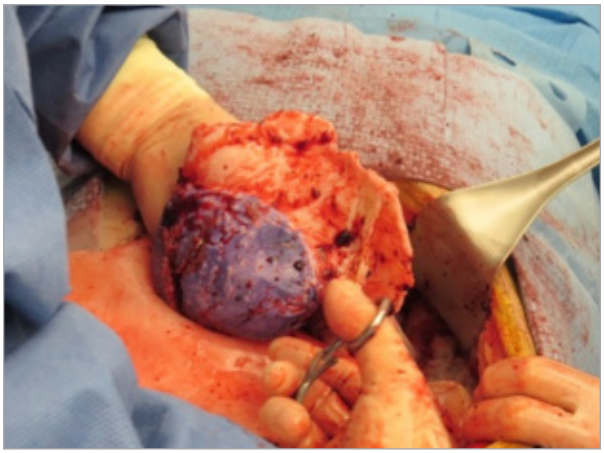

FIGURE 2: Mobilization of spleen in DCL Simulator (Figure used with permission from the authors)

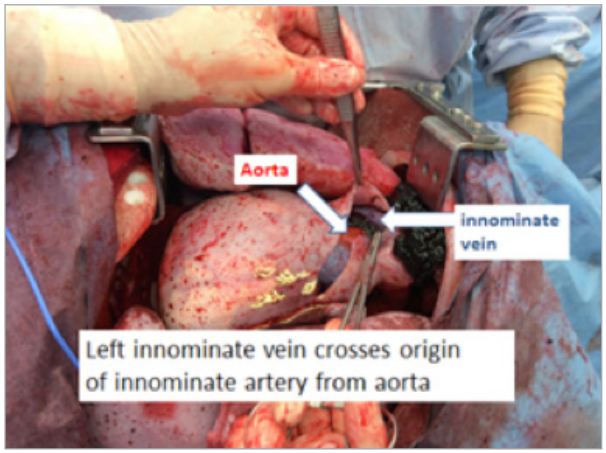

FIGURE 3: Exposure of innominate artery thru bilateral trans-sternal thoracotomy. (Figure used with permission from the authors)