

Intraosseous Vascular Access in the Treatment of Chemical Warfare Casualties Assessed by Advanced Simulation: Proposed Alteration of Treatment Protocol

Amir Vardi, MD^{*,†}, Haim Berkenstadt, MD^{*,†}, Inbal Levin, PCCRN^{*,†}, Ariel Bentencur, MD^{*,‡}, and Amitai Ziv, MD^{*}

*The Israel Center for Medical Simulation, Sheba Medical Center, Tel-Hashomer, Israel; and Departments of †Pediatric Critical Care, ‡Anesthesiology and Intensive Care, and §Emergency Medicine, the Chaim Sheba Medical Center, Tel-Hashomer, Israel (affiliated with the Tel-Aviv University, Sackler School of Medicine, Tel-Aviv, Israel)

Address correspondence and reprint requests to Amir Vardi, MD, Department of Pediatric Critical Care, Safra Children's Hospital, Sheba Medical Center, Tel-Hashomer, Israel 52621. Address e-mail to avardi@post.tau.ac.il.

Current treatment protocols for chemical warfare casualties assume no IV access during the early treatment stages. Time constraints in mass casualty scenarios, impaired manual dexterity of medical personnel wearing protective gear, and victims' complex clinical presentations render standard IV access techniques impractical. A newly developed spring-driven, trigger-operated intraosseous infusion device may offer an effective solution. Sophisticated simulators were developed and used to mimic scenarios of chemical warfare casualties for assessing the feasibility of intraosseous infusion delivery. We evaluated the clinical performance of medical teams in full protective gear. The success rate in intraosseous insertion, time to completion of treatment goals, and outcome were measured in a simulated setting. Medical teams from major hospitals in Israel, designated for emergency response in a real chemical warfare mass casualty scenario, were trained in a simulated setting. All 94 participating physicians were supplied with conventional treatment modalities: only the 64 study group physicians received intraosseous devices. The simulated survival rate was 73.4% for the study group and 3.3% for the controls ($P < 0.001$). Treatment goals were achieved within 3.5 min (range, 1–9 min) in the study group and within >10 min for controls ($P < 0.001$), and the complication rate for intraosseous use was 13.8%. Personnel satisfaction with the intraosseous device was unanimous and high. New-generation intraosseous infusions have great potential value in the early treatment stages of chemical warfare casualties.

IMPLICATIONS: In a chemical warfare mass casualty scenario, the protective gear worn by medical personnel, the time constraints, and the casualties' medical condition impose limitations on the establishment of IV access during early treatment of the victims. A spring-driven, trigger-operated intraosseous infusion delivery system may offer an effective solution.