Repetition is the mother of skill

Christopher R. Burke, MD, and Nahush A. Mokadam, MD

From the Division of Cardiothoracic Surgery, University of Washington, Seattle, Wash.

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Address for reprints: Nahush A. Mokadam, MD, Division of Cardiothoracic Surgery, University of Washington, 1959 NE Pacific St, Box 356310, Seattle, WA 98195 (E-mail: mokadamn@uw.edu).

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Changing norms in surgical education and resulting work hour restrictions, along with a shift toward increased public scrutiny of outcomes, has transformed surgical training in the past decade. Trainees today are often limited in both their overall case volume during residency and realizing less autonomy within the operating room. Gone are the days of a traditional surgical training “apprenticeship” paradigm of graduated responsibility in the operating room. Therefore, adjuncts to the traditional “Halsted” method of teaching have been implemented in many residency programs. Experiential learning through simulation and video aids has been widely used in a variety of fields, including the training of airline pilots, the armed forces, and athletes; it has also been shown to be an effective tool for teaching complicated cardiothoracic operations, including the use of 3-dimensional printed models to simulate a septal myectomy and complex congenital operations.^{1,2} Overall, interest in simulation training within the field of cardiothoracic surgery has increased dramatically in the past decade. This has led to the development of a standardized cardiothoracic surgery simulation curriculum that has been validated to show a significant benefit in both resident performance and perceived comfort level with components of various operations.³⁻⁵

In this issue of the *Journal*, Malas and colleagues⁶ present a compelling case for the use of visualization multimedia in teaching surgical residents to perform a vascular anastomosis. They present an intriguing randomized trial that once again illuminates the beneficial effects of simulation training in cardiothoracic surgery and specifically on the use of visual experiential learning. Surgical trainees randomized to undergo anastomotic training with the use of visualization multimedia performed significantly better than their peers who received expert-guided simulation training alone. It is also interesting to note that a greater benefit was noted among more senior residents, perhaps illuminating the additive impact of both operative experience and simulation training in acquisition of complex surgical skills.

Adjuncts to traditional operative experience must be used to obtain even mere competency among graduating surgical

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Central Message

Simulation-based training, such as visualization multimedia, provides a safe and effective environment for resident education. More investment is justified within this field.

See Article page 1686.

residents. Despite a wealth of literature in both cardiothoracic surgery and other surgical fields supporting the use of simulation-based training, these programs remain largely unfunded at most training sites. Increasing the fidelity of simulation is of paramount importance, as Malas and colleagues⁶ have shown by exploring the use of visualization training for teaching vascular anastomosis. As public scrutiny over surgical outcomes increases, one can easily imagine a time in the near future when simulation-based testing is part of the credentialing and certification process for surgeons. The field of simulation is likely to receive a tremendous advance in the near future as virtual reality and artificial intelligence technologies continue to be refined. Virtual reality simulators have been shown to be beneficial for teaching thoracoscopic lobectomy and components of cardiac surgery.^{7,8} Cardiothoracic surgery residency programs must continue to embrace, explore, and invest in simulation curricula in an effort to adequately train residents in an ever-changing and complex field. The need for simulation-based training in cardiothoracic residency is clear, and the data are robust to justify its use; therefore, the responsibility falls on educators within the field to advocate on behalf of trainees for increased investment in these programs.

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