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Simulation Based Medical Education: Cut the Long Story Short

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ABSTRACT

Background: Simulation-based medical education [SBME] has emerged as a powerful technique to enhance the quality and safety of patient care.

Aim of the work: This study aimed to evaluate the implementation of SBME for teaching basic surgical skills of vascular anastomosis [BSSVA] and basic endovascular skills [BES] in an internship training program and for resident vascular surgeons.

Methods: The SBME program consisted of lecture [30 minutes], Video demonstration [15 minutes], Multiple-choice quiz [20 questions] to assess knowledge and awareness, Simulation-based hands-on training and feedback survey.

Results: Learners reported high levels of satisfaction and achieved superior results compared to other topics in the same course [addressed by the quizzes]. To address the challenges of limited financial resources, the researchers designed and utilized three cost-effective simulation models using inexpensive materials for basic suturing, BSSVA, and BES, which enabled the successful implementation of the SBME program**.**

Conclusion: A comprehensive SBME program, even with limited resources, can effectively teach BSSVA and BES to medical trainees. The use of low-cost simulation models overcome the financial barriers and created an accessible and engaging learning environment. This reflects the value of SBME.

Keywords: Simulation; Medical education**;** vascular anastomosis; Endovascular.

INTRODUCTION

Simulation-based medical education [SBME] has emerged as a powerful technique to enhance the quality and safety of patient care. SBME allows learners to practice critical skills in a safe and controlled environment, without the risks associated with live patient interactions [1-3].

SBME is a technique and technology that can create unique environment of adult medical education, attractive way and satisfactory result that can improve the quality and safety for patient care [1-3].

As the SBME is safe to patient and learner and also proved to be effective in both under-graduate and post graduate education, it had been used it for teaching of basic surgical skills of vascular anastomosis [BSSVA] and for teaching basic endovascular skills [BES] at the internship training program before deciding their medical field and for residents of vascular surgeons at the first 3 months of their work [1-3].

SBME can rapidly increase self-efficacy or judgment if it's done in a perfect and well-designed course or learning cycle as in Kolb's experimental learning cycle [4] and by reflection on action [5] which could be achieved successfully during teaching of BSSVA and BES.

This study aimed to evaluate the implementation of SBME for teaching basic surgical skills of vascular anastomosis [BSSVA] and basic endo-vascular skills [BES] to medical trainees.

METHODS

The SBME program was implemented in an internship training program and for resident of vascular, plastic and neurosurgeons as well as intervention radiologist. The program consisted of the following components for each one of BSSVA or BES:

1. Lecture [30 minutes]: 20 learners received a didactic introduction to the relevant procedures, including indications, contraindications, and key steps with interactive discussions.

2. Video demonstration [15 minutes]: 20 learners observed a video depicting the correct technique for performing the BSSVA or BES procedures, 15 minutes for each procedure.

3. Multiple choice quiz [20 questions]: 20 learners completed a knowledge assessment to evaluate their understanding of the procedure's indications and contraindications, equipment, and safety considerations**.** As well as how to maintain safe environment of teaching and medical intervention.

4. Simulation based hands-on training: 20 learners practiced the BSSVA [Figs. 1, 2] and BES [Figs. 3, 4] procedures using specialized simulation models, handmade and prepared from very cheap material and from the rest of synthetic grafts as well as stripped great saphenous vein which help us to have dray and wet lab for vascular anastomosis [Fig. 1] .As we can design very simple, cheap and safe simulator for human arterial system for BES. At this step one trainer for 2 learners at each station, with 2 hours a maximum duration of this step for each procedure.

5. Feedback survey: Learners provided feedback on the overall quality and effectiveness of the SBME program and their recommendations.

RESULTS

Learners reported high levels of satisfaction [assessed subjectively and by their feedback] with the SBME program and achieved superior results compared to other topics in the same course [assessed through their grades in the quizzes after implementation]. To address the challenge of limited financial resources, the researchers designed and utilized three cost-effective simulation models using inexpensive materials. These models included basic suturing model, BSSVA model with artificial vessels embedded in synthetic tissue, and BES model with realistic vascular structures and fluoroscopic imaging capabilities

The use of these low-cost simulation models helped overcome financial barriers and created an accessible and engaging learning environment for the trainees. All learners were satisfied and were actually achieving marvelous results in comparison to other topics in the same course and for the same topic [according to survey before and after teaching].

The main challenge of SBME is the financial resources to have well equipped skill lab meet the expectations and requirements of all department and educators and can achieve the ideal environment for leaners' scientific gluttonous. Staring by models of clinical teaching and bedsides tests without

suitable simulators for BSSVA and BES was actual threat which can prevent development and progress of our medical education project. But I was lucky to can design 3 models of medical education based on simulation from very cheap materials one for basic sutures, the second for BSSVA and the third one for BES and I actually started to use it with satisfactory results. Actually, the numbers of trainer are very few, but my colleagues were cooperative and we arranged to do the 2 courses regularly at the first Sunday of each month to meet the number of trainers for great achievement.

Figure [1]: Description of demographic, clinical and laboratory data in all studied patients

Figure [2]: Multiple stations and trainers, hands on simulation for basic vascular anastomosis skills, in safe area of teaching with dray and wet lab

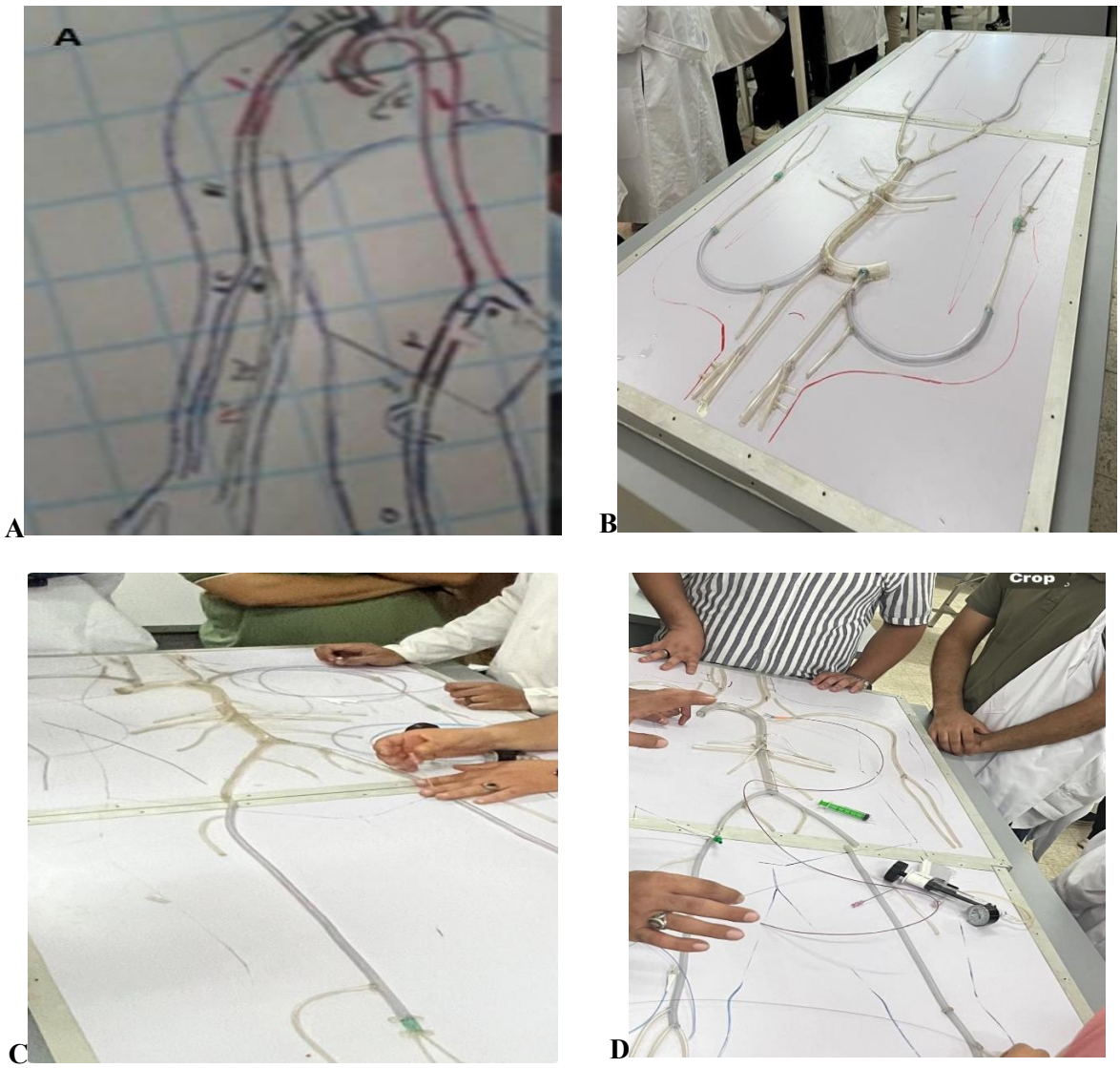

Figure (3): A, B-Arterial system of human body design, C, D- Multiple stations and trainers, hands on simulation for basic endovascular skills

DISCUSSION

Vascular anastomosis, the surgical connection of blood vessels, is a fundamental skill required for many vascular procedures. However, mastering this delicate technique can be challenging, as it requires a high degree of dexterity and precision. Similarly, the increasing complexity of endo-vascular interventions, such as stent placement and angioplasty, has led to a greater need for structured training in these basic endovascular skills [6-9].

Our results highlight how simulation-based training can provide a safe and controlled environment for vascular surgery trainees to develop and refine these crucial skills. Through the use of virtual reality, physical models, and other simulation platforms, trainees can repeatedly practice vascular anastomosis techniques and endovascular procedures without the risk of patient harm.

These results are in line with results of **Haiser *et al.*** [10] who reviewed 76 manuscripts reported the results from 34 vascular surgery simulators and training curricula. They concluded that, SBMT in vascular surgery is an effective training model in the vascular surgery. They added, this field developed overtime with exciting features, with development of vast majority of models and curricula. However, available studies did not measure the trainee skill retention over a longer time. The cost effectiveness is a matter of discussion. One of the powerful points of the current study is the use of cheap, easily and personally prepared models. In

addition, **Kweki *et al.*** [11] reported that, the training in the cardiovascular surgery is a challenge as it needs a lot of exposure which exposes patients to multiple risks and complications. The use of simulation to transfer skills could prevent these risks and ensure patient safety. After a systemic review of the controlled trials, the authors stated that, the majority of outcomes of these trials showed the SBME complements the traditional methods already applied for training. However, all studies in this review come from the Western world. This reflects the importance of the current study, as it provides a proof for the value of SBME from the Arab World. Furthermore, **Williams *et al.*** [12] after a review of published literature concluded that, the based simulation training is attaining wide acceptance year by year and become a relevant change in the surgical training paradigm shifts. They added, irrespective of the wide availability of articles about SBME, there is a lack of standardization in the grading/ rating system. The current study is not an exception as we used subjective evaluation to measure the value of our program. This is one of the limiting steps of the current work.

Gomaa et al. [13] assed in a systematic review the values of the use of high-fidelity simulators in the endovascular training. They reported that, the evidence for the effectiveness of simulation based medical training is heterogeneous. However, the authors were able to conclude that, SBME leads to an improvement in the performances of trainee, mostly in the terms of procedure and fluoroscopy time.

An interesting study by **Aeckersberg *et al.*** [14] concluded that the use of low-fidelity simulators, especially for navigation was associated with increased motivation in novice trainees. However, no evidence was provided for the increased confidence in practical skills or their assessment of these stills. They added; the low fidelity simulators provide a potential benefit for novice trainee. But the risk of SBME should be considered.

Finally, **Lawaetz *et al.*** [15] recommended the use of carefully designed and structured SBME programs as they are effective and associated with an improvement in the technical skills, especially in less experienced trainees. Again, the lack of assessment standard limiting the consensus on the value of SB training in vascular surgery.

In addition, several studies have demonstrated the benefits of SBT in this context. These studies show that trainees who undergo simulation-based training exhibit improved technical proficiency, reduced procedural errors, and faster skill acquisition compared to those who rely solely on traditional teaching methods [16-20].

In conclusion, this work highlighted the value of simulation-based training as an integrative method for training in vascular surgery, with a specific focus on developing proficiency in vascular anastomosis and basic endovascular skills. A comprehensive SBME program, even with limited resources, can effectively teach BSSVA and BES to medical trainees. The positive learner feedback and improved outcomes highlight the potential of simulation-based approaches to enhance medical education and patient safety. The successful implementation of this SBME program, facilitated by the use of cost-effective simulation models, suggests that such approaches can be readily adopted by medical training programs with budgetary constraints. However, the limiting steps of short-term evaluation is another limiting step of the current work. Thus, a future research should explore the long-term impact of SBME on clinical outcomes and the scalability of the cost-effective simulation models developed in this study.

Disclosure: None to be disclosed.

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