Vascular reparation training program in experimental model for general surgery residents

Programa de entrenamiento en reparacion vascular en modelo experimental para residentes de cirugía general

Miguel A. Sierra-Juárez¹, Christian I. Cruz-Romero^{2*}, Ansony R. Godinez Vida² and Marco A. Durán-Padilla³

¹Department of Angiology and Vascular Surgery; ²General Surgery; ³Pathology Department. Hospital General de México Dr. Eduardo Liceaga, Mexico City, Mexico

Abstract

Introduction: Simulated training programs allow to optimize resources, increase technical practice and shorten learning curves, constituting a safe, standardized and validated method of learning for all those trained. **Objective:** Develop a vascular training program through the elaboration of an end to end anastomosis of a vessel in an experimental model for General Surgery residents. **Method:** For the development of this training model, an amputated limb was used at the supracondylar level free of medical-legal process. The dissection of the femoral artery was performed, it was divided into two portions and an end to end anastomosis was performed. A system was designed that included the evaluation of the following variables using the OSATS (Objective Structured Assessment of Technical Skills) and Likert scales: 1) manual knot and single stitch; 2) permeability of the anastomosis; 3) symmetry of the stitches; 4) Anastomosis leakage; and 5) total time of the anastomosis. **Discussion:** Recognizing the advantages of experimental training, a reproducible, standardized, and low cost experimental biological model is proposed. **Conclusions:** The development of experimental biological models, allows the general surgeon the acquisition of surgical skills and abilities, improving performance during a surgical procedure and reducing risks.

Key words: Simulation training. Anastomosis. Anastomotic leak.

Resumen

Introducción: Los programas de entrenamiento simulado permiten optimizar recursos, aumentar la práctica técnica y acortar curvas de aprendizaje, y constituyen un método seguro, estandarizado y validado de aprendizaje para todos los entrenados. **Objetivo:** Desarrollar un programa de entrenamiento vascular mediante la elaboración de una anastomosis término-terminal de un vaso en un modelo experimental para residentes de cirugía general. **Método:** Para el desarrollo de este modelo de entrenamiento se utilizó una extremidad amputada a nivel supracondíleo libre de proceso médico-legal. Se realizó la disección de la arteria femoral, se dividió en dos porciones y se realizó una anastomosis término-terminal. Se diseñó un sistema que incluye la evaluación de las siguientes variables utilizando la escalas OSATS (Objective Structured Assessment of Technical Skills) y Likert: 1) nudo manual y punto simple; 2) permeabilidad de la anastomosis; 3) simetría de los puntos; 4) fuga de anastomosis; y 5) tiempo total de anastomosis. **Discusión:** Al reconocer las ventajas del entrenamiento experimental, se

Correspondence:

*Christian I. Cruz-Romero

Dr. Balmis, 148

Col. Doctores, Del. Cuauhtémoc

C.P. 06726, Ciudad de México, México

E-mail: chriscrurom@gmail.com

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propone un modelo biológico experimental reproducible, estandarizado y de bajo costo. Conclusiones: El desarrollo de modelos biológicos experimentales permite al cirujano general la adquisición de habilidades y destrezas quirúrgicas, mejorando el desempeño durante un procedimiento quirúrgico y reduciendo riesgos.

Palabras clave: Simulación. Anastomosis. Fuga de anastomosis.

Introduction

Surgery has been used as medical treatment throughout times; however, the question on how to obtain surgical skills and abilities remains a topic of intense debate. Medical education in general surgery has gradually moved away from the traditional paradigm of apprenticeship, with this evolution being multifactorial and that, as part of its advances, includes greater training standardization, tighter supervision of working hours and a focus on competence and evaluation of skills¹.

With graduation of competent surgeons being the goal, surgical educators have recognized the need to improve surgical training efficiency and effectiveness². The general surgery specialty takes 4 years in public or private teaching hospitals of the country and comprises three areas: 1) cognitive, where the diagnostic procedures are substantiated; 2) psychomotor, which points at the essential skills to be developed in the operating room; and 3) affective, where attitudes that will be maintained before patients and their families are learned³.

For the teaching-learning process to be efficient, it should focus on meaningful learning, focused rather on the method than on knowledge itself, where the important figure is the student and not the teacher; with an emphasis on learning and not so much on teaching, systematically questioning established knowledge, breaking stereotypes, promoting critical reflection rather than memorization, and students participation in planning and feedback of the program⁴.

Simulation is a technique based on mimicking some process through an equipment that resembles reality with the purpose to improve skills and abilities. In medicine, the use of simulators is essential for patient safety, which forces new teaching processes⁵. Jakimowicz⁶ points out the importance of virtual reality models and their advantages, such as objective performance evaluation, interactivity, video availability and didactic training. Simulation has allowed the acquisition of technical skills in traditional open and laparoscopic surgery in post-graduate training⁷. Simulated training programs allow optimizing resources, increase technical practice and shorten learning curves, and constitute a safe, standardized and validated way of learning for all trainees^{8,9}.

Figure 1. Femoral artery dissection.

The main purpose was to develop a vascular training program that consisted in performing an end-to-end anastomosis of a vessel in an experimental model. Secondary objectives included: 1) developing an instrument to evaluate technical performance, determining its reliability and validity for the performance of vascular anastomoses; and 2) creating a vascular surgery training program for general surgery residents.

Method

For the development of this training model, a limb amputated at the supracondylar level, free of medical-legal process, was used. Dissection of the femoral artery was performed, it was divided in two portions and an end-to-end anastomosis was carried out. Other essential materials for this practice are needle holders, dissection forceps, Metzembaum scissors, 8 Fr feeding tube, non-absorbable vascular suture (6-0 polypropylene), non-absorbable suture (2-0 silk), gloves, gauze and injectable water.

The model consists of femoral artery dissection in the amputated limb (Fig. 1), carrying out a careful separation until an approximate length of 10 cm is obtained. Permeability of the blood vessel is verified. The next

Figure 2. Test for vascular permeability with injectable water.

Figure 4. End-to-end anastomosis permeability and tightness.

Figure 3. Vascular lesion simulated by cross section.

step is placing the feeding tube at the proximal end, attaching it with a knot (2-0 silk), infusing 10 ml of injectable water and checking for permeability again (Fig. 2). Once the proximal end is secured, a total cross section is made to simulate the vascular lesion with the Metzemaum scissors (Fig. 3). End-to-end anastomosis is carried out with continuous stitches (6-0 vascular polypropylene), anastomosis permeability and tightness are verified by infusing 20 mL of injectable water through the tube (Fig. 4). Finally, the amount of anastomosis leakage is evaluated by instilling 20 mL of injectable water at 4 mL/s, placing at the distal end a container graduated in milliliters and observing the difference between instilled volume and final volume.

A practical evaluation system was designed, where the following variables were included when performing the end-to-end anastomosis: 1) manual knot and single stitch; 2) anastomosis permeability; 3) symmetry of stitches; 4) anastomosis leakage of solution; and 5) anastomosis total time. Internationally-validated global assessment scale Objective Structured Assessment of Technical Skills (OSATS) was used (Table 1)⁷. Measuring the attitudes and the degree of agreement of the evaluator is considered important, with a five-point Likert scale being included in our evaluation system: 1) strongly disagree; 2) disagree; 3) neither agree nor disagree; 4) agree; and 5) strongly agree.

Discussion

The training of general surgery residents has been carried out through live demonstrations, always directed by experienced and qualified surgeons. The use of experimental models has been shown to increase surgical skills, with a decrease in risks and surgical time optimization. Recognizing the advantages of experimental training, an experimental, reproducible, standardized and low-cost biological model is proposed.

The acquisition of skills and abilities for achieving competent surgeons is usually heterogeneous, given that there is no objective method to define the level of a skill, and thus the use of models and simulators is highly useful for assessing the capacity in the performance of a surgical procedure¹⁰.

Simulators have been reported in the literature to be effective during the initial training phase, and have

Table 1. Objective Structured Assessment of Technical Skills (OSATS) scale for general skills assessment

Score	Respect for tissues	Time and movements	Use of the instrument	Flow of surgery and post-planning	Knowledge
1	Frequent use of unnecessary force Damage caused by inappropriate use of instruments	Many unnecessary movements	Repeatedly makes hesitating movements	Frequently stops the procedure or requires discussing the following steps	Deficient knowledge and requires instructions in most surgical steps
2					
3	Careful manipulation of tissues, but occasionally causes inadvertent harm	Efficient relationship between time and movements but makes some unnecessary movements	Competent use of instruments but occasionally is observed stiff or clumsy	Shows skills to plan the next steps, with constant progression of the process	Know all important aspects of the operation
4					
5	Manipulates tissues properly with minimal harm	Economy of movements and maximum efficiency	Fluid movements with the instruments and no clumsiness	Planned course of the operation in an obvious way, with effortless flow	Familiarity demonstrated with all aspects of the operation

Source: modified from Martin, et al.⁷

been validated by various studies^{1,2} The use of biological models is still acceptable to explore and improve surgical techniques without compromising patient safety¹¹. The main limitation presented by cadaveric biological models is the lack of an imminent hemorrhage, but they are highly useful in the initial acquisition of cognitive and haptic skills that, undoubtedly, provide a benefit when performing a surgical procedure¹².

Conclusions

The development of experimental biological models allows the general surgeon to acquire surgical abilities and skills, thus improving performance and reducing risks during surgical procedure. This simulated program proposes an alternative and reproducible method for the development of technical competences and can be incorporated to the program for the training of general surgeons.

Ethical disclosure

Protection of people and animals. The authors declare that the procedures followed adhered to the ethical standards of the responsible human experimentation committee and are in agreement with the World Medical Association and the Declaration of Helsinki.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Conflict of interests

The authors declare that they have no conflicts of interest.

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