

Intensive vascular training for the non-vascular surgeon

Entrenamiento vascular intensivo para el cirujano no vascular

Jorge L. Salazar-Alarcón^{1*}, María A. Valcárcel-Saldaña¹, José G. Somocurcio-Vilchez¹,
Alfredo L. Sotomayor-Estrada² and Mónica Herencia-Souza³

¹Department of Teaching, Institute of Experimental Surgery, Universidad Nacional Mayor de San Marcos, Lima; ²Department of Thoracic and Cardiovascular Surgery, Hospital Nacional Hipólito Unanue, Lima; ³Department of Diagnostic Imaging, Hospital Nacional Daniel Alcides Carrión, Bellavista. Peru

Abstract

Introduction: In most emergency services in Peru there is no vascular surgeon, the general surgeon having to solve the vascular problems. General surgeons need to be trained in vascular management, especially those life-threatening conditions. **Objective:** To share the results of the first course of vascular surgery for the non-vascular surgeon and the level of satisfaction of the participating students. **Method:** The training course used five simulation models distributed in five practical sessions. At the end of the course, the students were evaluated using the OSATS (Objective Structured Assessment of Technical Skills) scale and the arterial anastomosis time was measured; Additionally, the level of satisfaction with the course was evaluated. **Results:** 12 students participated, 8 met the inclusion criteria, the mean age was 39.9 years, the OSATS score was 19 (± 2.1), and the anastomosis time 17.6 (± 7.9) minutes. The level of overall course satisfaction was 31.05; there were no significant differences between the satisfaction of the different practical sessions ($p = 0.85$). The Cronbach's alpha for the survey was 0.96 (Excellent). **Conclusions:** The intensive vascular training course combines different surgical scenarios based on simulation. The level of satisfaction of the course and the reliability of the survey "perception of simulation practices" were excellent.

Keywords: Basic course. Vascular surgery. Surgical training. Simulation. Medical education.

Resumen

Introducción: En la mayoría de los servicios de emergencia del Perú no se cuenta con un cirujano vascular, teniendo que resolver los problemas vasculares el cirujano general. Es necesario que los cirujanos generales estén entrenados en el manejo vascular, sobre todo de aquellas condiciones que pueden comprometer la vida. **Objetivo:** Compartir los resultados del primer curso de cirugía vascular para el cirujano no vascular y el nivel de satisfacción de los alumnos participantes. **Método:** El curso de entrenamiento utilizó cinco modelos de simulación distribuidos en cinco sesiones prácticas. Al final del curso se evaluó a los alumnos usando la escala OSATS (Objective Structured Assessment of Technical Skills) y se midió el tiempo de anastomosis arterial; adicionalmente se evaluó el nivel de satisfacción del curso. **Resultados:** Participaron 12 alumnos, de los cuales ocho cumplieron los criterios de inclusión. La edad media fue de 39.9 años. La calificación OSATS fue de 19 (± 2.1). El tiempo de anastomosis fue de 17.6 (± 7.9) minutos. El nivel de satisfacción global de curso fue de 31.05; no hubo diferencias significativas entre la satisfacción de las diferentes sesiones prácticas ($p = 0.85$). El alfa de Cronbach de la encuesta fue de 0,96 (excelente). **Conclusiones:** El curso intensivo de entrenamiento vascular combina diferentes

*Correspondence:

Jorge L. Salazar Alarcón
Jr. Estados Unidos 297
C.P. 15072, Jesús María, Lima, Perú
E-mail: jorge.salazar@unmsm.edu.pe

Date of reception: 04-04-2020
Date of acceptance: 12-08-2020
DOI: 10.24875/CIRUE.M20000322

Cir Cir (Eng). 2021;89(3):307-312
Contents available at PubMed
www.cirugiaycirujanos.com

2444-0507/© 2020 Academia Mexicana de Cirugía. Published by Permanyer. This is an open access article under the terms of the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

escenarios quirúrgicos basados en la simulación. El nivel de satisfacción del curso y la fiabilidad de la encuesta para «percepción de las prácticas de simulación» fueron excelentes.

Palabras clave: Curso básico. Cirugía vascular. Entrenamiento quirúrgico. Simulación. Educación médica.

Introduction

Surgery learning follows William Halsted classic model, which consists of watching, doing, and teaching a surgical procedure. In recent years, there has been an intense debate in the search for better teaching-learning tools for surgery¹. Simulation is an educational tool that places the apprentice in a scenario that mimics reality, which has allowed training without compromising patient safety². In different parts of the world, simulation-based surgical training courses are offered, which allow the acquisition of skills and abilities for both open and laparoscopic surgery³.

For vascular surgery training, three-dimensional impression, cadaveric and animal models have been used, all with results that positively impact participants' learning^{4,5}. However, the main limitation of these models is the lack of bleeding⁶. Nevertheless, they have been shown to provide initial or basic skills and abilities in vascular surgery⁶.

In Peru, vascular surgery is performed by thoracic and cardiovascular surgeons, and to a lesser extent, by other specialties as part of highly specialized groups (transplant surgery, oncological surgery, and general surgery). However, vascular emergencies are becoming increasingly common, either due to trauma or incidental, and correct control and appropriate vascular repair are necessary, since the prognosis will depend on the provided treatment^{7,8}. Despite this, in most emergency departments of Peru, vascular emergencies are resolved by the general surgeon or gynecologist on duty.

The Institute of Experimental Surgery at Universidad Nacional Mayor de San Marcos has a training policy that offers curricular and extracurricular courses for surgical skills and abilities refinement; in this sense, an intensive vascular surgery training course for non-vascular surgeons was planned and executed. The purpose of this study is to share the results of this course and students' satisfaction level.

Method

Quasi-experimental study. The course lasted 5 days and was developed in five theoretical sessions on vascular surgical technique basic concepts and 10 hours

of surgical training. On the first day of practice, the vascular instruments were recognized, and suture was practiced on a fabric model. On second day, training was performed on a goat aortic artery (*Capra aegagrus hircus*) preserved in 2% glutaraldehyde. On day three, suture was practiced on a silicone artery. On the fourth day, an anastomosis was performed between a silicone artery and a polyester (dacron) prosthesis. On day five, a pig (*Sus scrofa domestica*) main femoral artery was dissected, sectioned and anastomosed (Fig. 1). The theoretical and practical sessions were taught by two expert vascular surgeons.

The animal model was obtained in compliance with the Universal Declaration of the Rights of Animals (UNESCO, 1989) and Law No. 27265, on the protection of domestic animals and wild animals kept in captivity, and Law No. 30220 on Animal Protection and Wellbeing, in force in our country.

An evaluation was carried out at the end of the course using the Objective Structured Assessment of Technical Skills (OSATS) scale (Table 1). In addition, the time in minutes for the performance of the anastomosis on the pig femoral artery was measured. To assess anastomotic patency and leakage, the proximal end of the femoral artery was connected to a No. 12 feeding tube, which in turn was connected to sodium chloride stained with 5% azosulfamide⁹. Leakage was defined as even the slightest sodium chloride extravasation through the anastomotic suture, and patency, as the absence of obstruction at the anastomotic level.

Once the course was concluded, a satisfaction survey was applied through a "Perception on simulation practices" questionnaire. The survey includes seven statements, and each one of them can be answered according to a 5-point Likert scale (1: completely disagree; 2: disagree; 3: not sure or have no opinion, 4: agree; 5: completely agree), with a minimum score of 7 and maximum of 35 being obtained with regard to the degree of satisfaction².

Inclusion and exclusion criteria

The inclusion criteria comprised being a surgeon with a non-vascular surgical specialty, being enrolled in the vascular training course, having attended

Table 1. OSATS scale for surgical skills and abilities

Score	Respect for tissue	Time and motion	Instrument handling	Flow of operation and subsequent planning	Knowledge
1	Frequent use of unnecessary force Damage caused by inappropriate use of instruments	Many unnecessary moves	Repeatedly makes tentative moves	Frequently stops operating and seems unsure of next move	Poor knowledge and requires instructions in most surgical steps
2	-	-	-	-	-
3	Careful handling of tissue, but occasionally caused inadvertent damage	Efficient time/motion ratio, but some unnecessary moves	Competent use of the instruments, but occasionally appeared stiff or awkward	Demonstrates forward planning abilities, with constant progression of procedure	Knows all important aspects of the operation
4	-	-	-	-	-
5	Consistently handles tissue appropriately with minimal damage	Economy of movements and maximum efficiency	Fluid moves with instruments and no awkwardness	Obviously planned course of operation with effortless flow	Obviously familiar with all aspects of the operation

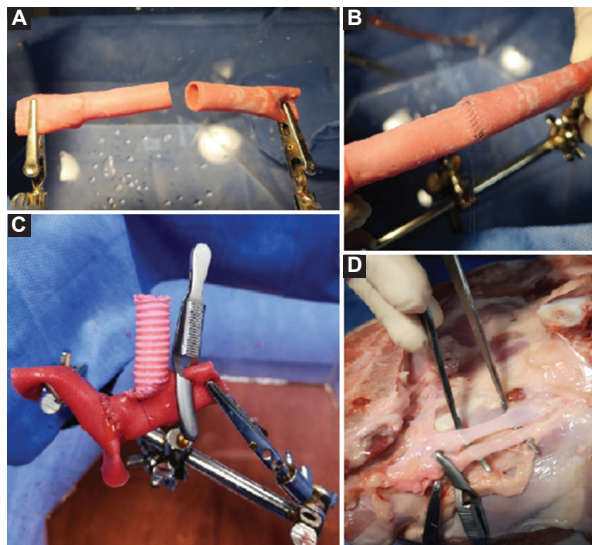


Figure 1. A and B: simulation models, anastomosis on silicone artery. C: silicone-dacron anastomosis. D: pig femoral artery dissection.

all the theoretical and practical sessions, and signing the informed consent to participate in the study. Four students who did not complete all training sessions were excluded.

Statistical analysis

The collected data were entered and tabulated in an Excel database, version 2010. The analysis included mean frequency measures, standard deviation, and percentages for OSATS score, anastomosis

time, leakage, and anastomotic patency. The Angoff cutoff point for OSATS overall score and the intra-class coefficient were calculated to assess concordance between evaluators for applying the OSATS scale.

For satisfaction with the course, the average for each statement of the questionnaire was calculated and, in addition, overall average was found for each practice and for the entire course with its respective standard deviation and confidence interval. Normality analysis was carried out with the Shapiro-Wilk test for overall averages of each practice. Since total scores did not follow a normal distribution, a non-parametric analysis was performed using Kruskal-Wallis test to assess whether there was a difference between the practice perception averages. In addition, Cronbach's alpha coefficient was estimated for the satisfaction survey.

Ethical aspects

The survey was carried out after informed consent was granted by the students, anonymously and respecting data confidentiality. Similarly, the information provided was solely used for academic purposes and was handled only by the researchers.

Results

Twelve students participated in the intensive vascular training course for non-vascular surgeons, out of

whom eight met the inclusion criteria for being considered for the study (Table 2). None of the students had undergone any previous vascular training. The highest score obtained by applying the OSATS scale was 21 and the shortest time to perform the end-to-end arterial anastomosis was 11 minutes. Three students (37.5%) achieved passing grades on OSATS scale (21 points) (Table 3). The Angoff cutoff point for OSATS overall score was established at 21 points (out of 25, equivalent to 84%). The intra-class correlation coefficient between evaluators was 0.82 (almost perfect).

The degree of satisfaction with the course was 31.05 (88.7%); all practices had an average (mean) score > 30. Fifth day practice, dissection and anastomosis on pig artery, was the one that obtained the highest degree of satisfaction (Table 4). There were no significant differences between the degree of satisfaction with the different training practices ($p = 0.85$) (Table 5). The Cronbach alpha value obtained for all questions in the satisfaction survey was 0.96 (excellent).

Discussion

This study was carried out with the purpose to share the results of the intensive vascular training course for non-vascular surgeons and to evaluate students' degree of satisfaction.

The course is characterized for being intensive and sequential; intensive, because it concentrates a large volume of training in a few days, and sequential because it is constituted of different surgical simulation scenarios that, chronologically distributed, seek to improve the vascular surgery teaching-learning process, going from lower to higher degree of complexity. Regarding the skills and abilities measured at the end of the course with the OSATS scale, our students obtained an overall mean below that necessary to pass the course (19 out of 21 points); however, when these results were disaggregated, we observed that three students did manage to pass. These results could be explained to some extent by the fact that final evaluation requires having advanced skills and abilities; however, intensive courses have shown higher effectiveness in basic or simple skills acquisition¹⁰. We consider that, despite this, the results are satisfactory, since the absence of leakage and complete patency of anastomosis was achieved in 87.5% of cases, since although the OSATS scale evaluates the performance shown by the student in the respect for tissues, time and quality of moves, instrument use, planning of the

Table 2. Characteristics of the students attending the intensive vascular training course for non-vascular surgeons

Characteristic	
Age, years (mean±SD)	39.9 ± 10.6
Gender, n (%)	
Females	1 (12.5)
Males	7 (87.5)
Specialty, n (%)	
General surgery	6 (75)
Urology	1 (12.5)
Gynecology	1 (12.5)
Work Institution, n (%)	
EsSalud	6 (75)
MINSA	2 (25)
Origin, n (%)	
Lima	6 (75)
Abancay	1 (12.5)
Cuzco	1 (12.5)
Previous vascular sutures, n (%)	
None	4 (50)
One	1 (12.5)
Two	3 (37.5)
Previous vascular anastomosis, n (%)	
None	7 (12.5)
One	1 (87.5)

EsSalud: Social Security; MINSA: Ministry of Health; SD: standard deviation.

Table 3. Vascular training intensive course for non-vascular surgeons final evaluation results

Result	Value
OSATS, mean ± SD	19 ± 2.1
Anastomosis time, minutes, mean ± DE	17.6 ± 7.9
Anastomotic leak, n (%)	
Yes	1 (12.5%)
No	7 (87.5%)
Anastomotic patency, n (%)	
Complete	7 (87.5%)
Partial	1 (12.5%)

OSATS: Objective Structured Assessment of Technical Skills; SD: Standard deviation.

procedure and knowledge of the technique, it does not assess the final result (anastomosis). It should be mentioned that there are numerous tools to evaluate surgical skills and abilities; however, as reported by Vaidya et al.¹¹, the most widely used is OSATS although it is not free of questionings, which is consistent with that which has already been stated.

As for the time to perform arterial anastomosis, although our work does not allow us to evaluate the

Table 4. Results of the survey of perception on the simulation practices of the intensive vascular training course for non-vascular surgeons

No.	Statement	Practice 1*	Practice 2*	Practice 3*	Practice 4*	Practice 5*
1	Practicing on simulated models improves my skills related to the performance of this procedure	4.6	4.5	4.4	4.5	4.6
2	I received useful educational feedback on the training session(s)	4.4	4.4	4.3	4.4	4.4
3	Practice with the model allows to make mistakes that are likely to occur in the real-life clinical setting	4.5	4.5	4.4	4.5	4.5
4	The model used in the workshop realistically simulates or represents the procedure	3.9	4.1	4.4	4.5	4.5
5	Practicing procedures with the simulated model reinforces my confidence in my clinical skills	4.4	4.5	4.5	4.4	4.5
6	Practical workshops, using simulated procedural models, should be a mandatory component in medicine teaching	4.5	4.5	4.5	4.5	4.5
7	Practicing with simulation models helps me to prepare for better performing clinical procedures than just clinical experience alone	4.6	4.4	4.4	4.5	4.5

*Mean total answers using a Likert scale, 1: Completely disagrees, 2: Disagrees, 3: Not sure or has no opinion, 4: Agrees, 5: Completely agrees.

Table 5. Degree of satisfaction with the vascular training intensive course for non-vascular surgeons using the simulation practices perception survey

Simulation practice	Media ($\pm$ SDS)	CI	p*
Anastomosis on fabric artery	30.88 ($\pm$ 3.7)	27.79-33.95	0.85
Suture and anastomosis on preserved pig artery	30.88 ($\pm$ 3.9)	27.57-34.17	
Silicone artery anastomosis	30.75 ($\pm$ 4.5)	27.01-34.48	
Silicone-dacron anastomosis	31.25 ($\pm$ 4.0)	27.01-34.48	
Pig femoral artery dissection and anastomosis	31.51 ($\pm$ 3.5)	27.88-34.61	
Overall satisfaction	31.05 ($\pm$ 3.92)	29.85-32.24	

CI: confidence interval; SD: standard deviation.

*Kruskal-Wallis test.

impact of training in terms of time, we consider it to be an acceptable time according to observations reported by Wilhelm et al.¹², who, after a 2.5-day vascular surgery intensive course found that attendees significantly improved the time needed for venous suture by 5.4 minutes (from 19.5 to 14.1 minutes) by the end of training. Similarly, Varas et al.¹³ reported that, in a 16-day laparoscopic skills basic training program for performing three intracorporeal knots, a gradual decrease in time was achieved during the first 5 days of training and, thereafter, the time was not significantly modified. Therefore, it is inferred that the intensive course has a positive impact that should be verified in a future study.

Simulation has been evolving until having become today an unobjectionable tool for surgical training. Among its benefits, an improvement in surgeons

confidence, an increase in residents' intraoperative autonomy, transfer of skills to the operating room, operative time reduction and improvement of the quality of procedures, among others, are reported¹⁴⁻¹⁸. Although the benefits are considerable, the question arises on why it is not universally applied. Some authors refer that the main cause is a lack of resources and funds for its implementation^{3,19}. Since our course is entirely simulated, we consider that it is essential to evaluate the degree of satisfaction by measuring the learning climate, defined as the perception of formal and informal characteristics of the education that is being received. In our case, we found no significant differences between the degree of satisfaction with the different practices. This contrasts with the findings published by Duran et al.²⁰, who report that, fifth year and more

advanced residents preferred cadaveric dissection models and endovascular training and, in contrast, residents from first to fourth year preferred the anastomotic model, although 86% of surveyed residents believed that simulation had an important educational role in the teaching-learning process. These contradictory findings could be explained by the higher critical viewpoint a vascular surgery resident has when immersed in the specialty, in comparison with our students, who are non-vascular surgeons with almost no experience in the field. In general, our course obtained an excellent degree of satisfaction, which is consistent with the positive perception towards simulation of the students of the above-mentioned study by Duran et al.²⁰.

Finally, it should be pointed out that this study only describes the final result of an intensive training course implementation and execution, and further analysis cannot be carried out because there are no pre-training evaluations or a control group (experts); in addition, we are aware that the small sample size could lead to errors in the interpretation of results.

Conclusions

The intensive vascular training course combines different simulation-based surgical scenarios. The degree of satisfaction with the course was excellent. It is necessary to demonstrate the effectiveness of the course in future studies.

Funding

By the researchers themselves.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures that were followed adhered to the ethical standards of the responsible committee for experimentation on human beings and were in agreement with the World Medical Association and the Declaration of Helsinki.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of referred subjects' data.

Right to privacy and informed consent. The authors have obtained informed consent from the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

References

- Costa GOF da, Rocha HAL, Moura Júnior LG de, Medeiros F das C. Taxonomy of educational objectives and learning theories in the training of laparoscopic surgical techniques in a simulation environment. *Rev Col Bras Cir.* 2018;45:e1954.
- Villagrán I, Tejos R, Chahuan J, Uslar T, Pizarro M, Varas J, et al. Percepción de estudiantes de pregrado de medicina de talleres de simulación de procedimientos médico-quirúrgicos. *Rev Med Chile.* 2018; 146:786-95.
- Robertson V, Davies R. Provision of simulation-based training (SBT) within UK vascular surgery training programmes. *Surgeon.* 2019;17: 321-5.
- James HK, Chapman AW, Pattison GTR, Griffin DR, Fisher JD. Systematic review of the current status of cadaveric simulation for surgical training. *Br J Surg.* 2019;106:1726-34.
- Achurra P, Mondragón G, Caro I, Figueroa D, Marine L, Mery D, et al. Modelo pionero de entrenamiento en trauma vascular impreso en 3D en base a imágenes de pacientes reales: un trabajo interdisciplinario de simulación en educación quirúrgica. *Inv Ed Med.* 2017;6:133-4.
- Sierra-Juárez MA, Cruz-Romero CI, Godínez-Vidal AR, Durán-Padilla MA. Programa de entrenamiento en reparación vascular en modelo experimental para residentes de cirugía general. *Cir Cir.* 2018;86:1230.
- Tyburnski JG, Wilson RF, Dente C, Steffes C, Carlin AM. Factors affecting mortality rates in patients with abdominal vascular injuries. *J Trauma.* 2001;50:1020-6.
- Siufi Neto J, Santos Siufi DF, Magrina JF. Trocar in conventional laparoscopic and robotic-assisted surgery as a major cause of iatrogenic trauma to the patient. *Best Pract Res Clin Obstet Gynaecol.* 2016; 35:13-9.
- Martin JA, Regehr G, Reznick R, Macrae H, Murnaghan J, Hutchison C, et al. Objective structured assessment of technical skill (OSATS) for surgical residents. *Br J Surg.* 1997;84:273-8.
- Morales-García D, Alcázar-Montero JA, Sanz-Sánchez M, Miguéla-Badilla JM. La simulación como modelo de enseñanza en cirugía. *Cir Esp.* 2018;96:313-4.
- Vaidya A, Aydin A, Ridgley J, Raison N, Dasgupta P, Ahmed K. Current status of technical skills assessment tools in surgery: a systematic review. *J Surg Res.* 2020;246:342-78.
- Wilhelm M, Klemm K, Assadian A, Schmidli J, Schumacher H, Merelaar J, et al. Besser und schneller! Evaluation eines 2,5-tägigen Gefäßchirurgischen Grundkurses für ChirurgInnen in Weiterbildung. *Chirurg.* 2013;84:125-9.
- Varas J, Mejía R, Riquelme A, Maluenda F, Buckel E, Salinas J, et al. Significant transfer of surgical skills obtained with an advanced laparoscopic training program to a laparoscopic jejunojunostomy in a live porcine model: feasibility of learning advanced laparoscopy in a general surgery residency. *Surg Endosc.* 2012;26:3486-94.
- Robinson WP, Doucet DR, Simons JP, Wyman A, Aiello FA, Arous E, et al. An intensive vascular surgical skills and simulation course for vascular trainees improves procedural knowledge and self-rated procedural competence. *J Vasc Surg.* 2017;65:907-915.e3.
- Kim SC, Fisher JG, Delman KA, Hinman JM, Srinivasan JK. Cadaver-based simulation increases resident confidence, initial exposure to fundamental techniques, and may augment operative autonomy. *J Surg Educ.* 2016;73:e33-41.
- James HK, Chapman AW, Pattison GTR, Griffin DR, Fisher JD. Systematic review of the current status of cadaveric simulation for surgical training. *Br J Surg.* 2019;106:1726-34.
- Egle JP, Malladi SVS, Gopinath N, Mittal VK. Simulation training improves resident performance in hand-sewn vascular and bowel anastomoses. *J Surg Educ.* 2015;72:291-6.
- Sidhu RS, Park J, Brydges R, MacRae HM, Dubrowski A. Laboratory-based vascular anastomosis training: a randomized controlled trial evaluating the effects of bench model fidelity and level of training on skill acquisition. *J Vasc Surg.* 2007;45:343-9.
- Moreira RCR. Critical issues in vascular surgery: education in Brazil. *J Vasc Surg.* 2008;48:87S-89S.
- Duran C, Bismuth J, Mitchell E. A nationwide survey of vascular surgery trainees reveals trends in operative experience, confidence, and attitudes about simulation. *J Vasc Surg.* 2013;58:524-8.