

Open surgery performance evaluation in undergraduate medicine students with a projection to undergo a surgical specialty training

Evaluación del desempeño de estudiantes de medicina de pregrado en cirugía abierta con proyección a realizar una especialidad quirúrgica

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Abstract

Objective: To determine the development of skills, knowledge, and trust levels in the field of open surgery among a group of undergraduate students enrolled in the medicine curricula who intend to undergo further training in a surgical specialty.

Method: A quasi-experimental study with a pre-posttest design was performed upon a group of sixth-year medical students who intend to undergo surgical specialty training. All participants had previously received a 2-week theoretical and practical open-surgery skills training; previously validated evaluation methods were enforced. A paired sample T-test was used for this analysis.

Results: Median pre-training score for the 13 basic skills was 28%, whereas post-training median score was 63%. During the surgical procedure, OSATS (Objective Structured Assessment of Technical Skills) method was applied, with average results of $70 \pm 14\%$. Regarding self-confidence levels among participants, 60% of the participants referred as being slightly confident before undergoing training, as opposed to an 80% of students perceiving themselves as highly confident after completing training.

Conclusion: The implementation of skill training for undergraduate students could prove cost-effective in the medical environment, allowing surgeons-to-be to reach the necessary competences in less time in accordance to current study plans.

Key words: Education. Undergraduate. Surgery. Surgical skills.

Resumen

Objetivo: Determinar el desarrollo de habilidades, los conocimientos y los niveles de confianza en el campo de la cirugía abierta en un grupo de estudiantes de pregrado de medicina que pretendan realizar una especialidad quirúrgica. **Método:** Se llevó a cabo un estudio en un grupo de estudiantes de sexto año de medicina con el enfoque de realizar una especialidad quirúrgica. Todos los participantes recibieron un entrenamiento teórico-práctico de habilidades en cirugía abierta. Se emplearon

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métodos de evaluación previamente validados. Se utilizó la prueba estadística *t* de Student para muestras pareadas.

Resultados: La media en la evaluación previa al entrenamiento fue del 28%, mientras que la media en la evaluación final del entrenamiento fue del 63%. Durante el procedimiento quirúrgico se empleó el método de evaluación OSATS (Objective Structured Assessment of Technical Skills), del cual se obtuvo un promedio del $70 \pm 14\%$. De acuerdo con el nivel de confianza de los participantes, antes de haber recibido el entrenamiento el 60% se autopercibió como ligeramente confiado, y al finalizarlo, el 80% se autopercibió como muy confiado. **Conclusiones:** La implementación de este tipo de entrenamientos en estudiantes de pregrado podría ser costo-efectiva y permitiría que los cirujanos en formación alcancen en menor tiempo las competencias necesarias.

Palabras clave: Educación. Pregrado. Cirugía. Habilidades quirúrgicas.

Introduction

For surgical training, different techniques, methods and models have been developed throughout the years, which have shown that surgical education increasingly needs innovation for proper training of surgical residents and for already qualified surgeons¹. All innovations made in surgical education have the purpose to perfect the technique and minimize errors when performing procedures in real patients. To be able to continue innovating, evaluations should be carried out that comprise both teachers' opinion and students' opinion, and that assess the effectivity of the instruments by means of which education is being provided².

Simulation emerges as a complementary learning tool in surgery, through training in a safe, controlled and standardized environment, without compromising patient safety. The purpose of simulation is that acquired skills are transferred to the operating room, thus allowing learning curves to be decreased and increasing the level of trust³.

Previously, surgical techniques were taught through watching, either in the operating room or with videos. Currently, there are diverse curricula where practice in simulated environments is carried out to perfection of the technique, before being able to practicing it on a real patient⁴. Initially, it is an extra investment for universities and surgical education institutions, since the costs for all these models are considerably high³.

Each of the different models has its advantages and disadvantages, and that is why surgical teaching workshops should include different models and learning techniques⁵.

Last-year undergraduate students express some anxiety regarding their competence in some basic practical skills. A low level of knowledge in practical skills in undergraduate students can not only be a source of anxiety for the physician, but also potentially

dangerous for the patient. That is why changes in the curricula are suggested emphasizing the acquisition of practical skills during medical training⁶.

Few studies in the literature include undergraduate students in training in order to know their competences. Their usefulness at this level has been demonstrated not only with regard to technical skills, but also in reducing the degree of stress once the actions are transferred to a real surgical scenario⁷.

In turn, this training can result in a benefit for patients through a lower risk due to the improvement of techniques and adequate management of complications⁸. In a health system like the Mexican, which is starting to look economically overwhelmed, adequate training of surgeons and residents, where resources are maximized and complications reduced through comprehensive surgery teaching workshops would be ideal⁹.

The purpose of this study was to determine the development of skills, knowledge and levels of confidence in the field of open surgery in a group of undergraduate medical students who plan to undertake a surgical specialty.

Method

A quasi-experimental study was carried out with pre-posttest design in a group of ten students who were on social service of the medical undergraduate curriculum, all of them with the focus of pursuing a surgical specialty, four of the female gender and six males, with an age range between 24 and 26 years. All participants received a theoretical-practical open surgery skills training taught by highly qualified surgeon teachers with extensive experience in surgical education, at the Surgery Department of the Faculty of Medicine of the National Autonomous University of Mexico.

The course had a duration of 2 weeks, with 20 hours of theoretical lessons and 20 hours of practice being

taught; the topics seen in class included basic surgical material identification, correct handling and proper use of surgical instruments, suture materials, sutures and surgical knots, and a master class on appendicitis and appendectomy was also taught.

A workshop was carried out where the participants had the opportunity to apply the knowledge acquired during the theoretical lessons, where various inanimate materials and models designed for meaningful learning of surgical abilities and skills were used. Practices for identification and correct handling of surgical material, sectioning, material identification and performance of simple stitches, Sarnoff stitch and subdermal stitch, and superficial and deep knots with one and two hands were carried out.

A previously validated evaluation method¹⁰, based on 13 open surgery skills, was used. Each of the 13 tasks has an established time limit; thus, in addition to assessing the quality of the performed activities, the time to carry out each task was also quantified.

The skills learned throughout the course were applied at last practice, which consisted of a closed-circuit visualization of an appendectomy procedure on a biological live model (rabbit of the New Zealand breed).

All participants received teaching and audiovisual materials for self-regulated learning throughout the study.

On day 10, the same evaluation method based on 13 skills¹⁰ of day 1 prior to the training was applied. In addition, the skills and abilities learned throughout the course were applied on the live biological model, with the opportunity to perform an appendectomy in two-person teams. To perform this activity, five surgical stations were installed, where an expert surgeon acted as evaluator and assistant of the procedure. In this activity, nine of the 13 tasks of the used evaluation scale could be applied to the model, as well as an Objective Structured Assessment of Technical Skills (OSATS) scale¹¹⁻¹⁵ adjusted to 30-point values as 100%, whereby the following aspects were assessed: gentleness with tissues, time and movements, knowledge and handling of the instrument, operation flow and specific knowledge of the procedure; in this same survey, the evaluators could comment on whether the participant would be able to perform the procedure autonomously.

To determine the participants' level of confidence, a Likert scale was used before, during and at the end of each of the scheduled activities, where 1 point was assigned for little confident, 2 points for slightly

confident, 3 points for neither confident nor unconfident, 4 points for confident and 5 points for very confident.

Statistical analysis was performed with the GraphPad Prism 6® software. The differences between initial and final assessments were obtained from the Student's t-statistical test for paired samples, with a p-value ≤ 0.05 being assigned as statistically significant.

Results

All participants in this study (n = 10) completed the training.

Basic skills

Mean value of the 13 basic pre-training skills initial assessment was 28%, while mean value of the evaluation after completing the training was 63%, with a statistically significant difference being found ($p < 0.005$).

As for basic skills (Table 1), it should be noted that, at the beginning of this study, 50% of participants ignored the correct form to manipulate a scalpel, and after completing the theoretical lessons and several hours of training, the error rate for scalpel handling went to 0% in the final evaluation. Similar results were observed when manual knot techniques were assessed, where the results improved dramatically, from 60% of the students who carried out the technique incorrectly to only 30% after the training; the continuous anchored suture also improved, with 90% of students performing the technique with an irregular distance between stitches before training in 30%, and 20% of students did not know this type of suture yet; finally, in subdermal suture, from an initial 70% of tissue injury or breakage it went to 10%, but perhaps the most noticeable improvement was observed in the handling of the needle holder, or more specifically, in the number of students who manipulated the needle directly with their hands instead of using the needle holder, with an improvement of the results from 80 to 0% in the final exam.

Surgical procedure in a living biological model

During the surgical procedure (appendectomy), performed on a living biological model, the application of 9 of the 13 basic skills could be assessed; in addition, the OSATS evaluation method was used, on which an

Table 1. Basic skills by areas

Basic skills	Level of competence		Time (seconds)		Number of errors	
	IE	FE	IE	FE	IE	FE
Sectioning with scalpel	30%	72%	17.1	14	1.3	0.3
Sectioning with straight-blade scissors	52.5%	72.2%	31	25	0.8	0.6
Needle holder handling	55.2%	77.1%	18.7	16.1	1.2	0.3
Single stitch in deep plane	11%	45%	98.5	71.9	1.9	0.8
One-handed manual knot without tension	28.6%	77.6%	31.7	16.2	1.4	0.5
Bi-manual knot without tension	31%	74%	29.3	17.8	1.5	0.5
Deep manual knot	22%	63%	34.2	25.5	1.9	0.6
Continuous anchored suture	30%	56%	446.5	335.2	2.8	1.9
Needle holder handling in deep plane	10%	47%	127.19	107.7	2.2	0.8
Single stitch	31%	66%	66.2	46.3	2.2	0.6
Needle holder handling in superficial plane	21%	56%	133.4	94.9	2.3	1.2
Sarnoff stitch	13%	51%	113.9	82.1	2.3	0.8
Subdermal suture	32%	63%	446	337	3.1	1.1

FE: final evaluation; IE: initial evaluation.

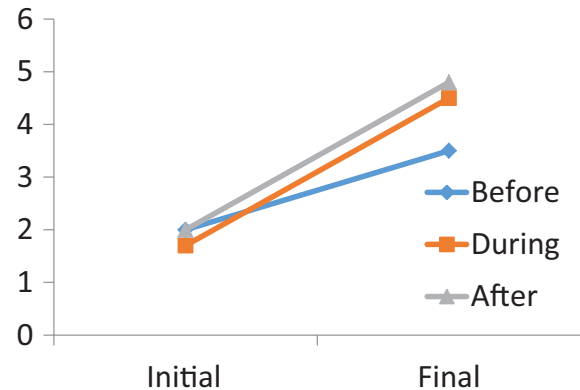
average of $70 \pm 14\%$ was obtained, and the evaluators indicated that they would allow 6 of the 10 participants to autonomously carry out the surgical procedure

Perception of confidence

According to the participants' level of confidence, prior to receiving the training, 20% perceived themselves with little confidence, 60% as slightly confident and the remaining 20% as neither confident nor unconfident. At the completion of training, 80% of participants perceived themselves as very confident and 20% as confident.

Basic skills, application of the Likert scale (Fig. 1)

- At initial evaluation: 60% felt slightly confident before the procedure, 20% little confident and

**Figure 1.** Likert scale of confidence perception when performing basic skills.

20% neither confident nor unconfident; during the procedure, 50% felt slightly confident, 40% little confident and 10% neither confident nor unconfident; at the end of the procedure, 40% felt slightly confident, 30% little confident and 30% neither confident nor unconfident.

- At final evaluation: at the beginning of the procedure, 50% felt neither confident nor unconfident and 50% felt confident; during the procedure, 50% felt confident and 50% very confident; after the procedure, 80% felt very confident and 20% confident.

Application of the Likert scale during the procedure on a living biological model

Before the procedure, 40% of participants felt neither confident nor unconfident, 30% confident, 20% slightly confident and 10% little confident; during the procedure, 60% felt confident and 40% neither confident nor unconfident; after the procedure, 60% felt confident, 30% very confident and 10% neither confident nor unconfident (Fig. 2).

When a survey was conducted at the beginning of the study, four participants responded that they felt prepared to start a surgical specialty and six felt that they lacked practical training. At the completion of the study, after the acquisition of abilities and skills in open surgery, nine participants responded that they felt prepared for starting a surgical specialty and only one of them replied that he still did not feel prepared for it. All participants responded that they would like to have the option of taking a course that would prepare them for a surgical residence at the end of

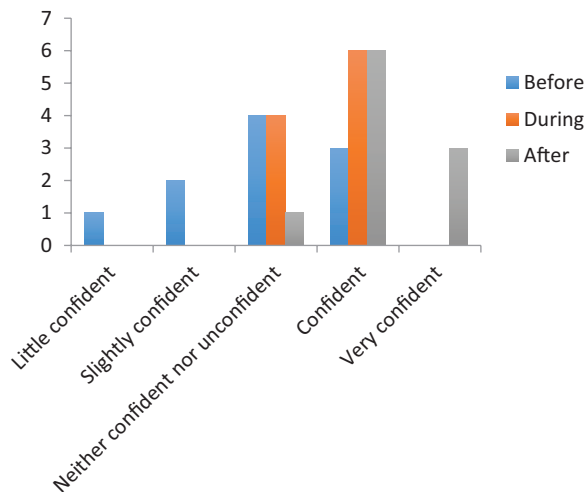


Figure 2. Likert scale of confidence perception during the procedure on a living biological model.

medical undergraduate education, and all of them would like for it to be theoretical-practical.

Discussion

For surgical training, throughout the years, different techniques, methods and models have been developed that have shown that surgical education increasingly needs innovation for proper training of surgical residents and already-qualified surgeons¹. All innovations made in surgical education have the purpose to improve techniques and minimize errors when performing procedures on real patients. To continue innovating, evaluations must be made that understand both teachers' opinions and students' opinions, and the effectiveness of the instruments whereby education is being provided should be assessed².

Simulation emerges as a complementary learning tool in surgery, through training in a safe, controlled and standardized environment, without compromising patient safety. The purpose of simulation is for acquired skills to be transferred to the operating room, and thus allowing learning curves to be reduced³; currently, simulation is the vanguard of all these surgical teaching techniques¹⁶.

Previously, surgical techniques were taught by watching, either in the operating room or with videos. Today there are diverse curricula where practice in simulated environments must be carried out to the perfection of the technique before being able to practice it in a real patient⁴. Initially, it is an extra investment for universities and surgical education institutions,

since the costs for all these models are considerably high³.

Each of the different models has its advantages and disadvantages, and that is why it is currently considered that surgical teaching workshops should include different models and learning techniques⁵.

Last-year undergraduate students express some anxiety regarding their competence in some practical basic skills. Low level of knowledge on practical skills in undergraduate students can not only be a source of anxiety for the physician, but also potentially dangerous for the patient. Therefore, changes in the curricula are suggested, emphasizing the acquisition of practical skills during medical training⁶, both for better qualification of future specialists and for an improvement in the training of general practitioners, since with the obtained results, it can be noticed that physicians about to graduate do not have the minimum necessary skills or lack the confidence to apply them, even when these skills are part of the general practitioner graduation profile in most universities of the country, since medical students have limited exposure to basic surgical skills¹⁷.

Few studies in the literature include undergraduate students on training period in order to assess their competences. Their usefulness at this level has been demonstrated not only with regard to technical skills, but also on the reduction of the degree of stress once the actions are transferred to a real surgical scenario⁷.

On the other hand, simulation is a training method that improves medical student confidence, and thus, it can have a positive effect on his/her academic experience⁸.

In turn, this training can result in a benefit for patients through a lower risk due to the improvement of the technique and adequate management of complications. In a health system like that of Mexico, which is beginning to look economically overwhelmed, and where general practitioners serve more than half the population at primary care, an adequate training of general practitioners, surgeons and residents, where resources are maximized and complications reduced through comprehensive surgery-teaching workshops, would be ideal.

Conclusion

Implementation of this type of training in undergraduate students could be cost-effective in our setting, it would allow surgeons in training to acquire in less time the necessary competences according to the curricula in force, thus strengthening teaching

didactics, maximizing time and resources for the training of highly qualified surgeons during surgical residence, as well as an increase in confidence of individuals when facing an open surgery procedure, which might allow better management of possible complications.

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Conflict of interests

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