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Learning methodology in surgical training

Metodologia de ensino no treinamento de habilidades cirúrgicas

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ABSTRACT: This manuscript aimed to review the literature data related to the surgical training program. This review showed some of the requirements to perform effective surgical training were direct supervision, predetermined repetitions according to surgical skill complexity, valid simulator models, number of students per model. This manuscript discussed how the surgical program could achieve competence using a critical thinking framework, integrated curriculum based on the rationale behind simulation training program.

Keywords: General surgery/education; Education/methods; Training/methods; Simulation training/methods.

RESUMO: Esse manuscrito tem como objetivo revisar dados da literatura relacionados ao treinamento cirúrgico para alunos de graduação me medicina. Essa revisão demostrou que alguns pré requesitos são necessários para se realizar treinamento cirúrgico de maneira eficaz: supervisão direta, repetições pré-determinadas de acordo com a complexidade da atividade a ser ensinada, modelos de simuladores válidos, número de alunos por modelo. Esse manuscrito também discutiu como o programa cirúrgico pode levar a competência pelo desenvolvimento do pensamento crítico e pela integração curricular baseado no racional da utilização de um programa de treinamento por simuladores.

Descritores: Cirurgia geral/educação; Educação/métodos; Capacitação/métodos; Treinamento por simulação/métodos.

INTRODUCTION

For many decades, the Halstedian paradigm was used in surgical learning: "see one, do one, teach one." However, since 2003, the learning method had changed due to the new medical curriculum demands[1].

We list below some of these demands[2,3]:

- New guidelines -better quality of patient assistance;
- Patient safety demands;
- Increase of Knowledge spectrum;
- Learning curve;
- Time restriction;
- Student-centered learning;
- New educational techniques (simulators).

The educational process requires a rehearsal phase (training) to enhance technical and non-technical skills, to improve the quality and safety of patient's assistance. Moreover, for adequate surgical training, it is mandatory

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a certain number of procedures repetitions to build a step-wise learning curve. The number of repetitions depends on the nature and complexity of this surgical skill. For example, to teach a simple task, glowing, it is necessary three to five repetitions; but to train a more complex surgical skill, E.g., central intravenous access it is required a higher number of repetitions (10-15 times)[1,3] .

Because of the significant knowledge load, the clinical rotation must be rescheduled to adapt the great knowledge volume in a shorter period. Therefore, the achievement of competence requires a more integrative curriculum, and a student-centered learning process.

In summary, we need an adequate education background to improve the learning process.

Student-centered method: students assume an active role in their learning process. Students will search for necessary information to build their knowledge.

Competence: successful performance of a particular ability.

To achieve this purpose, the students need to pass through some learning phases. According to Fitts and Posner's theory, the learner has to go through three steps[4] (Figure 1).

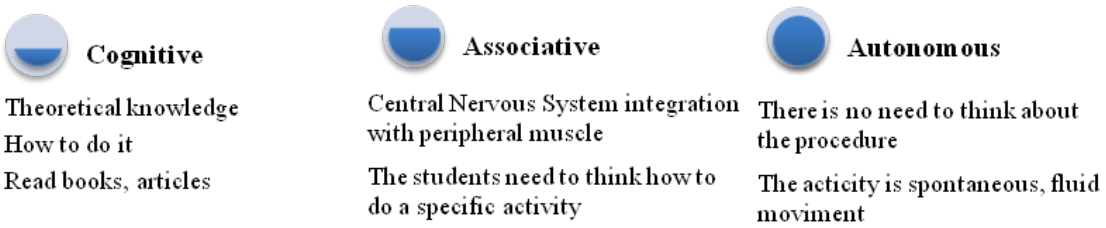


Figure 1 – Fitts and Posner's three steps theory. In the first phase (cognitive), the student learns by books, articles, and the task. In the second phase (associative), the knowledge is transmitted to motor activities. Finally, in the third step (autonomous), the student is familiar with the motor activity and, there is no need to think about how to perform the activity

Educational Background

New methods of training are available and changing over the time.

According to The Association of Surgeons in Training (ASIT) and, the Joint Committee on Surgical Training (JCST), the new educational technologies must be integrated to promote multi-surgical specialties. For example, knots and suture training can be practiced in the majority of surgical fields[5,6].

The surgical clerkship needs to consider the following aspects to organize practical surgical training:

- Simulator model;
- Number of repetitions;
- Classroom's basic schedule;
- Student's and staff's feedback.

Simulator model

Despite several simulators alternatives (Table 1), we need to consider some aspects.

Regarding the use of animal models in learning training, most medical schools abandoned this modality. From 171 American Medical Schools, only three schools use animal models for learning purposes[7]. More than 95% of Canadian and British schools eliminated animals as an educational learning model[8].

Despite ethical issues, we have to consider the level of fidelity. In basic training (E.g., knots and suture), a low-fidelity model (board tying device) shows similar results when compared to a high-fidelity model (humans replicas devices, computer simulators). See Table 1.

Table 1. Surgical model for training[9]

Simulator model	Description	Technical aspects
Low fidelity	Knot tying boards	Low cost, the student can use it at home
High fidelity model	Humans replicas (body or some specific region)	Expensive, commercially available, maintenance cost
Animal model	Live animals (rats, mice, swine)	Expensive, ethical issues
Computer simulator	Interactive programs, virtual	High cost, purchase maintenance

Simulation[10] -"A situation in which a particular set of conditions is created artificially in order to study or experience something that could exist in reality".

The challenge of the non-animal simulation is the creation of a real environment condition to mimic clinical situations.

In the last instance, surgical training aims to encode all the skills and information to produce a long-term memory. In this context, a systematic review analyzed 27 randomized clinical trials (RCTs) about the impact of the simulation-based curriculum in the operation room (real life). These RCTs showed a benefit in surgical performance due to simulation[11].

Number of repetitions

The ideal number of repetitions to achieve competence depends on the skill complexity.

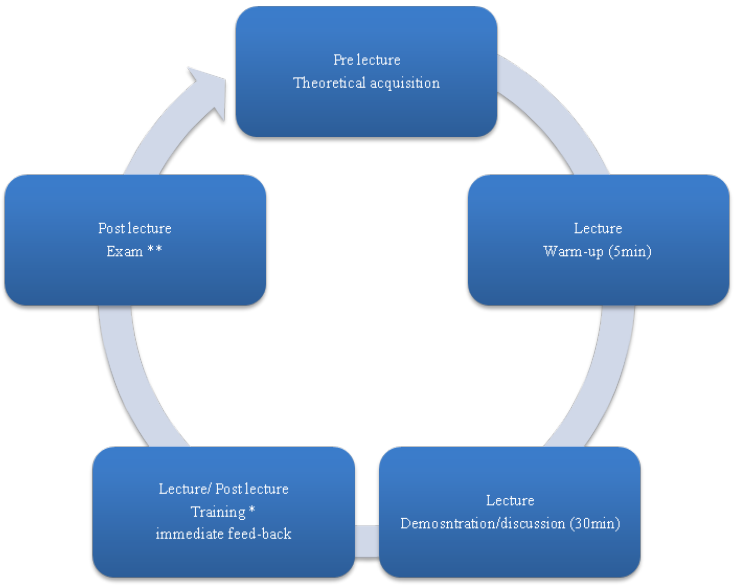
We reviewed the data available in the literature to support our educational program. See Table 2.

However, these numbers of repetitions only will be valid with direct supervision (teacher, monitors).

Table 2. Basic surgical abilities and number of repetition to achieve competence

Ability	Number of repetitions
Apparatus, instruments, hand hygiene, surgical hand washing, garment and gloves placement, surgical site preparation, antisepsis[12-14]	3 to 5
Nasogastric tubes[14]	3 to 5
Vesical catheter[14,16,17]	3 to 5
Peripheral venous and arterial access[14]	3 to 5
Central venous access[14-5]	More than 10
Airway access[14,18]	3 to 5
Knots/ Suture[19,20]	Knots 60-80 Suture 5 to 10
Drains and wound care[14,21]	5 to10
Local anesthesia/wound debridement[14,22]	5 to10

Classroom's basic schedule



* The training period depends on the ability

** The exam can be conducted as a pre-test and a post-test

Figure 2. Classroom structure for learning process

This structure aims to improve the effectiveness of the learning process. We must highlight some aspects:

- The student needs to study before the lecture;
- A warm-up period (first 5 minutes) is necessary to connect the previous learning to the training;
- During the lecture, some fast questions and interaction is mandatory to increase knowledge acquisition;
- Training depends on the previous student experience, handiness;
- Small groups (5-10 students) organization with one or two monitors;
- Immediate feedback for technical adjustments (Figure 2).

Student's and staff's feedback

Constant and immediate feedback must be given to improve training effectiveness. The teacher's feedback aims to correct an error in real-time performance and, to discuss some steps of the procedure[23].

On the other hand, student's feedbacks are interesting. In the student's comments, the clerkship can evaluate the learning process during the course (formative grading). This information is fundamental for learning effectiveness improvement. The second aspect is that the faculty can receive data for fine adjustments in the learning process.

CONCLUSION

In conclusion, this manuscript reviewed validated methods to train basic abilities in surgery (Apparatus, instruments, hand hygiene, surgical hand washing, garment and gloves placement, surgical site preparation, antisepsis, venous access, arterial access, knots, and suture).

Formative assessment- the goal is to monitoring student's performance during learning process.

This assessment allows an immediate intervention to improve learning.

Summative exam- the goal is to evaluate the final performance.

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