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Hands on as Educational Process in Cardiovascular Surgery

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1. Introduction

Methods of the teaching-learning binomial in cardiovascular surgery has undergone major transformations in the last decade, moving from purely informational content models for environments that stimulate theoretical "know-how" by incorporating skills and competencies [1,2].

Conducting the training procedures on animal models offers the closest scenario to surgery in human beings; however, the completion of this kind of training requires the sacrifice of these animals culminating with great opposition by the animals' protection organizations as well as by the general population.

This traditional method has well known limitations such as the need for a broad framework for hosting, maintenance and preparation of these animals and their subsequent disposal; which besides of high costs also requires the involvement of many professionals for the correct execution of these tasks. Routinely, these facilities are available only in medical schools and usually with restricted access to their own undergraduate or graduate students.

The task of producing scientific knowledge and validate it through the current methods of evidence-based medicine belongs primarily to the universities, which through its institutes and research laboratories, are prepared for this important and crucial stage of development of medical science.

On the other hand, the medical specialty societies must be in charge for the task of training and retraining the graduates of these educational institutions who completed their residency

program or fellowship in thoracic and cardiovascular surgery in order to maintain excellence in their daily practice [3, 4].

In the cognitive domain, the transmission and retention of the essential theoretical knowledge are required and of paramount importance for the judgment and proper handling of each patient.

That part has been widely covered by many mini-courses offered at numerous conferences in many different areas of the specialty, and also through continuing medical education programs carried out by schools and educational institutes created and maintained by the specialty societies and supported by pharmaceutical companies for equipments and instruments in cardiovascular surgery [5, 6].

Simply we could synthesize that surgeons should be prepared not only to know how to say, but essentially how do.

Currently, patients want safer treatments that offer greater efficiency with lower potential risks, less pain and faster recovery to their existential and work activities.

The rapid changes occurring in our specialty with the advent of new procedures with greater potential to contemplate the desires and needs described above, and also the dispute of these new treatment methods among professionals in other related areas, become them imperative to broaden the opportunities for qualification of our surgeons [7].

It seems increasingly clear that these new therapies will not be subject to appropriation of a particular specialty, but, of those professionals who are able to perform them with greater competence, i.e., for those getting better results and enabling to resolve their complications [8].

The formation of Heart Team has immense potential to reduce conflicts of opinion, democratize decisions and benefit patients, but our effective participation in it, still dependent on our skills in the practice of therapeutic acts with competence necessary to continue providing the best results.

The congresses of our specialty has been modified each year to discuss the incorporation of these new technologies by presenting the results of numerous studies well designed and well conducted on searching to validate, to disseminate and to extend their use in the daily practice [9].

Watch an operation, usually a complex case or a new procedure, performed at distance in a specialized center and broadcasted to an audience of the event, offers to the participating surgeons an opportunity to interact with the team that performs the surgery and to learn from them some useful surgical aspects; however, this do not endow observers in developing new skills. Additionally, this format has limitations, including legal matters. The surgical team responsible for the operation is subjected to a stress level above the usual. They cannot repeat tactical maneuvers ever performed by the imperative need to continue the operation. Steps or details which were not clear, even if well explained, cannot be repeated. The operation needs to have its normal course and the patient must not be subjected to additional risks, such as stopping at each step of the procedure to allow controversial debates and opinions.

The traditional video sessions, in which procedures can have their technical details presented and discussed, allowing for pauses or repetitions when necessary, are very instructive in providing opportunities for learning technical and tactical details without putting pressure on the surgical team and not subjecting patients to additional risks. This mode helps to understand how to overcome the difficulties in their implementation and the new ways of executing it. Although it is a very useful and attractive format, it does not provide new psychomotor skills for those attending this activity [10].

Therefore, these creative and innovative ways of transmitting knowledge, as described above, do not directly involve the community of observers in surgical procedures fields. The observer surgeons can even assimilate the steps and various tactical maneuvers essential to the operation; however, these do not give them the ability to implement it.

The annual scientific meetings of the various societies of thoracic and cardiovascular surgery worldwide gather at the same time surgeons with extensive experience and some even honored pioneers in surgical techniques with surgeons in the early learning phase and others with several years of experience in the labor market.

These moments are a unique opportunity for a desirable interaction, in that the more experienced ones can help to qualify this critical mass of professionals eager to learn new knowledge, but also willing to incorporate special technical skills as a basic support for their professional performances.

The Hands-On is a different strategy of teaching and learning because it allows interaction between the Expert (surgeon with recognized expertise and competence) with surgeons in different learning curve phases such as residents, junior surgeons or even those with several years of established surgical practice [11].

It differs from other teaching activities once the trainees are directly involved in the whole procedure by "using their hands". The trainee is incentivized to exercise the observation of all steps of the operation, to perform tactical movements and actions ordered in a logical sequence or may be, to incorporate new skills. All this is happening without urgency of time; and above all, under a qualified, enthusiastic and committed guidance and supervision of an Expert [12].

At the same time that it promotes teaching, it allows for both correction and evaluation of performance inducing satisfaction on trainees by creating a the pleasant sense of mastery of new skills or consolidation of the previous ones that now could be executed with a more refined technique [13].

These new skills will be definitely incorporated by salutary practice of exhaustive repetition that will make them automated. Once after its final registration in the brain centers that integrate knowledge with motor skills, it will emerge automatically when requested, completing the cycle: see-search-understand-perform].

2. Purpose

This strategy of teaching-learning is designed to offer live training on surgical techniques in simulators for the participants of the congresses of the specialty under the supervision of an experienced surgeon (EXPERT).

Primary objectives

- To enjoy the experience of experts attending the event;
- To consolidate technical skills in new procedures;
- To master the technical details in inserting new orthotics and prosthetics devices;
- To obtain efficacy in the performance of a specific procedure, avoiding technical flaws that compromise the short and late-term results;
- To incorporate into the surgeons' daily practice these new skills to benefit their patients.

Secondary objectives

- To extrapolate the knowledge acquired at the event on his/her way to work.
- To recognize which of these therapies will impact on their current and future practice.
- To become familiar with the new devices launched by the industry and with their proper use in patients.
- The Hands-On is very important to participants because constitutes a unique opportunity to watch an experienced and renowned expert to demonstrate step by step details of a particular surgical technique, and at the same time enable them to do it soon afterwards under the supervision of that expert.
- The main benefits for those who participate on the Hands-On are: the acquisition of special skills for the precise execution of new techniques and for those techniques already established as effective, which includes all details for executing them with greater security, and also the knowledge for proper use of new prostheses, surgical tools and suturing threads.

So, after this kind of experience, surgeons return to their workplace with greater knowledge and confidence to run more efficiently their surgical practice in those newly learned specific topics, thus directly benefiting their patients by reducing the risks of these procedures and increasing their safety.

In the last decade we have observed a growing supply of this type of teaching modality in large international congresses. In Brazil Andrade et al in 1993 [14], showed for the first time at an international symposium in Sao Paulo the "Laboratory of Cardiac Surgery", where renowned surgeons performed operations in a simulator located in a glass walls operating room mounted on the amphitheater of the convention center.

The operation was filmed and the images transmitted to a screen displayed in the same amphitheater, allowing interactivity between the surgical team and the participants of the

session. This lab was kept been used for 3 subsequent years in National Congress of the Brazilian Society of Cardiovascular Surgery; however, due to its laborious logistics and high cost it was subsequently discontinued.

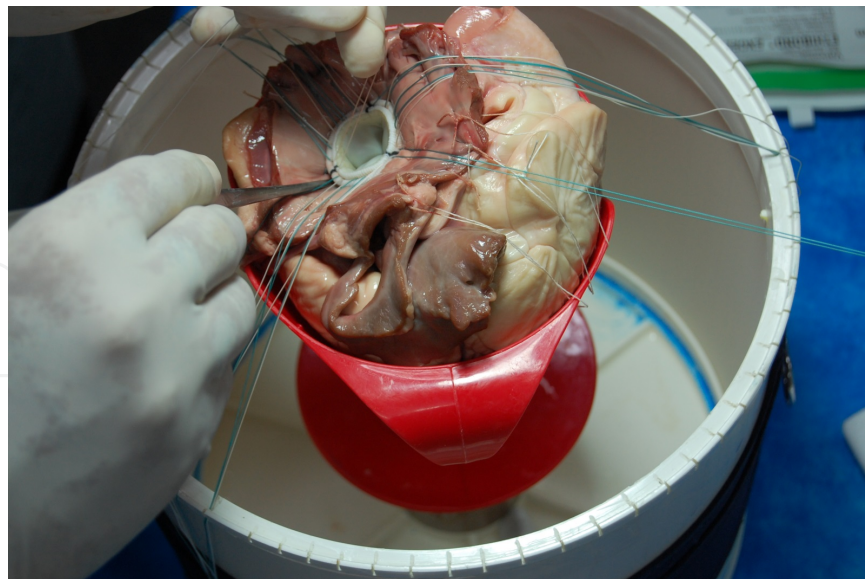
In 1986, as a preceptor for medical residency in thoracic and cardiovascular surgery at the Hospital of the Federal University of Rio Grande do Sul in Brazil, we have built a simple simulator, consisting of a wooden shaped-box with an internal structure large enough to fit a porcine or a bovine heart in anatomical position in order to provide a training scenario for the residents in mitral valve surgery.

This model have being used for many years to train several generations of surgeons, whose report thereof, after several years of practice in specialty, convinced us that this was a good and useful strategy with high potential to reduce the learning curve [12].

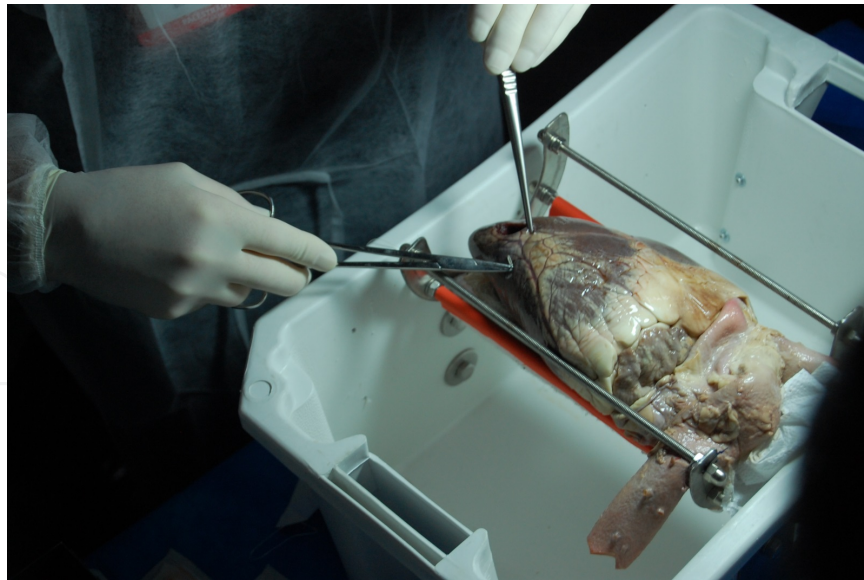
From this experience, we have designed and developed prototype simulators for valve surgery, coronary artery bypass grafting, correction of atrial fibrillation, cardiac transplantation, repair of congenital heart diseases and for minimally invasive video-assisted cardiac operations named these prototypes as "Professor Barbosa Cardiovascular Simulators".

We have developed three basic models for different purposes but of interchangeable use, characterizing them as low, medium and high fidelity.

In the low-fidelity model the heart not lies in the anatomic position and the area of the intervention is widely exposed facilitating the visualization and manipulation of anatomical structures and the performance of all steps of the procedure without imposing great hardship (Figs. 1).



The Medium-fidelity model provides an intermediate degree of difficulty; while in the high-fidelity model the heart is anatomically positioned as well as the structure to be approached on the intervention, mimicking a normal surgical field and offering the same level of difficulty of an intervention on a patient (Figs. 2 and 3).



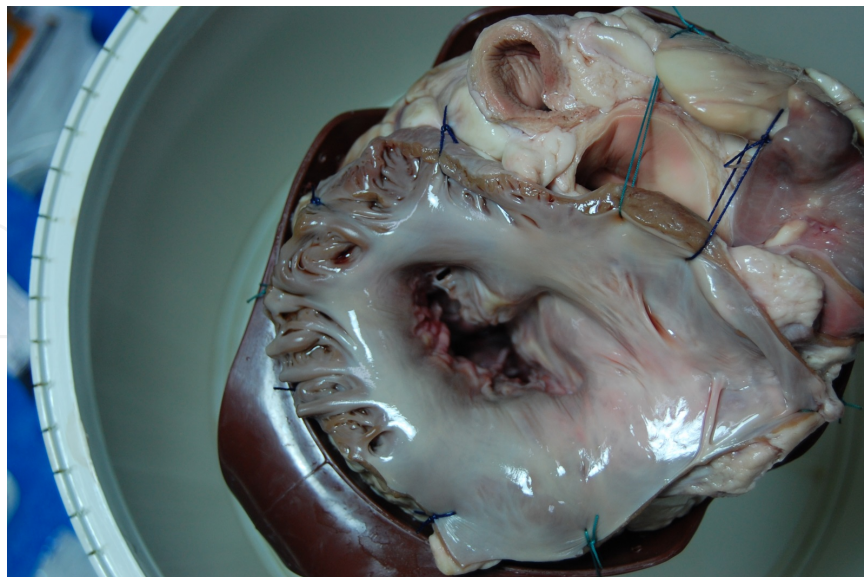
3. General basic features of the simulators

These devices are intended to facilitate the development of specific skills necessary for effective performance in cardiovascular operations, minimizing the required time in the process of learning curve.

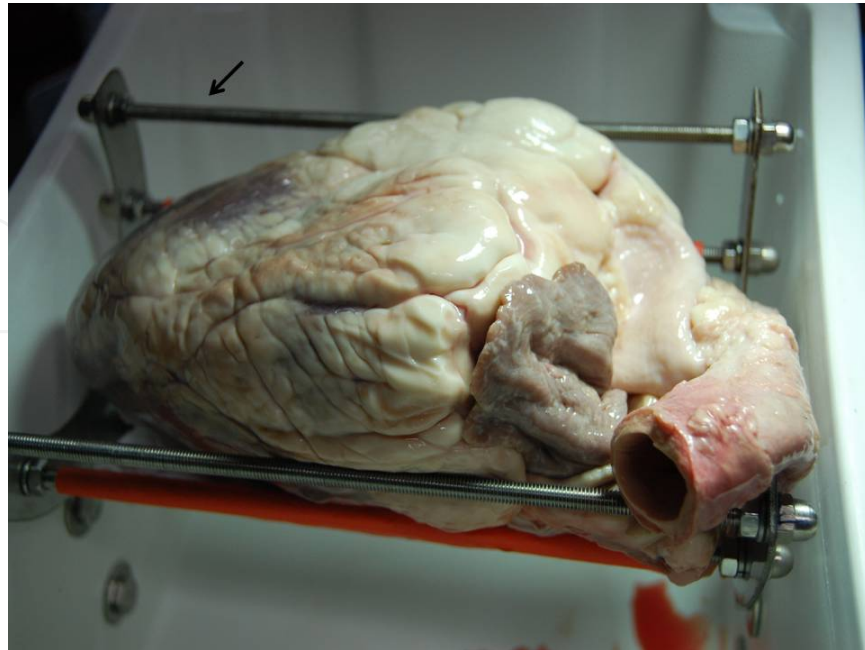
It also favors individual or group training on established techniques or new techniques and enables the performance and relationship of a team in systematizing routine procedures or new procedures.

The models have some main constructional features such as the use of lightweight, durable and easy to clean materials making their installation and portability easy, so they can be transported and used in several environments.

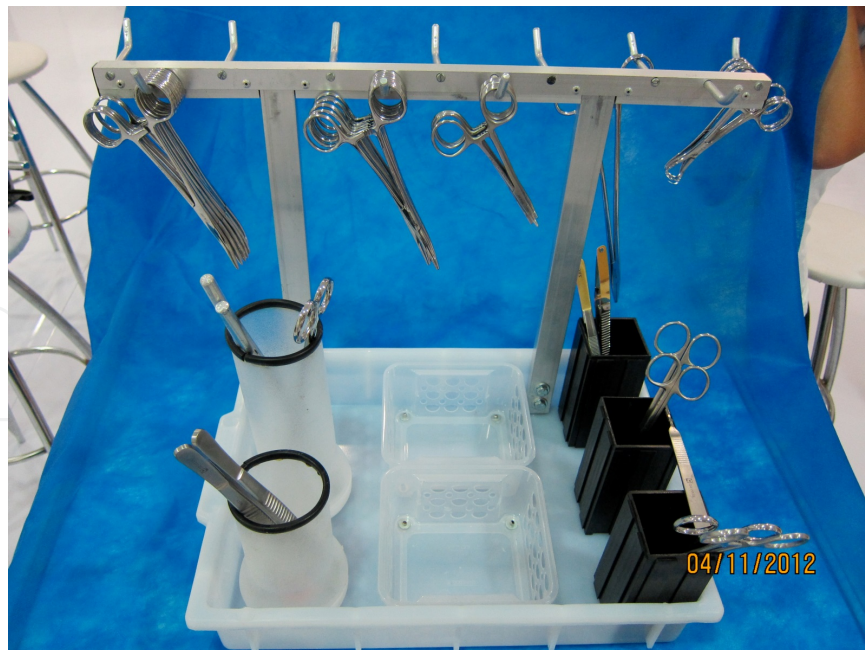
The models can harbor either porcine or bovine cardiopulmonary blocs or plastic and polymeric anatomical pieces. The cardiopulmonary blocs are obtained from slaughter houses for human consumption, avoiding the traditional sacrifice of other species in laboratories of experimental surgery (Figs.4 and 5).



Another advantage of the simulator is that its central part is mobile and deployable allowing that the anatomical structure could to be installed and stored in a freezer getting ready for later use (Figs. 6).



We have also developed an auxiliary unit for orderly displaying the surgical instruments and other materials necessary to perform the operation (Fig. 7).



Despite the simplicity of these simulators they have proven effectiveness for their intended purposes, since they can mimic the needs and difficulties experienced during surgery in humans.

As it was necessary to test them more broadly, we have decided to try them during major events to evaluate its effectiveness and gather feedback information from both trainees and experts in order to improve its characteristics.

In the last three annual meetings of the Brazilian Society of Cardiovascular Surgery (2010, 2011, 2012) we have resumed the Hands-On sessions as a priority activity by offering a large volume of sessions and of attendance positions [15, 16, 17].

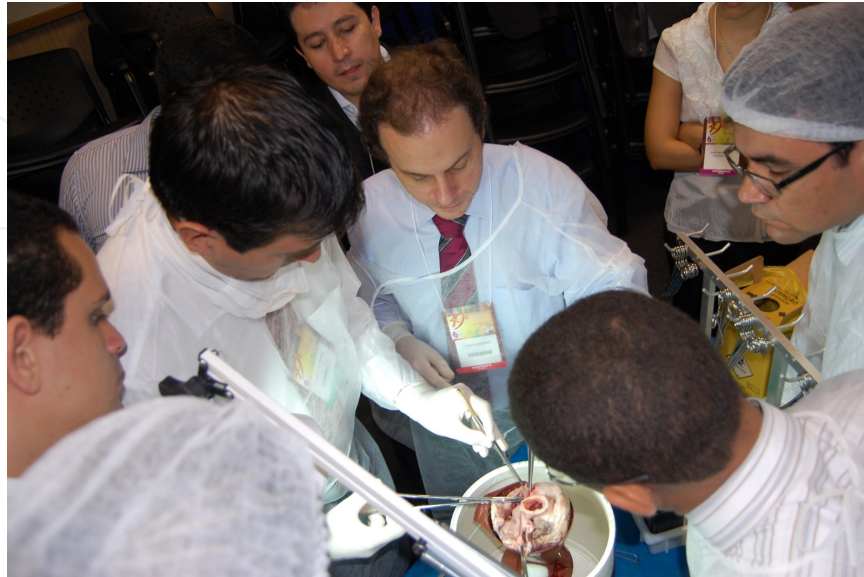
The use of simulators during these events enabled us to evaluate them and to make changes suggested by the users and also by those derived of our attentive observation serving as the basis for the development of third and fourth generation of prototypes with clear improvement of their performances.

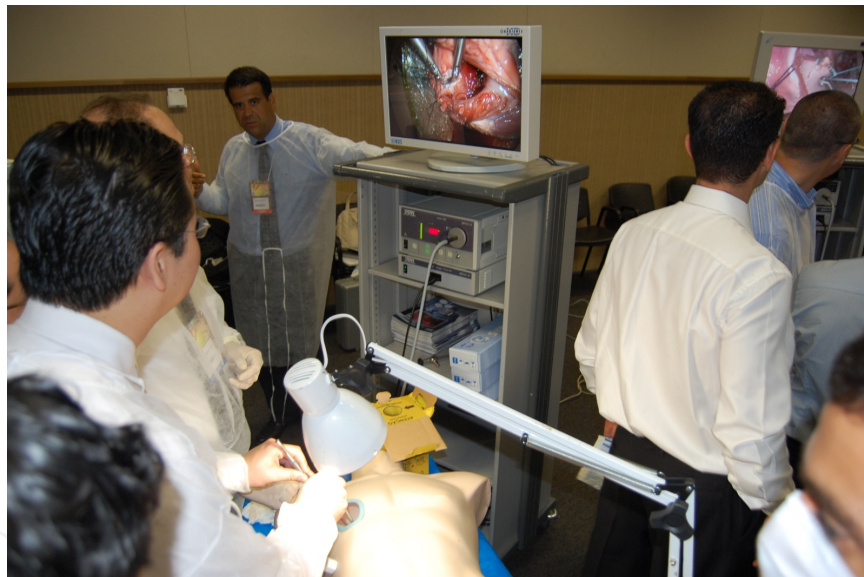
The planning of this activity starts one year prior the meeting and needs a local and national working force so that all details can be planned and discussed with the scientific and executive committee of the congress.

The selection of operations to be inserted on the modules of the Hands-On sessions takes into account their proven efficacy but with still low adoption rates among surgeons, and also new procedures restricted to few centers but in frank expansion in the surgical community worldwide.

As examples we can quote: mitral and tricuspid valvuloplasty, repair of atrial fibrillation, the Ross procedure, and the video-assisted minimally invasive and endovascular procedures and others (Figs. 8, 9, 10, 11 and 12).







4. Infrastructure facilities and staff

4.1. Room for the setting up the simulators and for the preparation of the anatomical specimens

This room must have minimum dimension of 100 m² of area with enough space to house all equipments, materials and working teams, which must also possess an adequate air conditioning system.

Besides of an adequate lighting, the room should have many points of electricity outlets distributed along their walls to connect the equipment and to facilitate the plugging of extension cables, which allow for the installation of lights on the individual working stations.

Equipments:

- Four upright freezers with glass front door with a minimum capacity of 600 liters each, equipped with thermostat and adjustable divisions for storage and maintenance of the anatomical specimens at adequate temperatures. In these freezers it will also be stored anatomical parts already assembled and cataloged on the simulators for prompt use in each session. The progressive thawing and maintenance at optimal temperatures aims to maintain the viability and flexibility of tissues;
- Workbench with 2 to 3 tanks with an independent water supply for washing the anatomical specimens, surgical instruments and other materials;
- A cylinder of compressed air equipped with a valve system to assist in drying the surgical instruments and other materials;
- An ultrasound washing system for the surgical instruments;
- Three tables with dimensions of approximately 1.0 x 4.0 x 0.80 meters (width x length x height) for the preparation of anatomical specimens and for the insertion and fixation of them on the mobile parts of the simulators. One of this table is intended to set up the instrumentation units for displaying surgical instruments, sutures, surgical towels and other materials;
- Chairs with high-backed seats in adequate numbers to accommodate all members of the working teams and the surgeons responsible for the preparation of anatomical specimens and simulators;
- Five tables located along the walls of the room, with approximate dimensions described above, for receiving the packed boxes containing all materials including: simulators, instrumentation units, surgical instruments, light bulbs, gowns, gloves, sutures, prostheses and other inputs. In this site materials are unpacked and distributed to the desktops;
- Containers for disposal of biological materials, organic waste baskets and disposable items basket.

5. Work team

The SBCCV (Brazilian Society of Cardiovascular Surgery) has a permanent National Committee composed by three (Full Members) cardiovascular surgeons that are responsible for the whole organization and improvement of this activity. This committee elects the procedures to be performed and the experts who will present the techniques to the surgeons during the training. This program is submitted to SBCCV Scientific Board for approval.

Local Committee: composed by one coordinator and at least five members (cardiovascular surgeons) from the state in which the Congress will be realized. This committee is responsible for the selection and storage of the anatomic specimens, according to National Committee rules.

Support Staff: composed by residents in cardiovascular surgery and invited cardiovascular surgeons. This group is responsible for preparing the anatomic specimens to be used in the simulators.

Technical Staff: composed by one nurse (or scrub-nurse) and at least three assistants with experience on operation rooms. This staff is responsible for the cleaning and storage of surgical instruments in the Hands-on Preparation Room, preparation of the work stations, disposal of the used anatomic specimens, cleaning of the Hands-on room.

Administration Staff: one secretary responsible for the Hands-on Preparation Room, the surgical instruments, equipments, communication and coordination of the technical staff.

These professionals must work specifically in the Hands-on Program and are coordinated by the National Committee. (Fig. 13)



6. Hands-on logistics

The Hands-on Room must support 4 or 5 “work stations”, corresponding to a dimension between 70 and 80 m². The room must be preferentially rectangular (for instance: 8 X 10 meters), because this configuration allows the free circulation of the participants, technical staff and organizers. The room must have an auxiliary table (for instance: 0.6 X 1.5 meters) to organize the material in use during the procedures (Figs. 14).

The Hands-on Room must have Multimedia Equipment (Computer, Projection, Microphones) for the presentation of the procedures by the “experts” (Figs. 15, 16 and 17).





The “Gold Standard” Hands-on is that composed by 4 or 5 rooms, each one with 4 or 5 “work-stations”, working simultaneously.

6.1. “Work- stations”

The “work-station” consists in a table with dimensions of 1.2 X 0.6 X 0.8 (length X width X height) meters. The surgical instruments, the simulators with the surgical specimens and all the materials are disposed on these tables (Fig. 18).



The Expert presents the surgical techniques in the simulators to 3 surgeons, previously registered in the hands-on activity, who will assist the expert first. After the presentation of the surgical technique, these surgeons will perform the procedure with the expert orientation. To repeat the procedure, the technical staff must only remove the central part of the simulator, which contains the surgical specimen, and replace it for another one previously prepared in the “preparation room” (Figs. 19 and 20).





To perform Endovascular or Minimally Invasive Procedures, there must be a larger room, in order to place all the materials used in these procedures.

6.2. Operational steps

1st Step: Registration

The Registration must be preferentially on-line, before the meeting. The Organizing Committee must allow on-site registration only for the remaining places.

The registered participants must receive the information material with the instructions for the Hands-on activity previously.

2nd Step: Room access

There must be a receptionist in each Hands-on room, in order to check the inscriptions and locate the participants in the corresponding “work-station”.

3rd Step: Surgical Technique Presentation

The Expert exposes the surgical technique in a short presentation (between 7 and 10 minutes).

4th Step: Hands-on

The Expert presents the surgical techniques in the simulators assisted by the participants. After the presentation of the surgical technique, these surgeons will perform the procedure with the expert orientation.

5th Step: Cleaning

After the procedures, the technical and support (residents) staff removes the surgical specimens, waste material (gloves, sutures, etc) and prepares the simulators for the next session. This step takes between 10 and 15 minutes.

6th Step: Surgical Instruments and Simulators Removal

After the last session of the day, the technical and support staff removes all the surgical instruments and simulators in order to clean it. The room must also be cleaned for the next day.

7th Step: Preparation of the next day Hands-on

After cleaning the room and the instruments, the “work-stations” must be prepared again for the next day activities.

The National Committee and the Local Committee must check all these steps, in order to perform the Hands-on activity on schedule.

6.3. Experience of the Brazilian Society of Cardiovascular Surgery (SBCCV)

In the last 3 SBCCV Congresses, the Hands-on activity was in evidence. It was carried out during 2 days, with 4 sessions a day, each session composed by 3 different wet labs, performing 24 wet labs each Congress. The wet labs have a duration time of 2 hours and each one included 4 work- stations, performing 288 work-stations during the Congress period [15, 16, 17].

Attendees in the Hands-on activities were 864 participants. From these, 62% were previously registered on-line in the Congress website. 288 expert surgeons were invited by the National Committee and the Scientific Board during these activities, many of them international guests (Figs. 21 and 22) and others are national guests (Figs. 23, 24 and 25).







Including the participants, 1152 cardiovascular surgeons were included in the Hands-on activities, what represents the greatest number of surgeons that performed Hands-on activities in International Congresses, according to the present literature (Figs. 26 and 27).



The evaluation forms reported by 76% of the participants, showed a massive approval of this activity in our Congress.

The SBCCV and their 9 Regional Societies performs Hands-on activities in their Regional Congresses and Meetings all over Brazil during the last decade.

In conclusion, we think that these Hands-on activities must be available in all the events of our specialty, once this method of “watching-doing”, offers the opportunity of training new

technologies and new surgical techniques, and also that these activities must be coordinated by an efficient Committee. The routine implementation of this strategy by each cardiovascular team in their workplace, become a potential tool to reduce the learning curve and increasing the patients safety.

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