Role of Simulators in Surgical Education

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Summary

Technical progress in surgical training and ethical issues are expected to replace traditional methods of residents learning surgery by apprenticeship in the operating room in a stressful atmosphere. With the development of Minimal Access Surgery (MAS) the surgical approach has changed totally, and curriculum-based, hands-on training is gaining importance in learning these new skills. Economic factors and ethical issues of learning basic skills on patients and animal models are driving progressive replacement with clinically closer simulators. There is scope for medical colleges and simulator manufacturers to work together to develop scientific simulators and discourage the use of animals for the acquisition of basic skills in surgery. This process can be accelerated only by incorporating simulator-based training modules in the curriculum of medical education. This change in curriculum can motivate the medical community to look for alternatives to animal use by accepting the 3R principles.

Keywords: Minimal Access Surgery (MAS), simulator, simulation, 3R principle, skill training, technique, procedure, Beetle Videoscopic Endo Trainer

More than a hundred years of surgical residency training programmes have used the operating room to teach basic surgical skills to residents. However, considering the accelerating changes in our health care system, this strategy may no longer be feasible. Several forces are making it difficult for the operating room to be the predominant venue for acquiring technical skills. There is tremendous pressure on our surgeons to be more efficient and competent in the operating room due to increasing financial constraints within our teaching institutes, which results in a lack of time, even in the operating room. Ethical issues concerning teaching or learning basic surgical skills on patients or using animal models are restricting the learning process.

Every skill involving life-threatening actions, such as aircraft navigation, marine operations, battlefield training and also surgery on a patient, requires simulations for learning. Simulation demonstrates physical, technical, biological, psychological or economical processes or systems using a mathematical or physical model. A simulator is a device used especially in training to reproduce the conditions of the working situation, enabling tasks to be learned and practiced safely and economically to build safety and a predictable outcome.

Simulator-based surgical training overcomes all these problems and enables learners to practice the tasks in a stress-free atmosphere outside the operating theatre, similar to the airline industry where pilots learn flying techniques on flight simulators. If we carry out the process of mapping surgery, we can divide the events into two separate parts i.e. surgical technique and surgical procedure.

Surgical technique is the proficiency and refinement of a particular skill which can be put into practice while conducting a surgical procedure, e.g. making a tissue incision, dissecting a tissue or suturing in depth. This can be learnt very well on a scientifically designed and validated simulator, and we need not use animal tissue or take the life of an innocent animal. In case of conducting a surgical procedure, for example removing a pathology or reconstructing a vital organ, we need to use knowledge and wisdom to select an appropriate training model. Learning on simulators helps to collapse the learning curve and also helps to convert inherent skills into tricks in case of emergency.

Economic and social factors are driving...
the change towards new forms of medical education and methods. There is a skill and technique component, which must be transmitted along with a knowledge component. The adoption of new technology and advanced surgical techniques is slow in medical education and is usually constrained by budgets and the needs of the teachers. Adoption spreads from one department to another, encouraged by the enthusiasm of students and teachers. For example, although the animal model used to be considered a requirement for acquiring basic skills in laparoscopic surgery, advances in simulator development have replaced such kinds of training models slowly, by applying 3R principles such as replacement, reduction and refinement. The change has not just happened overnight, but people who care for animal life have promoted such simulators aggressively by convincing the surgical community of the convenience and power of these learning tools. It is interesting to know that extensive use of animal models has never been reported in the past while learning open surgery.

Medical college teachers are the most valuable community who can encourage the development of clinically closer simulators to avoid or replace animal use in surgical training. It is a need of the time that such clinically closer and scientifically validated simulators should become part of the medical education curriculum. The medical universities should declare scholarships for inventing simulators to propagate 3R principles as part of education and cultural development. The simulator manufacturing industry and medical colleges should work together closely to develop scientifically validated simulators to transfer the techniques learnt in the operating room.

The medical device and pharmaceutical industry should also actively encourage and support simulator-manufacturing companies to develop innovative and cost-effective simulators as an alternative to animal models. This will help the surgical as well as medical community to use and adopt new technology products much faster in this competitive world and extend the benefit to patients more safely.

As the technology is changing rapidly, the learning process needs to be made much simpler, faster, more economical and safer. Therefore innovations in the computer simulation or simple simulators should be used extensively in medical colleges. This will definitely bring down costs and the use of animal models while improving the quality of learning and teaching in the dry labs.

With the advances in the development of optics, Minimal Access Surgery (MAS) has given a new direction to surgical science, which requires new surgical approaches and techniques. This is a great challenge for senior as well as young surgeons. When performing MAS, the surgeon needs to adapt from the 3-dimensional approach of open surgery to the 2-dimensional magnified view of the internal organs, which needs to be tackled acquiring depth perceptions. To acquire these new challenging techniques, the surgeon has to undergo extensive training to develop the required hand-eye coordination. Such skills can only be learnt on clinically close, scientifically developed simulators, e.g. the very cost-effective and clinically close Beetle Videoscopic Endo Trainer (Fig. 1). It is to be emphasised that to learn basic techniques in MAS, use of animal models is not at all necessary, and the surgeon can acquire such skills by defining the task while converting it into an exercise which can be memorable.

### References


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**Fig. 1: This Beetle Videoscopic Endo Trainer (design patented) has been developed by Ulhas S. Gadgil.**

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**Table 1: Comparison of learning models**

<table>
<thead>
<tr>
<th></th>
<th>Inanimate</th>
<th>Animate</th>
<th>Cadaver</th>
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