Self-taught surgery using simulation technology

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Behnoosh graduated from UNSW in 2010 and is currently working as an Intern at Hornsby Hospital, Sydney. Her elective experience fuelled her passion for surgery, particularly fostering an interest in laparoscopic upper gastrointestinal surgery. Behnoosh hopes to specialise in this area but also has interests outside of medicine, which she hopes to continue during her busy work years. She dabbles in the fine arts, languages and soccer.

During my elective term in early 2010 at the Royal Free Hospital, London, I was presented with a fantastic opportunity: to learn how to perform a laparoscopic gastric bypass procedure. The challenge was for myself, a medical student and complete novice in laparoscopic surgery, to use the hospital's state-of-the-art screen-based simulation technology to become proficient in a specific operation within six weeks in this rapidly advancing area of surgery.

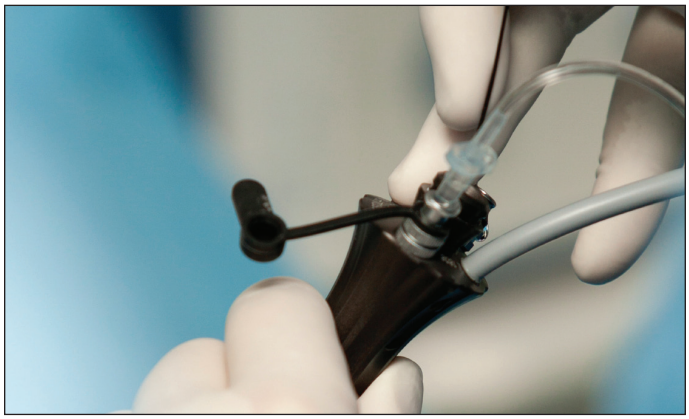
My training was to be undertaken using the Simbionix LAP Mentor (Simbionix, Cleveland, Ohio, USA): an advanced piece of technology made up of a computer with simulation software and accompanying hardware, consisting of ports and instruments. The difference between this and a video game is the presence of haptic feedback; when you hit something or pull it, you feel the corresponding tension, making it a highly realistic representation of surgery.

The training schedule consisted of successive steps to gradually build the skills and knowledge required for the real operation. I was to dedicate time every day for training on the simulator, in addition to background research. I was supervised by the head of the simulation centre Dr. Pasquale Berlingieri, a laparoscopic gynaecological surgeon, and my elective supervisor, Mr. Zak Rahman, a laparoscopic hepato-pancreatico-biliary surgeon.

The first step was to complete the "basic tasks" module on the simulator, which was aimed at training my hand-eye coordination, depth perception and an awareness of three-dimensional space on a two-dimensional screen. This was done by familiarising me with the instruments, as well as specific manoeuvres used in laparoscopic surgery, such as two-handed tasks of grasping and clipping or cutting.

The second step was to complete and achieve an accepted standard of proficiency (as measured by the simulator) in the "laparoscopic cholecystectomy" module. It consisted of three tasks that comprised almost all of the operation but with increasing complexity and difficulty levels: "exposure of cystic duct and artery," "separation of the gall-bladder from the liver pad" and "procedural task" which involves clipping and cutting the cystic duct to separate the gallbladder completely. Laparoscopic cholecystectomy is a relatively simple operation compared to a gastric bypass. It is also a procedure I had previously studied and seen many times. It would essentially serve as an introduction to imitating real operations on the simulator and to practice the application of the basic skills learnt in the previous module.

Concurrently, I studied the theory behind performing a laparoscopic gastric bypass procedure using primarily web-casts from sources such as YouTube© (YouTube, LLC) [1-3] and ORLive© (ORLive, Inc.). [4] I broke the operation down into steps that I could understand and described the most common techniques, that is, the proximal Roux-en-Y, as well as subtle variations, thereby developing my own preferences for techniques – just like a real surgeon. I familiarised myself with the laparoscopic instruments used, as well as their advantages and disadvantages, thereby developing my own preferences for tools – just like a real surgeon. For example, I preferred to use a linear stapler, which seemed easier to operate, as opposed to a circular stapler, and therefore the corresponding technique of performing the bypass procedure. I also observed Mr. Sufi and Mr. Rahman perform the real procedure at the Whittington Hospital to fully understand the procedure and to have my unresolved questions answered.



The third step was to commence the "laparoscopic gastric bypass" module. This involved adapting my knowledge and understanding of the procedure to the steps described in the module, which were slightly different, as well as any limitations of the simulator. This module consisted of four tasks that essentially covered the bypass procedure broken down into the four fundamental stages of the operation: creating the gastric pouch, dividing the jejunum, the jejuno-jejunostomy and the jejuno-gastrostomy.

The final step of the training schedule was to advance the simulation of the operation by simulating the environment in which the operation takes place, that is, the operating theatre. I performed the operation on the simulator with people watching me, talking and noise in the background, dressed in scrubs and wearing gloves.

I advanced on to the successive module by the end of each week, and confirmed what Dr. Berlingieri already suspected: the new generation of medical students have the ability to learn such skills quickly; not just because of our youth, but because we have grown up in an age of rapid technological advancement and therefore can adapt to new technologies quickly. I believe the aptitude for this type of problem-based learning and self-direction through the use of emerging technologies and the internet is common to all medical students today. See for yourself: my simulated operations can be seen on YouTube on the channel 'ScreenBased' (http://www.youtube.com/user/ScreenBased).

Early training of medical students in surgery using screen-based simulations presents many immediate advantages: it offers a way for the student to acquire the skills and knowledge of a particular procedure without setting foot in the operating theatres. This gives the student confidence and the aptitude to participate in the surgery and build surgical experience with minimal risk to patients. Screen-based simulations also afford the opportunity to observe and understand anatomy, complications of surgery, and limitations of the procedure. In addition, surgeons themselves can be reassured that the student is well-versed in the steps of the procedure.

But is it practical? The technology is still very new and there are still many limitations to its implementation. A single virtual reality laparoscopic surgery trainer costs around AUD$140,000. The expense of the machine, insurance, maintenance and warranties are hard to afford. Furthermore, the machines are still being fine-tuned and new programmes are constantly being developed. The current programmes

are limited in methods and materials. For example, there's no option to place 'stay-sutures' to fix the position of the bowel for jejuno-jejunostomy.

There are still some technical 'glitches' in the hardware and the software, such as pixel-errors, that need to be addressed. The program itself is quite temperamental and regularly freezes. The hardware (instruments in particular) are extremely delicate and any slight mishandling can result in hundreds of dollars worth of damage.

Obviously there is no way to programme for the vast amount of patient-specific variations encountered in real operations. It therefore stands to reason that the technology, despite its advanced nature, cannot properly equip a trainee to adapt to these complications, which is essential for the safety of the operation.

Nonetheless, though the knowledge and experience gained from the simulator is superficial, I believe it still provides an excellent platform from which to launch into the many years required for real surgical training. Personally, I found the most successful aspect of the simulator was not in the technical skills or knowledge gained, but the passion for surgery that it nurtured. It is feasible, therefore, to suggest that in the very near future, a programme of "self-directed learning" via the simulators can be integrated into the surgical rotations of medical students or junior doctors and even registrars in hospitals and medical schools.

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Conflict of interest

None declared.

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