



Instruments and Techniques

Development and Use of a Restructured Animal Tissue Model for Training in Laparoscopic Salpingostomy and Salpingectomy

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ABSTRACT Ectopic pregnancy is commonly managed via either laparoscopic salpingostomy or salpingectomy. However, there is a proficiency gain curve in mastering these 2 surgical procedures, and an effective simulated model is essential for training students of gynecology. The objective of this study was to develop and evaluate a restructured animal tissue model that can be used in the surgical training of gynecologists in laparoscopic salpingostomy and salpingectomy. Since 2005, a hands-on laparoscopic training course for gynecologic students has been developed and conducted at the Cuschieri Skills Centre, University of Dundee. A restructured animal tissue model of ectopic pregnancy was developed and used for practicing laparoscopic salpingostomy and salpingectomy. At the end of each course, data were collected using a standardized anonymous questionnaire using a Likert scale (1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; and 5 = strongly agree). Feedback on the ectopic pregnancy model from course participants was obtained insofar as the realism of the anatomical condition of the model, quality of the tissue and organ color, quality of organ consistency, and operative tactile properties during dissection. Over the last 6 years, from June 2005 to September 2010, 96 gynecologic trainees have practiced using this phantom. The mean (SD) overall satisfaction rate for the training phantom for laparoscopic salpingostomy and salpingectomy was 4.9 (0.1) on a scale of 1 (unrealistic/poor) to 5 (very realistic/useful). Compared with real operating conditions, quality assessment of the model for anatomical condition was 4.9 (0.2), for quality of tissue and organ color was 4.9 (0.4), for organ consistency was 4.8 (0.3), and for operative tactility was 4.8 (0.6). It was concluded that the restructured animal tissue model of laparoscopic salpingostomy and salpingectomy in ectopic pregnancy is realistic, cost-effective, and simple enough to be produced for use in laboratory-based surgical training courses. Journal of Minimally Invasive Gynecology (2011) 18, 785–791 © 2011 AAGL. All rights reserved.

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Ectopic pregnancy is still a major cause of death in the first trimester of pregnancy, and is responsible for 9% of all maternal deaths in the United States [1]. Most such pregnancies are implanted in the fallopian tube. Laparoscopy is

usually performed to confirm the presence or absence of an ectopic pregnancy. Surgery with either salpingostomy or salpingectomy is an established and effective management for this condition [2]. Clear advantages of laparoscopy over laparotomy for undertaking salpingostomy and salpingectomy include less intraoperative blood loss, shorter hospital stay, lower cost, less analgesic requirement, and fewer postoperative adhesions [3–5].

Despite these advantages, laparoscopic surgery entails visual and mechanical constraints that result in a relatively long proficiency gain curve and require training in both laparoscopic skills acquisition and repeated rehearsal of the steps involved in the surgical procedures [6]. Training using

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simulations and simulators can improve laparoscopic skills that subsequently can be transferred to surgical performance in the operating room [7–12]. Synthetic models, virtual reality simulators, animal tissue models, and lightly embalmed cadavers have been the most common approaches used for laparoscopic skills training in gynaecology [7,12–16].

Many training courses have been developed that focus on acquisition and training in generic laparoscopic skills, which are then universally applied across all surgical specialties. The teaching used in these courses, therefore, lack any focussed training in specific operative procedures [10–12]. This may be due to the difficulty in simulating a tubal ectopic pregnancy either in a live animal model or a human cadaver [16]. There are number of issues to be considered when designing a suitable training model for this procedure. The model should be as realistic as possible, to simulate the anatomy and pathologic condition involved in the procedure. It must also be cost-effective to produce, reproducible, and simple enough to be mass produced for use by trainers in abdominal laparoscopy in laboratory-based surgical training centers.

Since 2005, we have developed and used a simulated tubal ectopic pregnancy model made from a combination of restructured animal tissue and synthetic material to train gynecologic trainees in laparoscopic salpingostomy and salpingectomy. The present study describes the design of such a training phantom that enables trainees to practice the key skills and steps used in these 2 laparoscopic procedures.

Materials and Methods

Course Location and Setup

The Cuschieri Skills Center (formally Surgical Skills Centre), University of Dundee, is a multidisciplinary center for research and training in surgical skills. It is an enhanced custom-built facility with laparoscopic surgery, interventional human anatomy, virtual reality simulations, microsurgery, and a state-of-the-art simulated operating environment combined to produce one of the most innovative research and training facilities in Europe. In addition, the center is situated in a university teaching hospital, in which the course delegates are also able to attend live surgical demonstrations.

The teaching and research cover training that is predominantly, but not exclusively, in endoscopic surgery. Training is focused on intensive rehearsal of practical skills and individual steps for surgical procedures used in clinical practice. Individual performance is confidentially assessed, and constructive feedback is provided to the trainees one-to-one or in group discussion.

Program and Delivery of the Course

Since 2005, in close collaboration with the Royal College of Obstetricians and Gynaecologists in the United Kingdom, a course for gynecologic laparoscopic training has been developed. The course consists of didactic and practical

sessions with emphasis on hands-on practice using simulated models in a well-established training laboratory. The teaching faculty is drawn from a pool of senior consultant gynecologists expert in laparoscopic surgery with national and international reputations. The ratio of course participants to tutors is ensured at 4:1. The maximum number of delegates for each course is 20. The course is held over 2 days, and is divided into 2 major teaching modules.

Module 1 consists of rehearsal and acquisition of essential laparoscopic skills such as familiarity with the laparoscopic camera system, video monitor, insufflator and light source, laparoscopic portal access techniques (closed and open), pneumoperitoneum insufflation using carbon dioxide, camera orientation exercise, generic ergonomics in minimal-access surgery, tissue dissection and approximation techniques, tissue looping with pre-formed endoloops, hemostasis, and dissection using electrosurgical and other energized laparoscopic devices and techniques for tissue extraction. All of these skills are taught and practiced on the first day of the course.

Module 2 is a didactic session on the management of ectopic pregnancy that includes the theoretical knowledge on the pathophysiology of the disorder, diagnosis, indications and contraindications for the various treatment options, principles of preoperative and postoperative care, and prevention and management of surgical complications. This is followed by a video demonstration of the laparoscopic procedures.

Module 3 introduces the ectopic pregnancy model and essential steps in laparoscopic salpingostomy and salpingectomy, and is conducted by the tutor before the practical. Each participant has the opportunity to perform both a laparoscopic salpingostomy and salpingectomy using a model mounted inside a standard laparoscopic trainer. There is no time limit for participants to complete these exercises. Close supervision is provided by the training faculty during the course, and immediate feedback and guidance are provided. Modules 2 and 3 are provided on the second day of the course.

Design and Preparation of Ectopic Pregnancy Model

Porcine liver and red food dye are blended in a hand blender and used to simulate the trophoblastic tissue inside the fallopian tube. Both the liver mush and some larger chunks of the same tissue obtained during the blending process are used for preparation of the training model.

Porcine small bowel is prepared and cut into 15-cm segments with the mesentery still attached, simulating the fallopian tube. The small bowel is then sewn at a point 6 cm from one end (point A in Fig. 1) using a standard surgical suture. It is important to keep the mesentery intact to simulate the mesosalpinx (Fig. 2). Any excess red dye is drained from the liver mush. The dyed liver mush and chunks are then placed in the smaller end of the intestine (Fig. 2; arrow in Fig. 1) using a large curette or small teaspoon. The liver mush and chunks are pushed down to the tied off section

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