Original Article

The value of laparoscopic skills courses

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Objectives: To evaluate the effectiveness of 'hands-on' laparoscopic skills course.

Methods: A prospective observational study conducted between May 2005 and June 2006. All gynaecologists who attended 'hands-on' laparoscopic skills course held over a five-day period were assessed initially and at the end of the intensive course. Subjective assessment involved each attendee self-scoring their own knowledge in laparoscopy in different fields; this was done using visual analog scoring (VAS). Objective assessment was done through multiple choice questions (MCQs) and motor skill tasks. The difference between the performances of each of the candidates at pre- and post-course periods was evaluated using the Wilcoxon signed rank test. *P*-values < 0.05 represented statistical significance.

Setting: Centre for Advanced Reproductive Endosurgery (CARE), Royal North Shore Hospital, University of Sydney, Sydney, Australia.

Results: Twenty-four consecutive gynaecologists have been enrolled in the study – 14 were specialists and ten were obstetrics and gynaecology trainees. Mean age was 44.4 years (range 35–58 years). Pre- and post-course subjective assessment measuring VAS improved significantly for all variables. Objective measurements of pre- and post-course mean MCQ results also improved significantly from 71% to 84.5%, respectively (*P*-value < 0.0001). There was dramatic improvement in the performing of motor skills in the dry laboratory.

Conclusions: Laparoscopic skills workshops can improve both knowledge base and motor skills. Such courses result in a short-term measurable improvement. Future studies should focus on assessing the impact of such 'hands-on' courses to see if these skills are transferred to the operating room.

Key words: knowledge, laparoscopic, skills, surgery, training.

Background

The acquisition of laparoscopic skills represents an essential component in most training programs in gynaecology. Hands-on training courses have the potential to facilitate intensive training in laparoscopy. It has been demonstrated that attending intensive short courses can improve both knowledge and skills in evidence-based medicine.[1] Training on simulators can recreate operative conditions and offers the possibility of training outside the operating room. The skills acquired can be effectively transferred to the operating room thus enhance operative performance.[2–4] However, curriculums may vary considerably, and no consensus exists as to what type of training is appropriate and how much training is necessary.[5] The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) expects fellows to demonstrate competence in core laparoscopic procedures like diagnostic laparoscopy, salpingectomy and ovarian cystectomy.

The aim of this study was to evaluate the effectiveness of an advanced laparoscopic skills course combining formal teaching with 'hands-on' sessions at the simulator.

Method and design

This was a prospective observational study conducted between May 2005 and June 2006 at the Centre for Advanced Reproductive Endo-surgery (CARE), Royal North Shore Hospital, University of Sydney, Sydney, Australia. The Institutional Review Board approval was sought and granted by the Northern Clinical School, University of Sydney, Royal North Shore Hospital, for all the dry laboratory and animal laboratory sessions.

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The course was scheduled over five days and structured as a combination of six didactic lectures (30 min each), interactive and practical hands-on the dry laboratory and the sheep laboratory sessions. The practical component included two sessions, each lasting four hours in the dry laboratory to practise motor skills, and two sessions, each lasting four hours in the sheep laboratory to practise operative skills. The candidates were also exposed to five live operating sessions, each lasting four hours. Each delegate underwent an assessment on day 1 before the beginning of the intensive program and again on day 5 at the end of the program.

The assessment aimed to evaluate both the knowledge and the surgical performance of the participants. The knowledge component included a subjective scoring of their own personal knowledge in the following eight fields: anatomy of pelvis and anterior abdominal wall, electrosurgery, harmonic scalpel, physiological effects of laparoscopy and general anaesthesia, entry techniques, complications and management of laparoscopic surgery, knowledge in extra- and intracorporeal knot tying, and team importance.

Each participant was asked to give him/herself a visual analog scoring (VAS) from 0 to 10 in each of the aforementioned subjects. A score of 0–2 is defined as no knowledge, 2–4 as knowledge below the average, 4–6 as an average knowledge, 6–8 as knowledge above the average and 8–10 as perfect knowledge.

Background knowledge was then objectively evaluated using a multiple choice questionnaire (MCQ) administered by the course director in a paper-based format which had to be completed in 30 min. The questionnaire consisted of 96 questions on the same eight fields mentioned above. A score was given expressed in percentage of correct answers. The MCQs were assessed by an independent rater. The MCQs had been previously evaluated and accredited by the RANZCOG in accordance with the national Continuing Professional Development program.

Surgical performance was evaluated using the laparoscopic simulator. Each participant was asked to perform each of the following motor skill tasks:

- Picking of peas from a pod using grasping forceps with their dominant hand
- Picking of peas from a pod using grasping forceps alternating left and right hands
- Using an endo-loop to simulate a salpingectomy in the 'dry-lab'

Surgical performance was expressed by number of peas picked in 30 seconds and the time (in seconds) needed to close the endo-loop knot.

The difference between the performance of each candidate before and after the course was evaluated using the Wilcoxon signed rank test. *P*-values < 0.05 represented statistical significance.

Results

A total of 24 gynaecologists of varying experience attended the laparoscopic skills course.

Overall mean age of participants was 44.4 years (range 35–58 years). More than half of them ($n = 14$) were Caucasian residing in Australia. Fourteen were specialists with a median of seven years (range 1–25) of practice in obstetrics and gynaecology; the rest were trainees in obstetrics and gynaecology, with a median of five years (range 3–7) of practice.

The most advanced procedures performed 'with confidence' by the delegates included: laparoscopic-assisted vaginal hysterectomy (three of 24), ovarian cystectomy (six of 24), salpingectomy (nine of 24) and tubal ligation (six of 24). The mean number of laparoscopies done per month was ten (range 3–48) for the specialist group and six (3–14) for the trainee group.

At the baseline subjective assessment, participants scored themselves as having an excellent appreciation of team importance, with a median score of 84.5%. This score significantly improved in the post-course evaluation, achieving a median of 98% ($P = 0.0002$). Pre-course knowledge in anatomy of pelvis and anterior abdominal wall, electrosurgery and entry techniques resulted in median subjective scores of 49%, 40% and 57.5%, respectively. This represents average knowledge. These scores significantly improved in the post-course assessment to 70%, 73% and 81.5%, respectively ($P = 0.0002$, $P < 0.0001$, $P < 0.0001$, respectively).

The participants graded themselves as having knowledge below the average in the physiological effects of laparoscopy and general anaesthesia and complications and management of laparoscopic surgery with median scores of 37% and 37.5%, respectively. The post-course scores improved significantly to 72% and 65%, respectively. This represents knowledge above the average.

At the baseline subjective assessment, the worst median scores (poor knowledge) were in harmonic scalpel knowledge and knowledge in extra- and intracorporeal knot tying (13.5%, 8.5% and 5%, respectively). These scores had improved dramatically to 75%, 74% and 62.5%, respectively, in the post-course assessment ($P < 0.0001$, $P < 0.0001$, $P < 0.0001$, respectively) (see Table 1).

The objective assessment (MCQ) of knowledge had a median pre-course score of 71% (above average knowledge) which significantly improved to 84.5% (excellent knowledge) after the course ($P < 0.0001$).

Regarding the assessment of surgical performance there was no significant change in the median number of peas placed in the pod in 30 seconds using the dominant hand before and after the course (4.1 and 4.9, respectively, $P = 0.0757$). However, the median number of peas placed in the pod in 30 seconds alternating the left and right hands significantly improved after the course (3.3 and 4.3, $P = 0.0015$). There was a dramatic improvement in the median time needed to close a single laparoscopic endo-loop knot (simulating laparoscopic salpingectomy) in the dry laboratory (128.7 vs 67.5 seconds after the course, $P < 0.0001$) as well (see Table 2).

Table 3 presents the trend that the trainees benefited most when compared to specialists in most of the components of the course; however, these differences were not significant.

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Table 1 Overall pre- and post-course performance of each candidate in subjective evaluation

	Pre-course		Post-course		Difference	
Variable	Median	Range	Median	Range	Median	95% CI
Anatomy knowledge	49	22–88	70	8–100	19.5	12.1–26.9
Entry technique knowledge	57.5	32–76	81.5	62–100	26	21.8–30.2
Electrosurgical knowledge	40	23–88	73	50–100	34	24.5–43.5
Harmonic scalpel knowledge	13.5	0–56	75	40–100	62.5	52.5–72.6
Anaesthesia knowledge	37	14–80	72	50–100	34	24.0–44.1
Injuries knowledge	37.5	6–80	65	0–100	27.5	15.9–39.1
Extracorporeal knot tying skills	8.5	0–80	74	0–100	57.5	45.3–69.7
Intracorporeal knot tying skills	5	0–40	62.5	14–91	48.5	38.5–58.6
Team importance	84.5	28–100	98	78–100	7	−0.9–14.9

Table 2 Overall pre- and post-course objective scoring of the candidates in multiple choice questionnaire (MCQ) testing and motor skills

	Pre-course		Post-course		Difference	
Variable	Median	Range	Median	Range	Median	95% CI
MCQ (%)	71	55–85	84.5	73–95	12	7.8–16.2
Peas in pod dominant†	4.1	1–8	4.9	2–9	0	−1.1–1.1
Peas in pod left/right†	3.3	1–6	4.3	3–9	1	−0.1–2.1
Endo-loop task (seconds)	128.7	61–297	67.5	8–233	−59.5	−80.7–38.4

†Number of peas in the pod was recorded over 30 seconds.
CI, confidence interval.

Table 3 Trainees' versus specialists' performance in all the components

Variable	Median difference in trainees' performance	Median difference in specialists' performance	Theta† (95% CI)
MCQ	**12.5**	9	0.66 (0.43–0.83)
Anatomy knowledge	**26**	17.5	0.64 (0.41–0.82)
Entry technique knowledge	25.5	**26**	0.65 (0.42–0.82)
Electrosurgical knowledge	**37.5**	29	0.60 (0.37–0.79)
Harmonic scalpel knowledge	**63**	61.5	0.55 (0.33–0.75)
Anaesthesia	**37**	26.5	0.64 (0.41–0.82)
Injuries	**34**	15	0.65 (0.41–0.82)
Extracorporeal knots	**62**	51	0.70 (0.46–0.86)
Intracorporeal knots	**50.5**	41	0.65 (0.42–0.82)
Team importance	**8**	3	0.65 (0.42–0.82)
Peas dominant hand	**0.5**	0	0.54 (0.32–0.74)
Peas left/right alternating	0.5	**1.5**	0.66 (0.43–0.83)
Endo-loop time (second)	**−61.5**	−53	0.51 (0.30–0.72)

†Non-parametric effect size measurement, minimum is 0.50 (no difference in scores), maximum is 1 (perfect separation). Theta gives information on how much the improvement differs for trainees and consultants while taking into account the precourse result.
If theta = 0.50, there is no difference. If theta = 1 then all cases in one group have a higher relative improvement score than any case in the other group (i.e. perfect separation). Bold values indicate the best results, showing the trend that trainees benefitted more than specialists.
CI, confidence interval; MCQ, multiple choice questionnaire.

Discussion

This is the first longitudinal study to attempt to prospectively validate a 'hands-on' laparoscopic skills course. The results of this study demonstrate that such intensive courses can be beneficial to both trainees and qualified specialists. This appears to be the case for both acquisitions of knowledge as well as laparoscopic skills.

Rates of skill acquisition vary widely, hence in this study a comparison between baseline and final laparoscopic skills and knowledge acquired were evaluated. The two most common teaching programs used in training are one-day long sessions called 'massed practice' and the other involves multiple short practice sessions called 'interval practice'. Multiple studies have demonstrated that interval practice consistently shows more improvement than massed practice in learning a new skill.[6] This previously published study highlighted the potential benefits of an 'interval practice' teaching program. In that study, continuous improvement and evaluation of acquired skills was achieved. The course presented in our paper is a massed practice teaching program.

In one study that was conducted to quantify the learning curve of a previously validated laparoscopic skills curriculum, the subjects who performed poorly at baseline had a greater opportunity to improve than did subjects who did well on initial assessment.[6,9] The authors concluded that inexperienced subjects benefit the most from skills training. Our study supports these findings as the trainees benefited more compared to the specialists. The demonstrated improvement, although not significant, seen in the trainees may also be attributable to the group being younger and as a result they may be able to learn manual dexterity skills more quickly (see Table 3).

This 'hands-on' laparoscopic course follows the template proposed by Gallagher *et al.*[6] They proposed a template to develop a curriculum that includes the following in sequence: didactic teaching of relevant knowledge (anatomy, pathology, physiology), instruction on the steps of the procedure, defining and illustrating common errors, test of all previous didactic information to ensure understanding of all the skills before going to the technical part of training and to be able to determine when they make an error, technical skills training on the simulator, provide immediate feedback when an error occurs, provide summative feedback at the completion of a trial, and repeat the skills training while providing evidence at the end of each trial regarding the trainee progress (the learning curve). It provides a stepwise fashion of all components published in the literature.[6]

In our study, there was an overall low score in the pre-course baseline variables which included subjective assessment of knowledge, objective MCQs and hands-on laparoscopic motor skills, independent of the participant's level of experience or his/her laparoscopic surgical experience. All variables significantly improved when tested on the final day of the course, with the exception of putting peas in a pod using the dominant hand. This can be explained by the fact that the dominant hand has to do the same task every time repeatedly which is not considered to be a new skill. By comparison, the skill of learning to alternate between the dominant and non-dominant hands (peas in a pod) did indeed significantly improve over the course of the week. We believe that such short courses can improve the acquisition of both knowledge and motor skills.

This study has exposed the limitations of this 'hands-on' laparoscopic skills course. Such questions like 'What is the optimal duration of such courses?', 'How many times should a participant repeat each task to optimise their performance?', and 'Can these skills can be transferred to the live operating theatre?' remain unanswered. Previous studies have, however, demonstrated significant improvement if the task was repeated more than ten times. Scott *et al.* recommended that each task be practised for at least 30–35 repetitions for maximal benefit.[7] It has also been shown that such repetitions can significantly shorten the time required for each task.[7,8] Other studies have shown significant improvement after four to five of training.[9,10] Such data are not available from the current study.

Conclusions

Laparoscopic skills workshops can improve both knowledge base and motor skills. Our results highlight the importance of attending 'hands-on' laparoscopic skills workshops. Such courses result in a short-term measurable improvement in both the trainees and the qualified specialists. The improvement demonstrated by the two groups was not significantly different. The learning curve needs several steps and each is essential towards achieving improvement. The limitation of our study is the lack of long-term follow-up data and therefore we do not know if such courses impact positively on the laparoscopic operating skills of the delegates. More studies are needed to determine whether the skills acquired in an interval practice program can be adequately transferred to the operating theatre. This also will ensure that such 'hands-on' laparoscopic skills courses are indeed worth attending and in turn potentially improve live laparoscopic operating skills.

References

1 Fritsche L, Greenhalgh T, Falck-Ytter Y, Neumayer H-H, Kunz R. Do short courses in evidence based medicine improve knowledge and skills? Validation of Berlin questionnaire and before and after study of courses in evidence based medicine. *BMJ* 2002; **325**: 1338–1341.
2 Daniel JS, Patricia CB, Robert VR *et al.* Laparoscopic training on bench models: Better and more cost effective than operating room experience? *J Am Coll Surg* 2000; **191**: 272–283.
3 Olivier T, Matthew TG, Cheryl AN *et al.* The impact of intense laparoscopic skills training on the operative performance of urology residents. *J Urol* 2001; **166**: 1658–1661.
4 Dimitrios S, James RK, William Black F *et al.* Psychomotor testing predicts rate of skill acquisition for proficiency-based laparoscopic skills training. *Surgery* 2006; **140**: 252–262.
5 Daniel JS, William NY, Seifu TT *et al.* Laparoscopic skills training. *Am J Surg* 2001; **182**: 137–142.
6 Gallagher AG, Ritter EM, Champion H *et al.* Virtual reality simulation for the operating room: Proficiency-based training as a paradigm shift in surgical skills training. *Ann Surg* 2005; **241**: 364–372.
7 Rosser JC, Rosser LE, Salvalgi RS. Skill acquisition and assessment for laparoscopic surgery. *Arch Surg* 1997; **132**: 200–204.
8 Rosser JC, Rosser LE, Savalgi RS. Objective evaluation of a laparoscopic surgical skill program for residents and senior surgeons. *Arch Surg* 1998; **133**: 657–661.
9 Melvin WS, Johnson JA, Ellison EC. Laparoscopic skills enhancement. *Am J Surg* 1996; **172**: 377–379.
10 Shapiro SJ, Paz-Partlow M, Davkhovsky L, Gordon LA. The use of a modular skills center for the maintenance of laparoscopic skills. *Surg Endosc* 1996; **10**: 816–819.

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