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Telementoring as an adjunct to training and competence-based assessment in laparoscopic cholecystectomy

J. P. Byrne, M. M. Mughal

Department of General Surgery, Chorley and South Ribble NHS Trust, Preston Road, Chorley, Lancashire, PR7 1PP England

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Abstract
Background: We set out to assess telementoring as a training adjunct and an objective means of assessing competence in laparoscopic cholecystectomy (LC).
Methods: Consecutive patients underwent LC performed by a higher surgical trainee (HST). The laparoscopic image was relayed to an adjoining theater, where the trainer observed as he operated during a parallel operating list. Interaction occurred between trainer and trainee as appropriate; and interaction, procedure difficulty, and duration were recorded.
Results: LC was accomplished in 33 of 34 patients, with one (2.9%) open conversion and one (2.9%) postoperative bile collection. In 21 cases (69%), there was no interaction; in 11 cases (32.4%), there was verbal interaction; and in two cases (5.9%), the trainer scrubbed. Interaction rates for difficulty grades 1, 2, and 3 were 15% (2/13), 41.2% (7/17), and 50% (2/4), with median operating times of 35, 45, and 92 min, respectively.
Conclusions: Telementoring in LC is feasible, appears to be safe, and may generate objective assessment of a trainee's performance and progress. Evaluation of this technique in a cohart of trainees at different stages is now required.

Currently, there are many pressures on the traditional model of long apprenticeship for surgical training in the UK, with a reduction in overall clinical exposure and demands for ever increasing supervision of trainees. Clinical governance and the results of recent large scale audits [1] have led to a greater demand for direct consultant involvement and supervision of those cases traditionally left to the care of the (unsupervised) trainee [2]. Competence- rather than time-based assessment of trainees seems likely to be introduced, but there are as yet no reliable and robust techniques with which to make such an assessment [3, 5].

The ability to perform a procedure competently is made up of three components: (a) knowledge, (b) dexterity/manual skills, and (c) insight/judgment. Formal exams currently test knowledge, while skill workshops and virtual reality simulators can be used to teach and assess manual skills [5, 6]. It is the third of these competencies, insight/judgment, that is the most difficult to teach and assess objectively in a trainee. Traditionally, the trainee operates with the trainer at his or her side until competence is reached. It is difficult to assess progress with this model objectively because verbal and nonverbal cues between trainer and trainee undoubtedly influence the trainee's actions. Advances in telecommunication technologies have allowed the development of telementoring in surgery. Telementoring has been done successfully at a large physical distance (>1,000 ft) from the trainee [7] in the teaching of advanced surgical techniques, such as laparoscopic colon resections and antireflux surgery [8]. The performance of complex procedures by an experienced laparoscopic surgeon appears to be unaffected by the proximity of the supervising surgeon [9].

Telementoring with less experienced laparoscopic surgeons is also feasible [10], but this possibility has not yet been explored comprehensively. In particular, the use of telementoring for supervising surgeons in training has not been examined formally. A system of remote supervision from a short distance would permit observation and a more objective assessment of the progress of trainees, while still allowing the trainer to assist physically or even take over the case if necessary. Trainees most likely to benefit would be those who were competent to perform the constituent steps in an operation.

The aim of this study was to assess the safety and feasibility of telementoring in laparoscopic cholecystectomy and its utility as a training technique. The ultimate objective is to develop a means of permitting beneficial interactions in training and providing an objective measurement of surgical progress and competence.

Methods

Participants

Thirty-four consecutive patients scheduled for elective laparoscopic cholecystectomy under the care of one surgeon (M.M.M.) were enrolled. As

Correspondence to: M. M. Mughal

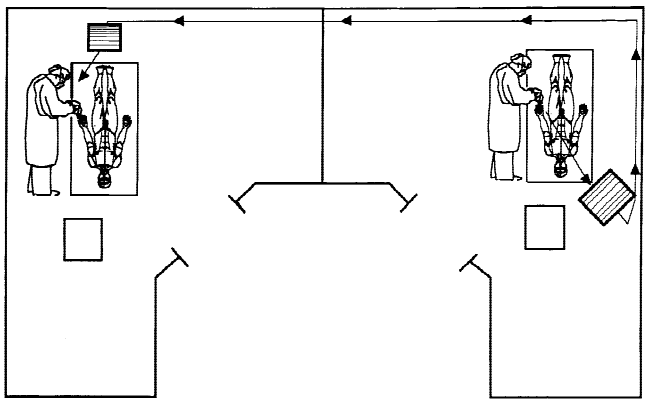

Fig. 1. Layout of operating theater and video link. The trainee operates as the image is relayed to the trainer in an adjacent theater via fixed co-axial cable.

part of the consent procedure, the patients met the operating surgeon before their operation and were informed that the operating surgeon would be supervised by M.M.M. Approval of the ethics committee was not sought for this study, since it had previously been customary for elective laparoscopic cholecystectomy under M.M.M. to be carried out by an experienced trainee, with a video link to the adjoining operating theater.

Procedures

A second/third-year higher surgical trainee (HST) was first trained to perform laparoscopic cholecystectomy competently with the trainer at his side acting initially as supervisor, then assistant. The HST then performed the operation with a junior assistant in 34 consecutive patients. Telementoring of these procedures took place while the trainer operated in an adjacent theatre (Fig. 1). The supervising surgeon observed the procedure on a monitor positioned in his line of sight, which relayed the laparoscopic view. The two monitors were linked using a co-axial cable installed between the two operating theaters via fixed wall-mounted sockets. Each case was graded for difficulty by the trainee according to the system used by Hanna et al. [4] (Fig. 2). There was a policy of selective operative cholangiography.

Interaction

Trainee and trainer could offer/request advice or physical assistance, and the trainer had options to (a) offer verbal advice, (b) scrub up and assist, or (c) take over the procedure. Both parties recorded their perceptions of procedure safety, demonstration of anatomy, and perceived difficulties with individual procedures.

Results

A total of 34 patients (six men and 28 women) with a median age of 50.3 years (range, 27–92) underwent laparoscopic cholecystectomy. In one patient (2.9%), the procedure was converted to an open operation because the gallbladder was densely adherent to liver, omentum, and abdominal wall. None of the patients underwent operative cholangiography. One patient developed a postoperative bile collection. This patient was well in the initial postoperative period and had been discharged home on the 2nd postoperative day but was readmitted after 7 days at home. Investigation confirmed this patient to have a large loculated bile collection due to a leak from the cystic duct, which subsequently required drainage at laparotomy. There were no other perioperative or follow-up complications.

Grade 1
No adhesions to gallbladder(GB), cystic duct seen on retraction of GB, no obvious anatomic anomaly, good view of Calot's triangle.

Grade 2
Obese patient, fat laden falciform, hypertrophied liver:quadrate lobe partially obstructing view. Areolar adhesions to GB, fat over Calot's.

Grade 3
Dense omental adhesions to GB, duodenal adhesion to GB, difficult/obscure/abnormal anatomy, contracted/inflamed/densely adherent GB, impacted stone in GB neck or Hartmann's pouch, GB neck adherent to bile duct.

Hanna, Shimi & Cuschieri, Lancet 1998

Fig. 2. Grading scale for difficulty of laparoscopic cholecystectomy.

Interventions

No intervention/interaction occurred in 23 cases (68%) (Fig. 3). In nine cases (26%), verbal advice was sought or proffered; and in two cases (6%), the supervising surgeon scrubbed up and took over the procedure. Trainee and trainer were equally likely to initiate an interaction. The trainee generally initiated interaction to inform the supervising surgeon that there was a difficulty of which the trainee was aware and to describe the plan of action to deal with the problem. The consultant initiated verbal interactions with technical advice to facilitate the dissection on three occasions and because of concern as to the progress of the dissection on two occasions. The trainer did not scrub up and assist in any cases. The trainer took over on two occasions from the trainee, once due to the pressure of time following division of the cystic duct during dissection and once because of persistent oozing in Calot's triangle during the dissection.

Difficulty and intervention

The median operating time was 40 min (range, 20–110). Both the duration of the procedure and the likelihood of interaction were clearly related to the difficulty of the procedure (Table 1, Fig. 4).

Trainer perception

Because the trainer was not assisting the trainee physically, he was able to observe how the trainee set about the dissection and how he got around the technical difficulties. He was therefore able to assess both technique and judgment. Over a period of time, the trainer also perceived a steady improvement in the trainee's operative technique. Telementoring was an efficient use of the trainer's time, in that he was able to supervise the trainee's without perceptible slowing of his own list. He was able to do this by choosing to observe the trainee at key stages and points. Having previously taught and assisted the trainee while standing at his side, he no longer routinely observed the creation of the pneumoperitoneum, the insertion of ports and instruments, or the detachment and extraction of the gallbladder unless he was asked to do so. Instead, he paused in the operation he was performing to observe the critical stages of the trainee's operation, such as the initial laparoscopic assessment, the application of instruments to gallbladder and associated structures, or the dissection and demonstration of anatomy.

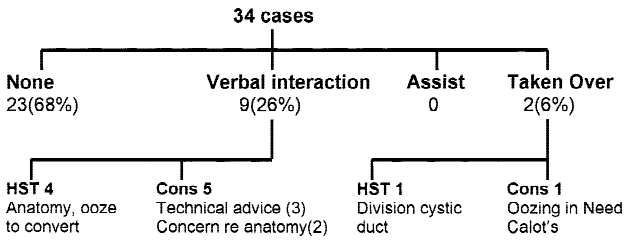

Fig. 3. Initiator and justification for interactions between trainee and supervisor in 34 laparoscopic cholecystectomy procedures.

Table 1. Median operating time and number of cases, both overall and by grade of difficulty

Trainee's assessment	Number of cases *n* (%)	Operating time median (range) (min)
Overall	34 (100)	40 (23–110)
Grade 1	13 (38.2)	35 (23–50)
Grade 2	17 (50)	45 (28–75)
Grade 3	4 (11.8)	92 (45–110)

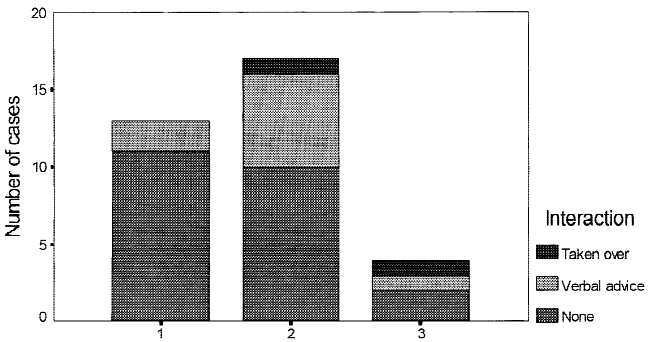

Fig. 4. Procedure difficulty, rate of interactions, and type of interaction between trainer and trainee using telementoring in 34 patients undergoing laparoscopic cholecystectomy.

He also observed the trainee's decision to pursue a particular course of action when confronted with a difficult or unusual situation.

Trainee's perception

Telementoring was viewed positively by the trainee, who felt that it allowed practice in the performance of laparoscopic cholecystectomy in a protected environment, which permitted development of confidence and skill.

Patients' perceptions

The patients' views regarding this study were not sought formally, but none of them objected to being operated on by a junior surgeon under the indirect supervision of a senior surgeon, and all of them were happy with their surgery.

Discussion

Telementoring has been used in 34 consecutive patients attending for laparoscopic cholecystectomy and was found to be feasible, safe, and useful. As a tool for training and continuous monitoring of a trainee's progress, telementoring has to be used across a short physical distance, ideally in adjacent operating theaters. It is of utmost importance that the patient should not be at risk because the supervising surgeon is unable to offer assistance quickly. Another proviso is that the supervising surgeon should have watched a number of complete procedures being performed by the trainee, so that he or she can make an assessment of the trainee's judgment, particularly the ability to anticipate difficulty. Thereafter, the onus is on the trainee to seek advice or assistance and on the supervisor to predict problems, so that he or she can either stop or redirect the trainee or go to assist the trainee.

It could be argued that a critical error takes a split second, and that unless the supervisor is watching the trainee's every move, the common bile duct could be divided or the hepatic artery transected while the supervisor is concentrating on his own operation. However, this situation can arise even when the supervising surgeon is standing by the trainee's side. The only way of avoiding it is to ensure that the trainee carefully dissects and identifies all the important structures before clipping and cutting. Telementoring in this context is therefore only suitable for an experienced trainee, who will benefit by having to make independent judgments about how to get around difficult situations with the safety net of having the supervising consultant available for advice or assistance next door.

We think that this type of telementoring, if it is used at an appropriate stage of training, could be an important step forward in defining the transition from competence under direct supervision to competence for the unsupervised performance of laparoscopic procedures. Further assessment in a cohort of trainees is required before this method can be recommended universally for laparoscopic cholecystectomy or other laparoscopic procedures.

References

1. Aitken RJ, Thompson MR, Smith JAE, Radcliffe AG, Stamatakis JD, Steele RJC (1999) Training in large bowel cancer surgery: observations from three prospective regional United Kingdom audits. Br Med J 318: 702–703
2. Collins C (1999) Surgical training, supervision, and service. Br Med J 318: 682–683
3. Darzi A, Smith S, Taffinder N (1999) Assessing operative skill: needs to be more objective. Br Med J 318: 887–888
4. Hanna GB, Shimi SM, Cuschieri A (1998) Randomised study of influence of two-dimensional versus three-dimensional imaging on performance of laparoscopic cholecystectomy. Lancet 351: 248–251
5. Hawasli A, Featherstone R, Lloyd L, Vorhees M (1996) Laparoscopic training in residency program. J Laparoendosc Surg 6(3): 171–4
6. Melvin WS, Johnson JA, Ellison EC (1996) Laparoscopic skills enhancement. Am J Surg 172: 377–379
7. Moore RG, Adams JB, Partin AW, Docimo SG, Kavoussi LR (1996) Telementoring of laparoscopic procedures: initial clinical experience. Surg Endosc 10: 107–110
8. Rosser JC, Wood M, Payne JH, Fullum TM, Lisehora GB, Rosser LE, Barcia PJ, Salvagi RS (1997) Telementoring: a practical option in surgical training. Surg Endosc 11: 852–855
9. Rosser Jr J, Wood M, Payne J, Fullum T, Lisehora G, Rosser L, Barcia PJ, Salvagi RS (1997) Telementoring: pushing the telemedicine envelope. J Assoc Academic Minority Physicians 8: 11–15
10. Schulam PG, Docimo SG, Saleh W, Breitenbach C, Moore RG, Kavoussi L (1997) Telesurgical mentoring: initial clinical experience. Surg Endosc 11: 1001–1005