Surg Endosc (2004) 18: 1805–1814
DOI: 10.1007/s00464-004-9011-x

SURGICAL ENDOSCOPY
and Other Interventional Techniques

Minimal-access surgery training in the Netherlands

A survey among residents-in-training for general surgery

M. P. Schijven,[1] J. T. M. Berlage,[2] J. J. Jakimowicz[2]

[1] Department of Surgery, Erasmus Medical Center, Dr. Molewaterplein 40, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands
[2] Department of Surgery, Catharina Hospital Eindhoven, Michelangelolaan 2, P.O. Box 1350, 5602 ZA Eindhoven, The Netherlands

Received: 17 January 2004/Accepted: 17 June 2004/Online publication: 28 October 2004

Abstract
Background: The purpose of this study was to assess the state of surgical training and its possible shortcomings in minimal-access surgery (MAS) among Dutch surgical residents.
Methods: A pretested questionnaire was distributed to all residents-in-training for general surgery in The Netherlands.
Results: The questionnaire was sent to 407 surgical residents. The response rate was 65%. Overall, 87.7% of all the responders were highly interested in the autonomous performance of laparoscopic surgery. Residents interested in gastrointestinal (GI) or oncologic surgery ($n = 137$) are significantly more interested than residents interested in non-GI/oncologic surgery. All the residents (100%) thought it was important to be able to perform the three basic MAS procedures (diagnostic laparoscopy, laparoscopic cholecystectomy, and laparoscopic appendectomy) autonomously at the end of their surgical training. Other MAS procedures were considered to be advanced procedures. Gastrointestinal/oncologic residents were most interested in performing advanced MAS procedures, although only 17.8% expected to be adequately prepared at the end of their surgical training. Most residents had the opportunity to attend MAS skills education. Irrespective of the format or training method, only 26.9% of residents stated their MAS skills training was objectively evaluated. The residents thought every surgical hospital department in the Netherlands should have a surgeon specialized in laparoscopic surgery (86.9%).
Conclusions: The current study showed that Dutch residents believe it is very important to perform basic MAS autonomously. Of the GI/oncologic–interested residents, the majority want to be able to perform advanced MAS, but expect to be unable to do so at the end of their training. They attribute this discrepancy to "not having enough chance to be the first operator" and to "lack of volume of procedures in the hospital." Specific and properly implemented, monitored, and evaluated MAS skills training programs in skills laboratory settings could offer a promising environment for overcoming this discrepancy.

Key words: Minimal access surgery (MAS) — Minimally invasive surgery (MIS) — Laparoscopy — Residents — Surgical education — Skills training — Skills laboratory

Numerous surgical procedures across a broad spectrum of clinical specialties have become adapted to minimal-access surgery (MAS). Probably the best example is laparoscopic cholecystectomy, currently the procedure of choice over its open counterpart. In MAS surgery, progress has been made regarding consensus in laparoscopic techniques and development of surgical equipment. Unfortunately, the same cannot be said for the current state of training in MAS procedures. Transfer of skills that builds on techniques learned performing open surgery is neither appropriate nor effective because the skills needed to perform MAS tend to be quite different [7]. Specific MAS skills training is thus a necessity for the adequate performance of MAS procedures. Studies have shown training in MAS in fact, to be inadequate [11, 14]. Different MAS training programs are likely to be necessary, depending on the skill or specific procedure to be trained, the resident's competence level, and the residents MAS interest. There is much controversy about the amount of training necessary (e.g., the learning curve associated with safe performance of advanced laparoscopic surgery for the individual surgeon) [16, 21]. However, there is consensus on the need for a national curriculum and for training guidelines [5, 14].

The first step to overcoming the aforementioned problems and creating accessible, tailored, validated,

Correspondence to: M. P. Schijven

and cost-effective skills training programs, is to inventory type and shortcomings of current MAS education. Therefore, it is important to quantify the interest and current format of education in MAS among surgical residents. Only then will it be possible to identify possible gaps between the factual and desired levels of MAS, and to address discrepancies properly.

This survey focuses on state of the art MAS training and its shortcomings in the Netherlands.

Materials and methods

Questionnaire

The questionnaire was adapted from a previously validated questionnaire developed by a Canadian research group [2]. Each resident-in-training for surgery in the Netherlands received an individually addressed package containing the questionnaire, an introductory letter, and a self-addressed, stamped return envelope. The questionnaire was distributed with approval of the Dutch Society for Endoscopic Surgery. An introductory letter, printed in the house style on posting paper of the Society accompanied the package. In this letter, the concept of anonymity for responders was stated. To maximize response ratings, a reminder package was sent to nonresponders 3 weeks after the initial posting date of the package. A second reminder by email was sent to nonresponders 6 weeks after the initial posting date of the package.

Scope of the questionnaire

The questionnaire (Fig. 1) addressed basic demographic issues, year of training, future perspective, presumed differentiation in surgery, interest in performance of laparoscopic surgery, current clinical laparoscopic training situation, and relevant MAS skills training issues. Basic and advanced laparoscopic procedures were selected as specified by the Society of American Gastrointestinal Endoscopic Surgeons (SAGES) because no Dutch consensus was available [19]. All procedures other than laparoscopic cholecystectomy, diagnostic laparoscopy, and laparoscopic appendectomy (the so-called ''core'' procedures) were considered to be advanced procedures [18].

Subjects

The package was sent to the cohort of Dutch residents-in-training for surgery, as specified in the particular section of Yearbook 2003 from the Dutch Society for Surgery. According to the Dutch surgical curriculum, these are residents in their first 4 years of general surgery, as well as residents in their fifth or sixth (last) year of surgical training, differentiating in a particular subspecialty of surgery. Surgeons, who have completed their formal training, but still are in training in the area of their differentiation or working as a fellow also were included.

Statistical analysis

Data were collected and analyzed using the Statistical Package for the Social Sciences (SpSS) version 9.0 (SpSS, Chicago, IL, USA).

Results

Demographics

The questionnaire was sent to 407 surgical residents. Of these residents, 31 were no longer in training for surgery nor working as a fellow, or did in fact not receive the questionnaire (sent back as undeliverable). These residents were considered as random dropouts. In all, 245 questionnaires were returned. The response rate therefore was 65%. The residents' average age was 32.4 years (range, 26–40 years) and followed a normal distribution curve. The respondent group was 67.6% male and 32.4% female. Whereas 40.7% worked in an academic hospital, 59.3% worked in a periphery teaching hospital. All eight surgical training regions were more or less equally represented (Fig. 2). Figure 3 shows the distribution according to year of training, and Fig. 4 the respondent's future career perspective.

In Fig. 5, the differentiation in a surgical subspecialty is depicted. The residents were split on the basis of their presumed differentiation into two groups: the nongastrointestinal (GI)/oncology –interested residents ($n = 98$) and the GI/oncology–interested residents ($n = 137$). This is because analysis showed that GI/oncologic–interested residents are more interested in MAS than non-GI/oncologic–interested residents (Mann–Whitney U test; $p = 0.001$). Figure 6 shows that more than twice as many females (55 vs 21) opt for a career in GI/oncology (Fisher's exact test, two-sided; $p = 0.002$); as compared with an evenly distributed the male population. According to t and chi-square statistics, there were no significant differences between the two groups in age distribution, region, academic/periphery hospital setting, year of training, or future career perspective.

Interest in autonomous performance of laparoscopic surgery

Overall, 87.7% of the responders were highly interested in the autonomous performance of laparoscopic surgery (score 4 or 5 on the Likert 5-point questioning scale). When clustered, the groups differed significantly in the extent of their interest (Fig. 7).

Skills laboratory for minimal access surgery

Most residents had the opportunity to attend MAS skills education (85.7%), and the majority in fact did so (82%). The 35 respondents who did not (yet?) have the opportunity, indicated it to be of high importance indeed (score 4 or 5, 88.9%). These 35 residents (13 who were not interested in GI/oncologic differentiation and 21 who were, with one undecided) did not differ in opinion concerning the importance of MAS training (Mann–Whitney U test; $p = 0.800$).

The residents who did attend MAS skills education most often received skills-box (organic and/or anorganic) training, and laboratory animal skills training (using anesthetized pigs). Remarkably, GI/oncologic–interested residents were exposed to virtual reality training curricula almost twice as often, and to a lesser extent to laboratory animal skills training (Fig. 8). The method, by which the MAS skills were taught varied from video training to hands-on procedural skills

Attachment 1: Questionnaire (*translated from Dutch format*)

Personal Characteristics

Age: _____(years)
Sex: M/F
Hospital: _____in _____(city)
Academic region-of-training:_____
Year of training: 1 / 2 / 3 / 4 / 5 / 6 / or 7 (=surgeon in advanced training or fellow)

Future Career Perspective

0 Plans to work in an academic medical centre, predominantly in a surgical specialty / subspecialty
0 Plans to work in a large periphery medical centre, predominantly in a surgical speciality / subspecialty
0 Plans to work in a large periphery medical centre, predominantly as a practitioner
0 Plans to work in a small (rural) periphery medical centre, predominantly as a practitioner
0 Undecided

Desired specialty / subspecialty:
0 vascular 0 trauma 0 gastrointestinal 0 pulmonary
0 children 0 oncology

Please indicate how interested you are in the autonomous performance of laparoscopic surgery, after becoming a qualified surgeon:
1 2 3 4 5
Not interested Very interested

Basic Skills Minimal Access Surgery (MAS)

1. Are you / have you been given the opportunity to attend a skills training course or education program for MAS?
0 yes, in 19__ in _____(location) -> go to question **1c**
0 yes, I have been given the opportunity but I did not attend due to_____ (please specify reason) -> go to question **2**
0 no -> go to question **1b**

1b. If not, on a scale of 1 to 5, encircle the number that best indicates how important you feel it is that MAS skills are being taught to you in a skills laboratory during your surgery training:
1 2 3 4 5
Not important Very important

1c. If yes, please answer the following questions:
- what kind of MAS skills will be / were taught to you? (multiple answers possible)
0 laparoscopic skills box (abdominal box model, abdominal mannequin, no organic substrate)
0 laparoscopic skills box with organic substrate (pig liver/ gallbladder, intestine etc)
0 virtual reality laparoscopic simulation model (i.e., MIST-VR, Xitact, LapSim)
0 live animal model (e.g. anaesthetized pig)
0 other, namely _____
0 do not know

-Are / were the MAS skills taught to you evaluated in an objective manner (standardized observation list, video, other method) ?
0 yes
0 no
0 do not know

-What kind of MAS skills instruction will be/ was given to you? (multiple answers possible)
0 observation of instruction videos of standard MAS procedures (laparoscopic cholecystectomy, Nissen fundoplication, laparoscopic hernia repair, laparoscopic appendectomy)
0 discussion about laparoscopic setup (stack, electronic gear, camera, insufflator, monitor, material and instruments)
0 basic MAS skills (navigation, pick-and-place, transfer, translocation, cutting, diathermy)
0 intracorporal suturing techniques
0 procedural MAS skills (e.g., clip-and-cut and dissection of Calot's triangle in gallbladder surgery)
0 other, namely_____

-On a scale of 1 to 5, please encircle the number that best indicates how important it is / was to you to acquire MAS skills in a skills laboratory setting, referring to your MAS skills in the actual operating theatre
1 2 3 4 5
Not important Very important

Fig. 1. Questionaire.

Basic Procedures for Minimal Access Surgery (MAS)

2. The following procedures are defined as basic laparoscopic procedures. Which of these do you expect to perform after becoming qualified surgeon?

	Performs autonomously	Would like to perform autonomously	Not interested
-Diagnostic laparoscopy	0	0	0
-Laparoscopic cholecystectomy	0	0	0
-Laparoscopic appendectomy	0	0	0

2a. Do you expect your current surgical training program to prepare you sufficiently for the autonomous performance of the afore mentioned basic laparoscopic procedures?
0 yes
0 no, because_____ (reason)

2b. Do you think it is a mandatory training obligation of the Surgical Society to offer you a validated skills training program for the afore mentioned basic laparoscopic procedures?
0 yes
0 no

2c. How important do you feel it is to be able to perform the afore mentioned basic laparoscopic procedures autonomously after becoming a qualified surgeon? (please circle)

1	2	3	4	5
Not important				Very important

Advanced Procedures for Minimal Access Surgery (MAS)

3. The following procedures are defined as advanced laparoscopic procedures. Which of these do you expect to perform, after becoming a qualified surgeon?

	Performs autonomously	Would like to perform autonomously	Not interested
-Nissen fundoplication	0	0	0
-Heller myotomy	0	0	0
-Gastric resection	0	0	0
-Gastro-jejunostomy	0	0	0
-Cyst-gastrostomy	0	0	0
-Bariatric surgery	0	0	0
-(partial) Hepatic resection	0	0	0
-CBD exploration	0	0	0
-Choledochojejunostomy	0	0	0
-Distal pancreatectomy	0	0	0
-Splenectomy	0	0	0
-Adrenalectomy	0	0	0
-Right hemicolectomy	0	0	0
-Sigmoid resection	0	0	0
-Rectal surgery	0	0	0
-Inguinal hernia repair	0	0	0
-Ventral hernia repair	0	0	0

3a. Do you expect your current surgical training program to prepare you sufficiently for the autonomous performance of the afore mentioned advanced laparoscopic procedures?
0 yes
0 no, because_____(reason)

3b. Do you think it is a mandatory training obligation of the Surgical Society to offer you a validated skills training program for the advanced laparoscopic procedures?
0 yes
0 no

Fig. 1. Continued.

training (Fig. 9). Irrespective of the format or the method by which the residents were trained, only 26.9% of the residents stated that their skills training program was, in fact, objectively evaluated.

The residents considered it important (76.1% scoring 4 or 5 on the 5-point scale of importance) to have the opportunity to acquire MAS skills in a skills laboratory to be prepared properly for the operating theatre. However, residents who did not attend MAS skills education did not feel inadequately prepared for performing basic MAS surgery (Fig. 10). Nevertheless, residents agreed about the importance of this (Mann–Whitney U test; $p = 0.702$).

Procedures in minimal access surgery

Three procedures were defined as basic laparoscopic procedures: diagnostic laparoscopy, laparoscopic cholecystectomy and laparoscopic appendectomy (Table 1). The groups did not differ in their expectation of performing these procedures autonomously after comple-

3c. In case you expect not to be skilled enough to perform afore mentioned advanced laparoscopic procedures after becoming a qualified surgeon, what do you feel is the cause? (multiple answers possible. Please indicate the strength of influence scaled 1 to 5)

	Not of much influence				Highly of influence
-Lack of interest of myself	1	2	3	4	5
-Lack of interest of my surgical educator(s)	1	2	3	4	5
-Lack of appropriate patients	1	2	3	4	5
-Not enough opportunity to be the first operating surgeon during procedures	1	2	3	4	5
-Not enough opportunity to assist surgeon during procedures	1	2	3	4	5
-Lack of theatre operating time to perform these procedures	1	2	3	4	5
-In my hospital, these procedures are not performed	1	2	3	4	5

3d. How important do you feel it is to be able to perform the afore mentioned advanced laparoscopic procedures autonomously afte becoming a qualified surgeon? (please circle)

1	2	3	4	5
Not important				Very important

Laparoscopic Surgery in the Netherlands

4. Do you feel every surgical training hospital should have a specialized laparoscopic surgeon ?
0 yes
0 no

4a. Do you feel there is a need for a subspecialty / specialty in laparoscopic surgery?
0 yes
0 no

4b. Is there /are there surgeon(s) working in your hospital who are specialized in MAS?
0 yes
0 no

4c. How important do you feel it is to have a MAS specialized surgeon in a surgical training hospital for the teaching/training of basic M.A.S. skills to surgical residents?

1	2	3	4	5
Not important				Very important

4d. How important, according to you, is it to have a MAS specialized surgeon in a surgical training hospital for the teaching/training of advanced MAS skills to surgical residents?

1	2	3	4	5
Not important				Very important

Remarks:

Thank you !

Fig. 1. Continued.

tion of their surgical training program (Mann–Whitney U test; $p = 0.774$). The residents believed strongly that educators are obligated to offer a validated skills training program for basic laparoscopic procedures during their residency (97.1%).

The groups were fully agreed about this obligation (Pearson's chi-square; $p = 1.000$). All the residents (100%) considered it important to very important (score 4 or 5) that residents be able to perform basic MAS procedures autonomously. Nevertheless, about 1 in every 10 residents (11.5%) expected to be inadequately prepared for performing this basic laparoscopic surgery after becoming qualified surgeon. Apparently, completion of MAS skills training programs is not the factor determining a resident's opinion about adequate preparation (Pearson's chi-square; $p = 0.431$).

According to the consensus established by SAGES (Table 2). 17 procedures have been defined as advanced laparoscopic procedures. Table 2 shows that, for all procedures, GI/oncologic–interested residents are more often interested, although hesitant in their expectation to perform these procedures autonomously at the end of their surgical training. Only 17.8% of the residents believed they would be adequately prepared for the advanced procedures they wished to perform once qualified. The groups did not differ in this expectation (Pearson's chi-square; $p = 0.593$). Nevertheless, 58.4% of the GI/oncologic–interested residents considered it important to very important (score 4 or 5) for them to be able to perform these advanced MAS procedures autonomously. Of the non-GI/oncologic–interested surgeons, 40.9% do so (Mann–Whitney U test; $p = 0.014$). Of all the residents, 53.3% believed educa-

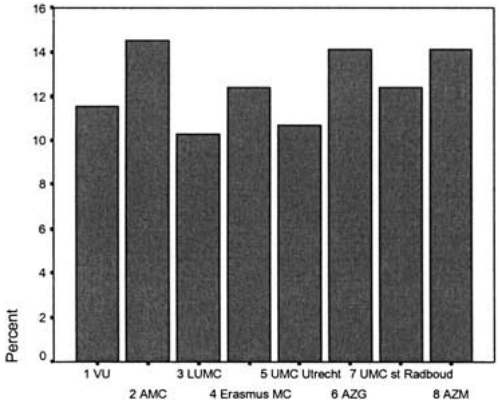

Fig. 2. Distribution by surgical training region.

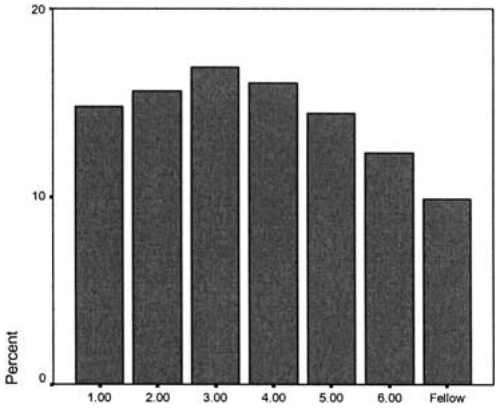

Fig. 3. Year of training.

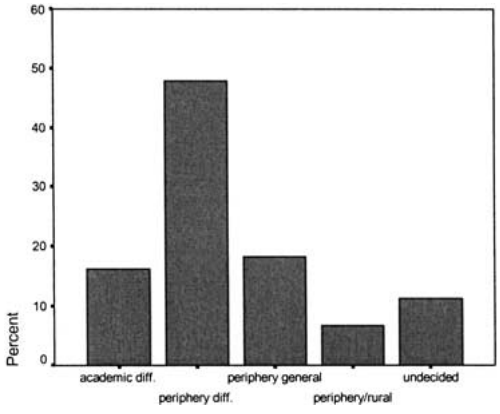

Fig. 4. Future perspective.

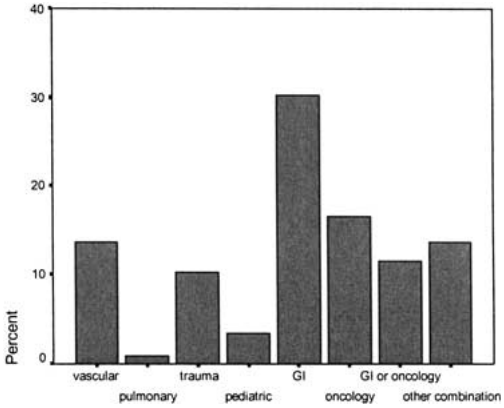

Fig. 5. Differentiation.

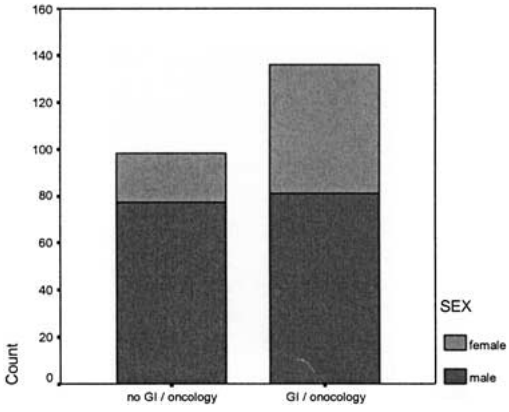

Fig. 6. Differentiation by sex.

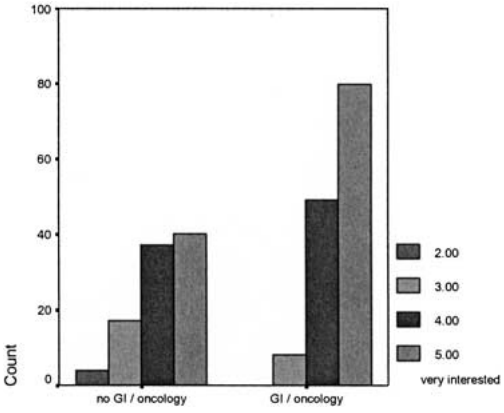

Fig. 7. Interest in autonomous performance of laparoscopic surgery.

tors are obliged to offer a validated skills training program for the advanced laparoscopic procedures (no significant difference between groups).

When there was an expectation of inadequate preparation for the advanced procedures, GI/oncologic–interested resident tended to attribute this significantly more to a presumed lack of interest on the part of the educator than to then non-GI/oncologic–interested residents do (Table 3). There were no significant differences between the groups for the other possible explanations. The most important reasons given were as follows: residents feel they do not have sufficient opportunity to be the first operator for these procedures and the procedures are not (often) performed in their hospital. These reasons likely are interdependent.

Laparoscopic surgery in the Netherlands

Residents stated that every surgical hospital department in the Netherlands should have a surgeon specialized in

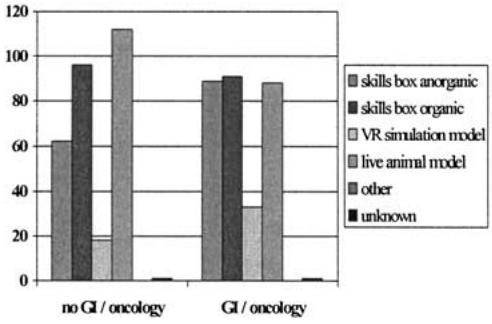

Fig. 8. Method of minimal-access surgery skills training.

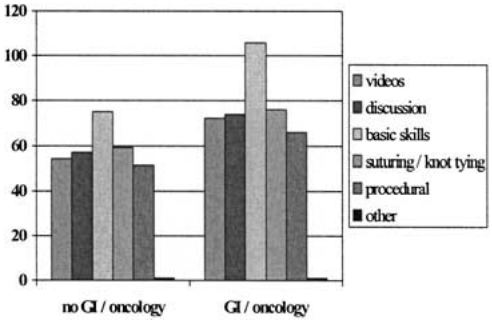

Fig. 9. Format of minimal-access skills training.

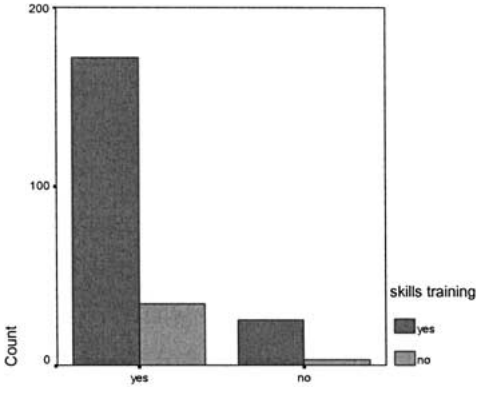

Fig. 10. Adequately prepared for basic laparoscopic procedures.

laparoscopic surgery (86.9%). In fact, 72% of the residents reported that there was such a surgeon in their clinic. A minority of the residents believed there should be a specific differentiation for laparoscopic surgery in the surgical curriculum (43%). Among the residents who had a surgeon specialized in laparoscopic surgery in their clinic, 82.2% believed the presence of this surgeon was important for the education of basic laparoscopic skills. For advanced laparoscopic skills, this estimate reached 88.3%.

Discussion

The results of the current survey, with a response rate of 65% and displaying an event distribution by region and by year of training, support a true reflection of the surgical resident population in the Netherlands. In conformity with results from a large Canadian study, Dutch residents (100 %!) believe it is very important to perform basic MAS procedures autonomously. The residents feel strongly about the need for validated basic laparoscopic procedural training in their surgical curriculum [2]. Most Dutch residents indeed had the opportunity to attend MAS skills education. Of the residents attending MAS skills laboratory education, more than two-thirds (76.1%) rated the benefit of such skill education highly relation to their clinical performance. Most residents (88.5%) also expected that they would be able to perform basic MAS procedures once they were qualified. This is promising, although educators should try to identify and educate the one resident in ten who feels insecure performing a laparoscopic cholecystectomy, appendectomy, or diagnostic laparoscopy.

Successful integration of advanced laparoscopic procedural training is a logical next step in education for MAS. Strikingly, only 17.8% of our residents estimated their MAS training to be adequate for the advanced MAS procedures they wish to perform. This percentage is identical to that in the Canadian study. Rattner et al. [16] and others [11, 13] revealed a similar problem for U.S. residents, perceiving a need for additional training in advanced laparoscopic surgery. Indeed, the problem seems to be global, because a Belgian study under the auspices of the Belgian Group for Endoscopic Surgery showed that two of every three surgical trainees consider their practical training in laparoscopy to be inadequate, with virtually no opportunity to perform advanced laparoscopic procedures [12]. It is stated, however that teaching of advanced laparoscopic procedures and basic procedures can, and in fact should, be incorporated into the surgical residency [11, 13].

The most important reasons mentioned for this gap between the current surgical curriculum and clinical practice in the current study and the Canadian study were "not enough chance of being the first operating surgeon" and "lack of volume of these procedures in the hospital" (median of 4). This implies that the learning curve for these procedures must be overcome, somehow crossing the boundaries of the current surgical curriculum. For the MAS–interested resident, who is most likely to be a GI/oncologic–interested resident, a skills training program with emphasis on specific MAS skills training could offer possibilities for overcoming this problem. In keeping with this view, SAGES supports the creation of skills laboratories, suggesting guidelines for faculty training and supporting (postgraduate) MAS fellowships [18].

Inside and outside the more or less controlled context of a skills laboratory, different models have been developed to train residents in MAS skills. These models, although heterogeneous in concept, have proved to be helpful in the learning of basic MAS skills, such as pick-and-place, translocation, and navigation [6]. So far, there is some, but little, evidence to suggest a positive relation between performance in the simulated environment and actual surgical performance [2, 17]. This

Table 1. Basic procedures in minimal-access surgery (MAS), in percentages

Basic procedures MAS	No GI/oncology			GI/oncology			p-value[a]
	Autonomous MAS	Would like to perform MAS autonomously	Not interested	Autonomous MAS	Would like to perform MAS autonomously	Not interested	
Diagnostic laparoscopy	82.7	17.3		76.6	22.6	0.7	0.266
Cholecystectomy	84.7	15.3		75.2	24.1	0.7	0.066
Appendectomy	67.3	29.6	3.1	66.2	31.6	2.2	0.964

[a] Pearson chi-square statistic

Table 2. Advanced procedures in minimal-access surgery (MAS), in percentages

Advanced procedures MAS	No GI/oncology			GI/oncology			p-value[a]
	Autonomous MAS	Would like to perform MAS autonomously	Not interested	Autonomous MAS	Would like to perform MAS autonomously	Not interested	
Nissen fundoplication	18.1	44.7	37.2	8.9	77.2	13.8	0.000[a]
Heller myotomy	4.9	47.6	47.6	3.1	57.7	39.2	0.376
Gastric resection	1.3	36.7	62.0	2.8	62.6	34.6	0.001[a]
Gastrojejunostomy	6.1	46.3	47.6	6.3	76.6	17.1	0.000[a]
Cyst-gastrostomy	3.8	37.2	59.0	2.0	66.0	32.0	0.001[a]
Bariatric surgery	5.1	25.6	69.2	8.6	38.1	53.3	0.093
Hepatic resection (partial)	1.3	27.3	71.4	1.0	48.0	51.0	0.021[a]
CBD exploration	5.9	60.0	34.1	11.5	70.8	17.7	0.020[a]
Choledochojejunostomy	1.3	38.0	60.8	4.0	66.3	29.7	0.000[a]
Distal pancreatectomy	1.3	32.1	66.7	1.1	48.9	50.0	0.081
Splenectomy	8.0	69.3	22.7	13.9	72.2	13.9	0.149
Adrenalectomy	7.2	42.2	50.6	6.7	64.4	28.8	0.007[a]
Right hemicolectomy	14.3	64.8	20.9	16.0	76.8	7.2	0.013[a]
Sigmoid resection	10.3	64.4	25.3	13.3	76.7	10.0	0.013[a]
Rectal surgery	3.7	43.9	52.4	6.5	73.1	20.4	0.000[a]
Inguinal hernia repair	31.9	53.2	14.9	27.2	63.2	9.6	0.274
Ventral hernia repair	26.1	54.3	19.6	21.1	65.1	13.8	0.284

CBD, common bile duct
[a] Pearson chi-square statistic

Table 3. Reasons for inadequate mastering of advanced laparoscopic procedures in minimal-access surgery (MAS), in percentages

Reasons	No GI/oncology					GI/oncology					Total median	p-value[a]
	Not of influence/highly of influence (%)					Not of influence/highly of influence (%)						
	1	2	3	4	5	1	2	3	4	5		
Lack of interest myself	47.7	22.7	18.2	8.0	3.4	58.9	21.8	9.7	6.5	3.2	1	0.381
Lack of interest of my surgical educator(s)	22.7	10.2	27.3	31.8	8.0	11.5	26.0	27.5	23.7	11.5	3	0.013*
Lack of appropriate patients	13.5	14.6	23.6	32.6	15.7	9.3	14.0	29.5	33.3	14.0	3	0.801
Not enough opportunity to be the first operating surgeon during procedures	6.9	10.3	11.5	32.2	39.1	7.6	4.5	16.7	39.4	31.8	4	0.276
Not enough opportunity to be the assisting surgeon during procedures	12.8	22.1	20.9	23.3	20.9	13.7	22.1	28.2	26.7	9.2	3	0.160
Lack of operating time to perform these procedures	9.5	22.6	29.8	21.4	16.7	9.6	24.8	28.8	27.2	9.6	3	0.591
In my hospital, these procedures are not performed	17.6	14.3	17.6	19.8	30.8	15.2	15.2	13.6	25.8	30.3	4	0.808

[a]Pearson chi-square statistic

might be attributable to the fact that for actual surgical outcome, decision-making processes and sequels of errors possibly leading to severe complications cannot be trained with the use of inanimate training models and only partly with the use of animate ones. Park and Witzke earlier assessed current training in MAS to be inadequate [14]. Explanation for this is that current MAS training programs are neither widespread nor standardized, resulting in graduate surgeons with a wide range of competence. In fact, there is little evidence concerning what a MAS training program needs to be effective. It is suggested that a multimedia training

program, incorporating interactive and various training methods, is both attractive and beneficial in the adoption of new MAS skills [15]. Training programs offered to residents should therefore be carefully evaluated for selection and separation of the most promising elements from the less promising ones. Our study showed that skills lab program evaluation in the Netherlands is, in fact, a scarce phenomenon.

Virtual reality (VR) procedural simulation is a novel development in surgical skills training. Reports of advances in MAS training using VR simulation are appearing in the literature, and first outcomes are promising indeed [1, 9, 10, 23]. Providing repetitive scenery combined with objective assessment, VR offers excellent and natural repetitive training opportunities for learning basic MAS skills. VR skills training introduces the trainee to the enlarged and two-dimensional monitor image of the three-dimensional workspace, to the fulcrum effect (the effecter end of the laparoscopic instrument moves in the direction opposite the surgeon's hand movement) inherent to laparoscopic surgery, and to limitations in vision and movements. Recent developments in VR simulation focus on haptic feedback, combining realistic anatomy graphics with realistic tissue deformation upon manipulation. Progress has been made in creating multiple MAS tasks, incorporating validated assessment modules and intelligent processing of error sequels [20]. Learning curves, inherent to the hurdles of MAS mastery, are known to impose a great deal of practice time on the surgical novice in achieving proficiency and competency. Indeed there is controversy about the amount of training necessary for the safe performance of laparoscopic surgery [16, 21]. This is to result from a combination of factors: the resident's ability for MAS surgery, the type MAS procedure, and, of course, the clinical variation in the patient's anatomy. There is no doubt that in time, objective, validated, and reproducible VR *procedural* simulation will become highly important in surgical training and the evaluation of surgical competence [3, 4, 20–22].

Another finding of our study is the fact that residents do believe every clinic needs to have an MAS-specialized surgeon. According to the residents, not every teaching hospital (28%) has employed such a surgeon. Residents believe the presence of an MAS-specialized surgeon is very important for the acquisition of both basic and advanced MAS skill. Fowler and Hogle [8] showed that the impact of an experienced MAS surgeon in the clinic raised the number of laparoscopic surgical procedures in which residents participated by more than 100%. Residents' involvement in laparoscopic training sessions and MAS research projects also increased measurably [8]. The fact that experienced MAS surgeons have once been residents themselves enhances the arguments for starting good skills training early as a means of increasing the potential of future trainers.

Conclusion

Dutch residents are interested in the autonomous performance of MAS surgery once they become qualified surgeons, and GI/oncologic–interested residents have even greater interest in this goal. For the basic MAS procedures–laparoscopic cholecystectomy, appendectomy, and diagnostic laparoscopy– residents are quite confident they will be able to perform them autonomously indeed (88.5%). As for the advanced procedures–residents are far more doubtful (17.8%) whether they are adequately prepared for these procedures once they become qualified surgeons. Most GI/oncologic–interested residents believe it is important to master advanced MAS procedures once they become surgeons. Skills laboratory offering MAS skills training programs could be helpful in shortening learning curves in MAS surgery outside the operating room. Most residents had the opportunity to attend such courses, which primarily emphasized acquiring basic laparoscopic skills using skills boxes as well as inanimate and animate models. Procedural skills are taught, but in a lesser extent than other formats of MAS skills training. This seems plausible because procedural skills can be taught only with the use of animate models, and therefore not repetitively or with the use of the still relatively new VR training simulation. A minority of residents report objective evaluation after participating in an MAS-skills course (26.9%). Residents believe that every surgical hospital department in the Netherlands should employ a surgeon specialized in MAS, and they believe the presence of such a surgeon is important for the acquisition of MAS skill. Indeed, one could suggest the importance of an MAS surgeon within other surgical specialties (e.g., gynecology, urology and orthopedics).

The results of our study indicate that there is a definite need for validated education in (advanced) MAS skill in the Netherlands. In the design of such a curriculum, multimedia and procedural skills training should be taught. Because of its standardized scenery, repetitive possibilities, and unbiased assessment methods, VR simulation is undoubtedly going to be important in future training programs. The skills laboratory seems to be the ideal place to set up, teach, and evaluate such curricula. Only by proper and multicentered evaluation of the skills training programs currently available, can a set of proper MAS training guidelines and materials to teach and test MAS skills be formatted. Therefore, a discussion under the auspices of the Dutch Society of Endoscopic Surgery with regard to method, amount, location, and regularity of such training modules, as well as its controlled implementation needs to be conducted.

References

1. Ali MR, et al. (1999) Training the novice in laparoscopy: more challenge is better. Surg Endosc 16: 1732–1736
2. Chiasson PM, et al. (2003) Minimally invasive surgery training in Canada: a survey of general surgery. Surg Endosc 17: 371–377
3. Coleman J, Nduka CC, Darzi A (1994) Virtual reality and laparoscopic surgery. Br J Surg 81: 1709–1711
4. Cosman PH, et al. (2002) Virtual reality simulators: current status in acquisition and assessment of surgical skills. Aust NZ J Surg 72: 30–34
5. Cushieri A, et al. (2003) Reflections on surgical training. Surg Endosc 7: 73–74

6. Derossis AM, Antoniuk M, Fried GM (1999) Evaluation of laparoscopic skills: a 2-year follow-up during residency training. Can J Surg 42: 293–296
7. Figert PL, et al. (2001) Transfer for training in acquiring laparoscopic skills. J Am Coll Surg 193: 533–537
8. Fowler DL, Hogle N (2000) The impact of a full-time director of minimally invasive surgery: clinical practice, education and research. Surg Endosc 14: 444–447
9. Gallagher AG, et al. (1999) Virtual reality training in laparoscopic surgery: a preliminary assessment of minimally invasive surgical trainer virtual reality (MIST VR). Endoscopy 31: 310–313
10. Jordan JA, et al. (2001) Virtual reality training leads to faster adaptation to the novel psychomotor restrictions encountered by laparoscopic surgeons. Surg Endosc 15: 1080–1084
11. Liberman MA, Greason K (1999) Residency training in advanced laparoscopic surgery: how are we doing? Surg Laparosc Endosc Percutan Tech 9: 87–90
12. Navez B, Penninckx F (1999) Laparoscopic training: results of a Belgian survey in trainees. Belgian Group for Endoscopic Surgery. Acta Chir Belg 99: 53–58
13. Nussbaum MS (2002) Surgical endoscopy training is integral to general surgery residency and should be integrated into residency and fellowships abandoned. Semin Laparosc Surg 9: 212–215
14. Park A, Witzke DB (2002) Training and educational approaches to minimally invasive surgery: state of the art. Semin Laparosc Surg 9: 198–205
15. Ramshaw BJ, et al. (2001) The role of multimedia interactive programs in training for laparoscopic procedures. Surg Endosc 15: 21–27
16. Rattner DW, Apelgren KN, Eubanks WS (2001) The need for training opportunities in advanced laparoscopic surgery. Surg Endosc 15: 1066–1070
17. Rogers DA, Elstein AS, Bordage G (2001) Improving continuing medical education for surgical techniques: applying the lessons learned in the first decade of minimal access surgery. Ann Surg 233: 159–166
18. SAGES (1998) Integrating advanced laparoscopy into surgical residency training. Surg Endosc 12: 374–376
19. SAGES, SAGES position statement on advanced laparoscopic training
20. Schijven M, Jakimowicz J (2002) Construct validity: experts and residents performing on the Xitact LS500 laparoscopy simulator. Surg Endosc 17: 803–810
21. Schijven MP, Jackimowicz JJ (2003) The learning curve on the Xitact LS500 laparoscopy simulator: profiles of performance. Surg Endosc 18: 121–127
22. Seymour NE, et al. (1992) Virtual reality improves operating room performance: results of randomized double-blind study. Ann Surg 236: 458–463
23. Strom P, et al. (2003) Validation and learning in the Procedicus KSA virtual reality surgical simulator: implementing a new safety culture in medical school. Surg Endosc 17: 227–231