

Changes in the Operating Time of Laparoscopic Cholecystectomy of the Surgeons and Novices between 1994-2012

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Rezumat

Modificările timpului operator în colecistectomiile laparoscopice efectuate de medici specialiști și rezidenți între 1994-2004

Introducere: Technica efectuării colecistectomiei laparoscopice (CL) nu s-a schimbat de câțiva ani, din această cauză există posibilitatea de a-i studia curba de învățare.

Materiale și metode: Retrospectiv au fost analizate CL din fiecare al treilea an între 1994-2004. Au fost examinate curbele de învățare ale instituției, medicilor specialiști și ale rezidenților. Chirurgii au punctat tehnica laparoscopică a colegilor pe o scară de la unu la zece, iar timpul de operație (TO) a fost examinat în funcția de tehnica asistentului.

Rezultate: În perioada examinată au fost efectuate 2216 CL. TO mediu al instituției a fost de 78,3 minute în 1994, care a scăzut la 45,4 minute (42,0%) în 2003. Rata de evoluție a medicilor specialiști și a rezidenților a fost de 36,7%, respectiv 9,9%, iar paralel cu aceasta s-au schimbat și valorile minime și maxime al TO. TO din primii trei ani de învățare a scăzut cu 13% în 2006, iar prima parte a curbei de învățare a devenit mai abruptă. La chirurgii al căror punctaj tehnic a fost scăzut, și TO scurt, punctajul mediu al asistentului a fost semnificativ mai înalt decât în cazurile chirurgilor al căror punctaj tehnic era mare și TO scurt.

Concluzie: TO singur nu este un factor obiectiv pentru definirea tehnicii chirurgicale.

Cuvinte cheie: colecistectomie laparoscopică, curbă de învățare, rezident, asistent

Abstract

Background: The technique of laparoscopic cholecystectomy (LC) has not changed over the past recent years; therefore the possibility is open to study its learning curve.

Methods: Retrospectively, every third year's LCs were analysed between 1994 and 2012. The learning curves of surgeons and novices were defined in the department. The surgeons have scored the laparoscopic technique of their colleagues on a scale of 1 to 10 and operation time (OT) was examined in light of the assistant's technique.

Results: 2,216 LCs were performed in the examined period. The average OT of the department was 78.3 minutes in 1994, which had decreased to 45.4 minutes (42.0%) by 2003. The improvement rates of surgeons and novices were 36.7% and respectively 9.9%, and the variance between the minimum and maximum OT changed in parallel. The OT in the initial 3 years of learning had become 13% shorter by 2006 and the first section of the learning curve has also become steeper. In case of surgeons whose technical points were low and OT was short, the assistants' average technical score was significantly higher than in case of surgeons whose technical score was high and the OT was short.

Conclusion: The OT alone is not an objective factor in the definition of the surgical technique.

Key words: laparoscopic cholecystectomy, learning curve, novices, assistant

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Introduction

Laparoscopy is a new challenge which has not ever been experienced since the appearance of surgery itself, and surgeons have proved to not be prepared for it: in the beginning, the use of the method was highly characterised by significantly higher rates of complications as compared to traditional surgery, as well as by new kinds of complications which appeared as a result of the peculiarities of the technique.

The term of learning curve was apparently used for the first time in industry in the 1930s, and in the 80s, in medicine to describe learning to perform coronary bypass, mitral valvuloplasty and the use of EEA stapler for lower rectum surgery, and reused again in connection to laparoscopic cholecystectomy. The curve is usually characterised by a sudden drop in its first phase, which is followed by a second phase, in which the pace of the drop slows down and finally an even straight line follows, which does not show any significant changes, but the appearance depends inter alia on the trainee and the method to be trained. The most often examined parameter in the study of a learning curve is the operation time; more rarely the rate of complications, rate of conversions and the hospitalisation period are also measured.

Since the initial phase of the learning curve is characterised by a high rate of complications, the common goal of surgeons, patients, as well as health insurers is to shorten the initial phase of the curve as much as possible.

The technique of laparoscopic cholecystectomy has not undergone any major change over the past recent years, that is, until the time single port surgery appeared. Statistical analysis of a large number of operations creates the possibility to study the learning curve of the department, of the residents and of the experienced surgeons and to investigate the effects which could impact operating time. The findings of such investigations could be of use not only in enhancing the efficiency of education of the residents, but also in improving the safety of operative procedures.

Patients and Methods

The data of LCs of the 1st Surgical Department of Semmelweis University were evaluated using the hospital information system database retrospectively pertaining to every third year in the period 1994-2012.

The surgeons who had less than 3 years of experience in LC were defined as novices. In 1994 everybody had less experience than three years (LC started in November of 1991) therefore their data are presented in the novices' group. Beginning with 2000 only the data of the residents is processed in this group.

The operation parameters subject to study were operative time (purely surgical time: skin to skin). All LCs were excluded from the study if any other procedures (biopsy, cholangiography, hernioplasty, etc.) were performed during the operation.

In addition to this, 13 experienced surgeons – all of whom had worked in our clinic since 1991 – were asked to

score all their colleagues' laparoscopic technique on a scale of 1 to 10 points based only on their personal experience from surgeries carried out together in the operating room.

Average operation time was compared to the technical score, then the average operation time was examined in the light of the technical score of the assistant in the operation.

The parameters studied were the operation time (average, minimum, maximum, standard deviation), and conversion rate beside the score of the surgeons' laparoscopic technique. Observed differences were subjected to statistical analysis using Pearson correlation test and Student's *t* test; a difference was considered significant if *P* was <0.05.

Results

Between 1994 and 2012 sixty-three surgeons performed 2,216 laparoscopic cholecystectomies. The number of novices was the highest in 1997 when the new surgical technique was introduced, and it changed from 13 to 2 later in the examined years. The rate of laparoscopy increased from 52.9% (1994), to 95.7% (2012) while the number of LCs increased from 129 to 424, which was due to the decreased ratio of relative contraindications (previous abdominal operation, pregnancy, morbid obesity, advanced age). The conversion rate was 5.15% in the beginning, which decreased to 1.7% in 2003, but increased again to 5.2% in 2012 owing to the above mentioned growth in the number of cases with complications. (Fig. 1)

Operation time

The learning curve of the entire department, the learning curve of experienced surgeons and that of the novices were analysed.

The average operating time for all LCs (learning curve of the entire department) was 78.3 minutes in 1994 which decreased slowly in the first period, and faster between 1997 and 2000. After this decrease of 32.1%, it went slowly further down (8.7%) until 2003, then it did not change significantly

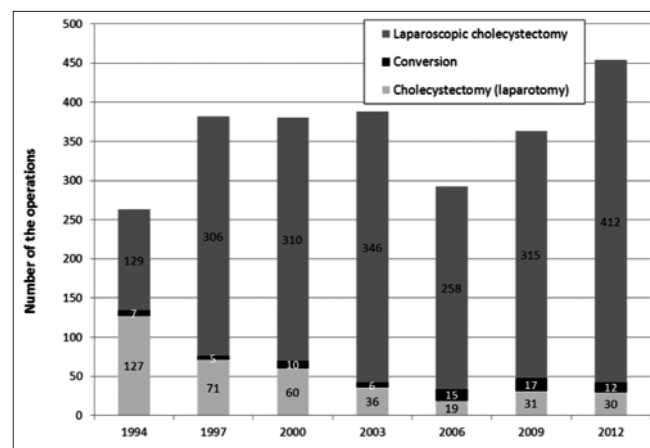


Figure 1. The number of cholecystectomies in the examined years

between 2003 and 2012. The average operation time of the total LCs decreased by 31.3%. (78.3 min to 53.74 min).

The learning curve of the experienced surgeons was examined beginning with 1997. The rate of improvement experienced surgeons achieved was 28.2% between 1997-2012 (70.6 to 50.7 minutes) ($p < 0.05$). The plateau of the learning curve of the surgeons started in 2003, after which a mild increase started.

The average operation time of novices showed an increasing trend from 1994 to 1997, and was higher than the operation time of their predecessors 3 years earlier. But after this point in time it decreased in parallel with the average operation time of surgeons. The decrease achieved by novices from 1997 to 2012 was 11.1% (84.5 to 75.1 minutes) and the same mild increase could be observed in 2003. (Fig. 2)

Minimum and maximum time of the LC

The maximum operative time of the novices (215 min. vs. 240 min.) showed a mild, insignificant increasing trend between 1994 and 1997, but then the operative time of both novices and experienced surgeons decreased significantly ($p < 0.05$). The minimum operation time of experienced surgeons and novices did not change significantly. The variance between the minimum and maximum operation time showed a parallel change in the case of both experienced surgeons and novices. (Fig. 3)

Novices' operating time

Comparing the learning curve of novices over the inspected 7 years, it becomes visible that the first section of the learning curve has become steeper. The operation time decreased by 35% in case of surgeons who were novices in 1997 due to their more extensive experience in traditional cholecystectomy. The improvement of the novices was only 20% in 2003, due to fewer relative contraindications and the laparoscopic operation of the more complicated cases, but after this period the average operation time has become more than 40% shorter by 2006. (Fig. 4)

Technical score of the surgeons' skill

Thirteen attending surgeons, who have been working at the Department since 1994, have been asked in 2012 to score the technical skills of their 53 colleagues on a scale of 1-10. The average point was 5.6. (SD ± 2.25). (Fig. 5)

Comparison of technical points with the average operation time

We have compared the results of 32 surgeons who performed LCs in 2012. There was a negative correlation between the average operation time and the technical score. The correlation coefficient was -0.428 using the Pearson correlation examination, ($p=0.001$) the average operation time of 4 surgeons was worse compared to the 20% margin (points over the rectangle)

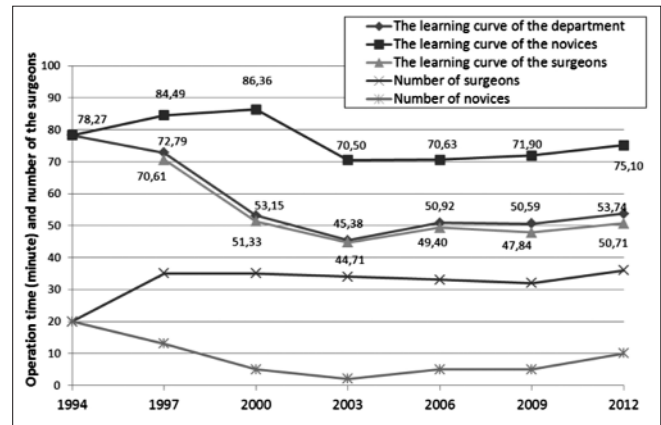


Figure 2. The learning curves of the department, the experienced surgeons and the novices

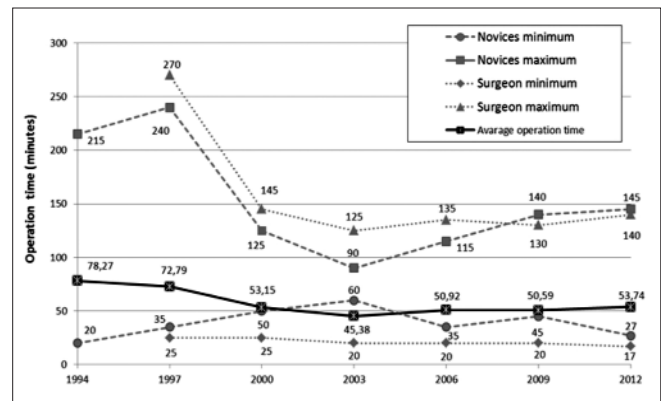


Figure 3. The minimum and maximum operating time of the experienced surgeons and the novices

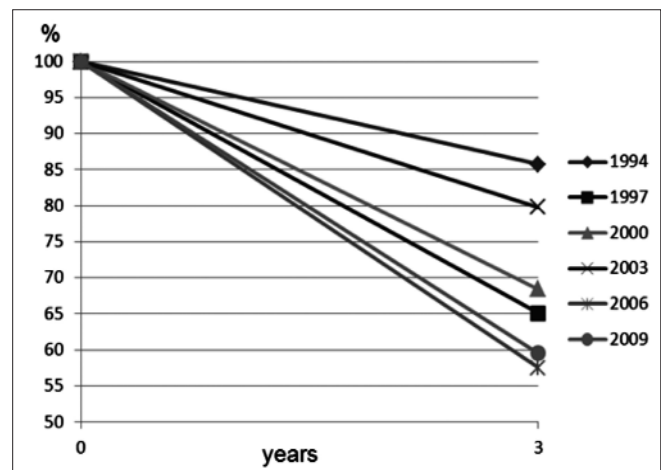


Figure 4. Decrease in the operating time of the novices in the first 3 years

and the result of 5 surgeons was better. (Their results are below and circle the 20% rectangle). There were no novices among these 5 surgeons. (Fig. 6)

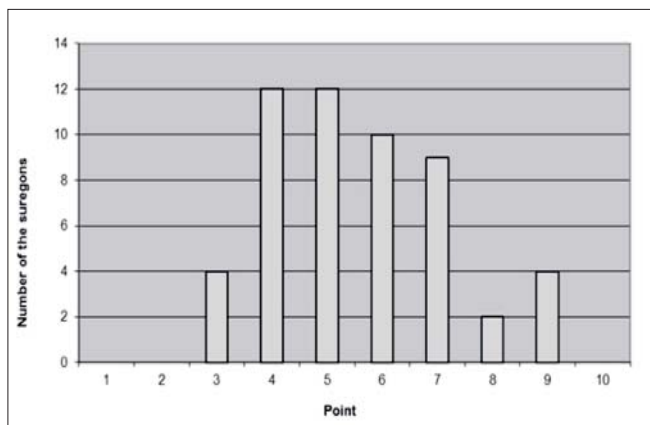


Figure 5. Technical points of the surgeons' laparoscopic skill

Comparison of the technical points of the assistants of the surgeons

The technical points of the surgeons have been used to score the assistants. The technical scores of the first assistant of all the surgeons have been added and averaged.

The average technical score of the assistants to surgeons, who had good operating time and bad technical points was 7.25, while the assistants in the other group reached an average technical score of 6.1. The difference was significant ($p=0.008$) with Student T test.

Originally, the operation time of the LCs of the novices had been studied from 1994 to 2012. Analysing the results we have detected that:

1. The learning curves of experienced surgeons and the novices have changed nearly in parallel, and the plateau started at the same time,
2. The change in the maximum operation time was observed to be similar both in the group of novices and that of experienced surgeons,
3. In the examined years the learning curve of novices started from a lower level, and the first section was steeper.
4. Usually, the surgeons whose technical point was low had longer average operating time. But there were some surgeons with low technical score and better average operating time, as well.

During the studied period there was no change in the education of novices, therefore only the experience of the assistants could play a part in the first three cases, which could be explained by the better technical skill of the assistant. Therefore, the average technical scores of the assistants to these surgeons have been counted, and they were found to be significantly higher in the aforementioned cases.

Discussion

There are limited data in the literature about the effect of the assistants' experience on the operation. Significant differences in operative time, estimated blood loss, re-

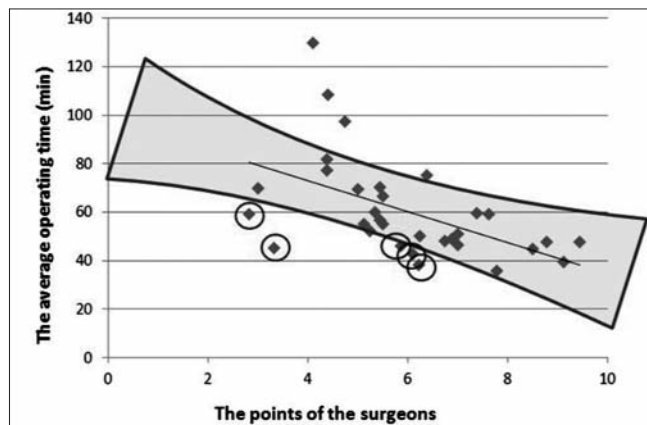


Figure 6. Comparison of the technical points with the average operating time (grey area is the 95% confidence interval)

admission rates and intraoperative complication rates among assistants of different training levels (attending, fellow, residents) have been found. (1) But in a teaching hospital no difference was found in respect of either complications or mortality in interventions made by surgeons no matter whether the assistant was a surgical resident or not. (2) Differences have been found not only on the level of residents but also on the level of junior and senior attendings, where operative times were longer for junior residents irrespective of attending seniority, and the overall rate of operative complications was higher in junior than in senior resident cases. Additionally, the senior attendings had a trend toward increased conversions. (3) Numerically, the operating time was about 1/3 longer in cases where a resident assisted in the LC. (4)

If the LC was performed by a tight-knit team with experienced surgeons, a 40% decrease could be achieved in the operation time by acquiring the technique of the LC. (5) In our department - which is a postgraduate centre, without standard teams, where usually residents assist in operations - this improvement was only 31.3%. This training of the surgical residents in the operating theatre is expensive. The cost was calculated in the USA, which was about \$ 53 million in 1997. (6) This sum could be decreased by the selection of the candidates and the development of the training curriculum. (7) The common aim of surgeons, patients and the healthcare industry is to shorten the first section of the learning curve. Nowadays the training box seems to be the most effective method for acquiring laparoscopic skill (8,9) but others believe that assistance in the operations helps to improve technical skills (10) and early operating room exposure is the most effective teaching method, all other methods being only secondary to this. (11)

Inspections have already been made regarding the impact of less experienced surgeons on the operation time and the complications, but very limited data exist about the effect of the more experienced surgeons acting as assistants in LC, although this could be a really important question, because this information may help the teaching hospitals

maximize the learning of novices and operative safety and efficiency at the same time.

Most of the complications in laparoscopic procedures tend to occur in the first, steep part of the learning curve. Residents usually need about 30-50 laparoscopic cholecystectomies (12) to reach the so-called "plateau" of the operation time after which no more improvement is seen in the operation time, complication rate and hospital stay. (13) One of the established facts is that an experienced surgeon - as an assistant - could reduce the incidence of the conversion to open surgery (14) and common bile duct injuries. (15)

However, the numbers of the operations were chosen arbitrarily and the individual differences of the novices were not considered either. As we proved, the experience and the skill of the first assistant have a great influence on the procedure, and it could falsify the operating time of the LC, making the novices' skill seem better than the reality. Therefore, in some countries the competency of any laparoscopic procedure is established based on an unedited video about the surgical procedure which is provided anonymously and analysed by an independent committee. In these countries the complication rate is found significantly lower in case of those surgeons who passed the exam successfully. (16)

Conclusion

Although it is considered that the operating time reflects faithfully a surgeon's laparoscopic skills, our results proved that operating time alone is not an objective factor in defining the personal laparoscopic competence. The assistants' experience has played an important role in decreasing the attendings' and novices' operating time, changing their learning curve in parallel with that of the surgeons' and contributing to the start of the plateau at a similar point in time.

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