Learning Curve in Laparoscopic Inguinal Hernia Repair: Experience at a Tertiary Care Centre

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Abstract One of the major reasons for laparoscopy not having gained popularity for repair of groin hernia is the perceived steep learning curve. This study was conducted to assess the learning curve and to predict the number of cases required for a surgeon to become proficient in laparoscopic groin hernia repair, by comparing two laparoscopic surgeons. The learning curve evaluation parameters included operative time, conversions, intraoperative complications and postoperative complications, and these were compared between the senior and the junior surgeon. One hundred thirty-eight cases were performed by the senior surgeon, and 63 cases by the junior surgeon. Both were comparable in terms of intraoperative and postoperative complications. Using the moving average method, minimum of 13 laparoscopic hernia repairs are required to reach at par the operating time of an experienced surgeon. For total extraperitoneal (TEP) repair, the number of cases was 14; and for transabdominal preperitoneal (TAPP) repair, this number was 13.

Keywords Learning curve · Laparoscopy · TEP/TAPP repair · Moving averages

Introduction

There has been lot of scepticism on the role of laparoscopy in the repair of groin hernias. Currently, laparoscopic herniorrhaphy accounts for 15 to 20 % of hernia operations in the USA and around the world [1]. One of the major reasons for laparoscopy not having gained popularity for repair of groin hernia is the perceived steep learning curve, working in an unfamiliar anatomy and risk of serious complications.

There have been many attempts to define learning curve in laparoscopic groin hernia repair and has been described in a few studies to be ranging from 20 to 250 cases [2–4]. However, there has been no general consensus in the literature as to the exact number of cases required to be performed by the surgeon before breaching the barrier of the learning curve. This prospective study was conducted with an objective to assess the learning curve of laparoscopic groin hernia repair and to predict the number of cases required for a surgeon to become proficient in both the total extraperitoneal (TEP) and transabdominal preperitoneal (TAPP) techniques of laparoscopic groin hernia repair.

Material and Methods

This study was conducted in a single surgical unit of a tertiary care referral hospital (where laparoscopic groin hernia repair was started in 2003) in a prospective manner comparing two surgeons performing laparoscopic inguinal hernia repair. The junior consultant (VKB) has had 14 years of experience in open surgery, 3 years experience of laparoscopic surgery and started doing laparoscopic inguinal hernia repair under the supervision of the senior surgeon. He had assisted the senior surgeon in around 10 cases as a first assistant and had

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observed more than 100 cases of laparoscopic inguinal hernia repair in the unit.

The senior surgeon (MCM) has been adept at doing both TEP and TAPP and has been performing laparoscopic surgery for the last 15 years. The junior surgeon learnt both the procedures simultaneously and performed laparoscopic inguinal hernia repair (TEP or TAPP) under the direct supervision of the senior surgeon. The senior surgeon observed from outside without being scrubbed, and in initial cases, if the junior surgeon felt that the case is not progressing well, then the senior surgeon would take over.

Patients with primary, unilateral uncomplicated inguinal hernia from January 2007 to December 2010 were included in this study. Patients with history of previous surgery in the inguino-scrotal region, recurrent inguinal hernia, complicated hernia, irreducible hernias and bilateral hernias were excluded from the study. All study subjects were included after they gave informed written consent.

The demographic profile, intraoperative variables and postoperative complications were recorded on a prestructured performa. All the data were entered prospectively in a computerized database.

Any intraoperative complications like vascular, nerve or vas injury, peritoneal laceration and visceral injuries were recorded. The operative time was recorded as the time from the first incision until skin closure. Any conversions from TEP to TAPP and from laparoscopic to open repair were recorded with the specific reason for conversion. The ease of operation was graded as easy, moderately difficult or difficult, and the grade was recorded by the operating surgeon immediately after the surgery. Bleeding was recorded as mild if no suction irrigation was required, moderate if suction was required at the end of the procedure or to improve vision and severe if blood transfusion was required. For postoperative pain relief in all patients, diclofenac sodium 75 mg was injected intramuscularly, and for vomiting, ondansetron 8 mg was injected intravenously in the recovery room. Pain was recorded at 1, 6 and 24 h after the operation, at the time of discharge, and during follow-up based on a visual analog scale (VAS) where 0 indicated no pain and 10 indicated the worst possible pain. The need for extra analgesics and antiemetics, postoperative time to resume feeding, return of bowel activity, postoperative hospital stay and any urinary retention were the other variables measured postoperatively. Complications, including hematoma or seroma formation and wound infections, were recorded. The port site wound infections were classified according to the CDC classification for surgical site infection. Follow-up was done at 1 and 6 weeks and at 3, 6, 12, 18, 24 and 36 months. The presence or absence of seroma, hematoma, wound infection, pain, numbness and recurrence were recorded.

The learning curve evaluation parameters included operative time, conversion from TEP to TAPP or to open, intraoperative complications and postoperative complications, and

these were compared between the senior and the junior surgeon.

Statistical Analysis

Statistical analysis was performed using SPSS version 15.0 and SYSTAT version 7.0. For learning curve analysis, the time series analysis using moving average method was applied comparing the operating time of junior surgeon with the standard mean time of the senior surgeon keeping as reference standard.

Results

From January 2007 to December 2010, 436 patients were operated for laparoscopic inguinal hernia repair. Three hundred twenty-one of these cases were done by the senior surgeon (MCM), while 115 cases were done by the junior surgeon (VKB). Only 201 cases were included in this study according to the inclusion criteria, 138 cases by the senior surgeon, and 63 cases by the junior surgeon.

The patients operated by the senior surgeon had a higher mean age as compared to the patients operated by the junior surgeon (50.9 vs. 42.76 years; $p=0.003$). Other demographic parameters were comparable between the two groups. 62.3 % of cases done by the senior surgeon was by TEP method as compared to 44.4 % of cases done by the junior surgeon ($p=0.03$) (Table 1).

The incidence of peritoneal tear was higher in cases performed by junior surgeon, but it was statistically not significant ($p=0.08$). There were no conversion to open in either group; however, there were few conversions of TEP to TAPP (2 for senior surgeon and 3 for junior surgeon) (Table 1). The senior surgeon was called up for assistance in three cases due to difficult anatomic delineation in the first 10 cases done by the junior surgeon.

There was no significant difference in any of the postoperative complication in the two groups. These patients have been followed up for a mean of 19.6 months, range of 3 to 48 months. There was one recurrence in a patient operated by the senior surgeon. There was no recurrence in patients operated by the junior surgeon (Table 2).

Using the moving average method, it was found that a junior consultant who is doing laparoscopic procedures needs a minimum of 13 laparoscopic hernia repairs to reach at par the operating time for the experienced surgeon (Fig. 1). For TEP repair, the number of cases was 14; and for TAPP repair, this number was 13 (Figs. 2 and 3). The operating time had significant difference for the first 13 cases after which it became insignificant ($p=0.12$). However, there was no significant difference in overall mean operating time between the two groups.

Table 1 Demographic profile and intraoperative variables

Data	Senior surgeon <i>n</i> =138	Junior surgeon <i>n</i> =63	<i>p</i> value
Mean age (years)±SD	50.9±18.2	42.7±16.8	0.003
Type of hernia			
Direct	47 (34.1 %)	23 (36.5 %)	0.73
Indirect	91 (65.9 %)	40 (63.5 %)	
Type of repair			
TEP	86 (62.3 %)	28 (44.4 %)	0.03
TAPP	50 (36.2 %)	32 (50.8 %)	
Conversions			
TEP→TAPP	2 (1.4 %)	3 (4.8 %)	0.1
Conversion to open	0	0	
Operating time			
Mean operating time (in min)±SD	53.7±10.2	59.4±18.6	0.12
TEP	52.2 (±8.6)	55.4 (±13.5)	0.15
TAPP	55.2 (±10.6)	64.5 (±21.7)	0.002
Intraoperative complications			
Injury to cord	1 (0.7 %)	0	1.0
Peritoneal tear	21 (15.2 %)	16 (25.4 %)	0.08

Discussion

Numerous reports have suggested that laparoscopic groin hernia repair is safe and effective for treating inguinal hernias, and the advantages over open repair are less pain, better cosmesis and quicker recovery. Yet, many surgeons hesitate to perform laparoscopic groin hernia repair since the pelvic anatomy is unfamiliar and the working space is narrow. Moreover, the learning curve for laparoscopic groin hernia repair is steep, and the technique is difficult.

The concept of a ‘learning curve’ was originally introduced in aircraft manufacturing in 1936 by T.P. Wright [5]. Since then it has been used in many fields outside healthcare. The term was introduced to medicine in the 1980s, mainly after the advent of minimally invasive surgery. The learning curve describes the time required for a surgeon to learn or master a technique. As the surgeon’s technique is revised and

perfected, measures of clinical outcome should improve. The widespread adoption of laparoscopic surgery in recent years has provided numerous opportunities to observe the effect of surgeon experience on clinical outcome [6].

The effect of the learning curve on traditional open hernia repair techniques has not been well described. It is interesting to note, however, that Shouldice initially reported a recurrence rate of 17 % with his anterior multilayered repair technique [7]. With additional experience, a remarkably low recurrence rate of 0.6 % involving >6000 hernia repairs with a minimum follow-up period of 10 years was reported.

Lal and colleagues [2] suggested that any laparoscopic procedure should be a copy of the basic open procedure, with modifications of the technique where applicable, and that 10 or more cases of open Stoppa pre-peritoneal procedures [8] might be helpful to train for laparoscopic TEP repair. On the other hand, Haidenberg and colleagues [9] suggested that laparoscopic TEP repair is simple, straightforward, logical and conceptually easier to teach than the modified Bassini, Lichtenstein or the mesh-plug techniques. Edwards and Bailey [10] reported that the factors that may influence the learning curve include the surgeon’s experience with laparoscopic procedures, sound knowledge of the pelvic anatomy and the ability to use a two-handed technique. In a multi-institutional study of TAPP herniorrhaphy, the frequency of hernia recurrence increased when performed by surgeons less familiar with the technique [11].

Learning curve has been defined previously as the number of operations required for the stabilization of the duration of surgery and complication rates. Liem and colleagues [12]

Table 2 Postoperative follow-up data

Postoperative follow-up			
Data	Senior surgeon <i>n</i> =138	Junior surgeon <i>n</i> =63	<i>p</i> value
Seroma	20 (14.5 %)	4 (6.3 %)	0.1
Cord edema	22 (15.9 %)	9 (14.3 %)	0.76
Scrotal edema	10 (7.2 %)	3 (4.8 %)	0.75
Recurrence	1 (0.7 %)	0	1.0

Fig 1 Moving average graph to show the comparison of mean operating time between the two groups

examined the learning experience of four different surgeons, each having performed 30 consecutive laparoscopic TEP repairs; however, no conclusions were drawn on the exact duration of the learning curve for the procedure. Lau and colleagues [1] suggested that the learning curve for laparoscopic TEP repair was 80 procedures, and Aeberhard and colleagues [11] reported that the duration of surgery dropped significantly to less than 1 h after performing 100 repairs.

The learning curve for laparoscopic inguinal hernia repair has been evaluated in three large multicenter trials from Switzerland, the Netherlands and the UK [11]. All of these studies documented a significant decrease in operating time, conversion rate, complications and number of recurrences with increasing surgeon experience. The pre-peritoneal anatomy may be unfamiliar and confusing to many surgeons when they begin laparoscopic hernia repair. Correct tissue handling is also of great importance to obviate the risk of damaging the peritoneum, which is currently the most common reason for conversion because it results in the loss of operating space, thus making it impossible to complete the repair. During the

learning curve, most early recurrences are due to technical errors or the failure to identify the hernia defect properly. As the surgeon's experience increases, these types of errors become easier to correct. The presence of experienced supervising surgeons appears to be a definite advantage during the learning phase and can help to prevent unnecessary morbidity.

Felix et al. [13] examined 10,053 laparoscopic hernia repair performed by seven expert surgeons who had done >500 laparoscopic hernia repair to avoid any distortion caused by the learning curve. The results were spectacular—the recurrence rates were 0.22 % with TEP and 0.46 % with TAPP after a mean follow-up of 3 years. Felix et al. contend that lack of experience is the factor that has the greatest impact on the incidence of complications; as the surgeon's experience increases, better results can thus be expected.

Voitk demonstrated in his series of 98 TAPP repairs in 1998 that the operating time for the unilateral inguinal hernia repair began to level off after 50 operations [14]. The mean operating time was 59 min in the first quartile of operations which gradually improved to 37 min in the fourth quartile. He also found

Fig 2 Moving average graph to show the comparison of mean operating time between the two groups in TEP repair

Conflict of Interest This is an original article and no financial grants have been received for this work. The authors have no conflict of interest.

Authors' Contribution VKB and MCM were the operating surgeons and made substantive intellectual contributions in this study, including acquisition of data, interpretation and drafting/editing of the manuscript, and have given final approval of the version to be published. AK has given substantive intellectual contributions in this study and helped in the interpretation and drafting/editing of the manuscript and has given final approval of the version to be published. SK made substantive contributions to this study, including acquisition of data, interpretation and drafting/editing of the manuscript, and has given final approval of the version to be published. All authors read and approved the final manuscript.

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