Original Article

The Effect of Minimally-invasive Surgery Fellowships on General Surgery Resident Case Volume

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Background: Laparoscopic surgery has become the standard treatment for many diseases, and some complex operations are now using this technique. Minimally-invasive surgery (MIS) fellowship training was developed to improve the safety of the patients and develop the modality of laparoscopic surgery in Thailand; however, there has been some debate regarding its effect on general surgical resident training.

Objectives: The aim of this study was to test the hypothesis that the presence of the MIS fellowship has had no adverse effect on chief resident laparoscopic case volume.

Materials and Methods: The operative case logs of graduating residents and fellows from 2008 to 2014 were reviewed, focusing on both basic and complex laparoscopic cases and comparing those 2 groups in terms of number of performing surgeons and assistant surgeons.

Results: The number of residents graduating from June 2008 to May 2014 (6 to 11 residents per year) was 53 (31 before and 22 after the establishment of the MIS fellowship program). A significant increase was observed in the number of total laparoscopic cases performed by chief residents (13.74 before and 25.86 cases after, $p<0.001$). There was no significant difference in the average number of cases performed by the residents in either basic or complex laparoscopic procedures (0.61 vs. 1.50, $p = 0.124$ and 0.06 vs. 0.05, $p = 0.769$) before and after the MIS fellowships program, but the average assistant cases increased in both basic and complex laparoscopic procedures (7.55 vs. 14.18, $p = 0.001$ and 5.52 vs. 10.14, $p = 0.001$). Over the same period, our fellows (2 fellows per year) performed an average of 50 cases per year, most of which were complex laparoscopic cases.

Conclusion: Minimally-invasive surgery fellowships have had no adverse effect on the basic or complex laparoscopic case experience of general surgical residents. There was an increase in the number of cases involving participation of residents after the MIS program. The MIS fellowships and general surgical residency can coexist successfully.

Keywords: Minimally-invasive fellowship program, Resident training

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Laparoscopy has become the preferred approach for many operations. Minimally-invasive surgery is now routinely used to treat gallbladder disorders, and it is increasingly applied in appendicitis, gastroesophageal reflux disease, colorectal, hepatopancreatobiliary and vascular surgery. This has predictably led to an increase in the number of minimally-invasive cases performed by general surgery residents during training[4].

A general consensus exists among surgeons that speciality fellowship training provides valuable experience, yielding superior operative skills and patient care, and resulting in improved outcomes and fewer complications after surgical procedures. Reports of studies which have examined the impact of fellowships on resident surgical training are sparse, and almost without exception, they have many limitations. Nevertheless, they all concur that the addition of specific fellowships creates an overall positive experience for residents, as well as no adverse impact on surgical outcomes or complications.

With the increasing demand for laparoscopic procedures, the need for surgeons adequately trained in minimally-invasive techniques is expected to rise. After the recent increase in 2007 by the Accreditation Council for Graduate Medical Education (ACGME) requirements for the number of basic and advanced laparoscopic cases performed during residency training, there has been ongoing debate as to the effects of fellowships on general surgical resident training. There is continued concern that fellowships, especially MIS fellowships, may interfere with general surgery resident experience or case volume.

We hypothesized that the presence of minimally-invasive surgery fellowships in Rajavithi Hospital has had no adverse effect on general surgery resident laparoscopic

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case volume.

Materials and Methods

Rajavithi Hospital, an academic tertiary care center, has a 4-year residency program in general surgical resident training, with an average of 6 to 11 chiefs graduating each year. The MIS fellowship program was established in 2011, with 1 to 2 fellows each year.

After the protocol of this research had been reviewed and approved by the ethics committee of Rajavithi Hospital No. 111/2558, a retrospective study was performed, reviewing the hospital database of operative logs from 2008 to 2014. Two groups were established, 3 years before (2008 to 2011) and 3 years after (2011 to 2014) the minimally-invasive surgery fellowships program. The operative case numbers were provided by year without identification of the resident or fellow. The total number of cases performed per year was recorded, as well as the number of basic and complex laparoscopic cases.

Basic laparoscopic cases were defined as laparoscopic cholecystectomy and laparoscopic appendectomy, while complex laparoscopic cases included laparoscopic gastrostomy or jejunostomy, laparoscopic inguinal and incisional herniorrhaphy, laparoscopic bariatric cases, laparoscopic antireflux procedures, laparoscopic enterolysis, laparoscopic small or large bowel resection, laparoscopic renal and adrenal procedures, and laparoscopic splenectomy.

All statistical analyses performed in this study were designed to test the null hypothesis that resident laparoscopic case volume was not significantly different because of the presence of a minimally-invasive surgery fellow. Statistical significance was determined at an α level of 0.05. Study outcomes and variable comparisons were established a priori, and inferential statistics were calculated using appropriate univariate hypothesis testing. All continuous data were expressed as mean $\pm$ SD, minimum & maximum and were compared using independent student t-test samples analysis of variance. Man-Whitney U-test was employed where data was not normally distributed. Calculated test statistics were used to derive reported 2-tailed *p*-values, and these were considered statistically significant at $p<0.05$. Data manipulation and statistical analyses were performed using the IBM SPSS statistics version 22.

Results

From June 2008 to May 2014, a total of 53 residents and 6 fellows graduated from our program. The average number of total general surgery cases was 2,500 per year, and laparoscopic surgery cases accounted for about 16 percent of these. During the study period, no significant change was observed in the number of laparoscopic cases (mean before MIS = 895.3 cases/year, after MIS = 956.3 cases/year).

In this study, 53 chief residents were included: 31 before and 22 after the MIS fellowships program was established.

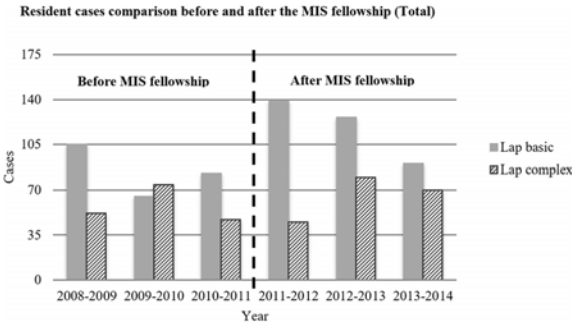

Figure 1. Chief resident experience of laparoscopic surgery (total cases) in Rajavithi Hospital.

Residents who graduated from June 2008 to May 2014 (6 to 11 per year) had experience with laparoscopic surgery as in Figure 1. Over the same period of time, our fellows (2 per year) performed an average of 50 cases per year, most of which were complex laparoscopic cases.

When comparing the two groups (before and after MIS fellowships program), a significant increase was observed in the number of total laparoscopic cases volume performed by chief residents (13.74 to 25.86 cases, $p<0.001$), in both basic and complex laparoscopic cases (8.16 to 15.68 basic cases, $p = 0.001$ and 5.58 to 10.18 complex cases, $p = 0.001$) as shown in Table 1.

We further compared the experience of residents and fellows in a basic laparoscopic case, cholecystectomy, as shown in Figures 2 and 3.

Discussion

During the past 2 decades, the independent clinical operative experience of the average finishing chief resident has been reduced because of a variety of factors, including the explosion of medical knowledge and the increasing role of specialization. A combination of all of these factors has left graduating residents with the feeling that they are incapable of independent practice on finishing residency, and this has led them to seek further training in unprecedented numbers, resulting in an explosion in postgraduate fellowships in a variety of surgical specialties. In 2001, Rattner et al found that 65% of residents felt they needed additional training[12]. Subsequently, an increase was noted in the number of residents seeking fellowships, reaching 77% in 2005 and remaining at that level in 2008. Bucholz et al found that residents who were worried about their skills were more likely to enroll in fellowships[3]. The popularity of postgraduate fellowship training in general surgical subspecialties appears to be here to stay.

With more fellowships, there is a great concern that the resident case volume may diminish. But in 2013, Peter T. Hallowell et al showed that a laparoscopic fellowship had not had an adverse impact on the complex or basic laparoscopic case experience of surgical residents.[6] In this

Table 1. Chief resident cases comparison before and after the MIS fellowship, Rajavithi hospital

Characteristics	Before MIS Fellowships (2008 to 2011) n = 31		After MIS Fellowships (2011 to 2014) n = 22		*p*-value
	Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)	
Basic laparoscopic					
Surgeon	0.61±0.88	0 (0 to 3)	1.50±1.95	1 (0 to 7)	0.124[A]
Assistant	7.55±3.24	8 (0 to 14)	14.18±7.64	12 (3 to 37)	0.001*
Total	8.16±3.58	8 (0 to 14)	15.68±8.98	13 (3 to 37)	0.001*
Complex laparoscopic					
Surgeon	0.06±0.25	0 (0 to 1)	0.05±0.21	0 (0 to 1)	0.769[A]
Assistant	5.52±2.99	5 (0 to 12)	10.14±5.24	8.5 (2 to 21)	0.001*
Total	5.58±2.98	5 (0 to 12)	10.18±5.22	9 (2 to 21)	0.001*
Total (basic + complex)	13.74±4.61	14 (0 to 22)	25.86±10.99	23 (9 to 56)	<0.001*

Values are presented as mean ± SD, median (Min-Max), * = Significant at $p<0.05$
All *p*-value from student t-test accepted [A] from Mann-Whitney U-test

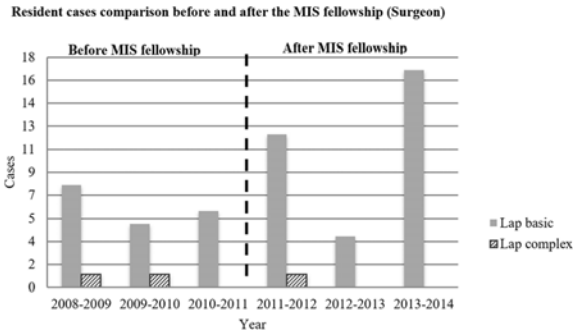

Figure 2. Chief resident experience of laparoscopic surgery (Surgeon) in Rajavithi Hospital.

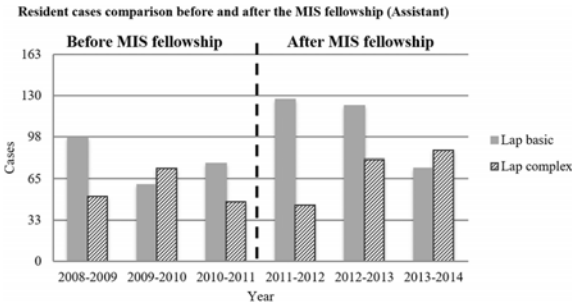

Figure 3. Chief resident experience of laparoscopic surgery (Assistants) in Rajavithi Hospital.

study, we found that there was no significant change in the number of laparoscopic surgery cases performed by chief residents, especially in the laparoscopic cholecystectomy, after the establishment of the MIS fellowship program, and there was a significant increase in total laparoscopic surgical cases performed with the participation of chief residents.

Our fellowship design allows residents and fellows to coexist. This provides a larger variety of cases from which the residents and fellows can choose; furthermore, when a fellow is serving in the role of attending surgeon for his or her own cases, it further allows opportunities for resident participation. At our institute, the average number of laparoscopic cases was significantly higher with a fellowship (Table 1).

We further compared the number of cases involving residents in basic and complex laparoscopic surgery acting as either surgeon or assistant (Figures 2 and 3).

There were some limitations in our research. This was a retrospective, single-institution study, and the validity of data from the operative logs was dependent on the accuracy and reliability of the data entered, so that the results may not be applicable to all residencies with fellowships. Secondly, we focused on resident case volume as a surrogate for adequate learning experience. We have no objective data on the residents' perceptions of their experience, and further studies may be necessary.

Conclusion

In our experience, our laparoscopic fellowship has not had an adverse impact on the complex or basic laparoscopic case experience of surgical residents. In a busy academic practice, laparoscopic fellowships and general surgical residency can coexist.

Adequate case volume for both fellows and residents is essential to ensure proper laparoscopic experience. Monitoring trainees' experience and case volumes serves as an ongoing confirmation that the operative experiences of both residents and fellows are being met in an ongoing fashion.

What is already known on this topic?

Nowadays, the laparoscopic technique has replaced open surgery as the standard treatment in many

fields of medicine, particularly in general surgery, enhancing instrumentation and the experience of the surgeons are key to its success. Complex operations in the past set major challenges which had to be overcome by laparoscopic surgery, and training programs underwent a paradigm shift towards minimally-invasive surgery. Our data shows that minimally-invasive fellowship training programs has not affected residency programs because complex cases can be handled by the fellow while primary cases could remain the realm of residents. Also, the resident gains more experience in advance surgery.

What this study adds?

These data show the effect of minimally-invasive fellowship programs on residents.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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