

# Open Cholecystectomy for the New Learner— Obstacles and Challenges

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## ABSTRACT

**Background:** Laparoscopy has become the standard of care in most general surgery procedures. This has led to a decrease in the number of open surgical procedures for surgical training, particularly as senior surgeons retire. The aim of this study was to evaluate the impact of retiring senior surgeons on our residents' operative experience.

**Methods:** Cholecystectomies performed between Jan 2010 and Dec 2016 were retrospectively reviewed. Surgeons training residents were divided into two groups based on their training experience. Group 1 were trained in the prelaparoscopic era, and group 2 were trained during the age of laparoscopy. We then evaluated the impact of retirement on the number of open cholecystectomies performed.

**Results:** There were 4555 laparoscopic cholecystectomies performed at our institution over a 7-year period. Overall conversion rate was 1.5% (66/4555). Conversion rates were higher in group 1 as compared to group 2. The analysis of the number of open cases performed by each graduating resident showed reduction in the number of open cholecystectomies performed over time.

**Conclusion:** The decline in the number of open cholecystectomies creates a challenge for the training of general surgery residents. To compensate, we have employed simulation curriculum with the use of cadaveric surgical anatomy courses. Additionally, with transplant curriculum, open cholecystectomy experience has increased with liver transplant exposure. Continued laparoscopic experience has also shown that advanced

laparoscopic techniques such as top down dissection laparoscopically have decreased the need for conversion to open and are skills that graduating residents possess.

**Key Words:** Open cholecystectomy, New learner, Obstacles, Challenges.

## INTRODUCTION

Laparoscopic cholecystectomy is the most commonly performed laparoscopic procedure in the United States. It is the standard of treatment for gallbladder disease in the United States. Although laparoscopic cholecystectomy is safe in terms of morbidity and mortality,<sup>1,2</sup> complications can arise. Common bile duct injury (0.49% – 1.2%) is the most common major complication, followed by vascular injury, bowel injury, complications related to pneumoperitoneum, as well as herniation at the 10-mm trocar site.<sup>3,4</sup> Complications are mainly influenced by the surgeon's experience and laparoscopic skills, as well as surgical pathology.<sup>5</sup> In an attempt to avoid these complications during challenging laparoscopic cases, surgeons convert to an open procedure. Most series report a conversion rate of 5–10%; however, others have reported lower rates in the 1–2% range.<sup>6,7</sup> Conversion rates vary depending on the institution, and it correlates directly with the laparoscopic skills of the surgeon, particularly, lower rates with more advanced laparoscopic skills. Namias and colleagues<sup>8</sup> showed that because of this, experience in open cholecystectomy is steadily decreasing.

Since the introduction of laparoscopic cholecystectomy 30 years ago, the number of open cholecystectomies performed by general surgery residents has declined. A study conducted at the University of Texas Health Science Center by Sirinek et al.<sup>9</sup> showed that “the average general surgery resident completing training in 2000 has performed 15.5 open cholecystectomies, versus 90 in the prelaparoscopic era. This figure decreased to 12.6 by 2004.” Subsequently, studies show that residents reported reduced confidence in the management of unexpected events during laparoscopic operations.<sup>10</sup>

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**Table 1.**  
Counts and Percentages of Total Procedures and Conversion Rates by Year

	2010	2011	2012	2013	2014	2015	2016	All Years
All, N								
Total	692	713	672	608	611	633	626	4555
Converted, N (%)	13 (1.8)	10 (1.4)	10 (1.5)	10 (1.6)	10 (1.6)	7 (1.1)	6 (1.0)	66 (1.5)
Open cases/resident	4.33	3.33	3.33	3.33	3.33	2.33	2.0	
Group 1, N								
Total	325	325	251	127	122	106	85	1341
Converted, N (%)	9 (2.8)	6 (1.9)	7 (2.8)	6 (4.7)	6 (4.9)	4 (3.8)	3 (3.5)	41 (3.1)
Open cases/resident	3.0	2.0	2.33	2.0	2.0	1.33	1.0	
Group 2, N								
Total	367	388	421	481	489	527	541	3214
Converted, N (%)	4 (1.1)	4 (1.0)	3 (0.7)	4 (0.8)	4 (0.8)	3 (0.6)	3 (0.6)	25 (0.8)
Open cases/resident	1.33	1.33	1.0	1.33	1.33	1.0	1.0	

The purpose of this study is to show whether our general surgery residents have acquired adequate exposure to open cholecystectomy to possess the technical skills needed to safely perform open cholecystectomy as an initial approach or as a result of conversion from a laparoscopic approach.

## MATERIALS AND METHODS

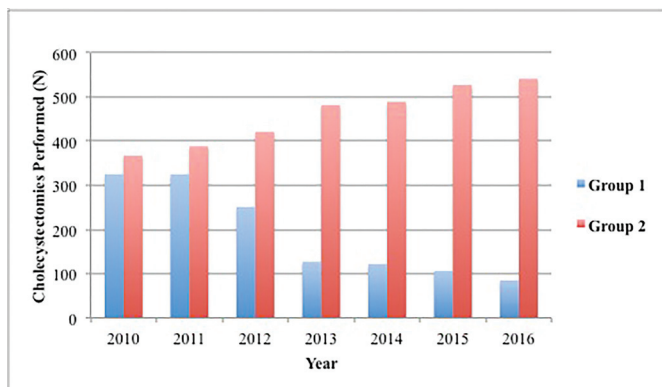
This retrospective study was reviewed and approved by the Institutional Review Board. Our institution is a community-based teaching hospital, which graduates 3 categorical residents per year. There were 4555 patients who underwent laparoscopic cholecystectomy between Jan 2010 and Dec 2016 at our institution. All conversions to open cholecystectomy were noted. No planned open cholecystectomies occurred. Surgeons involved in training residents were divided into 2 groups based on their personal training experience. Surgeons in group 1 received training in the prelaparoscopic era, before the rise of modern laparoscopy. Those who trained during the modern age of laparoscopy were placed into group 2. The total number of open cholecystectomies performed by surgeons in both groups 1 and 2 were calculated to show the total number of open cholecystectomies available for each chief resident.

## Statistical Analysis

All categorical data are described using counts and column percentages. All analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC).

## RESULTS

The number of laparoscopic cholecystectomies and the conversion to open cholecystectomies was reviewed at this facility over a 7-year period from Jan 2010 to Dec 2016 (**Table 1**). These numbers were shown as a raw number of laparoscopic versus open procedures, as well as a ratio of the number of open cases per year and per graduating general surgery resident (3 residents per year at this facility). These ratios were expressed and shown for the 2 groups of training surgeons: those trained in the prelaparoscopic era (group 1) and those trained in the laparoscopic era (group 2). There were 4555 laparoscopic cholecystectomies performed over the 7-year period. The overall conversion rate from laparoscopic to open cholecystectomy was 1.5% (66/4555; **Table 1**). Based on 3 categorical residents per year, this would permit each resident graduating in 2016 to perform 4.33 open cholecystectomies during their training. **Table 1** demonstrates that most of the conversions were in group 1. The overall conversion rate for group 1 is 3.1 compared to 0.8 for group 2. As we proceed from 2010 to 2016, we see a trend of



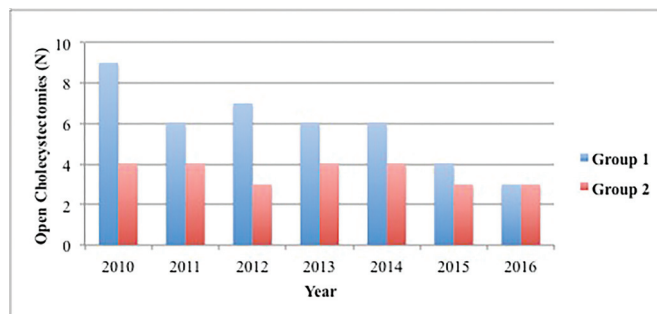
**Figure 1.** Number of cholecystectomies performed by group and year. Group 1 represents surgeons trained in the prelaparoscopic era and group 2 represents surgeons trained in the laparoscopic era.

decreasing numbers of cholecystectomies performed by group 1 surgeons and an increase in the number of cases performed by group 2 surgeons (**Figure 1**). As the number of cholecystectomies performed by surgeons in group 1 declines, the number of open cases also declines (**Figure 2**). As group 1 surgeons continue to retire, the overall number of open cases will continue to decrease tremendously.

## DISCUSSION

Laparoscopic cholecystectomy is the standard of care for treating gallbladder disease. After years of technological advancement in laparoscopy and increasing surgical experience, the number of patients undergoing open cholecystectomy has significantly decreased. However, those with complicated gallbladder pathology, such as extensive inflammation, intra-abdominal adhesions, or gallbladder cancer may still require an open approach. Additionally, Visser and colleagues<sup>11</sup> report that the most common indication for an open cholecystectomy today is that it is performed in conjunction with another procedure requiring laparotomy.

The conversion rate from laparoscopic to open cholecystectomy varies widely in reported series: some are at 10%, whereas other centers report rates that are closer to 1–2%.<sup>6,7</sup> Schulman and colleagues<sup>12</sup> in 2007 reported a 5.2% conversion rate for 745 patients undergoing laparoscopic cholecystectomy. Oymaci and colleagues<sup>13</sup> in 2014 reported a 27.9% conversion rate for 165 patients undergoing laparoscopic cholecystectomy for acute



**Figure 2.** Number of open cholecystectomies performed by group and year. As senior surgeons continue to retire the number of open cholecystectomies continues to decrease.

cholecystitis. Rates continue to decrease as reported by other authors.<sup>8,9</sup>

The question remains, are we adequately training our general surgery residents to possess the skills necessary to confidently and safely perform open cholecystectomy? There are no clearly defined numbers set by the Accreditation Council for Graduate Medical Education that define how many open cholecystectomies should be performed by each graduating general surgery resident.<sup>14</sup> Reines and Seneca<sup>15</sup> have commented that there is “no data on the number of open procedures necessary to make a competent surgeon.” Furthermore, de Costa<sup>16</sup> aptly notes that “there is a generation of surgeons emerging who have limited experience with the open operation.” He also notes that whereas the decision to convert to open technique may represent a retreat to common ground for an experienced senior surgeon, it may add unfamiliarity to an already hazardous situation for those with less experience.

In this study conducted at our institution, a community teaching hospital, we assessed the overall impact of decreasing numbers of open cholecystectomy on the residency training program. We looked at the average number of open cholecystectomies performed by each chief resident over a 7-year period. Analysis of data from all patients who underwent a cholecystectomy at our institution from Jan 2010 to Dec 2016 showed that the number of open cases varied between the two groups of surgeons. As shown in **Table 1**, there were more conversions in group 1 as compared to group 2. Additionally, as some of the surgeons in group 1 retired in 2013, the number of cholecystectomies in group 1 dropped from 325 to 127. As the number of general surgeons in group 1 continue to decrease due to retirement, we will be left with a marked reduction in the number of open cholecystectomies to less than 1 case per chief resident.

In modern-day training, residents are seeing minimal exposure to open cholecystectomies, raising concerns that residents may not be properly trained to perform open cholecystectomies. Sirinek et al.<sup>9</sup> stated that “this is problematic because they will not have enough know-how to take on a very complicated patient with severe inflammation secondary to acute/gangrenous cholecystitis.” Schauer and colleagues<sup>17</sup> first demonstrated the adverse effect of laparoscopic cholecystectomy on resident training. Our data and the literature to date support the contention of Visser et al.<sup>11</sup> that the “requisite technical skills” and “sufficient clinical experience” are problematic when it comes to performing open cholecystectomy. However, they suggest that this gap might be partially ameliorated by general surgery residents participating in a large number of emergency gastrointestinal and trauma procedures. They also contend “that the principles learned and experience gained from these cases are applicable to urgent biliary surgery.” An additional source of skills for complicated biliary tract surgery can be gained through elective operations involving pancreaticobiliary tumors according to Visser et al.<sup>11</sup> To make up for this deficit in the number of open cholecystectomies, several suggestions have been reported in the literature, but they have not been widely accepted. These suggestions include a video library of complicated biliary procedures available to residents, instructional presentations, and American College of Surgeons sponsored fellowships.<sup>18</sup> These adjuncts might make it possible for practicing young general surgeons in the future to possess the technical skills necessary to perform an open cholecystectomy, either initially or as a conversion from the laparoscopic approach.

As the emphasis for laparoscopic and simulation training continues to rise, the use of simulated learning techniques as adjunct learning will also continue to rise. In an attempt to provide simulated learning for open techniques, this program has employed simulation curriculum with the use of cadaveric surgical anatomy courses. During these courses both the surgical anatomy and the procedures can be taught in a simulated environment outside of the operating room to provide more adequate hands-on training.

Additionally, one reason for decreased conversion with laparoscopically trained surgeons is because of advanced laparoscopic skills that are subsequently passed down to training residents. One such skill is the use of a hybrid approach in which residents use a “top down” dissection approach during laparoscopy, similar to that which would be used during an open cholecystectomy. This technique provides a safe window of dissection just as the established critical view of safety, but with a different

perspective. Although teaching this technique decreases the rate of conversion to open, it also prepares residents for open dissection should they need to convert to open in difficult cases. Attendings are aware that this technique is challenging initially and an effort is made to use this technique in routine gallbladders as well as difficulty gallbladders to increase residents’ comfort level.

As has been shown by previous studies, residents are also exposed to open cholecystectomy during pancreaticobiliary procedures. The addition of a devoted transplant surgery rotation as required by the Accreditation Council for Graduate Medical Education has increased the exposure of senior residents to open cholecystectomies. As this rotation was not added until after the completion of this study, it is not evident how this will change the total number of open cholecystectomies performed by senior residents and would need to be evaluated further.

In conclusion, the number of open cholecystectomies will only continue to decrease in the coming years with increased skill in laparoscopy. As we examine the trends of the increasing numbers of laparoscopic procedures and the emphasis placed on this skill set during training, we see that there is an alarming trend of decreasing numbers of open surgical training. This decrease, as reflected in our results, can be expected to continue to fall dramatically as the generation of surgeons who trained prior to laparoscopy begin to reach the end of their careers. This gap in surgical training is not unique to general surgery alone; this problem is also currently being addressed in other fields such as gynecology and urology. This makes it necessary to take advantage of the few open cases available to them to adequately prepare. This applies not only to active case-load, but also to exposure via simulation, educational lectures, and videos. However, overall, the move to laparoscopic training is a great advancement in surgical training, and the skills used in laparoscopy translate well to the same procedures performed in the open setting.

## References:

1. Deziel DJ, Millikan KW, Economou SG, Doolas A, Ko ST, Airan MC. Complications of laparoscopic cholecystectomy: a national survey of 4,292 hospitals and an analysis of 77,604 cases. *Am J Surg.* 1993;165(1):9–14.
2. Goodman GR, Hunter JG. Results of laparoscopic cholecystectomy in a university hospital. *Am J Surg.* 1991;162(6):576–579.
3. Scott TR, Zucker KA, Bailey RW. Laparoscopic cholecystectomy: a review of 12,397 patients. *Surg Laparosc Endosc.* 1992; 2(3):191–198.

4. Bailey RW, Zucker KA, Flowers JL, Scovill WA, Graham SM, Imbembo AL. Laparoscopic cholecystectomy: experience with 375 consecutive patients. *Ann Surg.* 1991;214(4):531–540.
5. Kumar V, Pande GK. Complications of cholecystectomy in the era of laparoscopic surgery. *Trop Gastroenterol.* 2001;22(2):72–79.
6. Livingston EH, Rege RV. A nationwide study of conversion from laparoscopic to open cholecystectomy. *Am J Surg.* 2004;188(3):205–211.
7. Tang B, Cuschieri A. Conversions during laparoscopic cholecystectomy: risk factors and effects on patient outcome. *J Gastrointest Surg.* 2006;10(7):1081–1091.
8. Namias N, McKenney MG, Sleeman D, Hutson DG. Trends in resident experience in open and laparoscopic cholecystectomy. *Surg Laparosc Endosc.* 1997;7(3):245–247.
9. Sirinek KR, Willis R, Schwesinger WH. Who will be able to perform open biliary surgery in 2025? *J Am Coll Surg.* 2016;223(1):110–115.
10. Chung RS, Wojtasik L, Pham Q, Chari V, Chen P. The decline of training in open biliary surgery: effect on the residents' attitude toward bile duct surgery. *Surg Endosc.* 2003;17(2):338–340.
11. Visser BC, Parks RW, Garden OJ. Open cholecystectomy in the laparoendoscopic era. *Am J Surg.* 2008;195(1):108–114.
12. Schulman CI, Levi J, Sleeman D, Dunkin B, Irvin G, Levi D, et al. Are we training our residents to perform open gallbladder and common bile duct operations? *J Surg Res.* 2007;142(2):246–249.
13. Oymaci E, Ucar AD, Aydogan S, Sari E, Erkan N, Yildirim M. Evaluation of affecting factors for conversion to open cholecystectomy in acute cholecystitis. *Prz Gastroenterol.* 2014;6:336–341.
14. Department of Applications and Data Analysis, Accreditation Council for Graduate Medical Education. General surgery case logs: national data report 2007. Available from: <https://www.acgme.org/acgmeweb/portals/0/PDFs/GSNatData0607.pdf> [Accessed October 5, 2015].
15. Reines HD, Seneca RP. Enough, but not too much: or, are we the dinosaurs? *J Am Coll Surg.* 2005;200(6):930–931.
16. de Costa A. Teaching gallbladder surgery: remembrance of things past, or defensive cholecystectomy revisited. *Aust N Z J Surg.* 1999;69(12):834–836.
17. Schauer PR, Page CP, Stewart RM, Schwesinger WH, Sirinek KR. The effect of laparoscopic cholecystectomy on resident training. *Am J Surg.* 1994;168(6):566–569.
18. Lasko-Harvill A, Blanchard C, Lanier J, McGrew D. A fully immersive cholecystectomy simulation. In: Satava RM, Morgan K, Sieburg HB, Mattheus R, Christensen JP (editors): *Interactive Technology and the New Paradigm for Healthcare*. IOS Press: Amsterdam 1995:182–186.