Teaching Surgical Residents Dome-Down Laparoscopic Cholecystectomy in an Academic Medical Center

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ABSTRACT

Background: Although laparoscopic cholecystectomy is the most commonly performed laparoscopic procedure in the United States, complications may still arise, especially when acute inflammation or aberrant anatomy is present. In these situations, surgeons may choose to convert to a variation of the traditional laparoscopic cholecystectomy, the “dome-down” approach. We assessed the best approach to teaching this technique as a secondary method in an academic teaching hospital.

Methods: Surgical residents were first given didactic instruction on the dome-down laparoscopic cholecystectomy, then trained in the animate laboratory, and finally graduated to the operating room. Following training, the residents completed a 7-question questionnaire to assess their reaction to this method. The charts of 98 patients who underwent dome-down laparoscopic cholecystectomy were retrospectively reviewed to assess the complications associated with the procedure, the average operative time, and length of hospital stay.

Results: The resident questionnaire showed that the learning curve was dramatically affected when an adequate number of cases were performed. The mean number needed to gain competency was 14.7. The use of animate simulators was also important. The mean operative time was 78.40 minutes, with most cases performed by postgraduate year-2 and -3 residents. Only one complication, bile peritonitis, arose early in the study.

Conclusion: Dome-down laparoscopic cholecystectomy must be taught to surgical residents as a secondary approach to use when faced with a difficult case. The most important factor in teaching this technique is exposure to an adequate number of cases. The use of animate simulators and didactic training is also helpful.

Key Words: Dome-Down, Laparoscopic cholecystectomy, Resident training.

INTRODUCTION

Laparoscopic cholecystectomy (LC) is the most commonly performed laparoscopic procedure in the United States. Since the acceptance of the technique in 1988, it has become the preferred method for removal of the gallbladder. Multiple studies have shown LC to be safe in terms of morbidity and mortality.\(^1\)–\(^4\) When combined with shorter in-hospital stays for the majority of patients, LC is also more cost effective than open cholecystectomy.\(^2\),\(^4\) However, LC is known to have a slightly higher complication rate than open cholecystectomy, with the most common complication being injury to the common bile duct (0.49% to 1.2%)\(^1\),\(^3\),\(^4\) followed by vascular injury, bowel/hollow viscous injury, pneumoperitoneum-related complication, wound infection, and trocar site herniation.\(^1\),\(^5\)

The major factors in most, if not all, cases of intraoperative complication are operator inexperience, significant inflammation, difficulty in identification of the operative plane and/or pertinent anatomy, and electrocautery-related injury.\(^5\)–\(^10\) Historically, in each of these situations, surgeons may attempt to avoid complications by using a different laparoscopic approach or forego any laparoscopic techniques and convert to an open cholecystectomy. The dome-down laparoscopic cholecystectomy (DDLC), described by Drs Geiss and Fullum,\(^11\) is a common secondary technique that may be safer in acutely inflamed patients, in the presence of aberrant anatomy, and in the hands of less-experienced surgeons. The technique uses a retrograde approach and also the ultrasonic scalpel\(^11\) in lieu of electrocautery. However, if surgical residents only practice this approach when faced with acute circumstances, is their training adequate for them to be competent in this technique after residency?

The purpose of this study was to determine the optimal methods to teach surgical residents in an academic teach-
ing hospital dome-down laparoscopic cholecystectomy as a secondary technique while ensuring that their training in this technique was sufficient to use in future cases after residency. Our secondary goals were to determine the average operative time for the procedure, and to assess complication rates and length of postoperative hospital stay.

**METHODS**

Prior to using dome-down laparoscopic cholecystectomy in the operating room, the surgical residents at an academic teaching hospital were given didactic lessons on the procedure in a classroom setting. Following these lessons, the residents practiced the procedure in a porcine animate simulation center. Once the attending surgeon determined that the residents were able to perform the technique safely in the patient setting, the residents graduated to the operating room. They performed 98 consecutive dome-down laparoscopic cholecystectomies in a 41-month period while under intensive supervision.

The patients in these cases all had an indication for cholecystectomy but did not necessarily have significant inflammation or aberrant anatomy. Rather, these cases were performed in an attempt to achieve resident competency in the dome-down technique under nonacute circumstances.

After this 41-month period, the surgical residents completed a questionnaire comprising 7 questions. This questionnaire was designed to poll residents concerning their individual experience with both LC and DDLC, their impression of the advantages and disadvantages of DDLC, and their satisfaction with the methods used to train them in the DDLC technique (Figure 1).

After DDLC was completed in all 98 patients, the medical records of these patients were retrospectively reviewed and evaluated for operation time, length of hospital stay, and complications during and following the procedure.

All procedures were performed with the dome-down technique as described by Drs Geiss and Fullum.\(^1\) A 2-handed technique and a standard 4-trocar approach were used. Pneumoperitoneum was established and maintained at 15 mm Hg. Following insufflation, the optic was introduced via a nonbladed 10/12-mm infraumbilical visiport. A 10/12-mm instrument port was placed in the upper midline (left of the Falciform ligament) and two 5-mm instrument ports were placed in the right upper quadrant. This procedure has since been updated to the use of a 5-mm port in the upper midline instead of the second 10/12-mm port.

Once the gallbladder was adequately exposed, it was grasped by the dome and dissected free of the liver bed by using electrocautery in the first few patients and then an ultrasonic scalpel thereafter. The ultrasonic scalpel was set on level 2 with curved blades used on variable settings for improved hemostasis. Once the gallbladder was free of

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**Figure 1.** Questionnaire for “Dome-Down” laparoscopic cholecystectomy.
the liver bed, the anatomy of Calot’s triangle was identified by careful, blunt dissection. The cystic artery was transected with the ultrasonic scalpel, then the cystic duct was ligated by using a ligature loop and transected with the ultrasonic scalpel. The gallbladder was removed from the body via the 10/12-mm incision. A specimen bag was used only if the gallbladder had been perforated or if the integrity of the gallbladder was questionable.

RESULTS

General Characteristics

The residents performed dome-down laparoscopic cholecystectomies on 98 patients (14 male and 84 female) with a mean age of 39 years (range, 18 to 72). The mean operative time was 78.40 minutes (range, 40 to 155) with most cases performed by Post Graduate Year (PGY)-2 and PGY-3 residents. None of the cases required conversion to open cholecystectomy. The mean hospital stay was 29.3 hours, with 83% of patients being discharged from the recovery room or within the first 23 hours.

Complications

Only one complication was reported (1.0%). It was identified during one of the earliest cases performed before use of the ultrasonic scalpel. The complication resulted in readmission of the patient 14 days after discharge with bile peritonitis secondary to a biloma. A leak from the left main hepatic duct was identified during endoscopic retrograde cholangiopancreatography. This was found to have resulted from an unrecognized injury when electrocautery was used to coagulate bleeding from the liver bed. The patient was successfully treated with abdominal wash out and stent placement. The patient fully recovered and was discharged to home without further problems.

Resident Questionnaire

Twenty surgical residents, PGY-1 through -5, completed the 7-question questionnaire. The average number of traditional laparoscopic cholecystectomies performed by these residents was 49. Their average number of dome-down laparoscopic cholecystectomies performed at the time of completing the survey was 4.6. The mean number of cases that the residents felt were needed to attain competency in the performance of DDLC was 14.7. Although this number is much less than the historical number of ≤40 cases needed to be competent in the traditional laparoscopic cholecystectomy,12 the residents answering this question were already trained in traditional laparoscopic cholecystectomy. Therefore, when comparing the complexity of the DDLC and traditional LC on a scale from 1 to 10 with 10 being the most complex, the residents answered that the DDLC was a complexity level of 5 on average and the traditional LC was a complexity level of 4 on average. When asked which part of the training methods used in this study enhanced their learning of the DDLC procedure, 50% of the residents believed their learning curve was dramatically affected by exposure to greater numbers of DDLC cases in the patient setting. Thirty-six percent of residents believed the learning curve improved with animate lab experience. Residents who had performed DDLC in at least 3 animal lab sessions and 5 operative cases were more likely to have a greater comfort level with the DDLC in the patient setting. Of the residents who were planning on performing laparoscopic cholecystectomies in their future practices, 67% said they would use the DDLC technique under appropriate circumstances. The remainder of residents cited difficulty visualizing the anatomy due to bleeding and substantially greater comfort performing the traditional laparoscopic cholecystectomy as reasons why they would not use the dome-down approach in their future practices. Junior residents (PGY-1 through PGY-3) who had less experience with traditional LC and more lab opportunities were less likely to approach the DDLC negatively and were found to be able to incorporate the technique more rapidly and effectively.

DISCUSSION

The purpose of teaching residents to perform dome-down laparoscopic cholecystectomy is to provide them with an alternative method for laparoscopic removal of the gallbladder in technically difficult cases, particularly when altered anatomy or acute inflammation exists. However, DDLC is not intended to replace good surgical judgment and converting to open cholecystectomy should be used when applicable. In this study, we developed a method that would enhance the learning curve of residents training in the DDLC procedure. Not only did we use classroom didactics and animate laboratories, but also the residents performed the dome-down technique in consecutive LCs in an effort to expose the residents to a sufficient number of cases to develop competency in this procedure.

Based on the results from the resident’s questionnaire, the most important aspect to training residents in this procedure...
is exposure to an adequate number of cases in the operating room. Performing 14 DDLCs during a surgical residency may be difficult with only a few attending surgeons teaching this method. This is why having the residents perform the DDLC in consecutive cases where the patients do not necessarily have acute inflammation or aberrant anatomy may provide the necessary number of cases for proper training. Additionally, as seen by the results of our questionnaire, simulator training improves the laparoscopic skills and increases the confidence level of the residents prior to performing this procedure in the operating room.

The early use of electrocautery led to our only complication of a biliary leak that resulted in readmission secondary to bile peritonitis. However, this type of injury may have been avoided by the use of the ultrasonic scalpel based on its safety profile and the lack of stray current that can be associated with traditional electrocautery.

CONCLUSION

Future studies may include follow-up with the residents participating in this study to determine whether they do indeed use the dome-down laparoscopic cholecystectomy in their own practices and their comfort level with the procedure at the time of use. Another suggestion might be to incorporate this training method in multiple academic teaching facilities, then prospectively look at the number of cases needed to gain competency in performing the dome-down laparoscopic cholecystectomy compared with those facilities that have not incorporated this method.

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