

Harmonic Scalpel and Clipless Cholecystectomy

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Abstract

Background: The ultrasonically activated (Harmonic) scalpel has proven to be an effective, efficient, and safe instrument for dissection and hemostasis in both open and laparoscopic surgical procedures. This Harmonic scalpel work on the tissue's cutting and coagulating very effectively with the replacement the high frequency current, which can be connected with diverse complications. The principle is transforming of the electric power into mechanical longitudinal movement of the working part of the instrument, by piezoelectrical transducer situated in the handpiece. The primary use of the Harmonic scalpel in laparoscopic cholecystectomies has been for the division of the cystic artery and liver bed dissection. Advancements in the Harmonic scalpel blade tip now provide for the reliable ultrasonic division and closure of the cystic duct.

Keywords: Harmonic scalpel, Cholecystectomy.

INTRODUCTION

Designed as a safe alternative to electrocautery for the hemostatic dissection of tissue, the ultrasonically activated (Harmonic) scalpel was introduced into clinical use nearly a decade ago. This innovative method of cutting tissue was based upon the coagulating and cavitation effects provided by a rapidly vibrating blade contacting various tissues.^{1,2} The resulting decrease in temperatures, smoke, and lateral tissue damage placed the Harmonic scalpel in contrast to the effects seen with the more traditional electrocautery. In addition, the elimination of inadvertent, sometimes unrecognized, electrical arcing injuries with their potentially hazardous sequelae supported the role of the Harmonic scalpel as a potentially safer instrument for tissue dissection. Since its inception, the Harmonic scalpel has gained significant clinician acceptance and applications. Uses now range widely to include surgery of the head and neck, chest, liver, spleen, kidney, adrenal glands, colon, rectum, gastroesophageal junction, and others. Although variously described in the literature, wide acceptance and usage of the Harmonic scalpel for standard laparoscopic cholecystectomies is lacking among our American general surgeon colleagues. Clip and cautery techniques predominate. Furthermore, total Harmonic scalpel dissection in the performance of a laparoscopic cholecystectomy is a

technique described only in the European literature³ and, at best, is only anecdotal in the United States. This study was undertaken to demonstrate the efficiency, safety, and cost effectiveness of the Harmonic scalpel as the sole instrument to achieve complete hemobiliary stasis in the performance of laparoscopic cholecystectomies.

CASE REPORT

Patient ages ranged from 17 years to 73 years, and treatment was rendered in both elective outpatient and acute inpatient settings. Operative procedures were performed with the patient under general anesthesia and placed in the standard supine, crucifix, reverse-Trendelenburg position. Pneumoperitoneum was achieved by either Veress needle or visually guided cannula CO₂ insufflation. All procedures were performed through 2 operative ports and a camera port. Dissection of the gallbladder was initiated at the Triangle of Calot with identification, skeletonization, and division of the cystic duct and artery. Antegrade mobilization of the gallbladder from the liver bed followed with subsequent removal of the specimen through the umbilicus. In all but 2 cases, closure and division of the cystic duct and artery as well as mobilization of the gallbladder from the liver bed were accomplished solely with the Harmonic scalpel equipped with an LCS-C5 curved blade tip at a level 2 setting. Two patients with visibly large cystic ducts (greater than 5 mm) underwent additional Endoloop closure of the duct remnant. No intraoperative cholangiograms were performed. Any patients presenting with clinical evidence of choledocholithiasis or biliary pancreatitis underwent preoperative endoscopic retrograde cholangiopancreatography (ERCP) evaluation and treatment. All patients were evaluated up to 4 weeks postoperatively in the office.

BACKGROUND

Laparoscopic cholecystectomy is frequently complicated by gallbladder perforation and loss of bile or stones into the peritoneal cavity. The aim of this study was to compare the use of ultrasonic dissection and electrocautery with respect to the incidence of gallbladder perforation and intraoperative consequences.

Methods

Patients undergoing elective laparoscopic cholecystectomy were randomized to electrocautery or ultrasonic dissection of the gallbladder. The main outcome measures were gallbladder perforation, operating time and the number of times the lens was cleaned. Univariate and multivariate analyses were performed.

Conclusion

The use of ultrasonic dissection in laparoscopic cholecystectomy reduces the incidence of gallbladder perforation and helps the operation to progress. Less experienced surgeons benefit most from ultrasonic dissection, particularly in complicated intraoperative circumstances.

Advantages and Limits

The disadvantage of monopolar coagulation, the limits of the bipolar coagulation and the frequent changes of instruments during laparoscopic procedures, are three elements that make the harmonic dissectors very useful in laparoscopic surgery.

Results and Conclusions

After our short experience with HS and in concordance with literature, we consider that: The advantages are: the features to coagulate nearest delicate anatomic structures (biliary tree, large bowel, blood vessels) the absence of the smog and the slag; the scissors is a versatile device which allows the dissection and the coagulation without changes the instruments. The limits are: hemorrhages after insufficient coagulation or prehension, the necessity of the learning curve, high costs of the disposable materials. The HS device represents a real progress, especially for that laparoscopic surgery which requires the coagulation of blood vessels placed in thick and fat structures.

COMPLICATION OF HARMONIC SCALPEL

Background

The harmonic scalpel is an ultrasonically activated surgical instrument for tissue dissection. Despite its expanding surgical applications, there are no reports about associated complications.

CASE: A 35-year-old woman sustained injury to the sigmoid colon from the use of the harmonic scalpel during laparoscopic lysis of pelvic adhesions. The injury was identified and repaired laparoscopically in a primary fashion with no subsequent sequelae.

Conclusion

Acoustic energy coupling and overheating of the laparoscopic blade extender sheath occur with bending of the instrument.

This can happen with steering of the blade extender during laparoscopic surgery and may increase the exposure risk of adjacent tissues to injury.

Results

There was no conversion to open cholecystectomy and no intraoperative or immediate postoperative complications. The operative times varied depending on the degree of pericholecystic and cholecystic and/or associated intraperitoneal adhesions with an average incision to closure time of 42 minutes. Division of the cystic duct by the harmonic scalpel required approximately 2 to 3 minutes, depending on the ductal thickness and associated inflammation. In general, the cavitation effect on the surrounding pericholecystic tissues, especially in the region of the liver bed, allowed for easier mobilization of the gallbladder, thus avoiding inadvertent compromise of the gallbladder wall and bile spillage. No Liver bed charring or bilious seepage from any ducts of Luschka was observed. Length of procedure, hospital stay, and return to full functional status did not vary significantly from patients observed previously (personal experience) who underwent clip and cautery procedures. All patients evaluated in the office postoperatively demonstrated no evidence of bile leakage or atypical complaints.

DISCUSSION

This study clearly demonstrates that the Harmonic scalpel provides complete and reliable hemobiliary stasis in most patients undergoing laparoscopic cholecystectomies. In all patients who underwent division of the cystic duct and artery by harmonic scalpel alone, there were no clinically apparent immediate or remote postoperative bile leaks or hemorrhages. In the 2 patients with larger diameter cystic ducts (greater than 5 mm) identified intraoperatively, closure was accomplished with application of a chromic Endoloop. Harmonic scalpel division alone was not attempted due to the inherent limitations of the instrument. Except for the 2 to 3 minute interval required for cystic duct division, use of the harmonic scalpel did not adversely affect the length of procedures. In fact, properties intrinsic to the harmonic scalpel (cavitation and smokeless coagulation) seem to provide an advantage over electrocautery in the dissection of the gallbladder and may enhance surgeon performance. Certainly, harmonic scalpel division of the cystic duct could be utilized independently of the direction of gallbladder dissection. One additional benefit of harmonic scalpel dissection of the liver bed is the more effective closure of the ducts of Luschka. While rarely of clinical significance, bile leakage from the liver bed may contribute to postoperative pain, small bilomas, and the occasional return to the operative room. Objective data documenting length of hospitalization and

resumption of normal activities were not studied. In a previous investigation, Tsimoyiannis et al⁸ demonstrated comparable recovery times in patients undergoing laparoscopic cholecystectomies using ultrasonically activated shears for dissection when compared with patients undergoing the more traditional clip and cautery technique. Subjective observations throughout this study would substantiate this finding. There appears to be a cost benefit when using a single disposable instrument (LCS-C5 Harmonic scalpel blade tip), especially when compared with the usage of the disposable Endoshears and clip-applier in combination. At Clark Memorial Hospital, the difference is approximately \$20.00 per case. The cost benefit is more apparent in cases where other disposable instruments are used in conjunction with the Harmonic scalpel. However, it would be unrealistic to extrapolate these savings on a national level. Instrument costs vary considerably across the United States, depending on manufacturer fees, regional distribution contract fees, and hospital markups. Hopefully, a cost benefit would be realized in the majority of the country.

CONCLUSION

The Harmonic scalpel is a safe, efficient, and practical instrument to use during laparoscopic cholecystectomies, and its role can be expanded to include complete hemobiliary stasis.

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