

Needlescopic Clipless Cholecystectomy as an Efficient, Safe, and Cost-effective Alternative With Diminutive Scars

The First 1000 Cases

Gustavo L. Carvalho, MD, PhD,* Frederico W. Silva, MD,† José Sérgio N. Silva,*
Pedro Paulo C. de Albuquerque,* Raphael de Macedo C. Coelho,* Thiago G. Vilaça, MD,*
and Cláudio M. Lacerda, MD, PhD*

Background: The advent of natural orifice transluminal endoscopic surgery (NOTES) and single-incision laparoscopic surgery (SILS), surgery without skin scarring, is now challenging every surgeon to improve the esthetic results for patients. Minilaparoscopic cholecystectomy (MLC) represents a refinement in laparoscopic surgery, potentially as cosmetically effective as NOTES. Nevertheless, because of the increased cost and difficulty in managing the equipment, it has not been widely accepted among surgeons.

Objective: To report modifications of the minilaparoscopic technique that make it possible to conduct needlescopic procedures safely and effectively, thereby, considerably reducing costs and promoting the dissemination of this operation.

Method: One thousand consecutive patients who underwent MLC were analyzed, from January 2000 to May 2009 (78.7% women; average age 45.9 y). Surgical technique: after performing the pneumoperitoneum at the umbilical site, 4 trocars were inserted; 2 of 2 mm, 1 of 3 mm, and 1 of 10 mm in diameter, through which a laparoscope was inserted. Neither the 3-mm laparoscope, nor clips, nor manufactured endobags were used. The cystic artery was safely sealed by electrocautery near the gallbladder neck and the cystic duct was sealed with surgical knots. Removal of the gallbladder was carried out, in an adapted bag made with a glove wrist, through the 10-mm umbilical site.

Results: The operative time was 43 minutes. The average hospital stay was 16 hours. There was no conversion to open surgery; 2.8% of patients underwent conversion to standard (5 mm) laparoscopic cholecystectomy because of difficulties with the procedure; there were 1.9% minor umbilical site infections and 1.0% umbilical herniations. There was no mortality; no bowel injury, no bile duct injury, and no postoperative hemorrhage, only 1 patient with Luschka's duct bile leakage needed a reoperation.

Conclusions: The MLC technique shows no differences in risks as compared with other laparoscopic cholecystectomy procedures. It also entails a considerable reduction in cost, and, as it does not use the 3-mm laparoscope or disposable materials, it is possible to perform MLC on a larger number of patients. Owing to the near invisibility of scars, MLC may also be considered as cosmetically effective as NOTES and SILS.

Key Words: cholecystectomy, surgical-technical, laparoscopy, mini-instruments, needlescopic, minilaparoscopy, gallbladder

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Evolution in surgical techniques has been proven to bring advantages to surgeons. Such techniques often undergo many years of development before being presented to the world surgical community. In the mid-1980s, laparoscopic techniques with their minimally invasive incisions were widely recognized as a better surgical option to replace the traditional incision for open cholecystectomy, such as the Langenbuch Technique, 1882. Soon, laparoscopic techniques became mandatory in this surgical procedure, because they allowed a shorter hospital stay, a less painful procedure, quicker recovery, and better esthetic results.^{1,2}

Recently, minimally invasive surgery has made great strides and it has been possible to develop equipment with a greater accuracy and with an even more reduced diameter, which has brought us to the state-of-the-art of 2-mm and 3-mm instruments (needle trocars). The use of needlescopic instruments has shown even better results when compared with the widely used laparoscopic instruments.^{1–3}

Cystic duct closure with clips was largely used as the standard procedure in the late 1980s with the laparoscopic surgery technique. The clips, despite some inherent problems in their use, are widely accepted among laparoscopic surgeons for being more simple and faster. To perform minilaparoscopic cholecystectomy (MLC) at the time of clip placement an optic change (10-mm umbilical to 2-mm/3-mm minilaparoscopic one inserted at the epigastric incision) is necessary during the clipping, making it possible to insert the clip applicator through the umbilical trocar.^{1–9}

This optical change implies the use of 2 laparoscopes, which increases the operating time. In addition, the minilaparoscopic scope is expensive, has a short lifetime and an inferior image quality, when compared with the standard 10-mm scope, making its use not economically feasible for cholecystectomy or other minilaparoscopic procedures.

Despite the advantage of less trauma and a better cosmetic outcome, these aspects were not enough to motivate surgeons to adopt the minilaparoscopic practice.^{1–9}

The advent of natural orifice transluminal endoscopic surgery (NOTES) and single-incision laparoscopic surgery (SILS), surgery without skin scarring, is now challenging every surgeon to improve the esthetic results for patients.^{10,11} MLC represents a refinement in laparoscopic

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From the †Clínica Cirúrgica, Videolaparoscópica Gustavo Carvalho;
and *Department of Surgery, Faculdade de Ciências Médicas
(FCM), Member of SAGES, SOBRACIL, ELSA and Brazilian
College of Surgeons (CBC), Universidade de Pernambuco (UPE),
Recife, Brazil.

Reprints: Gustavo Carvalho, MD, PhD, Avenida Boa Viagem 5526B
Ap1902, Recife, Pernambuco 51030-000, Brazil (e-mail: gc@elogica.
com.br; glcmd1@gmail.com).

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surgery, potentially as cosmetically effective as NOTES. Nevertheless, because of the increased cost and difficulty in managing equipment, MLC has not yet been widely accepted by surgeons.¹²

The aim of this retrospective study with 1000 patients is to present a solution by replacing the usual needlescopic cholecystectomy for a simpler, safer, and more effective procedure, thereby, reducing costs and making it possible for this practice to become a routine procedure available to a greater number of surgeons.

PATIENTS AND METHODS

From January 2000 to May 2009, MLC was attempted in 1000 patients suffering from symptomatic chronic gallstone cholecystitis or gallbladder polyps (6.5%). The 78.7% of patients were women, with an age of 45.9 (range: 10 to 94 y) and 27.6 Kg/m² Body Mass Index in average (range: 18.2 to 42.8) and 16.2% suffering from acute cholecystitis. All these patients were first submitted to clinical evaluation and laboratory tests. Abdominal ultra-sonography was performed before the surgical intervention. The same surgical team worked with all cases. No exclusion criteria were used and needlescopic cholecystectomy was attempted in all patients eligible for cholecystectomy and in difficult cases, when judged necessary by the surgical team, the procedure was converted to the standard 5-mm port operation.

Surgical Technique

The positioning of the surgical team and trocar is shown in Figure 1. The pneumoperitoneum was performed by open technique at the umbilical site where a 10-mm trocar was inserted and maintained at an intra-abdominal pressure of 8 to 12 mm Hg throughout the procedure. As soon as the pneumoperitoneum was established, a 30 degree/10-mm scope was inserted through the umbilical trocar. Three other trocars were inserted. The 3-mm epigastric trocar was used for the hook, the suction, grasper forceps, and scissors (all 3-mm equipment). Other two 2-mm trocars were inserted at the right subcostal

region by the 2-mm grasper forceps and positioning was similar for all patients (Fig. 1).¹²

After the trocar insertion, an abdominal cavity evaluation was performed before the start of the procedure. Any potentially complex cases are, at this time, converted to standard 5-mm trocars including very inflamed or fibrotic gallbladder neck with impossibility of safe dissection, cancer suspicion, and massive intraoperative bleeding.

The procedure starts with the dissection of the neck; the cystic artery is identified and carefully cauterized in a relatively long segment of approximately 5 mm using monopolar electrocautery near the gallbladder neck, thereby avoiding injuries to the bile ducts (Fig. 2). The cystic duct is now closed with surgical knots using 2-0 polyester (Fig. 3) and the gallbladder dissection and liver hemostasis are made with a monopolar hook. When necessary, cholangiographic studies can also be performed (Fig. 4).

After the gallbladder has been completely released, the hemostasis is reviewed and the whole abdominal cavity is checked for injuries. A hand-made bag using the cuff of a sterile glove is always used to remove the gallbladder, replacing the expensive manufactured endobag. This bag is essential to avoid the use of the 3-mm scopes for safe remove the gallbladder. This bag is inserted through the 10-mm trocar site with the removal of the scope. The scope is then reinserted. The gallbladder is put in the bag and conducted by the most lateral forceps straight to the scope trocar under direct vision, from where it is removed. No clips, manufactured endobags or 3-mm minilap scopes were used in these procedures.¹²

RESULTS

In the 1000 patients undergoing this procedure, the average total operating time was 43 minutes (25 to 127 min). There was no conversion to open surgery. In 2.8% of the patients, it was necessary the convert to conventional 5-mm port laparoscopic cholecystectomy. No 10-mm port conversion was necessary.

The following complications were observed: umbilical site infection in 1.9% and umbilical incision herniation in

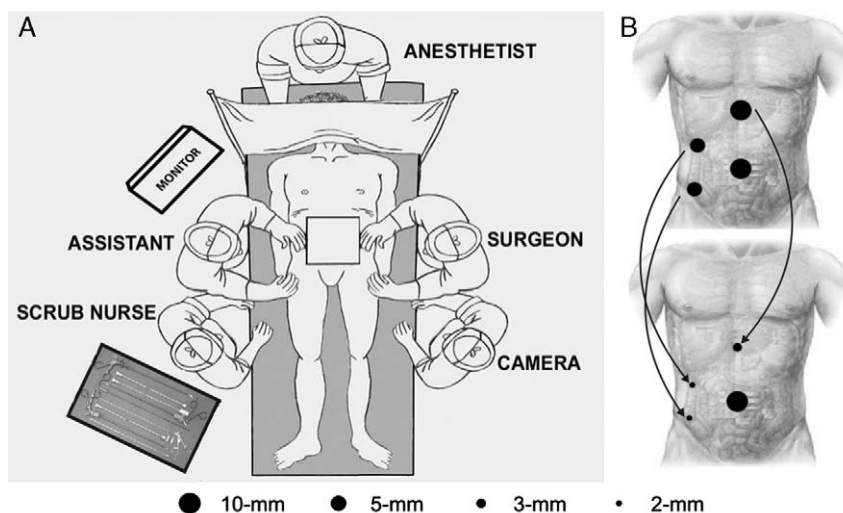


FIGURE 1. A, Positioning of the patient and the surgical team. B, The location of the 5-mm/10-mm trocars, which are replaced for the 2-mm/3-mm trocars are represented.

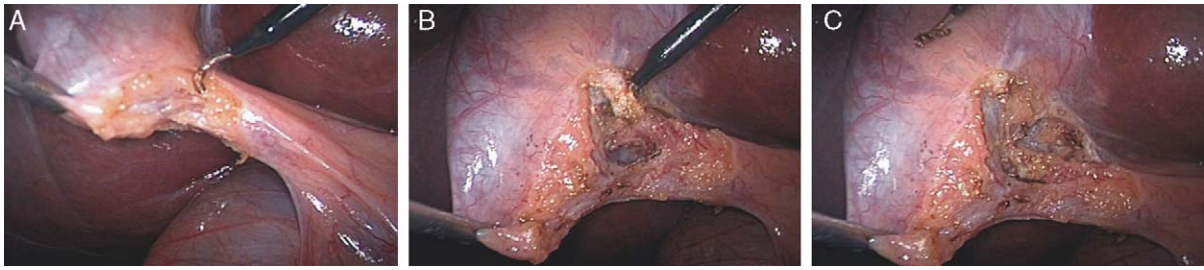


FIGURE 2. Laparoscopic views of the cystic artery cauterization and section. A, Cystic artery dissection being performed by hook electrode. B, Cystic artery is safely sealed by monopolar electrocautery (hook) in extension of approximately 5 mm near the gallbladder neck. C, Artery sealed without further bleedings.

1.0% of the patients. There was no mortality, no injuries to the bowel, and no hemorrhages. Only one patient with a Luschka's duct bile leakage was reoperated 48 hours after the initial procedure by emergency laparoscopy. In the postoperative period, the patients complained of little and demonstrated great satisfaction with the cosmetic results of surgery, with only 3 visible scars, in fact very small ones (Fig. 5). The average hospital sojourn was 16 hours, 97% of the patients being discharged within 24 hours.

DISCUSSION

Since its first description in 1887, the cholecystectomy technique has been evolving, making possible better results over time. Laparoscopic intervention in cholecystectomy was first reported in the 1980s, initiating the broad dissemination of minimally invasive surgery.⁴ With the advances in laparoscopic equipment and the advent of minilaparoscopy a new reality for this procedure has emerged. The use of instruments with the same accuracy, but smaller, from the traditional 10-mm/5-mm trocars to the 3-mm/2-mm trocars has made better cosmetic outcomes possible without a loss in efficiency.³

A consensus on the management of pain in the postoperative period has not yet proved possible in the patients submitted to MLC. However, patients submitted to minilaparoscopy have complained of less pain than those submitted to the conventional laparoscopy procedure.³ Owing to the great subjectivity of the analysis of the data on pain, most studies have proved inconclusive. It is widely accepted that a smaller surgical injury presents less risk of infection and better esthetic results (Fig. 5)

The average operative time in this study was 43 min (25 to 127 min), lower average compared with most of the studies in this area. It was shorter than those of Lee et al⁶ (68.8 ± 31.9 min), Cheah et al⁸ (50 min), Sarli et al²

(50.6 ± 12.3 min), and Hsieh¹³ with 113.8 ± 30.8 in patients submitted to mini-lap and 98.2 ± 33.2 minutes in patients submitted to the conventional 10-mm/5-mm operation.

The hospital sojourn was 16 hours, with almost all patients being discharged within 24 hours, which is a short time compared with Lee et al⁶ (2.5 ± 2.0 d), Lai et al¹⁴ 49.3 hours (41.8 to 56.8 h) using 2-mm instruments, 42.6 (39.2 to 46.2 h) with a 2.5-mm port and 36.6 (35.4 to 41.8 h) for 3-mm ports. This notable difference was probably because most of the cases in this study were elective operations; only 16.2% were acute cholecystitis. In 2.8% of the patients, a conversion to 5-mm instruments was needed. Ngoi et al¹⁵ showed conversion in 5.56% of their patients, Reardon et al⁷ reported conversion in 10% of their 50 patients. Cheah et al⁸ reported 3 (8.1%) conversions to standard laparoscopy procedure and 1 (2.7%) to open surgery. Lee et al⁶ reported conversion rate to open of only 0.2% in more than 1000, showing that a well-trained team makes most of the mini-lap procedures feasible. Nevertheless, Lee et al⁶ used a 5-mm trocar at the epigastric site in all patients, which contributed to the smaller number of conversions.

Among the main complications, umbilical site infection was present in 1.9% of cases and incisional herniation occurred in 1.0%. There was no mortality, which is a very positive outcome compared with the world average in laparoscopic cholecystectomy (0.3%¹⁵ in USA and 0.1%¹⁶ in Europe). In addition, there was no bowel damage; no bile-duct injuries, no hemorrhage and just one patient needed a reoperation due to a Luschka's duct not detected in the first procedure. All these complications are widely reported in many published studies on this subject.^{16,17}

Not using a 3-mm scope afforded advantages in this technique. The minilaparoscopic scope is an expensive fragile instrument and has a short lifetime, which contributes to a restriction of its use in a large number of

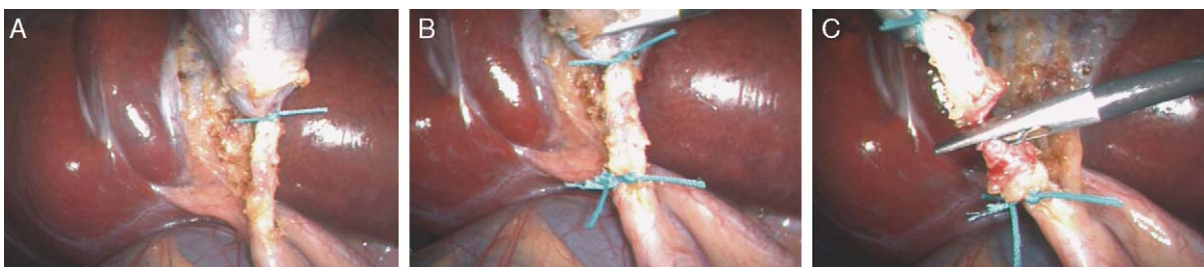


FIGURE 3. Laparoscopic views of the cystic duct ligation and section. A, Dissected cystic duct is being occluded by intracorporeal knot. B, Final aspect of the 3 tied knots, 2 proximal and 1 distal. C, Cystic duct sectioning by 3-mm endoscissors.



FIGURE 4. Laparoscopic views of the cholangiographic sequence. A, Cystic duct partial sectioning by 3-mm scissors. B, A catheter (4Fr in diameter) is being inserted into the cystic duct. C, A previous made false knot is closed to maintain the catheter attached without leaking. After performing the cholangiography, the catheter is removed and the false knot transformed in a true one closing the cystic duct.

patients. In addition, using only one laparoscope also reduces operating time because it is not necessary to change scopes during the procedure for the introduction of the clip applier.^{6,12} Cystic artery cauterization near the gallbladder neck by monopolar cautery (Fig. 2) proved to be safe and effective and there was no case of internal bleeding during surgery or in the postoperative period. The decision to coagulate near the gallbladder neck and far from the bile ducts prevented the occurrence of thermal injuries.^{12,18}

Replacing the clips for surgical knots (Fig. 3) significantly decreased equipment costs.^{19–21} Furthermore, it avoided certain complications that are inherent to clip usage, such as clip migration off the cystic artery, causing hemorrhage or off the cystic duct, causing bile leakage. In addition, clips that moved to the duodenum or the hepatic duct causing duct obstruction have been described.^{18–24}

This clipless technique led to a minimal increase in operating time due to the tying of knots (Fig. 3), which was compensated for by not having to change the scope and being able to maintain the 10-mm scope during the entire procedure.¹² The manufactured endobag replacement by a hand-made bag made from a sterile glove was an option that not only increased the economic feasibility of the operation, but also avoided an extra 10-mm incision to insert the manufactured endobag. Inserting the dissected gallbladder into the glove-bag makes it possible to remove it through the 10-mm–scope trocar at the end of procedure safely, keeping down the cost of this technique.¹²

The claim that the “needlescopic” instruments would necessarily have much shorter lifetime compared with the 5-mm instruments has proved not to be true. Except for the 3-mm scope, the other materials have been shown to be as durable and reliable as the 5-mm ones. Most of the instruments acquired are still in use as the first needlescopic cholecystectomy of this series. However, even experienced surgeons may need time to train and adapt, if they decide to use minilaparoscopic instruments.

Since the year 2000, the minilaparoscopy technique described in this study is the first choice in our institution for all patients eligible for laparoscopic cholecystectomy.

CONCLUSIONS

Considering the above-mentioned advantages it may be concluded that the MLC is as safe and effective as the 5-mm/10-mm laparoscopic procedures, but with clearly better esthetic outcomes. The technique presented did not show any difference regarding the operative risk when compared with the usual needlescopic procedure or the already established 5-mm/10-mm laparoscopy approach.

It also entails a considerable reduction in cost, and, as it does not use the 3-mm laparoscope or disposable materials, it is possible to perform MLC on a larger number of patients. Owing to the near invisibility of scars MLC may also be considered as cosmetically effective as NOTES and SILS.

This technique undoubtedly merits wide divulgation among surgeons, bringing benefits to the patients.

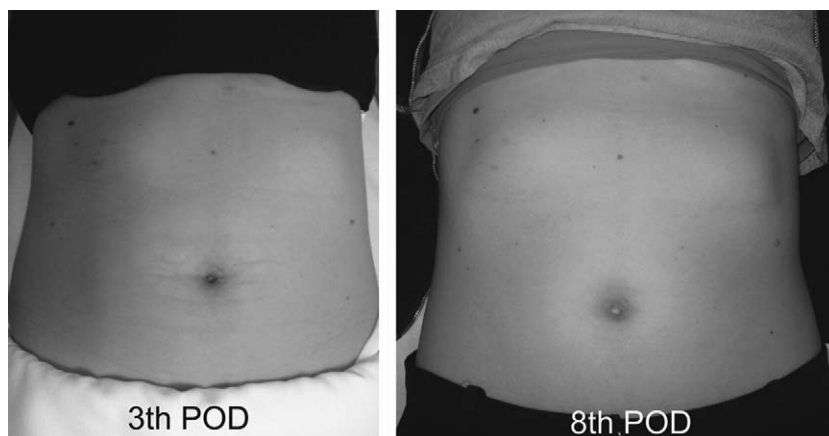


FIGURE 5. Views of a patient’s abdomen on the 3rd POD and 8th POD, showing almost no noticeable mini scars. POD indicates postoperative day.

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REFERENCES

- Ros A, Gustafsson L, Krook H, et al. Laparoscopic cholecystectomy versus mini-laparotomy cholecystectomy a prospective, randomized, single-blind study. *Ann Surg.* 2001;234:741–749.
- Sarli L, Costi R, Sansebastiano G. Mini-laparoscopic cholecystectomy versus laparoscopic cholecystectomy a matched case-control study. *Surg Endosc.* 2001;15:614–618.
- Mamazza J, Schlachta CM, Seshadri PA, et al. Needleoscopic surgery a logical evolution from conventional laparoscopic surgery. *Surg Endosc.* 2001;15:1208–1212.
- Franklin ME Jr, Jaramillo EJ, Glass JL, et al. Needleoscopic cholecystectomy: lessons learned in 10 years of experience. *JSLs.* 2006;10:43–46.
- Look M, Chew SP, Tan YC, et al. Post-operative pain in needleoscopic versus conventional laparoscopic cholecystectomy: a prospective randomized trial. *J R Coll Surg Edinb.* 2001;46:138–142.
- Lee PC, Lai IR, Yu SC. Minilaparoscopic (needleoscopic) cholecystectomy a study of 1011 cases. *Surg Endosc.* 2004;18:1480–1484.
- Reardon PR, Kamelgard JI, Applebaum B, et al. Feasibility of laparoscopic cholecystectomy with miniaturized instrumentation in 50 consecutive cases. *World J Surg.* 1999;23:128–131.
- Cheah WK, Lenzi JE, So JB, et al. Randomized trial of needleoscopic versus laparoscopic cholecystectomy. *Br J Surg.* 2001;88:45–47.
- Schwenk W, Neudecker J, Mall J, et al. Prospective randomized blinded trial of pulmonary function, pain, and cosmetic results after laparoscopic versus microlaparoscopic cholecystectomy. *Surg Endosc.* 2000;14:345–348.
- Zorron R, Maggioni LC, Pombo L, et al. NOTES transvaginal cholecystectomy: preliminary clinical application. *Surg Endosc.* 2008;22:542–547.
- Chamberlain RS, Sakpal SV. A comprehensive review of single-incision laparoscopic surgery (SILS) and natural orifice transluminal endoscopic surgery (NOTES) techniques for cholecystectomy. *J Gastrointest Surg.* 2009;13:1733–1740.
- Carvalho GL, Silva FW, Ramos CHC, et al. Colectomia minilaparoscópica sem utilização de endoclipes: Técnica e resultados em 719 casos. *Rev Bras Videocir.* 2007;1:5–11.
- Hsieh CH. Early minilaparoscopic cholecystectomy in patients with acute cholecystitis. *Am J Surg.* 2003;185:344–348.
- Lai ECS, Fok M, Chan ASH. Needleoscopic cholecystectomy: prospective study of 150 patients. *Hong Kong Med J.* 2003;9:238–242.
- Ngoi SS, Goh P, Kok K, et al. Needleoscopic or minisite cholecystectomy. *Surg Endosc.* 1999;13:303–305.
- Thomas R. US Experience with laparoscopic cholecystectomy. *Am J Surg.* 1993;165:450–454.
- Perissat J. Laparoscopic cholecystectomy: the European experience. *Am J Surg.* 1993;165:444–449.
- Huscher CG, Lirici MM, Di Paola M, et al. Laparoscopic cholecystectomy by ultrasonic dissection without cystic duct and artery ligation. *Surg Endosc.* 2003;17:442–451.
- Wasserberg N, Gal E, Fuko Z, et al. Surgical clip found in duodenal ulcer after laparoscopic cholecystectomy. *Surg Laparosc Endosc Percutan Tech.* 2003;13:387–388.
- Tamijmarane A, Campbell DF, Nassar AH. Intracorporeal ligation of the cystic duct and artery during laparoscopic cholecystectomy: do we need the endoclips? *Minim Invasive Ther Allied Technol.* 2000;9:13–14.
- Golash V. An experience with 1000 consecutive cystic duct ligation in laparoscopic cholecystectomy. *Surg Laparosc Endosc Percutan Tech.* 2008;18:155–156.
- Ahn S, Lee K, Kim S, et al. Surgical clips found at the hepatic duct after laparoscopic cholecystectomy: a possible case of clip migration. *Surg Lap Endosc Percut Tech.* 2005;15:279–282.
- Chong VH, Yim HB, Lim CC. Clip-induced biliary stone. *Singapore Med J.* 2004;45:533.
- Mouzas IA, Petrakis I, Vardas E, et al. Bile leakage presenting as acute abdomen due to a stone created around a migrated surgical clip. *Med Sci Monit.* 2005;11:16–18.