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Original Article

LESS - Practical and Technical Aspects

LESS – Prática e Aspecto Técnico

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ABSTRACT

Introduction: In recent years Laparoendoscopic Single-Site (LESS) cholecystectomy has emerged as a consensus technique between natural surgical access via the skin and a natural orifice, the umbilicus. Instruments are merged into a single incision. However, LESS surgery is hindered by a range of technical issues. Objective: To describe standardization of LESS cholecystectomy, with low cost and results similar to laparoscopic cholecystectomy (LapChol). Technical Report: Prospective randomized trial comparing LapChol and LESS. LESS portals were tested aiming to standardize the procedure. Preliminary Results: Forty-seven patients were operated using 10 and 5 mm optics, a clip applicator, and forceps through the portal. There were five conversions to conventional laparoscopy, no morbidity, and no deaths. Fifteen operations were performed without conversions with the final standardized configuration; the mean operative time for these 15 was 48 min. **Discussion**: LESS Cholecystectomy is a feasible procedure which requires the acquisition of fewer VL instruments. This standarded procedure is low-cost and achieves morbidity, operative and discharge times comparable to conventional VL Cholecystectomy.

Key words: SILS/ single site surgery. Cholecystectomy. Laparoscopic. Minimally Invasive. Trocar. LESS.

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INTRODUCTION

Laparoscopic cholecystectomy (LC) is the gold standard for the treatment of cholelithiasis and is currently the most common indication for elective surgery. Familiarity with videolaparoscopic (VL) procedures, training, and the development of new materials has made the rapid expansion of these operations possible. The pursuit of minimal surgical impact, lower morbidity, and fewer complications continues to drive the development of even less invasive techniques, involving one, or even no incisions, in order to make the surgery feasible and its outcomes and complications comparable to those with LC.[1]

In recent years Laparoendoscopic Single-Site (LESS) cholecystectomy emerged as a consensus technique between natural surgical access via the skin and a natural orifice, the umbilicus.[2] This technique includes a portal with multiple entries and flexible or adapted VL instruments merged into a single transumbilical incision approximately 3.0 cm in length. LESS leads to an excellent cosmetic result, with only one site of pain and potential infection and very low morbidity.[3-5] Several recent reports have demonstrated advanced procedures performed via LESS, including nephrectomy (including in renal transplantation), adrenalectomy, colectomy, and robotic surgeries.[6-17]

The objective of this article is to describe the surgical solutions and standardization of transumbilical LESS cholecystectomy which achieve surgical results similar to those obtained with conventional videolaparaoscopic cholecystectomy.

MATERIALS AND METHODS

In November 2008, a plastic conic prototype port was developed with an external opening of 15 cm and an internal opening of 3 cm for use in training boxes. Rigid and curved laparoscopic instruments were used for training with novel triangulation and reversed hands techniques. In April 2009, a single portal (SP) prototype was manufactured (Wom Industrias SRL, Argentina) along with 1.8-mm needle forceps for accessory puncture; this needle forceps, a new instrument, has a 5 mm tip, similar to that used in VL mounted inside the abdominal cavity.

In July 2009, a research project was proposed to the Post-Graduate Program of Surgical Sciences of the Federal University of Rio de Janeiro (UFRJ) to compare LC and LESS. Approval of the study protocol was obtained from the Ethics and Research Committee of UFRJ's Clementino Fraga Filho University Hospital. This prospective trial randomized twenty patients to LC and twenty patients to LESS. We compared the surgical results and measured pre- and post-operative polymerase chain reaction-t (PCR-t) and interleukin-6 (IL-6) levels, with the aim of quantifying the systemic inflammatory response.

The conventional VL and LESS portal instruments had been registered with and authorized by the appropriate federal regulatory agencies. A well standardized transumbilical LESS cholecystectomy procedure was used and the description of this standardized technique is the objective of this report.

- Technical Considerations

LESS surgery at the umbilicus and another locations can be hindered by several technical issues.[18,19] Most of these issues have been addressed by the medical and surgical instrument industries. The acquisition of new specially-designed instruments however, adds significantly to the cost of LESS procedures. Brazilian surgeons faces an additional challenge; in some instances these instruments are not available for purchase or have not been licensed by the regulatory authorities.

- The portals

LESS portals can be flexible or rigid, disposable or reusable, and are available in various lengths and diameters. These characteristics are all accompanied, to some degree, by problems of ergonomics, attrition, and triangulation. For example, the maximum working range between the outside and inside openings (or rings) and the forceps should be sought; motion must be free/seek over all axes, including the diagonal. Separate entrances restrict this mobility, and if an external part is rigid, the triangulation will depend exclusively on instrument curvature or articulation. A too-long inner portion results in higher friction and restraint, and if it is rigid, a larger incision in the skin and aponeurosis will be required to insert it. A flexible inner part can be deformed to adapt to a smaller wall incision, and preferably be self-expanding, a small incision can be dilated, facilitating the sealing and anchoring of the single port (SP). Although more economical in the long term, it is difficult to construct permanent SPs from flexible composites.

- Instrumentation

Classic LESS instrumentation includes a curved or flexible forceps, an optic, and a pincer for gallbladder traction; this fundus forceps creates tensile stiffness in the portal that immobilizes the entire system. There is also a workspace issue, since it is very difficult to manipulate two 10 mm instruments (for example, a clip applicator and an optic) through a single port. Acquiring the skill necessary to perform an inverted triangulation with one's hands crossed is challenging (Figure 1). One solution to these issues is to promote traction of the base of the gallbladder with an accessory instrument that can be inserted into the umbilicus via another punch in the aponeurosis a short distance from the SP. An even simpler solution is to place traction against the wall by placing a suture line in the intercostal space, an approach that we use routinely.[20] To avoid crossing hands, special curved pincers can be used (Figure 1).

PRELIMINARY RESULTS AND EVOLUTION OF THE TECHNIQUE

Several pilot surgeries (prior to enrolling patients in the present study) were performed beginning in July 2009 to determine the ideal technical conditions and to acquire expertise in terms of instrument and procedure standardization. The original prototype, a permanent autoclavable device, had a surgical steel skeleton, a silicone-nylon coating, two 5 mm entries, and two 10 mm entries. During this pilot stage ten patients were operated on with a 10 mm 30° optic, a

10 mm clip applier, curved tweezers for traction on the base of the gallbladder (5 mm), and needle forceps in the right upper quadrant. The mean operative time was 135 min, and the mean skin incision size was 4.5 cm. No conversions, complications, or deaths occurred.

Difficulties encountered during the pilot stage while operating through a single port included friction, suboptimal ergonomics, partial deflation of the pneumoperitoneum, and the sometimes awkward interplay between the camera and the new triangulation. Nonetheless, with this prototype we were able to eliminate the needle forceps and simultaneously place four instruments into the SP: a 10 mm optic, tweezers for the surgeon's left and right hands, and curved forceps for fundal traction. In three cases, the surgeon experienced a substantial deterioration of operability – finding it virtually impossible to coordinate the optics, tweezers, and clip applicator – and opted for conversion to conventional laparoscopy. The mean operative time for these conversions exceeded 150 minutes.

To address these limitations the traction forceps (at the fundus) was eliminated. Instead a needle puncture with a nylon suture was performed in the right costal margin through the gallbladder, retracting it to the abdominal wall and exposing the gallbladder pedicle. The second step was the change provided by the use of a 5 mm optic. Ten patients were operated with this configuration with an average operating time of 75 minutes; there were no conversions or deaths. Accessory 5 mm trocars were required in three cases: twice in the subxiphoid region for cholangiography, and once for ligation of the cystic duct with an external loop. All patients were discharged within 24 hours.

We also addressed the visibility of the 5 mm optic, which is worse than the 10 mm optic, but necessary when using a 10 mm clip aapplicator. The procedure is rendered more comfortable with the usual High Definition (HD) laparoscopic image, combined with only two 5 mm instruments. So we changed the clip applicator to this size. Nine procedures were performed with this configuration. There were no conversions; the mean operative time was 67 minutes.

Maintaining the pneumoperitoneum during LESS is challenging. A partially or completely flexible portal brings mobility to the system, but allows deformations that disrupt the pneumoperitoneum. With a single connection, the maximum CO_2 flow is approximately 17 L/min. To address CO_2 leakeage, we used a 40-L insufflator mounted on a Y-shaped silicon tube set allowing two entries for CO_2.which allowed more gas can be applied to compensate what was lost. (Figure 2)

The final technical change to the apparatus was the use of only a curved forceps in the surgeon's left hand, presenting the gallbladder infundibulum, and traditional straight laparoscopy instruments (hook, Maryland, clip applicator, and suction canula) in the right hand. This configuration – which is very similar to the conventional laparoscopic platform – was comfortable and was used successfully in fifteen operations with no conversions. The mean operative time was 60.5 minutes.

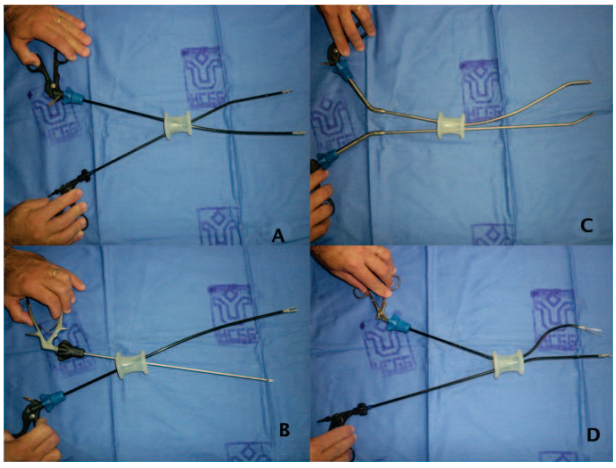

Figure 1
A and B - crossed hands
C and D - special curved instruments

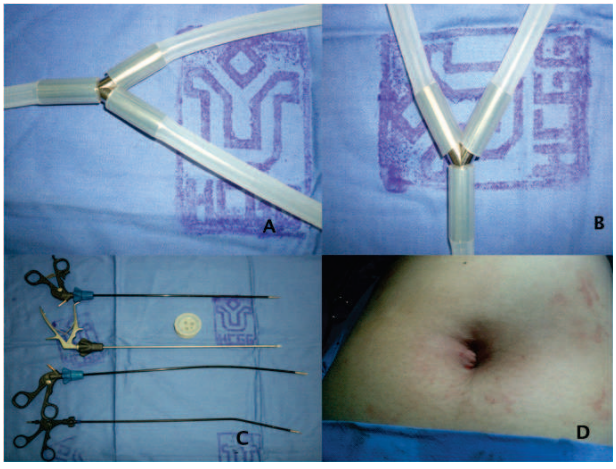

Figure 2
A and B - Y-shaped silicon tube
C - curved forceps
D - cosmetic results

In summary, this configuration consisted of a 10 mm 30° optic, curved forceps in the left hand, and a regular 5 mm instrument/instrumental (including clip applicator) in the right hand, with the gallbladder bottom retracted through the intercostal area. (Figure 2)

DISCUSSION

We attempted to standardize the LESS cholecystectomy to make it more ergonomic and similar to LC. The proposed configuration requires only the adaptation of a low cost forceps, which must be curved. Single ports vary in price, but would not exceed the cost of multiple disposable LC portals. A full discussion of the advantages and disadvantages of LESS cholecystectomy is beyond the scope of this technical note, which is based on preliminary data.

We achieved comparable surgical times, return of diet, conversion rates, and discharge times.[21-23] LESS surgery has the advantage that conversion to conventional laparoscopy when necessary merely requires additional trocars. There are no technical reasons for considering LESS procedures unsafe; on the contrary, many studies refer to them as safer.[24-29]

The umbilical skin incision can be round, transversal or vertical, and made at supra, infra, or transumbilical sites. We chose the vertical transumbilical pathway because a wider skin incision can be obtained with better cosmesis (Figure 2). The umbilicus is an inverted cone shaped scar; when using the lower and upper parts symmetrically, a 3-4 cm skin incision can be made inside the umbilicus. Furthermore, a transumbilical incision permits rapid and effortless removal of the gallbladder and promotes synthesis of the aponeurosis.

The emergence of a new generation of single ports (Gelpoint®, Applied Medical, CA, USA, for example) represents both a breakthrough and a paradox. These portals are extremely flexible in the external and internal rings, can be adapted to smaller incisions, and can be expanded from 1.5 to 7.0 cm.[30,31] Paradoxically, these materials are very useful in procedures such as splenectomy, nephrectomy, and colectomy that require larger incisions in the skin and wall to extract the specimen. Unlike in VL, if this larger incision is made at the beginning of the procedure, it accomodates a wider portal and offers a larger work area and easier triangulation. We anticipate that further development of LESS will highlight additional benefits and risks, and foster/accelerate new technological advances.[32]

CONCLUSION

LESS is a feasible and viable procedure which requires acquisition of fewer VL instruments than the conventional procedures currently performed in general hospitals. The standardization reported here is low-cost and achieves surgical times, morbidity rates, and discharge times comparable to conventional VL.

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