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Original Article

New Minimally Invasive Surgical Approaches: Transvaginal and Transumbilical

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ABSTRACT

Objectives: Since the advent of laparoscopy, surgical techniques have been changing in an attempt to reduce patient's morbidity, thus less invasive procedures have been used. The aim of this manuscript is to report our experience in regard to two new minimally invasive surgeries approaches, i.e., the transumbilical laparoscopic surgery (TLS) and the natural orifices transluminal endoscopic surgery (NOTES). Patients and Methods: Three periumbilical trocars have been used to perform transumbilical laparoscopic surgery. At completion of the procedure, all three port incisions were united and the specimen was retrieved from the abdominal cavity. NOTES was performed through transvaginal access. After opening the vaginal mucosa in the posterior cul-de-sac, a double-channel flexible endoscope was inserted into the abdominal cavity. One or two additional trocars were placed (hybrid technique) to control the pneumoperitoneum and to mobilize intrabdominal structures. Once the procedure was finished, the specimen was retrieved through the vagina. Results: Eight procedures were performed using the previously described techniques, including 3 cholecystectomies by TLS, 3 cholecystectomies by NOTES, 1 nephrectomy by TLS, and 1 nephrectomy by NOTES, with mean operative time of 40.3, 63, 171.6 and 170 minutes, respectively. Difficulty in handling the flexible endoscope in NOTES and intra and extra-abdominal instrument collision in TLS were the two intraoperative incidents observed. Conclusions: These new techniques are feasible; however prospective clinical studies are still necessary to confirm their real indications and benefits.

Key words: minimally invasive surgery, NOTES, transumbilical, cholecystectomy, nephrectomy.

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INTRODUCTION

Evolution is part of Medicine; however, it is not always easily accepted among physicians. In the last decades surgical specialties have been experimenting advances and changes, thus even more minimally invasive techniques have been adopted to reduce patient's morbidity.

Since the initial description of a laparoscopic cholecystectomy in 1987 by Mouret[1] this evolution process has started. In spite of its steep learning curve, different surgical specialties have already adopted this minimally invasive approach as a standard technique[2-3], which resulted in reduced postoperative pain, shorter hospital stay, earlier postoperative recovery and better cosmetic results[4-8].

Recent laparoscopic surgical advances have been associated to the reduced size and number of ports to reach the objective of a minimally invasive surgery[9-14]. In the literature there are an increase number of reports regarding the adoption of transumbilical approach to perform cholecystectomies[12], oophorectomies[13], appendectomies[14] and nephrectomies[9,10].

The most epic evolution of this continuous development process is the Natural Orifice Transluminal Endoscopic Surgery (NOTES). It is a new approach accessing without an incision the abdominal cavity ("scarless surgery") having natural orifices as the entry point to the abdomen, i.e., transgatric, transvaginal, transvesical or transcolonic access of the intra-abdominals organs through the

insertion of an endoscope into the peritoneal cavity[15]. Therefore, without the incisions in the abdominal wall surgical traumas would decrease even more. The first report of this surgical technique was by Gettman and cols. [16] in 2002, which depicted the feasibility of transvaginal nephrectomies in an experimental model at Texas University. Two years later, Kalloo e cols. [17] performed transgastric hepatic biopsy at Johns Hopkins University. After those initial reports other researchers depicted the safety of transgastric access to ligation of fallopian tubes[18], cholecystectomy[19], cholecystogastric anastomosis[19], gastrojejunostomy[20], partial hysterectomy with oophorectomy[21,22], splenectomy[23], gastric reduction[24], nephrectomy[25] and pancreatectomy[26] , all of them based on experimental studies in a porcine model. Since 2007, some surgeons have performed cholecystectomies[27-32] and nephrectomies[33] by means of a transvaginal route in human beings.

The objective of this manuscript is to present our clinical experience with these new minimally invasive approaches.

PATIENTS AND METHODS

Instruments For Transumbilical Surgery

Basic laparoscopy instruments have been used to perform transumbilical surgeries. Although some authors have already reported the use of articulated laparoscopic[10], staplers, magnetic positioning of intra-abdominal cameras, robotic prototypes[11,34], in our experience the use of these special instruments are not essential.

Surgical Team and Instruments for Notes

It is suggested that NOTES should be performed by a multidisciplinary team with at least general surgeons and endoscopists, as it is a surgical technique still being studied. A highly skilled team in advanced laparoscopic surgery is required; therefore in case of complications the surgery could be promptly converted to laparoscopy.

The basic instruments to perform transluminal endoscopic surgeries include:

· double channel flexible endoscope (Karl Storz Endoskopi, Germany);

· hook knife (Olympus, Tokyo, Japan);

· needle knife (Olympus, Tokyo, Japan);

· hot biopsy forceps (Boston Scientific, Natick, MA, USA);

· endoscopic clips (Clip Fixing Device, Olympus, Tokyo, Japan);

· grasping forceps (Olympus, Tokyo, Japan);

Transumbilical Access Surgical Technique

Patient should be placed in a position in the operating table accordingly to the surgical procedure to be performed. After induction of general anesthesia an oral-gastric tube is placed to aspirate the stomach contents. Through the umbilicus the Veress needle is inserted (Figure1A), thus allowing the influx of carbon dioxide. Then pneumoperitoneum is established and intra-abdominal pressure is maintained between 12 and14 mmHg. A 10mm trocar for a 30º optic is inserted into the periumbilical region, followed by two additional trocars (5mm or 10mm) placed adjacent to the primary trocar. Therefore, we have two trocars to perform the planned procedure (Figures 1B, 1C e 2).

At completion of the surgery, the specimen is placed into an endobag which is held with a grasping forceps. The three trocars are removed and the ports incisions are sutured (Figure 3A). Then, the orifice in the aponeurosis is enlarged and the endobag is easily retrieved from the abdominal cavity. In case of a cholecystectomy the gallbladder is directly removed without the use of an endobag (Figures 3B and 3C). Very large specimens are removed by morcellation. Figures 1D and 3D depicted the surgery final aspect.

Figure1 *- Transumbilical Laparoscopic Nephrectomy. (A) Transumbilical Veress Needle placement for insufflation of abdominal cavity. (B) Periumbilical trocars placement. (C) External manipulation of instruments (D) Final aspect of the surgery.*

Figure 2 - *Placement of trocars for transumbilical laparoscopic cholecystectomy.*

Figure 3 - *Transumbilical Laparoscopic Cholecystectomy. (A) Approximation of the skin incision. (B e C) Gallbladder removal through the umbilicus. (D) Final aspect of the transumbilical incision in lambda form.*

Transvaginal Access Surgical Technique in Human Beings

Preoperative preparation of the patient includes bowel preparation with fleet enema the night before and 8 hours fasting. One hour prior to the surgery vaginal embrocation with povidone-iodine is performed.

The procedure is performed under general anesthesia with patient placed in litothomy position, legs supported by padded obstetric leg holders and arms fastened along the body. Then, nasogastric and vesical probe are placed. During the induction of the anesthesia a prophylactic antibiotic (cefazoline 1g) is administered. Povidine-iodine is used for cleansing the operative field, and another vaginal embrocation is performed with this solution.

A Sims speculum is inserted into the vagina and the cervix is grasped with a Pozzi forceps in its posterior lip, then two Breisky retractors (one posterior and one lateral) are used to expose the structures. So, anterior traction of the cervix is performed to stretch the posterior fornix, and the vaginal mucosa in the posterior cul-de-sac is opened at the vaginal cervix junction by a 2,5cm smile incision. After that, the posterior margin is clamped with an Allis forceps and with the index finger blunt dissection is performed. Peritoneum of the posterior cul-de-sac is then identified and opened.

Flexible endoscope is inserted into the peritoneal cavity and gas is insufflated to establish pneumoperitoneum (Figure4A). A 5mm umbilical trocar is used to control the abdominal pressure (12 a 14 mmHg) and to insert a clamp to mobilize the abdominal structures (hybrid technique)[32]. Another 5mm trocar may be placed depending on the procedure[33]. (Figure 4D). Then proceed to endoscopic retro vision to visualize the endoscope exact entry point in the pouch of Douglas (Figure 4B). Then the endoscope is moved forward into the abdominal cavity and surgical procedure is performed (Figure 4C). At completion of the surgery, the surgical specimen is retrieved from the abdominal cavity with a polypectomy snare (Figure 9) (Olympus, Tokyo, Japan).

After reviewing the peritoneal cavity haemostasis, the pneumoperitoneum is deflated and the cul-de-sac is closed with continuous suture of 2-0 chromic catgut or 2-0 vicryl.

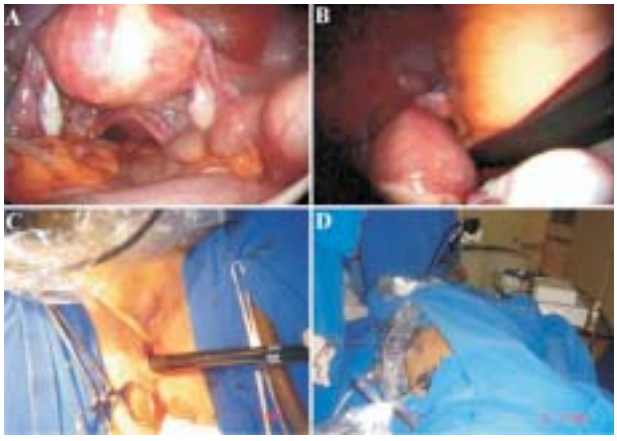

Figure 4 - *Hybride Transvaginal NOTES. (A) Laparoscopic visualization of the posterior cul-de-sac opening to vaginal access in transvaginal hybrid nephrectomy. (B) View after endoscope insertion through transvaginal route in transvaginal hybrid cholecystectomy.(C) External manipulation of the endoscope after insertion into the abdominal cavity. (D) Transvaginal hybrid nephrectomy with two accessory ports.*

RESULTS

From July 2007 until January 2008, one of the two approaches above described were performed in eight patients submitted to surgery. Subsequently we described the intraoperative details of each technique.

Transumbilical Approach

Until now we performed three transumbilical cholecystecytomy (Figures 5A,5B,5C e 5D) and one transumbilical nephrectomy in our service. All cholecystectomis were performed with two 5 mm trocars (one to the optical trocar) and one 10mm trocar. In fact, in the first case three trocars were being used until the identification and isolation of artery and the cystic duct; however, we had to substitute one of the 5 mm trocar by a 10 mm due to technical difficulties to place the clips using a 5mm clamp. Although during 20 minutes we attempted to apply the 5mm clamps, the operative time was 56 minutes. In the two following cases a 10mm trocar was used since the beginning of the surgery; therefore, the procedures last 30 and 35 minutes, respectively.

There were no complications in the nephrectomy; thus special articulated laparoscopic instruments were not necessary (Figure 6 and 7). Two 5mm trocar and one 10 mm trocar for a 30º optical were used. The procedure was performed in 63 minutes, and estimated bleeding was 50ml.

All postoperative patients had a good evolution, and they were discharged from hospital on the first day after surgery.

Transvaginal Notes

Four patients were successfully submitted to transvaginal hybrid surgery, 3 cholecystectomies and one nephrectomy.

In the cholecystectomies to control the pneumoperitoneum and the gallbladder mobilization a 5mm transumbilical accessory puncture was performed. None of the cases presented intraoperative bleeding (Figures 8A and 8B). Incidents happened due to the inexperience in handling the flexible endoscope to perform the surgery. The operative time of the three cholecystectomies was 150,270 and 95 minutes, respectively. Patients did not present any intraoperative complications and all of them were discharged from hospital on the first postoperative day.

Two 5mm abdominal accessory trocars were placed, one transumbilical and another subxiphoid

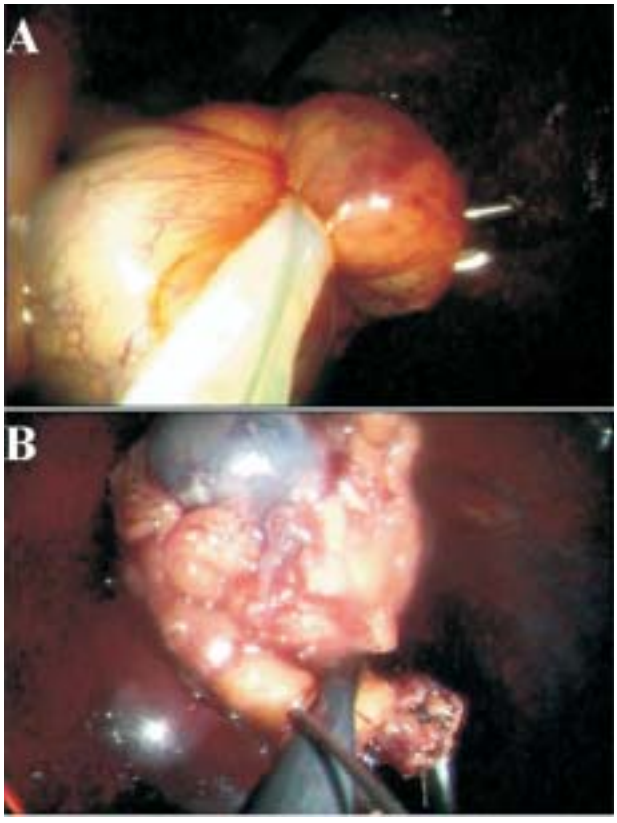

Figure 9 *- (A) Gallbladder removal with a polypectomy snare after transvaginal hybrid cholecystectomy. (B) Kidney prehension with polypectomy snare for retrieval from the abdominal cavity after transvaginal hybrid nephrectomy.*

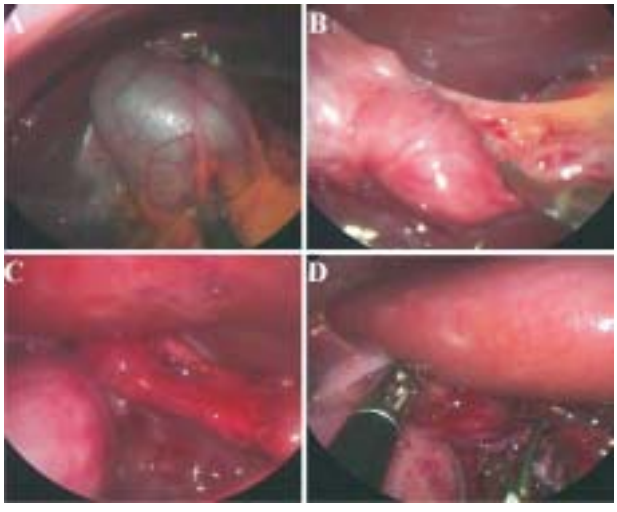

Figure 5 *- Transumbilical laparoscopic cholecystectomy. (A) Release of the adhesions around the gallbladder (B) Cystic duct dissection (C) Duct and cystic artery isolation. (D) Cystic duct section after clips placement.*

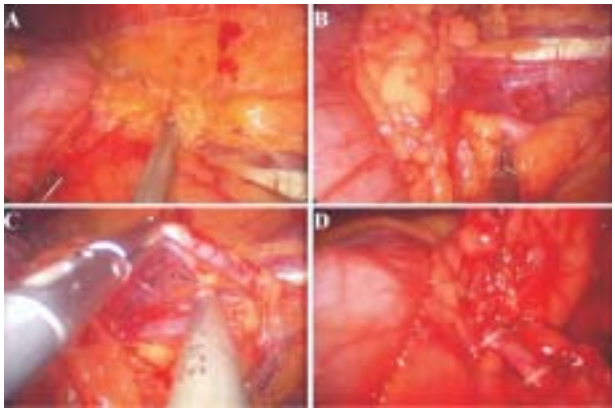

Figure 6 *- Transumbilical nephrectomy. (A) Colon medial mobilization. (B e C) Identification and dissection of the ureter. (D) Gonadal vein ligature.*

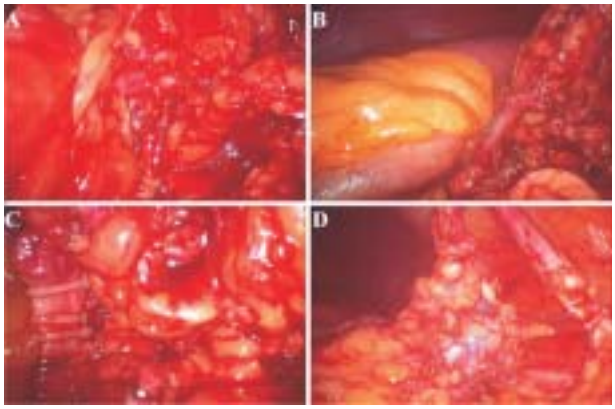

Figure 7 *- Transumbilical Laparoscopic Nephrectomy. (A) Left renal artery ligation with Hem-o-lok. (B) Left renal vein dissection. (C) Left renal vein ligation with Hem-o-lok. (D) Placement of Hem-o-lok into the ureter.*

during nephrectomy. Operative time was 170 minutes and estimated bleeding was 350ml.

On the morning day after surgery four patients received a regular diet and on the first postoperative day they were discharged from hospital. Analgesia required only ordinary analgesic (dipirone) to relieve pain in all cases.

Postoperatively patients were oriented to restart sexual activity after 40 days.

DISCUSSION

With the advent and rapid revolutionary evolution of laparoscopic surgery all over the world in 1990's decade, unquestionable advantages over open surgery are evident: as less postoperative pain, cosmetic surgery, short length of hospital stay, quick pulmonary recovery and prompt return to work.

Nevertheless, experimental and clinical researches are still searching for new minimally invasive surgical techniques and approaches. New procedures to improve postoperative recovery and reduce risks have been arising everyday in the world literature as a way to overcome the laparoscopic approaches results.

Enlargement of port site or an additional port is frequently necessary to remove specimen. Depending on the procedure performed at surgery completion patients usually have 3 to 6 incisions about 1 to 4 centimeters long. Laparoscopy incisions potential morbidity include: worst cosmetic results, cutaneous innervations injury, chronic pain, subcutaneous bleeding and development of incisional hernia[10].

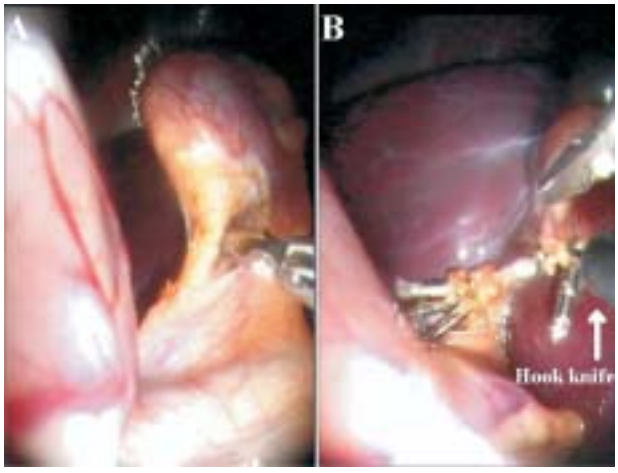

Figure 8 *- Hybrid transvaginal NOTES Cholecystectomy. (A) Cystic duct dissection. (B) Dissection of the gallbladder from the hepatic bed with a hook knife.*

In order to spare patients from morbidity associated to incisions, some techniques such as morcellation, transvaginal extraction of the surgical specimen, natural orifices surgery and transumbilical surgery have been developed to reduce the number of incisions and/or remove the surgical specimen after laparoscopic procedure.

As a way to reduce the above mentioned morbidity[35-40] morcellation of specimens have been performed in some institutions; however, this approach has a negative impact as the specimen can not be evaluated for pathological staging[41], limiting its use with malignant tumors.

Traditionally gynecologists used transvaginal route to performed procedures such as hysterectomies[42], adnexectomy[43], tubal ligation[44] and

others. In addition to that many authors have already described vaginal removal of surgical specimens after gynecological laparoscopies[45-49]. Transvaginal access has already been used to remove surgical specimens after laparoscopic procedures even by some general surgeons and urologists. Extraction of surgical specimens from the abdominal cavity is a feasible approach; however unfortunately it can only be performed in female patients.

Recently, the Natural Orifice Transluminal Endoscopic Surgery (NOTES) - a new revolutionary concept of minimally invasive surgery has attracted surgeons and endoscopists. The three main justifications for NOTES are improved cosmetic appearance, easy access, and the concept that human ability and technological advance can continue to reduce patients' trauma and discomfort, and maintain surgery effectiveness [55].

NOTES is a less invasive procedure as well as laparoscopy; therefore it is an alternative technique to open surgery as it can reduce postoperative stress, morbidity and hospital length stay. Moreover, NOTES has a theoretically potential to reduce risk of complications such as wounds infections, postoperative hernia and adhesions[17-19]. An additional advantage of this approach is that it could be performed in patients with extensive scars, serious burns, infection of the abdominal wall and morbid obesity, besides the high risk and critically ill patients[56]. In this manuscript we report four successful cases of hybrid transvaginal NOTES. Difficulty in handling the flexible endoscope and manipulating instruments to perform basic surgical maneuvers can be explained by our procedures operative time. Although we believe learning curve data should be evaluated as it is in laparoscopy; due to our small sample it was not possible to be evaluated. In our opinion, transvaginal endoscopic surgery benefits are scientifically acknowledged, thus it will not cause an additional risk of postoperative fistulae in patients (transgastric, transcolonic and transvesical access).

Transumbilical surgery is an alternative technique to traditional laparoscopy with an improved cosmetic result due to the periumbilical incision. Moreover, comparing to NOTES it has a short learning curve because the anatomic visualization is almost the same to the traditional laparoscopy what changes is the puncture site[10]. The four reported cases were successfully performed without difficulties. As trocars were placed into the periumblical region, they were jointed through elliptical incision to remove the surgical specimen. As we did not have any articulated instrument intra and extra-abdominal collision were the only intraoperative incident regarding trocars. One kidney and three gallbladders were removed from the abdominal cavity, without morcellation.

CONCLUSIONS

Any new technology should be carefully used with human beings. Until the present moment only a few cases were reported in the literature. The development of new endoscopic tools and accessories certainly will accelerate the development of NOTES technique and improve its results; therefore in the future it may become an acceptable alternative technique and a preferable access route for some special abdominopelvic conditions in well selected patients. Transumbilical laparoscopic surgery is a feasible technique, as it is similar to traditional laparoscopy, except for the position of the trocars. Proposed benefits and safety of both surgical techniques still need to be depicted in further clinical studies comparing the two techniques to traditional techniques.

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