Transvaginal cholecystectomy (NOTES) combined with minilaparoscopy

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ABSTRACT

Objective: to report on the first transvaginal cholecystectomy performed on a human being in Spain.

Patients and methods: a 35-year-old female with a history of recurrent bouts of biliary pain resulting from gallstones. A surgical procedure was performed by a multidisciplinary team composed of surgeons, gastroenterologists, and gynecologists. It involved creating a pneumoperitoneum by placing a Veres needle in the umbilical fundus, followed by the insertion of a 5-mm trocar. A second 3-mm trocar was placed in the right upper quadrant. A colpotomy was performed, and a 12-mm trocar placed inside the vagina allowed the insertion of a videogastroscope as far as the hilum of the liver.

Results: cholecystectomy was performed by using a combination of working tools inserted through the entry port for the minilaparoscopy and the videogastroscope. The gallbladder was removed transvaginally through the videogastroscope. There were no postoperative complications, and the patient was discharged within 24 hours.

Conclusions: transvaginal cholecystectomy is possible and safe when performed by a multidisciplinary team working together. Natural orifice transluminal endoscopic surgery (NOTES) is an emerging modality that seeks to be less invasive, better tolerated, and more respectful of esthetics than laparoscopic surgery. It will probably open the way for very important medical and technological innovations over the coming years.

Key words: Transvaginal cholecystectomy. NOTES. Minilaparoscopy.

INTRODUCTION

Natural orifice transluminal endoscopic surgery (NOTES) comprises several new endoscopic and surgical entryways into the abdominal cavity, with potential advantages over conventional laparoscopic surgery, including its being less invasive and even less traumatic to the
abdominal wall. NOTES in animals was first described by Kalloo in 2004 (1). In early 2007, Zarron (Brazil) reported the first transvaginal cholecystectomy. In March 2007, Bessler reported a laparoscopically-assisted transvaginal cholecystectomy (2). In April 2007, the procedure was performed by Marescaux using only an abdominal trocar that allowed him to create pneumoperitoneum and to exert traction on the gallbladder with forceps (3).

Currently, a second line of medical technology research concerns “minilaparoscopy”, or laparoscopy with instruments of smaller diameter and with the least possible number of entry ports in the abdominal wall. Reducing the size of laparoscopy instruments has provided us with 2.8 mm optics and working channels measuring 3 mm in diameter. By thus reducing invasiveness and surgical trauma, one can expectedly attain better operative and postoperative results, particularly in terms of postoperative pain, complications of the abdominal wall from incisions, recovery time, and costs, as well as a lesser impact on aesthetics.

A vaginal access route to the abdominal cavity, its opening, and its sutured closure are standardized procedures; the risk of infection and of short- and long-term local complications is very small (4-6). The 6-7 cm that separate the posterior surface of the vagina (where the colpotomy is performed to gain access into the abdominal cavity) from the vaginal introitus eliminate the serious disadvantages of the transgastric, transcolonic, and transvesical access routes.

PATIENTS AND METHODS

A thirty-five-year-old female with an unremarkable medical history, three normal deliveries and laparoscopic tubal ligation in 1995, complained of recurrent bouts of biliary pain. Abdominal ultrasound had revealed a gallbladder with microlithiasis and biliary ducts that were normal in size and morphologic appearance. Liver function tests were normal, and the patient was scheduled for cholecystectomy after informed consent for a transvaginal cholecystectomy was obtained. We contacted the Ethics and Clinical Research Committee of the Autonomous Community of the Balearic Islands and obtained specific informed consent. We used a 180 H videogastroscope (Olympus, Hamburg, Germany) that was sterilized with ethylene oxide, along with the irrigation bottle and its connecting tube. The surgery was performed on 10th October 2007. Operative field: The vagina, perineal region, and abdominal wall were disinfected with povidone-iodine, and urine was removed with a urinary catheter. General anesthesia with orotracheal intubation was applied, and prophylactic antibiotic therapy with amoxicillin plus 2 g clavulanic acid was given intravenously, according to protocol. The patient was placed in lower lithotomy position and maneuvered back and forth from the Trendelenbourg to the anti-Trendelenbourg position in order to displace the bowels and get the best view possible of the operative field.

—**Surgeon’s time.** Pneumoperitoneum was created by placing a Veres needle in the umbilical fundus. Subsequently, a working 5 mm trocar was inserted in the same spot. A second, 3 mm trocar was placed in the right upper quadrant.

—**Gynecologist’s time.** The vaginal labia majora were separated with silk sutures in order to gain better vaginal access. Two valves were placed so as to get the best view possible of the posterior vaginal wall. An incision was made at that level with an electric scalpel, while from the peritoneal side the incision was controlled with a 5 mm optical device and the uterus was lifted with 2.8 mm forceps. Under this visual monitoring, a rigid vaginal trocar measuring 12 mm in diameter and 15 cm in length (Tyco International Ltd., Norwalk, Connecticut) was inserted into the peritoneal cavity. A plastic bag (Unimax 5” × 7”, Unimax Medical Systems Inc., Taipei, Taiwan) was introduced through this trocar for the purpose of retrieving the gallbladder after removal.

—**Endoscopist’s time.** A videogastroscope was introduced through the vaginal trocar as far as the abdominal cavity (Fig. 1). First the bag for retrieving the gallbladder was placed in the subphrenic space. We then proceeded to identify the gallbladder and to attain the best possible position from which to begin dissecting the cystic pedicle.

—**Surgeons’ and endoscopist’s time.** We began to dissect the hilum of the gallbladder, the omental and peritoneal adhesions, and the cystic duct and artery, which were sealed with clips and sectioned afterward. The cholecystectomy was performed from the hilum to the fundus with electrocoagulation, and the specimen was placed in the retrieval bag. The gallbladder bed was inspected to ensure there was no hemorrhage or leakage of bile. During this entire surgical time the videogastro-
Scope kept shifting its position and angle in order to get a view that would make it possible to dissect, clip, and remove the gallbladder. The forceps inserted through the working channel of the endoscope for the purpose of exerting traction on the gallbladder did not do so very effectively.

—Endoscopist’s time. With a “mouse-toothed” forceps (Medi Globe GmbH, Achenmühle, Germany) that was slipped through the working channel of the videoendoscope, the plastic bag containing the gallbladder was gripped and slowly retracted until it had entered the vaginal trocar about 4 cm (Fig. 2). Under laparoscopic visual monitoring, the videoendoscope, the forceps holding the bag and the vaginal trocar were removed en bloc, until the bag became clearly visible inside the vagina.

—Gynecologist’s time. With the help of a pair of Kocher forceps, the gynecologist removed the gallbladder completely and closed the vaginal incision with two absorbable sutures. The operation lasted 95 minutes in all. There were no postoperative complications, and the patient was discharged in 24 hours. The length of time that each of these stages lasted is shown in Table I.

**Table I. Duration and temporal breakdown of the intervention**

<table>
<thead>
<tr>
<th>Times, by specialty</th>
<th>Procedure</th>
<th>Duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgeon’s time</td>
<td>Pneumoperitoneum</td>
<td>12</td>
</tr>
<tr>
<td>Gynecologist’s time</td>
<td>Colpotomy</td>
<td>8</td>
</tr>
<tr>
<td>Endoscopist’s time</td>
<td>Accessing and exposing the cystic pedicle</td>
<td>12</td>
</tr>
<tr>
<td>Surgeon’s and endoscopist’s time</td>
<td>Dissection and removal</td>
<td>50</td>
</tr>
<tr>
<td>Endoscopist’s time</td>
<td>Removal</td>
<td>9</td>
</tr>
<tr>
<td>Gynecologist’s time</td>
<td>Colpotomy closure</td>
<td>4</td>
</tr>
<tr>
<td>Total time</td>
<td></td>
<td>95</td>
</tr>
</tbody>
</table>

DISCUSSION

Closure of the natural orifices through which the abdominal cavity is accessed is one of the critical features of NOTES insofar as safety is concerned. There are no validated methods that are safe and effective for closing orifices in the stomach or intestines, despite the fact that different systems have been described, such as one with anchor sutures (7-9), the Eagle Claw (10,11) a system combining forceps with a suturing needle (12), an endoscopic stapler (13), and a system using multiple clips (14). These systems have different drawbacks, they are clumsy, and they must undergo further improvement before they can be passed through an endoscopic working channel and used to suture securely, simply, and rapidly. Conversely, the vagina provides easy, safe access, and colpotomy is a procedure that gynecologists have been performing routinely for years. The vagina is a fibromuscular tube made up of four layers: A mucosal layer composed of stratified squamous epithelium, a lamina propria with abundant elastic fibers and thin-walled blood vessels, a fibromuscular layer with poorly defined smooth muscle strands arranged in a circular pattern, a more prominent outer layer consisting of smooth muscle arranged longitudinally, and an adventitial layer composed of fibrocollagenous tissue containing numerous thick elastic fibers. The rich network of elastic fibers in the vaginal wall accounts for its elasticity and allows for the great temporal distension that is needed during labor.

Colpotomy is a common, standardized, and consolidated approach in gynecology; it is used in removing very large gynecologic lesions, such as ovarian cysts and uterine fibroids (4,15). The transvaginal route has also been described occasionally for removing non-gynecological organs, such as nephrectomy or hemicolectomy specimens (16,17). Posterior colpotomy is practically painless, except for minimal vaginal discomfort during the first week after surgery. Complications from colpotomy are very rare; they include lesions of the urinary bladder (5), pelvic hematomas, urinary tract infection, and infection of the suture site (6,18). Dyspareunia can be one of its complications, but the risk of developing dyspareunia that is clinically relevant and persistent after posterior colpotomy is extremely small (4).

Pneumoperitoneum has to be created in any type of NOTES. The introduction of a Veres needle, normally in the umbilical fundus, works well functionally and aesthetically. The incision can be used to place a trocar with a small diameter and slide in laparoscopic instruments. In our case, we used this entryway and a second one measuring 3 mm in the right upper quadrant to introduce both working instruments used in performing the cholecystectomy. A third entry port was the working channel of the videoendoscope, which allows passage of different auxiliary systems, in addition to being useful as a light source and camera.
The videoendoscope was introduced via the colpotomy after directly inserting into the peritoneal cavity a rigid trocar measuring 12 mm in diameter and 15 cm in length. The trocar made it possible to aim the videendoscope toward the subhepatic space and stabilize it. We feel it is a good idea to introduce the bag for retrieving the gallbladder when the videoendoscope is inserted, since it prevents having to withdraw it once and introduce it again and shortens the duration of the surgery. Longer trocars that spare the distal tip of the videendoscope, where it bends, may provide greater stability. Accessing the gallbladder’s operative field may be difficult for endoscopists, who are not used to moving about and finding their way inside the peritoneal cavity. The help surgeon can provide very valuable assistance by inserting laparoscopic forceps through the opening in the right upper quadrant and using a longer vaginal trocar. There is a type of flexible outer tube that can adapt to different pathways and is endowed with a built-in memory, based on Shape Lock technology, that makes it become rigid (18,19). Such technology could adapt to different natural orifices and serve as a common access and support platform for the videoendoscopes employed in NOTES.

The procedure for removing the gallbladder need not differ from a classical laparoscopic cholecystectomy. To operate through this entry port and with these instruments, the surgeon must meet certain conditions: He must be highly experienced in performing biliary laparoscopic surgery, be adept at applying this technique with only two working channels (the left-handed one for exerting traction on the gallbladder and the right-handed one for surgical maneuvers), be familiar with minilaparoscopy tools and, finally, have become accustomed, through previous practice with a simulator or experimental animals, to the view provided by the videoendoscope. This can be one of the most complex aspects of the surgery. The videoendoscope provides a much less static image than the laparoscope, which is a rigid instrument furnishing an image that moves about less. Additionally, the videoendoscope is much more sensitive to slight changes in traction or in the position of the working tools, making it necessary to change the field and the angle of vision often. It is essential that the endoscopist and the surgeon go through a period of training together so they become used to each other and learn to coordinate and synchronize their gestures and maneuvers.

The traction exerted on the gallbladder with forceps through the endoscopic working channel was not effective. We feel forceps should be designed specifically for endoscopy so as to be able to exert traction and hold things in place with longer, rotating blades having an atraumatic surface. A conventional two-channel videoendoscope would have made collaboration easier, but its effectiveness is limited by the inability to make spatial movements or to angle the two working channels independently of each other. On the other hand, the videoendoscope’s role as a camera may not be compatible with the tasks performed by endoscopic instruments through working channels, given their mutual structural dependence. There is a type of videoendoscope that is not on the market, the R-Scope, with two working channels, each measuring 2.8 mm, allowing for greater angulation and vertical motion in one channel and greater horizontal motion in the other (20). It was the surgeon who dissected the hilum of the gallbladder; identified, clipped, and sectioned the cystic duct and artery; and severed adhesions between the gallbladder and the duodenal wall and liver parenchyma, as well as peritoneal and omental adhesions. We believe this is the best approach as long as endoscopic materials and technologies adapted for surgery through videoendoscopes are not available. This is supported by the fact that it took us 95 minutes to complete our first transvaginal cholecystectomy, whereas Bessler et al., who performed part of their dissection with videoendoscopic instruments, took 210 minutes (2).

After removing the gallbladder, we placed it in a plastic bag with a lip around the edge that allowed us to get a firm, slip-resistant hold with mouse-toothed foreign body forceps. We feel that removing the gallbladder and placing it inside the plastic bag has advantages over using an endoloop (Olympus) at the cystic end of the gallbladder after removal (2). Placing the gallbladder in a bag can keep the contents from spilling into the peritoneal cavity and prevent bile and stones from spilling if the gallbladder is ruptured during removal; it can protect against the appearance of neoplastic implants on contact surfaces when the gallbladder harbors an undetected neoplasm, and it probably contributes to faster removal through the vagina.

REFERENCES