

## Transvaginal cholecystectomy: technical aspects and future perspectives of NOTES surgery

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Notes surgery (Natural Orifice Transluminal Endoscopic Surgery) is a novel approach for surgical treatment of abdominal diseases. It is based on the use of a flexible scope to enter the abdominal cavity (*via* transesophageal access, transgastric, transcolonic, transvaginal, or tranvescical). This approach is also based on the combination of modern endoscopic and laparoscopic procedures and technologies. One of the most known procedures is the transvaginal cholecystectomy (TVC): it is realised making a posterior colpotomy, in order to enter the abdominal cavity. Two types of TVC have been described: a "pure TVC" which is completely performed through the vagina, and a "hybrid TVC", in which colpotomy represents only a visual support for the abdominal operation. Although TVC is now considered a very interesting approach both for surgeons and patients, its role is limited by the lack of a proper equipment and it might be impaired by a high rate organ injury due to instruments introduction; more, it is a very challenging procedure for surgeons. In this review we go through all the most recent techniques and modern equipment which are currently used to realize the TVC.

**KEY WORDS:** Endoscopy - Cholecystectomy - Surgical procedures, operative.

NOTES surgery represents a novel approach to treat abdominal diseases. It is based on the use of a flexible scope to enter the abdominal cavity, using a transesophageal, transgastric, transcolonic, transvaginal or tranvescical access. This approach is also based on the combination of modern endoscopic and laparoscopic procedures and technologies.<sup>1</sup>

TVC was first described by an american gynecologist, D. Tsin, who performed this operation at Mount Sinai Hospital, NYC, in 2003.<sup>2</sup> After this first descriptions, many authors have proposed lots of technical modifications, by the use of flexible scopes and a wide variety of laparoscopic assistance. Although this new procedure might be attractive for patients compared to standard laparoscopy, thanks to a lower postoperative pain as abdominal wall is not involved, it is certainly a very challenging procedures for surgeons: access is very difficult, a proper instrumentation is not available yet, and the risk of organ injury during instruments introduction is still very high.<sup>3</sup>

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Due to these current problems, the clinical use of NOTES is still limited and it is often considered as an experimental procedure.

In this review we go through all the most recent techniques and modern equipment which are currently used to realize the TVC.

### State of the art

According with its first description,<sup>4</sup> TVC is realized through a posterior colpotomy to enter the abdominal cavity; this incision is used as the visual or operative access. Pneumoperitoneum is obtained with Verres technique; the needle is then replaced with a 5 mm trocar under colposcopic view. In this first description Calot's triangle dissection and cholecystectomy is achieved with the use of the abdominal trocar; the specimen will be then extracted through the vagina. After this first experience, a great interest has been focused on the TVC, as demonstrated by a high variety of studies from the literature; nevertheless, most of these studies only investigate results on small patients group<sup>5</sup> or on animal models. The most important problem, anyway, is still represented by the lack of a proper instrumentation for the vaginal access.

TVC still presents lots of problems: some of them are shared with laparoscopic surgery, such as the triangulation, orientation and images rotation.<sup>5</sup> Due to these problems, TVC is now a slow and a challenging procedure.<sup>5</sup>

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### Pure TVC

"Pure TVC" does not require any laparoscopic assistance, and it is performed with two use of two flexible tools

in the abdominal cavity.<sup>6-11</sup> De Sousa *et al.*,<sup>12</sup> described their experience in 2004, with 4 women affected by symptomatic cholelithiasis. Because of the absence of dedicated tools, pneumoperitoneum was established connecting a flexible tube to a standard gastroscope that was inserted through a 2.5 cm posterior colpotomy. A second colonoscope with two operative channels was inserted using the same access. Gallbladder traction was achieved using the first scope, while Calot's triangle dissection was performed using the second colonoscope along with the ordinary endoscopic tools (hook, endoscopic forceps, polypectomy diathermy). Authors considered the view and the spatial resolution to be of good quality. The main problem was represented by the introduction of working tools through a small access (the vagina) and the lack of triangulation.

Gumbs *et al.*<sup>6</sup> have recently described a pure TVC performed on an American patient. A posterior colpotomy was realized under direct view and a 15 mm access (Applied Medical, Rancho Santa Margarita, CA) was used to establish the pneumoperitoneum. A double channel gastroscope (Storz, 13806 NKS, Tuttlingen, Germany), was inserted and pelvic inspection was performed to be sure that no injuries to pelvic organs were made during the insertion maneuvers. The main novelty of this approach lays in the use of an extra-long instrument (Novare, Cupertino, CA), that was inserted in the abdomen through a second lateral colpotomy. Endoscopic hook and biopsy forceps were inserted in the gastroscope operative channel in order to dissect the Calot's triangle. Authors report that the main problem with this approach lies in the impossibility to get a real safe view, as the gastroscope is inserted from behind, with some risk of biliary duct lesions.

Bigger randomized controlled trials seem to be necessary for a complete evaluation of short and long-term results, safety and cost-effectiveness profile.

### Hybrid TVC

Most authors support the idea that TVC still requires the use of abdominal tool to help the procedures.<sup>9</sup> That's why TVC is often realized as a fusion technique which stays in between endoscopic and laparoscopic procedures; this approach is called "hybrid TVC".

Some disputes still exist between the "transvaginal surgery, laparoscopically assisted" and the "laparoscopic surgery, transvaginally-assisted". The first one refers to an operation which is mostly performed through the vaginal access, while the abdominal access is only used to help the retraction. The second operation, instead, is mainly a conventional laparoscopic procedure, with some tools inserted through the vagina to assist tractions. Horgan *et al.*<sup>8</sup> report one of the biggest series of transvaginal cholecystectomy, laparoscopically assisted: in 5 patients a 5 mm trocar was inserted through the umbilicus in order to explore the abdomen and determine the transvaginal approach feasibility. This was the only trocar inserted in the abdomen, while all the other steps were performed through the vagina. Some difficulties arise from the pneumoperitoneum (as the insufflation is difficult to control) and the dissection of gallbladder from the hepatic bed; finally endoscopic clips are not

specifically designed for cystic duct. This emphasizes the importance of keeping up the research on the equipment.

Noguera *et al.*<sup>10</sup> describe their technique: a 12 mm trocar is inserted through a 12 mm colpotomy; pneumoperitoneum is better controlled thanks to trocar valve and the scope is better stabilized through the trocar, so that it is easier to get a proper view of the gallbladder. All endoscopic instruments are inserted through the scope operative channels; this approach might be defined as a transvaginal cholecystectomy totally laparoscopically assisted: in fact, even if two trocars were inserted through the abdominal wall, all the main steps of the operations were performed through the vagina.

On the other hand, Ramos *et al.*,<sup>8</sup> describe their experience with a laparoscopic cholecystectomy transvaginally-assisted: they use a standard laparoscopic equipment, without the need to use flexible scopes.

A laparoscopic cholecystectomy transvaginally-assisted is also described by Zorning *et al.*,<sup>1</sup> which report one of the biggest experience from literature: they use a combined approach with the instruments inserted through the vagina and a third one through the umbilicus.

These series demonstrate that hybrid TVC is feasible in adult women, no matter the age, also in the obese ones with previous operations or history of gallbladder inflammation. Anyway the authors also confirm that traditional flexible scopes are really difficult to use in abdominal surgery, requiring longer operative time.

### Future perspectives

TVC scopes should be characterized by high resolution, big operative channels, adequate length and possibility to get a decent triangulation. Only few devices present these features nowadays. "R" scopes by Olympus and USGI Medical can solve some of the problems related to access and view, while the Eagle Claw (Olympus), Swain system (Ethicon), and the G-prox (USGI) seem to be able to offer better intraoperative performance. Unfortunately there are still lots of drawback which limit the wide adoption of this approach.<sup>11</sup>

Anyway lots of companies are currently hardly working on producing a more adequate equipment, which might offer better performances.

Lower wound infection rates, lower risk of incisional hernia, better postoperative pain, better cosmetic results and a shorter postoperative recovery, certainly represents the best arguments to invest and make research on this novel field.

### Riassunto

*Colecistectomia transvaginale: aspetti tecnici e prospettive future della chirurgia transorifizia*

La chirurgia transorifizia, definita NOTES (Natural Orifice Transluminal Endoscopic Surgery), rappresenta un approccio alquanto recente al trattamento chirurgico di alcune patologie addominali. Dal punto di vista tecnico, si basa sull'utilizzo di un endoscopio flessibile con il quale si accede alla cavità addominale; tale accesso è stato descritto per *via* trans esofagea, trans gastrica, trans

colonica, trans vaginale o trans vescicale. Tale metodica si avvale, altresì, della combinazione delle più moderne tecnologie endoscopiche e laparoscopiche. La procedura transorificiale più studiata è certamente la colecistectomia transvaginale (TVC). In questa review analizziamo e descriviamo gli attuali orientamenti e le più moderne procedure per la realizzazione della colecistectomia transvaginale. Tale metodica si basa sull'accesso alla cavità addominale attraverso una colpotomia posteriore. Sono descritte due tipi principali di TVC: la colecistectomia trans vaginale "pura", che è completamente realizzata attraverso la vagina e una variante "ibrida", in cui l'accesso vaginale rappresenta solo un supporto visivo per l'intervento eseguito fondamentalmente per *via* addominale. Nonostante la TVC sia considerata un approccio molto interessante sia per i pazienti che per i chirurghi, il suo ruolo è ancora molto limitato dall'assenza di una vera strumentazione dedicata ed ancora sussistono dubbi riguardanti la comparsa di lesioni viscerali nella fase di introduzione dello strumento. Da ultimo, si tratta di una procedura certamente molto impegnativa sul piano tecnico per il chirurgo. In questa review verranno analizzate le procedure più recenti, lo strumentario ed i problemi che ancora attualmente esistono nella realizzazione della chirurgia transorificiale ed in particolar modo della TVC.

**PAROLE CHIAVE:** Endoscopia - Colecistectomia - Procedure chirurgiche operative.

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*Conflicts of interest.*—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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