

## CIRUGÍA ESPAÑOLA

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## Editorial

**NOTES: a new minimal invasive approach****NOTES: un nuevo abordaje mínimamente invasivo**

Although pain diminution has, of course, not yet been definitively established, the avoidance of abdominal wall transgression achieved by natural orifice transluminal surgery (NOTES) removes the risk of abdominal wound dehiscence, infection, and hernia. It also preserves the anterior peritoneal plane for any future operation. Now that its feasibility has been established in both preclinical and basic clinical settings, progress, and expansion in the field of NOTES depends on proving that the modality has real clinical applicability not limited to diagnostic or rudimentary intervention. The simple action of purposely puncturing a healthy viscera has raised many questions: What are the infectious implications? How can reliable closure be achieved? Is it practical to make a viscerotomy in the era of minimal access laparoscopic surgery? These questions all require cogent answers before proceeding to routine clinical NOTES. It is therefore necessary to verify that elaborate intra-abdominal operations can also be adapted for performance by NOTES with full obedience to governing surgical principles (including full visualization of the operative field, adequate tissue manipulation and retraction and capacity for haemostatic, and contamination control from within the peritoneal cavity). Circumspect laboratory investigation is critical to understanding the physiologic impact of transluminal surgery. In addition, the methodology employed needs to be ergonomic and economical.

From the first description by Kalloo et al in 2004, research mainly focused on finding the best access to the peritoneal cavity, with the caveat of an absolute need for a perfect closure of the entry point. Since 2004 many abdominal procedures that use a NOTES approach have been performed in survival animal models. Several authors have already described cholecystectomy, hysterectomy, splenectomy, nephrectomy, pancreatectomy, and other procedures performed through the stomach, the vagina, the urinary bladder, and/or the rectum although the transgastric route has been the most commonly used in experimental research setting.<sup>1-11</sup>

Both transvaginal and transgastric cholecystectomy have recently been transposed to clinical application attracting an explosion of interest.<sup>12,13</sup> Although the transgastric access seemed initially the most reasonable, the method

of gastrotomy closure most applicable to clinical practice is still an issue. The transvaginal route, despite its inherent limitations, was therefore the model chosen for the first human NOTES cholecystectomy. In fact, while secure closure of the gastric access site is critical and difficult, transvaginal access, a route well known to gynaecologists, de facto overcomes these problems.

Closure of the colpotomy is performed under vision using standard surgical techniques. Transvaginal surgery is not particularly novel with the first performances of incidental vaginal appendectomy at the time of vaginal hysterectomy reported by Bueno in 1949.<sup>14</sup> This first case report was shortly followed by the successful report of 12 and 8 cases from Pelosi and MacGowan respectively.<sup>15,16</sup> The procedures were described as simple, quick and safe. The experience by gynecologists performing transvaginal procedures has demonstrated safety also in regards to rarity of pelvic infection. Additional unique advantages associated with this NOTES approach are a straight shot when targeting organs in the upper abdominal quadrants and, the fact the colpotomy allows the use of rigid laparoscopic instruments at the side of the scope that could assist in different steps of the procedure. The most obvious limitation is that it is sex-specific and patient approval outside of the gynaecological arena.

The use of a transgastric route to perform surgical procedure is not new either. The first transgastric procedure dates back to percutaneous endoscopic gastrostomy (PEG) feeding tube placement reported in 1980.<sup>17</sup> PEG is today a common well standardized transgastric procedure, with a low complication rate. Even if some purists consider pancreatic necrosectomy via a posterior gastrotomy as the first published NOTES procedure, it's in 1998 that the Apollo group led by Kalloo brought new fuel and new prospective to this approach. Although most believe that the transgastric route will be the one to dominate NOTES in the future, today there are still some challenges for this approach before it becomes wide spread. The success of the procedure, and perhaps particularly, of the closure will depend on the route of access. In the near future we will most likely perform the enterotomy depending on what operation we are planning to accomplish just like in laparoscopic surgery. Furthermore

although up to now the described techniques are limited to a single point of access, this concept might evolve to multiple entry sites through the same organ which could overcome the lack of triangulation while using currently commercially available scopes.

Controlling contamination is a rather contentious issue. Recently this issue has been addressed by J. Hazey who investigated the bacterial load and contamination patients experience during laparoscopic roux-en-y gastric bypass while having their gastrotomy for gastrojejunostomy.<sup>18</sup>

Of the 50 patients enrolled only 5 patients demonstrated cross-contamination of bacterial loads from the stomach to the abdomen. None of these cross-contaminants resulted in clinically significant infection. Thus these findings support our hypothesis that while transgastric instrumentation does contaminate the abdominal cavity, introduced pathogens are clinically insignificant due to species or bacterial load.

Secure closure of the gastrotomy is crucial and represents today the single most significant concern associated with transgastric NOTES. This might be the rate-limiting step for the transition of transgastric NOTES into clinical practice. Although in some early studies, the gastrotomy performed with balloon technique was left open, there is now general agreement that a secure closure with minimal risk of leak must be achieved so as to avoid major complications. The ideal closure should be rapid, reproducible, and safe. Ideally the closure should be performed under vision to avoid any injury to the adjacent organs and should guarantee a full thickness closure. In addition a method that is easy and inexpensive is highly desirable. Different techniques have been reported in the literature with variable results and success rates. Mucosal flap, endoclips, percutaneous endoscopic gastrotomy tubes, prostheses, tissue glues, cardiac septal occluders, and suture closure have been described, but none has been universally adopted.<sup>19-28</sup> Endoclips represent the most commonly used method of closure. However, the simple application of mucosal clips enable only a single-layer tissue approximation and is limited and best suited for small defects. In addition their application might be sometimes difficult due to tangential orientation of the tissue or because of tissue edema. Suturing is a fundamental surgical step for secure tissue apposition and is considered without doubt the ideal closure method. Accurate stitch placement, control of the needle insertion depth and knot tying are the basic steps that still challenge any endoscopic attempt at suturing in NOTES.

While NOTES in its infancy is still experiencing some teething problems, the interest in this field is growing exponentially. Although fascinating this new approach still poses some technical challenges. As data accumulate we are learning that NOTES techniques require substantial refinement before achieving widespread clinical applicability. Today constraints on visual feedback and dexterity may limit the scope of NOTES procedures. Further research and developments are required to satisfy all the needs of this technique. We may be a long way from routine clinical applications of NOTES, but we are making steady progress. To overcome the problems with currently available endoscopic instruments, a stepwise clinical approach to clinical NOTES which entails the use of hybrid procedures blending the use

of both a laparoscope and a flexible endoscope has been successfully attempted. Transumbilical endoscopic surgery, TUES, might represent as well a bridge between laparoscopic and transluminal surgery excavating an embryologic resect.

The future of natural orifice surgery lies in the application of computer and robotic technologies with the vision of a fully autonomous endoscopic platform, optimal visual feedback, and full computer assisted motion of endoscopic instruments. The next generation of NOTES operations will probably utilize surgical tools capable of entering the human body through natural orifices and then configuring themselves into complex kinematic structures at the specific site of intervention. Until this technology will definitely complete its translation from fiction to science, the success of NOTES will depend on the application of broad-scope teaching and in-depth surgical and endoscopic training. This coupled with the awareness of the ethical and social implications that every "revolution" implies will be indispensable to the performance of NOTES in a safe and responsible manner. The initial applications of NOTES will most likely transcend the boundaries of conventional general surgery. There may be a time when pure natural orifices surgery is routine, but that time is not now. Awaiting the confirmation of our suspicion that NOTES is the way of the future a wise step back to a hybrid procedure with the use of a 5mm umbilical trocar may be the safest and most efficient alternative for patients.

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