CURRENT PERSPECTIVE OF NATURAL ORIFICE TRANS-LUMINAL ENDOSCOPIC SURGERY

Essay

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List of abbreviations

Abbreviation	Meaning
ASGE	The American society for gastrointestinal endoscopy
CT	Computed tomography
DCE	Dual channel scope
DDES	Direct drive endoscopic system
EGJ	Esophagogastric junction
EMR	Endoscopic mucosal resection
ERCP	Endoscopic retrograde cholangiopancreaticography
ESD	Early stage disease
EURO-NOTES	European association of translumenal surgery
EUS	Endoscopic ultrasonography
GE	Gastroesophageal
GERD	Gastroesophageal reflux disease
HoLEP	Holmium laser enucleation of the prostate
ICU	Intensive care unit
IOP	Incisionless operating platform
IRB	Institutional Review Board
IT	Insulation tripped electrosurgical knife
LED	Light emitting diodes
LES	Lower esophageal sphincter
LS	Laparoscopic surgery
MAS	Minimal access surgery
MIS	Minimally invasive surgery
MRI	Magnetic resonance imaging

NOSCAR	Natural orifice surgery consortium for assessment and research
NOTES	Natural orifice transluminal endoscopic surgery
OTSC	Over the scope clip
PCEEA	Premier curved end to end anastomosis circular stapler
PDT	Photodynamic therapy
PEG	Percutaneous endoscopic surgery
RPS	Retroperitoneal surgery
RYGBP	Roux en Y gastric bypass
SAGES	Society of American gastrointestinal endoscopic surgeons
SN	Sentinel LN
SSI	Surgical site infection
TEM	Transanal endoscopic microsurgery
TEP	Totally extraperitoneal hernioplasty
TIF	Transoral incisionless fundoplication
TNM	Tumor nodal metastasis
VBG	Vertical banded gastroplasty
YAG	yttrium-aluminum-garnet laser

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Mohamed Fawzy Attia

INTRODUCTION TO NOTES

Change is part of surgery but it is never easy to accept. At the dawn of surgery, excellence was associated with big incisions: “Big scar, big surgeon.” Surgery with no scars was an impossible reverie. Now natural orifice transluminal endoscopic surgery (NOTES) is being performed, and the philosophy of surgery will be dramatically changed. Transluminal surgery has the potential to break the physical barrier between body trauma and surgery, representing an epical evolution in surgery. Laparoscopic gallbladder resection changed the focus of surgery and the mindset of nearly all surgeons. Cholecystectomy seems to be the logical next step in developing the clinical application of NOTES ***(Marescaux et al., 2007)***.

In 1882, Langenbuch, as cited by ***van Gulik, 1986***, successfully removed the gallbladder in a 43-year-old man who had cholelithiasis. His initial report was ignored. Nevertheless, Langenbuch’s open cholecystectomy remained the standard criterion for the treatment of symptomatic cholelithiasis for More than a century. In1985, Muhe, as cited by ***Reynolds, 2001***, performed the first laparoscopic cholecystectomy using a modified laparoscope, called the galloscope. In 1986, he presented his technique at the German Surgical Society Congress but was strongly criticized. In 1987, Mouret performed the first laparoscopic cholecystectomy with an

approach that would become the standard technique within 2 years which was the use of one optical trocar and two other trocars. The world of general surgery was soon divided into a small group of enthusiastic surgeons convinced of the superiority of laparoscopic over conventional cholecystectomy and a second, large group of surgeons with varying opinions ranging from curiosity to frank condemnation of laparoscopic cholecystectomy ***(Mouret, 1996)***.

The controversy was intense but short. In 1992, the National Institutes of Health Consensus Development Conference statement on gallstones and laparoscopic cholecystectomy concluded that, compared with open cholecystectomy, laparoscopic cholecystectomy was safe and effective in most patients and should be the treatment of choice ***(NIHCDC, 1992)***.

Even if surgeons were reluctant to acknowledge this shift in treatment, patients applauded the new minimally invasive surgery. Whenever it was possible, patients would ask for a surgical procedure that left no outer scarring and resulted in no postoperative pain. Patients, both male and female, independent of age and body shape, dislike scars, not only for cosmetic reasons but because scars indicate they have undergone treatment because of illness ***(NIHCDC, 1992)***.

This resulted in NOTES, with its general goal of minimizing the trauma of any interventional process by eliminating the incision through the abdominal wall and using natural orifices ***(NIHCDC, 1992).***

In 2004, Kalloo and his coworkers reported on a series of transgastric peritoneoscopies done in a porcine model-a procedure to be later termed natural orifice translumenal endoscopic surgery (NOTES) ***(Kalloo et al., 2004)***. That same year Reddy and Rao presented a video of the first human transgastric appendectomy at the Annual Conference of the Society of Gastrointestinal Endoscopy of India ***(Reddy and Rao, 2004).***

As with the laparoscopy revolution, the introduction of NOTES caused a stir among general surgeons and many scrambled to learn more in anticipation of the next possible wave of minimally invasive surgery. Interestingly, a subgroup of advanced therapeutic gastroenterologists was also intrigued by this new field and equally interested in learning more. By 2005 the first NOTES hands-on training course was conducted at Case Western Reserve School of Medicine in Cleveland, Ohio despite the fact that only one human case had been done in the world! Multiple courses followed both in the US and Europe ***(Dunkin, 2010)***.

NOTES training is unique in that it crosses specialty lines (general and thoracic surgery, gynecology, gastroenterology) and most practitioners do not possess both the knowledge and skill to perform the procedures in their current form. The flexible endoscopy instruments used in NOTES are not familiar to most surgeons while surgical technique and procedures are not familiar to most gastroenterologists ***(Dunkin, 2010)***.

Adding unique points of access such as transvaginal, transcolonic or transesophageal further add to the learning curve and the whole process becomes even more complex because the field is in constant evolution with advances in technology and technique being introduced almost daily! ***(Dunkin, 2010).***

DEFINITION OF NOTES

Natural orifice transluminal endoscopic surgery (**NOTES**) ***(Halim and Tavakkolizadeh, 2008)*** is an experimental surgical technique whereby "scarless" abdominal operations can be performed with an endoscope passed through a natural orifice (mouth, urethra, anus, etc.) then through an internal incision in the stomach, vagina, bladder ***(Lima et al., 2006)*** or colon, thus avoiding any external incisions or scars ***(Baron, 2007)***.

This technique has been used for diagnostic and therapeutic procedures in animal models, including transgastric (through the stomach) organ removal. Most recently, the transvesical and the transcolonic approaches have been advocated by some researchers as being more suited to access upper abdominal structures that are often more difficult to work with using a transgastric approach***(Fong et al., 2007)***. In this sequence, a group from Portugal ***(ICVS,)*** used transgastric and transvesical combined approach to increase the feasibility of moderately complex procedures such as cholecystectomy ***(Rolanda et al., 2007)***.

NOTES was originally described in animals by researchers at Johns Hopkins University ***(Anthony Kalloo et al.),*** and was recently used for transgastric appendectomy in humans in India ***(by Drs. G.V. Rao and N. Reddy).*** On June 25, 2007 Swanstrom and colleagues reported the first human transgastric cholecystectomy ***(NOTES Transgastric***

Cholecystectomy). Totally transvaginal cholecystectomy has been described in experimental model without using laparoscopic assistance ***(Sánchez-Margallo et al., 2008).***

In late 2008 surgeons from Johns Hopkins School of Medicine removed a healthy kidney from a woman donor using NOTES. The surgery was called transvaginal donor kidney extraction ***(InfoNIAC, 2009)***.The transvaginal access to NOTES seems to be the most safe and feasible for clinical application. In early March 2007, the NOTES Research Group in Rio de Janeiro, Brazil, led by Dr. Ricardo Zorron, performed the first series of transvaginal NOTES cholecystectomy in four patients, based in previous experimental studies. With fewer potential complications, the procedure has a disadvantage of being possible only in women ***(Sánchez-Margallo et al., 2009)***.

Proponents and researchers in this field recognize the potential of this technique to revolutionize the field of minimally invasive surgery by eliminating abdominal incisions. NOTES could be the next major paradigm shift in surgery, just as laparoscopy was the major paradigm shift during the 1980s and 1990s. Potential advantages include lower anesthesia requirements; faster recovery and shorter hospital stays; avoidance of the potential complications of transabdominal wound infections (e.g. hernias); less immunosuppression; better postoperative pulmonary and diaphragmantic function; and the potential for "scarless" abdominal surgery. Critics challenge the safety and advantages of this technique in the face of effective