

Methods of treatment for gallbladder diseases

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Abstract

In this article we discuss all contemporary methods of gallbladder disease treatment regardless of their routine or experimental use. At the moment, we can perform open cholecystectomy, laparoscopic cholecystectomy, single incision laparoscopic surgery (SILS) or natural orifice transluminal endoscopic surgery (NOTES). All these procedures complement one another. When making a decision on the choice of operative method, one should take into consideration not only the patient's physical condition and patient's preference but also the skills and experience of the surgeon, and current state of knowledge.

Key words: cholecystectomy, laparoscopic cholecystectomy, open cholecystectomy, NOTES, SILS, LESS.

Introduction

Surgery has been developing very dynamically in the last two decades. Progress is due not only to advances in medical sciences, but also the development of new technologies. Wide popularization of laparoscopic procedures created new therapeutic opportunities for both surgeons and patients. Contemporary therapeutic options for treatment of gallbladder diseases became an interesting issue. We are capable now of performing classic procedures, laparoscopy, single incision laparoscopic surgery (SILS) or finally natural orifice transluminal endoscopic surgery (NOTES). All these techniques must not be considered equal, nor should they be regarded as competitive. These procedures ought to be viewed as supplementary therapeutic methods in treatment of gallbladder pathology. A contemporary surgeon involved in treatment of gallbladder diseases ought to possess a broad spectrum of operative skills from classic open surgery to technologically advanced methods.

In this report we discuss every method of modern surgical treatment of gallbladder pathology, indepen-

dently of their routine or experimental applications. We did not try to compare the value of each method. We do not believe comparison between various methods of surgical treatment for gallbladder diseases according to evidence-based medicine standards is now possible, since open/classic surgery or laparoscopy are recognized and accepted options and NOTES and SILS/LESS (laparo-endoscopic single-site surgery) are at the beginning of their development.

“Classic” surgery

Surgery of the gallbladder is over 300 years old. In the beginning, only gallstones from an inflamed organ were removed, until cholecystectomy was performed in the 1880s. Familiarity with open/classic cholecystectomy technique is important to every surgeon. Nowadays, indications for classic procedure are innumerable. The necessity for conversion, when troubles or intra-operative complications occur, in laparoscopic cholecystectomy is a particular reason for application of classic technique. It is stressed that the risk of conversion is much higher in emergency

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procedures for gallbladder hydrops, empyema or pericholecystitis.

Most often it is done due to inability to show all anatomical structures. Level of technical complication is mostly defined by inflammation, which blurs the borders of separate anatomical structures. Infiltration of Calot's triangle remains the first indication for conversion. An important factor which also must be taken into consideration in making a decision to convert and perform open cholecystectomy is "lack of progression of the procedure".

Another reason for classic surgery is gallbladder cancer. Although the number of incidentalomas, i.e. accidentally discovered, early stage gallbladder cancers, increases with the number of performed cholecystectomies, pre-operative suspicion of a cancer of this organ remains an indication for open surgery. Mirizzi syndrome (cholestasis, and jaundice caused by obliteration of the hepatic duct lumen from pressure of the gallbladder or cicatrization) is another indication for this type of treatment [1]. According to some authors, patients in whom stones from the common bile duct could not have been removed on pre-operative ERCP, and size of the stone, skills or equipment limitations of the centre do not allow for laparoscopic removal, are also candidates for classic surgery.

Indications for open cholecystectomy are shrinking gradually. At present, cholangitis, biliary peritonitis or portal hypertension can no longer be considered indications for the classic procedure. Indications disputed vigorously not long ago such as 3rd trimester of pregnancy, coagulation disturbances, long-term preoperative oral anti-coagulant therapy, extensive adhesions from previous surgeries, complicated abdominal anatomy, and circulatory or respiratory disturbances, cannot now be considered absolute contraindications for laparoscopy or indications for classic surgery. The classic procedure is performed less often by paediatric surgeons as well [2, 3].

Laparoscopic surgery

The history of laparoscopy dates back to the beginning of the 20th century, when in 1901 Kelling for the first time performed diagnostic laparoscopy in a dog with Nitze's cystoscope. The first laparoscopy in a human was done by the Swede Hans Christian Jacobaeus in 1910. Dynamic development

of the laparoscopic instrumentarium began in the 1980s. The first laparoscopic cholecystectomy was performed in 1987 in Lyon by a French gynaecologist, Phillip Mouret [4, 5]. In the beginning, the new technique for operative treatment of surgical diseases was treated with caution. Time and satisfactory treatment results were needed to convince the majority of surgeons about this novel method. At present, we can easily state that laparoscopy has revolutionized surgical practice, and gallbladder surgery in particular. The undisputed and widely known advantages of laparoscopic procedures caused laparoscopic cholecystectomy to become a gold standard in many diseases of this organ, such as symptomatic gallstones, acute cholecystitis [6, 7], mechanical jaundice [7, 8] and gallstone-related pancreatitis [7]. The list of indications for laparoscopy grows, while that of contraindications contracts. Obesity used to be a contraindication to a laparoscopic procedure in the past and now is an indication; it is the same with 1st and 2nd trimester of pregnancy [9]. Most contraindications are now relative: peritonitis, prior surgery with adhesions which significantly perturb anatomy and make laparoscopic tool manipulations trickier, portal hypertension and severe cardiovascular, respiratory, liver insufficiency or severe coagulation disorders – only until disturbances are controlled.

Laparoscopic technique in comparison to classic surgery necessitates only a few small incisions 0.5-1.5 cm long for introduction of the camera and laparoscopic tools. The first incision is made above or below the umbilicus. Pneumoperitoneum is set via a Veress needle up to 12 mm Hg. A trocar at the umbilical site is usually used for camera placement. The remaining trocars are positioned in sites allowing for proper traction and triangulation during the procedure. In laparoscopic cholecystectomy trocars are placed: below the xyphoid process, in the right anterior axillary line at the subcostal margin, and in the right midclavicular line. Calot's triangle structures are dissected (artery and cystic duct), then clipped and cut. The gallbladder is freed from its hilus and removed through a 10 mm trocar port. The procedure is finished with or without Redon drain placement and deflation of the peritoneum.

Opponents of this method give arguments pointing to difficulty in manoeuvring laparoscopic tools, the two-dimensional view, higher cost of equipment, and complications, i.e. injuries of the

biliary tree and bile leakage from ill-prepared bile ducts or miss-positioned clips on the bile ducts [10, 11], bleeding after clip slipping [11], gas emboli, and injury of the GI tract during trocar introduction. However, the rate of occurrence of these complications is not that high and is not different from that observed in the conventional procedure. What is more, laparoscopic surgery is associated with less formation of adhesions and lack of complications attributable to the operative wound (eventration, large hernias, etc.).

Laparoscopic cholecystectomy is a safe and efficient method [11]. Some clinical situations however still require classic cholecystectomy. It should not be considered a complication but the necessity for application of a better method in a particular situation.

SILS (single incision laparoscopic surgery)/LESS (laparo-endoscopic single-site surgery)

Although laparoscopy is a less invasive technique in comparison to conventional surgery, it requires a few small tegument incisions to reach the peritoneal cavity. Any wound in the abdominal wall creates some risk of bleeding, herniation and injury to internal organs and worsens the cosmetic effect of the procedure. Additionally, even small scars are considered undesirable by patients, particularly by young women. Laparoscopic cholecystectomy has been given a viable alternative in the form of SILS [12, 13]. Apart from SILS, the procedure has been called many other terms in the literature: LESS (laparo-endoscopic single-site surgery), SAS (single access site), SPA (single port access), SPL (single port laparoscopy), SSA (single site access), OPUS (one port umbilical surgery) and SLiPP (single laparoscopic port procedure). SILS technique uses a natural scar – the umbilicus. The umbilicus is opened longitudinally (along the body long axis), and pneumoperitoneum is achieved with a Veress needle or with Hasson's technique port placement. A special single port with 3 channels for the video camera (usually 30°) and tools is introduced. For cholecystectomy, the patient is laid as for the regular laparoscopic procedure in the anti-Trendelenburg position with slight leftward rotation. When necessary, the gallbladder can be suspended on the abdominal wall with straight-needle sutures,

which allows for appropriate visualization of Calot's triangle. The cystic artery and duct are prepared with laparoscopic or hook-tipped tools designed specially for SILS, and closed with a 5 mm clip applicator. The gallbladder is removed via the operative wound in the umbilicus. The procedure is accomplished with closure of the wound within the umbilicus, which does not form another scar but only re-creates an existing one [14, 15].

The main complication in the SILS procedure is that the tools and camera remain in close proximity and parallel via different channels of the same port. Because of this, tools are introduced under a suboptimal angle, which makes traction and preparation more difficult. To bypass this problem, special hook-tipped tools are applied. Optimal tool manipulation requires crossing two of them within the peritoneal cavity; thus handling, traction and coagulation are done with the contralateral hand to conventional laparoscopy. As a result, preparation sometimes must be done with the non-dominant hand [16].

Another challenge of SILS is to avoid tool handles and videoscope conflict outside the port. For that, a long camera or cameras with a cable attached in the longitudinal axis rather than at the side are used; hence full rotation of the camera without colliding with other tools can be achieved [14]. Other qualities of the tools easing operation with this method must be mentioned. The port is made from spongy, plastic material which is able both to adapt to the operative wound in the umbilicus and to secure air tightness of tools constantly changing their position. The trocars have much smaller handles than classic trocars – which allows them to be held very close, nearly parallel. The trocars are also short, so as not to hinder the site view.

If necessary, the surgeon can convert to conventional laparoscopy by just adding one or more additional laparoscopic trocars, without the necessity to change position or introduce new tools [16]. Placement of a single port in the umbilicus results in a better cosmetic effect and prevents passing of the trocars through the muscles, which minimizes pain in the puncture site. Significant reduction of abdominal wall injury translates into less post-operative pain, faster recovery, fewer wound-related complications and a better aesthetic effect [16]. This method is a little more difficult than conventional laparoscopy, yet the learning curve is very short [14]. Its rapid development and popularization seems likely.

Natural orifice transluminal endoscopic surgery

Natural orifice transluminal endoscopic surgery (NOTES) seem to be a logical consequence of progress in minimally invasive surgery. NOTES is a natural step in the development of minimally invasive techniques, which – by gradual decrease of the size of surgical incision as it happens today – should allow trans-parietal access to be avoided completely. It is going to be a radical fulfilment of the surgical postulate to tailor access solely to the area of tissues affected by disease. Avoidance of transabdominal access results in less pain from the operative wound, and prevents such wound-attributable complications as infection, evisceration, and postoperative hernias. Moreover, a perfect aesthetic effect is accomplished [17].

The era of dynamic progress in laparoscopy in the last two decades has revolutionized imaging technology, mechanical suture and haemostasis techniques. NOTES also creates opportunities for further development of innovative technology, such as robotic surgery, intraoperative navigation or virtual reality, and modern techniques of anaesthesia, such as deep hibernation. Modern surgery will be performed by modern surgeons, bred and educated in the information age.

The history of NOTES begins in the 21st century. The early years were spent on elaborating the operative technique, finding acceptable access points, learning the technique of opening and closing the GI tract at peritoneal access points, insufflation and maintenance of adequate pneumoperitoneum pressure and tool inventing. The majority of procedures were performed in a laboratory setting on animals. Presently, more numerous experimental studies are being undertaken in humans.

NOTES technique uses the following access points for cholecystectomy:

- via the posterior fundus of the vagina,
- via the gastric wall,
- via the rectal wall [18, 19].

Transvaginal access is the preferred option. Hence, most operated patients are women. This does not necessarily mean that the procedure can be performed only in 50% of patients. Approximately 85% of gallbladder diseases occur in women. Thus, theoretically, most NOTES procedures via vaginal access are doable. Other ways of access in

NOTES technique for cholecystectomy are not used in practice. Most of the cholecystectomy procedures are conducted with double-lumen Olympus GIF 2T160 operative fibroscopes. Each patient should be examined by a gynaecologist experienced in transvaginal procedures and fluent in diagnosis of endometriosis within the abdominal cavity. In transvaginal access the patient is laid on her back, with lower limbs in a gynaecological position. Pneumoperitoneum is insufflated by a Veress needle introduced through the umbilicus – a natural cicatrix in the abdominal wall. Then, a 5 mm trocar is placed for camera institution into the peritoneal cavity. We find it a necessary element of the procedure in the early stage of learning this technique. Then, a vaginal speculum is introduced and the fundus is opened on the right under visual control. Next, the fiberoptic endoscope is inserted into the peritoneal cavity. Air-tightness is accomplished with placement of moist gauze within the vagina, which is sufficient to carry out the procedure. When the endoscope is introduced, the camera is removed. Pneumoperitoneum is maintained by gas insufflation through a valve of a 5 mm trocar in the umbilicus. The operating table is then set in the Trendelenburg position to show the underside of the liver with the gallbladder. At this point a decision is made to suspend the fundus of the gallbladder to the abdominal wall below the subcostal arch with a suture placed across the abdominal tegument or use a 5 mm umbilical port to introduce 5 mm laparoscopic forceps for traction of the gallbladder fundus. Another way is to introduce 2 mm forceps for paediatric laparoscopy directly across the abdominal wall. In some centres another fibroscope is put in through the fundus of the vagina for gallbladder traction. At the moment, with available equipment traction with laparoscopic forceps and use of the umbilical port is the easiest option. When the fundus of the gallbladder is retracted, Calot's triangle can be seen. Endoscopic forceps are put through one of the working channels for cystic duct retraction, while a coagulation and incision hook goes into another. The cystic duct and artery are prepared with the hook and clips are placed with flexible clip applier HX 201 LR – 135 LR – two from the side of the biliary tract and one from the gallbladder. Then is the laborious stage of gallbladder dissection from its fossa. Preparation ought to be made slowly, with major attention to perfect haemostasis. After

excision, the gallbladder is grabbed with endoscopic forceps and, by pulling it along the endoscope, removed from the peritoneal cavity. Closure of the vaginal fundus finishes the procedure. This suture is technically not difficult. No tampon needs to be put in the vagina in the post-operative period. NOTES cholecystectomies via other than vaginal access – through the gastric wall or transrectally – are performed extremely rarely. The procedure from these accesses is far more complicated technically with available operative endoscopic equipment. Samorai and Octopus endoscopes designed for NOTES are now in the experimental phase and are not available for the medical market or clinical applications.

Hence, we now have at our disposal a broad spectrum of options for surgical treatment of gallbladder diseases. They are not competitive. Each of them has its benefits and weaknesses. When choosing the type of operation, not only clinical status but also patient preferences and own skills, experience and scientific evidence must be taken into account. In any case, one should never adopt a passive attitude to the challenges of the future.

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