

## APPLICATION OF THE SINGLE ACCESS TECHNIQUE IN LAPAROSCOPIC SURGERY

MARCIN STRZAŁKA, MACIEJ MATYJA, MACIEJ MATŁOK, MARCIN MIGACZEWSKI,  
PIOTR BUDZYŃSKI, ANDRZEJ BUDZYŃSKI

2<sup>nd</sup> Department of General Surgery of the Jagiellonian University Medical College in Cracow  
Kierownik: prof. dr hab. K. Rembiasz

Laparoscopic single access technique is a next step in development of minimally invasive surgery.

**The aim of the study** was to present results of different laparoscopic single incision procedures and evaluate application of this technique.

**Material and methods.** 102 patients (15 males and 87 females) who underwent laparoscopic single incision procedure from 15<sup>th</sup> October 2009 to 31<sup>st</sup> December 2012 were included in the study.

**Results.** In the analyzed period we performed 72 cholecystectomies (70.6%), 8 left adrenalectomies (7.8%), 3 right adrenalectomies (2.9%), 7 splenectomies (6.9%), 5 spleen cysts unroofings (4.9%), 2 appendectomies (2%), 1 Nissen fundoplication procedure (1%), 1 removal of the adrenal cyst (1%) and 3 concomitant splenectomies and cholecystectomies (2.9%). There were 3 technical conversions to multiport laparoscopy, but no conversion to open technique. Complications were observed in 5 patients (4.9%). Average operation time was 79 min (SD=40), average hospitalization time 2.4 day (SD=1.4).

**Conclusions.** Laparoscopic single incision technique is a safe method and can be used as a reasonable alternative to multiport laparoscopy in different minimally invasive procedures especially in young patients to whom an excellent cosmetic effect is particularly important.

**Key words:** laparoscopy, single access technique, results

Clearly the greatest progress in recent years in the general surgery involved launching and worldwide spread of laparoscopic technique. Currently the number and extent of minimally invasive procedures is growing, the contraindications are becoming more and more limited and furthermore some types of procedures are considered the gold standard therapeutic management (1, 2).

Development of laparoscopy would be impossible were it not for the number of benefits that this type of surgical method brings to the patients. The most important of them include reduced pain in the postoperative period, less common postoperative complications, shorter hospitalization after the surgical procedure, quicker return to full activity after the procedure or better cosmetic effect of surgical treatment (1, 2).

Attempts to further minimize trauma related to surgical procedures and improve their cosmetic effects resulted in modification of laparoscopic technique, i.e. a surgical procedure with a single, small incision most commonly in the umbilicus. According to some authors this method is an intermediate stage to surgical procedures through natural body orifices (NOTES), while for others may be a rational final proposal (3).

This involves a technical modification versus conventional laparoscopic procedures, i.e. replacing several incisions with a single through which a multichannel port is inserted. Change of access has no effect on the type and extent of the surgical procedure.

The aim of the study is to present results of various minimally invasive procedures using a single access technique and assessment of

utility of this surgical method in the laparoscopic surgery.

## MATERIAL AND METHODS

The study enrolled 102 patients who underwent a single incision laparoscopic procedure at the 2<sup>nd</sup> Department of General Surgery of the Jagiellonian University Medical College in Cracow between 15.10.2009 and 31.12.2012. This group included 15 males (14.7%) and 87 females (85.3%). An average age of patients undergoing surgical procedure was 42.6 years (SD = 15.8), 48.3 years in males (SD = 16.7) and 41.4 years for females (SD = 15.5). The youngest patient undergoing surgical procedure was 18 years old, while the oldest was 77 years old.

Retrospective analysis included such factors as: number of patients, age, sex, and type of performed surgical procedure. Furthermore frequency of conversion for all types of single incision procedure was established and causes for changes of surgical technique for both conventional laparoscopy through increased number of used trocars) and for open surgery were characterized.

Types of intraoperative and postoperative complications of individual surgical procedures were presented and characterized in detail. Average duration of hospitalization of patients treated with this method and average duration of individual single incision laparoscopic procedures was determined.

Various trocar types were used during the surgical procedures involving a single incision of the umbilicus. The most commonly used trocars included: SILS-Port, Covidien (65 times), Triport, Olympus (18 procedures) or, less often, port Ethicon SSL (1 procedure). Laparoscopic procedure was performed using this technique without using any special port in 18 cases.

## RESULTS

Seventy two laparoscopic cholecystectomies (vast majority, 70.6% of all such procedures) were performed in the analyzed period using the technique of single incision of the umbilicus. Cholecystectomy was performed using this technique in 3 cases due to acute

cholecystitis, in one case due to gall-bladder hydrops and in 68 due to symptomatic cholelithiasis.

Other procedures performed using this method included: 8 left adrenalectomies (7.8%), 3 right adrenalectomies (2.9%), 7 splenectomies (6.9%), 5 spleen cysts unroofings (4.9%), 2 appendectomies due to acute appendicitis (2.0%), 1 Nissen fundoplication procedure due to GERD (1%), 1 removal of the adrenal cyst (1%) and 3 concomitant splenectomies and cholecystectomies (2.9%) (fig. 1).

Indications to adrenalectomy included: Cushing's syndrome in 4 cases, pheochromocytoma in 3 cases, incidentaloma in 3 cases and Conn's syndrome in 1 case. Average size of the adrenal mass was 3.55 cm (ranging from 2 to 5 cm).

Conversion took place during 3 procedures conducted using SILS technique; therefore incidence of conversion was 2.9%. These were two cholecystectomies and one left adrenalectomy. Difficult anatomy was the cause for conversion to conventional laparoscopy (insertion of one or two additional trocars) in all cases. All conversions were of technical nature and were not forced by intraoperative complications. There were no cases of conversion to open surgery in the analyzed period.

Average duration of all single access laparoscopic procedures was 79 min (SD = 40).

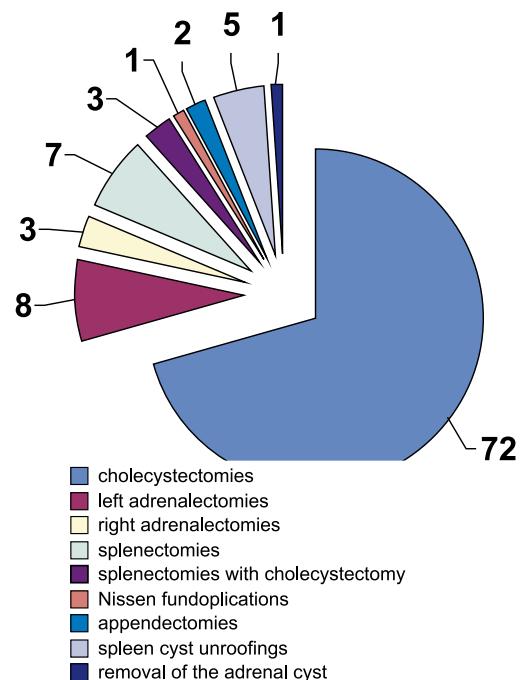


Fig. 1. Number of different procedures performed in the analyzed period

Average duration of the most common single port procedure, i.e. cholecystectomy, was 65 min (SD = 23). Table 1 summarizes average duration of individual procedures.

Average duration of postoperative hospitalization for all single access laparoscopic procedures was 2.4 days (SD = 1.4). Table 2 presents data on average duration of hospitalization after specific surgical procedures.

Both the intraoperative and postoperative period was uncomplicated in vast majority of patients (97 patients, 95.1%) undergoing single incision laparoscopic procedure. No deaths were recorded. Five complications (4.9% of all patients undergoing surgical treatment) occurred in the analyzed group of patients.

A 34-year old female who underwent splenectomy due to autoimmune thrombocytopenia and underwent umbilical hernioplasty underwent reoperation on day one after the surgery using the same technique, with the drain left due to bleeding from a wound after the umbilical port.

Approximately 100 ml hemolyzate was aspirated through puncture of lower abdomen in a 21-year old female with congenital spherocytosis on day 2 after the concomitant splenectomy and cholecystectomy. This management proved successful and the patient was discharged home on day 4 after the surgery.

Chronic infection manifesting as massive umbilical wound suppuration occurred only in a single patient. This was a 50-year old female who underwent surgical treatment due to acute suppurative appendicitis. This complication resulted in prolongation of hospitalization (5 days) and wound healing time.

A 49-year old overweight female (BMI = 27.94) developed hernia in the scar 9 months after a single access cholecystectomy; the hernia was corrected surgically.

A 55-year old male with ACTH-independent Cushing's syndrome who underwent left adrenalectomy, developed pulmonary embolism after the surgical procedure. This complication required 5-day hospitalization at the Intensive Care Unit.

## DISCUSSION

Laparoscopy using a single access through the umbilicus is most commonly referred to as SILS (single incision laparoscopic surgery). However, it is also called: TUES (transumbilical endoscopic surgery), E-NOTES (embryonic natural orifice transumbilical endoscopic surgery), SPA (single-port access), LESS (laparo-endoscopic single-site), SSL (single-site laparoscopy), OPUS (one-port umbilical

Table 1. Average operation time of the different laparoscopic single incision technique procedures

Type of procedure	Average duration time (min)	SD
Cholecystectomy	65	23
Left adrenalectomy	100	30
Right adrenalectomy	125	52
Splenectomy	143	68
Splenectomy with cholecystectomy	177	35
Nissen fundoplication	100	–
Appendectomy	43	25
Spleen cyst unroofing	85	37
Removal of the adrenal cyst	70	–
All	79	40

Table 2. Average postoperative hospitalization time of the different laparoscopic single incision technique procedure

Type of procedure	Average time of hospitalization (days)	SD
Cholecystectomy	2	1,2
Adrenalectomy	3,18	1,5
Splenectomy	3,5	1,2
Nissen fundoplication	1	0
Appendectomy	4	1,4
All	2,4	1,4

surgery), NOTUS (natural orifice transumbilical surgery), SLAPP (single laparoscopic port procedure), SPLS (single-port laparoscopic surgery), SPL (single-port laparoscopy), SLIT (single laparoscopic incision transabdominal) (4).

Until recently, most of the procedures performed using SILS involved relatively simple procedures, in particular cholecystectomies. There are many reports in the literature documenting good results of cholecystectomy with this technique (5-12). With time the number of types of laparoscopic procedures performed using a single incision increased. Such procedures as: appendectomies, adrenalectomies, splenectomies, large intestine resections, surgical procedures of inguinal hernia, bariatric procedures and other procedures emerged among them (13-22).

SILS technique that limits the extent of surgical access to a single small incision, seems to be gaining popularity. It is also utilized in other specialties than general surgery, such as urology (nephrectomies, surgery of the prostate), gynecology (hysterectomies, surgery of the appendages) or pediatric surgery (appendectomies, splenectomies, cholecystectomies, surgery of the intussusception) (23-28).

First literature data are promising and underscore safety of use, number of complications comparable to conventional laparoscopy and excellent cosmetic effects of minimally invasive SILS procedures, however further studies are required to assess utility of this new surgical technique. There is still no unequivocal evidence documenting better postoperative course and smaller adhesions in patients undergoing laparoscopic procedures using a single port versus conventional laparoscopy. Some authors are concerned about potentially high incidence of scar hernia after the umbilical trocar with SILS procedures.

Our results indicate that the laparoscopic technique using single umbilical incision can be safely used during various minimally invasive procedures.

Rate of conversions to conventional laparoscopy in the analyzed patient group was low, 2.9%. All conversions were of technical nature and depended on difficult anatomy and were not forced by intraoperative complications. What must be emphasized, there were no cases of conversion to open surgery. In all these

cases insertion of additional trocars was sufficient and had no significant effect on the postoperative period.

Complications that occurred in the analyzed patient group were not directly related to the single access surgical technique and could have occurred also with conventional laparoscopy. Reoperation due to postoperative bleeding was required only in a single patient and was performed from the same single umbilical access.

Subjects who underwent concomitant splenectomy and cholecystectomy seemed to get the greatest benefit from the single access laparoscopic procedure. Splenectomy and cholecystectomy from the single umbilical incision, despite inconveniences related to changing position of the patient during the procedure, markedly reduced the number of postoperative wounds.

Recently published metaanalyses comparing results of conventional and single access laparoscopic cholecystectomies did not demonstrate any differences with regard to number of complications, including infected wounds, conversion rate, number of scar hernias, need for analgesic drugs, duration of hospitalization (29, 30). However, longer duration of the procedure (29, 30), slightly larger average blood loss (30) with better cosmetic effect was found for SILS cholecystectomy (29, 30).

Clearly a relatively high cost of umbilical trocar that increases the total cost of the surgical procedure and hospitalization, especially in Poland, limits wider use of this surgical technique.

Lack of clear advantage of the single access procedures over the conventional laparoscopic procedures in literature reports except for better cosmetic effects, economic consideration and our own experience leads to the situation that with time we perform such procedures with less enthusiasm and slightly less common.

## CONCLUSIONS

Our results clearly indicate that single access laparoscopic procedures are safe. It may be a rational alternative to conventional laparoscopy in various minimally invasive procedures, in particular in young patients for whom excellent cosmetic effects of surgical treatment are of particular importance.

## REFERENCES

1. *Strzałka M, Bobrzyński A*: Laparoscopy in the treatment of acute abdominal diseases. *Wideochir Inne Tech Malo Inwazyjne* 2008; 3: 1-9.
2. *Strzałka M, Budzyński A, Bobrzyński A i wsp.*: Analiza częstości i przyczyn konwersji w chirurgii małoinwazyjnej. *Pol Przegl Chir* 2009; 81(12): 648-54.
3. *Elazary R, Khalaileh A, Zamir G et al.*: Single-trocar cholecystectomy using a flexible endoscope and articulating laparoscopic instruments: a bridge to NOTES or the final form? *Surg Endosc* 2009; 23: 969-72.
4. *Zhu JF*: Which term is better: SILS, SPA, LESS, E-NOTES, or TUES? *Surg Endosc* 2009; 23: 1164-65.
5. *Kravetz AJ, Iddings D, Basson MD, Kia MA.*: The learning curve with single-port cholecystectomy. *J Soc Laparoendosc Surg* 2009; 13: 332-36.
6. *Kuon Lee S, You YK, Park JH et al.*: Single-port transumbilical laparoscopic cholecystectomy: a preliminary study in 37 patients with gallbladder disease. *J Laparoendosc Adv Surg Tech A*, 2009; 19: 495-99.
7. *Hernandez JM, Morton CA, Ross S et al.*: Laparoendoscopic single site cholecystectomy: the first 100 patients. *Am Surg* 2009; 75: 681-685; discussion 685-86.
8. *Langwieler T.E, Nimmegern T, Back M*: Single-port access in laparoscopic cholecystectomy. *Surg Endosc* 2009; 23: 1138-41.
9. *Vemulapalli P, Agaba EA, Camacho D et al.*: Single incision laparoscopic cholecystectomy: A single center experience. *Int J Surg* 2011;9(5):410-13.
10. *Prasad A, Mukherjee KA, Kaul S, Kaur M*: Postoperative pain after cholecystectomy: Conventional laparoscopy versus single-incision laparoscopic surgery. *J Minim Access Surg* 2011; 7(1): 24-27.
11. *Rasić Z, Schwarz D, Neseck VA et al.*: Single incision laparoscopic cholecystectomy – a new advantage of gall-bladder surgery. *Coll Antropol* 2010; 34(2): 595-98.
12. *Ito M, Asano Y, Horiguchi A et al.*: Cholecystectomy using single-incision laparoscopic surgery with a new SILS port. *J Hepatobiliary Pancreat Sci* 2010; 17(5): 688-91.
13. *Budzyński A, Pędziwiatr M, Matłok M et al.*: Preliminary experience with transperitoneal single incision laparoscopic surgery adrenalectomy. *Wideochir Inne Tech Malo Inwazyjne* 2010; 5 (3): 87-92.
14. *Feinberg EJ, O'Connor DJ, Feinberg ML et al.*: Single-incision laparoscopic appendectomy: an early experience. *Am Surg* 2011; 77(3): 286-89.
15. *Jacob BP, Tong W, Reiner M et al.*: Single incision total extraperitoneal (one SITE) laparoscopic inguinal hernia repair using a single access port device. *Hernia* 2009; 13: 571-72.
16. *Barbaros U, Dinccag A*: Single incision laparoscopic splenectomy: the first two cases. *J Gastrointest Surg* 2009; 13: 1520-23.
17. *Varela JE*: Single-site laparoscopic sleeve gastrectomy: preclinical use of a novel multi-access port device. *Surgical Innovation* 2009; 16: 207-10.
18. *Merchant AM, Lin E*: Single-incision laparoscopic right hemicolectomy for a colon mass. *Dis Colon Rectum* 2009; 52: 1021-24.
19. *Froghi F, Sodergren MH, Darzi A, Paraskeva P*: Single-incision Laparoscopic Surgery (SILS) in general surgery: a review of current practice. *Surg Laparosc Endosc Percutan Tech* 2010; 20(4): 191-204.
20. *Katsuno G, Fukunaga M, Nagakari K et al.*: Single-incision laparoscopic colectomy for colon cancer: early experience with 31 cases. *Dis Colon Rectum* 2011; 54(6): 705-10.
21. *Chow AG, Purkayastha S, Zacharakis E, Paraskeva P*: Single-incision laparoscopic surgery for right hemicolectomy. *Arch Surg* 2011; 146(2): 183-86.
22. *Huang CK*: Single-incision laparoscopic bariatric surgery. *J Minim Access Surg* 2011; 7(1): 99-103.
23. *Seo IY, Lee JW, Rim JS*: Laparoendoscopic single-site radical nephrectomy: a comparison with conventional laparoscopy. *J Endourol* 2011; 25(3): 465-69.
24. *Ferrara V, Giannubilo W, Azizi B et al.*: SILS extraperitoneal radical prostatectomy. *Minerva Urol Nefrol* 2010; 62(4): 363-69.
25. *Kim TJ, Lee YY, Kim MJ et al.*: Single port access laparoscopic adnexal surgery. *J Minim Invasive Gyn* 2009; 16: 612-15.
26. *Langebrette A, Qvigstad E*: Total laparoscopic hysterectomy with single-port access without vaginal surgery. *J Minim Invasive Gynecol* 2009; 16: 609-11.
27. *Ponsky TA, Diluciano J, Chwals W et al.*: Early experience with single-port laparoscopic surgery in children. *J Laparoendosc Adv Surg Tech A* 2009; 19: 551-53.
28. *Ergün O, Tiryaki S, Celik A*: Single center experience in single-incision laparoscopic surgery in children in Turkey. *J Pediatr Surg* 2011; 46(4): 704-07.
29. *Hao L, Liu M, Zhu H, Li Z*: Single – incision versus Conventional Laparoscopic Cholecystectomy in Patients with Uncomplicated Gall-bladder Disease: A Meta-analysis. 2012; 22(6): 487-97.
30. *Trastulli S, Ciocchi R, Desiderio J et al.*: Systematic review and meta-analysis of randomized clinical trials comparing single-incision versus conventional laparoscopic cholecystectomy. *Br J Surg* 2013; 100: 191-208.

Received: 17.01.2013 r.

Adress correspondence: 31-501 Kraków, ul. Kopernika 21