Laparo-Endoscopic Single Site (LESS) Management of Benign Kidney Diseases: Evaluation of Complications

Sompol Permpongkosol MD, PhD*,
Pokket Ungbhakorn MD*, Charoen Leenanupunth MD*

** Division of Urology, Department of Surgery, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand*

Background: *To present our experience with Laparo-Endoscopic Single Site (LESS) management of benign kidney diseases.*
Material and Method: *Between September 2008 and November 2009, 18 patients underwent single port transumbilical laparoscopic surgery for nephrectomy for a nonfunctioning kidney (7 cases), cyst decortications for symptomatic renal cyst (10 cases), and redo-dismembered pyeloplasty with previously failed laparoscopic surgical repair (1 case). Patients underwent surgery through a single 2-cm infraumbilical incision with the triport laparoscopic-port. All pathological reports of LESS nephrectomy and cyst decortications confirmed with chronic pyelonephritis and simple cysts, respectively. Histology of xanthogranulomotus pyelonephritis showed two cases of the nephrectomy procedure.*
Results: *Mean patient age and BMI were 61 $\pm$ SD 14.2 years and 24.75 $\pm$ SD 11.2 kg/m^2, respectively. Mean operating time was 187.7 $\pm$ SD 71.4 min. LESS was a possible and safe approach in 77.8% of patients. All LESS cyst decortications and redo-pyeloplasty were completed without major complications or conversion to open surgery. However, there was one case each of LESS cyst decortication and pyeloplasty requiring an additional 3-mm port for suturing due to bleeding and an instrument error. For LESS nephrectomy, two (28.6%) with higher waist circumference were converted to standard laparoscopic nephrectomy due to failure to progress. One post operative complication of incisional hernia occurred in a patient with chronic bronchitis and asthma.*
Conclusion: *LESS for the management of benign kidney diseases is an effective and safe treatment option with selected patients and experienced surgeon.*

Keywords: *Laparo-endoscopic single site (LESS), Laparoscopy, Benign, Kidney disease, Renal cysts, Redo-pyeloplasty*

J Med Assoc Thai 2011; 94 (1): 43-9
Full text. e-Journal: *http://www.mat.or.th/journal*

Single port laparoscopy, also known as Laparo-Endoscopic Single Site (LESS) surgery is a newly developed field, with several potential patient advantages[1]. Numerous initial experiential reports have been confirmed the feasibility of single-port surgery[2-4]. Single-port-access provides for improved cosmesis and potentially faster recovery, without sacrificing technique, safety, or outcome[5].

Although several observational studies have been published describing and advocating the use of transperitoneal single-port laparoscopy, no substantive data have been presented to support single-port surgery through a benign kidney disease approach to the surgical treatment of xanthogranulomatous pyelonephritis (XGP), symptomatic simple renal cysts, and ureteropelvic junction obstruction (UPJO) with a history of prior failed laparoscopic transmesenteric pyeloplasty. In addition, standard laparoscopic nephrectomy for XGP and redo-pyeloplasty is complicated and more technically demanding than those for noninfectious etiologies and primary UPJO repair, respectively[6]. The authors present our institution's operative experience with single-port laparoscopic intraperitoneal surgery nephrectomy, cyst decortications, and redo-dismembered pyeloplasty for chronic non-functioning pyelonephritis, symptomatic simple renal cyst and previously failed laparoscopic surgical repair. Furthermore, different complications such as an incisional herniation were reported in the authors' series of LESS procedure.

Correspondence to:
Permpongkosol S, Division of Urology, Department of Surgery, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Rama 6 Rd, Bangkok 10400, Thailand.
Phone: 0-2201-1315, Fax: 0-2201-1315
E-mail: sompolpermpong@gmail.com

Material and Method

Patient and surgical characteristics

The present study was approved by the

institutional review board. The surgical indications for single port laparoscopic surgery were the same as those for conventional laparoscopic surgery. All procedures were consecutively performed by a single surgeon during the present study period. Patient data, including patient demographics; operative details, including operative time, estimated blood loss (EBL), the need for extra port placement, conversion to traditional laparoscopy or open surgery, and intra- and post-operative complications, were collected retrospectively.

Operative procedure

All operations were performed in the operating room under standard general anesthesia with endotracheal tube intubation, bladder catheterization, and orogastric tube placement. As is standard with any laparoscopic intraperitoneal surgery, the patient was placed in the 45° modified flank position with the operating table minimally flexed, pressure points were fully padded, and the patient secured with adhesive tape.

The authors used an open Hasson technique about 2-3 cm below umbilicus. The TriPort (Olympus Winter & IBE GMBH, Germany), was inserted through a transumbilical incision into the abdomen in all cases. It required a fascial incision approximately 2-3 cm long. A sheath was placed through the fascial opening, and the peritoneal surface of this sheath had a self-expanding ring, allowing the TriPort to remain inside the peritoneum. CO_2 pneumoperitoneal pressure of 15 mm Hg was achieved through an insufflation channel of the port.

A viedo telescope "EndoEye" 5 mm, 30 degree digital laparoscope with an integrated camera head (Olympus Medical, Tokyo, Japan) was introduced, and the patient landmarks were identified. Standard laparoscopic instruments were used for the majority of the procedure and curved or bent instruments were used only selectively. A starion tissue welding technology was used to dissect the tissue and to stop bleeding during the operations. The specimens were removed through the umbilicus using a standard Endo-catch bag. The skin and sheath incision was extended as necessary to permit extraction of the intact specimen. The fascia in all cases was closed using 0 vicryl suture and the skin was closed with a running 4-0 monocryl subcuticular stitch.

LESS nephrectomy

The operative technique for the laparoscopic transperitoneal nephrectomy has previously been described[6]. In brief, the colon was generously reflected medially by incising along the line of Toldt and using a combination of the laparoscopic starion scalpel. The nephrectomy was carried out in a standard manner with the use of curved or bent instruments to overcome the lack of triangulation that occurs with a single port. If a very large diseased kidney was found, needle aspiration of the kidney was required to remove pus or urine. Control of the hilar vessels was achieved through the use of large Hem-o-lock clips. The ureter was managed as described previously. After complete mobilization, the kidney was secured in an entrapment sac, and removed through the single infra-umbilical incision. A Jackson-Pratt drain was left in situ through a separate fascial puncture but the same skin incision.

LESS cyst decortication

Cysts of all patients enrolled in the present study were classified as simple cysts (Bosniak class 1-2). After Gerota's fascia was incised, the cyst was identified. The blue dome of the cyst was opened using the laparoscopic starion scalpel and the fluid was aspirated using the suction irrigation device. A sample of the fluid obtained for cytological analysis, also the roof of the cyst, was sent for pathologic evaluation. The base of the cyst was next coagulated with the argon beam, and hemostasis was checked. Subsequently, the port was removed, and the fascia and skin was closed. A Jackson-Pratt drain was left in place for 24 hours.

All patients underwent radiological follow-up with a repeated CT and/or ultrasonography 6-12 months after surgery. Procedural success was defined as no recurrence of the cyst and having complete pain relief. Symptomatic success was defined as significant pain decrease. Recurrence was defined as the presence of a perirenal anechoic area with a diameter of > 4 cm.

LESS redo-dismembered pyeloplasty

A 39-year-old female presented with urinary tract infection and had a prior failed procedure of laparoscopic transmesenteric pyeloplasty one year ago. The body mass index was 24.2 kg/m^2. Her intravenous pyelography demonstrated ureteropelvic junction obstruction, which was confirmed on diuretic renal nuclear scintigraphy.

The patient underwent cystoscopic placement of seven Fr.double-J ureteral stent before LESS. The kidney was first mobilized from the surrounding fat, and the ureter identified. By tracing the ureter toward

the kidney, the renal pelvis was next identified and Anderson Hynes dismembered pyeloplasty was performed. The ureter was transected from the renal pelvis at the UPJ. The renal pelvis was reduced and the ureter was then spatulated laterally for approximately 1 cm. The ureter was re-anastomosed to the renal pelvis with a running 4-0 vicryl suture with Endostich. Removal of the ureteral stent was undertaken 3 weeks postoperatively. Descriptive statistics were used to summarize the data.

Results

Between September 2008 and November 2009, 18 patients underwent single port transumbilical laparoscopic surgery: nephrectomy for nonfunctioning kidney (7 cases), cyst decortications (10 cases) and redo- dismembered pyeloplasty (1 case), respectively. The demographic and operative data are listed in Table 1. The mean patient age was 61 $\pm$ SD 14.2 years (range 37-91). The mean body mass index (BMI) and waist circumference was 24.75 $\pm$ SD 11.2 kg/m^2 (21.3-28.4) and 34.2 $\pm$ SD 25.6 inches (29-42.4), respectively. Ten patients (71.4%) had medical history significant for hypertension. The mean operative time and estimated blood loss was 187.7 $\pm$ SD 71.4 minutes and 192 $\pm$ SD 194.6 mL, respectively. LESS was a possible and safe approach in 77.8% of patients. The majority of patients required no narcotics post-operatively. The post-operative analgesic requirement in all cases was minimal.

LESS nephrectomy

Three men and four women were included in the present study. The mean patient age was 60.8 years (range 37-91 years) and mean BMI was 26.7 (range 25-28.4). All had recurrent urinary tract infection with nonfunctioning kidneys; no patient had a medical history of diabetes mellitus. Two kidneys had a staghorn calculus and one had a distal left ureteric stone (stone size, 2 x 1.5 cm, Fig. 1). Radionuclide renography showed an average function of 5% in the affected kidney (range 0% to 12%). Preoperatively, one patient underwent percutaneous nephrostomy. All nephrectomy procedures were successfully completed through the umbilical incision with no need for conversion to an open procedure. Nevertheless, needle aspiration of the kidney was required to remove pus in the two patients (600 and 200 cc), due to a very large diseased kidney. Two (33.3%) LESS nephrectomies with higher waist circumference (36.8 and 42.4 inches, respectively) were converted to standard laparoscopic nephrectomy due to failure to progress.

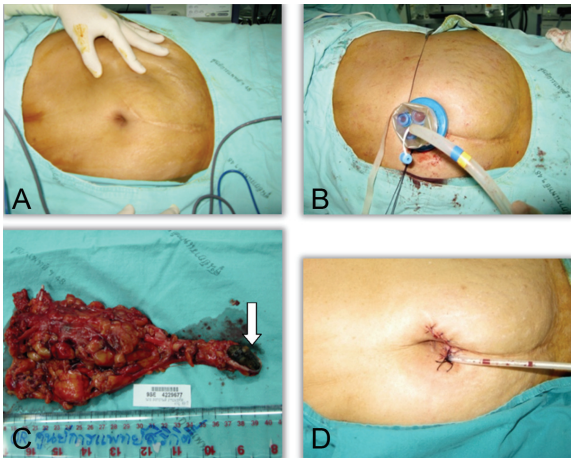

Fig. 1 A 69 year female patient with a history of caesarian section on LESS nephrectomy (A), intraoperative photograph demonstrating port configuration within the transumbilical incision during LESS procedure (B), a renal specimen with a distal left ureteric stone (white arrow, C) and postoperative surgical incision with tube drainage(D)

Table 1. Patient characteristics and procedures performed by LESS surgery

Procedure	n	Mean BMI (kg/m^2)	Mean OR time (min)	Mean waist circumference (inch)	Mean EBL (mL)
Nephrectomy	7	26.7	246.7	35.4	241.7
Cyst decortication	10	22.9	120	33.4	175
Redo-pyeloplasty	1	24.2	270	32	100
All patients	18	24.75	187.7	34.2	192

EBL = estimate blood loss; BMI = body mass index (weight [kg]/height^2); OR = operative time; LESS = laparo-endoscopic single site

The mean operative duration was 246.7 ± 32.65 minutes (median 223 minutes, range 200-300 min), and a mean estimated blood loss was 241.7 mL (range 100-500 mL). No intra-operative complication occurred. One patient had postoperative complication including port-site incisional herniation (Fig. 2). All specimens were pathologically confirmed as chronic pyelonephritis, and two were xanthogranulomatous pyelonephritis and the nephrectomies were successfully completed through the umbilical incision.

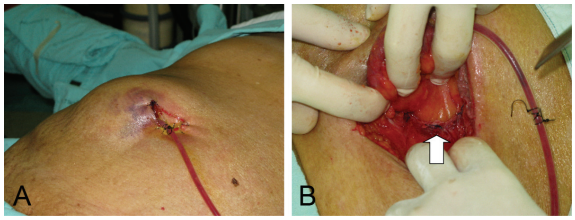

Fig. 2 91 year female with severe cough, chronic bronchitis and asthma on postoperative day 2 after LESS nephrectomy was found with an incision hernia at the umbilicus (A). The patient underwent repairing the tear abdominal sheath (arrow, B).

LESS cyst decortications

Seven men and three women with a symptomatic simple renal cyst were included in the present study. The mean patient age was 64 years (range 50-82 years) and median BMI was 22.94 kg/m^2 (range 21.3-26.3). The mean cyst size at CT was 6.9 (range 5.3-11) cm. Of these cysts, all were peripheral, four were upper pole and six were lower pole. The mean operative time was 120 (range 100-180) minutes. The mean EBL was 175 (range 50-450) mL. All 10 procedures were laparoscopically completed without major complication or conversion to open surgery. However, there was one case requiring an addition 3-mm port for suturing due to bleeding from the renal parenchyma at the cyst excision margin. All patients had negative cytological and pathological findings for malignancy or any other abnormalities. At 12 months of mean follow up, none of the patients reported symptomatic and/or radiologic failure (Fig. 3).

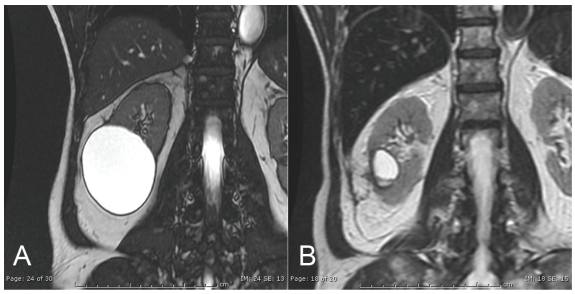

Fig. 3 Preoperative abdominal imaging (magnetic resonance imaging; MRI) (A) of a 74-year-old man with a simple renal cyst, about 9 cm in diameter, located in the lower pole of the right kidney. His MRI (B), 10 months after LESS laparoscopic cyst resection using Starion scalpel, revealed procedural success

LESS redo-dismembered pyeloplasty

The surgical steps of redoing single port laparoscopic pyeloplasty followed those of a standard dismembered pyeloplasty. Intense inflammation and fibrosis around the ureteropelvic junction led to a more extensive dissection and long ureteral spatulation. Redoing single port laparoscopic pyeloplasty was technically successful. However, the endostich was accidentally broken and needed an additional port for intracorporeal suturing. The total operative time was 270 minutes, and the estimated blood loss was 100 mL. There was no complication during or after surgery. At a median follow-up of 12 months postoperatively, the patient has remained free of symptoms and had no urinary tract infection. Intravenous pyelogram 12 months after surgery confirmed that there was no obstruction at the UPJ (Fig. 4).

Discussion

Since the initial report of single-port nephrectomy in 2007, urologists have successfully performed various procedures with LESS, including partial nephrectomy, pyeloplasty, orchiectomy, orchiopexy, ureterolithotomy, sacrocolpopexy, renal biopsy, renal cryotherapy, and adrenalectomy[7]. In July of 2008, the Laparo-endoscopic Single-Site Surgery Consortium for Assessment and Research [LESSCAR] suggested the name laparo-endoscopic single-site (LESS) surgery[7,8].

Single-port surgery may offer better cosmetic results because of a single "hidden" scar and the need for fewer trocar incisions, may be associated with less risk of vascular or visceral injury, and may be associated with decreased rates of wound infection and hernia formation and decreased need for postoperative analgesics[9]. Single-port surgery involves multiple technical challenges different from classic laparoscopy, including loss of triangulation, challenging work angle, limitation in instrumentation, difficulty retracting,

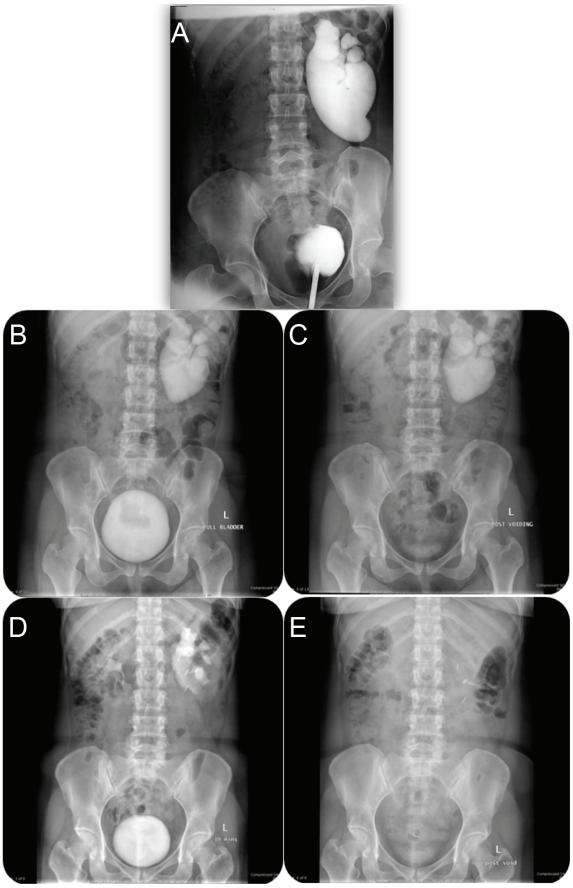

Fig.4 Patient preoperative intravenous pyelography (B-C, IVP). A 39 year female patient underwent laparoscopic transmesenteric pyeloplasty for ureteropelvic junction obstruction one year before (A, retrograde pyelography before laparoscopic repair), but had a failed procedure of pyelopasty. Her intravenous pyelography before LESS demonstrated hydronephrosis in full bladder (B) and post-void view (C) IVP 12 months after LESS surgery confirmed that there was no obstruction at UPJ (D, E)

instrument crowding, crossing instruments, and in-line vision[10,11].

To the authors' knowledge, there are no published reports of LESS utilized to treat benign kidney disease and complications similar to the presented series. It is clear that the laparoscopic approach for XGP is complicated and more difficult than standard laparoscopic nephrectomy for treatment of noninfectious entities[6]. Raybourn et al reported laparoscopic single-site surgery for nephrectomy as a feasible alternative to traditional laparoscopy, but excluded patients with simple nephrectomies for XGP, infected kidneys, and renal calculi[12]. The present study indicated that in experienced hands, the single-port laparoscopic approach presented a reasonable surgical option for the treatment of infectious etiologies such as XGP. Recently, the first 100 cases of the Cleveland clinic series demonstrated nine Clavien Grade II (transfusion, 7; urinary tract infection, 1; deep vein thrombosis, 1) and two Clavien Grade IIIb (recto-urethral fistula, 1; angioembolization, 1) surgical complications[13]. However, one additional concern with all minimally invasive surgery is the risk of port-site incisional hernia. There is no long-term data available on the potential for incisional hernia in patients undergoing single-port surgery for any specialty[9]. This is the first published series describing port-site incisional hernia in single-port laparoscopic nephrectomy. The causes in this series may be weakness of the fascia or thinness of muscle layer due to age, and technical insufficiency. If a patient undergoing LESS has a risk of incisional hernia, a prevention procedure should be performed.

BMI has also been used as a selection criterion for the performance of LESS procedures because of the difficulty in using the umbilicus as a landmark and the increased distance to the target organ in these patients[10]. An obese patient represents an additional challenge for LESS surgery, especially during early experience, because the thick abdominal wall interferes with the instruments and makes their movement even more challenging[14]. For LESS nephrectomy, two patients (28.6%) with higher waist circumference were converted to standard laparoscopic nephrectomy due to failure to progress. In the authors' opinion, special patient selection is required for the LESS series.

Laparoscopic cyst decortication is an option for treating symptomatic Bosniak category I-II renal cysts because it offers an ideal situation for developing laparoscopic skills. In the authors' opinion, LESS laparoscopic cyst decortication is the easiest procedure and practical to perform. The present series demonstrated that to avoid bleeding, the surgeon should not excise the wall close to the parenchyma when the border is not obvious. Moreover, conventional open and laparoscopic surgery for failed pyeloplasty are very challenging because of the fibrosis and scarring at the previous surgical site[15]. The present series reports that redo-pyeloplasty by transumbilical single-port laparoscopic pyeloplasty is feasible. In experienced hands, redoing LESS

pyeloplasty can be performed safely with a success rate similar to that of standard laparoscopic surgery. Further studies are needed to better define the role of single port laparoscopic surgery in re-operative pyeloplasty.

Conclusion

LESS is feasible in selected cases and is a safe cosmetic alternative to conventional multiport laparoscopy. Further studies are needed to better define the ideal urologic procedures for single-site surgery and to assess the benefits of LESS compared with more conventional minimally invasive approaches for benign kidney disease.

Potential conflict of interest

None.

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การศึกษาผลการผ่าตัดและผลข้างเคียงของการผ่าตัดผ่านกล้องด้วยการเจาะเพียงรูเดียวในการรักษาโรคไตที่ไม่ได้เป็นโรคเนื้องอกชนิดร้ายแรง

สมพล เพิ่มพงศ์โกศล, ปกเกศ อึ๊งภากรณ์, เจริญ ลีนานุพันธุ์

วัตถุประสงค์: *เพื่อแสดงประสบการณ์การผ่าตัดผ่านกล้องด้วยการเจาะเพียงรูเดียว หรือ laparo-endoscopic single site (LESS) ในการรักษาโรคไตชนิดไม่ได้เป็นเนื้องอกชนิดร้ายแรง*

วัสดุและวิธีการ: *จากเดือนกันยายน พ.ศ. 2551 ถึงเดือนพฤศจิกายน พ.ศ. 2553 มีผู้ป่วย 18 คน ได้รับการผ่าตัดผ่านกล้องด้วยการเจาะเพียงรูเดียวผ่านสะดือ มีการผ่าตัดไตที่ไม่ทำงานออก 7 ราย การปอกเปลือกถุงน้ำไต และมีอาการปวด 10 ราย และการผ่าตัดตกแต่งกรวยไตและหลอดไต ที่อุดกั้นและมีประวัติการผ่าตัดแก้ไขมาก่อน 1 ราย ผู้ป่วยได้รับการผ่าตัดผ่านสะดือด้วยท่อแทงเจาะชนิดพิเศษ การรายงานทางพยาธิวิทยาแสดงว่าไต และถุงน้ำไตไม่ได้เป็นเนื้องอกชนิดร้ายแรง มีผู้ป่วยอยู่สองรายที่ไตถูกรายงานว่าเป็น Xanthogranulomatous pyelonepritis*

ผลการศึกษา: *ผู้ป่วยทั้งหมดมีค่าเฉลี่ยของอายุและ BMI เท่ากับ 61 $\pm$ 14.2 ปีและ 24.75$\pm$ SD 11.2 kg/m^2 ตามลำดับ มีเวลาเฉลี่ยของการผ่าตัดเท่ากับ 187.7 $\pm$ 71.4 นาที การผ่าตัดผ่านกล้อง ด้วยการเจาะเพียงรูเดียวเป็นไปได้และปลอดภัยร้อยละ 77.8 ของผู้ป่วยทั้งหมด การผ่าตัดผ่านกล้องปอกเปลือกถุงน้ำไต และการตกแต่งทางต่อระหว่างกรวยไต และหลอดไตที่มีการอุดกั้นใหม่ไม่มีผลข้างเคียงและไม่ได้เปลี่ยนเป็นการผ่าตัดแบบเปิด อย่างไรก็ตามมีผู้ป่วยหนึ่งรายในแต่ละการผ่าตัดของการผ่าตัดผ่านกล้องปอกเปลือกถุงน้ำไตและการตกแต่งทางต่อระหว่างกรวยไตและหลอดไตต้องใส่ท่อแทงเจาะขนาดเล็กเพิ่มหนึ่งท่อสำหรับการผ่าตัดผ่านกล้อง เอาไตออกมีสองรายที่เส้นรอบเอวสูงและต้องเปลี่ยนเป็นการผ่าตัดแบบเปิด หลังการผ่าตัดมีผู้ป่วยหนึ่งรายมีปัญหาไส้เลื่อนที่แผล เนื่องจากไออย่างรุนแรง*

สรุป: *การผ่าตัดผ่านกล้องด้วยการเจาะเพียงรูเดียวในการรักษาโรคไตที่ไม่ได้เป็นเนื้อร้ายแรงสามารถ ทำได้อย่างปลอดภัยเมื่อมีการเลือกผู้ป่วยและอยู่ในมือศัลยแพทย์ที่มีประสบการณ์*