Single-port laparoscopic cholecystectomy: Initial experience at Ain Shams University Hospitals

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Abstract

Background: As surgeons embrace the concept of increasingly less invasive surgery, techniques using only a single small incision have begun to gain traction. Single-port access cholecystectomy is a new laparoscopic procedure using only one transumbilical placed port. We report one of the initial clinical experiences at Ain Shams University Hospitals with this new technique. Our study aimed to assess whether these devices allow safe and reliable access for laparoscopic cholecystectomy (LC).

Methods: From December 2009 to March 2010, single port laparoscopic cholecystectomy was performed on 10 consecutive patients with mean age ±S.D. 31.0± 11.879 years (range, 18-50) years. The patients were 8 females and 2 males with mean weight ±S.D. 66.700± 10.252kg (range, 50-80) kg. Diagnoses for cholecystectomy were: chronic calcular cholecystitis (n=7), gallbladder polyp (n=1) and chronic non calcular cholecystitis (n=2) with exclusion of patients with acute cholecystitis, history of jaundice, biliary pancreatitis and prior abdominal surgery. These restrictions were to facilitate the procedure since we are still in the beginning of the learning curve. All procedures were done using the SILS™ port (Covidien, Inc., Norwalk, CT, USA). In our study, the operative time, reasons for conversion to standard four port laparoscopic surgery, per operative and postoperative complications, as well as hospital stay were studied.

Results: Single port laparoscopic cholecystectomy was feasible in 8 cases (80%) 7 females and 1 male. Two cases (20%) were converted to four port laparoscopic surgery. No per operative or post operative complications were recorded. The operative time was longer than in common laparoscopic cholecystectomy with mean time ±S.D. 125.0±37.796 (range, 90-180) minutes. The mean hospital stay ±SD. was 29.66±4.4 (range, 24-36) hours.

Conclusion: The results from this study show that single port laparoscopic cholecystectomy seems to be safe and feasible when performed by experienced laparoscopic surgeon.

Introduction:

Currently, laparoscopic cholecystectomy (LC) is indisputably regarded as the gold standard for the treatment of symptomatic gallbladder stone disease, even in the case of acute cholecystitis.[1] In recent years, natural orifice transluminal endoscopic surgery (NOTES) has been offered as the next generation of minimally invasive surgery with no scars.[2] However, serious drawbacks specifically belonging to this technique such as access, safety of closure, infection, lack of appropriate instrumentation, and difficulty in orientation have discouraged the use of NOTES procedures.[3]

Because of the inconvenience associated with NOTES, single incision laparoscopic surgery (SILS)[4] has gained greater interest and popularity in the surgical community.

Single port or single incision laparoscopic cholecystectomy was reported first in 1997 and then again in 1999.[5] The recent popularity of this approach stems from an increasingly accepted shift away from the dogmatic concept of triangulation in minimally invasive surgery. We believe this shift is directly due to the development of natural orifice transluminal endoscopic surgery (NOTES).[6]

Single port or single incision laparoscopic surgery is a recent technical advancement in

minimally invasive surgery. The concept revolves around the idea that all the laparoscopic instrumentation is introduced via the same access point in the abdominal wall.[7]

Despite the recent enthusiasm for this new type of minimal access surgery, the terminology remains confusing. The early name to merge for single-port surgery was single port access (SPA). Other names are single incision laparoscopic surgery (SILS), single site laparoscopy (SSL) and single instrument port laparoscopy (SIMPL).[8]

Whatever the terminology, all the reports emphasize the feasibility and safety of such technique. In this study, we report one of the initial clinical experiences at Ain Shams University Hospitals with this new technique. Our study aimed to assess whether these devices allow safe and reliable access for laparoscopic cholecystectomy (LC).

Patients and methods:

From December 2009 to March 2010, single port laparoscopic cholecystectomy was performed on 10 consecutive patients with mean age ±S.D. 31.0± 11.879years (range, 18-50) years. The patients were 8 females and 2 males with mean weight ±S.D. 66.700± 10.252kg (range, 50-80) kg. Diagnoses for cholecystectomy were: chronic calcular cholecystitis (n=7), gallbladder polyp (n=1) and chronic non calcular cholecystitis (n=2) with exclusion of patients with acute cholecystitis, history of jaundice, biliary pancreatitis and prior abdominal surgery **Table(1)**. These restrictions were to facilitate the procedure since we are still in the beginning of the learning curve. All procedures were done using the SILS^{TM} port (Covidien, Inc., Norwalk, CT, USA). In our study, the operative time, reasons for conversion to standard four port laparoscopic surgery, per operative and postoperative complications, as well as hospital stay were studied.

Table (1): Patients' data.

No.	Age	Sex	Weight	Indication
1	40	Female	75	Chronic calcular cholecystitis
2	47	Male	80	Chronic calcular cholecystitis
3	18	Female	57	Chronic calcular cholecystitis
4	38	Female	64	Gall bladder polyp
5	28	Female	60	Chronic non calcular cholecystits
6	50	Female	80	Chronic calcular cholecystitis
7	20	Male	70	Chronic non calcular cholecystits
8	19	Female	50	Chronic calcular cholecystitis
9	23	Female	72	Chronic calcular cholecystits
10	27	Female	59	Chronic calcular cholecystitis

All patients were offered this approach after providing informed consent. All patients received information about surgical technique, the difference between the single incision and the standard four-incision approach and the risks associated with cholecystectomy.

Operative technique:

Following basic surgical principles, first inject some local anesthetic in the umbilical and periumbilical areas. Then, identify the deepest point of the umbilical scar (inner ring), and evert the umbilicus from its normal position, by lifting that area with toothed forceps or atraumatic graspers **Figure(1)**. A mark is done at 6 and 12 o'clock of the umbilicus to mark the incision which should not breach umbilical ring.

Figure (1): Evertion of the umbilicus from its normal position.

A 2 cm vertical incision is used to cut through the skin and the subcutaneous tissue to reach the fascia then a 2 cm fascial incision is used to gain entrance into the abdominal cavity in preparation of SILS port placement. One must be careful not to create a much larger incision, especially at the fascia; otherwise the port may be too loose, resulting in an inadequate pneumoperitonium due to gas leak around the blue flexible port **Figure(2)**.

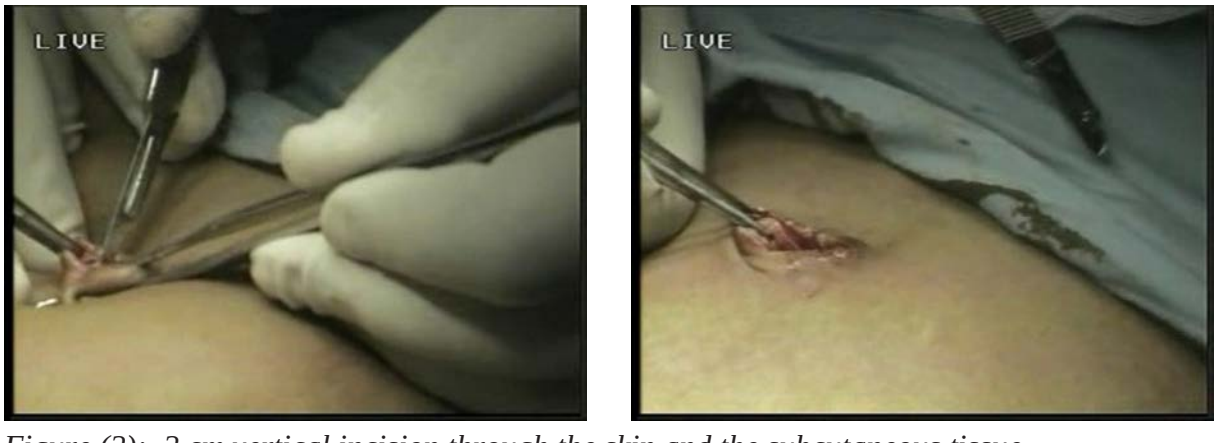

Figure (2): 2 cm vertical incision through the skin and the subcutaneous tissue
2 cm fascial incision is used to gain entrance into the abdominal cavity.

Next, the flexible SILS^{TM} Port which consists of a blue flexible soft-foam port, with access channels for three cannulae **Figure(3)** is folded at its lower edge (contra lateral to the insufflation system), and with the use of a proper surgical instrument (i.e., artery forceps) is advanced under direct vision into the abdomen **Figure(4)**. Once the bottom part of the port is inside the abdomen, the port is released from our surgical instrument. The 5mm cannula may be interchanged at any time during the procedure with a 5mm to 12mm cannula **Figure(5)**.

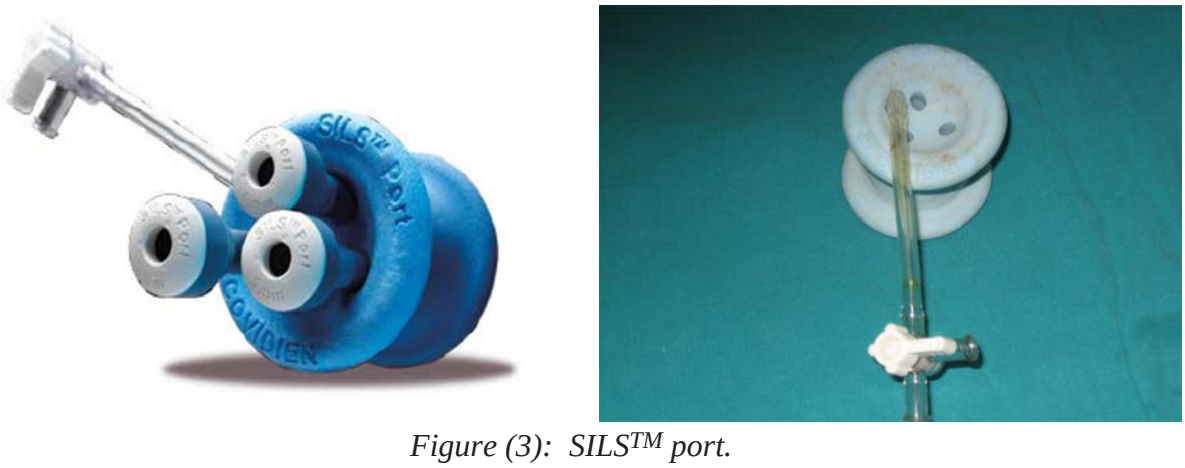

Figure (3): SILS^{TM} port.

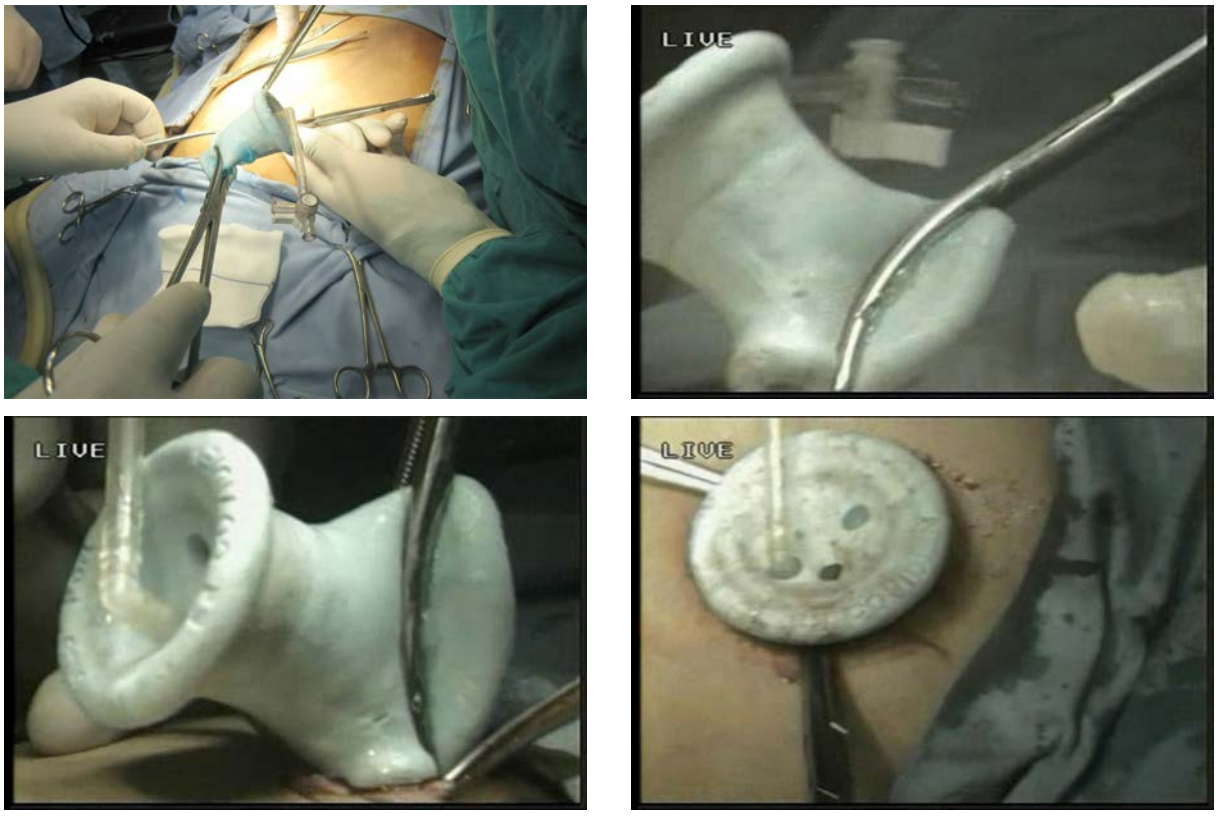

Figure (4): Introduction of SILS™ port.

Figure (5): SILS™ port + cannulae.

Following this, the SILS™ Port cannulae are introduced through the access channels. Pneumoperitoneum may not be initiated until the three cannulae are placed inside the SILS™ Port. A 5mm cannula may be exchanged as needed with a 5mm to 12mm cannula. The SILS™ Port adapts to either size, and continues to maintain pneumoperitoneum **Figure(6)**.

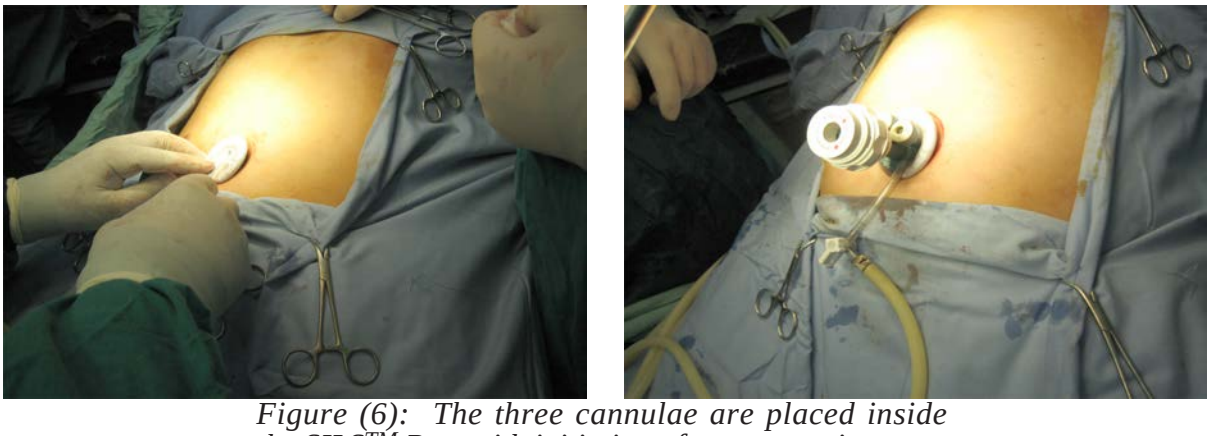

Figure (6): The three cannulae are placed inside the SILS™ Port with initiation of pneumoperitoneum.

A 5 or 10 mm 30º scope is used to inspect the abdominal cavity and visualize the surgical field. After the fundus of the gallbladder is visualized, a 2-0 prolene suture on a straight needle was introduced through the abdominal wall; the suture was grasped and passed through the fundus of the gallbladder, then passed back through the abdominal wall. Traction on the suture, which was clamped at the skin level, retracted the gallbladder **figure(7).**

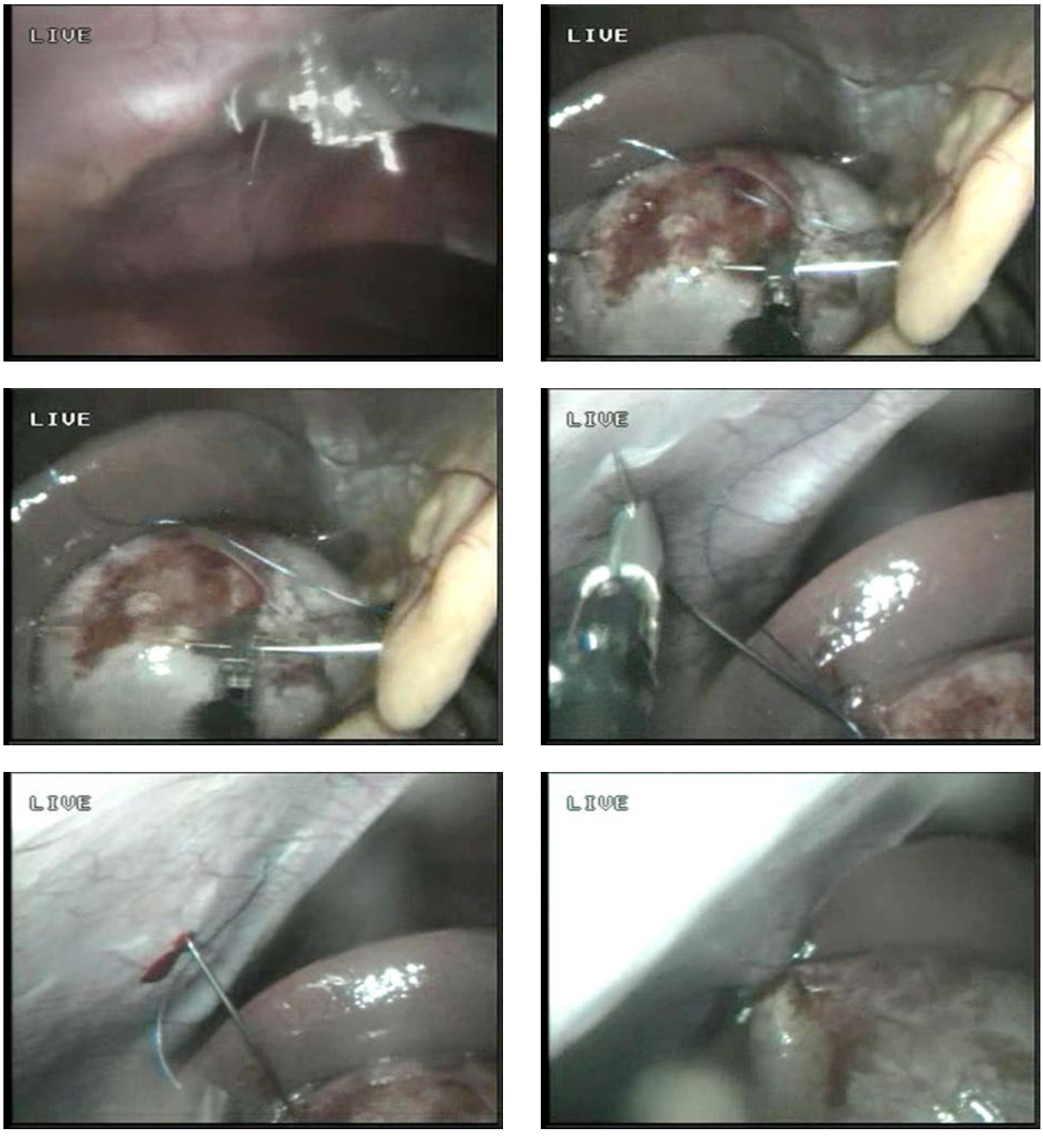

Figure (7): A 2-0 prolene suture on a straight needle was introduced through the abdominal wall and passed through the fundus of the gallbladder, then passed back through the abdominal wall. Traction on the suture at the skin level, retracted the gallbladder.

A 5 mm roticulator grasper **Figure(8)** is passed through the right port and held by the right hand to retract the infundibulum of the gall bladder **Figure(9)** while a 5 mm roticulator dissector **Figure(10)** is passed through the left port and held by the left hand performing the dissection of the Callot triangle **Figure(11)**. These roticulating instruments can be articulating from 0 to 80 to allow triangulation for retraction and dissection.

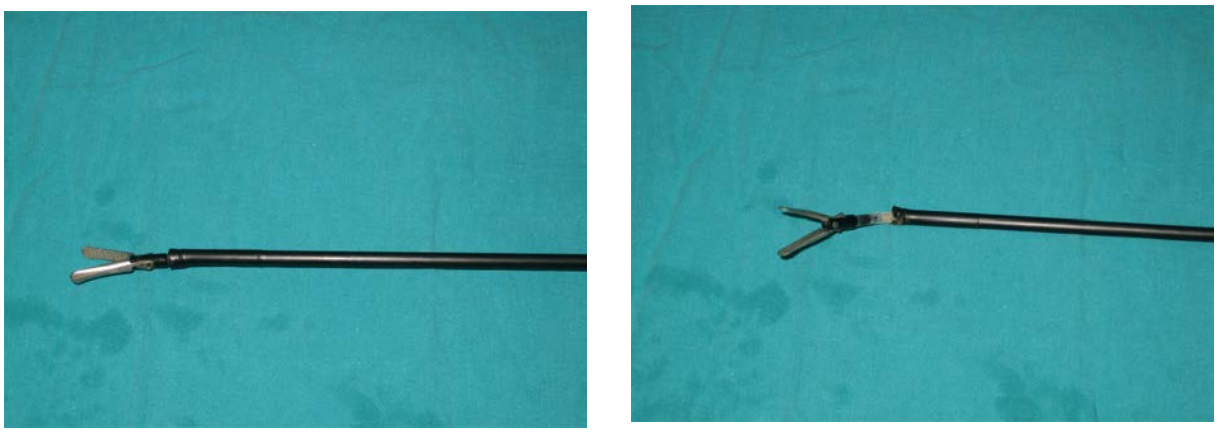

Figure (8): Roticulator grasper.

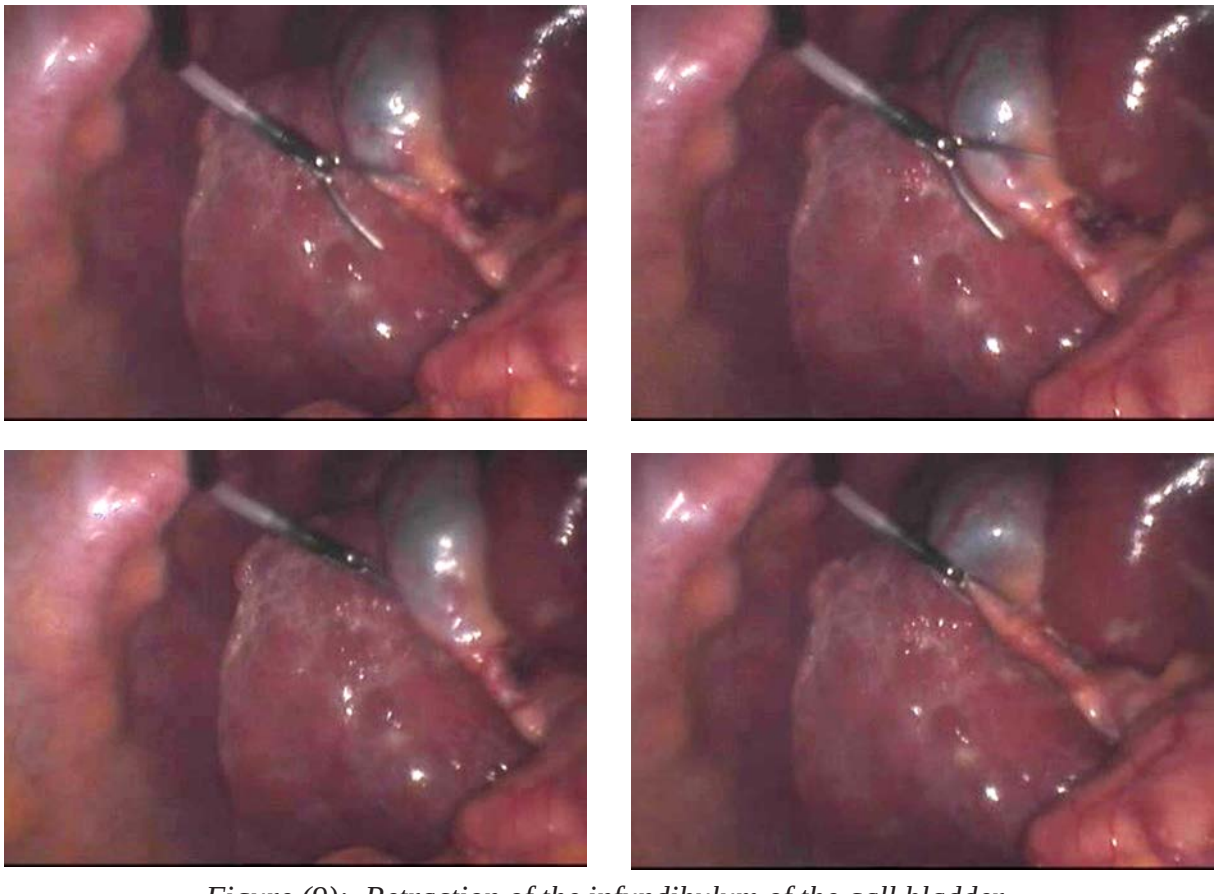

Figure (9): Retraction of the infundibulum of the gall bladder.

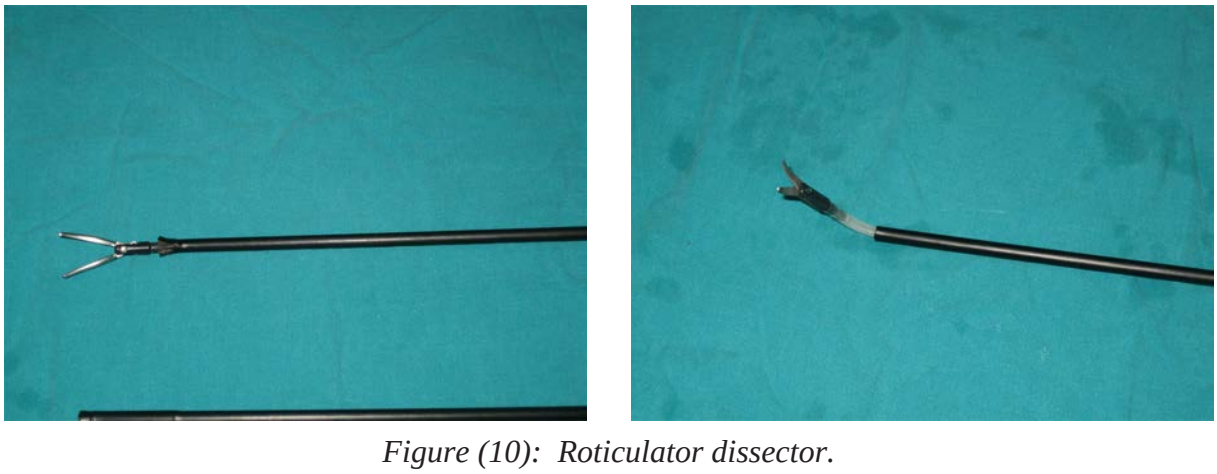

Figure (10): Roticulator dissector.

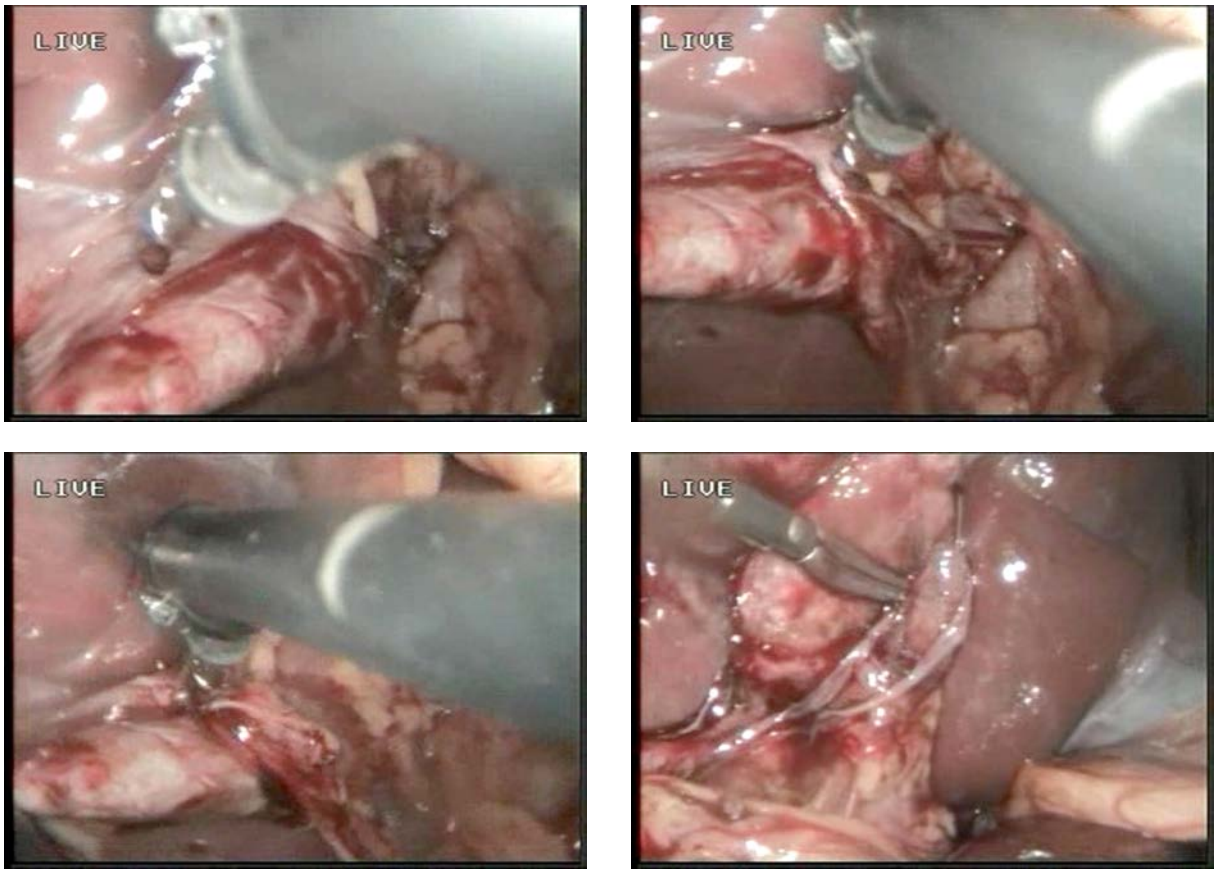

Figure (11): Dissection of the Callot triangle using roticulator dissector.

After appropriate exposure of the hepatocystic triangle was obtained, the cystic duct and artery were clipped and divided using scissor **Figures(12,13)**.

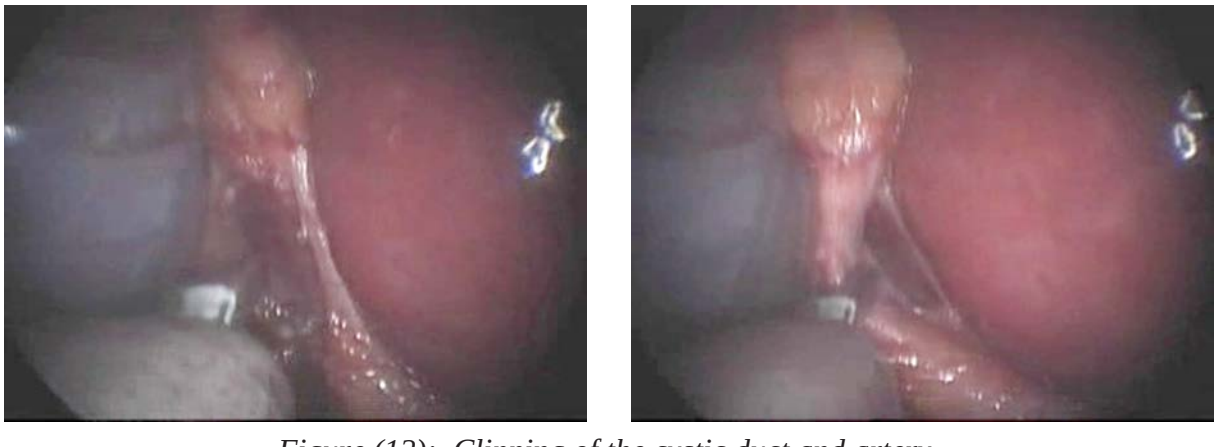

Figure (12): Clipping of the cystic duct and artery.

Figure (13): Endoscissor.

The hook cautery and sometimes 5mm harmonic scalpel **figure(14)** held by the left hand and passed through the left port is used to open the medial side of the peritoneum between the gall bladder and the liver bed. Then the reticulator instrument is straightened and switched with the hook which is held by the right hand and is passed through the right port to dissect the lateral side while the roticulator grasper is retracting the infundibulum of the gall bladder medially. Finally the hook cautery is controlled by the left hand and brought in through the left port to remove the gall bladder off the liver bed.

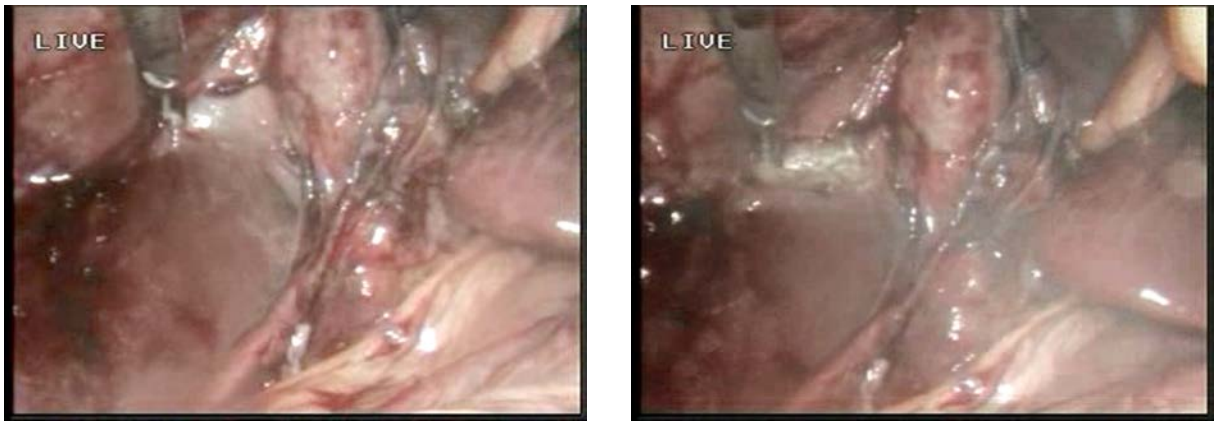

Figure (14): Gall bladder dissection off the liver bed.

Once the gall bladder is removed off the liver bed, instruments are removed as well as the suture holding the gall bladder, followed by suction irrigation of the liver bed, checking haemostasis and that the clips are intact and on the cystic duct and artery.

Finally the SILS port along with the gall bladder held with the grasper is removed **Figure(15)**.

Figure (15): Removal of the gall bladder.

Wound closure should be carried in a correct and perfect way and in layers to avoid wound complications. The abdominal wall fascia is closed using zero maxon followed by 3-0 polysorb suture to re-attach the base of the umbilicus to the fascia and finally the umbilical skin is closed using absorbable suture **figure(16)**.

Figure (16): The wound after completion of SILS.

Results:

Single port laparoscopic cholecystectomy was attempted in 10 patients with mean age ±S.D. 31.0±11.879 years (range, 18-50) years. The patients were 8 females and 2 males with mean weight ±S.D. 66.700±10.252kg (range, 50-80) kg. Diagnoses for cholecystectomy were: chronic calcular cholecystitis (n=7), gallbladder polyp (n=1) and chronic non calcular cholecystitis (n=2) with exclusion of patients with acute cholecystitis, history of jaundice, biliary pancreatitis and prior abdominal surgery.All procedures were done using the SILS™ port (Covidien, Inc., Norwalk, CT, USA). Single port cholecystectomy was completed successfully in 8 cases (80%), they were 7 females and 1 male, while conversion to standard four-port LC was carried in two cases (20%)(no=2&6). The cause of conversion in the two cases was improper orientation of the Callot triangle due to the presence of adhesions; hindering the proper view of the cystic duct and artery.

The mean operative time was ±S.D. 125.0±37.796 (range, 90-18o) minutes. We started by 180 minutes in the first 2 cases then the operative time was decreased gradually until it reached 90 minutes in the last 2 cases and this can be explained by the ascendance of the learning curve **Figure(17)**. We had strictly chosen the cases and the instruments suitable for this new technique.

No operative or post operative complications were recorded including bleeding or biliary injury. The post operative courses were uneventful.The patients were almost pain free and all were allowed to feed orally (fluids) in the night. The mean hospital stay ±SD was 29.66±4.4 (range, 24-36) hours. Follow up visit was one week and one month postoperatively, none complained about the operation and there were no incision complications including infection or port site hernia.

Table (2): Results.

No	Age	Sex	Weight	Indication	Procedure	Operative time (min)
1	40	Female	75	Chronic calcular cholecystitis	SILS	180
2	47	Male	80	Chronic calcular cholecystitis	Four Port LC	120
3	18	Female	57	Chronic calcular cholecystitis	SILS	180
4	38	Female	64	Gall bladder polyp	SILS	140
5	28	Female	60	Chronic non calcular cholecystits	SILS	120
6	50	Female	80	Chronic calcular cholecystitis	Four Port LC	90
7	20	Male	70	Chronic non calcular cholecystits	SILS	100
8	19	Female	50	Chronic calcular cholecystitis	SILS	100
9	23	Female	72	Chronic non calcular cholecystits	SILS	90
10	27	Female	59	Chronic calcular cholecystitis	SILS	90

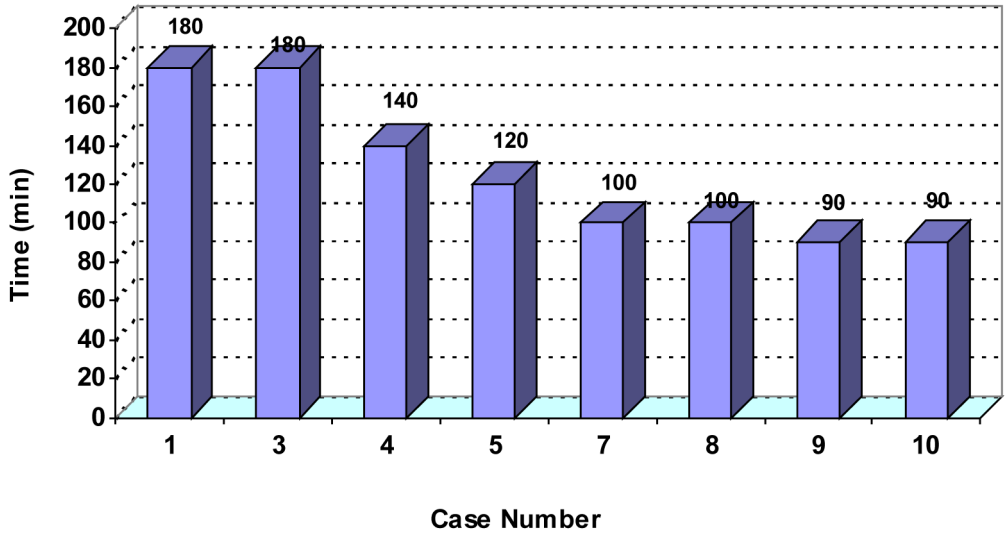

Figure (17): Operative time (min).

Discussion:

Single port laparoscopic surgery is a growing trend in minimally invasive surgery. The potential for less pain, faster recovery, and improved cosmesis has surgeons, their patients, and the industry interested in pushing the technique forward.[7]

Of paramount importance, as with any emergent technique, it only makes sense to practice a very careful patient selection, especially at the beginning of one's experience, using strict criteria to find ideal patients. Once great expertise is achieved, these criteria can be relaxed.[9]

In our study, the patients' selection was restricted to those with weight range (50-80)Kg, and we excluded patients with acute cholecystitis, history of jaundice, biliary pancreatitis and prior abdominal surgery. These restrictions were to facilitate the procedure and this also goes with the study carried by Sinan et al[10] which stated that, patient related factors definitely affect the success rates, particularly in the learning period, and since. It was previously reported that the incidence of bile duct injury is three times higher with LC used for cases of acute cholecystitis than with elective cholecystectomy. Indeed, these considerations were the main reasons why the cohort in their study was composed of patients without any signs of inflammation. Also, the patients were selected from those without any coexistent diseases or higher BMIs. These selection criteria provided them facility in the learning period with reasonable operation times.

On the other hand Tacchino et al[4] stated that neither a BMI greater than 30 nor signs of cholecystitis are to be considered contraindications to SILS cholecystectomy because in both cases, they experienced no major additional difficulties. Should any issue arise, a SILS procedure can always be converted to a standard laparoscopic cholecystectomy easily, with no need for a change in operative position or additional instruments.

In our study, single port cholecystectomy was completed successfully in 8 cases (80%), they were 7 females and 1 male, while conversion to standard four-port LC was carried in two cases (20%)(no.2&6). The cause of conversion in the two cases was improper orientation of the Callot triangle due to the presence of adhesions; hindering the proper view of the cystic duct and artery.

Romanelli et al[7] stated that cholecystectomy is performed with a low morbidity rate across the world, but one important factor with laparoscopic approaches to the gallbladder is the ability to see the critical view. Most surgeons who routinely perform laparoscopic cholecystectomy would be greatly disinterested in a new technique if the critical view was compromised. We believe that the inability to achieve the critical view at this time should result in conversion to standard laparoscopic cholecystectomy.

The mean operative time±S.D. was 125.0±37.796 minutes (range, 90-180) minutes. We started by 180 minutes in the first 2 cases

then the operative time was decreased gradually until it reached 90 minutes in the last 2 cases and this can be explained by the ascendance of the learning curve.

The operative time decreased considerably, from 3 hour for the first SILS cholecystectomy to 1 hour 45 min for the second intervention, then stabilized at an average of 50 min in the study carried by Tacchino et al[4] thus demonstrating not only that SILS cholecystectomy is feasible for more than non-complicated cholecystectomies, but also that the learning curve is very short.

The learning curve for single port cholecystectomy primarily reflects the difficulty experienced in understanding the spatial restriction caused by the close proximity of the instruments and the camera. With multiple trocar surgery, the degree of instrument conflict is inversely related to the distance between port sites. However, in single port surgery, all instruments pass through one fascial incision and therefore only one focal point.[11]

As a matter of fact, the use of crossed over articulating instruments requires a long operative time for achievement of careful and precise dissection, and some adjustments in the strategy of exposure are necessary, particularly because less strength is applied to tissue than with the standard laparoscopic techniques.[4]

The real challenge of SILS is to avoid conflict between the operative instruments and the camera, to maintain the pneumo-peritoneum and reduce operative stress. The use of an extra-long scope or a scope with a cable connection on the posterior rather than the lateral aspect permits full rotation of the 30^{o} optic device without interference from the operative instruments. Nevertheless, an understanding between the operating surgeon and the camera assistant is essential because every movement of the one can interfere with the other.[4]

When a new technology is adopted, the question must be raised whether clinicians are adhering to important surgical principles. Certainly, with any new technique, the complication rate is expected to be higher for surgeons early in their learning curve, as was the case with the introduction of laparoscopic gallbladder surgery two decades ago. To date, the true complication rate of single incision laparoscopic cholecystectomy is unknown. It can only be hoped that the lessons learned in the implementation of laparoscopic cholecystectomy will guide adherence to certain dogmatic principle in the name of patient safety.[7]

No operative or post operative complications were recorded in our study including bleeding or biliary injury. The post operative courses were uneventful. The patients were almost pain free and all were allowed to feed orally (fluids) in the night. The mean hospital stay ±SD. was 29.66±4.4 (range, 24-36) hours. Follow-up visit was one week and one month postoperatively, none complained about the operation and there were no incision (port site) complications.

It should be noted that any port incision has potential complications, although the rate of incidence varies with the port size and type. Port complications may include hernias (0.65% to 2.8%), abdominal wall bleeding (0.2%), bowel injury (0.06%), and wound infection (0.06%). Reducing the number of incisions from 4 to 1 should reduce the incidence of these morbidities.[12]

Uslu et al[12] stated that the incidence of trocar-site infection and herniation are well documented. After LC, the rate for infection is reported to be 2% compared with 5.2% for herniation. Reasonably lessening the number of trocars will lead to a decrease in the complication rates.

Also the incidence rate of major complications (common bile duct and major vessel injury) following three or four trocar laparoscopic cholecystectomy is well documented at < 1% with an overall complication rate of -3.[13]

Post laparoscopic cholecystectomy pain and recovery time is also significantly lower when compared to the alternative open procedure.[14] Whether there is less postoperative pain associated with SILS is so far a subjective conclusion and systematic objective assessments of post procedural pain, as well as procedure related complication rates, are lacking.[15]

As a novel technique, cholecystectomy via SILS has introduced some advantages of its own. The prominent expectations for the short and long terms are lower rates for pain, infection, and herniation. However, no prospective study has shown the superiority of SILS with regard to postoperative pain despite the existence of such an opinion.[15]

Conclusion:

The results from this study show that single port laparoscopic cholecystectomy seems to be safe and feasible when performed by experienced laparoscopic surgeon and by using the proper instruments. Studies are needed to examine the true impact of this new technique in terms of outcomes.

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