ORIGINAL ARTICLE
doi: 10.35366/106719

Cirujano General
April-June 2021
Vol. 43, no. 2 / p. 86-96

Single-port laparoscopic cholecystectomy. Prospective non-randomized study of 106 cases

Colecistectomía laparoscópica por puerto único. Estudio prospectivo no aleatorizado de 106 casos

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Keywords:
Laparoscopic cholecystectomy, single-port cholecystectomy, single-port laparoscopic surgery, minimally invasive cholecystectomy, single-port robotic cholecystectomy.

Palabras clave:
Colecistectomía laparoscópica, colecistectomía por puerto único, cirugía laparoscópica por puerto único, colecistectomía por mínima invasión, colecistectomía robótica por puerto único.

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ABSTRACT

Introduction: Laparoscopic single-port surgery has been considered the natural evolution of minimally invasive surgical techniques for cholecystectomy, with the advantages of less postoperative pain, faster return to normal daily activities, and better cosmetic outcomes. **Objective:** To describe the analysis of 106 cases of laparoscopic cholecystectomy with the single-port technique. **Material and methods:** We present the results of a prospective, observational study of single-port laparoscopic cholecystectomy (SPLC) performed with a standardized technique over eight years of patients with clinical, ultrasonographic, and computed axial tomography diagnoses of chronic calculous cholecystitis, non-lithiasis cholecystitis, and acute cholecystitis. Demographic variables, surgical time, bleeding, days of hospital stay, complications, and postoperative pain were studied. **Results:** 106 patients were operated from June 2010 to December 2018, 44 (41.5%) were operated urgently and 62 (58.5%) electively (p = 0.0001). The mean operative time recorded was 85.7 ± 35.7 minutes. Ten patients (9.4%) presented complications, six were transoperative, and four were postoperative; according to the Clavien-Dindo classification, two were type II, one type IIIa and one type IIIb. **Conclusions:** The single port technique for cholecystectomy has proven to be safe, reliable, reproducible, and comparable in results and complications with the conventional laparoscopic technique with a relevant cosmetic advantage.

RESUMEN

Introducción: *La cirugía laparoscópica por puerto único se ha considerado la evolución natural de las técnicas de cirugía de mínima invasión para colecistectomía, con las ventajas de menor dolor postoperatorio, regreso más rápido a la actividad normal diaria y mejor resultado cosmético.* ***Objetivo:*** *Describir el análisis de 106 casos de colecistectomía laparoscópica con técnica de puerto único (SPLC).* ***Material y métodos:*** *Presentamos los resultados de un estudio prospectivo, observacional de SPLC realizados con una técnica estandarizada en un periodo de ocho años, de pacientes con diagnóstico clínico, ultrasonográfico y por tomografía axial computarizada de colecistitis crónica litiásica, no litiásica y colecistitis aguda. Se estudiaron las variables demográficas, tiempo quirúrgico, sangrado y días de estancia hospitalaria, así como complicaciones y dolor postoperatorio.* ***Resultados:*** *De junio de 2010 a diciembre de 2018 se operaron 106 pacientes, 44 (41.5%) fueron operados de manera urgente y 62 (58.5%) de manera electiva (p = 0.0001). El tiempo quirúrgico promedio registrado fue de 85.7 ± 35.7 minutos. Diez pacientes (9.4%) presentaron complicaciones, seis fueron transoperatorias y cuatro postoperatorias, de estas últimas, acorde a la clasificación Clavien-Dindo, dos fueron tipo II, uno tipo IIIa y uno tipo IIIb.* ***Conclusiones:*** *La técnica de puerto único para colecistectomía ha demostrado ser segura, confiable, reproducible y comparable en resultados y complicaciones con la técnica laparoscópica convencional con una ventaja cosmética relevante.*

How to cite: Martínez-Salas AJ, Cázares-García V, Martínez-Oñate AJ. Single-port laparoscopic cholecystectomy. Prospective non-randomized study of 106 cases. Cir Gen. 2021; 43 (2): 86-96. https://dx.doi.org/10.35366/106719

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Received: 06/22/2020
Accepted: 04/06/2022

INTRODUCTION

For more than 100 years, open gallbladder resection remained the gold standard for cholecystectomy. The first cholecystectomy was performed by Carl Johan Langenbuch (1846-1901) in Berlin on July 15, 1882.[1] The first cholecystectomy with the laparoscopic technique was performed by Erich Muhe at the Boblingen County Hospital near Stuttgart, Germany, on September 12, 1985; while the first laparoscopic appendectomy had been performed earlier by Kurt Semm (1927-2003), gynecologist, on September 13, 1980[2] in Kiel, Germany. It is worth mentioning that Dr. Semm was harshly criticized nationally and internationally for having performed the procedure without his critics knowing the path being opened with this first laparoscopic gastrointestinal procedure.

During the last 30 years, and thanks to the improvement of vision technology and the development of *ad hoc* surgical instruments and materials for laparoscopic surgery, important advances have been made in the surgical procedures that can be performed with this technique in different specialties in the abdomen, pelvis, and thorax. Laparoscopic cholecystectomy is the gold standard for gallbladder resection for acute and elective cases. It has sought to further reduce trauma to the abdominal wall by reducing the number of surgical incisions or ports for its performance. This has led to the search to perform laparoscopic cholecystectomy through single access or port (single-port laparoscopic surgery). In 1995 Paganini performed the first single port laparoscopic cholecystectomy (SPLC); in 1997, Navarra published the first SPLC procedure in the world literature.[3] In our country Dr. Fausto Davila, in Poza Rica, Veracruz, performed the first procedure of this type also in 1997. Since then, there has been great enthusiasm worldwide for applying this technique to different pathologies in the abdomen and thorax. This is the report of the SPLC experience of a group in private practice over eight years.

MATERIAL AND METHODS

A prospective, observational study of SPLC performed from June 2010 to December 2018 in a private general surgery practice was performed. The same surgical team operated on patients in different hospitals in Mexico City, Puebla, Puebla, and Acapulco, Guerrero.

All patients of both sexes between 18 and 75 years of age were included. They were non-consecutive patients with clinical, ultrasonographic, and computed axial tomography diagnoses of chronic calculous cholecystitis, non-lithiasis cholecystitis, and acute cholecystitis. In the absence of ultrasonographic evidence of gallbladder stones and based on the clinical picture, the history, the thickness of the gallbladder wall greater than or equal to 5 mm, the presence of excessive peri-vesicular fluid or a "bull's eye" image suggestive of peri-vesicular edema were the diagnostic criteria for acute cholecystitis and indication for surgery.

Initially, it was proposed to perform SPLC on all cases scheduled for laparoscopic cholecystectomy; subsequently, subjects were selected based on imaging findings, general condition, and comorbidities of patients with acute and chronic cholecystitis.

Figure 1: *The single-port laparoscopic cholecystectomy platform used in the study meets the features of other platforms.*

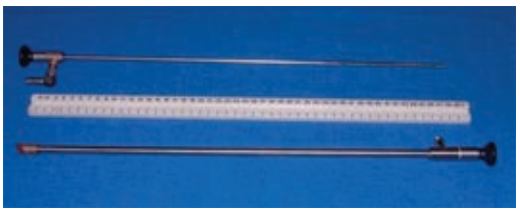

Figure 2: *5- and 10- mm diameter telescopes, 45 cm working length, and fiber optic 90-degree adapter.*

Single-port laparoscopic cholecystectomy (SPLC)

In all cases, different single-port laparoscopic surgical platforms commercially available in our country were used *(Figure 1)*. The incision to enter the peritoneal cavity was trans umbilical, longitudinal, 2.5 to 3 cm in length, hidden within the umbilicus limits, and indistinguishable three weeks after the procedure. No trocar was used immediately outside the trans umbilical incision. In some cases, an extra 3.5- or 5-mm puncture was used to help expose Calot's triangle or to hold the fundus of the gallbladder, depending on the anatomical difficulty of the case. Before the incision and with the patients under general anesthesia, a field block was applied with six subaponeurotic anesthetic points with 2 or 7.5% ropivacaine or 2% lidocaine with epinephrine, in addition to anesthetizing the skin and adipose tissue of the umbilicus.

In the first 30 cases, standard telescopes with a 30-degree viewing angle and 33 cm in length and laparoscopic instruments of average size that could not be angled were used. In two cases, a flexible tip laparoscope was used. Subsequently, 30- and 45-degree viewing angles and 45cm-long telescopes with 90-degree fiber optic adapter for the fiber optic cable or fiberoptic cables with 90-degree angled end on the telescope were used *(Figure 2)*, as well as 44cm-long instruments, some with an angled tip and others with fixed bends. Insufflation pressure of 15 mmHg with maximum gas flow, illumination with the highest intensity, and monopolar and bipolar coagulation were used.

Once inside the peritoneal cavity, the platform chosen for SPLC was placed; in most cases, this included a surgical wound protector secured to the inside of the peritoneal cavity; for this reason, it was not necessary to use an extractor bag for the gallbladder. In patients with previous abdominal surgery, a digital dissection was performed to make room for the placement of the platform wound protector. After positioning the platform, a peritoneal cavity was reviewed with a 5 mm telescope inserted through the access in the 3 o'clock quadrant. The instruments for dissection and cutting were introduced through the access in the 6 and 12 o'clock quadrants. Occasionally, four devices, including the optics, were introduced simultaneously through the umbilical incision; in these cases, the diameter of the instruments was always 5 mm.

The first maneuver was clamping the gallbladder fundus with grasping forceps; in most cases, a 44cm, 5mm diameter SILS Endo Clinch™ forceps (Medtronic®), which is angled and rotating, was used *(Figure 3)*. Then, a percutaneous suture of polypropylene 00 or preferably silk 0 or 1 with a straight needle was placed with an entry in the anterior aspect of the abdomen to the right of the round ligament of the liver and exit in the right subcostal lateral portion according to the dimensions of the abdomen of each patient. Anchoring of the suture was performed at the level of Hartman's pouch. This maneuver facilitates exposure of Calot's triangle and allows a critical safety revision *(Figures 4 and 5)*.

Figure 3: *5 mm long clamping instrument with an angled tip and fixed curve.*

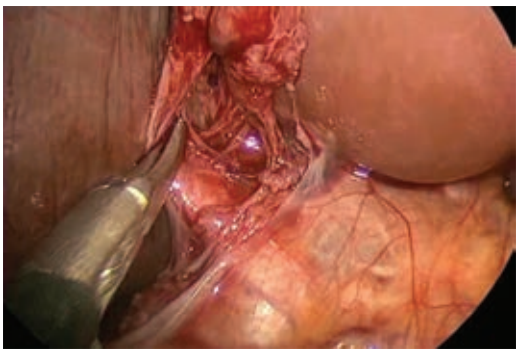

Figure 4: *Critical safety view possible with adequate dissection and long instruments.*

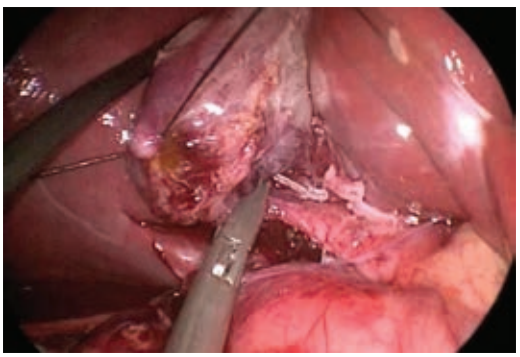

Figure 5: *Dissection of Calot's triangle with the aid of a percutaneously placed rein with 0 or 1 silk passed with a straight needle to perform the "puppeteer's maneuver" of Hartman's pouch.*

Section of the peritoneum was performed with a 45 cm long hook or monopolar scissors; the cut is in a V-shape of 3 to 4 cm in each branch with vertex at the site where the arrival of the cystic duct to Hartman's pouch was. Dissection, cutting, and closure of the cystic duct or cystic artery were never attempted as a first intention, even though they were easily identifiable.

Once the critical safety check had been performed, nylon hemostasis staples (Hem-o-Lok, Weck®) were placed with a reusable 45 cm-long applicator *(Figure 6)*, and the artery and cystic duct were cut, as well as any other accessory vessels that might be found. In some cases, a 5mm diameter disposable automatic metal staple applicator was used, and a 10mm diameter one-by-one reusable staple applicator. Then, sub-serosal dissection of the gallbladder was performed with different maneuvers using the percutaneous reins and the gallbladder fundus clamp until reaching the fundus of the gallbladder. The gallbladder's opening during sub-serosal dissection was not considered a complication or adverse event, nor was the outflow of bile from the gallbladder during these maneuvers or during the placement of the reins for manipulation of the Hartman's pouch during surgery. In three cases, sub-serosal retrograde dissection was performed due to the difficulty in identifying the structures of Calot's triangle. The gallbladder was removed through the umbilical incision without the need to enlarge it in any case. Before the conclusion of the surgery, hemostasis of the gallbladder bed was verified.

Only in one case was a vacuum drain left, which was decided at the end of the procedure, so that incision was not initially used to place any extra trocar for surgery. In female patients, the pelvic revision was performed before the end of the surgery, taking advantage of the ideal location of the trans-umbilical access in the center of the abdomen; if it was considered convenient, lysis of peritoneal pelvic adhesions was performed. In all cases, the incision was closed with non-absorbable 0 or 1-gauge polypropylene material with continuous stitches.

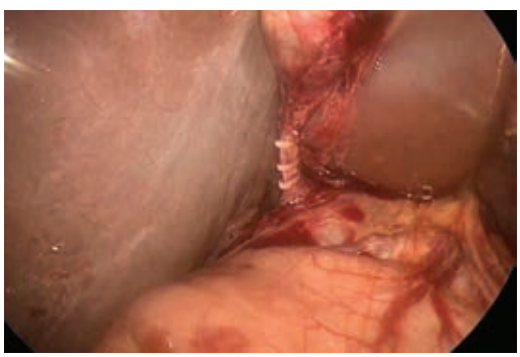

Figure 6: *Nylon staples in the cystic duct before cystic duct cutting.*

Surgical outcome variables

The variables studied were age, sex, body mass index, risk of pulmonary thromboembolism, *American Society of Anesthesiologists* (ASA) classification, surgical time in minutes, days of hospital stay (stratified into three groups: the first of stay less than 24 hours, the second of 24 to 48 hours and the third of more than 48 hours), whether the surgery was urgent or elective, conversion to conventional multiport surgery or open surgery, transoperative and postoperative complications, the performance of critical safety review, pain based on days of analgesic consumption, transoperative hemorrhage and degree of patient satisfaction.

The analgesic regimen used was the same for all patients: oral paracetamol every 8 hours alternating with sublingual ketorolac every 8 hours.

A questionnaire developed by our surgical team was used to define four levels of satisfaction: not satisfied, indifferent, satisfied, and very satisfied *(Annex 1)*. The extended Clavien-Dindo classification[4] was used to analyze complications, and the Caprini scale was used to classify the risk of pulmonary thromboembolism (PTE).[5]

Descriptive and analytical statistics

A database was created, initially in Excel, which was subsequently imported into the SPSS Statistics program for the Windows system, version 23.0. For quantitative variables, the mean was used as a measure of central tendency, along with the standard error of the mean (SE) and the standard deviation (SD), according to the distribution of the variable data, as measures of dispersion.

Qualitative variables were reported in frequencies and percentages, using Pearson's χ^2 test as the analytical statistic; for quantitative variables, the Kruskal-Wallis test for independent samples was used. The relationship of nonparametric variables was analyzed using Pearson's correlation coefficient.

RESULTS

Demographic and clinical characteristics of patients

A total of 106 patients undergoing SPLC were included. All patients were operated on one of the three single port platforms available (Lagis Port®, Gelport Applied Medical®, and SILS Medtronic®).

Of the total 106 patients, 88 (83%) were female and 18 (17%) were male (p = 0.00). The average age was 38.7 ± 12.6 years, with the youngest patient being 14 years old and the oldest 73. The population's average body mass index (BMI) was 26.3 ± 3.9, with the maximum BMI being 42. For preoperative thromboembolic risk, 79 (74.5%) patients presented a low risk, 24 (22.7%) moderate risk, and three (2.8%) high risk. Regarding the pre-surgical ASA classification, 95 (89.6%) patients presented grade I and 11 (10.4%) grade II. Demographic characteristics are reported in *Table 1*.

Surgical procedure and postoperative outcome

The mean surgical time recorded was 85.7 ± 35.7 minutes. The average trans-surgical

Table 1: Demographic and clinical features.

Feature	n (%)
Age	38.7 ± 12.6
Sex	
Female	88 (83.0)
Male	18 (17.0)
Body mass index	26.3 ± 3.9
PTE risk	
Low	79 (74.5)
Moderate	24 (22.7)
High	3 (2.8)
ASA Classification	
I	95 (89.6)
II	11 (10.4)

PTE = pulmonary thromboembolism,
ASA = *American Society of Anesthesiologists*.

bleeding was 36.2 ± 28.3ml. Of the total number of surgical procedures, the year in which SPLC was performed the most was 2012, with 18 (17%) procedures, followed by 2011 and 2013 with 17 (16%) procedures each; for each consecutive year of the study, the average surgical time was obtained, and the difference was found between the different years, with a p = 0.005 using the Kruskal-Wallis statistic, seeing a trend towards a decrease in the mean surgical time over the years, which is reported in *Figure 7*. Using Spearman's correlation coefficient, a value of -0.29 was obtained, with a p = 0.003, finding an inversely proportional correlation between the years of experience and surgical time. Similarly, an attempt was made to associate the presence of complications, conversion to conventional laparoscopic surgery, and days of hospital stay with the experience acquired over the years of surgery without finding any statistical significance.

Of the operated patients, 44 (41.5%) were operated on urgently and 62 (58.5%) electively (p ≤ 0.0001). Only two conversion cases to conventional laparoscopic surgery found no relationship with urgent or elective surgery. One patient with gallbladder cancer was initially converted to conventional multiport laparoscopic surgery. One patient with Mirizzi syndrome type I was initially converted to multiport surgery and open surgery. One patient had an accessory bile duct and choledocholithiasis and was directly converted to open surgery.

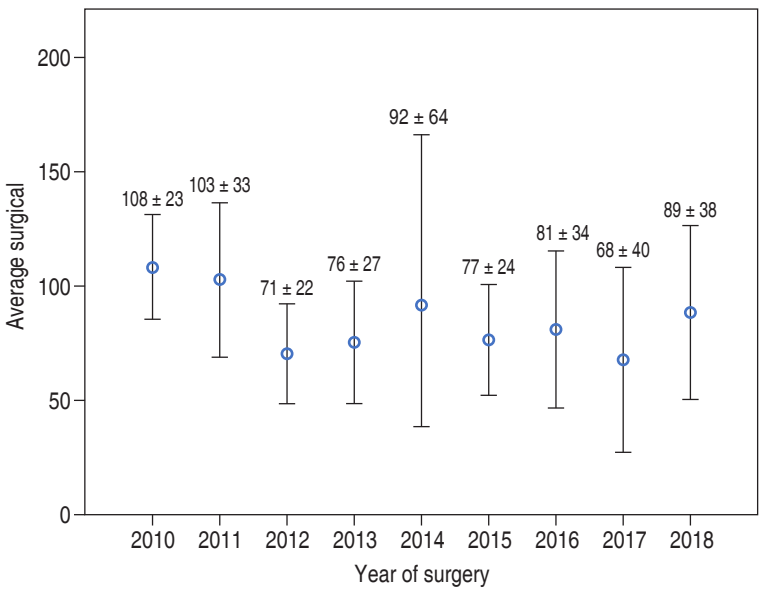

Figure 7: *Average surgical time (minutes) according to the year of surgery.*

Transoperative and postoperative complications

Ten (9.4%) patients presented complications, six were transoperative, and four were postoperative; according to the Clavien-Dindo classification, two were type II, one type IIIa and one type IIIb. No relationship was found between complications and urgent or elective surgery; there were no deaths.

Three trans-surgical hemorrhages were reported and resolved during the same surgical event without needing technique conversion. Only one patient required transfusion of an erythrocyte concentrate on the second postoperative day.

In one patient, surgical wound dehiscence was managed on an outpatient basis with a primary suture in the office. Another patient operated during an instruction course in the technique presented intestinal occlusion on the seventh postoperative day with reintervention with exploratory laparotomy on the eleventh postoperative day, finding pexy of the terminal ileum loop in the umbilical scar wound, performing intestinal resection with primary anastomosis, with an excellent postoperative outcome; a different surgical team than ours intervened this patient. One patient was readmitted 40 days postoperatively due to intense abdominal pain. With imaging techniques, postoperative complications were ruled out and managed with analgesia and antibiotic therapy, resolving the abdominal pain.

Regarding hospital stay, 92.5% of the patients stayed between 24 and 48 hours after the surgical procedure, 4.7% stayed less than 24 hours after surgery, and the remaining 2.8% stayed more than 48 hours. Regarding postoperative pain, 73.6% of the patients presented low analgesic consumption.

Table 2: Surgical procedure features and outcomes.

Feature	n (%)	p
Surgery time	85.7 ± 35.7	
Bleeding	36.2 ± 28.3	
Type of surgery		0.080
Urgent	44 (41.5)	
Elective	62 (58.5)	
Complications		0.520
Transoperative	6 (5.6)	
Postoperative	4 (3.8)	
Total	10 (9.4)	
Conventional laparoscopic conversion	3 (2.8)	
Hospital stay		0.000
Less than 24 hours	5 (4.7)	
Between 24 and 48 hours	98 (92.5)	
Greater than 24 hours	3 (2.8)	
Postoperative pain		0.000
Mild	78 (73.6)	
Moderate	21 (19.8)	
Severe	7 (6.6)	
Satisfaction		0.690
Satisfied	51 (48.1)	
Very satisfied	55 (51.9)	

Therefore, they had mild postoperative pain. *Table 2* summarizes the results related to the surgical procedure. Regarding the post-surgical satisfaction questionnaire, 48% of the patients indicated feeling "satisfied" and 52% "very satisfied", *Annex 1 shows the* satisfaction questionnaire used.

DISCUSSION

Since the appearance and recognition of minimally invasive surgery (MIS), attempts have been made to improve techniques and add benefits for the patient by applying the principle of less surgical trauma. As a collateral effect, new instruments have been developed, and benefits that were not initially expected, such as better cosmesis, and others that were always sought after, such as less postoperative pain (POP) and faster recovery.

The intention of reduced port surgery (RPS) and single port laparoscopic cholecystectomy is to achieve all the above outcomes *(Figure 8)*. SPLC has become "the natural evolution" of MIS for cholecystectomy. In 2013, a randomized, prospective, multicenter, blinded, 1-year study comparing conventional multiport laparoscopic cholecystectomy surgery (MPLC) vs. SPLC was published.[6] A total of 200 patients were randomized, 119 with SPLC vs. 81 with MPLC. In the preliminary phases of the study, the authors reported as primary objectives the feasibility and safety of SPLC and, as secondary objectives, POP pain, cosmesis, satisfaction with the procedure, and quality of life. The closure of the umbilical wound was at the discretion of the surgeon who had operated and is not specified in the material and methods section; therefore, no conclusions can be drawn about the influence of this aspect of the surgical technique used, which is very important in the development of a post-incisional hernia. The patients were blinded to how many incisions had been made up to seven days POP if any of the four surgical dressings placed (even if only one incision had been made) had not become dislodged. The MPLC group had one post-incisional hernia vs. 10 in the single-port group. Of these, five required reoperations. The SPLC group reported better cosmesis

Figure 8: *The trans umbilical surgical scar appearance two weeks after single-port laparoscopic cholecystectomy.*

rates at all stages of evolution up to 12 months after surgery. Other complications of the SPLC procedures were like those of MPLC. The authors conclude that cosmetically SPLC is better and that 50% of patients would be willing to pay more to be operated on with this technique.

Koo EJ and colleagues[7] published a retrospective series of 100 cases similar to the present report regarding the evolution of the technique. In their results, like ours, they do not attribute any consequence to bile leakage during the separation of the gallbladder from the liver or during the manipulation of the gallbladder. Their percentage of conversion to multiport technique is high, with 21 cases, and the cause was poor visualization of Calot's triangle due to anatomical conditions of the liver. They did not have any conversion to open surgery. Their postoperative stay was long at 2.18 ± 1.2 days. They also report decreasing operative time as more experience is gained. They set their learning curve at 30 procedures, like our report. They had no complications that merited reoperation. They do not evaluate the long-term cosmetic outcome or the occurrence of post-incisional hernia. They conclude that SPLC is a safe and reproducible technique, with an adequate surgical time that can be reduced according to the experience acquired over time.

Few meta-analyses compare four-port MPLC vs. SPLC. Recently, in the article published by Laura Evers and collaborators,[8] of the University of Maastricht, The Netherlands, they found nine studies that met the inclusion criteria with a total of 860 patients, all over 18 years of age, with ASA I to III classification, most of them being ASA I-II. Some of the studies included a comparison with mini-laparoscopic cholecystectomy; more moderate (wound infections, bile leaks, or intra-abdominal collections that were easily treated or subsided spontaneously) and severe adverse events (bile duct disruption, bile duct injuries, reoperations, intra-abdominal collections, bile leaks or intra-abdominal abscesses that required drainage) were reported in the single-port cholecystectomy (SPC) group. POP pain and cosmesis were significantly better in SPC patients. However, the authors did not consider this to affect patients' quality of life. Surgical time was longer in SPC, and hospital stay did not vary between MPLC and SPLC.

In the study by Cinar H and his team from Turkey, the impact of SPC on quality of life was analyzed.[9] Over nine years (2009-2018), 43 patients were operated on for SPLC and 114 with MPLC. The SF-36 format was used to measure the quality of life. The questionnaire evaluates physical functioning, social functioning, mood, vitality, pain, and well-being. POP complications were higher in MPLC than in SPLC (8 vs. 5). The incidence of post-incisional hernia in the SPLC group was not significantly higher than in MPLC. It is important to note that the authors closed the single incision in the SPLC with a nonabsorbable suture. Finally, the quality of life measured on the SF-36 format was similar in both groups, with better physical functioning in the SPLC patients.

Regarding the perception of the general population and patients regarding the procedure, there is an article in Holland by Sofie Fransen AF and colleagues[10] in which the aspects mentioned above were studied. An anonymous questionnaire of 33 questions was applied to the general population with different levels of school education and to patients who were going to have a consultation with the surgeon to be scheduled for cholecystectomy; these were adult patients between 17 and 82 years of age. The questionnaire informed them of what SPLC and MPLC consisted of. It included 101 people from the general population and 104 patients who were going to be operated on for cholecystectomy. Seventy-two percent of the patients had never heard of SPLC. The safety of the procedures was the most critical issue for 96% of the respondents; 70% of the participants would be willing to travel to another city if their local hospital did not offer SPLC. The authors conclude that, although being cured of the condition and safety are most important for the general population, the perception of SPLC is favorable.

Our group of patients answered "satisfied" or "very satisfied" based on the satisfaction questionnaire attached at the end. Only one patient to whom the procedure was proposed was adamant in rejecting it for philosophical/religious reasons regarding the navel, as she explained.

Ning Sun and his group,[11] of Shenyang, Liaoning, in the People's Republic of China, conducted a systematic review and meta-analysis published in 2018. They found six studies with 633 patients from 2011 to 2017 comparing SPLC vs. single-port robotic cholecystectomy (SPCr) using the single-port platform for the da Vinci Si robot system (Intuitive). They had an outcome of interest such as operative time (OT), intra- (IO), and postoperative (PO) complications, readmission rate, hospital stay, and cost. Skin-to-skin OT between the two techniques was similar; however, robot *docking* time was not considered. IO and PO complications were similar in both groups, so the authors conclude that using the da Vinci Si robot does not reduce the number of complications. The other outcomes, such as readmission, hospital stay, and conversions, are the same. There is an essential difference in the cost, with the robotic technique being significantly more expensive: 6,053.53 vs. 2,352.72 US dollars.

In a study by Fuertes-Guiró and Girabent-Farrés,[12] the cost of surgery and surgical time by comparing SPLC vs. MPLC were analyzed; in this study, they performed a meta-analysis to compare only these two aspects. They conclude that any surgical technique should include the cost-opportunity variable. Likewise, they report that the cost of both surgical techniques is the same, but from the point of view of surgical time, SPLC is at a disadvantage since the extra time used to perform it could be used to perform other procedures. This last aspect could be relevant for its use in public institutional settings, where optimizing surgical time, anesthesia, and the use of operating rooms is essential.

CONCLUSION

While the multiport technique is sufficient (and therefore considered in many cases the gold standard) to meet minimally invasive requirements, SPLC offers additional benefits in terms of postoperative pain (73.6% with low analgesic consumption), cost, the level playing field in terms of hospital stay (97.2% of our patients had less than 48 hours of hospital stay) and surgical time (average of 85 minutes after obtaining the learning curve).

Our surgical team already has extensive experience in various single-port surgeries in addition to SPLC, with a total of 254 procedures, including appendectomies, Hiatal surgery, colonic resections, inguinal hernias, and scheduled and urgent gynecological procedures. We consider pelvis surgery and appendix surgery the ideal techniques to begin the practice of single-port surgery. Given that the patients were predominantly operated on privately, the SPLC does represent significant savings by dispensing with disposable trocars, whose cost is always higher than that of the single-port platform.

Regarding the future of SPLC, we think the technique is again considered an option, partly because a new robot designed exclusively for a single port has been developed. Undoubtedly, SPLC, which we could now call conventional SPLC without robot, as described in our study, represents a significant saving in several aspects such as equipment, instrumentation, and training, offering the same advantages; therefore, it should be a tool at the disposal of general surgeons trained in minimally invasive surgery.

ACKNOWLEDGMENTS

To Drs. Luis Feria-Bernal (Surgeon General), Gustavo Cruz-Santiago (Surgeon General) and Juan M González-Machuca (Surgeon General), for their contribution with clinical cases.

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Ethical considerations and responsibility: Data privacy. According to the protocols established in our work center, it is declared that the protocols on patient data privacy have been followed and their anonymity preserved.

Funding: No financial support was received for this work.

Disclosure: None of the authors have a conflict of interest in the conduct of this study.

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Annex 1: Satisfaction questionnaire.

Please indicate the option most closely matches your post-discharge experience following your surgery for each column

	Indifferent	Not satisfied	Satisfied	Very satisfied
1) Pain related to surgery	Indifferent to pain	Severe	Moderate	Mild
2) Return to normal activities	Indifferent	More than 2 weeks	1 to 2 weeks	Less than 1 week
3) Scar appearance one month after surgery.	Indifferent	Not satisfied	Satisfied	Very satisfied
4) Feeling of well-being	Indifferent	Bad	Good	Very good
5) Would you recommend this technique to anyone who requires it?	Indifferent	Definitely not	Yes	Definitely yes