



Single-Incision Laparoscopic Appendectomy with a Low-Cost Technique and Surgical-Glove Port: “How To Do It” with Comparison of the Outcomes and Costs in a Consecutive Single-Operator Series of 45 Cases

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During the last decade, an innovative but technically demanding technique, single-incision laparoscopic surgery (SILS), has been implemented with the intent to improve the impact of minimally invasive surgery on cosmesis, postoperative pain, and return to normal activity.^{1,2} Several studies and randomized controlled trials (RCTs) have compared SILS with laparoscopic appendectomy (LA) and have reported similar postoperative results.^{3,4} However, the increased costs for SILS compared with the already costly LA, especially when performed using expensive equipment, is still a considerable disadvantage that limits use of this technique.^{5,6} In addition, use of curved instruments and the loss of triangulation among the instruments due to coaxiality makes SILS a much more difficult and challenging procedure to learn as it requires advanced laparoscopic skills. This can lead to longer operative times and a possible increased rate of iatrogenic injuries and postoperative complications.⁶

More recently, however, a few authors have described a novel, self-made, and inexpensive single-port laparoendoscopic single-site surgical method.⁷⁻¹⁰ Using a surgical glove, this simple, single-port laparoscopic technique

has several advantages: it is associated with substantially decreased costs compared with commercial single-port equipment and requires just the use of common laparoscopic standard straight instruments with reduced coaxiality, without need for laparoscopic instruments with curved architecture, which are more expensive and less widely available to the community hospital. This means more working space and wider feasibility for this modified single-incision laparoscopic technique. Surgical-glove port has been adopted for several minimally procedures, including cholecystectomies¹¹ and appendectomies.¹²

The encouraging early results reported for surgical-glove port laparoscopy,¹³ and the absence in the contemporary scientific literature of a detailed description of a standardized technique for SILS using a surgical-glove port, led us to explore this original technique for minimally invasive abdominal surgery through a single umbilical incision. We have improved our experience with technical refinement and standardization of the surgical-glove port technique, adding a well-documented, step-by-step, description with educational tips.

Based on our consecutive and prospectively collected series of SILS appendectomies and as, to the best of our knowledge, the largest ever published series on the technique of surgical-glove port in the literature, we aimed to investigate the feasibility, safety, and efficacy with particular focus on the cost-effectiveness of surgical-glove port, single-incision laparoscopic appendectomy (SGP-SILA) for acute appendicitis performed by a single surgeon with specific training in advanced laparoscopic surgery. We also aimed to assess the results of this procedures and the cost-effectiveness in comparison with a control group of classic SILA performed in the same institution by another surgeon using a commercial device

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Abbreviations and Acronyms

AIR	= Appendicitis Inflammatory Response
LA	= laparoscopic appendectomy
RCT	= randomized controlled trial
SGP-SILA	= surgical-glove port, single-incision laparoscopic appendectomy
SILS	= single-incision laparoscopic surgery

available on the market specifically for single-incision procedures.

METHODS

From December 2011 to July 2015, forty-five consecutive selected patients with clinical diagnosis of acute appendicitis were operated on using SGP-SILA by the same attending consultant surgeon, Dr Salomone Di Saverio, at the Emergency Surgery and Trauma Center Unit of the Maggiore Hospital in Bologna, Italy.

The data from the SGP-SILA group were therefore analyzed and compared with a control group of 14 cases of SILA performed using the Single-Site Laparoscopy Access System (Ethicon Endo-Surgery Inc). Between January 2009 and June 2013, all patients in the SILA group were operated on by a single surgeon, Dr Elio Jovine, Chairman of the General Surgery Department in the same institution.

Preoperative study

Preoperative clinical assessment was based on blood tests and physical examinations. Additional investigations, such as abdominal ultrasound and/or CT scan, were eventually ordered by the attending surgeon or attending emergency department physician, according to guidelines from the American College of Radiology Appropriateness Criteria for right lower-quadrant pain and suspected appendicitis.¹⁴ Alvarado¹⁵ and Appendicitis Inflammatory Response (AIR)¹⁶ scores were evaluated and recorded by the attending surgeon seeing the patient.

Clinical, laboratory, and pathologic details; preoperative, intraoperative, and postoperative data; and operative and hospital costs for all patients selected to undergo SILS for appendectomy with preoperative suspicion of acute appendicitis were collected from an institutional database that was prospectively recorded in the Department of Surgery of Maggiore Hospital, AUSL Bologna.

SILS was considered successful if the entire appendectomy was completed laparoscopically through the single umbilical incision. Two types of conversion were considered. Open conversion was classified as any case when the minimally invasive procedure was terminated and a

laparotomy (median or McBurney or transverse incision) was made. Another type of conversion was classified whenever the SILS procedures was continued and finished, and at any time during the operation, 1 or 2 additional trocars were inserted as an aid for dissection, completion of the appendectomy, or abscess evacuation. In such cases, the conversion was defined as “conversion to 2-port (additional port)” or “conversion to 3-port standard laparoscopy.” All surgical specimens were sent for histologic evaluation. Complicated acute appendicitis was defined as gangrenous or perforated appendix or when a purulent collection, abscess, or diffuse peritonitis was present. This definition was in accordance with a score ≥ 2 on the laparoscopic grading system of acute appendicitis described by Gomes and colleagues.¹⁷

Preoperatively, patients received ampicillin/sulbactam (3 g) intravenously during the induction of anesthesia, or metronidazole (500 mg) and gentamicin (160 mg) if the patient was allergic to penicillin. Postoperatively, antibiotics were administered only in cases of gangrenous or perforated appendicitis with finding of an abscess or peritonitis. Antibiotics were continued until the patient remained afebrile for a minimum of 24 consecutive hours.

Surgical technique

Surgical-glove port, single-incision laparoscopic appendectomy (Salomone Di Saverio, operating surgeon)

The technique uses simple and inexpensive instruments, which are widely available (Fig. 1). Only a standard laparoscopic tower set is needed, with a standard light source,

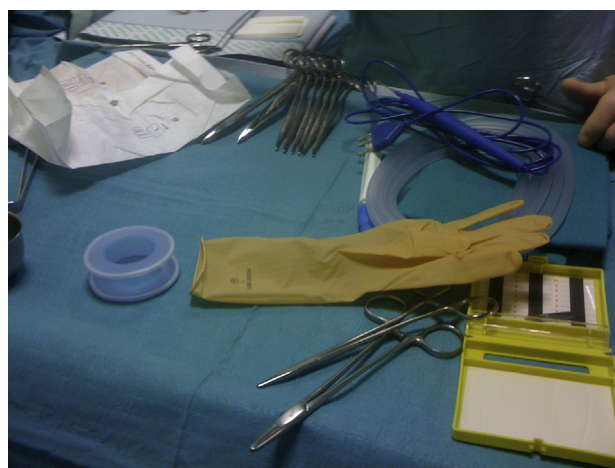


Figure 1. The simple and inexpensive equipment needed for establishment of a surgical-glove port: a wound protector sized small or extra small, a surgical sterile glove, and the usual traditional equipment for open Hasson technique for umbilical access.

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