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Feasibility and safety of single-incision laparoscopic splenectomy: a systematic review

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ABSTRACT

Objective: The aim of this review was to evaluate the feasibility, safety, and potential benefits of single-incision laparoscopic splenectomy (SILS-Sp).

Methods: We conducted a systemic review of literature between 2009 and 2012 to retrieve all relevant articles.

Results: A total of 29 studies with 105 patients undergoing SILS-Sp were reviewed. Fifteen studies used a commercially available single-port device. The range of body mass index was 14.7–41.4 kg/m^2. Six studies described combined operations including cholecystectomy ($n = 8$), mesh-pexy ($n = 1$), and pericardial devascularizaion ($n = 1$). The ranges of operative times and estimated blood losses were 28–420 min and 0–350 mL, respectively. Of 105 patients, three patients (2.9%) required additional ports, two patients (1.9%) were converted to open, and three patients (2.9%) to conventional multiport laparoscopic splenectomy (overall conversion rate, 4.8%). Postoperative bleeding occurred in two patients (1.9%) who both required reoperation. Overall mortality was 0% (0/105). The length of postoperative stay varied across reports (1–11 d). Among four comparative studies, one showed greater estimated blood loss and lower numeric pain rating scale score in the SILS-Sp group than in the multiport laparoscopic splenectomy group (206.25 ± 142.45 *versus* 111.11 ± 99.58 mL) and (3.81 ± 0.91 *versus* 4.56 ± 1.29), respectively. Another comparative study showed that SILS-Sp was associated with a shorter operative time (92.5 *versus* 172 min; $P = 0.003$), lower conversion rate, equivalent length of hospital stay, reduced mortality, similar morbidity, and comparable postoperative narcotic requirements.

Conclusions: In early series of highly selected patients, SILS-Sp appears to be feasible and safe when performed by experienced laparoscopic surgeons. However, as an emerging operation, publication bias is a factor that should be considered before we can draw an objective conclusion.

1. Introduction

Splenectomy is a very common surgical procedure but with varied indications. Depending on the surgical indications, the operative steps, difficulty of the surgical procedure, and postoperative outcomes could differ. Laparoscopic splenectomy was first described by Rhodes *et al.* [1]; thereafter, it has been widely used in clinical practice [2–8]. The surgical

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approach has a lower overall complication rate than open splenectomy and can be attempted in all patients [9]. Natural orifice transluminal endoscopic surgery, which is modified from laparoscopic surgery, does not produce any visible surgical scar but is associated with an increased risk of visceral injury [8]. It also lacks reproducibility because the procedure needs highly elaborate equipment, which is still being developed. These elaborate instruments are costly and require significant learning curve, whereas routine laparoscopic instruments are much more familiar to use, need no extra learning curve, and surgeon has excellent control over them. Single-incision laparoscopic surgery (SILS), a separate modification of laparoscopic surgery, uses existing laparoscopic instruments and requires only minor adjustments of the conventional multiport laparoscopic technique. SILS has so far been used for various abdominal procedures including cholecystectomy [10], appendectomy [11], colectomy [12], and thyroidectomy [13], and recently splenic surgery [14]. Compared with conventional laparoscopy, SILS yields better cosmetic appearance and causes less incisional pain and avoids port site–related complications.

A limited number of studies have been reported on single-incision laparoscopic splenectomy (SILS-Sp), and there has been no systemic review of these studies. Here, we reviewed the literature on SILS-Sp between 2009 and 2012 and analyzed the feasibility and safety of SILS-Sp for splenic diseases and further compared its benefits over multiport laparoscopic splenectomy (MLS).

2. Materials and methods

2.1. Literature search strategies

A systematic search of the scientific literature published between 2009 and June 2012 was carried out using the PubMed, EMBASE, online journals, and the Internet for all publications on SILS-Sp. The search was restricted to publications in English. To avoid duplication of data, we only included articles from the same institution once if data were being updated in a subsequent publication. The search terms were "single incision," "single port," "single access," "single site," "laparoscopic splenectomy," "splenectomy," and "laparoscopic splenic surgery." All available major publications from the review period were considered.

2.2. Article selection criteria

Articles were selected if the abstract contained data of patients who underwent SILS-Sp for splenic diseases in the form of case reports, case series, and controlled or comparative studies. Conference abstracts were included if they contained relevant data. The reference lists of these articles were also reviewed to find additional candidate studies. In the case of duplicate publications, the latest and most complete study was included. Review articles were excluded from this study. Data extracted for this study were taken from the published reports; authors were not contacted to obtain additional information. The following data were collected from each eligible article: first author's surname, publication date, study design, patient numbers, length of follow-up, main results, and conclusions. We did not define a limit on the minimum number of patients to include a study in our meta-analysis. Case series were not reviewed if patient accrual was not consecutive. When multiple case series reported the same or a cumulative group of patients, only the most inclusive case series was selected. All articles selected for review of full text were distributed to two reviewers (Y.F. and J.K.) with the use of a standard form and *a priori* criteria for outcome assessments. The reviewers independently decided on inclusion or exclusion and abstracted the study data. Any discrepancies in agreement were resolved by consensus. The flow chart of this selection process is summarized in Figure. The entire process of study selection, data analysis, and presentation of results was carried out in accordance with the Quality of Reporting Meta-Analysis (QUOROM) statement [15] to ensure the highest quality of this meta-analysis.

2.3. Assessment

Complications related to splenectomy were defined as those occurring within 30 d of splenectomy or later if the complication occurred during the original hospitalization for splenectomy. Complications beyond the postoperative period that may be attributable to the absence of the spleen were not analyzed. All data were entered into a Microsoft Access (Redmond, WA) database. Morbidity rates with SILS-Sp and MLS were compared by using the chi-square test. A two-sided $P < 0.05$ was considered statistically significant.

3. Results

3.1. Study characteristics

Using the specified search strategy, we identified a total of 39 potentially relevant citations. One irrelevant article and two non-English articles were excluded from review of titles and abstracts. Thirty-six publications were selected for review of full text and five duplicate publications and two review articles were excluded from further review. Twenty-nine studies [16–44], with a total of 105 patients undergoing SILS-Sp, met the criteria for analysis. These included four case-matched comparative studies (Table 1). There were no randomized controlled trials and meta-analyses.

3.2. Surgical indications and procedures

Indications for SILS-Sp were varied in these series with the most common indication being idiopathic thrombocytopenia ($n = 28$, 26.7%) [16–29] followed by splenic cystic disease ($n = 14$, 13.3%) [21,24,27–33] and hereditary spherocytosis ($n = 10$, 9.5% [18,21,33–35]. Other less common indications included splenic tumor ($n = 5$, 4.76%) [21,24,36], liver cirrhosis ($n = 3$, 2.86%) [24,37], β-thalassemia ($n = 3$, 2.86%) [38], myeloproliferative disorder ($n = 3$, 2.86%) [28], hemolytic anemia ($n = 2$, 1.91%) [28], and splenic aneurysm ($n = 2$, 1.91%) [23]. Indications also included human immunodeficiency virus–related hypersplenism, splenic abscess, splenic rupture,