# *Single incision versus reduced port splenectomy—searching for the best alternative to conventional laparoscopic splenectomy*

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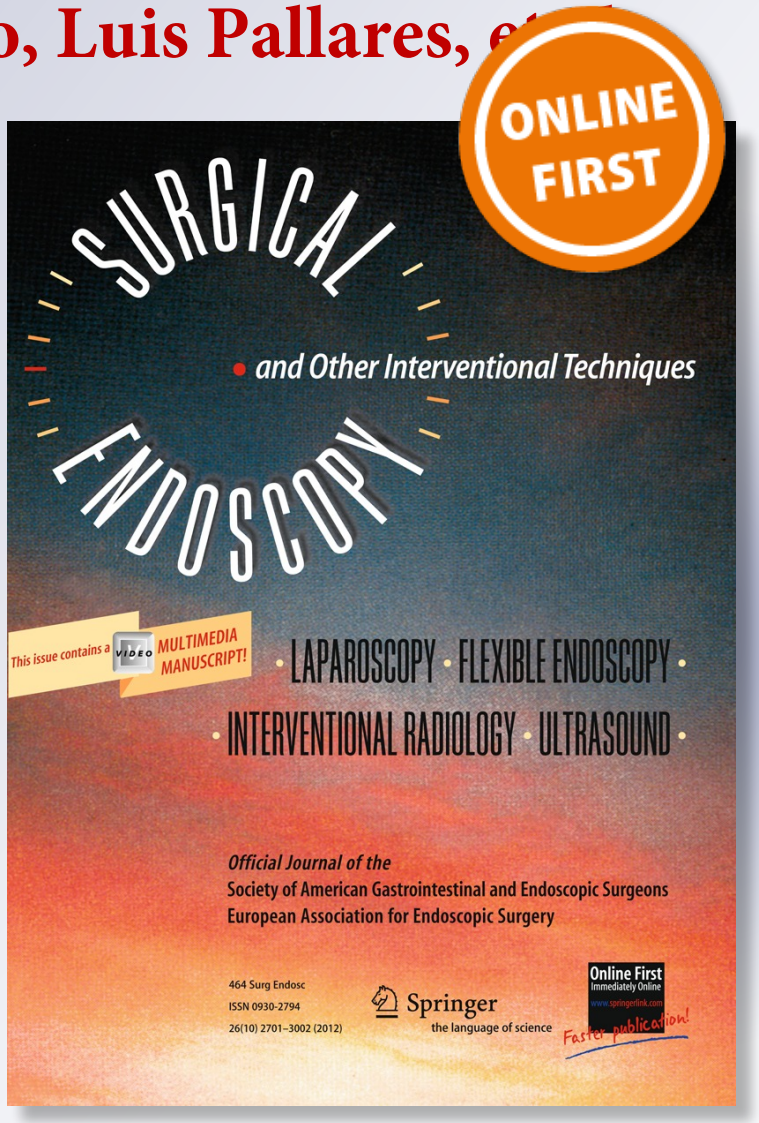


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# Single incision versus reduced port splenectomy—searching for the best alternative to conventional laparoscopic splenectomy

**Julio Lopez Monclova · Eduardo M. Targarona · Pablo Vidal · Yerald Peraza · Francisco Garcia · Carlos Rodriguez Otero · Luis Pallares · Carmen Balague · Manuel Trias**

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**Abstract**
*Background* Laparoscopic splenectomy (LS) is a well accepted approach for the treatment of multiple hematologic diseases. Single port access splenectomy (SPAS) emphasizes the concept of surgery through one small incision. The reduced port access splenectomy (RPAS) entails the use of fewer trocars of smaller sizes. The aim of this study was to compare the clinical outcomes after LS, SPAS, and RPAS, and to analyze the aesthetic result and patient satisfaction.
*Methods* We included patients who underwent LS (group 1, $n = 15$), SPAS (group 2, $n = 8$), and RPAS (group 3, $n = 10$) between June 2008 and February 2012, whose final spleen weight was less of 500 g. The outcome parameters analyzed were operative time, need of additional trocars, blood loss, blood transfusion, weight of the spleen, postoperative complications, and duration of hospital stay. To evaluate the cosmetic result, patients were asked to take the Body Image Questionnaire.
*Results* Patients in group 3 were younger than group 1. Operative time was significantly longer in group 2 compared to groups 1 and 3 ($83 \pm 19$ vs. $131 \pm 43$ vs. $81 \pm 22$ min, $p = 0.01$). There was no need to convert to open surgery in any group, nor were there differences in intra- or postoperative outcome. There were no differences between the groups in relation to the analgesic requirements. Twenty-two out of the 33 patients answered the questionnaire. There was a significant advantage in group 2 and 3 in the body image index with respect to group 1. There were no differences between groups 2 and 3 ($7.3 \pm 2.8$ vs. $5.8 \pm 1.3$ vs. $5.1 \pm 0.4$, $p < 0.02$).
*Conclusions* RPAS is a good alternative to LS and SPAS. It improves the aesthetic results as compared to LS, whereas minimizes the technical challenges faced with SPAS.

**Keywords** Analgesic requirements · Body image · Cosmesis assessment · Laparoscopic splenectomy · Reduced port surgery · Single port splenectomy

Laparoscopic splenectomy (LS) was first described in 1992 and is now a well-accepted approach for the treatment of multiple hematologic diseases, primary splenic tumors, and metastatic disease involving the spleen. In fact, it is now considered the gold standard for patients with idiopathic thrombocytopenic purpura and other surgical diseases with normal or slightly enlarged spleens [1]. In an effort to improve functional and cosmetic results, new techniques and increasingly improved instruments have been developed to further reduce invasiveness.

Single port access splenectomy (SPAS) emphasizes the concept of surgery through one small transabdominal incision rather than the standard multiple trocar sites, with theoretical benefits of less pain and better cosmetics. The incision can be hidden periumbilically and can be used as the specimen extraction site as well [2]. Nevertheless, the SPAS approach for solid organs poses several technical challenges besides instrument clashing, difficult visualization, and limited range of movements. First, solid organs cannot be grasped, and retraction is more difficult. Second, during SPAS, exposure of the lesser sac and upper pole of spleen is sometimes suboptimal. Third, the approach

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**Table 1** Single port access splenectomy, world experience

| Study | *N* | Device | Patient position | Approach | Conversion | Operative time (min) | Hospital stay (days) | Spleen weight (g) |
|---|---|---|---|---|---|---|---|---|
| Barbaros [4] | 2 | SILS | Semilateral | Umbilical | No | NA | NA | NA |
| Vatansev [6] | 1 | 2 ports + sutures | Semilateral | Umbilical | No | 45 | NA | NA |
| Malladi [7] | 1 | SILS | Semilateral | Umbilical | No | 133 | 2 | NA |
| Targarona [5] | 8 | Several | Lateral | Umbilical/subcostal | 3/8 | 131 | 4 | 398 |
| Hong [8] | 3 | 3 ports | Semilateral | Subcostal | No | 150 | NA | NA |
| Rottman [9] | 1 | 3 ports | Semilateral | Umbilical | No | 180 | NA | NA |
| Misawa [10] | 10 | 1 + tugs | Semilateral | Umbilical | 1/10 | 230 | 6.8 | 260 |
| Colon [11] | 2 | SILS | Lateral | Umbilical | No | 160 | 2 | NA |
| Oyama [12] | 1 | SILS | Semilateral | Left lower abdomen | No | 123 | 4 | 160 |
| Taher [13] | 1 | SILS | Semilateral | Umbilical | No | 180 | 3 | NA |
| Srikanth [14] | 1 | 3 ports + sutures | Lateral | Umbilical | No | 150 | 2 | NA |
| Jing [15] | 1 | 3 ports | Semilateral | Umbilical | No | 240 | 4 | NA |

*SILS* single incision laparoscopic surgery, *NA* not available

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through the umbilicus in cases of high body mass index (BMI) or very tall patients may preclude one from reaching the spleen adequately. An alternative single access through a subcostal incision loses the aesthetic advantages [3]. In fact, SPAS, first described by Barbaros et al. [4] in 2009, has not caused an important clinical interest, with no more than 32 cases published so far, most of which are anecdotal case reports (Table 1) [4–15].

The reduced port access splenectomy (RPAS) approach represents a hybrid option between the standard LS and SPAS, and it makes it possible to perform the operation using fewer trocars of smaller sizes and taking advantage of the umbilical scar as main entrance, thereby reducing the already minimal parietal trauma and improving the cosmetic result.

Clinical trials comparing standard LS, SPAS, and RPAS approaches are difficult to undertake because elective splenectomy is not a frequent operation in most surgical units [1]. Thus, the aim of this study was to compare the clinical outcomes after LS, SPAS, and RPAS, as well as to analyze the aesthetic result and patient satisfaction after the three types of technical options.

## Materials and methods

### Study design

In this prospective, comparative, and nonrandomized study, we included the patients who underwent splenectomy at the Hospital de la Santa Creu I Sant Pau by conventional laparoscopic, single access port, and reduced port surgery between June 2008 and February 2012, and whose final spleen weight was 500 g or less. The patients were classified into three groups according the surgical procedure performed: group 1, conventional LS ($n = 15$); group 2, SPAS ($n = 8$); and group 3, RPAS ($n = 10$). The patient parameters, retrieved from a prospective database, included the following: age, gender, body mass index, diagnosis, preoperative platelet count, and surgical technique. The outcome parameters analyzed were: operative time, need of additional trocars or conversion to open surgery (and cause), blood loss, blood transfusion, weight of the spleen, postoperative pain as evaluated by the number of analgesic doses required (either nonsteroidal anti-inflammatory drugs or opiates), complications, and duration of hospital stay.

To evaluate the cosmetic result, all the patients were contacted during March 2012 (either by phone or personally in the outpatient clinic) and asked to take the Body Image Questionnaire (BIQ) [16] regarding the cosmesis and body image after the surgery. Body image can be defined as a multidimensional construct that represents how patients think, feel, and behave with regard to their own physical attributes, including their incisional scar. Cosmesis was defined as the degree of explicit satisfaction with the incisional scar. The BIQ has been described previously [17, 18]. In summary, the BIQ consists of eight questions combined to form two scales: a body image scale and a cosmesis scale. Five questions regarding body image assess patient perception of their own body and their satisfaction with that perception, while also evaluating patient attitudes toward bodily appearance. The body image scale ranges from 4 (lowest body image score) to 20 (highest body image score). Three questions regarding the cosmetic result after the operation assess the degree of satisfaction with respect to the physical appearance of the incisional

scar. The combined scores of these three questions resulted in the cosmesis scale ranging from 3 (lowest satisfaction) to 24 (highest satisfaction). This survey had been previously used to evaluate the patient satisfaction after open and laparoscopic surgery for Crohn disease and proctocolectomy (Appendix).

## Surgical technique

Preoperative workup for endoscopic splenectomy has been published elsewhere [1]. All the patients were placed in right lateral decubitus. The techniques used for LS [1] (Fig. 1A) and SPAS [5] (Figs. 2A, 3A, 4A) have been previously described in detail.

For RPAS, the patient is placed in lateral decubitus, and the access to the abdominal cavity is gained with a 12-mm optic bladeless trocar (Excel Endopath; Ethicon Endo-Surgery, Cincinnati, OH) introduced through the umbilicus. We routinely used a 10-mm flexible tip HD scope (Endoeye, Olympus). A subcostal 5-mm trocar is placed under direct vision at the level of the anterior axillary line. Finally, a 3-mm port is inserted at the midepigastric region (Fig. 5A). The sequential steps are essentially the same as with SPAS. With a 5-mm harmonic scalpel (Harmonic Ace, Ethicon Endo-Surgery)

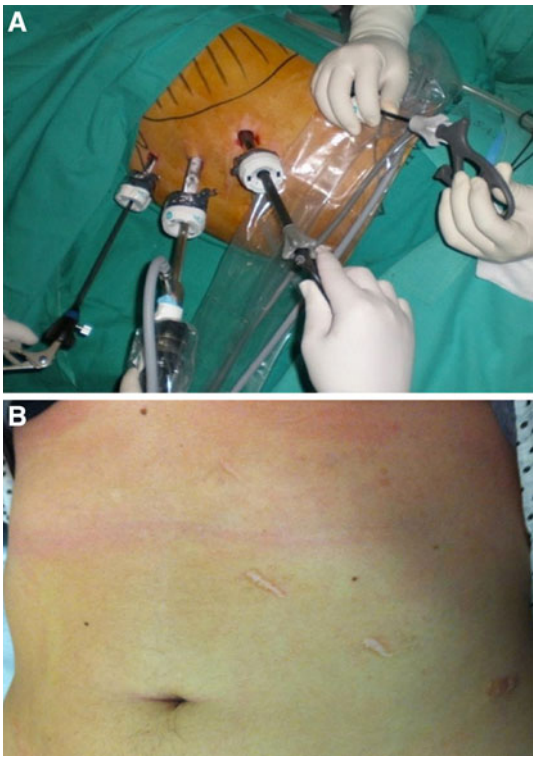


**Fig. 1** **A** Operative view of trocar placement for conventional laparoscopic splenectomy (LS, group 1). **B** Postoperative image of abdominal scars after LS

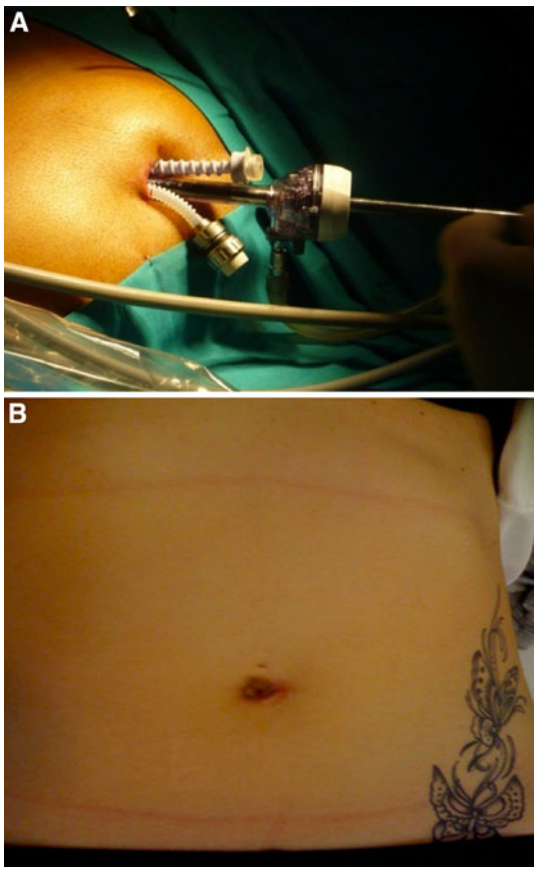


**Fig. 2** **A** Operative view of trocars for single access port splenectomy through the umbilicus (SPAS, group 2). **B** Postoperative image of abdominal scars after SPAS

and 3-mm instruments (Storz, Tuttinglen), access was gained to the lesser sac by dividing the gastrosplenic ligament and short vessels until the upper pole of the spleen. Every attempt was made to ligate the splenic artery at the superior border of the pancreas to allow some shrinkage of the spleen. Next, splenic flexure of the colon was mobilized to get the lower pole of the spleen freed. The table was then tilted to the right to obtain a good exposure of the retrosplenic area, taking advantage of gravity. The posterior splenorenal ligament was then freed. Once the spleen was completely dissected free from all of its attachments, the optic was changed for a 5-mm, 30° scope introduced through the left hypochondrium trocar, and a stapler with a 60-mm white cartridge (Echelon, Ethicon Endo-Surgery) was deployed through the umbilical port, advanced to the splenic fossa, and fired to divide the splenic artery and vein at the level of the hilum (Fig. 5B). A 15-mm endobag (EndoCatch II, Covidien, Mansfield, MA) was used to retrieve the spleen after being morcellated through the umbilical incision. A drain, exteriorized through the lateral 5-mm trocar, was used selectively.

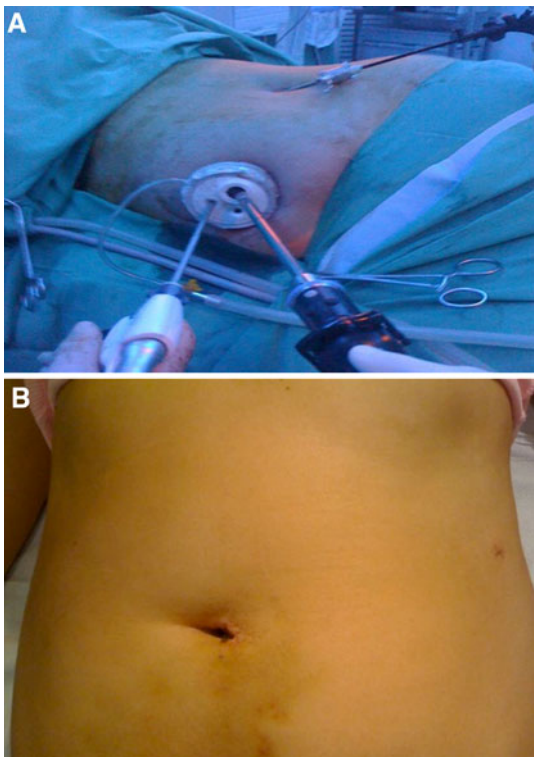


**Fig. 3** **A** Operative view of trocar placement for single access port splenectomy through the umbilical site (SPAS, group 2) and minimal assistance with a 3-mm instrument. **B** Postoperative image of abdominal scars after SPAS

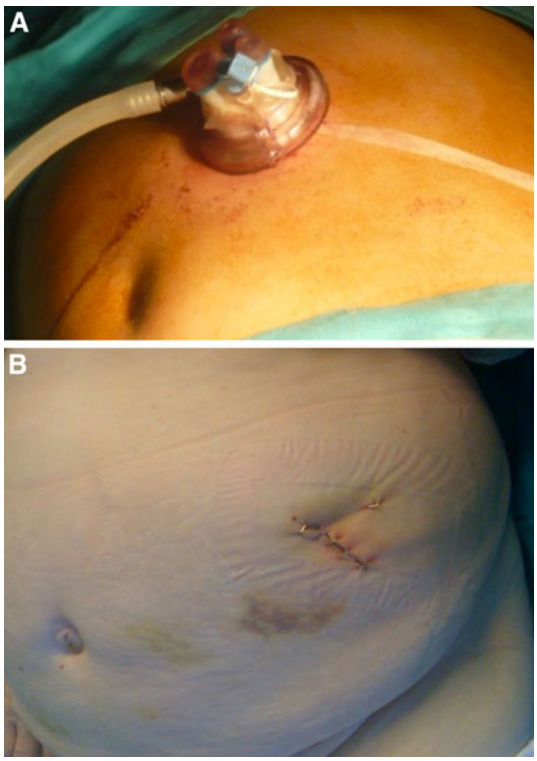


**Fig. 4** **A** Operative view of trocar placement for single access port splenectomy through a subcostal incision (SPAS, group 2). **B** Postoperative image of abdominal scars after SPAS

### Statistical analyses

Data were expressed as mean ± standard deviation. For comparisons of continuous variables (e.g., age, BMI, operation time, duration of hospital stay), the one-way ANOVA test was applied to determine the overall differences between study groups. Student's *t* test or Fisher's exact test were used for every other comparisons, as needed. All calculations were made by SPSS 15.1 for Windows (SPSS Inc., Chicago, IL).

## Results

The groups were comparable in terms of, sex, BMI, diagnosis, and platelet count, although patients in group 3 were significantly younger than those of group 1 (Table 2).

### Intraoperative outcome

Intraoperative outcomes are described in Table 3. Operative time was significantly longer in group 2 compared to groups 1 and 3 (83 ± 19 vs. 131 ± 43 vs. 81 ± 22 min, $p = 0.01$). There was no need to convert to open surgery in any group, neither to conventional laparoscopy in groups 2 and 3.

In group 1, all patients were operated on using four ports (two 12 mm and two 5 mm), and one required an additional 5-mm trocar. In group 2, three patients required additional trocars to complete the operation (two patients required two 5-mm trocars, and one patient required an additional 3-mm trocar). In group 3, one patient required an additional 3-mm trocar, and in another patient with a height of 1.85 m, the endostapler deployed through the umbilicus did not reach the splenic hilum, so the subcostal 5-mm trocar was replaced by a 12-mm trocar.

One patient in group 1 needed repeat laparoscopy to control a bleeding vessel of the greater omentum, and one patient developed a subphrenic fluid collection and pancreatic fistula that solved after percutaneous drainage. In group 2, two patients developed a subphrenic hematoma and hematocrit drop, but none required blood transfusion, and one patient in group 3 also had a drop of hemoglobin level and a subphrenic hematoma without need of transfusion. Only one patient in group 1 required a blood transfusion. Hospital stay was similar in the three groups (Table 3).

Pain medication needs are shown in Table 4. There were no differences between the groups in relation to the type of analgesia (opiates vs. nonsteroidal anti-inflammatory drugs) or postoperative period (first day vs. subsequent days vs. overall).

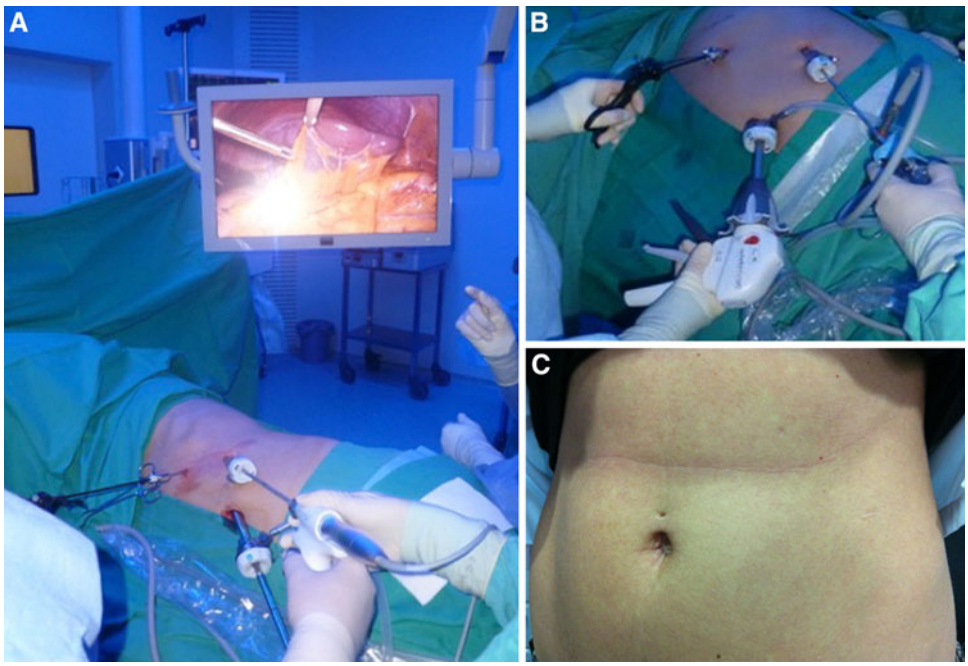


**Fig. 5** **A**, **B** Operative view of trocar placement for reduced port access splenectomy (RPAS, group 3). **C** Postoperative image of abdominal scars after RPAS

The satisfaction survey (Table 5) was taken after a mean follow-up of 17 (range, 2–45) months. Twenty-two of the 33 patients answered the questionnaire. The reasons why the remainder of patients did not answer it were as follows. One patient died during the follow-up period. One had Down syndrome and two had Alzheimer disease. One patient with multiple sclerosis refused to answer the questionnaire because she had no interest in the survey. Two patients could not be contacted; two had undergone previous open abdominal surgery; and two had undergone surgery less than a month ago. Overall, all the patients were highly satisfied with the aesthetic outcome of the three procedures. There was a significant advantage in groups 2 and 3 in the body image index with respect to group 1. There were no differences between groups 2 and 3 ($7.3 \pm 2.8$ vs. $5.8 \pm 1.3$ vs. $5.1 \pm 0.4$, $p < 0.02$) (Fig. 1B, 2B, 3B, 4B, 5C).

**Table 2** Patient demographics

| Characteristic | LS | SPAS | RPAS | $p^a$ |
|---|---|---|---|---|
| *N* | 14 | 8 | 10 | |
| Age (years) | 55 ± 18 | 50 ± 19 | 41 ± 13 | NS |
| Sex (M/F) | 6/8 | 5/3 | 3/6 | NS |
| BMI (kg/m$^2$) | 28 ± 5 | 25 ± 4 | 24 ± 4.5 | NS |
| Platelets (×10$^3$) | 104 ± 123 | 145 ± 96 | 93 ± 72 | NS |
| Diagnosis | | | | |
| ITP | 13 | 3 | 8 | |
| Spherocytosis | | 2 | | |
| AIHA | 1 | | 1 | |
| Malignancy | | 3 | 1 | |

*LS* laparoscopic splenectomy, *SPAS* single port access splenectomy, *RPAS* reduced port access splenectomy, *BMI* body mass index, *ITP* idiopathic thrombocytopenic purpura, *AIHA* autoimmune hemolytic anemia

[a] One-way analysis of variance

**Table 3** Intraoperative outcomes

| Characteristic | LS | SPAS | RPAS | $p^a$ |
|---|---|---|---|---|
| *N* | 14 | 8 | 10 | |
| Operative time (min), mean ± SD | 83 ± 19 | 131 ± 43* | 81 ± 22 | 0.01 |
| Conversion | | | | |
| Open | 0 | 0 | 0 | NS |
| Additional trocar | 0 | 3/8 | 1/10 | NS |
| Morbidity | 2/14 | 2/8 | 1/10 | NS |
| Blood transfusion | 1/14 | 1/8 | 0/10 | NS |
| Stay (days), mean ± SD | 5 ± 3 | 4 ± 2 | 3 ± 2 | NS |
| Spleen weight (g), mean ± SD | 212 ± 127 | 394 ± 153* | 230 ± 87 | 0.02 |

*LS* laparoscopic splenectomy, *SPAS* single port access splenectomy, *RPAS* reduced port access splenectomy

[a] One-way analysis of variance

* Statistically significant at $p < 0.05$

## Discussion

LS has become the preferred surgical approach in cases of normal or slightly enlarged spleens [1]. This procedure has been shown to be safe and reproducible, and it offers better outcomes than open surgery. There are no randomized

**Table 4** Analgesic requirements

| Characteristic[a] | LS | SPAS | RPAS | $p$[b] |
|---|---|---|---|---|
| *N* | 16 | 6 | 7 | |
| First 24 h | 8 ± 2 | 6 ± 3 | 7 ± 3.4 | NS |
| NSAIDs | 4 ± 2 | 3 ± 2 | 5 ± 1.6 | NS |
| Opiates | 3 ± 2 | 3 ± 2 | 2 ± 2 | NS |
| 24 h and beyond | 14 ± 11 | 19 ± 10 | 10 ± 6 | NS |
| NSAIDs | 13 ± 11 | 17 ± 12 | 9 ± 4.5 | NS |
| Opiates | 1 ± 1 | 2 ± 2 | 1 ± 2 | NS |
| Total | 19 ± 12 | 22 ± 11 | 17 ± 6 | NS |

*LS* laparoscopic splenectomy, *SPAS* single port access splenectomy, *RPAS* reduced port access splenectomy, *NSAID* nonsteroidal anti-inflammatory drug. Data are presented as mean ± SD

[a] NSAIDs included acetaminophen, dexketoprofen, metamizole, and diclofenac; opiates included morphine, tramadol hydrochloride, and methadone

[b] One-way analysis of variance

**Table 5** Aesthetic survey answers

| Assessment | LS ($n = 10$) | SPAS ($n = 5$) | RPAS ($n = 6$) | $p$ |
|---|---|---|---|---|
| Question | | | | |
| 1. Body image satisfaction? (>1 <4) | 1.6 ± 0.8 | 1.6 ± 1.3 | 1 ± 0* | 0.03 |
| 2. Body image damage? (>1 < 4) | 1.7 ± 0.7 | 1.2 ± 0.4 | 1.2 ± 0.4* | 0.02 |
| 3. Less attractive? (>1 < 4) | 1.5 ± 0.7 | 1 ± 0 | 1 ± 0* | 0.03 |
| 4. Less masculine/ feminine? (>1 < 4) | 1.1 ± 0.3 | 1 ± 0* | 1 ± 0* | NS |
| 5. Uncomfortable when naked? (>1 < 4) | 1.4 ± 0.7 | 1 ± 0 | 1 ± 0 | NS |
| Body Image Index | 7.3 ± 2.8 | 5.8 ± 1.3* | 5.1 ± 0.4* | 0.02 |
| 6. Wound satisfaction (1–7) | 5.6 ± 1.6 | 5 ± 2.3* | 5.5 ± 2.3* | 0.05 |
| 7. Wound appearance (1–7) | 5.7 ± 1.4 | 5 ± 0.6 | 4.8 ± 1.2 | NS |
| 8. Wound rate (1–10) | 8 ± 1.8 | 7.2 ± 2.1 | 8 ± 1.6 | NS |
| Cosmesis Index | 20 ± 4 | 17 ± 4.5 | 18 ± 4 | NS |

*LS* laparoscopic splenectomy, *SPAS* single port access splenectomy, *RPAS* reduced port access splenectomy

* Student's $t$ test; statistically significant at $< 0.05$

trials comparing both procedures, thanks to the overwhelming evidence of the advantages of LS. However, the spleen is a fragile and bulky organ, and advanced laparoscopic skills should be mastered to produce optimal outcomes [18]. The general dissemination of LS around the world is not known, but a study performed in 2009 showed that only 20 % of spleens amenable to laparoscopic surgery were approached via this method in the United States [19].

During the last few years, and after the dissemination of the concept of natural orifice transluminal endoscopic surgery, a trend to reduce the access trauma by minimizing the abdominal wall injury in laparoscopic surgery has emerged, and after anecdotal approaches through techniques assisted by natural orifice transluminal endoscopic surgery [20], the spleen has also been approached by SPAS, showing it to be a feasible and reproducible technique. However, there has not been great success, and published cases so far do not reach more than 32, with most of them being case reports (Table 1).

When analyzing our initial experience in a series of eight cases [5], we found that SPAS takes longer and include a number of controversies, as follows. First, ought the device for SPAS be placed subcostally or umbilically? The subcostal placement facilitates the performance but obviously reduces the potential aesthetic advantages (Fig. 3). In the case of a purely umbilical approach, the aesthetic result is maintained, but the difficulty increases to the point of becoming nearly impossible in the case of obese or very tall patients. Second, several published series noted the need for some type of additional instrument to hold or expose surgical areas during SPAS. Tugs [10], strings [6, 14], or merely additional mini-instruments [5] have been used (Fig. 4). Finally, in some cases, a drain is needed, and a left subcostal incision for drain placement may be required. All these factors and the current availability of dedicated instrumentation (deflectable scope) encouraged us to design a hybrid reduced port approach that could overcome some of the drawbacks of SPAS while maintaining the clinical and aesthetic advantages of an even less invasive minimal approach. To evaluate our hypothesis, we devised this study, the results of which permit us to conclude that RPAS is an easier and more efficacious alternative than SPAS to conventional LS when the goal is to reduce the invasiveness of the approach and to preserve the abdominal wall integrity, maintaining its aesthetic advantages.

Splenectomy is an infrequent operation in the average hospital, and this feature precludes the performance of statistically powered randomized trials. We performed this study comparing a consecutive series of LS, SPAS, and RPAS for these reasons. Obviously, the characteristics of this study entail some bias (nonrandomized study, consecutive patient selection, no uniform postoperative pain protocol, development of the technique), but the homogeneity of the patients population (spleen size $< 500$ g, BMI, single-center experience) allow us to compare those groups.

Our results clearly show that RPAS is a good alternative to LS and SPAS. RPAS had operative times that were comparable to that of LS and significantly shorter than SPAS. No patients were converted to open surgery in any

group, but three patients required additional trocars to finish the SPAS. Blood loss and morbidity was similar in the three groups, as well as the clinical outcomes in terms of complications, reoperation, and duration of stay.

When analyzing the outcome after SPAS or RPAS, one of the main advantages in comparison to LS should be better postoperative comfort and aesthetic results. Pain differences between conventional laparoscopy and SPAS are a matter of controversy, observing contradictory results in the literature [21, 22]. In our study, we found no differences in relation to pain medication between the three groups. However, the nonrandomized nature of the study without a defined protocol to evaluate postoperative pain precludes establishing definitive conclusions.

Other aspects considered to be important after RPAS are the aesthetic results and the possible avoidance of abdominal wall hernias, observed when large-bore trocars are placed in the abdominal wall. It is noteworthy that after the analysis of the aesthetic survey, all three technical options were followed by a high degree of patient satisfaction—a finding that makes it difficult to compare these techniques from the aesthetic point of view. However, both SPAS and RPAS showed a significant improvement in the body image index in relation to LS. This analysis has some bias: the number of patients included is small, patients were assessed at different times after surgery, and male and female patients of different ages were included. However, the overall results allow us to definitely conclude that the reduction of wound sizes has a small but positive impact on the perception of scars.

The evolution of minimally invasive surgery in the ongoing quest for surgery with very little scarring has resulted in complex procedures that require sophisticated tools. However, this philosophy may preclude the widespread acceptance of these techniques. RPAS permits maintenance of the basic surgical features (triangulation) with similar clinical outcomes and better preservation of the abdominal wall. An additional issue is the cost. The technical option that we propose here can be performed without increasing the overall expenditure, but obviously it is best performed with the aid of more sophisticated surgical tools (e.g., deflectable scope).

According to the beliefs of Curcillo et al. [2], SPAS is not a "closed" concept. The technique that we have shown may be facilitated with a SPAS device placed at the umbilicus and adding other instrumentations through the umbilicus as needed, according to the needs and experience of the surgeon.

**Disclosures** Drs. Julio Lopez, Eduardo Targarona, Pablo Vidal, Yerald Peraza, Francisco Garcia, Carlos Rodriguez, Luis Pallares, Carmen Balague and Manuel Trias have no conflicts of interest or financial ties to disclose.

## Appendix

Satisfaction survey and aesthetic outcome after laparoscopic splenectomy

1. Are you less satisfied with your body since the operation?
   Range
   1 = no, not at all
   2 = a little bit
   3 = quite a bit
   4 = yes, extremely
2. Do you think the operation has damaged your body?
   Range
   1 = no, not at all
   2 = a little bit
   3 = quite a bit
   4 = yes, extremely
3. Do you feel less attractive as a result of your disease or treatment?
   Range
   1 = no, not at all
   2 = a little bit
   3 = quite a bit
   4 = yes, extremely
4. Do you feel less feminine/masculine as a result of your disease or treatment?
   Range
   1 = no, not at all
   2 = a little bit
   3 = quite a bit
   4 = yes, extremely
5. Is it difficult to look at yourself naked?
   Range
   1 = no, not at all
   2 = a little bit
   3 = quite a bit
   4 = yes, extremely
6. On a scale from 1 to 7, how satisfied are you with your (incisional) scar?

| Very unsatisfied | | Not unsatisfied/not satisfied | | | | Very satisfied |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

7. On a scale from 1 to 7, how would you describe your (incisional) scar?

| Revolting | | Not revolting/not beautiful | | | | Beautiful |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

8. Could you score your own incisional scar on a scale from 1 to 10?

## References

1. Park A, Targarona EM, Trías M (2001) Laparoscopic surgery of the spleen: state of the art. Langenbecks Arch Surg 386:230–239
2. Curcillo PG 2nd, Podolsky ER, King SA (2011) The road to reduced port surgery: from single big incisions to single small incisions, and beyond. World J Surg 35:1526–1531

3. Targarona E, Lima M, Balague C, Trias M (2011) Single-port splenectomy: current update and controversies. J Minim Access Surg 7:61–64
4. Barbaros U, Dinççağ A (2009) Single incision laparoscopic splenectomy: the first two cases. J Gastrointest Surg 13: 1520–1523
5. Targarona EM, Pallares JL, Balague C, Luppi CR, Marinello F, Hernández P, Martínez C, Trias M (2010) Single incision approach for splenic diseases: a preliminary report on a series of 8 cases. Surg Endosc 24:2236–2240
6. Vatansev C, Ece I Jr (2009) Single incision laparoscopic splenectomy with double port. Surg Laparosc Endosc Percutan Tech 19:e225–e227
7. Malladi P, Hungness E, Nagle A (2009) Single access laparoscopic splenectomy: case report. JSLS 13:601–604
8. Hong TH, Lee SK, You YK, Kim JG (2010) Single-port laparoscopic partial splenectomy: a case report. Surg Laparosc Endosc Percutan Tech 20:e164–e166
9. Rottman SJ, Podolsky ER, Kim E, Kern J, Curcillo PG 2nd (2010) Single port access (SPA) splenectomy. JSLS 14:48–52
10. Misawa T, Sakamoto T, Ito R, Shiba H, Gocho T, Wakiyama S, Ishida Y, Yanaga K (2011) Single-incision laparoscopic splenectomy using the "tug-exposure technique" in adults: results of ten initial cases. Surg Endosc 25:3222–3227
11. Colon M, Telem D, Chan E, Midula P, Divino C, Chin E (2011) Laparoendoscopic single site (LESS) splenectomy with a conventional laparoscope and instruments. JSLS 15:384–386
12. Oyama K, Sasaki A, Chiba T, Nitta H, Otsuka K, Wakabayashi G (2011) Single-incision laparoscopic splenectomy for idiopathic thrombocytopenic purpura: report of a case. Surg Today 41: 1091–1094
13. Taher R, Tawfeeq M (2011) Single-port laparoscopic splenectomy for idiopathic thrombocytopenic purpura. Ann Saudi Med 31:655–656
14. Srikanth G, Wasim M, Sajjad A, Shetty N (2011) Single incision laparoscopic splenectomy with innovative gastric traction suture. J Minim Access Surg 7:68–70
15. Jing K, Shuo-Dong W, Ying F (in press) Transumbilical single-incision laparoscopy surgery splenectomy plus pericaudial devascularization in one case with portal hypertension: the first report. Surg Innov
16. Dunker MS, Stiggelbout AM, van Hogezand RA, Ringers J, Griffioen G, Bemelman WA (1998) Cosmesis and body image after laparoscopic-assisted and open ileocolic resection for Crohn's disease. Surg Endosc 12:1334–1340
17. Polle SW, Dunker MS, Slors JF, Sprangers MA, Cuesta MA, Gouma DJ, Bemelman WA (2007) Body image, cosmesis, quality of life, and functional outcome of hand-assisted laparoscopic versus open restorative proctocolectomy: long-term results of a randomized trial. Surg Endosc 21:1301–1307
18. Fraser SA, Bergman S, Garzon J (2012) Laparoscopic splenectomy: learning curve comparison between benign and malignant disease. Surg Innov 19(1):27–32
19. Singla A, Li Y, Ng SC, Csikesz NG, Tseng JF, Shah SA (2009) Is the growth in laparoscopic surgery reproducible with more complex procedures? Surgery 146:367–374
20. Targarona EM, Gomez C, Rovira R, Pernas JC, Balague C, Guarner-Argente C, Sainz S, Trias M (2009) NOTES-assisted transvaginal splenectomy: the next step in the minimally invasive approach to the spleen. Surg Innov 16(3):218–222
21. Ma J, Cassera MA, Spaun GO, Hammill CW, Hansen PD, Aliabadi-Wahle S (2011) Randomized controlled trial comparing single-port laparoscopic cholecystectomy and four-port laparoscopic cholecystectomy. Ann Surg 254:22–27
22. St Peter SD, Adibe OO, Juang D, Sharp SW, Garey CL, Laituri CA, Murphy JP et al (2011) Single incision versus standard 3-port laparoscopic appendectomy: a prospective randomized trial. Ann Surg 254:586–590