

## Population perception of surgical safety and body image trauma: a plea for scarless surgery?

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### Abstract

**Background** Laparoendoscopic single-site surgery (LESS) and natural orifice transluminal endoscopic surgery (NOTES) are prospected as the future of minimally invasive surgery. While scarless surgery (NOTES and LESS) is gaining increasing popularity, perception of these approaches should be investigated.

**Methods** An anonymous questionnaire describing laparoscopy, LESS, and NOTES was given to medical staff ( $n = 120$ ), paramedical staff ( $n = 100$ ), surgical patients ( $n = 100$ ), and the general population ( $n = 100$ ). The survey participants (median age, 37 years; range, 18–81 years) were queried about their expectations for surgical treatment and their approach preference.

**Results** The first concern of the survey responders was the risk of surgical complications (92%). When asked about the respective importance of surgical safety, cure, and cosmetics, cure was placed first by 74%, safety by 33%, and cosmetics by 3%. These results were not influenced by sex, age, prior surgery or endoscopy, or education. When operative risk was similar, 90% of the participants preferred a scarless approach (75% preferred LESS and 15% preferred NOTES) to laparoscopy. The scarless approach preference was significantly higher among the younger participants (age <40 years;  $p = 0.026$ ), whereas sex showed no influence. The LESS preference was significantly higher among patients and the general population (86%) than among medical (67%) and paramedical (70%) staffs ( $p < 0.001$ ). A

decreasing trend of preference for LESS and NOTES was observed with increased procedural risks.

**Conclusion** Although cure and safety remain the main concern, the population has a favorable perception of scarless surgery, even in the case of increased procedural risk, with LESS favored over NOTES. Such a popular adoption of scarless surgery should warrant the promotion of further research, technological innovations, and the establishment of surgeon training to improve its safety.

**Keywords** Laparoendoscopic single-site surgery · Laparoscopy · LESS · Natural orifice transluminal endoscopic surgery · NOTES · Scarless surgery · SILS · Single-incision laparoscopic surgery · Single-port access · SPA

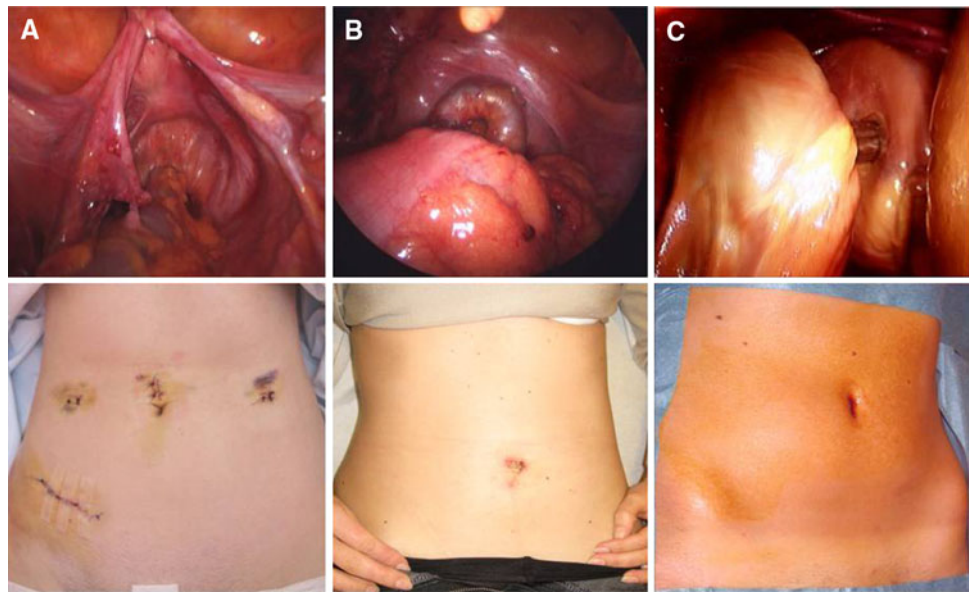
As innovation continues to push 21st-century clinical surgery forward, one of the emerging clinical concepts is laparoendoscopic single-site surgery (LESS) followed by natural orifice transluminal endoscopic surgery (NOTES) [1, 2]. Minimally invasive surgery (MIS) revolutionized the surgical world 20 years ago and changed the approach of surgical procedures forever [3, 4]. Currently, MIS procedures are the standard of care for many operations such as laparoscopic appendectomy and cholecystectomy, and surgeons continue to develop advanced applications for endoscopy [5].

As an evolution of laparoscopy, LESS reduces the number of transparietal accesses to one, the umbilicus, whereas NOTES may constitute the threshold of another such revolution changing transparietal to natural orifice transluminal access via the stomach, rectum, colon, vagina, or bladder [1]. Theoretically, LESS offers the possibility of less invasive surgery than laparoscopy, with

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**Fig. 1** Surgical characteristics and cosmetic results of laparoscopic and scarless sigmoidectomy, with an intraoperative view of colorectal anastomosis performance during sigmoidectomy and cosmetic results according to approach. **A** Laparoscopy [26]. **B** Laparoendoscopic single-site access (LESS) [6]. **C** Natural orifice transluminal endoscopic surgery (NOTES) [9] These views were not presented in the survey questionnaire



NOTES decreasing invasiveness even further. The postulated benefits are better cosmesis, less pain, shorter recovery, lower impact on quality of life, and less immunosuppression (Fig. 1). Whereas NOTES still is embryonic, transumbilical LESS has made its initial forays into clinical MIS [6].

As with laparoscopic surgery, the advancement of MIS is largely a patient-driven process. Patients are interested in MIS procedures, and this probably will not change in our society, which places increasing importance on cosmesis [2, 7–9].

A “wildcard” in the proposed development of MIS is the reaction of the popular media and the public to the concepts of LESS and NOTES [2, 10]. In relatively recent history, the rapid introduction and spread of laparoscopic cholecystectomy has been driven largely by public demand [4]. Therefore, with the prospect that clinical LESS and later NOTES introductions will increase in the near future, we need a better answer to the question of whether the public will adopt these new technologies and start demanding them as an alternative to current approaches.

This question is a critical one for several reasons. Specific medical societies need to project the adoption rates for LESS and NOTES so they can proactively design clinical trials and educational models. Surgeons need to know how soon, if ever, they will need to learn and apply these approaches. Engineers and industry need to know how much of their resources to direct toward research and development [11]. Finally, all medical actors need to know and understand further the preferences, worries, and demands of their patients.

If LESS or NOTES appears to be a desirable alternative to common surgical approaches, surgeons will need to

learn and adopt these techniques early. To understand better the impact that public opinion might have on LESS and NOTES, we performed an opinion survey of medical and paramedical staffs, patients, and the general population to assess attitudes toward these new approaches.

## Methods

### Survey development and structure

The survey was developed by the investigators (P.B., F.P., S.O.). The questionnaire items included age, sex, educational status, profession, experience of prior surgery or endoscopy, and patient preference for the technique of visceral surgery (laparoscopy, LESS, or NOTES). No pictures were presented in the survey questionnaire. The questionnaire also included questions about expectations for surgical treatment. The surveyed persons who preferred LESS or NOTES were questioned about the reasons for their preference.

### Survey population

This study was a 12-week cross-sectional survey of the visceral operation technique preferred by medical staff, paramedical staff, patients, and the general population directly contacted by the investigators. The medical staff responders were university surgeons, internists, and anesthesiologists. The paramedical staff responders consisted of nurses, scrub nurses, and paramedics from a university hospital.

The patients were collected in the visceral surgery unit, whereas the general population persons surveyed were

approached through street interview. The study excluded patients and population requiring emergency surgery, those younger than 16 years, and those unable to read and complete the questionnaire.

### Survey information

Information on the concept of laparoscopy, LESS, and NOTES was provided to all the people surveyed. The information on laparoscopy was adapted from the Society of American Gastrointestinal Endoscopic Surgeons (SAGES) booklet on laparoscopic cholecystectomy and included the risks and benefits of laparoscopy. The possible access used for LESS was the umbilicus, and the possible orifices used for NOTES were the stomach, the rectum, and the vagina. It was stated clearly that LESS and NOTES still were under evaluation and that procedural risks were not clearly quantified. The major potential advantages of NOTES were a lack of external scarring and parietal pain, whereas LESS offered the advantages of an invisible external scar and less parietal pain (Fig. 1).

### Survey procedure

Participation in the study was voluntary, and no reward was offered for participation. A physician (P.B., S.O., or F.R.) offered the survey participants the opportunity to complete an anonymous 11-question survey in French. The participants were allowed to complete the questionnaire at the time of distribution or to return it later.

### Survey sample size

To calculate sample size, we assumed that two-thirds (66%) of the sample would prefer the scarless approach, based on a recent study [12]. To determine whether this proportion was significantly different from the 50% distribution, a sample

size of 75 per group with an alpha of 0.05 (two-tailed) and a power of 80% was required.

### Survey statistics

Categorical variables were reported as frequencies and percentages and compared using the chi-square or analysis of variance (ANOVA) test. Adjusted odds ratios were calculated by multiple logistic regression methods whereby analysis in a multivariate setting estimated the effect of each factor after adjustment for the contribution of each of the other factors. Clinically significant variables were included in the logistic model. The reported *p* values are two-tailed. By recognizing the issue of multiple testing of outcome data arising from individual patient respondents and the possibility of multifactor interaction effects, the *p* values of the multiple logistic regression analysis were taken as definitive. All *p* values less than 0.05 were considered clinically significant. The analysis was conducted using GraphPad InStat, version 3.0 (GraphPad InStat, San Diego, CA, USA) and SAS statistical software, version 9.1 (SAS Institute Inc, Cary, NC, USA).

## Results

### Survey respondents

Surveys were collected from 420 participants including medical staffs (*n* = 120), paramedical staffs (*n* = 100), patients (*n* = 100), and the general population (*n* = 100). The demographics of the responders are presented in Table 1. Significant differences in educational level between medical staff and other groups and in sex ratio between paramedical staff and other groups were observed (*p* < 0.05).

**Table 1** Survey population demographics

Characteristic	Medical staff	Paramedical staff	Patients	General population	Total
<i>n</i>	120	100	100	100	420
Median age: years (range)	37 (27–65)	36 (23–58)	42 (18–81)	38 (18–68)	37 (18–81)
Sex (%)					
Male	56	29	51	53	51
Female	44	71	49	47	49
Education (%)					
University	100	37	43	55	61
High school		56	46	33	32
Secondary school		7	11	12	7
Prior abdominal surgery (%)	20	39	38	30	31
Prior endoscopy (%)	17	23	29	17	23

### Perception of surgical safety and cosmesis

The most important concern regarding surgical therapy was the fear of surgical complication, with 92% placing it first (Table 2). Postoperative scar was the first concern for only 2% of the responders. This was not influenced by age, sex, medical history, education, or profession. Confirmation for the fear of operative risk is found in patient and general population groups, who would choose larger incisions (93%) with lower operative risk (91%). Interestingly, medical and paramedical staffs would choose this approach at significantly lower rates of 83% and 80%, respectively ( $p = 0.012$ ). This had no relation to age, sex, education, or medical history among any of the responders. Surgical cure, safety, and scar issues were placed in the following order of expectation from surgical treatment for 62% of the responders. Whereas 33% placed these priorities in the order of safety, cure, and scar, only 1% placed scar as a first choice. This order was not influenced by any factors.

### Perception of laparoscopy, LESS, and NOTES

When responding to the question of a hypothetical visceral surgery with the same risk for different techniques, 75% of the responders would opt for a LESS approach, whereas 15% preferred NOTES and 9% preferred laparoscopy (Table 3). Patients and the general population even opted for LESS at significantly higher rates (respectively 83% and 89%) than medical and paramedical staff (respectively 67% and 70%) ( $p = 0.001$ ). Medical and paramedical staffs had higher rates for acceptance of the NOTES approach (respectively 25% and 20%) than patients and the general population (5%) ( $p = 0.001$ ).

The same trend of choice for the umbilicus as access into the peritoneal cavity was observed, with 95% of the patients and the general population indicating this as their first choice in contrast to only 75% of medical and paramedical staffs ( $p = 0.002$ ). Increase in the operative risk rates for LESS and NOTES were directly associated with a shift in the choice of the technique for laparoscopy (62%) (Fig. 2). However, 38% of the responders still chose a higher-risk scarless approach rather than laparoscopy (Table 3).

### Factors related to adoption of scarless surgery

The most frequent reasons reported for the choice of a scarless technique (LESS or NOTES) when the risk rate was the same as for laparoscopy were better cosmetic results (82%), reduced postoperative pain (66%), and interest in new technologies (28%).

### Discussion

The current survey results show that the vast majority of potential patients favor transumbilical laparoendoscopic single-site surgery (LESS) for a visceral operation provided the risk increase is nonsignificant compared with conventional laparoscopy or NOTES. The frequent adoption of this scarless surgery approach may result from the place of cosmesis in our society as well as from the importance of body image and surgical safety.

Medical scientists and clinicians often do not consider the impact of public opinion on their practice [10, 11]. Certainly, changes in clinical practice are conceived on the basis of scientific or technologic advances evaluated scientifically. In spite of this, outside forces including

**Table 2** General consideration of the survey population for surgical treatment

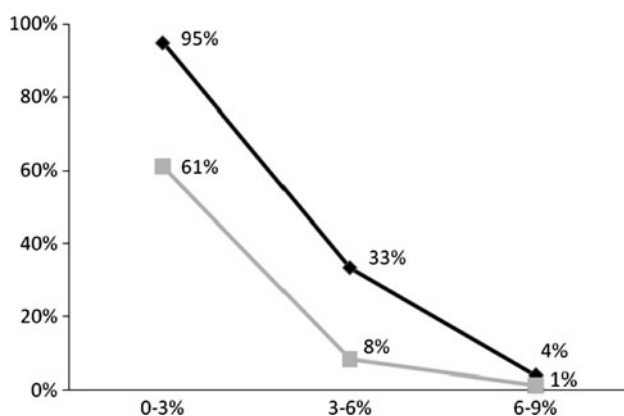
Items	Medical staff (%)	Paramedical staff (%)	Patients (%)	General population (%)	Total (%)
Most feared before surgery					
Scar	3	3	1	1	2
Postoperative pain	0	16	4	3	6
Complications	97	81	95	96	92
Surgical risk versus scar					
Smaller scar but higher risk	16	16	5	4	11
Larger scar but lower risk	83	80	93	91	86
Do not know	1	4	2	5	3
Importance order of surgical treatment characteristics (decreasing order)					
Security, cure, scar	32	44	32	20	33
Cure, security, scar	65	50	61	77	62
Scar, security, cure	0	2	0	1	1
Cure, scar, security	3	4	7	3	4

**Table 3** Perception of scarless surgery by the survey population

Items	Medical staff (%)	Paramedical staff (%)	Patients (%)	General population (%)	Total (%)
Choice when risk for each technique is the same					
Standard laparoscopy	7	10	12	7	9
Transumbilical LESS	68	70	83	89	75
NOTES	25	20	5	4	15
Choice when estimated risk for each technique is as follows <sup>a</sup>					
Standard laparoscopy (0–3%)	65	60	55	67	62
Transumbilical LESS (2–5%)	34	38	45	33	37
NOTES (5–9%)	1	2	0	0	1
Reason to choose scarless approach <sup>b</sup>					
Reduced scar	85	80	83	78	82
Decrease postoperative pain	75	58	66	66	66
New technologies	5	8	28	8	11
Other	0	4	0	9	3

<sup>a</sup> The operative risk for each technique was estimated according to the recent literature and recent meeting report regarding clinical cases of single-port access (LESS) and natural orifice transluminal endoscopic surgery (NOTES)

<sup>b</sup> Multiple response allowed in the questionnaire (total may be >100%)



**Fig. 2** Survey population preference trends for single-port access (LESS) (black line) and natural orifice transluminal surgery (NOTES) (gray line), with varying complication rates for these techniques. The complication rate for laparoscopy was reported as 0% to 3%

economics, interspecialty politics, industry marketing, and public demand can have a tremendous impact on the adoption of new procedures [10].

A recent illustration showing the effect of public demand on surgical practice should be viewed with interest as new scarless surgical approaches develop. Laparoscopic cholecystectomy, a totally new approach and technique for gallbladder surgery 20 years ago, was introduced by a small number of pioneers [4, 13]. A minority of surgeons enthusiastically embraced the concept, whereas the vast majority, including experts, did not. Early studies seemed to show that laparoscopic cholecystectomy resulted in little patient benefit besides cosmesis, increased cost to society, and had some potential for patient harm due to higher operative risk [11, 14,

15]. Despite this, the vast majority of cholecystectomies currently are performed through laparoscopy [16]. However, patient demand and industry, at least in part, has driven the advance of laparoscopy to this day.

The authors recognize several limitations of this study. The sample size was limited, and the survey was not evaluated for validity or reliability. Because this is a very rapidly progressing field and the time required to validate a questionnaire would be excessive for the purpose of this study [2], it should be noted that the results of this survey provide only a rough overview of a distinct geographic area and have several limitations with regard to the extent of explanation for participants, participant understanding of the procedures, and the meaning of risk increase.

A major strength of this study, however, was its heterogeneous population. Moreover, importantly, this study is the first to investigate population feeling about transumbilical LESS.

The results of this survey illustrate that security of surgical procedure remains the first concern among potential patients [17]. However, the importance of cosmesis in our society should not be neglected, as reflected in this survey [7, 8]. The non-negligible part of the population studied who prefer a scarless surgical approach, even with increased surgical risk, illustrate this fact [9, 18]. This accords with the increase in plastic and cosmetic procedures performed each year in the Western world [7, 8].

The results of the current survey show some indication that LESS may fall more in line with the laparoscopic cholecystectomy adoption scenario [11]. Of the population surveyed, 75% preferred that visceral surgery be performed via LESS provided there is no significant risk increase

despite the recent introduction of LESS in clinical practice. Interestingly, only 15% preferred a NOTES approach, which may contradict previously reported surveys [11, 17, 19–21]. In fact, all these surveys have offered NOTES as the sole scarless option to laparoscopy, and population acceptance of LESS was never investigated. The favorable adoption of scarless surgery (LESS and NOTES) was positively influenced by younger age but not by sex, medical history, educational degree, or profession.

What is the reason why the public favors LESS over NOTES? One reason may be the newness of NOTES. However, LESS should be viewed in this regard without any difference in age compared with NOTES, at least in the media [22]. Another reason may be the choice of route to the abdominal cavity. Whereas LESS procedures use the umbilicus, NOTES access is through the vagina, stomach, or rectum [1, 23]. According to the current results, the general population seems largely to favor the umbilicus as a sole access, thus promoting LESS in favor of NOTES. These results are in accordance with previous results reported recently regarding transvaginal access [19, 24, 25].

An important point should be raised. More than 40% of the responders adopted scarless approaches (LESS and NOTES) with significant risk increase compared with laparoscopy. This should strengthen surgeons in conforming to the principle of avoiding harm and should warrant their pursuit of safety improvement in these approaches before diffusing them [11].

Finally, we stress that we do not regard cosmetic aspects as more important than safety in surgery. However, despite the limitations of these data, we believe that even in the absence of other advantages offered by LESS and NOTES, population desire for scarless surgery is an important rationale for further research and investment in these fields by industries and the development of these approaches by concerned health care providers.

## Conclusion

Although cure and surgical safety remain the main concern, the general population has a favorable perception of scarless surgery. The majority of potential patients would prefer the transumbilical LESS approach for visceral surgery as long as the inherent procedure risks are not significantly increased. This should encourage surgeons to improve LESS approach safety, and industries should continue their development efforts because a rapid public demand may soon arise.

**Disclosures** Pascal Bucher, François Pugin, Sandrine Ostermann, Frederic Ris, Michael Chilcott, and Philippe Morel have no conflicts of interest or financial ties to disclose.

## Appendix

### Etude image corporelle et chirurgie



#### **Patient(e) interrogé(e):**

Sexe :	Femme	Homme	Age :.....	
Formation :	Ecole obligatoire		Collège	Université
Profession :	Médicale		Paramédicale	Autre
Déjà été opéré du ventre :	oui		non	
Déjà eu une gastroscopie ou coloscopie :			oui	non

#### **QUESTIONNAIRE :**

1. **Pour une intervention abdominale, si une petite cicatrice implique des risques opératoires plus grands, choisiriez-vous cette approche à une plus grande cicatrice mais avec moins de risques opératoires.**

- Plus petite cicatrice mais plus de risques.  
 Plus grande cicatrice mais moins de risques.  
 Sans importance ou ne sais pas.

2. **Pour une intervention abdominale, que craignez-vous le plus ?**

- Les cicatrices.  
 Les douleurs post-opératoires.  
 Les complications.

3. Pour une opération abdominale pouvant être réalisée par laparotomie ou par laparoscopie, quelle technique choisiriez-vous si les risques opératoires sont les mêmes par laparoscopie (« petit trou ») ou par laparotomie (voie ouverte).

- Laparotomie.
- Laparoscopie.
- Ne sais pas, demanderais l'avis de son médecin traitant ou du chirurgien.

• Quelle technique choisiriez-vous si les risques opératoires étaient plus grands par laparoscopie (« petit trou ») que par laparotomie (voie ouverte)

- Laparotomie.
- Laparoscopie.
- Ne sais pas, demanderais l'avis de son médecin traitant ou du chirurgien.

4. Classez selon l'ordre d'importance les différents points suivants concernant une intervention chirurgicale abdominale : Sécurité de la chirurgie (pas de complication), être soigné (guérit), aspect des cicatrices. Choisissez une des propositions suivantes (du plus important au moins important).

- Sécurité de la chirurgie (pas de complication), être soigné (guérit), aspect des cicatrices.
- Etre soigné (guérit), Sécurité de la chirurgie (pas de complication), aspect des cicatrices.
- Aspect des cicatrices Sécurité de la chirurgie (pas de complication), être soigné (guérit).
- Etre soigné (guérit), aspect des cicatrices, Sécurité de la chirurgie (pas de complication).

Suite au dos...

5. Différentes approches chirurgicales existent ou se développent pour réaliser les mêmes opérations :

**Laparoscopie :** technique des « petits trous » avec plusieurs petites cicatrices réparties sur le ventre, dont une dans le nombril.

**Single Port Access :** un seul « petit trou » au niveau du nombril, similaire à une laparoscopie par un abord unique, cicatrice très discrète presque invisible.

**NOTES :** Chirurgie par voie naturelle : bouche, anus, ou vagin chez la femme, avec perforation d'un organe (estomac, intestin ou vagin) pour atteindre la cavité abdominale, sans cicatrice cutanée.

Quelle techniques choisiriez-vous si les risques étaient les mêmes entre ces techniques (entourez votre réponse) :

Laparoscopie	Single Port Access	NOTES
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• Si vous avez choisi le NOTES ou le Single Port Access, pourquoi ?

- Absence de cicatrice visible
- Moins de douleur éventuelle
- Techniques nouvelles
- Autre : .....

6. Si les risques du Single port access et du NOTES étaient un peu plus élevés que la laparoscopie, choisiriez-vous une de ces techniques ?

- Oui le NOTES
- Oui le Single Port Access
- Non je choisirais la laparoscopie

7. Si les risques de complications sont environ de 0 à 3% pour une opération par laparoscopie, pour quel risque choisiriez-vous une intervention par Single Port Access (un seul petit trou au lieu de plusieurs) :

- Si risque Single port access 0-3% :      choisit single port – choisit laparoscopie
- Si risque Single port access 3-6% :      choisit single port – choisit laparoscopie
- Si risque Single port access 6-9% :      choisit single port – choisit laparoscopie

Si les risques de complications sont environ de 0 à 3% pour une opération par laparoscopie, pour quel risque choisiriez-vous une intervention par NOTES (pas de cicatrice au ventre au lieu de plusieurs petits trous) :

- Si risque NOTES 0-3% :      choisit NOTES – choisit laparoscopie
- Si risque NOTES 3-6% :      choisit NOTES – choisit laparoscopie
- Si risque NOTES 6-9% :      choisit NOTES – choisit laparoscopie

**8. Avec les données scientifiques actuellement connue, les risques de la laparoscopie sont de 0-3%, ceux du single port access de 1-5% et ceux du NOTES de 5-9%.  
Quelle technique choisissez-vous en connaissant ces risques :**

- Laparoscopie
- Single port access
- NOTES

***Merci pour votre participation qui nous aidera a dirigé nos recherches afin de mieux répondre à vos attentes. A retourner au Dr P Bucher, Chirurgie Viscérale***

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