Minimally invasive strategies in rectal neoplasia
Barendse, R.M.

Citation for published version (APA):

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CHAPTER 6

Transanal single port surgery: selecting a suitable access port in a porcine model

R.M. Barendse
T. Verlaan
W.A. Bemelman
P. Fockens
E. Dekker
J. Nonner
E.J.R. de Graaf

— Surgical Innovation 2012 Sep;19(3):323–6
ABSTRACT

› Background
Single port surgery of rectal tumours may be associated with a shorter learning curve and fewer costs than transanal endoscopic microsurgery (TEM). We aimed to select the most optimal single access port for transanal employment.

› Methods
Four single access ports (GelPOINT®, TriPort, SSL Access System and SILSTM) were tested in two pigs. Insertion feasibility and intraoperative features of each port were assessed. A rectal excision was attempted using the most suitable port.

› Results
Insertion of GelPOINT® was impossible. SILSTM and TriPort were easily inserted, however, insufficient stability demanded manual fixation. CO₂ leaked through the TriPort trocar ports. Insertion of the 2cm SSL Access System retractor was difficult, but pneumorectum and surgical circumstances were favorable.

› Conclusions
Single port transanal surgery may be a promising alternative for TEM. We found the SSL Access System most suitable for this indication in a porcine model.
INTRODUCTION

Transanal endoscopic microsurgery (TEM), first described by Buess et al, has proven to be superior to conventional transanal excision for the surgical treatment of rectal lesions.1-3 It has been implemented as the standard resection method of rectal adenomas and selected carcinomas by many surgical practices. Although TEM has proven to be more cost-effective than total mesorectal excision, acquisition of the specialized instrumentation is expensive and a long learning curve is present even after a multiple day workshop. 4,5

Minimally invasive surgery is a burgeoning field, in which the rapid development of new instrumentation has led to multiport devices, requiring only single incision. These devices have already facilitated a broad spectrum of abdominal procedures.6-8 Little evidence is available on the utilization of single access ports for transanal surgery. Conceptually, transanal use of these ports demands different features to ensure safe and effective surgery.

Four case series report successful transanal use of a single access port for the resection of rectal lesions in 1-6 patients.9-12 All authors have utilized the SILSTM port (Covidien) for their procedures. However, three other kinds of disposable single access ports for laparoscopic surgery are currently available.

The purpose of this study was to evaluate all available disposable single access ports in a porcine model, and to select the most suitable port for a feasibility study in human subjects.

METHODS

Procedures were performed by a single surgeon, who is extensively experienced with TEM (EdG). The rectum of two female pigs in lithotomy position was prepared by means of saline enemas under general anesthesia. Four available single access ports were evaluated; GelPOINT® (Applied Medical), TriPort (Olympus), SSL Access System (Ethicon Endo-Surgery) and SILSTM (Covidien).

Transanal insertion of all ports was attempted in the first pig to evaluate feasibility and ease of port insertion. When inserted successfully, CO₂ was insufflated to assess the pneumorectum. If the mucosal exposure was considered sufficient for rectal surgery, a standard 30 degree laparoscope and two surgical instruments were inserted through the trocar ports and manipulated to assess maintenance of the pneumorectum and stability of the port. Port features were scored independently by 5 researchers (RB, TV, WB, JN and EdG) according to the criteria summarized in Table 1. Attributed scores were discussed until consensus was reached.

The port with the best pneumorectum and best stability was selected for a rectal excision in the second pig. Approximately 10 cm proximal to the dentate line, a full thickness rectal wall excision with a diameter of 2cm was performed. Manoeuvres required to remove the specimen were then assessed.

The pigs were sacrificed after termination of the procedure.
Table 1. Port score criteria with regards to ease of insertion, pneumorectum and mucosal exposure and port stability.

<table>
<thead>
<tr>
<th>Port insertion</th>
<th>Feasible</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

RESULTS

Feasibility and ease of port insertion

The SILSTM, TriPort, GelPOINT® and SSL Access System were successively inserted transanally in the first pig. The interior ring of the GelPOINT® port was too large for intraluminal expansion. Therefore, this port was judged not suitable for transanal employment. Insertion of the SILSTM was the easiest, followed by TriPort and SSL Access System (Table 2). For the SSL Access System, we only had the small, 2cm fixed-length retractor at our disposal, and we hypothesized that the 4cm retractor would fit better. None of the ports caused mucosal damage.

Perioperative features

Manual fixation of the SILSTM port was necessary to prevent partial dislocation after CO₂ insufflation, as well as dislocation of the entire port intraluminally during trocar introduction. (Figure 1) With manual stabilization, a good luminal overview was achieved. The TriPort achieved a good mucosal exposure after CO₂ insufflation. However, CO₂ leakage occurred through the trocar ports after introduction of the laparoscope and instruments (Figure 2), the flexibility of the port retractor hampered a secure position of the interior ring behind the anal sphincter, and manual fixation of the port was required as well.

With the SSL Access System, despite a tedious insertion, an excellent pneumorectum was created. The fixed–length retractor enables a stable position of the port; the interior membrane is held in place by the internal anal sphincter and the exterior membrane by the anal verge. (Figure 3) Insertion of the laparoscope and instruments did not influence the position or stability of the port and did not cause any CO₂ leakage. After these observations, we selected the SSL Access System as the most optimal single–access port for transanal employment.
Table 2. Attributed scores to ports with regards to ease of insertion, pneumorectum and mucosal exposure and port stability

<table>
<thead>
<tr>
<th></th>
<th>SILSTM</th>
<th>TriPort</th>
<th>GelPOINT®</th>
<th>SSL Access System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port insertion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feasible</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Ease</td>
<td>5</td>
<td>3</td>
<td>NA*</td>
<td>2</td>
</tr>
<tr>
<td>Intraoperative</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumorectum / mucosal exposure</td>
<td>5</td>
<td>3</td>
<td>NA*</td>
<td>5</td>
</tr>
<tr>
<td>Port stability</td>
<td>2</td>
<td>2</td>
<td>NA*</td>
<td>5</td>
</tr>
</tbody>
</table>

* NA: not applicable

Resection
In the second pig, a rectal excision was attempted with the SSL Access System and conventional laparoscopic instrumentation. The surgeon (EdG) was seated between the pigs hind legs; a surgical resident (JN) handled the laparoscope and was standing to the left of the surgeon. The seal cap of the port can be rotated 360 degrees, allowing quick reorientation of instrumentation throughout the procedure without necessitating instrument exchanges. Resection circumstances were comparable to TEM. The port with the 2 cm retractor dislocated once during the procedure. The detachable seal cap facilitated collection of the resected specimen, without further disassembly of the operating set-up.
DISCUSSION

This study is a first step in assessing the feasibility of transanal employment of single access ports for rectal surgery. Not all of the various single access ports currently available seem suitable for transanal surgery. The limited space of the rectal cavity and the features of the anal sphincter in comparison with the abdominal wall necessitate certain dimensions of the port retractor and orientation of the trocars. Fixation of the access port in the anal canal may be more difficult than fixation in an abdominal wall incision as the interior retractor membrane needs to unfold within the rectum. Rectal shape varies with gender and is subject to pelvic floor contractions.

Because the rectal cavity is limited in space and the rectal wall itself is operated on, a stable pneumorectum is highly important for safe surgery and proper appreciation of the endoluminal image. We found that due to its dimensions, the GelPOINT® is not suitable for transanal surgery. Due to limited stability, the SILSTM and TriPort systems require manual fixation or supportive sutures, as reported in previous case reports. Our experiences with the SSL Access System however were encouraging. Once inserted, an excellent pneumorectum was achieved and the ability to rotate the seal cap facilitated easy instrument reorientation. Although we encountered some difficulty with insertion, we hypothesized that this was due to the short retractor, to which we were limited during this study. The longer retractor may not be associated with these difficulties. Stability of the set-up was found to be excellent.

The surgical skills required for single access surgery are comparable to those required for TEM, as working angles and endoscopic suturing in both techniques are similar. Transanal employment of single access ports may be a promising alternative for TEM in rectal surgery. If the effectiveness and safety of single port transanal surgery are comparable to TEM, this technique may compete with TEM and may be associated with fewer costs. Few others have reported promising clinical results in small case series of patients operated with the SILSTM. In our opinion, the SSL Access System is more appropriate for transanal surgery. Feasibility in humans should be investigated. Prospective case series are needed to show the effectiveness and safety of this operating set-up.
REFERENCES


