A number of laparoscopic ports exist that have one or more of the following features: a tubular shape, a valve to allow instrument access, cutting or dilating inserts, and a CO₂ insufflation channel. The R-Port (ASC, Wicklow, Ireland) is a novel device that has a profile entirely different from any other device currently available on the market and does away with the necessity to have either a tubular shape or a cutting insert. We have used the R-Port to perform five interventional urologic procedures as single-port access (SPA) procedures, a variant of which is one-port umbilical surgery (OPUS). Here we report our initial urology-specific experience with this novel device.

**MATERIAL AND METHODS**

The R-Port is a U.S. Food and Drug Administration–approved access system comprising a series of devices that can be introduced into defects of any size within the abdominal wall, from a 5-mm incision up to a hand-assisted laparoscopic surgery incision.

Each device consists of a retractor component and a valve component. The retractor component has a distal ring and an outer proximal pair of concentric rings. A doubled-over cylindrical sleeve of film material is fixed to the innermost of the proximal rings and flows down around the distal ring and back up and out between the outer proximal ring pair. To achieve retraction of an incision, the distal ring is passed through the incision into the abdominal cavity. For smaller defect sizes an introducer is used to introduce the distal ring. Pulling up on the sleeve draws the distal ring and the outer proximal ring pairs together, which creates a retracting tension in the sleeve between the rings. The pulley-like arrangement of the sleeve and rings ensures that the sleeve self-locks in place to maintain retraction. The valve component consists of a unique thermoplastic elastomeric material mounted in a housing, which in turn can be removable attached to the retractor component for specimen removal. The valve allows all standard laparoscopic instruments and scopes from 5 mm to 12 mm to pass through the same valve. It also allows more than one instrument to pass through the same valve simultaneously. Insufflation is provided through the valve housing. A removal ribbon is provided to remove the device from the incision at the end of the procedure. The low profile of the R-Port device allows for non-straight instruments to be introduced into the abdomen. Furthermore, the high elasticity of the gel valve allows small specimens to be removed through the gel valve (Figs. 1-3).

We performed the following procedures after siting a single R-Port in each of the following 5 patients (Table 1).

**Patient 1**

A 52-year-old man (height 156 cm, weight 56 kg) presented with symptoms of recurrent urinary tract infections. Radiologic
imaging confirmed a small, nonfunctioning kidney (4.5 cm × 3 cm) with a large renal pelvic calculus. He was counselled appropriately and underwent transperitoneal SPA surgery with the port placed in the right upper quadrant in the mid-axillary line. The procedure was carried out with the patient positioned in the standard lateral position. A 5-mm 30° Olympus high-definition telescope (Tokyo, Japan) was used along with two working instruments. Circumferential mobilization of the specimen was performed using the Harmonic Scalpel (Ethicon, Cincinnati, OH) and Hem-o-lok clips (Weck, Research Triangle Park, NC) clips. The specimen was removed piecemeal through the port ring, without having to enlarge the 2-cm incision, which was closed with a subcuticular absorbable suture.

Patient 2
A 58-year-old man (height 160 cm, weight 56 kg) presented with left ureteric colic. Excretory urography revealed incomplete obstruction due to an impacted 2.5-cm stone in the upper ureter. He was counselled appropriately, stented, and thereafter underwent OPUS with the R-Port placed in the umbilicus. Using instrumentation as described above, the colon was mobilized, the stone identified, and a ureterotomy performed to deliver the stone, which was extracted intact. The 1.5-cm incision was closed with a subcuticular absorbable suture. A tube drain was left in situ for 24 hours.

Patient 3
A 2-year-old boy presented with an empty right hemiscrotum. The parents were counselled appropriately, and OPUS was performed using a 10-mm R-Port placed at the umbilicus. A nubbin of tissue representing the undescended testicle was seen at the internal ring. This was excised uneventfully using instrumentation as described above. The 1.2-cm incision was closed with a subcuticular absorbable suture.

Patient 4
An 18-year-old man presented with an undescended inguinal right testis and appendicitis; after due counselling, OPUS was performed using a 10-mm R-Port placed at the umbilicus; an uneventful appendectomy and orchidopexy were performed using instrumentation as described above. The 1.2-cm incision was closed with a subcuticular absorbable suture.

Patient 5
A 40-year-old woman presented with recurrent urinary tract infections. She had undergone right percutaneous nephrolithotomy and open pyelolithotomy in the past. Investigations confirmed that this was a nonfunctioning kidney. She was counselled appropriately and underwent transperitoneal SPA surgery with the port placed in the right upper quadrant in the mid-
aspect of laparoscopy. Access-related complications during laparoscopy can be placement related (vascular and visceral injury, abdominal wall hematoma), procedural (gas leak and loss of pneumoperitoneum), and postoperative (wound infection, port-site hernia formation). The overall incidence of complications in laparoscopic urologic surgery has been reported as 0.2%-0.27%. Techniques to minimize access-related injuries have been devised, for example the open “Hasson” technique, disposable trocars with safety shields, direct-view trocars, and radially dilating trocars. A recent review, however, did not quantify any one of the established techniques as the one with the least risk. Traditional cutting trocars often require significant downward force to penetrate the abdominal wall during insertion, which increases the risk of vascular and visceral injury.

The plastic trocar of the R-Port introducer has only to penetrate the peritoneum and then the inner flange is delivered. We had no significant difficulty achieving access with the R-Port in any of our cases. The port provides a blunt dilating tip, which in contrast to a cutting tip may help decrease the incidence of intra-abdominal vascular and visceral injury and abdominal wall bleeding. The tamponade effect of the twin flanges may also contribute to a decreased risk of port-site bleeding. During surgery the ports provided a gas-tight seal, with no need to place purse-string sutures. Once inserted, the R-Port does not slide or skew; this eliminates the necessity to place supporting bolster sutures. In comparison, traditional trocars may allow gas leaks or require bolstering sutures to maintain the seal between the flange and the fascia. Finally, “pop-outs” do not occur with the R-Port because it cannot be removed except by pulling on the removal ribbon.

Surgical procedures with the R-Port seem to have few limitations and disadvantages as compared with conventional laparoscopy. The main disadvantage is that the instruments are fairly close to each other, with loss of conventional triangulation offered while performing multi-port laparoscopic surgery. This disadvantage may be, in part, overcome by using bent multi-angled instruments, which are in the process of being developed. We have not yet used the R-Port for retroperitoneoscopy because this initial feasibility clinical study concentrated on OPUS whenever possible. Suturing is possible with the R-Port, and at least two pyeloplasties have been performed to date (personal communication).

### RESULTS

During surgery all attempts to place the ports were successful and without incident. There were no cases of inadvertent port removal, vascular or visceral trocar injury, loss of pneumoperitoneum, or intraoperative port-site bleeding. After surgery there were no cases of wound hematoma, wound infection, early port-site hernia (at 6 months), or delayed bleeding. Patients were examined at scheduled follow-up appointments at 3 and 6 months, and none were lost to follow-up.

### COMMENT

Conventional trocars have a number of disadvantages when used in laparoscopic surgery. The first of these is that they have a long (normally 10-cm) tube, which substantially encroaches into the abdominal cavity. This means that the visibility achieved through them is limited because the camera must protrude beyond this tube before the surgical field becomes visible. Second, the range of motion of the surgical instrument is curtailed in several ways. Instruments cannot be opened until they are fully through the cannula. This means that instruments with a large action, such as surgical staplers, are limited in their possible applications. Third, it is not possible to use more than one instrument through a conventional trocar because the long cannula does not allow for their relative movement. Fourth, because of the length of the cannula and its rigid properties, the shaft of a laparoscopic instrument for use with a trocar must be straight. Finally, most current standard trocars are not securely held in the incision margin and have a tendency to “pop out” or leak gas.

Trocar insertion is still the most dangerous technical aspect of laparoscopy. Access-related complications during laparoscopic surgery can be placement related (vascular and visceral injury, abdominal wall hematoma), procedural (gas leak and loss of pneumoperitoneum), and

### Table 1. Details of five procedures performed using the R-Port

<table>
<thead>
<tr>
<th>Patient sex, age</th>
<th>Procedure</th>
<th>Diagnosis</th>
<th>No. of instruments used</th>
<th>Comments/SPA/OPUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female, 40 y</td>
<td>Right simple nephrectomy</td>
<td>Right renal calculus, chronic pyelonephritis</td>
<td>3</td>
<td>Previously operated twice (pyelolithotomy &amp; PCNL); SPA</td>
</tr>
<tr>
<td>Male, 3 y</td>
<td>Laparoscopic right orchidectomy</td>
<td>Right undescended testes</td>
<td>3</td>
<td>Hypoplastic testis removed; OPUS</td>
</tr>
<tr>
<td>Male, 58 y</td>
<td>Left ureterolithotomy</td>
<td>Left upper ureteric calculus</td>
<td>3</td>
<td>OPUS</td>
</tr>
<tr>
<td>Male, 18 y</td>
<td>Left orchidectomy, appendectomy</td>
<td>Left inguinal testes, appendicitis</td>
<td>3</td>
<td>OPUS</td>
</tr>
<tr>
<td>Male, 52 y</td>
<td>Right simple nephrectomy</td>
<td>Right renal calculus</td>
<td>3</td>
<td>Large pelvic calculus, nonfunctioning kidney; SPA</td>
</tr>
</tbody>
</table>

SPA = single-port access; OPUS = one-port umbilical surgery; PCNL = percutaneous nephrolithotomy.
The aim of minimally invasive surgery is to reduce access-related trauma while maintaining optimal operating conditions. Laparoscopic access offers a cosmetic outcome far superior to that with open surgery. However, surgeons have been trying to improve on the issue by using fewer and smaller ports.\(^1\) A single-trocar laparoscopic nephrectomy using a novel prototype magnetic anchoring and guidance system has recently been performed in the porcine model.\(^12\) The investigators concluded that intracorporeal instrument manipulation may overcome the limitations of current laparoscopic and robotic surgery by allowing unhindered intrabdominal movement.

**CONCLUSIONS**

The R-Port seems to offer surgeons the option of delivering a cosmetically superior, safe outcome using current instrumentation. In selected cases the surgeon creates no new visible scars on the patient, using only the previously scarred umbilicus. More clinical data are needed and are being accrued.

**References**


**EDITORIAL COMMENT**

A new era of laparoscopy has arrived, with the potential for scarless surgery. Standard rules for laparoscopic surgery are being challenged to allow parallel insertion of multiple instruments and scope through a single port.

This article reflects the current evolution of single-port access (SPA), which uses multiple laparoscopic ports through a single abdominal incision of various lengths. Although SPA avoids parallel insertion of instruments, the length of the abdominal incision needed may eliminate the advantages of this approach. That said, SPA provides an excellent start to gain experience with laparoscopy performed through ports placed adjacent to each other.

With the introduction of novel multi-channel laparoscopic ports that allow simultaneous insertion of multiple instruments through a single port, single-port laparoscopy (SPL) has emerged. Obviously, SPL creates the additional challenge of reduced instrument maneuverability because the parallel insertion results in significant clashing of instruments and scope while they compete for the limited space around the single port. The use of bent instruments as described in this article or the use of available flexible laparoscopic graspers, scissors, and needle holders may be vital for improving the surgical range of motion. Some investigators use additional 2-mm instruments inserted percutaneously away from the single port, without adding additional ports, to provide some triangulation and allow better tissue retraction, thus minimizing the challenges of a pure single-port approach. These additional 2-mm instruments do not add morbidity and are barely visible after surgery. However, a step forward toward the evolving field of natural orifice transluminal endoscopic surgery (NOTES), which may deliver the promise of scarless surgery, requires the completion of the entire procedure through a single port without additional transabdominal insertions of tiny instruments outside a single port or platform.

Although NOTES, in which access is gained through the stomach, vagina, or rectum, is in its experimental phase, the use of the umbilicus (an obliterated embryonic natural orifice) as a point of access is ready for clinical “prime time.” Single-port laparoscopy through the umbilicus provides safe access to perform embryonic (for umbilical access) NOTES, or E-NOTES. To date we have performed more than 60 E-NOTES procedures, including ablative procedures of simple nephrectomy, renal cryoablation, renal cyst decortication, and donor nephrectomy. Reconstrucrative E-NOTES has also been performed for pyeloplasty, sacrocolpopexy, construction of ileal ureter, partial nephrectomy, radical prostatectomy, and even radical cystectomy. As such, emerging data on surgical outcomes confirm the conclusion of this article that SPA, SPL, or E-NOTES is feasible and safe even for complex urologic procedures. Proper patient selection is vital for a successful outcome.\(^1\)\(^-\)\(^4\)

Additional surgical experience with E-NOTES and the emergence of a new generation of laparoscopic equipment that is not only curved but flexible and steerable is essential for the advancement and adoption of SPL or E-NOTES. Although cosmesis is superior, the advantages of this new approach need to be evaluated carefully with regard to effectiveness (particularly for cancer patients) and morbidity, especially in consideration of the high bar for minimally invasive surgery already raised by standard laparoscopy.

**References**