ABSTRACT  Because it is minimally invasive, laparoscopic surgery is preferred over open surgery. However, it is often difficult to maintain an adequate surgical field during the procedure. As in open laparotomy, securing an adequate surgical field is important for adequate visualization. We evaluated the effectiveness and safety of the Endoractor, an organ retraction sponge that can be inserted through a 12-mm trocar to secure a surgical field in gynecologic laparoscopic surgery. The Endoractor, a 100% cellulose compressed sponge, can be expanded using physiologic saline solution, with the result that the swollen sponge displaces organs away from the surgical field. Between October 2009 and April 2010, we used the Endoractor in 24 patients, placed in a Trendelenberg position, during laparoscopic surgery. In no patients, even with return to a horizontal position, did the intestines fall into the pelvis, and surgery was easily performed. Mean (SD; 95% CI) operative time was 92.7 (44.5; 74.0–111.6) minutes, and blood loss was 54.1 (73.1; 22.9–82.1) mL. All patients were discharged on postoperative day 3. Even with the patient in a horizontal position without use of the Trendelenberg position, the Endoractor enables a good surgical field to be secured. It remains to be seen whether this device works as well in obese patients. Journal of Minimally Invasive Gynecology (2011) 18, 507–511 © 2011 AAGL. All rights reserved.
Patients and Methods

Patients

The study included 24 patients with uterine myomas or ovarian cysts, or both, in whom the Endoractor was used at laparoscopic surgery at our hospital between October 2009 and September 2010. Mean (SD) patient age was 34.2 (6.8) years (95% CI, 31.4–37.1 years). Fifteen patients underwent 4-port surgery, 4 underwent 2-port surgery, and 5 underwent single-port surgery. Myomectomy was performed in 10 patients, ovarian cystectomy in 9 patients, myomectomy with ovarian cystectomy in 4 patients, and oophorectomy in 1 patient (Fig. 1). Operative time, blood loss, and number of postoperative days in the hospital were evaluated in these patients.

Methods

The Endoractor (Kawamoto Corp, Osaka, Japan) is a 100% cellulose compressed sponge $8 \times 8 \times 200$ mm that can be inserted through a 12-mm port. With approximately 80 mL of physiologic saline solution introduced into the pelvic cavity, the device will swell to $60 \times 40 \times 210$ mm (Fig. 2), thus displacing organs away from the surgical field.

The Endoractor was tested for cytotoxicity, ethylene oxide sterilization residuals, skin sensitization, and intracutaneous reactivity. Under the present experimental conditions, no cytotoxicity was observed; ethylene oxide residual was sufficiently below the standard value; no considerable skin sensitizing potential was noted; and irritation response to the extract solutions was regarded as none or negligible.

Operative Procedure

All surgical procedures were performed with the patient under general anesthesia via endotracheal intubation and in the lithotomy position. The uterus was handled using a uterine manipulator (Ethicon Endo-Surgery, Inc, Cincinnati, OH). Blood loss was estimated via suction during surgery.

In 4-port surgery, pneumoperitoneum was achieved using a closed method from under the umbilical region, and an 11-mm trocar was inserted in the umbilical region for introduction of the laparoscope. A 5-mm trocar was inserted on each side of the lower abdominal region, and a 12-mm trocar was inserted in the left upper abdominal region (2 cm above the umbilical region along the anterior axillary line) [5].

In 2-port surgery, a 12-mm port was placed at the umbilical incision, and a 5-mm flexible scope was inserted through this port. Another surgical port was then made in the left inguinal region for insertion of a 5-mm port, and an additional scope was inserted through this inguinal port. Another 5-mm port was inserted caudal to the 12-mm port while monitoring the umbilical region using the flexible scope. The 12- and 5-mm ports were inserted through the same umbilical incision and positioned vertically [6].

In single port surgery, a 2.5-cm vertical incision was made on the extended umbilicus using 4 Kocher clamps. This method prevents incising beyond the umbilicus, using the umbilical bottom as a center point for the skin incision. After the rectus fascia and peritoneum were sharply incised, a single multichannel port (SILS Port; Covidien, Mansfield, MA) with capacity for as many as 3 laparoscopic instruments and an insufflation channel was inserted [7].

Insertion and Withdrawal of the Endoractor

The patient was placed in the Trendelenburg position at approximately 15 degrees of incline. The Endoractor was inserted into the body cavity through a 12-mm port when the intestine shifted from the pelvis to the upper abdomen. The Endoractor was fully swelled with physiologic saline

Fig. 1
Surgical procedure. Four-port surgery was performed in 15 patients, two-port surgery in 2 patients, and single-port surgery in 5 patients.
solution injected into the body cavity. The ends of the device were placed in the left and right iliac fossae, with the center fixed slightly cephalad to the promontory, and the patient was returned to a horizontal position. In patients with ovarian cysts or uterine myomas, the Endoractor was able to hold the intestine in the upper abdomen. To withdraw the Endoractor, in both the 4-port and 2-port procedures, the end of the device was pulled through the 12-mm trocar lumen using grasping forceps, and pulled together with the trocar from the 12-mm trocar insertion site (Fig. 3). In the single-port procedure, the device was withdrawn through the incision.

Results

After Endoractor insertion and displacement of the intestine into the upper abdomen, in no patients did the intestine fall into the pelvis even after return to a horizontal position, and surgery was easily performed. No spillage of cyst contents or blood into the upper abdomen was observed. Patient mean (SD) body mass index (BMI) was 21.7 (4.7) (95% confidence interval [CI], 19.9–23.6). The organ retractor sponge was easily withdrawn through the 12-mm port incision. Operative time was 92.8 (44.5) minutes (95% CI, 74.0–111.6 minutes), and estimated blood loss was 54.1 (73.1) mL (95% CI, 22.9–82.1 mL). All patients were discharged by postoperative day 3.

Discussion

Laparoscopic surgery is a treatment of choice because, compared with open surgery, it is minimally invasive. However, it is often difficult to maintain an adequate surgical field during the procedure. As in open laparotomy, securing an adequate surgical field is important for adequate visualization. We evaluated the effectiveness and safety of the Endoractor, an organ-retraction sponge that can be inserted through a 12-mm trocar to secure a surgical field in gynecologic laparoscopic surgery. The Endoractor, a 100% cellulose compressed sponge, can be expanded using physiologic saline solution, and the resultant swollen sponge displaces organs away from the surgical field.

In general, in gynecologic laparoscopic surgery, the patient is placed in a Trendelenberg position to displace the intestine away from the pelvis. Because of intra-abdominal fat, in obese patients, it is difficult to secure the surgical field. Therefore, common gynecologic laparoscopic surgery in obese patients requires the deep Trendelenberg position. In robotic surgery, the steep Trendelenberg position required for visualization may cause problems; thus, it is conceivable that a less steep Trendelenberg position would be beneficial. Because the robot arms are fixed and rigid with respect to the patient’s abdominal wall, shift in position may not only place undue strain on the abdominal wall but also result in trauma to intra-abdominal structures [8]. The hemodynamic changes resulting from a Trendelenberg position result in difficult management of anesthesia during procedure [9,10]. Reported postoperative complications may include nerve paralysis [11] and increased intraocular pressure [12]. Moreover, the Trendelenberg position may cause spillage of cyst contents into the upper abdomen, leading to postoperative complications such as peritonitis. The Endoractor makes it possible to avert use of a long steep Trendelenberg position during the procedure because of its ability to prevent both the fall of intestine and spillage of fluid and blood into the upper peritoneal cavity.

In the present study, mean (SD) patient BMI was 21.7 (4.7), which is the same as in healthy Japanese women. Three patients were classified as overweight (BMI 25 to <30), and 1 as obese (BMI ≥30). The highest BMI in our patients was 35.6. Obesity was originally considered a relative contraindication to advanced laparoscopic procedures because of difficulty in entering the peritoneal cavity, maintenance of pneumoperitoneum, impaired tolerance of the Trendelenberg position, and limited visualization of pelvic organs. Adoption of gynecologic laparoscopic surgery in obese patients is controversial. In recent studies that evaluated the effect of BMI on outcomes in total laparoscopic hysterectomy and robotic-assisted total laparoscopic hysterectomy, it was concluded that total laparoscopic hysterectomy could be performed successfully in most obese patients [13–15]. In contrast, other studies reported that obese and overweight women undergoing laparoscopic management of a benign adnexal mass were at an increased risk of conversion to laparotomy and longer surgery, and longer hospital stay [16,17]. A nationwide study of 20,353 women in Denmark undergoing hysterectomy to treat benign conditions from 2004 through 2008 demonstrated
that high BMI is associated with increased overall risk of complications such as heavy bleeding during surgery and longer operating time [18]. It may be worthwhile to explore whether this device will work as well in obese patients. The present study included a limited number of overweight or obese patients. Nevertheless, we did not observe difficulty in using this device in overweight or obese patients compared with patients who were not overweight.

One limitation of this device is that because it is made of cellulose sponge, it can be easily torn during withdrawal through the narrow trocar lumen. However, by using our withdrawal procedure, the device can be removed safely from the body cavity.

Hospitalization for 3 days for this procedure has been standard in Japan for both patient and physician assurance. This length of stay may be different in the United States because the cost for medical services is relatively higher than in Japan.

**Conclusion**

To secure sufficient working space in the pelvis and to prevent spillage of ovarian cyst contents and blood into the upper
abdomen, the Endoractor organ retraction sponge may be useful and result in safer gynecologic laparoscopic surgery.

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Supplementary Data

Supplementary data related to this article can be found online at doi:10.1016/j.jmig.2011.04.012.

References