

# Laparoscopic Right Colon Resection With Transvaginal Extraction: A Systematic Review of 90 Cases

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**Background:** Natural orifice specimen extraction is a laparoscopic technique that reduces the procedure's invasiveness.

**Objective:** We aimed to examine all the available data for the transvaginal extraction of laparoscopic right-sided colonic resections.

**Data Sources:** A systematic search was conducted using PubMed/MEDLINE, Cochrane, Google Scholar, EBSCO, clinicaltrials.gov, and congress abstract databases.

**Study Selection:** All case-control series, case series, and case reports were included, irrespective of age, region, race, obesity, comorbidities, or history of previous surgery. No restrictions were made in terms of language, country, or journal.

**Main Outcome Measures:** Patient selection criteria and results of the cumulative data.

**Results:** The search identified 10 studies including 90 cases. Most patients were elderly (mean, 65.9; range, 29 to 87 y) and had comorbid diseases (96%). 33.8% had a history of abdominopelvic surgery. The mean body mass index was 25.7 kg/m<sup>2</sup> (range, 18 to 50 kg/m<sup>2</sup>). Most patients (83%) had malign or premalign (14%) diseases and required regular or extended right hemicolectomies (99%). The mean operating time and blood loss ranges were 193 (140 to 471) minutes and 62.4 (0 to 300) mL, respectively. Overall, morbidities were seen in 18 patients (20%), and 3 of them were related to the transvaginal extraction. There were no abdominal wound related early or late complications. When compared with laparoscopic colon resections with transabdominal extraction, the procedure seems to result in decreased postoperative pain and length of hospital stay.

**Limitations:** There are a limited number of comparative studies and an absence of randomized studies.

**Conclusions:** Laparoscopic resection and transvaginal specimen extraction is a promising technique for some right-sided colon pathologies. For patient selection, an accessible vaginal port (patient acceptance and a vagina that is not narrow) and an en-mass lesion of  $\leq 8$  cm were necessary. Malignancy, previous abdominopelvic surgery, obesity, and old age were not considered as contraindications.

**Key Words:** natural orifice, surgery, hemicolectomy, specimen extraction, colon, transvaginal

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Laparoscopic surgical techniques have various advantages when compared with open surgery. Laparoscopic surgery decreases both wound complications in the early

postoperative period and the long-term incisional hernia risks.<sup>1</sup> The length of hospital stays and patient recovery periods are also decreased by smaller incisions of the laparoscopic techniques. However, laparoscopic colorectal surgical procedures usually require resection of some bowel segments, which means additional abdominal incisions are necessary for either taking the bowel out, stapling the anastomosis, or diverting the stomas. Additional incisions can increase the risk of abdominal wound complications and impair the postoperative recovery of the patients.

Natural orifice specimen extraction (NOSE) is one of the new stages of ever-evolving laparoscopic surgery. NOSE allows laparoscopic colorectal resections only through 5- to 12-mm trocar orifices on the abdominal wall without any additional incisions or extensions. Transoral, transanal, and transvaginal routes are available for NOSE. Transanal routes can be the most natural method for removing the left-sided colon and rectal specimens.<sup>2</sup> However, transvaginal extraction looks like the only favorable way for certain right-sided colonic specimens.<sup>3</sup>

This systematic review aims to examine all the available data about the transvaginal extraction of laparoscopic right-sided colonic resections, with a particular focus on the patient selection criteria and the updated cumulative results of this promising procedure.

## MATERIALS AND METHODS

Electronic searches of the PubMed/MEDLINE, Cochrane, Google Scholar, and EBSCOhost—Academic Search Complete databases, including CINAHL and Central & Eastern European Academic Sources, were carried out by January 3, 2014 using the key words “(transvaginal OR (natural AND orifice) OR (specimen extraction)) AND (right OR colon OR colonic OR hemicolectomy OR ileocecal OR ileocaecal OR caecal OR cecal OR cecum OR caecal).” All studies, including congress proceedings and abstracts that describe the clinical course of patients, were accepted for the analysis. During the first search, 2 reviewers (C.K., M.A.Y.) assessed the list of titles and/or abstracts of the scanned articles in PubMed/MEDLINE and Cochrane using the key words as a function of (all fields). If the articles met our inclusion criteria, the full text was obtained for assessment. If the articles were obviously irrelevant to the aim of this systematic review, they were excluded. Some more studies were also excluded after the first scanning because of their content (editorial letters, reviews, experimental studies, duplicated studies, technical notes, and survey studies including questionnaires). After the PubMed and Cochrane search, we also scanned the EBSCOhost—Academic Search Complete and Google Scholar databases using the same key words but as the function of (title). If any additional studies were found, they were added to the first search results. The unpublished potentially relevant trials in the database of registered trials

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at <http://www.clinicaltrials.gov> were searched as well. The references of the selected relevant articles were cross-checked to decrease the possibility of missing publications. All the reasons for the exclusion of the studies were recorded in the algorithm flow-chart (Fig. 1).

Transvaginal extraction of the right-sided colon resection has been defined as complete laparoscopic resection of the right-sided colon resection, intracorporeal anastomosis, and removal of the specimen through the vaginal route without requiring any extra-abdominal wall incisions. All patients who underwent surgery using the described technique were included irrespective of age, region, race, obesity, comorbidities or history of previous surgery. Studies including transvaginal extractions combined with other organ resections were accepted for the analysis as well. When studies described only transvaginal assistance with a laparoscopic port, but not extraction through the vagina, they were not considered for this systematic review. No restrictions were made in terms of language, country, or journal. With any disagreements during the study selection and analysis, the reviewers discussed the issue and a consensus was obtained. Data for publication date, language, country, inclusion and exclusion criteria, number of patients, age, ASA (American Society of

Anesthesiologists) score, body mass index, comorbidities, history of prior abdominal surgery, clinical diagnosis, lesion location and size, extent of surgical resection, number of laparoscopic trocars, additional surgeries, operating time, blood loss, transvaginal access technique, colpotomy closure technique, gynecological assistance, conversions to abdominal incisions, complications, length of hospital stay, and follow-up time were recorded. A computer program including spreadsheet was used for records (Excel 2013, Microsoft Windows). If there were any missing data, we contacted the investigators of the articles by e-mail.

The data were tabulated in tables, and summaries of the colons were created by the numbers or the means and the ranges of the relevant parameters. When studies reported the median and the range, we estimated the mean value using the method described by Hoza et al.<sup>4</sup> Basic calculations were used for the total numbers of the dichotomous outcomes and weighted means for the continuous outcomes. Calculations of the cumulative means were based on the weight (number of patients) of each study.<sup>5</sup> The  $\chi^2$  test or the Fisher exact test (if expected values were  $< 5$ ) and the student *t* test were used for statistical analysis of both dichotomous and continuous variables (SPSS 13.0). A *P*-value  $< 0.05$  was considered significant.

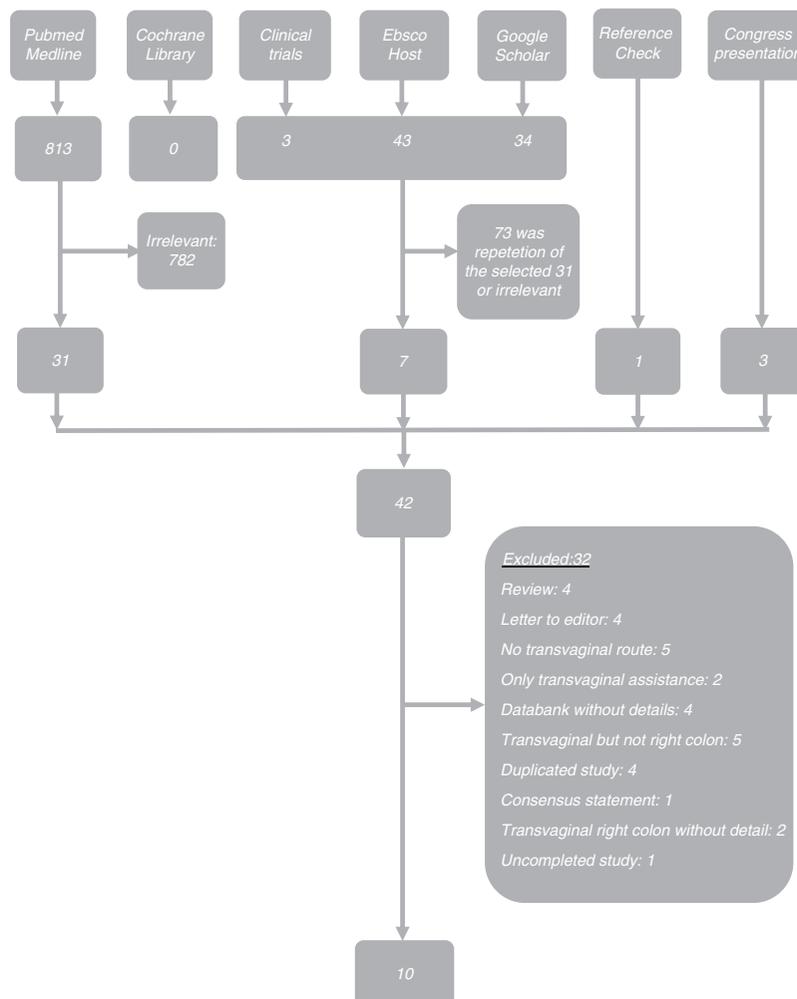


FIGURE 1. Data search flow-chart.

**RESULTS**

A total of 813 articles were retrieved from the PubMed/MEDLINE database, and no additional study was available in the Cochrane library. After elimination of the 782 irrelevant studies, the remaining 31 were selected for full-text examination. Google Scholar, EBSCOhost—Academic Search Complete, <http://www.clinicaltrials.gov>, reference cross-checking and congress presentations defined 34, 43, 3, 1, and 3 studies, respectively (Fig. 1). After elimination of the repetitive studies, 11 studies were added to the previously selected 31, articles and a total of 42 studies were checked with their full texts. Studies not including patient data (reviews, book chapters, technical notes, editorial letters, working group status statements) and duplicated data were eliminated, and finally 10 articles<sup>2,6-14</sup> were selected for analysis (Fig. 1). A case series study<sup>2</sup> had been presented in a congress as a case-control study as well.<sup>15</sup> To eliminate data duplication, the latest and the most comprehensive version was selected for the analysis,<sup>2</sup> and the case-control study<sup>15</sup> was used separately.

The studies originated from Europe, North America, or Asia. Most of them were in English (9/10) but 1 was in German.<sup>7</sup> There were a total of 90 transvaginal extractions of laparoscopic right-sided colonic resections, and the first study was published in 2007.<sup>6</sup> Five studies were case reports,<sup>6-8,10,13</sup> 3 were case series,<sup>9,12,14</sup> and the remaining 2 included cases with control groups.<sup>11,15</sup> The exclusion criteria of the authors is shown in Table 1. Previous abdominal surgery was not a widely accepted contraindication for transvaginal specimen extraction, although some authors accepted it as an exclusion criterion.<sup>9,11</sup> Of 62 patients with available data, 21 (33.8%) underwent previous open or laparoscopic abdominal surgeries, including laparoscopic cholecystectomy, appendectomy, tubal ligation, and open surgeries including hysterectomy, small bowel resection, tubal ligation, appendectomy, bladder repair, cesarean section, cholecystectomy, and gastric bypass. Most patients were of old age and had comorbid diseases (Table 2). Of the total number of patients, 78% had ASA score II or III. Obesity was not a contraindication, and some patients whose body mass indexes were higher than 30 kg/m<sup>2</sup> (up to 50 kg/m<sup>2</sup>) were also included. Most of the patients (83%) had malign or premalign (14%) diseases and required regular or extended right hemicolectomies (Table 3). The remaining benign diseases had also been treated with right hemicolectomies and there was only 1 ileocecal resection for endometriosis. Most authors preferred a total of 4 or 5 trocars (including the vaginal trocar), and there was only 1 case report with a single-incision laparoscopic surgery combined with transvaginal assistance and extraction.<sup>13</sup> Simultaneous organ resections were reported in 4 cases as hysterectomies,<sup>8,14</sup> an oophorectomy,<sup>14</sup> and a sigmoid resection for diverticulitis.<sup>10</sup> The mean operating time and blood loss ranges were 193 (140 to 471) minutes and 62.4 (0 to 300) mL, respectively.

The abdominal parts of the procedures were similar to the conventional laparoscopic right hemicolectomies. The main difference was the patient position, which was the supine split leg or modified lithotomy position to allow a transvaginal route. Laparoscopic right hemicolectomies were performed in a standard manner through vascular control, bowel resections, and intracorporeal anastomosis. Some authors preferred transvaginal assistance during colon resection and anastomosis<sup>7,11,13,14</sup>; however, others

**TABLE 1.** Exclusion Criteria for Transvaginal Extraction of Laparoscopic Right Colon Resections

References	Exclusion Criteria
McKenzie et al <sup>9</sup>	Clinically staged T4 tumor Previous pelvic surgery
Park et al <sup>11</sup>	At preoperative evaluation Narrow vagina History of endometriosis Virginity Major pelvic organ surgery Patient planning pregnancy Cosmetic result is not a concern
Awad et al <sup>12</sup>	During surgery Pelvic adhesion Size disparity of the tumor (> 5 cm)
	At preoperative evaluation Narrow vagina History of endometriosis Virginity
	During surgery Extensive pelvic adhesion Inability to access the cul-de-sac Lesion > 6 cm

completed the resection and anastomosis through abdominal trocars, and used the transvaginal route only for specimen extraction. All authors performed intracorporeal ileocolic anastomosis using laparoscopic staplers. There were various opening methods for the posterior fornix of the vagina (colpotomy) and closing techniques for the cul-de-sac after specimen extraction (Table 4). Some authors reported the assistance of gynecologists during these vaginal procedures.<sup>7,8,12,14</sup>

There were 2 intraoperative complications, sigmoid colon and rectal injuries, and both occurred during the transvaginal extraction of the specimens.<sup>2</sup> They were repaired laparoscopically but required protective ileostomies. Ileus (n: 5) and bleeding (n: 5) were the main postoperative morbidities, and 2 patients for each complication required laparotomy because of an internal hernia and intra-abdominal bleeding. Other complications were treated by nonsurgical methods. There was no mortality in this systematic review and no wound-related complications such as infections or hernias were reported (Table 5). Table 6 summarizes the cumulative results of all studies.

We have compared some available parameters of transvaginal and transabdominal specimen extraction in Table 7. Two comparable studies pointed out that transvaginal extraction took more time during surgery. The amount of blood loss was controversial. There were trends of less postoperative pain and shorter hospital stays in the transvaginal groups. Transvaginal extraction did not increase the rate of morbidities, and there were no reported wound-related complications (infection or incisional hernias) in the transvaginal groups.

**DISCUSSION**

At first, we can comment that a considerable amount of female patients who require right colonic resections can be candidates for transvaginal specimen extraction. Malignancy, previous abdominopelvic surgery, obesity, and old age were not considered as contraindications. Previously, it has been demonstrated that laparoscopic surgery for colorectal cancer is an oncologically effective treatment

TABLE 2. Patient and Publication Details

References	Language	Country	N	Age (y) [Means (Range)]	BMI (kg/m <sup>2</sup> ) [Means (Range)]	Previous Surgery	ASA Score	Comorbidities [N (%)]
Wilson et al <sup>6</sup>	English	England	1	84	NA	NA	NA	NA
Burghardt et al <sup>7</sup>	German	Germany	1	66	22	1	II	NA
Pickron and Cooper <sup>8</sup>	English	USA	1	40	NA	No	NA	1 (100)
McKenzie et al <sup>9</sup>	English	USA	4	75 (68-81)	24.4 (19.8-31.1)	No	NA	3 (75)
Stipa et al <sup>10</sup>	English	Italy	1	73	36	No	NA	1 (100)
Park et al <sup>11</sup>	English	Korea	34	61	23.9	9	I (12), II (18), III (4)	NA
Awad et al <sup>12</sup>	English	USA	14	62 (50-80)	31.6 (18-50)	11	II (1), III (13)	14 (100)
Karahasanoğlu et al <sup>13</sup>	English	Turkey	1	29	27.50	NA	I	No
Franklin et al <sup>2</sup>	English	USA	26	70	NA	NA	NA	NA
Hirukawa et al <sup>14</sup>	English	Japan	7	79 (72-87)	21.9 (18-26)	No	II (2), III (5)	7 (100)

ASA indicates American Society of Anesthesiologists; BMI, body mass index; NA, not available.

modality and offers precise advantages compared with open surgery.<sup>16</sup> The cumulative data did not identify any significant differences between oncologic end points in laparoscopic surgery compared with traditional open techniques.<sup>16</sup> In this analysis, 83% of the right colonic masses were malignant, and all were removed through the vaginal method without any early adverse effects. There was only 1 distant recurrence (lung) reported.<sup>11</sup> To make a more clear comment about transvaginal extraction of a malignant colon cancer, the necessity of a longer follow-up is inevitable. However, it is expected that the transvaginal route does not carry any additional risks for the oncological

results over conventional laparoscopic colorectal surgery, in which the specimen is removed transabdominally. When the same preventive procedures for the oncological principles are carried out during the specimen extraction, the oncological outcomes of the transvaginal and transabdominal extraction methods can be expected to be identical.

Older age and comorbidities can be thought of as limiting factors for NOSE. However, most of the patients in this systematic review were in the older age group up to 87 years old<sup>14</sup> and had significant comorbidities such as chronic renal failure, cerebrovascular accident, myocardial infarct,

TABLE 3. Abdominal Surgery Details

References	N	Diagnosis	Location	Type of Resection	Trocar No	Concomitant Resections	Operating Time [Mean (Range)]	Blood Loss [Mean (Range)]
Wilson et al <sup>6</sup>	1	Carcinoma (1)	Hepatic flexura (1)	RHC (1)	4	No	NA	NA
Burghardt et al <sup>7</sup>	1	Adenoma (1)	Ascending colon (1)	RHC (1)	3	No	192	NA
Pickron and Cooper <sup>8</sup>	1	Endometriosis (1)	Ileocecal (1)	Ileocecal resec- tion (1)	4	Hysterectomy (1)	NA	NA
McKenzie et al <sup>9</sup>	4	Carcinoma (2), adenoma (2)	Right colon (4)	RHC (4)	4	No	212 (156-263)	51 (30-75)
Stipa et al <sup>10</sup>	1	Carcinoma (1) with sigmoid colon diverticular disease	Right colon and sigmoid colon (1)	RHC (1)	NA	Sigmoidectomy (1)	265	Minimal
Park et al <sup>11</sup>	34	Carcinoma (34)	Ascending colon (16), cecum (10), hepatic flexura (8)	RHC (24) ERHC (10)	5	No	170.8	42.5
Awad et al <sup>12</sup>	14	Carcinoma (8), adenoma (4), carcinoid (1), cystadenoma (1)	Right colon (12), cecum (1), appendix (1)	RHC (12) ERHC (2)	5	No	229 (172-360)	93 (0-300)
Karahasanoğlu et al <sup>13</sup>	1	Crohn's disease (1)	Ileocecal (1)	RHC (1)	2	No	140	20
Franklin et al <sup>2</sup>	26	NA (26)	Right colon (26)	RHC (26)	4	No	159	83.3
Hirukawa et al <sup>14</sup>	7	Carcinoma (7)	Ascending colon (5), transverse colon (2)	RHC (5) ERHC (2)	3	Hysterectomy (1), oophorectomy (1)	341.5 (244-471)	32.8 (minimal- 100)

ERHC indicates extended right hemicolectomy; NA, not available; RHC, right hemicolectomy.

**TABLE 4.** Transvaginal Approach Details

References	N	Transvaginal Procedures	Colpotomy Technique	Colpotomy Closure Technique	Gynecologist Assistance
Wilson et al <sup>6</sup>	1	TVE	TV incision without prior trocar placement	Extracorporeal, interrupted	NA
Burghardt et al <sup>7</sup>	1	TVR, TVA, TVE	TV trocar insertion and TV dilatation	Extracorporeal, interrupted	Yes
Pickron and Cooper <sup>8</sup>	1	TVE	Opened during hysterectomy	Extracorporeal, interrupted	Yes
McKenzie et al <sup>9</sup>	4	TVE	TV trocar insertion or TV incision and TV dilatation	Extracorporeal, interrupted	NA
Stipa et al <sup>10</sup>	1	TVE	TV trocar insertion and laparoscopic dilatation	Intracorporeal, running	NA
Park et al <sup>11</sup>	34	TVR, TVA, TVE	TV trocar insertion and laparoscopic dilatation	Extracorporeal, NA	NA
Awad et al <sup>12</sup>	14	TVE	Laparoscopic incision	Intracorporeal, interrupted	Yes
Karahasanoglu et al <sup>13</sup>	1	TVR, TVA, TVE	TV trocar insertion and TV dilatation	Extracorporeal, running	NA
Franklin et al <sup>2</sup>	26	TVE	TV incision without prior trocar placement	Extracorporeal, running	NA
Hirukawa et al <sup>14</sup>	7	TVR, TVA, TVE	TV trocar insertion but dilatation method was NA	Extracorporeal, NA	Yes

NA indicates not available; TVA, transvaginal anastomosis; TVE, transvaginal extraction; TVR, transvaginal resection.

polycythemia vera, diabetes mellitus, atrial flutter, chronic obstructive pulmonary disease, a history of pulmonary embolism, or a history of bilateral lower extremity deep venous thrombosis.<sup>10,12,14</sup> As expected, all these comorbidities and the older age resulted in longer postoperative hospital stays,<sup>10,12,14</sup> but there was no mortality.

At the beginning of the laparoscopic surgery, obesity was considered to be a relative contraindication. In time, it changed from being a contraindication and became a preference criterion for laparoscopic surgery.<sup>17,18</sup> In obese patients, the incidence of wound infection was reduced by laparoscopic colorectal surgery compared with open surgery.<sup>17</sup> Here it was demonstrated that

**TABLE 5.** Results

References	N	Complications	Conversion	Hospital Stay (d) [Mean (Range)]	Tumor Size (cm) [Mean (Range)]	Stage	Follow-up (mo) [Mean (Range)]
Wilson et al <sup>6</sup>	1	No	No	NA	8	NA	NA
Burghardt et al <sup>7</sup>	1	Lower GI bleeding (1)	No	NA	8	Stage 0 (1)	NA
Pickron and Cooper <sup>8</sup>	1	No	No	NA	NA	Endometriosis (1)	19
McKenzie et al <sup>9</sup>	4	Internal hernia (1),* abscess (1), nausea (1)	No	11.5	2.75	Stage 0 (2) Stage II (1) Stage III (1)	NA
Stipa et al <sup>10</sup>	1	No	No	7	NA	Stage II (1)	NA
Park et al <sup>11</sup>	34	Ileus (1), urinary retention (1), hemorrhage requiring transfusion (2)	2	7.9 (6-10)	3.8	Stage I (11) Stage II (16) Stage III (7)	23 (5-40)†
Awad et al <sup>12</sup>	14	Ileus (3), lower GI bleeding (1), intra-abdominal bleeding (1)*	1	9.57 (2-30)	3.75 (1.8-8.0)	Stage 0 (4) Stage I (5) Stage II (2) Stage III (3)	17.8 (8-32)
Karahasanoglu et al <sup>13</sup>	1	No	No	4	NA	Crohn's (1)	NA
Franklin et al <sup>2</sup>	26	Injury to rectum (1), injury to sigmoid colon (1) Atelectasis (1)	No	5.5	NA	NA (26)	NA
Hirukawa et al <sup>14</sup>	7	Minor morbidity (not specified) (1) Cholecystitis (1)	No	12 (6-26)	4.1 (1.3-8.0)	Stage I or II (5) Stage III (2)	7 (1-14)

\*Requiring postoperative laparotomy.

†One patient lung recurrence.

GI indicates gastrointestinal; NA, not available.

**TABLE 6.** Results of the All Available Data

Parameters	Results
Age (y)	
Mean (range)	65.6 (29-87)
BMI (kg/m <sup>2</sup> )	
Mean (range)	25.7 (18-50)
ASA [n (%)]	
I	13 (22)
II	22 (38)
III	22 (38)
NA	33
Comorbidities	
Yes [n (%)]	27 (96)
No	1
NA	62
Prior abdominal surgery [n (%)]	
Yes	21 (34)
No	41 (66)
NA	28
Location [n (%)]	
Appendix	1 (2)
Cecum/ileocecal	13 (28)
Ascending colon	22 (47)
Hepatic flexura	9 (19)
Transverse colon	2 (4)
Right colon not specified	43
Diagnosis [n (%)]	
Carcinoma	53 (83)
Adenoma	7 (11)
Crohn's	1 (1.5)
Carcinoid	1 (1.5)
Cystadenoma	1 (1.5)
Endometriosis	1 (1.5)
NA	26
Resection type [n (%)]	
Ileocecal resection	1 (1)
Right hemicolectomy	75 (84)
Extended right hemicolectomy	14 (15)
No. trocars [n (%)]	
2	1 (1)
3	8 (9)
4	32 (36)
5	48 (53)
NA	1 (1)
Combined resections [n (%)]	
Yes	4 (5)
No	86 (95)
Operating time (min)	
Mean (range)	193 (140-471)
Blood loss (mL)	
Mean (range)	62.4 (0-300)
Complications [n (%)]	
Bleeding	5 (5.5)
Ileus	5 (5.5)
Bowel injury	2 (3.0)
Abscess	1 (1.0)
Urinary retention	1 (1.0)
Cholecystitis	1 (1.0)
Nausea	1 (1.0)
Atelectasis	1 (1.0)
Minor morbidity (not specified)	1 (1.0)
No complication	72 (80)
Conversion [n (%)]	
Yes	3 (4)
No	87 (96)
Hospital stay (d)	
Mean (range)	7.9 (2-34)
Tumor size (cm)	
Mean (range)	3.9 (1.3-8.0)

**TABLE 6.** (continued)

Parameters	Results
Carcinoma stage [n (%)]	
0	7 (8)
I or II	41 (69)
III	13 (21)
Others (endometriosis, Crohn's)	2 (2)
NA	27

obesity was not a contraindication for transvaginal extraction for right colon resections and it could be performed for some morbidly obese patients as well.<sup>12</sup> Panait et al demonstrated that natural orifice surgery is an attractive alternative to laparoscopy in female patients with morbid obesity.<sup>19</sup> They concluded that the labial adipose tissue might cause a slight difficulty in terms of the access to the posterior vaginal fornix during the initial insertion of the 12-mm trocar or during the colpotomy closure. However, they reported that this was a minor drawback and could be overcome with the use of larger vaginal retractors or the placement of a single-arm tenaculum on the uterine cervix.<sup>19</sup> Previous abdominal or particularly pelvic surgery can be thought of as a limitation for transvaginal specimen extraction. However, this analysis demonstrated that even previous pelvic surgeries, such as a hysterectomy or a cesarean section, are not major obstacles for transvaginal extraction.

The vaginal outlet width shows an individual difference among women. Age, previous transvaginal deliveries, and a history of pelvic surgeries can affect vaginal outlet width. What sized masses can be removed through the vagina is still a matter of debate. We can say that transvaginal right-sided colon extractions can be performed if the en-mass size of the specimen is  $\leq 8$  cm and if there is suitable vaginal access (the patient is not a virgin and does not have a narrow vagina) with patient acceptance. The presence of pregnancy is a clear contraindication for transvaginal access. Endometriosis can be a contraindication because of the risk for implantation during extraction (Table 2). However, in this analysis, there was a woman who needed right-sided colonic resection because of the endometrial involvement of the cecum, and her specimen was extracted through her vagina. The patient was well after a 19-month follow-up.<sup>8</sup> A similar study including 11 patients by Boni et al<sup>20</sup> demonstrated the feasibility of laparoscopic left-sided colon and rectum resections with a transvaginal specimen for severe endometriosis. Their results were satisfactory, but the follow-up time was short (a mean of 4 months). We can say that the effects of the presence of endometriosis are still not clear for transvaginal bowel extraction.

There was no conversion to open surgery in this study. Three patients converted to conventional laparoscopy, which required an additional abdominal incision for specimen extraction. In 2 patients vaginal extraction was aborted because of the inadequate size of the posterior colpotomy,<sup>11</sup> and in 1 patient the lesion was found to be larger than the preoperative evaluation.<sup>12</sup> Right-sided colon tumors, particularly when located in the cecum, can be more voluminous than left-sided tumors. Large tumors in the right colon are most problematic for NOSE. Transesophageal or transcolonic extraction is not possible for these tumors, and it appears that the transvaginal route is the only chance and, of course, is only available for women. Measurement of the tumor size by preoperative radiologic evaluation is important for the selection of the patients. Despite the preoperative selection of the patients,

**TABLE 7.** Comparison of Transvaginal and Transabdominal Specimen Extractions After Laparoscopic Right-sided Colon Resection and Intracorporeal Ileocolic Anastomosis

Parameters	Studies	Transvaginal Extraction	Abdominal Extraction	P
Operating time	Park et al <sup>11</sup> (n: 34 vs. 34)	170.8 ± 46.4	146.7 ± 57.2	0.094
	Franklin et al <sup>15</sup> (n: 25 vs. 25)	159 ± 27.1	133.5 ± 29	0.002
Blood loss	Park et al <sup>11</sup> (n: 34 vs. 34)	42.5 ± 34.9	32.3 ± 32.6	0.368
	Franklin et al <sup>15</sup> (n: 25 vs. 25)	83.3 ± 14.4	133 ± 65.5	0.001
Hospital stay	Park et al <sup>11</sup> (n: 34 vs. 34)	7.9 ± 0.8	8.8 ± 1.5	0.003
	Franklin et al <sup>15</sup> (n: 25 vs. 25)	5.5 ± 2.5	5.9 ± 2.2	0.547
Complications	Park et al <sup>11</sup> (n: 34 vs. 34)	Bleeding* (n:2) Bleeding* (n:2) Ileus (n:1) Urinary retention	Wound infection Wound infection Bleeding* (n:2) Bleeding* (n:2) Intra-abdominal abscess Pulmonary infection Pulmonary infection Ileus (n:1) Ileus (n:1)	0.119
	Franklin et al <sup>15</sup> (n: 25 vs. 25)	Rectal injury Sigmoid colon injury Atelectasis Minor morbidity (NA)	Incisional hernia Wound infection Minor morbidity (NA) Minor morbidity (NA)	1.000
Additional analgesia	Park et al <sup>11</sup> (n: 34 vs. 34)	16 (47%)	23 (68%)	0.070
	Franklin et al <sup>15</sup> (n: 25 vs. 25)	NA	NA	NA

\*Required reintervention.  
NA indicates not available.

radiologic evaluations cannot always precisely measure the correct size and sometimes decisions regarding transvaginal extraction can be made during surgery. We believe that more studies are required regarding the relationship between the size of the right-sided colon tumors and the preoperative/postoperative measurement errors to investigate the factors affecting these fallibilities.

When compared with the conventional surgery in 2 case-control studies,<sup>11,15</sup> this systematic review demonstrated some trends in the results (Table 7). The operating time was longer for transvaginal extraction than transabdominal extraction.<sup>11,15</sup> It is possible that opening and closing the posterior fornix was more time-consuming than opening and closing an abdominal incision. There was only 1 study that analyzed postoperative pain and it found that transvaginal extraction resulted with fewer additional analgesics than transabdominal extraction.<sup>11</sup> Hospital stays were shorter for the transvaginal extractions and morbidities were similar.<sup>11,15</sup> For the first time, we cumulated all of the published data related to this novel technique. This early systematic review can guide forthcoming studies, and it is clear that more comparative studies are required for precise comments about the advantages or disadvantages of transvaginal extraction of resected right colon masses.

Laparoscopic resection and transvaginal specimen extraction is a promising technique for some right-sided colon pathologies. An accessible vaginal port (patient acceptance, not a narrow vagina) and an en-mass size ≤ 8 cm are necessary for selection. Malignancy, previous abdominopelvic surgery, obesity, and old age have not been thought of as contraindications.

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