

## Original Article



# Cancer field surgery in endometrial cancer: peritoneal mesometrial resection and targeted compartmental lymphadenectomy for locoregional control

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## OPEN ACCESS

Received: Aug 19, 2020

Accepted: Oct 1, 2020

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### Conflict of Interest

Rainer Kimmig declares Proctoring and  
Presentations for Intuitive Surgical Inc.,  
Advisory Board and Presentations for  
Medtronic; Advisory Board for Medicaroid. The  
other authors declare no conflict of interest.

## ABSTRACT

**Objective:** Peritoneal mesometrial resection (PMMR) plus targeted compartmental lymphadenectomy (TCL) aims at removal of the locoregional cancer field in endometrial cancer (EC). Optimal locoregional control without adjuvant radiotherapy and acceptable surgical morbidity should be achieved concomitantly sparing systematic lymphadenectomy (LNE) for most of the patients.

**Methods:** We evaluated data from 132 patients treated for EC. Out of these, between January 2017 and June 2020 we performed robotic PMMR and TCL on 51 women. We present the first data of feasibility and safety of the procedure as well as preliminary oncological results.

**Results:** The 51 patients treated with robotic PMMR and TCL showed comparable morbidity to classic laparoscopic hysterectomy or PMMR without LNE. One intraoperative complication occurred. Postoperative complications grade 3 and higher occurred in 2 cases (3.9%). One of these (85 years old) experienced grade 5 following pulmonary embolism with lysis therapy. Fifteen patients (29.4%) could be spared complete LNE. The rate of adjuvant radiotherapy was 3.9% in our collective (n=2), compared to 39.2% of patients (n=20) eligible for irradiation according to international guidelines. In a mean follow-up time of 15 months (0–41), no locoregional recurrences were observed, although three patients showed distant relapse.

**Conclusions:** Our data suggest that robotic PMMR and pelvic TCL can be performed regardless of BMI and comorbidities without a relevant increase in surgical morbidity. Moreover, despite a relevant reduction of adjuvant radiotherapy, first follow-up data hint at a favorable locoregional recurrence rate in the reported cohort.

**Keywords:** Endometrial cancer; Cancer field surgery; Peritoneal mesometrial resection; Sentinel lymph node; Targeted compartmental lymphadenectomy

## INTRODUCTION

With around 11,090 newly diagnosed patients per year (forecast for 2020: 11,200), endometrial cancer (EC) is the 4th most common cancer in women in developed countries and the most common female genital cancer entity in Germany [1,2]. In Korea, the age-

**Author Contributions**

Conceptualization: B.P., R.P., M.P., K.R.;  
Data curation: B.P., K.R.; Formal analysis:  
B.P., K.R.; Investigation: B.P., R.P., M.P.,  
K.R.; Methodology: B.P., K.R.; Project  
administration: B.P., K.R.; Supervision: K.R.;  
Validation: K.R.; Visualization: K.R.; Writing  
- original draft: B.P., K.R.; Writing - review &  
editing: B.P., R.P., M.P., K.R.

standardized incidence rate per 100,000 increased from 2.4 in 1999 to 5.7 in 2015 with 2,263 new cases diagnosed in 2015 [3]. Despite the overall good prognosis, around 2,600 women die of the disease every year. In most stages, therapy consists of hysterectomy and bilateral salpingo-oophorectomy, followed by adjuvant radio- or chemotherapy according to risk factors [4]. Still, recurrence rates across all stages are around 13% [5], suggesting a need for improved treatment concepts for this very common entity.

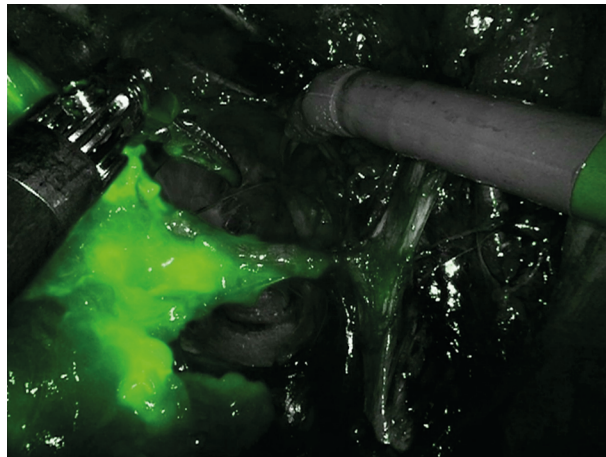
EC originates in the embryologically determined Müllerian Compartment. Organ-compartments are derived from common precursor tissues and are topologically organized in defined structures - the so-called morphogenetic fields [6]. During the development of organs and tissues, compartment borders remain and are rigidly controlled within the organism [7]. According to the ontogenetic theory on carcinogenesis pathological reactivation of normally blocked developmental programs during cancer progression enables the cell to grow outside its own compartment step by step [8]. Whereas tumor growth is therefore restricted to a certain compartment for a long time, increasing malignant progression may thus facilitate tumor spread across compartment borders. The validity of this theory could already be demonstrated for cervical, vulvar and rectal cancer [9-11]. The same principles can be applied to the spread of tumor cells to the regional lymph vessels, which belong to the tumor bearing compartment and originate in the embryonal veins [12]. As the regional lymph nodes own the same topical information, the entire locoregional lymph compartment is permissive for growth and spread of tumor cells derived from the drained tissue compartment.

The aim of ontogenetically defined surgical techniques is thus to achieve optimal locoregional control by complete resection of the tumor-bearing (and permissive) compartment ("cancer field"). For cervical and vulvar cancer, the techniques of total mesometrial resection and therapeutic lymphadenectomy (TMMR+tLNE) and of vulvar field resection (VFR) were developed and described on the basis of these concepts [13]. The unicentric data published so far convincingly support the expectation of excellent locoregional control without adjuvant irradiation [14,15].

In EC, removal of the cancer field consists in complete resection of the Müllerian compartment except of the vagina including the regional draining primary lymph compartments containing the first line nodes. The resulting technique of peritoneal mesometrial resection (PMMR) by minimally-invasive, robot-assisted surgery was published in 2013 [16]. First data including therapeutically intended systematic lymphadenectomy (LNE) indicate excellent locoregional tumor control rates even without postoperative radiotherapy [17].

However, a question of ongoing debate is the role of LNE in the surgical treatment of EC due to enhanced perioperative morbidity and development of lymphedema [18]. Usually, indication for LNE is based on the risk for lymph node metastases. For tumors with a high risk of nodal involvement, complete pelvic and paraaortic LNE is still the guideline recommendation [4,19]. Nevertheless, diagnostic sentinel-LNE has become a worldwide standard due to excellent data regarding sensitivity and safety [20,21]. For the detection of sentinel-nodes indocyanine green (ICG) is regarded as safe and reliable [22-24].

As a consequence, systematic LNE for diagnostic purposes should be replaced by sentinel node detection. However, with respect to therapeutic efficacy it may leave lymphatic tissue



**Fig. 1.** Preparation of right vascular mesometrium.

and eventually lymph-nodes, at risk between tumor and sentinel node in situ since they belong to the locoregional cancer field at risk. A resection of selected nodes only, therefore, violates the therapeutic aspect of compartmental cancer field resection. Since in case of negative sentinel nodes involvement of further downstream nodes is extremely unlikely, the original concept of PMMR and complete therapeutic pelvic and paraaortic LNE has been adapted to a technique of targeted compartmental lymphadenectomy (TCL). This aims to resect the first line nodes only including the cancer field in continuity from tumor to the nodes identified by the ICG stained draining lymphatic channels and sentinel nodes.

At least the first two draining nodes in series will be removed in each channel together with the draining lymphatics after visualization by ICG corresponding usually to about 4 nodes each pelvic side. Technique of dissection for this series of published data is shown in the video attached in the appendix. **Fig. 1** shows the preparation of the right vascular mesometrium. Thus, the entire locoregional cancer field including the first line nodes is removed, leaving no tissue at risk in situ.

If it could be shown, that surgical morbidity of PMMR+TCL is expectedly low, it may be assumed that it could be offered to all EC patients independent of their preoperative risk profile. Undertreatment of patients who are incorrectly considered “low-risk” before surgery could be avoided. On the other hand, the lymph-node negative patients can be spared the morbidity of systematic LNE maintaining excellent locoregional control.

## MATERIALS AND METHODS

### 1. Retrospective control groups

First, as a basis data of our first analysis of cancer field surgery (CFS) in EC [25] were updated increasing mean observation time from 24 to 60 months for comparison and analysis of site and time kinetics of recurrences.

In total, 132 patients were treated for EC stage I-IV by different approaches listed below: The results of our 51 patients analyzed for PMMR and TCL were compared to those of the following groups (for characteristics and clinical stages compare **Table 1** and **Supplementary Table 1**):

**Table 1.** Cohort characteristics

Variables	PMMR+TCL (n=51)	PMMR (n=25)	PMMR+LNE (n=36)	TLH for endometrial cancer (n=20)	TLH for benign conditions (n=262)
Age at surgery (yr)	60.6 (29, 85; 12.1) [n=51]	54.6 (32, 71; 8.9) [n=25]	56.8 (25, 81; 13.3) [n=36]	65.6 (45, 91; 13.2) [n=20]	47.6 (28, 78; 9.1) [n=262]
BMI (kg/m <sup>2</sup> )	35.4 (19, 62.4; 10.4) [n=31]	35.0 (18, 62; 13.1) [n=24]	31.2 (20, 57; 9.6) [n=34]	32.9 (17, 56; 10.5) [n=18]	25.8 (17, 48; 5.1) [n=105]
Skin-to-skin time (min)	176.6 (108, 410; 50.0) [n=51]	177.6 (109, 348; 67.0) [n=25]	373.0 (119, 614; 103.0) [n=36]	129.6 (59, 191; 43.2) [n=20]	117.9 (41, 610; 53.4) [n=234]
Length of stay (days)	6.7 (3, 21; 3.6) [n=51]	7.6 (4, 20; 3.5) [n=25]	10.4 (5, 36; 6.1) [n=36]	9.0 (4, 31; 6.2) [n=20]	5.7 (1, 16; 2.3) [n=262]
Hb decrease (g/dL)	2.7 (0.7, 5.9; 0.99) [n=51]	2.0 (0.1, 4.0; 1.1) [n=25]	2.3 (-1.5, 5.8; 1.4) [n=36]	1.2 (-0.3, 2.9; 1.2) [n=20]	1.7 (-6, 4.5; 1.2) [n=242]
Uterus weight (g)	n.a.	201.0 (40, 784; 185.6) [n=19]	181.3 (68, 364; 82.9) [n=26]	119.1 (54, 220; 58.1) [n=18]	185.0 (27, 729; 129) [n=214]

All values are given as mean (min, max; standard deviation).

BMI, body mass index; Hb, hemoglobin; LNE, lymphadenectomy; PMMR, peritoneal mesometrial resection; TCL, targeted compartmental lymphadenectomy; TLH, total laparoscopic hysterectomy.

- Thirty-six patients underwent robotic PMMR and systematic LNE between 2010 and 2015. Mean follow up time was 55.5 months (0–114; standard deviation [SD] 35.8).
- Twenty-five patients received robotic PMMR without LNE between 2010–2014. Mean follow up for this cohort was 62.0 months (0–106; SD 33.1).
- Twenty patients were treated by minimally-invasive (robotic or conventional laparoscopy) simple hysterectomy for EC during this time period. Mean follow up was 34.0 months in this group (0–116; SD 37.6).

To compare morbidity of MIS in simple hysterectomy treated in our clinic data of the following patients were analyzed:

- Two hundred sixty-two patients received classic laparoscopic hysterectomy for benign indications between 2001 and 2015.

## 2. PMMR+TCL collective 2017–2019

As outlined, we adapted surgical concept of treatment of EC to the robotically assisted pelvic PMMR and TCL. 51 patients with EC FIGO stage I–III were included in the analysis. Mean patient age was 60.6 years (29–85; SD 12.1). Patients had a mean BMI of 35.4 kg/m<sup>2</sup> (19.0–62.4; SD 10.4). Most patients (n=44; 86.3%) suffered from EC FIGO stage I, 2 patients had stage II and 5 had stage III disease (lymph node involvement). Histopathological subtype was endometrioid adenocarcinoma in 41 patients (80.4%) and non-endometrioid in 8 patients (15.7%). In two patients no residual tumor was found in the surgical specimen.

Surgery was performed by one surgeon in all cases. All patients gave written, informed consent to the procedure after being educated about the underlying concept and available data.

Generally, no adjuvant radiotherapy was recommended after compartment-based CFS. However, patients who had a recommendation for adjuvant irradiation according to actual guidelines were offered to see a radiotherapist to discuss the indication. Recommendation for systemic therapy was given according to international guidelines.

Clinical and follow-up data were collected from our institution's own clinical information system and patient-files. In case of missing follow-up data patients were contacted to acquire information on health status and survival. Mean follow up for these patients was 15 months (0–41).

ICG was applied to the corpus myometrium. An IOWA trumpet as used for pudendal anesthesia in obstetrics was inserted into the corpus transcervically and a total of 2 mL ICG-solution (1.66 mg/mL) was injected into 4 different sites, fundus right/left and midcorporal

right/left, 0.5 mL/each. In order to avoid perforation and thus contamination of the situs, injection was performed under laparoscopic visual control following coagulation of the fallopian tubes. Cervical channel was closed by a suture and additionally by an alcohol sponge to prevent cell spilling.

Preparation follows the steps described for PMMR [16] restricted to the pelvic region (**Supplementary Video 1**). TCL in the mesonephric compartment (following the ovarian vessels including the first line paraaortic nodes) is only performed in the presence of risk factors for isolated positive paraaortic nodes such as G3/>50% myometrial invasion as originally demonstrated in 2017 [26].

Systematic pelvic and paraaortic LNE was recommended to patients with positive sentinel nodes (TCL) in a second procedure.

## RESULTS

### 1. Surgical morbidity

#### *PMMR+TCL cohort 2017–2020*

Mean length of stay was 6.7 days (3–21; SD 3.6) and skin-to-skin time 176.6 minutes (108–410; SD 50.0). Patients suffered a mean decrease in hemoglobin levels of 2.7 g/dL (0.7–5.9; SD 0.99) calculated as the difference between preoperative and first postoperative day. A mean number of 9 lymph nodes was removed during TCL (2–25; SD 5.4).

Intraoperative complication occurred in one patient (intraoperative injury of the bladder) and was sutured immediately without any sequelae.

Postoperative complications were observed in 7 patients (13.7%). These included postoperative infections with need for antibiotic treatment (n=3), superficial hematoma of trunk and labia (n=1), deep vein thrombosis/peripheral pulmonary embolism (n=1), transfusion for postoperative anemia, postoperative bleeding following lysis for pulmonary embolism (n=1) and severe abdominal pain leading to revision for successful exclusion of bowel perforation (n=1). Altogether, two patients had revision surgery. The 85 years old patient following pulmonary embolism with lysis therapy and consecutive extensive bleeding died on the intensive care unit on the third postoperative day.

Taking into account the severity of postoperative complications according to the Clavien-Dindo classification [27], two complications (3.9%) had to be classified as grade 3 and higher of which one (2%) did not reveal any pathology at revision surgery.

#### *EC patients treated by simple hysterectomy or PMMR +/- systematic LNE*

Simple hysterectomy was performed via conventional laparoscopy in 8 cases and robotically assisted in 12. All PMMR procedures were performed robotically assisted.

Mean length of stay was 9.0 days (4–31; 6.2) after simple hysterectomy, 7.6 days (4–20; 3.5) after PMMR without LNE compared to 10.4 days (5–36; 5.9) after PMMR + LNE. Skin-to-skin times for the three groups were 129.6 min (59–191; 43.2), 177.6 min (109–348; 67.0) and 373.0 min (119–614; 103.0), respectively.

**Table 2.** Surgical morbidity

Variables	PMMR+TCL (n=51)	PMMR (n=25)	PMMR+LNE (n=36)	TLH for endometrial cancer (n=20)	TLH for benign conditions (n=262)
Intraoperative complications	1 (2.0)	0	0	0	7 (2.7)
Postoperative complications	7 (13.7)	1 (4.0)	4 (11.1)	2 (10.0)	20 (7.6)
Complications $\geq$ Grade 3	2 (3.9)	0	1 (2.8)	1 (5.0)	5 (1.9)

Values are presented as number (%).

LNE, lymphadenectomy; PMMR, peritoneal mesometrial resection; TCL, targeted compartmental lymphadenectomy; TLH, total laparoscopic hysterectomy.

No intraoperative complications were observed in neither simple hysterectomy nor PMMR with or without systematic LNE.

Two patients after simple hysterectomy showed complications (10.0%), one of these was classified as  $\geq$ grade 3 (5.0%). This was the case in an 84-year-old patient who experienced myocardial infarction and pneumonia with subsequent sepsis and died 11 days after surgery.

Postoperative complications were rare in PMMR alone (n=1; 4.0%. Mild wound infection. No  $\geq$ grade 3 complications).

Out of the patients treated with PMMR+systematic LNE, 4 (11.1%) experienced postoperative complications, one of which (2.8%) had to be classified as  $\geq$ grade 3. This patient required revisional surgery for abscess formations in the iliac regions.

#### *Simple hysterectomy for benign conditions*

Two hundred sixty-two patients underwent simple laparoscopic hysterectomy for benign conditions. Mean skin-to-skin time was 117.9 minutes (41–610; SD 53.4) and mean length of stay 5.7 days (1–16; SD 2.3). Postoperative complications occurred in 20 patients (7.6%), 5 of those being classified as grade 3 or higher (1.9%). Seven intraoperative complications (2.7%) occurred during hysterectomy for benign conditions. An overview of the surgical morbidity of all groups is given in **Table 2**.

## **2. Oncologic safety**

Information on adjuvant treatments was available for all patients with EC. In the PMMR+TCL group, 2 patients (4.4%) received irradiation and 7 patients (15.6%) chemotherapy. The 2 patients (FIGO IIIC) receiving irradiation both had relevant lymphonodular involvement (5/8 and 6/22 nodes, respectively). Both patients refused additional systematic pelvic and paraaortic LNE and chose percutaneous radiochemotherapy. In the PMMR without LNE and PMMR with systematic LNE groups, rates of adjuvant radiotherapy were 8.0% and 11.2%, respectively. No radiotherapy was administered after simple hysterectomy.

For the PMMR+TCL group, follow-up data were still immature at the time of analysis. In a mean follow-up time of 15 months (0–31), three distant recurrences were observed (5.9%). Two of the patients experiencing recurrence were primarily classified with FIGO stage IIIC (6/22 and 3/17 nodes positive, respectively). One of these women presented with disseminated cerebral and bone metastasis currently undergoing palliative chemotherapy and irradiation. The other presented with pleural carcinomatous effusion 5 months after adjuvant chemotherapy currently receiving palliative chemotherapy. The third patient with a pT1a, G3 tumor experienced an epileptic seizure with consecutive diagnosis of a cerebral metastasis 7 months after surgery currently without evidence of disease following surgical resection and irradiation. No locoregional recurrences were observed so far.

**Table 3.** Oncologic outcome

Variables	PMMR+TCL (n=51)	PMMR (n=25)	PMMR+LNE (n=36)	TLH for endometrial cancer (n=20)
Recurrences	3 (5.9)	1 (4.0)	6 (16.7)	1 (5.0)
Follow-up time (mon)	15.0	62.0	55.5	34.0
Deaths	1 (2.0)	0	7 (19.4)	8 (40.0)
Mean time to recurrence (mon)	8.3	30.0	11.2	4.0

Values are presented as number (%) unless otherwise indicated.

LNE, lymphadenectomy; PMMR, peritoneal mesometrial resection; TCL, targeted compartmental lymphadenectomy; TLH, total laparoscopic hysterectomy.

**Table 4.** Recurrence patterns

Variables	PMMR+TCL (n=51)	PMMR (n=25)	PMMR+LNE (n=36)	TLH for endometrial cancer (n=20)	Total (n=132)
Distant recurrences including peritoneal carcinosis	3 (5.9)	1 (4.0)	4 (11.1)	1 (5.0)	9 (6.8)
Locoregional recurrences	0	0	2 (5.6)	0	2 (1.5)

Values are presented as number (%).

LNE, lymphadenectomy; PMMR, peritoneal mesometrial resection; TLH, total laparoscopic hysterectomy.

One patient (4.0%) after PMMR without LNE recurred, whereas in the PMMR+LNE group the recurrence rate was 16.7% (n=6). Of the 20 patients treated by simple hysterectomy, one patient (5.0%) experienced a recurrence.

Notably, in the 132 patients only two locoregional recurrences were observed, which occurred in the PMMR+LNE group, both cured by salvage treatment. All other recurrences represented systemic disease with distant metastases or peritoneal carcinosis. Oncological outcomes and recurrence patterns are summarized in **Tables 3** and **4**.

### 3. Effect of PMMR+TCL on adjuvant treatment strategy

To assess the effect of the concept of PMMR+TCL on the treatment strategy for EC patients, we compared the treatment patients received to the actual German S3 and ESMO-ESGO-ESTRO guideline recommendations. Patients who had an indication for systematic LNE but were confirmed node-negative by TCL were counted as “LNE spared.” Patients who had an indication for adjuvant radiotherapy but did not receive irradiation due to the concept of cancer field resection were counted as “radiotherapy spared.”

Following these definitions, 15 patients (29.4%) could be spared complete LNE. Eighteen patients (35.3%) would have been eligible for adjuvant radiotherapy following conventional hysterectomy but went without irradiation according to the compartment-based concept of PMMR+TCL. The rate of adjuvant radiotherapy was 3.9% in our collective (n=2), compared to 39.2% of patients (n=20) who would have otherwise been irradiated according to international guidelines. Postoperative therapies are summarized in **Table 5**.

**Table 5.** Postoperative therapy

Variables	PMMR+TCL (n=51)	PMMR (n=25)	PMMR+LNE (n=36)	TLH for endometrial cancer (n=20)
Observation	42 (82.4)	22 (88.0)	15 (41.7)	17 (85.0)
Radiotherapy alone	0	2 (8.0)	2 (5.6)	0
Chemotherapy alone	7 (13.7)	1 (4.0)	17 (47.2)	2 (10.0)
Chemo+radiotherapy	2 (3.9)	0	2 (5.6)	0

Values are presented as number (%).

LNE, lymphadenectomy; PMMR, peritoneal mesometrial resection; TCL, targeted compartmental lymphadenectomy; TLH, total laparoscopic hysterectomy.

## DISCUSSION

CFS is based on the findings of compartmental order of tissues according to the ontogenetic development [9]. Cancer progression is understood as a process of dedifferentiation [28]. This in line with recent findings in pulmonary cancer [29]. The consistency of this theory as proof of concept has been already shown convincingly for cervical, vulvar and rectal cancer [10,13]. With respect to EC the approach of CFS has been described as PMMR including the lymphatic draining system [16]; First data of efficacy were published for PMMR and therapeutically intended pelvic and paraaortic LNE [17].

Meanwhile, it has been shown that pelvic sentinel node biopsy may predict lymph node involvement with high accuracy in EC [20,21]. Therefore, the concept of CFS has been adapted. The cancer field will be resected in continuity with the lymphatic draining system including the pelvic first line nodes only, detected by “extended” sentinel node labelling. The method has been described as PMMR with TCL [26].

We present the first data regarding surgical morbidity, effect on treatment strategy and preliminary oncologic outcome for the concept of PMMR+TCL for EC. To put these data into perspective, we compared them with differently operated cohorts of EC patients.

Regarding surgical morbidity, patients treated by PMMR and TCL had the shortest length of stay of all EC patients and stayed only one day longer than women after simple laparoscopic hysterectomy for benign conditions.

The concept of PMMR+TCL aims at combining optimal locoregional control and oncologic safety with acceptable morbidity. We, therefore, focused on morbidity and the effect this concept on adjuvant treatment and outcome for every individual patient.

No conversion to laparotomy was necessary in our collective. Iavazzo and Gkegkes [30] reported a conversion rate of 4.1%. In a metaanalysis including 2,769 obese patients treated by robot-assisted hysterectomy, Cusimano et al. [31] showed a conversion rate of 5.5% in 10,800 robotically treated EC patients with obesity. Despite still small numbers, the ability to perform PMMR+TCL using a minimally-invasive, robot-assisted approach even in high-BMI patients (up to 62.4 kg/m<sup>2</sup>) indicates technical feasibility independent of the patient's physical constitution. This seems especially important for EC patients, a cohort that usually presents with rather high age, high prevalence of comorbidities and obesity.

In our cohort, the incidence of complications Clavien-Dindo grade  $\geq$ III was 3.9%. This seems acceptable when compared to data available from the literature.

For classic laparoscopy, Walker et al. [32] reported results from 1,696 patients treated by laparoscopic hysterectomy and salpingo-oophorectomy in the GOG-LAP2 study. Of note, a conversion rate to laparotomy of 25.8% is reported indicating inferior feasibility of classical laparoscopic surgery compared to the robotic approach. The postoperative rate of moderate/severe postoperative complications in Walker's collective was 14%. In a randomized controlled trial of laparoscopic vs. robot-assisted surgery in EC including 99 patients, Mäenpää et al. [33] found a rate of 10% major early complications in the robotic group. In a retrospective study of 251 patients with robotic surgery in EC, Bogani et al. [34] reported postoperative complications of grade  $\geq$ 3 in 3.2% of patients. Even though comparison of



retrospective data on postoperative complications is difficult due to inconsistent definitions and incomplete documentation it seems reasonable to say that the higher surgical radicalness of PMMR+TCL did not increase severe complications compared to simple robotic hysterectomy in EC patients. Moreover, length of stay is considerably shorter in international patient collectives compared to Germany enhancing the risk of underestimating systematically mild complications in retrospective international studies.

As stated above, 2 patients experienced complications of grade III and V needed revision surgery.

In a statewide database analysis including 1,338 robotic hysterectomies performed for benign indications in Michigan, USA, Swenson et al. found a reoperation rate of 2%. However, as one patient in our collective suffered a thromboembolic complication with subsequent lysis therapy and uncontrollable bleeding and the other was operated without any organic pathological finding, both cases of reoperation are unlikely to represent specific risks of the method. Accordingly, also in the group treated with simple laparoscopic hysterectomy, one fatal case of myocardial infarction and pneumonia occurred. In the 262 patients receiving classic laparoscopic hysterectomy for benign conditions, the rate of severe postoperative complications was lowest (1.9%) with one surgical revision (0.4%) and no fatal outcome. The risk of death related to surgery might therefore reflect the specific vulnerability of EC patients.

All patients received TCL in our cohort, regardless of preoperative indication according to current international guidelines. Of the four patients with positive lymph nodes, one woman with pT1a, G2 carcinoma would not have been recommended to undergo LNE, supporting the rationale to perform TCL even in low-risk patients, having in mind up to 10% positive sentinel nodes in this group [AbuRustum 2020]. All node-positive patients decided against systematic LNE. Three received adjuvant chemotherapy and two postoperative irradiation. Another nine patients could be spared complete LNE as they had an indication for LNE according to guidelines but were proven node-negative by TCL. This is very relevant given the high morbidity of pelvic and paraaortic LNE in a high-risk patient collective [18,35,36].

In 15 cases, postoperative radiotherapy was omitted with respect to the resection of the cancer field, reducing the rate of postoperative irradiation from 33.3% to 3.9%. Thus, early and late toxicities of pelvic irradiation could be avoided for a relevant number of individuals.

Oncologic outcome data are still immature in our collective with a mean follow-up time of 15 months. However, no locoregional recurrences were observed with a maximum follow-up of 41 months. It has to be mentioned that 6 out of the 7 recurrences which we observed in our PMMR +/- systematic LNE patients (follow-up of 62.0 and 55.5 months, respectively), occurred within the first 24 months. Two of these were locoregional recurrences (vaginal cuff and iliac lymph nodes) and could apparently be cured by salvage surgical and radio(chemo)therapy. The patient with the iliac node recurrence, however, died in a septic shock of unknown etiology three years after the recurrence. Having in mind that adjuvant radiotherapy was spared from almost one third of our patients the observation that 2/132 patients (1.5%) developed locoregional recurrence only might hint at a good local control by CFS in EC. Further studies with longer follow-up times will have to confirm this trend. In this regard, we would like to mention the European Multicentric Observational Study on PMMR+TCL (NCT04504006; German Clinical Trials Register identifier DRKS00016541) open for recruitment.

In summary, our data suggest that robotic PMMR and pelvic TCL can be safely performed in EC patients even with respect to BMI and comorbidities. Moreover, despite a relevant reduction of adjuvant radiotherapy compared to current guideline recommendations, first follow-up data do not show any locoregional recurrences so far in the reported cohort, which is in line with the findings in cervical, rectal and vulvar cancer following CFS.

## ACKNOWLEDGMENTS

We gratefully thank the patients for their participation and their consent to the anonymous publication of their data.

## SUPPLEMENTARY MATERIALS

### Supplementary Video 1

Cancer Field Surgery in Endometrial Cancer: PMMR and pelvic TCL targeted by ICG

[Click here to view](#)

### Supplementary Table 1

Disease stages

[Click here to view](#)

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