Thieme

Impact of Introducing a PACU24 Concept on the Perioperative Outcome of Patients with Advanced Ovarian Cancer Treated with Cytoreductive Surgery

Einfluss der Einführung eines PACU24-Konzepts auf das perioperative Outcome von Patientinnen mit zytoreduktiver Operation unter Anwendung des Fast-Track-Konzepts bei fortgeschrittenem Ovarialkarzinom

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ABSTRACT

Introduction Patients with ovarian cancer who undergo multivisceral surgery usually require intensive care monitoring postoperatively. In view of the ever-fewer numbers of high-care/intensive care beds and the introduction of fast-track treatment concepts, it is increasingly being suggested that these patients should be cared for postoperatively in 24-h Post Anesthesia Care Units (PACU24). No analyses have been carried out to date to investigate whether such a postoperative care concept might be associated with a potential increase in postoperative complications in this patient cohort.

Methods A PACU24 unit was set up in our institution in 2015 and it has become the primary postoperative care pathway for patients with ovarian cancer who have undergone cytoreductive (debulking) surgery. A structured, retrospective analysis of data from patients treated before (control group) and **after** (PACU group) the introduction of this care concept was carried out, with a particular focus on postoperative complications and secondary admission to an intensive care unit where necessary.

Results The data of 42 patients were analyzed for the PACU group and 45 patients for the control group. According to the analysis, the preoperative and surgical data of both groups

were comparable (age, ASA, BMI, FIGO stage, duration of surgery, blood loss). The Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM score) as a measure for the risk of postoperative complications was higher in the PACU group (11.1 % vs. 9.7 %, p = 0.001). Patients in the PACU group underwent bowel resection with anastomosis significantly more often (76.3 % vs. 33.3 %, p < 0.001), although the extent of surgery was otherwise comparable. The total number, type and severity of postoperative complications and the duration of the overall stay in hospital did not differ between the two groups. None of the patients required secondary transfer from the PACU or normal ward to an intensive care unit (ICU).

Summary Our data support the assumption that the care concept of transferring patients to a PACU24 represents a safe and cost-saving care pathway for the postoperative care of patients even after complex gynecological-oncological procedures.

ZUSAMMENFASSUNG

Einleitung Patientinnen mit Ovarialkarzinom und multiviszeralen Eingriffen bedürfen in der Regel einer postoperativen intensivmedizinischen Überwachung. Bei zunehmend angespannten Ressourcen bezüglich High-Care-Intensivbetten und gleichzeitiger Einführung von Fast-Track-Behandlungskonzepten wird eine postoperative Betreuung auch dieser Patientengruppe in 24-h Post Anesthesia Care Units (PACU24) propagiert. Analysen, ob ein solches postoperatives Versorgungskonzept mit einer eventuellen Zunahme von postoperativen Komplikationen in diesem Patientenkollektiv vergesellschaftet ist, liegen bisher nicht vor.

Methoden In unserer Institution wurde 2015 eine PACU24-Einheit eingeführt und für Patientinnen mit Ovarialkarzinom und einer zytoreduktiven (Debulking-)Operation als primärer postoperativer Behandlungspfad implementiert. Es erfolgte eine strukturierte, retrospektive Analyse der Patientendaten vor (Kontrollgruppe) und **nach** (PACU-Gruppe) Einführung dieses Behandlungskonzepts insbesondere in Bezug auf postoperative Komplikationen und gegebenenfalls notwendige, sekundäre Aufnahme auf eine Intensivstation.

Ergebnisse In der PACU-Gruppe wurden 42 Patientinnen analysiert und in der Kontrollgruppe 45 Patientinnen. Beide Gruppen zeigten in der Analyse vergleichbare präoperative und chirurgische Daten (Alter, ASA, BMI, FIGO-Stadium, Dauer der Operation, Blutverlust). Der „Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity“ (POSSUM-Score) als Maß für das Risiko bezüglich postoperativer Komplikationen war in der PACU-Gruppe höher (11,1 % vs. 9,7 %, p = 0,001). Patientinnen aus der PACU-Gruppe erhielten relevant häufiger Darmresektionen mit Anastomosen (76,3 % vs. 33,3 %, p < 0,001) bei sonst vergleichbarem Operationsumfang. Die Gesamtzahl, Art und Schweregrad der postoperativen Komplikationen und die Dauer des Gesamtkrankenhausaufenthalts unterschied sich in beiden Gruppen nicht. Keine Patientin musste sekundär von PACU oder Normalstation auf Intensive Care Unit (ICU) verlegt werden.

Zusammenfassung Unsere Daten unterstützen die Annahme, dass das Behandlungskonzept einer PACU24 einen sicheren und ressourcensparenden Behandlungspfad für die postoperative Versorgung von Patientinnen auch nach komplexen gynäkoonkologischen Eingriffen darstellt.

Introduction

Ovarian cancer is the second most common malignant disease of the female sexual organs. With an age-standardized death rate of 6.5 per 100 000 women, patients with this diagnosis have the highest mortality rates of all gynecologic tumors [1]. This is primarily because the diagnosis often comes very late as patients remain asymptomatic for a long period of time and the peritoneal tumor burden in late-stage disease is high. The gold standard of treatment for advanced ovarian cancer is cytoreductive surgery (debulking) and platinum-based chemotherapy [2, 3]. The most important prognostic factor for every individual patient is an absence of macroscopically visible tumors following surgery [3]. Because of the peritoneal spread of tumors throughout the abdomen, surgery often includes extensive deperitonealization of the lesser pelvis, colonic groove, and diaphragm. Multivisceral surgery is also usually necessary to achieve a tumor-free status. In addition to bilateral adenectomy surgery usually includes radical hysterectomy, resection of parts of the small and large intestine, the deep rectum, the spleen, der gallbladder, parts of the liver, an infragastric omentectomy, the resection of bulky nodes, as well as systematic paraaortic and pelvic lymphadenectomy in the early stage of disease [4]. Another very important prognostic factor is currently the time between diagnosis/debulking and the start of adjuvant chemotherapy [5]. Because of the extent of surgery, the postoperative phase after multivisceral surgery is characterized by an extensive inflammatory systemic response, which can result in a high complex morbidity rate of more than 30% (grade II to V using the Clavien-Dindo classification) [6, 7]. This high rate of complications means that providing the best possible perioperative care along with rapid postoperative rehabilitation is particularly important. The goal is to reduce direct postoperative complications, specifically with regards to morbidity and mortality rates, as well as ensuring that the time to the start of adjuvant chemotherapy is as short as possible as this will also improve prognosis. A number of different fast-track concepts have been developed to optimize perioperative treatment after extensive abdominal-surgical interventions/procedures. The best known of these are the standardized therapy regimens of the ERAS society. They are evidence-based, multimodal treatment concepts which require extremely close interdisciplinary and interprofessional cooperation. This applies especially to the cooperation between gynecologists, anesthesiologists, nursing staff and physiotherapists. Providing

detailed preoperative information to the patient and preparing the patient, avoiding inappropriate periods of preoperative fasting and colonic irrigation, using surgical techniques which are as atraumatic as possible, early mobilization, early postoperative enteral nutrition, avoidance or early removal of wound drainages and feeding tubes, and optimized opioid-sparing pain therapy based on the use of epidural anesthesia all depend on a good interaction between these different medical professionals [8, 9, 10, 11, 12, 13, 14]. The concept was first introduced for colorectal surgery [15]; after its successful implementation, the concept was expanded and introduced in many other medical areas including cardiac, thoracic, and vascular surgery, urology, orthopedics, and gynecology. Although studies have confirmed the superiority of fast-track strategies as they reduce morbidity, shorten the time patients spend in hospital, reduce the number of readmissions to hospital wards, and improve patient satisfaction [16, 17], the implementation in Germany has been rather slow. In gynecology, the fast-track concept was strongly promoted for patients with epithelial ovarian cancer [18, 19]. As the number of high-care beds in intensive care units is increasingly limited, postoperative care of these patients in a PACU24 is being pushed. The main goal of our PACU24 was an interdisciplinary and interprofessional implementation of all the previously described elements of the fast-track concept with a primary treatment goal of reducing postoperative complications. Implementation of the PACU24 concept could save limited resources with regards to the number of intensive care beds available in Germany, and continuous anesthesia treatment should reduce the number of patient handovers where patient information can be lost, as patients spend no time in an intensive care unit after surgery before being transferred to a regular ward [20]. Necessary decision-making processes are more stringent, and reaction times, for example in cases with secondary bleeding, are shorter due to the ward's vicinity to operating theater. One of the concerns that has been raised about this approach is that if treatment is only carried out in the recovery room, even if it is done in accordance with the PACU24 concept, the result could be undertreatment, especially in view of the very high surgical invasiveness of the procedure, which would increase the risk for patients. The aim of this study was therefore to evaluate whether:

1. caring for patients with ovarian cancer who have undergone debulking surgery in a PACU24 results in an increase in postoperative complications or a rise in postoperative in-hospital mortality compared to classic care provided to these patients in an intensive care unit using a fast-track concept, and
2. to confirm that treatment in a PACU24 does not lead to a longer in-hospital stay;
3. the already implemented fast-track concept can also be implemented in a PACU24.

Methods

Study design

This study was approved by the appropriate ethics commission of the Hamburg Medical Council (PV190504). Written consent for us to collect and analyze the data was obtained from every patient.

Initially, the majority of patients who underwent multivisceral surgery received postoperative care in a high-care intensive care unit. Starting on December 1, 2015, we set up an interdisciplinary 24 h Post-Anesthesia Care Unit (PACU24).

The essential difference between the two historic patient cohorts was that from 01.12.2015, patients were moved to the PACU24 immediately after surgery for subsequent care.

This observational study consists of an analysis of retrospectively collected data from 42 patients who underwent cytoreductive (debulking) surgery for ovarian cancer or ovarian cancer recurrence with planned multivisceral resection **after** the introduction of a postoperative treatment regimen in a PACU24 unit (study group). Their data were compared with the data from a historic control group of 45 patients with the same indications for surgery treated **before** the introduction of the PACU24 treatment pathway (control group).

Between 1 December 2015 and 31 December 2016, 53 patients were prospectively included in the PACU group. All patients with planned debulking surgery in this period were earmarked for the PACU24 treatment pathway. Eleven of these patients had to be excluded from the final analysis due to incomplete datasets. A total of 42 patients were included in the final data analysis. The patient files of 51 patients treated between 1.01.2015 and 30.11.2015 were reviewed for the pre-PACU control group. Six patients were excluded due to incompleteness of the datasets as defined for the data analysis; the data of 45 patients was entered in the final analysis.

Study groups and treatment strategies

The introduction and implementation of a fast-track concept in our department was accomplished in several stages. Necessary elements of the surgical fast-track concept which includes preoperative preparation, perioperative management, and postoperative care in a normal ward using standard operating procedures (SOP) were specified for both study groups. Since 2010, for example, preoperative care began to dispense with colonic irrigation, administering mini enemas instead; intraoperatively, a restrictive (2–4 ml/kgKG/h) fluid management regimen was followed with fluids administered by infusion of crystalloid solutions using functional hemodynamic monitoring, and a strict pain therapy regimen (preferably administered via an epidural catheter) was implemented and as few wound drainages as possible were used. Postoperatively, in addition to ensuring that adequate pain therapy was continued, the focus was on early mobilization as well as rapid transition to a normal diet for patients.

▶**Table 1** Demographic data and perioperative risk stratification.

	Pre-PACU n = 45	PACU n = 42	P value
Age (median [IQR])	56 (51–70)	61.5 (54–72)	0.194
BMI (kg/m^2), (median [IQR])	25.4 (22–28)	25.45 (22.83–27.75)	0.648
ASA (n, %)			0.934
1	0 (0%)	0 (0%)	
2	23 (51.1%)	20 (47.6%)	
3	20 (44.4%)	20 (47.6%)	
4	2 (4.4%)	2 (4.8%)	
POSSUM (mean ± SD)	9.7% ± 1.899	11.1% ± 1.912	0.001
Hb (g/dl) (mean ± SD)	12.4 ± 1.5	11.9 ± 1.3	0.092

Abbreviations: BMI = body mass index; ASA = American Society of Anesthesiologists; POSSUM = Physiologic and Operative Severity Score for enUmeration of Mortality and Morbidity; Hb = hemoglobin; PACU = Post-Anesthesia Care Unit

PACU group

In addition to the above-listed aspects of the fast-track concept, the following treatment goals of the PACU24, which were also set out in writing in the form of standard operating procedures, was implemented for the group of patients treated between 1 December 2015 and 31 December 2016 (study group): early mobilization on the day of surgery with the aim of getting the patient out of bed; immediate postoperative re-evaluation of all access lines including the central venous catheter, gastric tube, and bladder catheter, with the aim of removing them as early as possible; administration of medication to prevent nausea and vomiting; transition to an oral diet starting on the day of the operation itself; avoidance of sedating substances; optimized pain therapy, preferably using an epidural catheter and avoiding systemic opioids; and close monitoring of breathing therapy using a respiratory therapy device with the patient's upper body elevated at an angle of 30°.

Pre-PACU group

For this group, patients with the same surgical indications were recruited. They were treated using the fast-track concept in the period between 01.01.2015 und 30.11.2015, i.e., shortly before the full PACU24 concept was introduced. All patient files were analyzed accordingly and patients were included if at least 80% of the end data used for retrospective data collection in the PACU24 group was also available.

Statistical analysis

Data were analyzed using the software program R, version 4.1.2 [21]. Normally distributed data are presented as mean and standard deviation, and groups were compared with linear ANOVA. Variables with skewed distribution are presented as median and interquartile range (IQR) and were either logarithmically transformed and groups compared with linear ANOVA or retransformed and evaluated with the Kruskal-Wallis rank sum test. Categorical variables were analyzed using Fisher's exact test to compare groups. Assumptions about distributions were based on histograms and measure of location. The two-tailed significance level was set to 5%. The two primary hypotheses about complications and the duration of patient stay in hospital were ordered hierarchically. This meant that no adaptation for multiple testing was necessary. All other analyses were explorative, and P values were interpreted as descriptive measures.

Results

Demographic and preoperative data

Demographic and preoperative data are shown in ▶ **Table 1**. There was no relevant difference between groups with regards to age, body mass index (BMI), preoperative hemoglobin, and preoperative risk estimation based on the ASA score (ASA: American Society of Anesthesiologists) [22]. According to the POSSUM scores [23], patients in the PACU group had a 1.4% high risk of postoperative complications.

Surgical and perioperative data

The surgical and perioperative data of both groups are summarized in ▶ **Table 2**. FIGO staging of oncological findings [24] was comparable for both groups, but there were significantly more patients who underwent primary debulking in the pre-PACU group (pre-PACU group: primary debulking surgery 95.5% vs. PACU group 81.0%; $p < 0.047$). There were no relevant differences between groups with regards to the extent and scope of surgery in the pelvis and abdomen, and of the paraaortic lymph nodes. However, bowel resections and the corresponding anastomoses were carried out significantly more often in patients from the PACU group (PACU group 76.3% vs. pre-PACU group 33.3%; $p < 0.001$). There were no clinically relevant differences with respect to other variables such as intraoperative blood loss, the administration of blood products, and fluid or volume replacement therapy.

▶**Table 2** Surgical and perioperative data.

	Pre-PACU n = 45	PACU n = 42	P value
Indication for surgery [n (%)]			
Primary	42 (95.5%)	34 (81.0%)	0.047
Interval debulking	2 (4.5%)	8 (19.0%)	
Unknown	1	0	
FIGO I–II	11 (24.4%)	6 (14.3%)	0.2853
FIGO ≥ IIIA	34 (75.6%)	35 (83.3%)	
Unknown	0	1	
Extent of surgery [n (%)]			
HE, BSO, omentectomy	39 (86.7%)	39 (92.9%)	0.486
Upper abdomen (resection of the spleen, part of the liver, the small intestine, diaphragmatic deperitonealization)	29 (64.4%)	35 (83.3%)	0.073
Systematic LND, para-aortic, pelvic	31 (68.9%)	25 (59.5%)	0.381
Bowel anastomoses	15 (33.3%)	32 (76.2%)	< 0.001
Duration of surgery [mean (SD)]	4.82 (± 1.42)	5.32 (± 1.40)	0.097
Intraoperative blood loss [ml (median, IQR)]	800 (500–1100)	800 (500–1500)	0.158
Residual disease [n (%)]	21 (46.7%)	18 (42.8%)	0.8299
Ascites [ml (median, IQR)]	1500 (50–3000)	500 (200–2000)	0.235
Intraoperative fluid and volume replacement [ml (median, IQR)]	5500 (4000–7000)	5500 (3500–7452)	0.714
Crystalloids [ml (median, IQR)]	4000 (3500–5000)	3750 (3000–5000)	0.620
Colloids [ml (median, IQR)]	1000 (500–1500)	500 (0–1500)	0.780
Blood products [ml median, IQR)]	0 (0–1000)	0 (0–1100)	0.783

Abbreviations: BSO = bilateral salpingo-oophorectomy; FIGO = tumor staging using the International Federation of Gynecology and Obstetrics staging system [25]; HE = hysterectomy; LND = lymphadenectomy

The postoperative stay in hospital (LOS) of the PACU group was 2 days shorter (pre-PACU group: 14 vs. PACU group: 12 [p = 0.133]).

Pre- und postoperative management

The important pre- and postoperative management data are presented in ▶**Table 3**. Patients in the PACU group received preoperative drugs for postoperative nausea and vomiting (PONV) prophylaxis significantly more often (pre-PACU group: 57.8% vs. PACU group: 83.3%; p = 0.011).

Significantly more patients in the PACU group received an epidural catheter (92.9% vs. 71.1%; p < 0.001). The epidural catheter also remained significantly longer in place in this group (5 days [4–6] vs. 3 days [0–5]; p = 0.003). Pain control using only oral analgesics was similar in both groups, including the use of significantly less strong opioids 48 h postoperatively (45.2% vs. 26.7%; p < 0.001) in the PACU group and a similar percentage of non-steroidal anti-inflammatory drugs (NSAID) (pre-PACU group: n = 6 [17.1%] vs. PACU group; n = 12 [28.6%]; p = 0.287) (p = 0.067). There were no differences in time with regards to the removal of gastric tubes and urinary catheters or the administration of thrombosis prophylaxis. There was a significant difference in the number of patients who could not be mobilized on the day of surgery (pre-PACU group n = 35 [87.5%] vs. PACU group n = 21 [50.0%], p < 0.001). This difference between the two groups with regards to the duration of mobilization was still significant on the third day postoperatively (p = 0.033). On the third postoperative day, patients in the PACU group mobilized independently for a median of 45 minutes compared to 30 minutes for patients in the pre-PACU group. As shown in ▶**Table 4**, a comparable number of patients stayed in the intensive care unit/PACU24 for one night (p = 0.1034). All patients in the PACU group were transferred to a regular ward after 24 hours without requiring readmission to the PACU. Four patients in the pre-PACU group stayed in the ICU for more than 24 hours (p = 0.181).

▶**Table 3** Intraoperative management and immediate postoperative management.

	Pre-PACU n = 45	**PACU** n = 42	**P value**
Gastric tube intraoperatively [n (%)]	45 (100 %)	42 (100 %)	1.000
Gastric tube postoperatively [n (%)]	14 (31.8 %)	14 (34.1 %)	1.000
Gastric tube postoperatively in the normal ward [n (%)]	5 (11.1 %)	3 (7.1 %)	0.715
Urinary IC intraoperatively [n (%)]	45 (100 %)	42 (100 %)	1.000
Urinary IC, 1 st postoperative day [n (%)]	42 (93.3 %)	40 (95.2 %)	1.000
Urinary IC, 3 rd POD in the normal ward [n (%)]	19 (42.2 %)	21 (50 %)	0.522
Time to removal of the urinary IC [nights (median, IQR)]	3 (2–4)	3.5 (2–5)	0.559
Epidural catheter [n (%)]	32 (71.1 %)	39 (92.9 %)	< 0.001
Time to removal of the EDC [nights (median, IQR)]	3 (0–5)	5 (4–6)	0.003
Postoperative duration of oral analgesics [nights (median, IQR)]	6 (4–7)	7 (5–9)	0.067
No use of parenteral/oral opioids in the first 48 h postoperatively [n (%)]	12 (26.7 %)	19 (45.2 %)	< 0.001
Use of non-steroidal analgesics for 48 h postoperatively [n (%)]	6 (17.1 %)	12 (28.6 %)	0.178
Non-mobilization on the day of surgery [n (%)]	35 (87.5 %)	21 (50 %)	< 0.001
Duration of mobilization on POD3 [min (median, IQR)]	30 (10–45)	45 (25–60)	0.040

Abbreviations: IC = indwelling catheter; h = hours; EDC = epidural catheter; POD = postoperative day

▶**Table 4** Time spent in the intensive care unit and the hospital.

	Pre-PACU n = 45	**PACU** n = 42	**P value**
Primary treatment only in RR/normal ward [n (%)]	8 (17.8 %)	12 (28.6 %)	0.309
Primary treatment in ICU [n (%)]	37 (82.2 %%)	0 (0 %)	0.001
Duration of treatment in ICU/PACU (days)	1.5 (0.5–2.5)	1 (0.5–1)	0.181
Secondary postoperative transfer to ICU from normal ward/PACU	0 (0 %)	0 (0 %)	1.000
Duration of hospital stay [days (median, IQR)]	14 (11–18)	12 (10–14.8)	0.133
Hospital discharge within 30 days [n (%)]			
Discharged	43 (95.6 %)	40 (95.2 %)	0.799
Remained in hospital	1 (2.2 %)	0	
Died in hospital	1 (2.2 %)	2 (4.8 %)	

Abbreviations: ICU = intensive care unit; RR = recovery room

▶ **Table 5** shows that there was no difference between the two groups in either the number or the type and severity of complications.

▶**Table 5** Postoperative complications.

	Pre-PACU n = 45	PACU n = 42	P value
Number of patients with postoperative complications [n (%)]	25 (55.6%)	21 (50.0%)	0.670
Type of complication			
Infection	24 (53.3%)	21 (50%)	0.495
Cardiovascular	6 (13.3%)	3 (7%)	0.715
Renal	0 (0%)	1 (2.4%)	0.230
GI	14 (31.1%)	15 (35.7%)	0.938
Total number of postoperative complications [n]	44	40	
Severity of complications (Clavien classification [26]) [n]			
None	20	21	0.865
≤ IIIA	20	17	0.777
≥ IIIB	5	4	0.658

Abbreviation: GI = gastrointestinal

Discussion

In this observational study we were able to show that the introduction of a PACU24 for postoperative care combined with the fast-track concept established in our hospital based on written standard operating procedures allowed patients who had undergone multivisceral debulking surgery to be treated without requiring care in a high-care intensive care unit. Treatment of our patients in a PACU24 was not associated with an increase in postoperative complications and did not require secondary postoperative transfer to an intensive care unit.

When we were designing our study, we decided to investigate patients with ovarian cancer who undergo cytoreductive surgery because gynecologic oncology has the highest mortality rates [1] and a high rate of perioperative complications [6]; moreover, in our experience, the overwhelming majority of patients required a short postoperative stay in an intensive care unit.

Since 2010, individual fast-track elements which include dispensing with intestinal preparations, avoiding long periods of fasting, early start of enteral feeding, intraoperative fluid restrictions, the rapid removal of drainages including indwelling catheters, an adapted perioperative pain management concept and an increased intra- and postoperative use of epidural analgesia to ensure adequate pain therapy with no or almost no use of opioids have been implemented as part of our perioperative treatment management. To prevent fluid deficits, we do not carry out colonic irrigation for intestinal preparation prior to possible colorectal interventions.

Postoperative maintenance of the fast-track concept was ensured with the admission of patients to the PACU24. Postsurgical management was already started on the day of surgery and included consistent mobilization, stringent prevention of nausea and vomiting using PONV prophylaxis, enteral feeding, and bowel stimulation initiated on the day of surgery. Pain levels were closely monitored and recorded, and pain therapy using epidural analgesics was consistently implemented in the PACU group while the use of opioids was minimized. Ultimately, significantly more patients in the PACU had an epidural anesthesia, which corresponds to modern anesthesiological care, and epidural analgesia was maintained for a significantly longer period of time. This type of pain therapy with its limited use of opioids allowed one of the most important elements of the fast-track concept to be implemented: patient mobilization starting on the day of surgery, which increased patient alertness. The positive effect of mobilization carried out as early as possible under sufficient pain therapy continued over the next postoperative days with significantly longer mobilization times. This consistent concept of mobilization combined with pain therapy made it possible to transfer patients from the PACU24 to a normal ward after a maximum of 24 hours and was reflected in the slightly earlier discharge from hospital. For clinical practice, this leads to optimized bed management and allows additional surgeries to be planned better. But our findings did not show that consistent PONV prophylaxis and consistent early oral feeding starting on the day of surgery had a significant positive effect on gastrointestinal complications (nausea, vomiting, paralytic and mechanical ileus). Our results are comparable with the data published by Kalogera et al., who found that early enteral feeding and sufficient PONV prophylaxis did not reduce nausea in patient who underwent gynecological surgery [25, 27]. As more fast-track concepts have been implemented over the years, intraoperative anesthesiological management has also changed. To prevent intraoperative stress, there has been an increased focus on warmth management, the optimized administration of fluids, early extubation, and balanced transfusion management. Of course, these factors are part and parcel of optimized perioperative care. None of our patients was transferred from the operating theater to the ICU or PACU24 while still being ventilated.

The POSSUM scores of the PACU group were higher, the median age of patients in the PACU group was higher by 5.5 years, there were slightly more patients with advanced disease (FIGO ≥ IIIA; pre-PACU group n = 34 [75.6 %] vs. PACU group n = 35 [83.3 %]) in the PACU group and a significantly higher number of bowel anastomoses (PACU group 76.3 % vs. pre-PACU group 33.3 %; (p < 0.001). However, the rate of complications (using the Clavien classification [7, 26]) observed in the PACU group was not higher. The higher percentage of interval debulking surgeries in the PACU group is certainly remarkable, because the expected surgical trauma and postoperative risk profile are lower. But the extent of surgery recorded, duration of surgery, blood loss, and rate of residual tumors were comparable between the two groups.

According to reports in the literature, up to 14 % of all elective surgeries are now being postponed due to a lack of intensive care beds [28, 29]. The current figures are probably even higher as a result of the coronavirus pandemic. This fundamental problem of our healthcare system cannot be solved by simply introducing a fast-track concept. But a combination of fast-track concepts with treatment units which specifically focus on postoperative care as described here for the PACU24 model could take some of the strain away from high-care intensive care units by allowing even highly complex postoperative patients to be cared for in a PACU24. Because of the initially greater need of staff, these innovations require an intensive, well-planned approach to ensure that they become widely accepted [30, 31]. But the additional staffing costs can be justified if complications are minimized, the time spent in hospital is reduced, and ultimately the pressure on high-care intensive care capacities is reduced.

If we were to cast a critical eye, we should need to point out that there are currently no evidence-based defined standards for a PACU24. Moreover, reservations against this approach are still quite high, many of them voiced by surgeons. The primary finding of this study was that patient safety was not reduced by patients being treated in a PACU24, even when these patients had undergone highly complex gynecologic oncology surgery. This is an important signal when promoting innovative perioperative concepts.

Conclusion

In summary, the concept of a PACU24 combined with implementation of a fast-track concept is a safe way to provide postoperative care to patients who have undergone highly complex and invasive multivisceral gynecologic oncology surgery.

Conflict of Interest

Prof. Woelber received grants from: the German Cancer Society, medac oncology and Roche diagnostics. She received honoraria/personal fees from: Roche, Eisai, Novartis, MSD, Seagen, GSK, AstraZeneca, Pfizer, Lumenis, Teva, pomedicis, Omniamed. Dr. Jaeger received personal fees from AstraZeneca, Molecular Health, GSK, Roche, Clovis Oncology, and MSD outside the submitted work. Dr. Reuter, Prof. Schmalfeldt, Prof. Zöllner, Prof. Müller, Prof. Haas, Prof. Zapf, Cevirme, PD Dr. Prieske declare no conflict of interest.

References/Literatur

[1] Robert Koch Institut. Krebs in Deutschland. Eierstockkrebs 2017/2018. Accessed January 01, 2022 at: https://www.krebsdaten.de/Krebs/DE/Content/Publikationen/Krebs_in_Deutschland/kid_2021/kid_2021_c56_eierstoecke.pdf?__blob=publicationFile

[2] du Bois A, Neijt JP, Thigpen JT. First line chemotherapy with carboplatin plus paclitaxel in advanced ovarian cancer–a new standard of care? Ann Oncol 1999; 10 (Suppl 1): 35–41. doi:10.1023/a:1008355317514

[3] du Bois A, Reuss A, Pujade-Lauraine E et al. Role of surgical outcome as prognostic factor in advanced epithelial ovarian cancer: a combined exploratory analysis of 3 prospectively randomized phase 3 multicenter trials: by the Arbeitsgemeinschaft Gynaekologische Onkologie Studiengruppe Ovarialkarzinom (AGO-OVAR) and the Groupe d'Investigateurs Nationaux Pour les Etudes des Cancers de l'Ovaire (GINECO). Cancer 2009; 115: 1234–1244. doi:10.1002/cncr.24149

[4] Harter P, Sehouli J, Lorusso D et al. A Randomized Trial of Lymphadenectomy in Patients with Advanced Ovarian Neoplasms. N Engl J Med 2019; 380: 822–832. doi:10.1056/NEJMoa1808424

[5] Hofstetter G, Concin N, Braicu I et al. The time interval from surgery to start of chemotherapy significantly impacts prognosis in patients with advanced serous ovarian carcinoma – analysis of patient data in the prospective OVCAD study. Gynecol Oncol 2013; 131: 15–20. doi:10.1016/j.ygyno.2013.07.086

[6] Iyer R, Gentry-Maharaj A, Nordin A et al. Predictors of complications in gynaecological oncological surgery: a prospective multicentre study (UKGOSOC-UK gynaecological oncology surgical outcomes and complications). Br J Cancer 2015; 112: 475–484. doi:10.1038/bjc.2014.630

[7] Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004; 240: 205–213. doi:10.1097/01.sla.0000133083.54934.ae

[8] Bardram L, Funch-Jensen P, Jensen P et al. Recovery after laparoscopic colonic surgery with epidural analgesia, and early oral nutrition and mobilisation. Lancet 1995; 345: 763–764. doi:10.1016/s0140-6736(95)90643-6

[9] Kehlet H, Dahl JB. Anaesthesia, surgery, and challenges in postoperative recovery. Lancet 2003; 362: 1921–1928. doi:10.1016/s0140-6736(03)14966-5

[10] Brady M, Kinn S, Stuart P. Preoperative fasting for adults to prevent perioperative complications. Cochrane Database Syst Rev 2003. doi:10.1002/14651858.Cd004423

[11] Spies CD, Breuer JP, Gust R et al. Preoperative fasting. An update. Anaesthesist 2003; 52: 1039–1045. doi:10.1007/s00101-003-0573-0

[12] Halaszynski TM, Juda R, Silverman DG. Optimizing postoperative outcomes with efficient preoperative assessment and management. Crit Care Med 2004; 32: S76–S86. doi:10.1097/01.ccm.0000122046.30687.5c

[13] Anderson AD, McNaught CE, MacFie J et al. Randomized clinical trial of multimodal optimization and standard perioperative surgical care. Br J Surg 2003; 90: 1497–1504. doi:10.1002/bjs.4371

[14] Spanjersberg WR, Reurings J, Keus F et al. Fast track surgery versus conventional recovery strategies for colorectal surgery. Cochrane Database Syst Rev 2011. doi:10.1002/14651858.CD007635.pub2

[15] Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. Br J Anaesth 1997; 78: 606–617. doi:10.1093/bja/78.5.606

[16] Khan S, Wilson T, Ahmed J et al. Quality of life and patient satisfaction with enhanced recovery protocols. Colorectal Dis 2010; 12: 1175–1182. doi:10.1111/j.1463-1318.2009.01997.x

[17] Philp S, Carter J, Pather S et al. Patients' satisfaction with fast-track surgery in gynaecological oncology. Eur J Cancer Care (Engl) 2015; 24: 567–573. doi:10.1111/ecc.12254

[18] Wodlin NB, Nilsson L. The development of fast-track principles in gynecological surgery. Acta Obstet Gynecol Scand 2013; 92: 17–27. doi:10.1111/j.1600-0412.2012.01525.x

[19] Muallem MZ, Dimitrova D, Pietzner K et al. Implementation of Enhanced Recovery After Surgery (ERAS) Pathways in Gynecologic Oncology. A NOGGO-AGO* survey of 144 Gynecological Departments in Germany. Anticancer Res 2016; 36: 4227–4232

[20] Kastrup M, Seeling M, Barthel S et al. Effects of intensivist coverage in a post-anaesthesia care unit on surgical Patients' case mix and characteristics of the intensive care unit. Crit Care 2012; 16: R126. doi:10.1186/cc11428

[21] R Core Team. A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2020. Accessed January 01, 2022 at: http://www.r-project.org/

[22] Doyle DJ, Goyal A, Bansal P, Garmon EH. American Society of Anesthesiologists Classification. StatPearls.Treasure Island (FL)StatPearls Publishing; 2021

[23] Copeland GP, Jones D, Walters M. POSSUM: a scoring system for surgical audit. Br J Surg 1991; 78: 355–360. doi:10.1002/bjs.1800780327

[24] Meinhold-Heerlein I, Fotopoulou C, Harter P et al. The new WHO classification of ovarian, fallopian tube, and primary peritoneal cancer and its clinical implications. Arch Gynecol Obstet 2016; 293: 695–700. doi:10.1007/s00404-016-4035-8

[25] Kalogera E, Bakkum-Gamez JN, Jankowski CJ et al. Enhanced recovery in gynecologic surgery. Obstet Gynecol 2013; 122: 319–328. doi:10.1097/aog.0b013e31829aa780

[26] Clavien PA, Barkun J, de Oliveira ML et al. The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg 2009; 250: 187–196. doi:10.1097/sla.0b013e3181b13ca2

[27] Kalogera E, Dowdy SC. Enhanced Recovery Pathway in Gynecologic Surgery: Improving Outcomes Through Evidence-Based Medicine. Obstet Gynecol Clin North Am 2016; 43: 551–573. doi:10.1016/j.ogc.2016.04.006

[28] Sanjay P, Dodds A, Miller E et al. Cancelled elective operations: an observational study from a district general hospital. J Health Organ Manag 2007; 21: 54–58. doi:10.1108/14777260710732268

[29] Argo JL, Vick CC, Graham LA et al. Elective surgical case cancellation in the Veterans Health Administration system: identifying areas for improvement. Am J Surg 2009; 198: 600–606. doi:10.1016/j.amjsurg.2009.07.005

[30] Ender J, Borger MA, Scholz M et al. Cardiac surgery fast-track treatment in a postanesthetic care unit: six-month results of the Leipzig fast-track concept. Anesthesiology 2008; 109: 61–66. doi:10.1097/ALN.0b013e31817881b3

[31] Priestap FA, Martin CM. Impact of intensive care unit discharge time on patient outcome. Crit Care Med 2006; 34: 2946–2951. doi:10.1097/01.Ccm.0000247721.97008.6F