

# Abdominal and Laparoscopic Cervical Carcinoma Therapy – a Comparative Economic Assessment

## Vergleichende ökonomische Bewertung der abdominalen und laparoskopischen Therapie des Zervixkarzinoms



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### ABSTRACT

**Objective** The LACC (Laparoscopic Approach to Cervical Cancer) study revealed advantages in terms of overall survival and relapse risk favouring abdominal radical hysterectomy over the laparoscopic procedure. The present paper will compare the two surgical techniques from the economic point of view based on a process cost calculation.

**Material/Methods** A retrospective cost analysis of all radical hysterectomies from the year 2018 was done at the Hanover University Medical School based on the bottoms-up method and guided by the clinical treatment pathway.

**Result** Of 51 primary cases treated, 19 patients underwent radical hysterectomies, of which 8 were performed using the abdominal technique and 11 as endoscopic surgeries. 89.4% of the cancers were FIGO IB1 carcinomas. The total cost of a laparoscopic radical hysterectomy with an average hospital stay of 4.6 days came to € 2512.34, compared to an abdominal radical hysterectomy at € 2586.78 with an average hospital stay of 7.6 days. The greatest cost factor in which the laparoscopic method exceeded abdominal radical hysterectomy was the surgical procedure itself (€ 1836.75 vs. € 1411.21). Personnel represented the largest cost item in the surgical theatre (59%), so that surgery time was a significant multiplying factor. Average surgical time required for abdominal radical hysterectomy was 154 minutes, whereby the laparoscopic procedure required an average of 220.1 minutes. Inpatient care in the abdominal radical procedure cases was more costly by € 499.98 due to the longer hospitalization and additional medication required. Profit levels, including the DRG revenues, were higher with the abdominal method than with the laparoscopic method by € 186.21 despite longer hospital stays.

**Conclusion** The present paper shows slightly greater profitability for the abdominal radical hysterectomy. On the other hand, this method entails longer hospitalization and a higher level of personnel deployment. Adequate occupancy management could make up for the revenue shortfall observed with the laparoscopic method.

## ZUSAMMENFASSUNG

**Zielsetzung** Die LACC-Studie (Laparoscopic Approach to Cervical Cancer) zeigte einen Vorteil bezüglich des Gesamtüberlebens und des Rezidivrisikos bei der abdominalen radikalen Hysterektomie im Vergleich zum laparoskopischen Vorgehen. Diese Arbeit vergleicht nun beide Operationstechniken anhand einer Prozesskostenrechnung aus ökonomischer Sicht.

**Material/Methoden** Es erfolgte eine retrospektive Kostenanalyse aller radikalen Hysterektomien aus dem Jahr 2018 an der Medizinischen Hochschule Hannover anhand des Bottom-up-Verfahrens mithilfe des klinischen Behandlungspfades.

**Ergebnis** Von 51 behandelten Primärfällen erhielten 19 Patientinnen eine radikale Hysterektomie. Davon wurden 8 abdominale und 11 endoskopische Operationen durchgeführt. Bei 89,4% der Krebserkrankungen handelte es sich um FIGO-IB1-Karzinome. Die Gesamtkosten der laparoskopischen radikalen Hysterektomie lagen bei einer durchschnittlichen Liegedauer von 4,6 Tagen bei 2512,34 Euro, die der abdominalen radikalen Hysterektomie bei 2586,78 Euro mit einer Aufenthaltsdauer von 7,6 Tagen. Beim laparoskopischen Verfahren lag

der größte Kostenfaktor im Vergleich zur abdominalen radikalen Hysterektomie im operativen Bereich (1836,75 Euro vs. 1411,21 Euro). Im Operationssaal boten die Personalkosten den größten Kostenpunkt (59%), sodass die Operationszeit einen wichtigen Multiplikator darstellt. Die Operationszeit bei der abdominalen radikalen Hysterektomie betrug im Mittel 154 Minuten und 220,1 Minuten beim laparoskopischen Verfahren. Die stationären Kosten der Betreuung beim abdominalen Verfahren waren aufgrund der längeren Aufenthaltsdauer und Medikamentenapplikation um 499,98 Euro höher. Der Gewinn war unter Berücksichtigung der DRG-Erlöse beim abdominalen Verfahren trotz der längeren Liegedauer um 186,21 Euro höher als beim laparoskopischen Verfahren.

**Schlussfolgerung** Die vorliegende Arbeit zeigt einen geringen Gewinnunterschied für die abdominale radikale Hysterektomie. Die Liegedauer und Personalbindung ist hingegen bei diesem Verfahren höher. Ein adäquates Belegungsmanagement könnte die Erlösdifferenz des laparoskopischen Vorgehens ausgleichen.

## Introduction

A focus on healthcare economics is a matter of growing urgency in these times of Diagnosis Related Group (DRG) cost accounting and increasing cost pressures on providers. In addition to their medical care mandates, hospitals must also meet economic targets to survive in the current market. The introduction of a performance-based remuneration system has forced Germany's hospitals to develop new revenue optimization strategies. The advent of DRG has apparently rendered the previously widespread function-based problem-solving structures unsuitable. Transparent presentation of centralized processes, procedures and the respective optimization potentials is now the more promising approach.

The data obtained in the Laparoscopic Approach to Cervical Cancer (LACC) study were revealed for the first time at the 49th Congress of the Society of Gynaecological Oncology in March 2018. This randomized, international, multicentric phase 3 study compared laparoscopic/robot-assisted radical hysterectomy with abdominal radical hysterectomy. In the abdominal method, radical hysterectomy is performed via an incision through the abdomen and parametrium as determined by the Piver type. In the laparoscopic procedure, on the other hand, uterus and parametrium preparation are based on laparoscopy and the uterus is removed by the vaginal route. Sentinel lymphonodectomy and lymph node removal were carried out regardless of the surgical technique employed. The primary endpoint was investigation of disease-free survival and the secondary objectives comprised investigation of relapse risk, therapy-associated morbidity, overall survival, cost effectiveness and quality of life of the women [1]. Based on the results, which indicated a disadvantage for women in the laparoscopic investigative cohort, the study had to be discontinued prematurely. The most important result of the study was a high rate of relapse and poorer overall survival of patients with laparoscopic radical hysterectomy [1].

The Endoscopy Working Group (AGE) of the German Gynaecological and Obstetric Association (DGGG) and the Gynaecological Oncology Working Group (AGO) issued a statement of position on the LACC study in August 2018 [2] which recommends clarification based on the study and its results for patients with stage IA2 and IB1 cervical carcinomas.

In view of the current study status [3] and the increasing cost pressure on healthcare providers, the present paper aims to present a comparative process cost calculation for surgical therapy of cervical carcinoma. A critical consideration of use of medical resources is also to be included in this context. To this end, the endoscopic methods with laparotomy based on the clinical treatment pathway were juxtaposed with the DRG-based revenues and clinical costs.

## Methods

### Study description

A retrospective cost analysis of the radical hysterectomies performed on patients without DRG-relevant secondary diagnoses from the year 2018 at the Hanover University Medical School was carried out. The analysis was based on the bottom-up method [4] following the clinical treatment pathway. The data were presented and analysed using Microsoft Excel.

The clinical treatment pathway was first presented with its four main process steps. Process steps and activity analyses were defined based on the clinical treatment pathway. The data were collected from surveys and records research as well as nursing and surgical protocols. The information on workload and time requirements for postoperative patient care were derived from the electronic nursing protocols and employee interviews. This was followed by definition of a process hierarchy in which the sub-processes were assigned to specific cost centres. The final step was

determination of the cost drivers. The cost centres used for the analysis were as follows: Personnel costs, equipment costs, maintenance costs, surgical theatre costs, nuclear medicine, pathology, central sterilization, bed preparation, patient meals, patient accommodation, laboratory tests, clinic infrastructure costs. All essential cost drivers impacting the process cost calculation were covered. Multiplication of the personnel costs and material cost rates (standard evaluation rates) by the performance standards, e.g. surgery time or duration of the processes to be carried out, then resulted in the process cost rate. This included cost calculation for pre-hospitalization admissions, surgery, postoperative course and discharge as determined previously in individual treatment pathways as correlated with laparotomy and laparoscopy. Personnel account for a predominant share of the costs. Process cost calculation was used for the analysis since this method considers the individual processes, which then contribute to the calculation. The advantages of process cost calculation are its window on cost transparency, efficient deployment of resources and causality-based accounting results. Process cost calculation accounts for overall process costs in their entirety.

The results describe assessment of all abdominal and laparoscopic radical hysterectomies in terms of average values. The “Results” section below presents personnel expenditures for surgical treatment of cervical carcinoma. The study investigation covered only standard cases without complications and without ICU stays. Thus a total of 13 cases were included (8 abdominal radical hysterectomies, 5 laparoscopic radical hysterectomies). The laparoscopic radical hysterectomy procedures employed a modified, nerve-sparing technique. A camera-supported robotic system was used in two cases.

The robot-assisted surgeries (da Vinci Xi) were not considered.

## Objective

This paper presents an economic comparison of abdominal radical hysterectomy and laparoscopic radical hysterectomy based on a process cost calculation.

## Results

### Patient collective

Fifty-one cases of cervical carcinoma were treated at the Hanover University Medical School in 2018. Forty-six of these patients underwent surgery. A radical hysterectomy was performed in 19 patients without DRG-relevant secondary diagnoses. The remaining patients received laparoscopic staging with removal of the pelvic and para-aortal lymph nodes followed by primary radiochemotherapy.

Surgical treatment in 8 of the 19 patients comprised abdominal radical hysterectomy and the remaining 11 patients were treated with endoscopic radical hysterectomy. Of these, 5 patients had surgery employing laparoscopy and the other 6 procedures were performed using the Da Vinci Xi surgical robot. A total of 89.4% (17 cases) of the carcinomas were in FIGO stage IB1. The remaining 10.5% comprised one case in FIGO stage IB2 (5.3%) in the laparoscopic treatment arm and one case in FIGO stage IIB

► **Table 1** Overview of patient characteristics and evaluation of the cervical carcinoma patients included in 2018.

	Abdominal radical hysterectomy	Laparoscopic radical hysterectomy
FIGO IB1	7	10
FIGO IB2	0	1
FIGO IIB	1	0
Age	47	48.3
Body Mass Index	24.3	23.5
Duration of surgery/min	154	220.1
Inpatient stay	7.6	4.6
Blood loss (Hb difference), g/dl	2.5	2.1

(5.3%) in the abdominal treatment arm. There were no demographic differences between the two surgical collectives.

### Surgical theatre costs

When comparing laparoscopic and abdominal radical hysterectomy, the longer time requirement for surgery in the laparoscopic arm, by an average of approx. 1 hour, is notable (220.1 vs. 154 minutes; ► **Table 1**). This results in higher surgical costs for theatre occupancy (abdominal: € 169.40; laparoscopic € 242.11) as well as for personnel (abdominal: € 708.76; laparoscopic € 995.43) in the laparoscopic arm (► **Table 2**). The longer duration of surgery also raises costs for pharmaceuticals and medical materials required for anaesthesia in the surgical theatre for endoscopic radical hysterectomies. The technical requirements of the laparoscopic tower and the relevant instruments, plus replacement purchases, contribute to driving costs upwards for laparoscopic radical hysterectomy procedures in this area as well. Based on the useful equipment life of 8 years, the costs came to € 20.10 per day (laparoscopic) and € 2.58 per day (abdominal). ► **Table 3** provides a detailed overview of the specific consumables employed for the respective surgical techniques and their costs. The costs were calculated per person, i.e. per case.

### Costs of postoperative care

Regarding the postoperative inpatient stays with the two different surgical techniques, the greatest difference was in the nursing personnel costs. The time required for nursing care of abdominal radical hysterectomy patients averaged 20 minutes longer than for laparoscopic patients. This also impacted personnel costs: € 21.60 (laparoscopic) and € 32.40 (abdominal).

Patients operated on using the abdominal method were hospitalized approx. 3 days longer than the endoscopic patients. The two surgical methods reveal no difference in pre-hospitalization costs. Taking all costs into consideration, the cost of pre-hospitalization admissions was € 105.66. This amount covers personnel, laboratory and material costs as well as equipment depreciations. The postoperative time requirements for the treating physicians hardly differed. Flat fees were applied for physiotherapeutic treatment, so that no differences could be detected in this area. In

► **Table 2** Comparison of surgical theatre personnel costs for laparoscopic and abdominal radical hysterectomy.

Professional groups	Laparoscopic Wertheim Average duration: 220.1 min	Abdominal Wertheim Average duration: 154 min
Anaesthesiologist + Anaesthesiology Nurse Anaesthesia induction	36.14	35.4
Surgical Nurse (patient positioning)	3.99	4.56
Gynaecologist (2 persons) € 0.88/min	387.37	271.04
Anaesthesiologist (1 person) € 0.90/min	198.09	138.60
Anaesthesiology Nurse (1 person)	118.54	83.16
Surgical Nurse (2 persons)	250.91	175.56
<b>Total costs</b>	<b>995.04</b>	<b>708.76</b>

► **Table 3** List of total costs of surgical therapy of cervical carcinoma – comparison of laparoscopic and abdominal radical hysterectomy.

Cost items	Laparoscopic radical hysterectomy/ € costs	Abdominal radical hysterectomy/ € costs
<b>Pre-hospitalization admissions</b>	105.66	105.66
Surgical costs		
Surgical theatre/maintenance costs	242.11	169.40
Consumable, surgery preparation	7.99	7.99
Nuclear medicine, sentinel node marking	235.62	235.62
Surgical personnel	995.43	708.76
Equipment costs, anaesthesia, surgery acc. to Wertheim	32.91	32.91
Costs of pharmaceuticals and medical materials, anaesthesia, in surgical theatre	134.25	44.75
Equipment costs gynaecology, surgery acc. to Wertheim	20.10	2.58
Antibiosis cefuroxime 1.5 g	3.05	3.05
Surgical consumables (suture material)	5.94	60.49
Replacement purchase of surgical theatre equipment	13.69	–
Costs of central sterilization	40	40
<b>Total surgical costs</b>	1731.09	1305.55
Inpatient stay costs	Average inpatient stay 4.6	Average inpatient stay 7.6
Personnel costs, inpatient care	177.10	374.68
Pharmaceuticals used on ward	24.61	42.01
Laboratory costs, blood count and CRP	10.80	10.80
Meals	82.80	136.80
Patient accommodation costs	354.20	585.20
Bed preparation	8.64	8.64
<b>Total inpatient stay costs</b>	658.15	1158.13
<b>Discharge</b>	17.44	17.44
<b>Total costs</b>	<b>2512.34</b>	<b>2586.78</b>

summary, per diem personnel costs amounted to €38.50 Euro with laparoscopic and €49.30 with abdominal radical hysterectomy. Personnel costs for laparoscopic radical hysterectomy amount to €177.10 with an average inpatient stay of 4.6 days,

which costs for abdominal radical hysterectomy amount to €374.68 with an average inpatient stay of 7.6 days. Use of pharmaceuticals, mainly for analgesic needs, was greater with the ab-

dominal radical hysterectomy, and was thus more costly by € 17.40 than laparoscopic radical hysterectomy.

## DRG revenues

Average DRG revenues for abdominal radical hysterectomy in 2018 were € 11 754.38, slightly higher than those for laparoscopic radical hysterectomy at € 11 493.73 (► **Table 4**).

Discharge management costs were equivalent for the two surgical methods.

Pre-tax clinic profit from abdominal radical hysterectomies thus averaged € 186.21 higher than from laparoscopic radical hysterectomies (► **Table 4**).

## Discussion

DRG revenues for the surgical techniques investigated here amounted to € 11 754.38 (abdominal radical hysterectomy) and € 11 493.73 (laparoscopic radical hysterectomy). The profit from abdominal radical hysterectomies was thus € 186.21 higher than from laparoscopic radical hysterectomies.

A notable result of the process cost calculation is that the overall costs for surgical therapy of cervical carcinoma differ only minimally. The costs for the surgery alone are higher for the endoscopic method than for the abdominal radical hysterectomy (► **Table 3**).

Shortening inpatient stays in the abdominal radical hysterectomy cases would offer the greatest potential for savings, whereby the minimum length of stay should however be reached. The minimum for radical hysterectomy in 2018 was two days. Resumption of physical activity is realized earlier following laparoscopic hysterectomy [5].

Two main factors are involved when it comes to reducing the costs of surgical therapy of cervical carcinoma. Shortening of both the time required for the surgical procedure and of the inpatient stay is conceivable. Realization of a reduction of surgery time and shorter inpatient stays requires an experienced surgical team, whereby intraoperative blood loss should be kept to a minimum [6, 7]. Hertel et al. [8] also demonstrated that the rate of complications depends on the level of experience of the respective surgeon. Furthermore, exhaustive preoperative consultation and prehabilitation make for optimized preparation. The term prehabilitation refers to preoperative mobility and sports therapy, which can improve complication rates and quality of life [9]. This principle has become a familiar instrument in the fields of chemotherapy and radiotherapy [10], one that can be utilized to reduce the length of inpatient stays in cases of abdominal radical hysterectomy. This would not only increase profitability, it would also be advantageous for patients to achieve earlier mobilization and resumption of physical activities. It must be noted that prehabilitation is more difficult to realize than classic preventive and rehabilitative measures. In underdeveloped regions in particular, prehabilitation can be hard to achieve. Also, uniform standards must be established so the results can be meaningfully compared. The costs of prehabilitation measures can also vary depending on a patient's constitution. On the whole, such programmes do benefit patients.

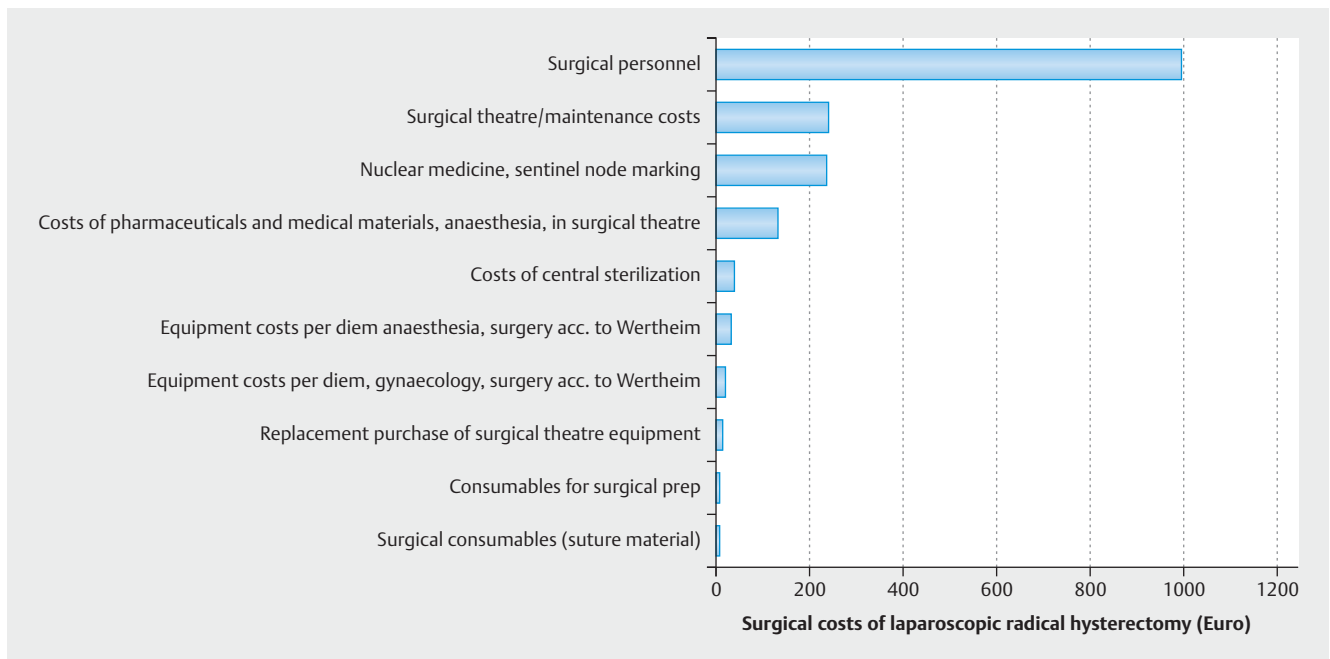
► **Table 4** Average DRG revenues for laparoscopic and abdominal radical hysterectomy with respective codes.

Main diagnosis/DRG	OPS Code	Revenues (€)
<b>Abdominal radical hysterectomy</b>		
C53.0/D25.1	5-685.41, 5-401.42, 5-401.41	10 261.03
C53.1	5-685.1	10 261.03
C53.9	5-685.1, 5-653.Y, 5-569.30	13 263.99
C53.0/E66.90	5-685.1	13 156.85
C53.0	5-685.1	10 261.03
C53.0	5-685.43, 5-401.42, 5-401.41	15 815.08
C53.1/K50.1, Z92.6, Z93.4, K66.0	5-685.1, 5-469.20, 5-569.30	10 261.03
C53.0	5-685.1, 5-569.00, 5-653.30, 5-543.20	10 755.02
<i>Average DRG revenues</i>		<b>11 754.38</b>
<i>Clinic costs</i>		<b>2 586.78</b>
<i>Clinic profit (pre-tax)</i>		<b>9 167.60</b>
<b>Laparoscopic radical hysterectomy</b>		
C53.9/O09.2	5-685.41, 5-401.92	10 261.03
C5C53.0	5-685.41, 5-401.92, 5-401.91	13 156.85
C53.1	5-685.41, 5-401.91, 5-401.92, 5-987.0	10 261.03
C53.1/Z92.3, Z92.6	5-683.22, 5-703.1, 5-987.0	13 156.85
C53.0	5-685.1	10 632.91
<i>Average DRG revenues</i>		<b>11 493.73</b>
<i>Clinic costs</i>		<b>2 512.34</b>
<i>Clinic profit (pre-tax)</i>		<b>8 981.39</b>

Discharge of patients with residual haemorrhaging are nonetheless to be avoided, so that complex discharge management is still unavoidable. It must be noted that while costs in a given year may be lowered, the reduced costs and length of hospital stays contribute to the DRG calculation for the following year, resulting in the staircase effect of sustained cost pressure.

The surgical costs of laparotomy are lower than those for laparoscopy. This is due to the instruments required and the shorter operating time in abdominal radical hysterectomy. Duration of the surgical procedure is an important multiplier, especially in terms of personnel costs (► **Fig. 1**). Personnel costs account for the majority of costs overall (59%). Due to this high percentile of personnel costs, rising labour costs in Germany are another factor that must be considered – they increased by 2.3% compared to the 2017 figures [11]. The overall rise in labour costs also drives healthcare costs upwards.

To sum up the economic advantages of laparoscopic radical hysterectomy, they are due for the most part to shorter inpatient stays, resulting in lowered accommodation costs overall. A hospital bed that is no longer occupied can be seen as a renewed opportunity to offer medical services. Within a framework of high-



► **Fig. 1** Presentation of the respective cost items accruing during the surgical procedure laparoscopic radical hysterectomy.

value surgical procedures, annual departmental revenues could then yield positive figures. The pharmaceutical expenditures were generally lower for each patient due to the briefer inpatient stay. On the other hand, the surgical costs are much higher than for abdominal radical hysterectomy.

The advantages of laparotomy are the lower costs during surgery due to the shorter procedure duration and less expensive instruments. On the other hand, the inpatient stay and the amount of time spent caring for the patient each day are longer, driving up the accommodation costs for inpatient care.

Mapping out a clinical treatment pathway as in this paper is a step in the direction of standardizing procedures and rendering them more transparent, ultimately optimizing the processes involved [12]. This in turn contributes to optimization of surgical sequences by removing complications. Restructuring of the sequences then also becomes possible, further reducing delays and disturbances that waste time. Viewing these contributory aspects within the framework of the present paper, reducing the duration of surgery and inpatient stay length would have a positive impact on the net profit balance. To make the processes even more comparable, external benchmarking in cooperation with other clinics, or internal benchmarking, could be realized. This makes it possible to improve processes, quality and results, simultaneously achieving both economic optimization and greater patient satisfaction.

A limitation of the present paper is that it was not possible to list 100% of all costs. The reason for this is lack of a small volume of data, due partially to use of flat rate costs, an example being the costs of sterilization of surgical instrument sets and physiotherapy. This made it impossible to cover some costs in the present process cost calculation. The relevant costs are, however, unrelated to a specific surgical technique for the most part and

thus do not impact the primary comparison between the laparoscopic and abdominal procedures. Exceptions to this are sterilization of the surgical instrument sets and physiotherapy. Notwithstanding, an attempt was made to list all costs of the two surgical techniques comparatively for maximum transparency. The calculation did not include costs for pathology, since these can vary depending on preparation size and thus falsify the revenue balance. This cost item is independent of surgical technique. Overall, this must be taken into account for the total revenue figures, which will then be less than presented here. The problem of missing data demonstrates the considerable value of efficient networking with all clinic departments, in particular Purchasing, Controlling and Management.

The present paper does not cover any DRG-relevant secondary diagnoses or intraoperative and postoperative complications, making it easier to compare the two surgical techniques. Our analysis did not include any ICU stays – a potential source of higher costs.

The present paper results from the close cooperation of Controlling, Management, treating physicians and nursing personnel as demanded by the current situation. It also demonstrates the importance of analysis of economic aspects, which must however always remain within the given ethical and moral boundaries. The wellbeing of the patient must always be the main focus. What this means is that overall survival and relapse-free survival must be the main focus, regardless of the revenue-cost balance. The LACC study data reveal the drawbacks of the laparoscopic procedure. This makes standardization of surgical techniques all the more important so as to realize better comparability and a higher medical standard. Introduction of standardized procedures/clinical treatment pathways can not only improve therapeutic success, it can also increase economic transparency.



Generally speaking, further comparative studies are needed that describe standardized surgical sequences and facilitate improved clinical and economic comparability and transparency.

## Conclusion

The LACC study [1] revealed better survival data and a lower relapse rate for abdominal radical hysterectomy.

Since introduction of the DRG system in Germany, cost pressures have come to bear on providers, reflected e.g. in ever-shorter inpatient stays, which factors favour laparoscopic surgeries. It must also be taken into account that DRG revenue for laparoscopic radical hysterectomy is less than for the abdominal procedure in the analysis presented here (► **Table 4**).

The process cost calculation demonstrated a difference in profit favouring laparotomy over laparoscopy by € 186.21. This profit difference can be expanded further by shortening the inpatient stay following the abdominal surgeries. This could be made possible by employing prehabilitation and good pain management.

In summary, the present paper reveals a profit difference favouring abdominal radical hysterectomy. It should not, however, be forgotten that despite all of these economic considerations the patient must remain the primary focus of medical efforts.

The clinical treatment pathway can help us map out sequences and processes and optimize them both clinically and economically.

## Conflict of Interest

The authors declare that they have no conflict of interest.

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