Original Article

Peritoneal Flap in Robot-Assisted Radical Prostatectomy

Results of a Multicenter, Randomized, Single-Blind Study (PIANOFORTE) of the Efficacy in Reducing Postoperative Lymphocele

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Summary

Background: Lymphocele is the most common complication arising after pelvic lymph node dissection (PLND) in the setting of robot-assisted radical prostatectomy (RARP). The only data available until now on the utility of a peritoneal flap to prevent lymphocele were retrospectively acquired.

Methods: A randomized, controlled, multi-center trial with blinded assessment of endpoints was carried out on 232 patients with prostate cancer who underwent RARP with PLND. The patients in the intervention group were given a peritoneal flap; in the control group, surgery was performed without this modification. The two joint primary endpoints were the rates of symptomatic lymphocele during the same hospitalization as the operative procedure (iT1) and within 90 days of surgery (iT2). The secondary endpoints were lymphocele volume, the need for treatment of lymphocele, complications requiring an intervention, and the degree of postoperative stress incontinence. German Clinical Trials Register number: DRKS00011115.

Results: The data were evaluated in an intention-to-treat analysis, which, in this trial, was identical to an as-treated analysis. 108 patients (46.6%) were allotted to the intervention group. There were no statistically significant intergroup differences with respect to any clinical or histopathological criteria. A median of 16 lymph nodes were removed (interquartile range, 11–21). A symptomatic lymphocele arose in 1.3% (iT1) and 9.1% (iT2) of the patients, without any statistically significant difference between the two trial groups ($p = 0.599$ and $p = 0.820$, respectively). Nor did the groups differ significantly with respect to lymphocele volume ($p = 0.670$ on hospital discharge [T1], $p = 0.650$ 90 days after surgery [T2]) or the type and frequency of need for subsequent surgical intervention ($p = 0.535$; iT2). 81.5% of all patients ($n = 189$) had no complications at all in the first three months after surgery. Nor were there any intergroup differences at 90 days with respect to the degree of stress urinary incontinence ($p = 0.306$) or complications ($p = 0.486$).

Conclusion: A peritoneal flap after RARP was not found to influence the rate of postoperative lymphocele, whether asymptomatic or requiring treatment.

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With almost 61 000 new cases per year, prostate cancer (PCa) is the most common male cancer in Germany (1, 2). Of the potentially curative treatment options, radical prostatectomy with concomitant pelvic lymph node dissection (PLND) is the most commonly chosen surgical procedure (3–5). On the one hand, PLND remains the most accurate staging procedure for the detection of lymphatic metastasis and, on the other hand, the decision on which consecutive treatment should

be performed is informed by PLND. In addition, surgical removal of lymphatic (micro-) metastasis may be associated with improved prognosis (6–8).

In comparison with open radical prostatectomy (ORP), robot-assisted radical prostatectomy (RARP) is associated with reduced peri- and postoperative morbidity while offering comparable oncological safety (9). The majority of adverse events after RARP were associated with PLND and lymphoceles

CONSORT flow diagram of the PIANOFORTE study

CONSORT, Consolidated Standards of Reporting Trials; PLND, pelvic lymph node dissection; RARP, robot-assisted radical prostatectomy

(encapsulated collections of lymphatic fluid in the PLND bed) were the most common complication (ORP 2–61%, RARP 9–51%) (8, 10–12). While most lymphoceles remain asymptomatic, some patients experience lymphocele-associated adverse events. Clinical signs and symptoms range from abdominal/pelvic pain or difficult urination to deep vein thrombosis and septic conditions requiring surgical intervention. In the past, a variety of pharmacological and surgical approaches to reduce the lymphocele rate have been published (13–15).

Lebeis et al. presented a surgical modification of RARP, which involved the creation of a peritoneal flap, in 2015 (16). By standard release of the bladder as an access route to the extraperitoneal space, a so-called peritoneal flap is created. In the intervention (peritoneal flap) group, this flap was fixed with two separate sutures at the perivesical adipose tissue of the lateral (anterior) bladder wall towards the end of the surgical procedure to improve drainage of lymphatic fluid and to increase the peritoneal absorption area by reperitonealization of the lymph node dissection bed. In the retrospective data analysis, this technique significantly reduced the rate of symptomatic lymphoceles (11.6% versus 0%). Since adverse events or changes in early functional or oncological criteria were not observed with this modification, the authors recommended this surgical modification as safe, effective and feasible for broad adoption in daily clinical routine (16). Even though other working groups have published confirmatory results from their peritoneal flap studies, this modification has not yet been validated by direct evidence from studies with a prospective controlled design (17).

The aim of our study was to prospectively validate the results of the retrospective Lebeis study in a multicenter setting.

Methods

Study design

G*Power 3.1.9.4 for Windows was used to estimate the sample size for this multicenter, prospective, randomized, single-blind study, PIANOFORTE (Impact of Peritoneal Flap on Outcome after Robotic Prostatectomy), with blinded outcome assessment. Since the PIANOFORTE study was designed as a prospective validation of the Lebeis study, the effect size reported in the Lebeis study was used for biometric sample size estimation (16) (*eMethods*).

After obtaining the ethics committee approval, the PIANOFORTE study was registered in the German Clinical Trials Register (DRKS00011115) (18). The study was conducted according to good clinical practice (GCP) guidelines and data presentation followed the Consolidated Standards of Reporting Trials (CONSORT) recommendations for parallel-group randomized studies (19, 20).

Study group

Between March 2017 and December 2017, 404 robot-assisted radical prostatectomies were performed in 3 German centers and 1 Austrian center; of these, after application of the inclusion and exclusion criteria, 232 patients (57.4%) were included in the PIANOFORTE study (*Figure*). The inclusion and exclusion criteria as well as the obtained patient characteristics and study endpoints were recorded in the study protocol. Randomization was performed on a decentralized basis by the operating surgeon. Using randomization boxes (with fixed block length $n = 40$), patients were 1:1 block randomized

to receive either a peritoneal flap (intervention group) or no peritoneal flap (control group). The single-blind study design with blinded outcome assessment required that only the operating surgeon and one data manager per center were informed about the group assignment of the patients. Neither the patients nor any of the urologists involved in the collection of outcome data knew which group the patients belonged to.

Surgical technique

RARP with concomitant bilateral PLND was performed in a standardized way via a transperitoneal approach. Electrocautery and clips were allowed to seal lymphatic vessels. Finally, in every patient a pelvic drain was placed.

In the intervention group, the peritoneal flap was created with two-point fixation after completion of the vesicourethral anastomosis, exactly as described in the original article by Lebeis et al. (16). For the peritoneal flap, a standard release of the bladder was performed to obtain an access route to the extraperitoneal space and finally the lateral (anterior) bladder wall was fixed at the perivesical adipose tissue (*eFigure*).

Endpoints of the study

At the time of hospital discharge (T1) and 90 days after surgery (T2), data on the study endpoints were obtained. For the T2 follow-up, all patients were called in to the respective center. Patients were asked about any complications which may have occurred since the surgery and data were documented using the Clavien–Dindo classification system (21).

The co-primary endpoints of this study were the symptomatic lymphocele rates during the inpatient stay after surgery (iT1) and in the first 90 days (iT2). The secondary endpoints were the lymphocele volumes at the time of hospital discharge (T1) and at day 90 after surgery (T2), the lymphocele treatment and complications classified according to Clavien–Dindo (iT2), as well as stress urinary incontinence at day 90 after surgery (T2).

In the study protocol, an asymptomatic lymphocele was defined as a pelvic collection of lymphatic fluid detected by ultrasound. By contrast, symptomatic lymphoceles were defined by

- newly developed voiding abnormalities due to lymphocele formation adjacent to the bladder
- rheological problems (deep vein thrombosis, lymphatic drainage disorder/leg swelling)
- lymphocele infection (fever, sepsis), and/or
- abdominal pain with regional relationship to the lymphocele (after exclusion of other potential causes).

Consequently, symptomatic lymphoceles always required interventional/surgical treatment.

The integrity of the vesicourethral anastomosis was assessed by cystography (on day 3–6 after surgery) as described by Patil et al. (22). Postoperative stress

urinary incontinence was classified in severity according to the Ingelman–Sundberg scale (23–25).

Statistical methods

Continuous variables were reported as median and interquartile range (IQR), categorical endpoints as absolute and relative frequencies. The Kruskal–Wallis H-test was used to differentiate the distribution of continuous criteria (endpoints) between the treatment groups. Center effects on the co-primary study endpoints were evaluated using multivariable logistic regression analysis (factor variables: study group and study center). The distribution of categorical endpoints was analyzed using the chi-square test (in case of 2×2 contingency tables, Fisher's exact test). For the secondary endpoints, only exploratory testing was performed; thus, the reported p values should be regarded as descriptive indicators.

The statistical software package SPSS 25.0 was used for all data analyses. All reported p values are two-tailed; for the evaluation of the co-primary endpoints, statistical significance was set as $p < 0.025$ (for the other explorative tests, the significance level was set at $p < 0.05$). Consequently, this study can only be rated as positive if the null hypothesis for the two co-primary endpoints can be refuted at a significance level of $< 2.5\%$.

Results

Altogether, 232 patients (57.4%) were included in the PIANOFORTE study (*Figure*). Of these, 108 patients (46.6%) were assigned to the intervention (peritoneal flap) group and 124 (53.4%) to the control group. All patients underwent surgery as randomized (intention-to-treat analysis = as-treated analysis); conversion to open surgery was not required in any of the patients. The analysis of perioperative patient characteristics found no statistically significant differences between the two groups (*Table 1*).

A median of 16 lymph nodes were retrieved (IQR: 11–21); no statistically significant difference was observed between the study groups ($p = 0.946$). The primary and secondary study endpoints are shown in *Table 2* and *Table 3*. Of all patients, 1.3% (iT1) and 9.1% (iT2) developed a symptomatic lymphocele with no statistically significant difference between the two study groups ($p = 0.599$ and $p = 0.820$, respectively). In addition, no differences in lymphocele volume (T1: $p = 0.670$; T2: $p = 0.650$) or in the type and frequency of lymphocele treatment ($p = 0.535$) were found. Ninety days after surgery, 43.1% of patients ($n = 100$) achieved complete urinary continence; 81.5% ($n = 189$) of patients experienced no adverse events during the first 90 days after surgery. There was no difference in the extent of stress incontinence ($p = 0.306$) or in complication rates ($p = 0.486$) between the two study groups.

Center effects on the co-primary study endpoints were excluded (p values between 0.169 and 0.999).

TABLE 1

Distribution of patient characteristics in the study groups

Criteria	Total study sample (n = 232)	Peritoneal flap (n = 108)	Control group (n = 124)	p value
Median patient age in years (IQR)	65 (60–70)	64.5 (59.5–69)	66 (60.5–66)	0.385*
Charlson score ≥ 1 . n (%)	43 (18.5%)	25 (23.1%)	18 (14.5%)	0.127
Previous abdominal surgery, n (%)	104 (44.8%)	51 (47.2%)	53 (42.7%)	0.511*
Median body mass index in kg/m ² (IQR)	27.2 (25.2–29.7)	27.4 (25.6–29.7)	27.2 (25–29.9)	0.449*
Median primary PSA level in ng/mL (IQR)	8.2 (6–12.9)	8.1 (6.2–13.5)	8.3 (6.0–12.9)	0.791*
Median operating time in minutes (IQR)	167 (130–217)	160 (130–205)	172 (128–225)	0.337*
Median intraoperative blood loss in mL (IQR)	165 (120–220)	180 (125–300)	150 (115–200)	0.068*
Nerve-sparing surgery, n (%)	122 (52.6%)	61 (56.5%)	61 (49.2%)	0.293
Pathologic tumor stage, n (%)				0.343
pT2	165 (71.1%)	72 (66.7%)	93 (75%)	
pT3a	31 (13.4%)	16 (14.8%)	15 (12.1%)	
pT3b	35 (15.1%)	20 (18.5%)	15 (12.1%)	
pT4	1 (0.4%)	0	1 (0.8%)	
Nodal stage pN1. n (%)	16 (6.9%)	7 (6.5%)	9 (7.3%)	1.000
Positive surgical margin, n (%)	36 (15.5%)	18 (16.7%)	18 (14.5%)	0.718
Post-operative Gleason score, n (%)				0.840
Group 1 (3+3)	17 (7.3%)	8 (7.4%)	9 (7.3%)	
Group 2 (3+4)	120 (51.7%)	54 (50%)	66 (53.2%)	
Group 3 (4+3)	56 (24.1%)	29 (26.9%)	27 (21.8%)	
Group 4 (8)	21 (9.1%)	8 (7.4%)	13 (10.5%)	
Group 5 (9–10)	18 (7.8%)	9 (8.3%)	9 (7.3%)	
Median lymph node yield (IQR)	16 (11–21)	15 (10–22)	16 (11–21)	0.946*

*Wilcoxon–Mann–Whitney test (without asterisk: chi-square test). IQR, interquartile range; PSA, prostate-specific antigen

Discussion

Today, just over half of the about 25 000 radical prostatectomies performed in Germany each year are robot-assisted procedures (26). Postoperative lymphoceles are the most common complication of pelvic lymph node dissection and at times associated with considerable morbidity. Recently, two working groups evaluating a modification of the surgical technique—the creation of a peritoneal flap—have reported positive effects on the postoperative lymphocele rate (16, 17). Our external validation by means of a multicenter, randomized, controlled study with blinded assessment of the study endpoint provided evidence in support of the following points:

- The use of a peritoneal flap does not result in a statistically significant reduction in the rate of symptomatic lymphoceles.
- Likewise, the use of a peritoneal flap is not associated with a statistically significant reduction in lymphocele volume.
- In addition, no statistically significant difference was found with respect to the overall complication rate in the first 90 days after surgery and the type and frequency of lymphocele treatment.
- Furthermore, the use of a peritoneal flap had no significant effect on the continence status of patients 90 days after surgery.

The rates of asymptomatic postoperative lymphoceles reported in the literature range from 2% to 61%, depending on the surgical technique used (8, 10–12). In our sample, the rates of asymptomatic lymphoceles (>30 mL) at the time of discharge and after 90 days were 5.6% and 12.9%, respectively, and thus comparable with other RARP series (17, 27). However, it should be noted that the rates of asymptomatic lymphoceles can only be compared to a limited extent (detection bias). This is due, on the one hand, to differences in the methods used for lymphocele detection (clinical signs and symptoms, ultrasonography, CT, etc.) and, on the other hand, to study-specific variations in follow-up intervals.

Still, some patients develop symptomatic lymphoceles (see above), requiring surgical intervention. Rates of symptomatic lymphoceles after PLND reported in the current literature vary from 0% to 16% (16, 27, 28). Thus, many preventive approaches have been proposed in the past (14, 29–32). Fundamentally, the access route (extraperitoneal versus transperitoneal) seems to play a key role. Stolzenburg et al. reported that bilateral peritoneal fenestration during extraperitoneal laparoscopic prostatectomy resulted in reduced rates of both asymptomatic and symptomatic lymphoceles. The authors attributed this finding to improved postoperative drainage of lymphatic

TABLE 2

Distribution of primary and secondary endpoints in the study groups in relation to the postoperative formation of asymptomatic lymphoceles and lymphoceles requiring treatment

Criteria	Total study sample (n = 232)	Peritoneal flap (n = 108)	Control group (n = 124)	p value
Lymphocele volume at discharge (T1). n (%)				0.670
No lymphocele	195 (84.1%)	89 (82.4%)	106 (85.5%)	
<30 mL	24 (10.3%)	13 (12%)	11 (8.9%)	
31–100 mL	12 (5.2%)	6 (5.6%)	6 (4.8%)	
101–200 mL	1 (0.4%)	0	1 (0.8%)	
>200 mL	0	0	0	
Symptomatic lymphocele (primary inpatient stay = iT1). n (%)	3 (1.3%)	2 (1.9%)	1 (0.8%)	0.599
Symptoms (multiple items)				
- Lymphocele infection (fever/sepsis)	1 (0.4%)	1 (0.9%)	0	
- Abdominal pain with regional relation to lymphocele	3 (1.3%)	2 (1.9%)	1 (0.8%)	
Lymphocele volume 90 days after surgery (T2) n (%)				0.650
No lymphocele	183 (78.9%)	89 (82.4%)	94 (75.8%)	
<30 mL	19 (8.2%)	8 (7.4%)	11 (8.9%)	
31–100 mL	17 (7.3%)	6 (5.6%)	11 (8.9%)	
101–200 mL	8 (3.4%)	2 (1.9%)	6 (4.8%)	
201–300 mL	2 (0.9%)	1 (0.9%)	1 (0.8%)	
>300 mL	3 (1.3%)	2 (1.9%)	1 (0.8%)	
Symptomatic lymphocele (in the first 90 days = iT2), n (%)	21 (9.1%)	9 (8.3%)	12 (9.7%)	0.820
Symptoms (multiple items):				
- Abnormal voiding with increase in stress incontinence	1 (0.4%)	0	1 (0.8%)	
- Rheological problems (deep vein thrombosis, lymphatic drainage disorder etc.)	4 (1.7%)	0	4 (3.2%)	
- Lymphocele infection (fever/sepsis)	9 (3.9%)	4 (3.7%)	5 (4.0%)	
- Abdominal pain with regional relation to lymphocele	14 (6.0%)	8 (7.4%)	6 (4.8%)	
Lymphocele treatment (in the first 90 days = iT2), n (%)				0.535
None	211 (90.9%)	99 (91.7%)	112 (90.3%)	
Drainage (alone)	2 (0.9%)	0	2 (1.6%)	
Drainage and sclerotherapy	12 (5.2%)	5 (4.6%)	7 (5.6%)	
Laparoscopic lymphocele resection	7 (3%)	4 (3.7%)	3 (2.4%)	

fluid into the intraperitoneal space where it is then absorbed (13). However, the working group led by Horovitz did not find approach-associated differences in the incidence of symptomatic lymphoceles (33).

The peritoneal flap as a modification to the surgical procedure was first described by Lebeis in 2015, based on an anatomical rationale: The reperitonealization of anterior and lateral parts of the bladder was intended to optimize drainage of lymphatic fluid by creating a larger drainage area from the PLND bed towards the intraperitoneal space. In the retrospective, non-randomized single center study with 154 patients undergoing RARP, the risk of symptomatic lymphocele formation within 12 months after surgery was found to be reduced from 11.6% to 0% ($p = 0.003$). However, no routine follow-up examinations were

carried out to systematically determine the rate of asymptomatic lymphoceles (16).

Equally, Stolzenburg et al. reported that a similar modification of the surgical procedure had a preventive effect following RARP (17). Using four-point peritoneal flap fixation to the anterior and lateral pelvic side wall, the risk of symptomatic lymphocele formation during the first 90 days after surgery was reduced from 4.6% to 1.03% ($p = 0.032$). In addition, asymptomatic lymphoceles were identified by ultrasound in this retrospective matched-pair analysis, including 193 patients in each group (8.30% versus 2.07% within 90 days after surgery; $p = 0.005$) (17).

The sample of the PIANOFORTE study with altogether 232 patients is comparable with respect to patient characteristics, (peri-) operative data and rate

TABLE 3

Distribution of perioperative criteria and secondary endpoints between the study groups not directly related to the postoperative lymphocele rate

Criteria	Total study sample (n = 232)	Peritoneal flap (n = 108)	Control group (n = 124)	p value
Median duration of inpatient stay in days (IQR)	8 (7–9)	8 (6–8.5)	8 (7–9)	0.386*
Median duration of indwelling catheter in days (IQR)	5 (4–5)	5 (4–5)	5 (5–5)	0.232*
Cystogram (days 3–6 after surgery), n (%)				0.734
Patil grade 0 (satisfactory anastomotic situation)	209 (90.1%)	99 (91.7%)	110 (88.7%)	
Patil grade 1 (circumscribed extravasation <6 cm of anastomosis)	20 (8.6%)	8 (7.4%)	12 (9.7%)	
Patil grade 2 (circumscribed extravasation >6 cm of anastomosis)	2 (0.9%)	1 (0.9%)	1 (0.8%)	
Patil grade 3 (diffuse extravasation towards abdominal space)	1 (0.4%)	0	1 (0.8%)	
Stress incontinence (90 days after surgery = T2) with Ingelman–Sundberg scale				0.306
Grade 0 (no stress incontinence)	100 (43.1%)	51 (47.2%)	49 (39.5%)	
Grade 1 (incontinence on coughing or sneezing)	77 (33.2%)	37 (34.3%)	40 (32.3%)	
Grade 2 (incontinence with abrupt movements, sitting down & standing up)	44 (19%)	15 (13.9%)	29 (23.4%)	
Grade 3 (incontinence when lying or making less strenuous movements)	11 (4.7%)	5 (4.6%)	6 (4.8%)	
Clavien–Dindo grade (in the first 90 days = iT2), n (%)				0.486
Grade 0 (no complications)				
Grade 1 (deviation from normal course, without pharmacological treatment or surgical intervention)	189 (81.5%)	89 (82.4%)	100 (80.6%)	
Grade 2 (mild complication requiring pharmacological treatment)	14 (6%)	6 (5.6%)	8 (6.5%)	
Grade 3a (intervention not under general anesthesia)	8 (3.4%)	5 (4.6%)	3 (2.4%)	
Grade 3b (intervention under general anesthesia)	12 (5.2%)	3 (2.8%)	9 (7.3%)	
Grade 4 (life-threatening complication/ or 5 mortality)	9 (3.9%)	5 (4.6%)	4 (3.2%)	
	0	0	0	

*Wilcoxon–Mann–Whitney test (without asterisk: chi-square test). IQR, interquartile range

of asymptomatic (12.9%) and symptomatic (9.1%) lymphoceles to the patient samples of published studies (16, 17, 27). In contrast to the results reported by Lebeis et al. and Stolzenburg et al., peritoneal flap use did not lead to a significant reduction in the rate of symptomatic lymphoceles in the prospective randomized setting, neither during the inpatient stay (1.9% versus 0.8%; $p = 0.599$) nor during the first 90 days (8.3% versus 9.7%; $p = 0.820$). Similarly, no statistically significant reduction in mean lymphocele volume was found.

It is known that the risk of lymphocele formation increases with the extent of PLND and the number of obtained lymph nodes, plateauing at about 13 removed lymph nodes (34, 35). In the PIANOFORTE study, on average 16 lymph nodes were sampled in patients undergoing bilateral PLND. This number is comparable to other studies and shows that PLND was adequate (17, 27, 36). Contrary to current guideline recommendations for bilateral PLND, in the study by Lebeis et al. only one-sided and limited lymph node dissection was performed in nearly half of the cases (45.5%); this is reflected in the low

number of removed lymph nodes (4.2 versus 3.8; $p = 0.042$) (16). Nevertheless, the reported rate of lymphoceles requiring intervention was 11.6% in the control group. In contrast, the rate of symptomatic lymphoceles reported by Stolzenburg et al. was only 4.6%, despite the fact that on average 15 lymph nodes were removed in their study (17). Thus, it remains to be seen whether the number of sampled lymph nodes or the extent of PLND affects the effectiveness of a peritoneal flap as demonstrated by a reduced number of symptomatic lymphoceles.

In principle, the peritoneal flap is a safe technical modification of the overall standardized procedure of RARP with concomitant PLND. In the PIANOFORTE study, no negative effects on surgical (operating time, intraoperative blood loss, rate of nerve sparing) or oncological (pTNM, R1 rate) safety was observed. Likewise, in terms of integrity of the vesicourethral anastomoses, no differences were found. In this respect, our prospective patient safety results were consistent with the results of the retrospective matched-pair analysis by Stolzenburg et al. (17). Morbidity in the first 90 days was systematically assessed

using the Clavien–Dindo classification (21). In the intervention group, no increase in the rates of minor complications (Clavien–Dindo ≤ 2 : 10.2% versus 8.9%) or complications requiring intervention (Clavien–Dindo $\geq 3a$: 7.4% versus 10.5%) were found ($p = 0.486$). The most common adverse events were vesicourethral anastomotic leaks, urinary retention, temporary neuropraxia, deep vein thrombosis, and lymphoceles requiring intervention. The study groups led by Lebeis et al. (no use of the Clavien–Dindo classification) and Stolzenburg et al. (16, 17) found comparable complication rates. From a purely functional perspective, the use of a peritoneal flap had neither a positive nor a negative effect on the patients' continence situation 90 days after surgery.

Our study has several limitations which should be considered when interpreting its results. Due to the clearly defined inclusion and exclusion criteria, only a limited number of patients could be included in the study (232/404; 57.4%). Another limitation is the difference in size between the two study groups which is explained by the decentralized patient inclusion procedure (individually in each center), using randomization boxes ($n = 40$) with fixed block length. As the follow-up interval was limited to 90 days, group differences in lymphocele rate, rate of late complications, and functional situation could develop in the long term. RARP with PLND was performed by 9 surgeons in this multicenter study. The surgical learning curve for creating a peritoneal flaps is considered negligible by other working groups too (16). Our patient sample also included patients with an anastomotic leak on postoperative cystogram; consequently, extravasation observed during the follow-up ultrasound examination may have been misinterpreted as a collection of lymphatic fluid. In addition, ultrasonography for lymphocele assessment is an examiner-dependent diagnostic modality. Due to radiation hygiene considerations, cross-sectional imaging in the form of computed tomography was not performed as a standard imaging procedure.

Conclusion

Lymphoceles are a common complication after robot-assisted radical prostatectomy with concomitant pelvic lymph node dissection. Performing a peritoneal flap as part of this surgical procedure did not reduce the rates of asymptomatic or symptomatic lymphoceles. Our study results provide direct evidence which conflicts with the results of previously published retrospective series.

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Conflict of interest statement

Prof. Weikert received proctoring fees from Intuitive Surgical Sàrl. The other authors declare no conflict of interest.

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Key messages

- The peritoneal flap is a safe surgical modification of robot-assisted radical prostatectomy (RARP).
- The use of a peritoneal flap does neither reduce the rate of symptomatic lymphoceles nor lymphocele volume.
- In addition, no difference was found with respect to the overall complication rate in the first 90 days after RAPD and the type and frequency of lymphocele treatment.
- The use of a peritoneal flap has no effect on urinary continence 90 days after surgery.

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► Supplementary material

eMethods and eFigure:
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Supplementary material to:

Peritoneal Flap in Robot-assisted Radical Prostatectomy

Results of a Multicenter, Randomized, Single-Blind Study (PIANOFORTE) of the Efficacy in Reducing Postoperative Lymphocele

by Johannes Bründl, Sebastian Lenart, Gjoko Stojanoski, Christian Gilfrich, Bernd Rosenhammer, Michael Stolzlechner, Anton Ponholzer, Christina Dreissig, Steffen Weikert, Maximilian Burger, and Matthias May

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eMETHODS

Study design

G*Power 3.1.9.4 for Windows was used to estimate the sample size for this multicenter, prospective, randomized, single-blind study, PIANOFORTE (Impact of Peritoneal Flap on Outcome after Robotic Prostatectomy), with blinded outcome assessment.

Since the PIANOFORTE study was designed as a prospective validation of the Lebeis study, the effect size reported in the Lebeis study (Φ and Cramers V , each = 0.249) was used for biometric sample size estimation (16). According to the study protocol, symptomatic lymphoceles at 2 different time points were treated as co-primary endpoints; therefore, considering the multiple testing issue, a two-sided alpha error of 2.5% ($p = 0.025$) was set for both endpoints. The type II error was set at $\beta = 0.2$ (power 80%).

The PIANOFORTE study was designed with 1:1 randomization; considering the parameters relevant for biometric planning, 77 patients per group were required (16, 18). In order to increase the validity of the study results, we intended to exceed the biometrically required sample size by fully using the planned study duration of 9 months, given the high level of patient safety reported in the previous publication, resulting from the modification of the surgical technique.

eFigure

Peritoneal flap (intraoperative pelvic view):

- Dissection of what will later become the peritoneal flap at the start of the robot-assisted radical prostatectomy (RARP) by bilateral incisions lateral to the medial umbilical fold (cranial margin of the peritoneal flap, left [A] and right [B], respectively)
- Release of the peritoneal flap and the caudally adjacent urinary bladder from the anterior abdominal wall by bilateral transection of the medial umbilical fold.
- After completion of the vesicourethral anastomosis (*) and bilateral pelvic lymph node dissection (PLND), the cranial margin of the peritoneal flap (A/B) is fixed to the perivesical adipose tissue of the lateral (anterior) bladder wall (C/D) by two interrupted vicryl sutures (A→C; B→D).
- After completion of the peritoneal flap, the anterior and lateral portions of the bladder are covered with peritoneum in the direction of the PLND bed.