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Original Article

Ultrasound characteristics of a symptomatic and asymptomatic lymphocele after pelvic and/or paraaortic lymphadenectomy

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ABSTRACT

Objective: To describe the sonographic characteristics of a lymphocele after pelvic and/or paraaortic lymphadenectomy for gynecological malignancy, analyze and identify ultrasound characteristics related to the symptomatic and asymptomatic lymphoceles.

Materials and methods: This is a retrospective analysis of ultrasound examination data collected consecutively in patients after pelvic and/or paraaortic lymphadenectomy in one institution. We recorded the number of lymphoceles, localization, size; ultrasound morphology following International Ovarian Tumor Analysis group classification and symptoms.

Results: We described and analyzed 227 lymphoceles (150 asymptomatic and 77 symptomatic) in 161 patients. The asymptomatic lymphocele is typically a thick-walled cystic lesion without vascularization, round and unilocular with anechoic or ground-glass content. The symptomatic lymphocele is typically an oval, or ovoid, unilocular lesion with low-level or anechoic content (ground glass content is unlikely to be present, $p < 0.001$) and the presence of debris and septations. The lymphocele size ($p = 0.001$), number of lymphoceles (>1) ($p = 0.005$), septa ($p = 0.002$), and debris ($p < 0.001$) were independent ultrasound features correlating to symptoms development. More than one lymphocele ($p = 0.047$), septations ($p = 0.007$) and presence of debris ($p < 0.001$) were independent ultrasound features correlated to infection.

Conclusion: Ultrasound features of symptomatic and asymptomatic lymphocele differ. The clues for lymphocele differential diagnosis are the history of lymphadenectomy and the finding cystic lesion with typically ultrasound features of lymphocele, adjacent to great pelvic vessels. Unique ultrasound features of lymphocele may help to distinguish from tumor relapse, hematoma, abscess, seroma or urinoma.

Introduction

A lymphocele is a cystic mass that can form in the pelvic retroperitoneum or in the paraaortic region after pelvic or pelvic and paraaortic lymphadenectomy. A lymphocele is a collection of lymph bordered by a thick fibrous wall without vascular supply and epithelial lining, expanding from the retroperitoneum into the pelvis or the abdominal cavity. The pathophysiological basis for lymphocele development is an incomplete lymphostasis with post-operative lymph leakage in an amount exceeding the capacity for spontaneous peritoneal reabsorption and the accumulation of lymph in spaces that have formed as a result of lymphatic tissue removal [1]. The lymph tends not to clot and contains only a minimum number of thrombocytes and coagulation factors [2]. Most commonly, lymphoceles develop during the post-operative period, most of them usually within one year post-procedure [3]. The incidence of all lymphoceles has been reported to span broadly from 1 to 58%, out of which 5–35% are referred to as symptomatic [4–8].

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Most lymphoceles are asymptomatic; they are an accidental finding during a post-operative follow-up. If a patient is asymptomatic, no therapeutic intervention is required, and the patient should be instructed to come in as soon as any symptoms develop, namely signs of infection, swelling, or pain [3–5,7]. In most instances, an asymptomatic lymphocele reabsorbs within one to two years after surgery [5]. On the other hand, the symptomatic lymphocele is a serious postoperative complication. It may cause severe postoperative morbidity and consequently delay the subsequent cancer therapy [3,4,7,9]. They cause abdominal pain or symptoms resulting from the compression of adjacent structures - hydronephrosis, swelling of the lower limbs, and secondarily deep vein thrombosis. The most serious complication is an infection and consequent sepsis [10–13]. A lymphocele never transforms into the malignant tumor, it can be, however, misinterpreted during post-op follow-up as a recurrence [14,15]. A lymphocele may cause CA 125 tumor marker elevation. The pathophysiological basis for CA 125 elevation is peritoneal irritation caused by the lymphocele or development of secondary infection in the lymphocele.

For daily clinical practice, it is very important to distinguished lymphocele from a relapsing malignant tumor, hematoma, urinoma, seroma or abscess. Therefore, the aim of our study was to describe the sonographic characteristics of a lymphocele after pelvic and/or paraaortic lymphadenectomy according to IOTA (International Ovarian Tumor Analysis group) terminology and to analyze and identify ultrasound characteristics related to the symptomatic and asymptomatic lymphoceles [16].

Materials and methods

Study design and population

This is a retrospective analysis of ultrasound examination data collected consecutively in patients after pelvic and/or paraaortic lymphadenectomy in one institution [17]. We analyzed the ultrasound data - sonographic morphology and characteristics of a lymphocele after pelvic and/or paraaortic lymphadenectomy for gynecological malignancy to differentiate a lymphocele from recurrence or other cystic lesions in the abdominal cavity. We described in detail the ultrasound features of asymptomatic and symptomatic lymphocele and risky features in the ultrasound morphology picture regarding the possible future occurrence of symptoms caused by lymphocele in the patient. The analysis of above mentioned ultrasound data was performed on the group of 161 patients included to the former published study Zikan et al. [17] who underwent standard pelvic and/or paraaortic lymphadenectomy in one institution between February 2006 and November 2010 and who developed a lymphocele. The sample size of the patients included into the study was defined by time interval of data collection.

As a part of a standard follow-up, the patients underwent an ultrasound examination every 3 months (+/−1 month), or outside of this interval in presence of symptoms, for a period of up to two years post-surgery. All patients with lymphocele diagnosis were followed up by ultrasound up to the finalized 2 years-time frame after the surgery or up to the detection of the recurrence. When a lymphocele was detected, the patient was enrolled in this particular study and the following data were recorded: the number of lymphoceles; localization (external iliac, obturator, internal iliac, common iliac, paracaval, interaortocaval, paraaortic area); size (in three dimensions); morphology following the IOTA classification [16]; and symptoms (if present). We present a longitudinal data on symptoms development including infection of lymphocele after the lymphocele was detected. A lymphocele was marked as symptomatic according to the clinical examination in the following cases: manifesting as pain localized on the same side as the lymphocele, infection, urinary bladder compression causing urinary urgency or ureter compression causing hydronephrosis, lower limb swelling and/or thrombosis secondary to the lymphocele compressing a vein, or thromboembolic complication. In some cases, the lymphocele caused more than one symptom in one patient. For our study analysis, we marked the clinically most relevant and major symptom of them, and therefore we report one symptom for one patient. This study was approved by a local ethical committee, and all patients gave their informed consent.

Imaging

The ultrasound assessments were performed by one of three experienced gynecologic oncology sonographers. These were expert sonographers with gynecological oncology experience certificated by national Ultrasound Society as high-level experts in oncogynecological sonography. The ultrasound examiners did not perform gynecologic palpation and they all had information of clinical examination and referral data of the patient prior to the ultrasound examination. The transabdominal (probe RAB4-8-D, GE Health care Austria GmbH & Co OG, Zipf, Austria) and transvaginal (probe RIC6-12-D) ultrasound examination were performed using GE Voluson Expert E8 BT 09 or GE Logiq9 (GE Health care Austria GmbH & Co OG, Zipf, Austria) in B-mode and color and power Doppler mode. Each ultrasound examination was immediately described in the written report – these reports were used for the study analysis. The description and examination reports were based on the standards applied by our center. The pelvis was examined transvaginally both on the longitudinal and transversal plane. Doppler scans were used to evaluate vascularization of a lesion. If a lesion was found, it was evaluated according to the IOTA consensus described by Timmerman et al. [16].

A lymphocele was defined as follows: any uni- or multilocular tumor detected that had a thick wall; contained fluid of varying echogenicity (anechoic, low-level, ground-glass, hemorrhagic, mixed); oval, round, or hourglass-shaped; and with or without intraluminal septations or debris (Figs. 1–7). For each lymphocele, measures were taken in three dimensions (craniocaudal, anteroposterior, transverse). The absolute number of symptomatic and asymptomatic lymphoceles, as well as their anatomic and lateral localization in the pelvic retroperitoneum and the abdominal cavity (external iliac, obturator, internal iliac, common iliac, paracaval,

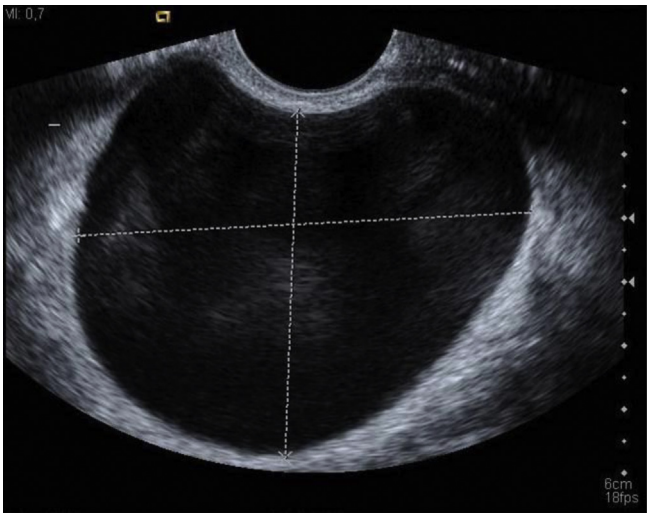

Fig. 1. Unilocular round shaped lymphocele with low level content.

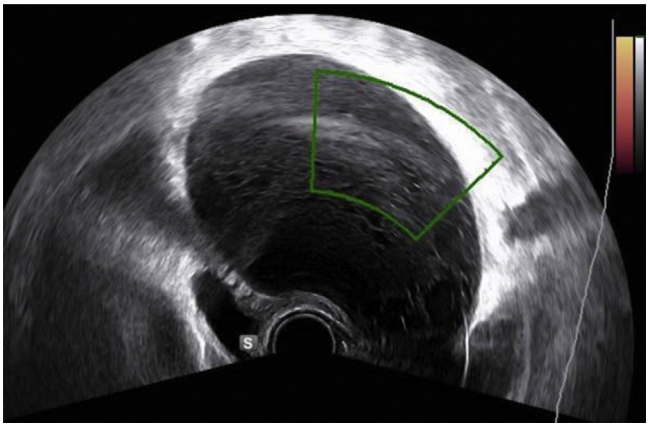

Fig. 2. Unilocular oval shaped lymphocele with septations and debris, low-level content without vascularization.

Fig. 3. Unilocular lymphocele with solid component with low level content.

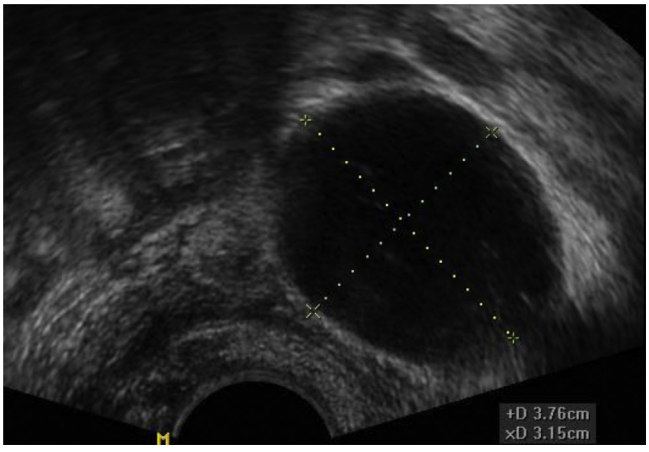

Fig. 4. Unilocular lymphocele with low-level content in iliac external area, 6 months after surgery.

interaortocaval, paraaortic area) were described in detail. The vascularization of the lesion was examined in the power Doppler mode, and the presence of solid components or tumor calcifications were assessed independently. In cases in which there was doubt

Fig. 5. Unilocular infected lymphocele with less defined edges and nonhomogeneous hypoechoic content with debris. Nine months after surgery; the same patient as Fig. 4.

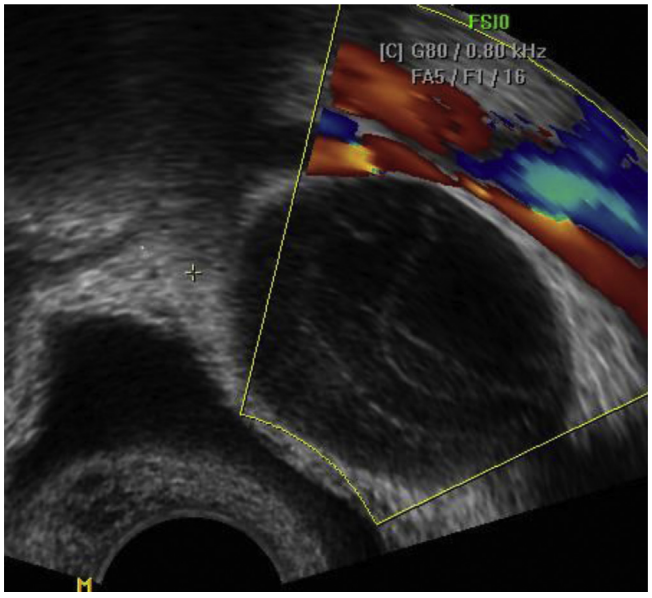

Fig. 6. Unilocular lymphocele with septations in iliac external area, 9 months after surgery.

relating to the nature of the lesion, computed tomography (CT) was carried out. In cases of persisting uncertainty, under ultrasound guidance, needle aspiration and evacuation with cytological evaluation of content was undertaken (if the lesion was cystic) or a Tru-Cut biopsy was performed (if a solid component was present) to exclude recurrence of the disease.

Statistics

The data were analyzed by a chi-square test, two-sample binomial test, by Fisher's exact test or Student's t test as appropriate. The parameter of lymphocele size was normalized by logarithmic transformation (ln), the tables give numerical characteristics after inverse transformation (mean; 95% confidence interval for the mean). The risk factors for symptomatic and infected lymphocele development were assessed by logistic regression. All the potential factors were added in the multivariate model regardless of their significance in the univariate analysis. OR means the relative risk of

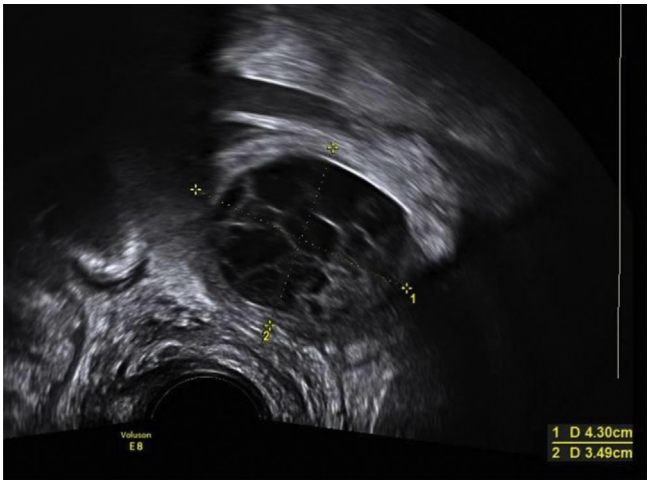

Fig. 7. Unilocular infected lymphocele with less defined edges and nonhomogeneous hypoechoic content with septations. 13 months after surgery; the same patient as Fig. 6.

a symptomatic lymphocele development. The analyses were performed using 0.05 significance level.

Results

Of the 800 patients who were followed up according to the study protocol, ultrasound revealed thick wall cystic retroperitoneal structures identified to be lymphoceles in 161 patients (20.1%) [17]. Characteristics of the patients with lymphoceles are provided in Table 1. We analyzed ultrasound morphology data of 227 lymphoceles diagnosed in 161 patients by transabdominal and transvaginal ultrasound examination as a part of a post-surgery follow-up. 150 lymphoceles were asymptomatic (115 patients) and 77 lymphoceles were symptomatic (46 patients). The most common symptoms in the study population were a pain (N = 33), infection (N = 25), lower limb lymphedema (N = 7), urinary bladder compression (N = 6), thromboembolism (N = 5), and hydronephrosis (N = 1).

Table 1
Characteristics of the patients with lymphoceles. Categorical data are described with absolute numbers and the percentage of patients in each given category; continuous variables are described by median (min; max) and mean (SD); follow-up is described using median (5th; 95th percentile).

Characteristic	Patients with lymphocele N = 161
Age at surgery (years)	53 (20–82)
	52 (13)
BMI (kg/m^2)	25 (17–47)
	26 (6)
Weight (kg)	70 (44–131)
	72 (16)
Type of cancer	
Endometrial cancer	43 (27%)
Cervical cancer	47 (29%)
Ovarian cancer	66 (41%)
Vulvar cancer	5 (3%)
Type of lymphadenectomy	
Sole pelvic	59 (37%)
Combined pelvic and paraaortic	102 (63%)
Approach	
Laparotomy	148 (92%)
Laparoscopy	13 (8%)
Total no. of nodes obtained	45 (2–113)
	47 (21)
Patients with positive nodes	36 (22%)
Number of positive nodes	2 (1–63)
	6 (11)
Postoperative radiotherapy	26 (16%)
Postoperative chemotherapy	79 (49%)

A single lymphocele was diagnosed in 109 (67.7%) patients, out of which 85 (78.0%) were asymptomatic and 24 (22.0%) were symptomatic. Two lymphoceles were detected in 39 (24.2%) patients, out of which 23 (59.0%) were asymptomatic and 16 (41.0%) were symptomatic. More than three lymphoceles were discovered in 13 (8.1%) patients, out of which 7 (53.8%) were asymptomatic and 6 (46.2%) were symptomatic. There was a significant trend of a higher probability of clinical symptoms ($p = 0.027$) with a higher number of lymphoceles in the patient.

There were 222 (97.8%) unilocular and only 5 (2.2%) multilocular lymphoceles in the study population. In only three lymphoceles (1.3%), calcifications were detected in the walls, vascularization was not seen in any of the lymphoceles (grade 1 according to IOTA definitions), and a solid component was found in only one case (0.4%). Based on the dimensions taken in all three planes, the lymphoceles were described as oval, or rather ovoid (N = 124, 54.6%), or as rounded (N = 103, 45.4%). From the total of 227 lymphoceles, 119 (52.4%) had ground-glass content, 97 (42.8%) had low-level content, and 11 (4.8%) were anechoic. Intraluminal septa were observed in 35 (15.3%) and debris in 48 (21.0%) lymphoceles. Table 2 shows a difference in the sonographic morphology of symptomatic and asymptomatic lymphoceles. Symptomatic lymphoceles were more often ovoid or oval-shaped (47.2%) with low-level (59.2%) or anechoic contents (72.7%). Ground glass content was significantly less present in symptomatic lymphoceles ($p < 0.001$). Septa and debris were more often detected in symptomatic lymphoceles, 80.0% respectively 79.2%. Asymptomatic lymphoceles were more often round in shape (82.7%), with hyperechoic (ground-glass) content (90.8%), less frequently with anechoic (27.3%) or low-level (hypoechoic) content (40.8%), and septa (20.0%) or debris (20.8%) were found even less often. The lymphocele size (OR 1.02, CI 1.01–1.04, $p = 0.001$), number of lymphoceles (>1) (OR 3.64, CI 1.53–9.34, $p = 0.005$), septa (OR 7.55, CI 2.23–30.21, $p = 0.002$), and debris (OR 6.67, CI 2.55–18.86, $p < 0.001$) were independent ultrasound characteristic features correlating to symptoms development in a multivariate model. With respect to the most serious complications, more than one lymphocele (OR 3.92, CI 1.09–16.81, $p = 0.047$), septations (OR 5.89, CI 1.66–22.44) and presence of debris (OR 45.89, CI 11.60–265.11, $p < 0.001$) were independent ultrasound features correlated to infection (Table 3).

Discussion

We described the sonographic characteristics of 227 lymphoceles (150 asymptomatic and 77 symptomatic) in 161 patients after pelvic and/or paraaortic lymphadenectomy for gynecological malignancy. We identified and analyzed ultrasound features related to the symptomatic and asymptomatic lymphoceles. Lymphoceles were analyzed with respect to their number, anatomical localization in the retroperitoneum, and ultrasound morphology in accordance with the standard IOTA ultrasound terminology. We discovered that IOTA terminology cannot be applied for lymphocele description without exceptions. Following this rule, debris within lymphocele should be described as mixed echogenicity cyst and lymphocele with septations as a multilocular cyst. In fact, debris and/or septations are unique ultrasonic characteristic features of lymphocele and for this reason; they should be excluded from IOTA terminology to avoid confusions. Our suggestion is that the new original ultrasound description terminology for lymphocele with septations should rather use terms like “layering” or “web like appearance”.

Table 2
Ultrasound characteristics of asymptomatic and symptomatic lymphoceles (location, morphology according IOTA terms and definitions) with respect to symptoms. Numbers in parentheses are column percentages of total number of lymphoceles. Numbers in brackets are row percentages. DVT – deep venous thrombosis.

	Total	Asymptomatic	Symptomatic	Pain	Infection	Lower limb lymphedema	DVT	Urinary bladder compression	Hydronephrosis
Number of lymphoceles	227 (100)	150 [66.4]	77 [33.6]	33 [14.4]	25 [10.9]	7 [3.1]	5 [2.2]	6 [2.6]	1 [0.4]
Lymphocele diameter (mm)									
Mean	47,8	40,2	67,3	64,7	64,2	78,1	84,2	69,3	64
95% CI for mean	44.4–52.6	36.9–43.8	60.2–75.3	53.3–78.6	55.4–74.5	43–141.8	65.2–108.9	55.1–87.3	
Location									
External iliac	148 (65.5)	100 [67.3]	49 [32.7]	18 [24.6]	15 [21.2]	6 [8.2]	4 [5.5]	5 [6.2]	1 [1.1]
Obturator	65 (28.4)	40 [63.1]	24 [36.9]	11 [26.7]	10 [32.2]	1 [2.1]	1 [2.1]	1 [5.9]	0
Common iliac	7 (3.1)	5 [71.4]	2 [28.6]	2 [58.3]	0	0	0	0	0
Total pelvic	220 (96.9)	145 [66.2]	75 [33.8]	31 [27.6]	25 [23.8]	7 [6.5]	5 [4.6]	6 [5.3]	1 [0.7]
Paraaortic	7 (3.1)	5 [71.4]	2 [28.6]	2 [28.6]	0	0	0	0	0
Locularity									
Unilocular	222 (97.8)	148 [67]	74 [33]	33 [14.7]	23 [10.3]	7 [3.1]	5 [2.2]	5 [2.2]	1 [0.4]
Multilocular	5 (2.2)	2 [40]	3 [60]	0	2 [40]	0	0	1 [20]	0
Shape									
Round	103 (45.4)	85 [82.7]	18 [17.3]	7 [6.7]	6 [5.8]	4 [3.8]	0	1 [1]	0
Oval	124 (54.6)	65 [52.8]	59 [47.2]	26 [20.8]	19 [15.2]	3 [2.4]	5 [4]	5 [4]	1 [0.8]
Content									
Anechoic	11 (4.8)	3 [27.3]	8 [72.7]	4 [36.4]	1 [9.1]	0	3 [27.3]	0	0
Ground-glass	119 (52.4)	108 [90.8]	11 [9.2]	4 [3.3]	6 [5]	1 [0.8]	0	0	0
Low-level	97 (42.8)	39 [40.8]	58 [59.2]	25 [25.5]	18 [18.4]	6 [6.1]	2 [2]	6 [6.1]	1 [1]
Internal structure and vascularization									
Septations	35 (15.3)	7 [20]	28 [80]	13 [37.1]	14 [40]	1 [2.9]	0	0	0
Debris	48 (21)	10 [20.8]	38 [79.2]	11 [22.9]	22 [45.8]	1 [2.1]	3 [6.3]	0	1 [2.1]
Solid	1 (0.4)	1 [100]	0						
Color score	0	0	0						
Calcifications	3 (1.3)	3 [100]	0						

A symptomatic lymphocele presents a clinical problem. The incidence of postoperative lymphocele in the literature is reported in the broad range of 1–58%; 5–18% of those who are symptomatic, our data are close to upper limit of the range referred to in literature [4–8]. In the study population, 77 symptomatic lymphoceles (27.9% of all patients with lymphocele) were detected. A symptomatic lymphocele was typically presented as unilocular oval cyst with low level or anechoic contents, with septa and debris, surrounded by a thin wall with no visible blood circulation in the Doppler mode. An oval shape of lymphocele occupies more space than round shaped lymphocele and so can push to the adjacent structures and organs. This may be the explanation, why more oval than round shaped lymphoceles are symptomatic. The debris ($p < 0.001$) and septa ($p = 0.002$) are unique features presented more frequent in

Table 3
Results from univariate and multivariate logistic regression analyses of presence of symptomatic or infected lymphoceles according to lymphoceles characteristics. For each data set, the first set of numbers are ORs, with 95% confidence intervals (CIs) in parentheses. The second numbers are P values, which reflect the statistical difference in the OR from 1. Odds ratio determines how much more likely a symptomatic/infected lymphocele is to occur.

Risk factors	Symptomatic vs Asymptomatic				Infected vs Uninfected			
	Univariate		Multivariate		Univariate		Multivariate	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Diameter of lymphocele(mm)	1.029 (1.019–1.041)	<**0.001**	1.022 (1.009–1.036)	**0.001**	1.011 (0.999–1.021)	0.053	0.99 (0.969–1.009)	0.322
Left side of the pelvis[a]								
Right side of the pelvis (Ref. Left)	1.182 (0.668–2.094)	0.566	0.731 (0.294–1.765)	0.49	1.638 (0.709–3.782)	0.248	1.228 (0.334–4.351)	0.75
Paraaortic (Ref. Left)	0.836 (0.156–4.474)	0.834						
External iliac[a]								
Obturator fossa (Ref. External iliac)	1.207 (0.657–2.217)	0.545	1.286 (0.488–3.37)	0.607	1.636 (0.693–3.865)	0.261	2.559 (0.649–10.914)	0.184
Common illiac (Ref. External iliac)	0.824 (0.154–4.402)	0.821	1.057 (0.073–10.677)	0.965				
1 lymphocele[a]								
Number of lymphocele >1	2.802 (1.585–5.061)	<**0.001**	3.638 (1.527–9.344)	**0.005**	2.571 (1.07–6.857)	**0.043**	3.92 (1.09–16.811)	**0.047**
Unilocular[a]								
Multilocular (Ref. Uniloc.)	3.041 (0.497–18.593)	0.229	1.742 (0.157–25.188)	0.655	5.826 (0.925–36.702)	0.061	19.235 (0.933–369.203)	0.051
Round shape[a]								
Oval shape (Ref. Round)	4.271 (2.303–7.92)	<**0.001**	2.158 (0.875–5.489)	0.098	2.928 (1.123–7.631)	0.028	1.846 (0.447–8.539)	0.407
Low-level content[a]								
Anechogenic content (Ref. Low-level)	1.839 (0.46–7.359)	0.389	1.267 (0.207–9.303)	0.806	0.444 (0.053–3.696)	0.453	0.257 (0.011–2.304)	0.280
Ground-glass content (Ref. Low-level)	0.07 (0.033–0.146)	<**0.001**	0.128 (0.05–0.306)	<**0.001**	0.234 (0.089–0.615)	**0.003**	0.823 (0.166–4.099)	0.808
Septations[b]	11.837 (4.864–28.804)	<**0.001**	7.547 (2.23–30.209)	**0.002**	11.091 (4.466–27.545)	<**0.001**	5.888 (1.658–22.438)	**0.007**
Debris[b]	13.836 (6.333–30.229)	<**0.001**	6.671 (2.55–18.859)	<**0.001**	50.205 (14.035–179.585)	<**0.001**	45.893 (11.604–265.11)	<**0.001**

P value in bold is statistically significant.
[a] Reference-standard variable with which covariates were compared.
[b] Coded with score 1 for presence and score 0 for absence.

the symptomatic lymphocele than in the asymptomatic one. Clinically, the most severe situation is presented by an infected lymphocele causing a general inflammatory response of the body accompanied by typical clinical manifestations. When pressed with the vaginal or abdominal transducer during a clinical examination, a symptomatic lymphocele may be very painful. Its thick wall contains no vessels and the fibrin network of the wall is a favorable environment for the growth of infectious agents. In a lymphocele modified by infection, nonhomogeneous hypoechoic contents with debris and septations are always seen. Infected lymphocele boundary is often effaced in the surrounding matter due to the local inflammatory exudation into the adjacent structures. Several lymphoceles with atypical appearance have been reported in literature. It was always the case of a lymphocele modified by inflammation where the fluid contents were so thick that the picture seemed to mimic a 'sponge-like' solid structure [18].

In the literature, there is only one prospective observational study performed by Tam et al. with 108 patients included [3]. Patients underwent uni- or bilateral pelvic lymphadenectomy for gynecological cancer in one unit. Tam et al. described incidence of lymphocele formation, their change in size with time, risk factors for lymphocele development and their correlation with symptoms. In the CT scans, lymphocele is thin-walled hypodense lesions with negative Hounsfield unit (as low as−18 HU) values usually adjacent to large vessels in the retroperitoneum in patients who underwent lymphadenectomy [19]. Infected or complicated lymphoceles usually have thick irregular enhancing wall and can measure up to 24 Hounsfield units on CT. On MRI lymphoceles appear as lobulated highly hiperintense structures on T2-weighted images with imperceptible wall and negligible wall enhancement on post-contrast T1-weighted images. Characteristic location, lobulated contour and cystic nature of the lesion allow differentiation from other cystic structures and hematoma. Debris within a lymphocele can be seen as a nodular lesion; however, lack of enhancement after gadolinium administration differentiates from a mural nodule [19].

In early post-operative period a lymphocele must be distinguished from hematoma, abscess, seroma or urinoma. Urinomas are encapsulated collections of chronically extravasated urine secondary to iatrogenic injury. They are usually located along the course of the urinary tract, in the perirenal space, retroperitoneum, or pelvis. The urine stimulates an intense fibrous reaction which forms a thick wall. On US, they are simple or septated fluid collections, without blood flow and solid component. To distinguish urinoma from lymphocele in two particular cases from our study, we used CT scan with demonstration of contrast leakage within the fluid collection on delayed post-contrast imaging and in one case needle aspiration of the cyst structure under ultrasound control to take cytological sample for urine verification. Seromas are post-operative fluid collections that usually develop early in the post-surgical period. Seromas can occasionally reaccumulate or persist but most decrease in size over time and eventually resolve [20]. Typically complex at imaging, a seroma can contain "solid-like" echogenic components, which likely represent resolving post-operative hematomas. Blood clots inside the cystic mass are not called as solid component according to IOTA terminology, they can slightly move ("jelly like"), when pushed by ultrasound probe at the wall of the cyst, no blood flow is detected. Although an abscess may be echogenic at US, it more often has mixed echotexture, more or less defined edges and rich blood flow can be detected in the capsule of the abscess by Doppler. In the late post-operative period, following typical ultrasound features of lymphocele, it is crucial to differentiate it from the cancer relapse [12,21]. In our study, no lymphocele was misdiagnosed on the ultrasound as tumor recurrence. In the whole group of patients, 32 (19.9%) developed a recurrence during the follow-up period, and none of them was misdiagnosed as a lymphocele by the ultrasound. Typical appearance of a recurrence is finding of uni- or multilocular tumor with solid structure in most cases [22]. A purely solid structure can be detected in almost half of the recurrences of gynecological cancers, while in the remaining cases a cystic part in the tumor was seen also. Nevertheless, in case any doubt concerning the biological origin and nature of the mass emerges, the golden standard is a cytological or histological verification.

Weaknesses of our study should be considered. We present one institution study of high experienced sonographers. There is no clear definition, what sufficient expertise is and how to achieve this. It has been already shown that the accuracy of ultrasound depends extremely on sonographer's experience. All the examinations were done in gynecological oncology center, where the ultrasound is used as first choice imaging method in gynecologic oncology staging and follow-up. We did not correlate our results with another imaging method of choice – computed tomography (CT) or magnetic resonance imaging (MRI) as this is not a standard follow-up modality in our institution. The strength of the study lies in the inclusion of a large number of patients. We present the largest group of symptomatic and asymptomatic lymphoceles post radical gynecological surgeries and for the first time transvaginal and transabdominal ultrasound characteristics of the large group of lymphatic cysts are described with well-defined criteria.

In conclusion, ultrasound features of asymptomatic and symptomatic lymphocele differ. Common signs of all lymphoceles are following: a cyst with thick wall with no vascularization, no intraluminal calcifications and no signs of solid components. The asymptomatic lymphocele is usually a round, unilocular cyst with ground-glass contents and differ from symptomatic which is usually an oval, or ovoid, unilocular cyst with low-level or anechoic content and presence of debris and septations. Typical sonographic features of symptomatic and asymptomatic lymphocele allow to distinguish from tumor relapse, hematoma, abscess, seroma or urinoma. Moreover, bigger size, higher number of lymphoceles, presence of septations and debris are independent sonographic risk features correlating to symptoms/infection. IOTA terminology is not applicable for lymphocele without exceptions, debris should be considered as a typical ultrasound feature of lymphocele and septations may be described as "layering" or "web like appearance".

Conflicts of interest

The authors declare no conflicts of interest.

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