The role of computed tomography in the evaluation of the spread of ovarian cancer

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ABSTRACT

The aim: To determine the role of CT in the evaluation of the spread of ovarian cancer.

Methods: The data of 64 female patients who underwent abdominal and pelvic CT examinations due to the suspicion of ovarian cancer during 2014–2015 in HLUHS CK were analyzed. All patients were operated and ovarian cancer was confirmed histologically.

Results: The average age of the patients was 60,06 ± 14,95 years. By the histological type, 37 (57,7%) cases of tumor were serous type. By the differentiation degree, 41 (63,5%) cases of tumor were G3. 27 (42,2%) of all the cases of ovarian cancer were diagnosed in the stage IIIC. CT sensitivity in the assessment of pathological lymph nodes was 41,9%, specificity – 81,8%, PPV – 68,4%, NPV – 60,0%, accuracy – 51,6%. CT sensitivity in the evaluation of peritoneal carcinomatosis was 62,5%, specificity – 81,3%, PPV – 90,9%, NPV – 41,9%, accuracy – 67,2%. The CT sensitivity to ascites was – 86,5%, specificity – 88,9%, PPV – 91,4%, NPV – 82,8%, accuracy – 87,5%.

Conclusions: 1. The symptoms of the ovarian cancer spread were determined more frequent in high-grade tumors. 2. Larger ovarian tumors typically were spread to the bladder and rectum. 3. The results of lymph nodes and peritoneal carcinomatosis showed that CT had moderate sensitivity, NPV, and accuracy, but it had high specificity. According to the pathological lymph nodes, PPV was average, but high according to peritoneal carcinomatosis. 4. The evaluation of ascites showed that CT sensitivity, specificity, PPV, NPV, and accuracy were high.

Keywords: ovarian cancer, spread, computed tomography.

INTRODUCTION

Ovarian cancer is one of the most common oncogynecological diseases diagnosed all over the world, which takes the fifth place amongst women malignant tumors. General morbidity of ovarian cancer in European Union (EU) countries is 13 per 100000 women, mortality – 7 per 100000 women. Around 400 new incidences of ovarian cancer are determined in Lithuania each year. Although there is similar morbidity in all EU, however there are most of all ovarian cancer death end cases calculated in our country. The reason is that an early stage of ovarian cancer has no characteristic symptoms; it is usually diagnosed already spread in third and fourth stages [1-3].

Early ovarian cancer diagnostics and detailed evaluation of tumor spread in later disease stages are relevant topics in oncogynecology. Timely diagnosis of the disease and evaluating its spread helps to choose optimal treatment tactics which are important for the prognosis of disease and the quality of life of the patients. Timely diagnostics also remains important for evaluation of the response to the treatment [1].

Ovarian cancer diagnosis can only be made based on conclusions of morphological examination. FIGO and TNM clinical classifications are used for the evaluation of ovarian cancer spread. The stage of the disease is mostly confirmed after surgical intervention. However, in some cases the staging of surgical disease cannot be done and the clinical stage of the disease then is confirmed based on morphological, objective and radiological research data only [1,4].

Various diagnostic tests are used to evaluate the spread of ovarian cancer, however CT remains the main test not only for ovarian cancer diag-

nosis and spread measurement but also for the evaluation of the possibility of optimal cytoreduction and response to the treatment [5].
Based on 2014–2015 years HLUHS Obstetrics and Gynaecology Clinics patients charts and the data of abdominal and pelvic CT tests, performed at Radiology clinics, retrospective analysis we aimed to determine the role of CT in the evaluation of the spread of ovarian cancer. By examining size, histological type, the degree of differentiation of malignant tumors, the age of the patients'interrelation, also by evaluating values of diagnostic parameters, we aimed to analyze the possibilities of CT test.

METHODS

The data of 64 female patients, who underwent abdominal and pelvic CT examinations at the HLUHS CK Radiology Clinic in 2014–2015, surgical treatment at Obstetrics and Gynaecology Clinics, when ovarian cancer diagnosis was confirmed by histology for the first time, were analyzed retrospectively. Data about the age of the patients, histological test results and conclusions, confirmed stages of TNM and FIGO classifications and additional ovarian cancer surgical findings (ascites, peritoneal carcinomatosis, lymph nodes metastasis) were collected from patients' charts.

Abdominal and pelvic CT images were also evaluated retrospectively. By analyzing CT images the size of primary tumor and additional findings (ascites (Fig. 1), pelvic and abdomen lymph nodes metastasis (Fig. 3), liver metastasis (Fig. 4), peritoneal carcinomatosis (Fig. 2, Fig. 3), tumor spread to bladder and rectum) which shows tumor spread, were evaluated. The results of CT scans were compared with histological tests and surgical findings Abdomen and pelvic CT were performed with "GE Light Speed VCT 64" or "Toshiba Aquilion One 320" multi-slice scanners with patient lying on the back and putting hands above his head. Native and contrast scans using non-ionic intravenous contrast were performed craniocaudally. 100–120 ml. contrast was injected with 3,0 ml/s speed automatic syringe. CT scans were performed in 30 and 55 seconds after contrast injection. Evaluation and measurements of CT scans were performed with images archiving, transferring and analyzing program "Cedara I–Reach 4.4". Microsoft Office Excel 2007 and SPSS 22.0 were used to systemize and analyse data. Significance level $p<0,05$ was chosen. For evaluation of CT method sensitivity, specificity, TPV, NPV and accuracy were calculated [7].

Fig. 1 **Abdominal CT. Ascites streak is visible near the liver** (white arrow)

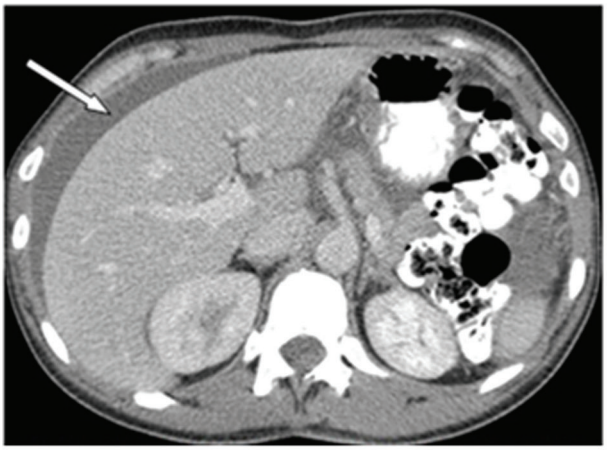
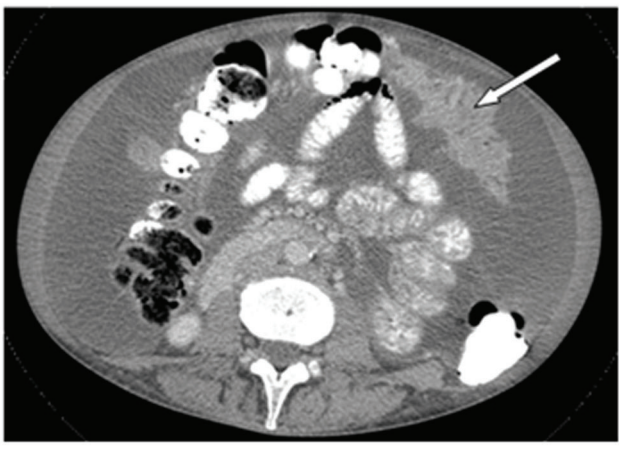


Fig. 2 **Abdominal CT. Ascites and peritoneum carcinomatosis are visible** (white arrow)



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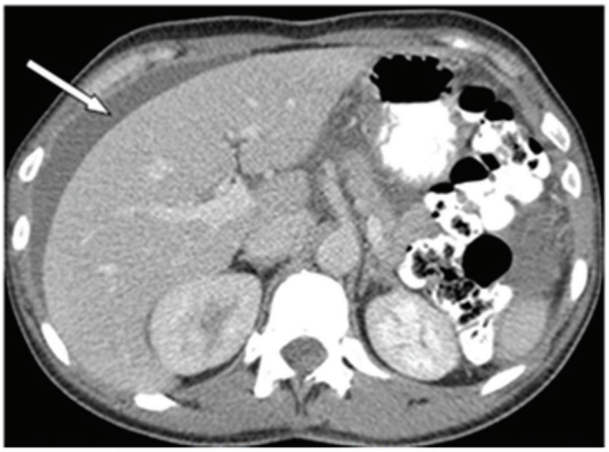

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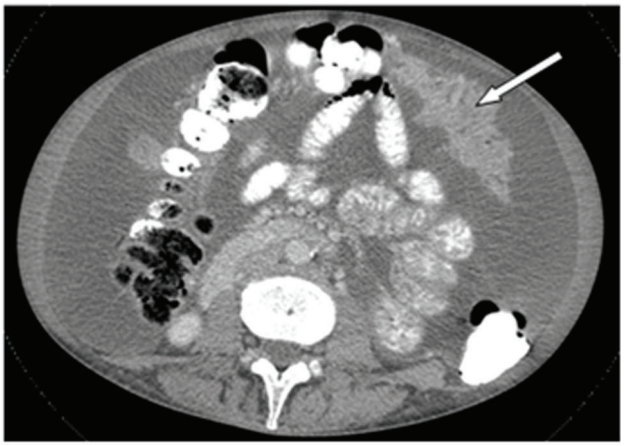

RESULTS

The study group consisted of (n=64) patients, who underwent abdominal and pelvic CT examinations at the HLUHS CK Radiology Clinic in 2014–2015, surgical treatment at Obstetrics and Gynecology Clinics, when ovarian cancer diagnosis was confirmed by histology for the first time. The age of patients in this group ranged from 29 to 86 years with an average age of 60,06±14,95 years. In most cases, ovarian cancer was diagnosed among patients, aged 40–60 (Fig. 5).

By the histological type, the highest number of serous tumors was detected - 37 (57,7%); the number of endometriotic tumors detected was 13 (20,3%). Relatively a little number of mucinous cells – 4 (6,3%), bright cells – 3 (4,7%), undifferentiated carcinomas – 2 (3,1%) and mixed – 2 (3,1%) ovarian cancer types were found; germ cells, genital mutilation, stroma and transitional epithelial tumors were detected only once (1,6%). During the study, the mean tumor size detected was 11,93 ± 5,0 cm. By the differentiation degree, a great number of G3 differentiation grade tumors was detected – 41 (64,1%) (Table 1). According to the FIGO stage, ovarian cancer was most commonly diagnosed in stage IIIC – 27 (42,2%), the cancer was detected just a few times in IVA–10 (15,6%), IA – 8 (12,5%) and IC – 7 (10,9%) stages.

Analyzing the possible relationship between ovarian cancer and the degree of differentiation of tumors, a statistically significant relationship was found between the signs of tumor spread (ascites, pathological lymph nodes, peritoneum carcinomatosis, urinary bladder and rectum) and differentiation degree. With increasing degree of tumor differentiation, these ovarian symptoms are more often diagnosed ($p<0,05$). However, there was no statistically significant relationship between degree of tumor differentiation and detectable metastases in the liver ($p>0,05$) (Table 2).

Analyzing the relationship between ovarian cancer spread and tumor size, two groups of subjects were selected, based on the largest tumor size. The first group consisted of patients with tumors less, than 10 cm in length; the second group consisted of patients with tumors larger, than 10 cm. Data analysis revealed a statistically significant relationship only between tumor size and penetration in the bladder and rectum ($p<0,05$). Tumors of the most patients (83,3%), who had a tumor spread in the urinary bladder, was larger, than 10 cm. Tumors larger, than 10 cm were also detected among patients (62,2%) with signs of cancer, spreading to the rectum (Table 3).

To determine the effectiveness of the CT test method, its susceptibility, specificity, PPV, NPV and accuracy were estimated for evaluation of pathological lymph nodes. CT sensitivity was 41,9% in the assessment of pathological lymph nodes (95% confidence interval (CI) 2–53%), specificity – 81,8% (95% CI 72–93%), PPV – 68,4% (95% of CI 57–80%), NPV–60,0% (95% CI 48–72%), accuracy – 51,6% (95% of CI 39–64%).

To determine the effectiveness of the CT scan in evaluating peritoneal carcinomatosis, its susceptibility, specificity, PPV, NPV and accuracy were estimated. CT sensitivity in the evaluation of peritoneal carcinomatosis was 62,5% (95% confidence interval (CI) 51 – 74%), specificity – 81,3% (95% CI 72–91%), PPV–90,9% (95% CI 84 – 98%), NPV–41,9% (95% CI 30–54%), accuracy – 67,2% (95% CI 56–79%). To determine the effectiveness of the CT test method, its susceptibility, specificity, PPV, NPV and accuracy are estimated for ascites. The CT sensitivity to ascites was 86,5% (95% confidence interval (CI) 78–95%), specificity – 88,9% (95% of CI 81–97%), PPV – 91,4% (95% of CI 85–98%), NPV – 82,8% (95% CI 74–92%), accuracy – 87,5% (95% of CI 79–96%).

Fig. 5. Patients age groups distribution

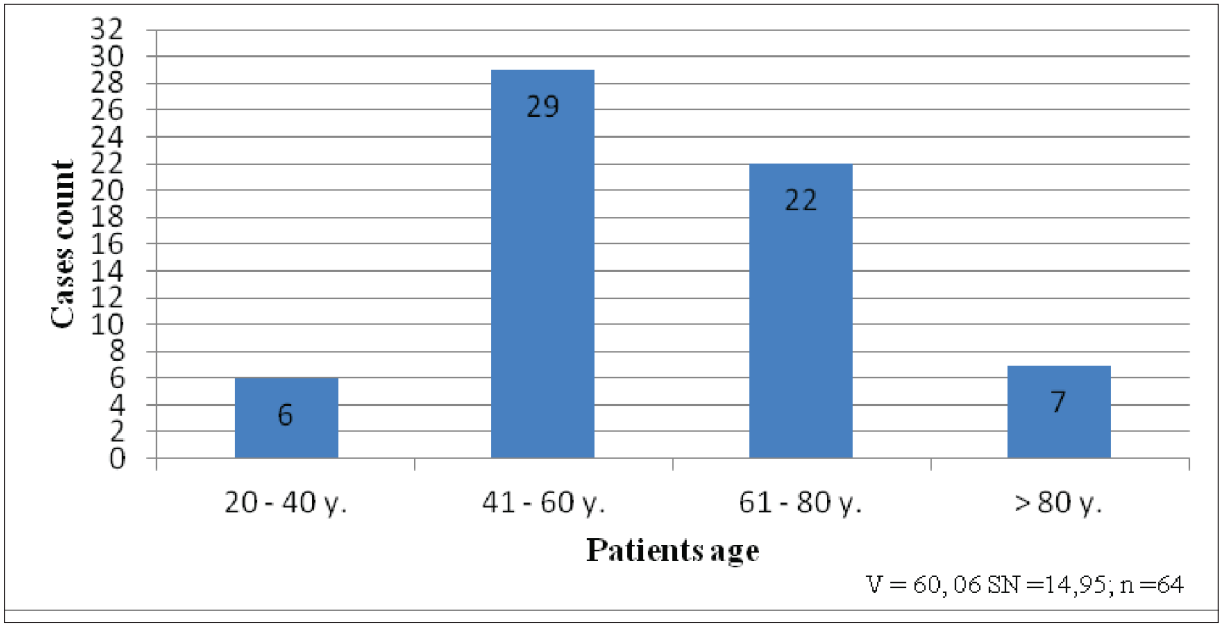

Table 1. Tumors distribution by differentiation grade

Tumors differentiation grade (G)	Cases count	
	n	%
G1	16	25,0
G2	7	10,9
G3	41	64,1
Altogether	64	100

Table 2. Comparison between spread of ovarian cancer and tumor degree of differentiation

Signs of the spread	Tumors differentiation grade (G)	Signs of tumor spread				p*
		Yes		No		
		n	%.	n	%.	
Ascites	G1	2	5,7	14	48,3	χ^2=14,17 p=0,001
	G2	3	8,6	4	13,8	
	G3	30	85,7	11	37,9	
Pathological lymph nodes	G1	1	5,3	15	33,3	χ^2=26,21 p=0,001
	G2	4	21,1	3	6,66	
	G3	14	73,6	27	60,0	
Peritoneum carcinomatosis	G1	3	9,1	13	41,9	χ^2=24,97 p=0,001
	G2	5	15,2	2	6,5	
	G3	25	75,7	16	51,6	
Metastases in liver	G1	0	0	16	28,6	χ^2=4,53 p=0,104
	G2	0	0	7	12,5	
	G3	8	100,0	33	58,9	
Spread to bladder	G1	14	30,4	2	11,1	χ^2=2,33 p=0,01
	G2	5	10,9	2	11,1	
	G3	27	58,7	14	77,8	
Spread to rectum	G1	2	9,5	14	32,6	χ^2=9,23 p=0,01
	G2	0	0	7	16,3	
	G3	19	90,5	22	51,2	

Table 3. Comparison between spread of ovarian cancer and tumor size groups

Signs of the spread	Tumors size group	Signs of tumor spread				p*
		Yes		No		
		n	%.	n	%.	
Ascites	< 10 cm	5	14,3	9	31,1	χ^2=0,53 p=0,467
	≥ 10 cm	30	85,7	20	68,9	
Pathological lymph nodes	< 10 cm	6	31,6	19	42,2	χ^2=2,05 p=0,152
	≥ 10 cm	13	68,4	26	57,8	
Peritoneum carcinomatosis	< 10 cm	13	39,4	8	25,8	χ^2=0 p=0,972
	≥ 10 cm	20	60,6	23	74,2	
Metastases in liver	< 10 cm	4	57,1	21	36,8	χ^2=1 p=0,317
	≥ 10 cm	3	42,9	36	63,2	
Spread to bladder	< 10 cm	3	16,7	22	47,8	χ^2=4,72 p=0,03
	≥ 10 cm	15	83,3	24	52,2	
Spread to rectum	< 10 cm	8	42,1	17	37,8	χ^2=4,66 p=0,03
	≥ 10 cm	28	62,2	11	57,9	

DISCUSSION

The study group consisted of 64 patients, who underwent abdominal and pelvic CT examinations at the HLUHS CK Radiology Clinic in 2014–2015, surgical treatment at Obstetrics and Gynecology Clinics, when ovarian cancer diagnosis was confirmed by histology for the first time. The age of patients in this group ranged from 29 to 86 years with an average age of 60,06 ± 14,95 years. Relatively, the similar average age of patients (63 years) is also indicated in literature sources [7–9]. In our study, ovarian cancer was predominantly diagnosed in patients, aged 40–60 years (n=29), although the literature suggests that this oncogynecological disease is most commonly diagnosed at a later age – in the seventh and eighth decades of life [7–9].

During the study, serous ovarian tumors were detected in the most cases, 37 (57,7%), of which 27 (65,9%) were of G3 differentiation degree. Similar results were obtained during the study, conducted by Pratt J., in which women with ovarian cancer of Spain participated. Comparing our results with the results of the Spanish study, it may be noted that early stage ovarian cancer usually does not have the characteristic symptoms of the disease, thus already advanced cancer is diagnosed – stages III and IV [4]. During our study, 30 patients (46,9%) had ovarian cancer, diagnosed in stage III, and 13 (20,1%) – in stage IV.

The study showed a statistically reliable relationship between CT scan of ovarian cancer (ascites, pathological lymph nodes, peritoneum carcinomatosis, urinary bladder and rectum) and tumor differentiation degree. Signs of ovarian cancer spread more frequently in tumors with higher differentiation degrees ($p<0,05$). References also indicate that there is a significant relationship between the FIGO stage and the tumor differentiation degree, the later stage of ovarian cancer is more often determined for tumors with higher differentiation degrees [10–14].

The study also showed a statistically significant relationship between tumor size and the spread of cancer to the bladder and rectum. In larger ovarian tumors, a higher incidence of urinary bladder and rectum ($p<0,05$) was observed. Similar results were obtained in a study, conducted in the United States of America, where it was found that the increase in tumors is characterized not only by the increased frequency of their spread to adjacent organs (bladder, rectum, uterus), but also by more frequent clinical signs of local tumor proliferation (urination, bowel obstruction, pain syndrome) [15].

During the study, we found that, in the evaluation of pathological lymph nodes, the CT sensitivity was 41,9%, specificity – 81,8%, PPV – 68,4%, NPV – 60,0%, accuracy – 51,6%. Relatively, similar results were obtained in a study, conducted by Aquilani L. and co–authors, where, in the evaluation of pathological lymph nodes, the CT sensitivity was 50%, specificity – 85,9%, PPV – 50%, NPV – 75,3 %, accuracy – 70,3 % [16]. During our study, in evaluating peritoneal carcinomatosis, CT sensitivity was 62,5%, specificity – 81,3%, PPV – 90,9%, NPV – 41,9%, precision – 67,2%, the CT sensitivity was 86,5%, specificity – 88,9%, PPV – 91,4%, NPV – 82,8%, accuracy – 87,5%. Similar data was obtained in a study, conducted by Aquilani L. and co– authors, where, in evaluating peritoneal carcinomatosis, the CT scan specificity was 47,6%, PPV – 86,2%, NPV – 48,7%, accuracy – 78,5%, in evaluating the ascites, the CT method specificity was 55,7%, PPV – 70,9%, NPV – 84,5%, accuracy – 75%. Relatively, Bezirgcioglu I. and co–authors in a study, conducted in Turkey to investigate ovarian cancer in women, comparing the CT scan sensitivity evaluation results. The authors state that, in evaluating peritoneal carcinomatosis and ascites, CT sensitivity is 57,4%. and 85,2 % accordingly [17].

Having reviewed the results of our and previous studies, as well as the literature data, we can observe that the ovarian cancer evaluation is relatively similar during CT, the differences are possible due to uneven research methods in various health care institutions.

CONCLUSIONS

1. The symptoms of the ovarian cancer spread were determined more frequent in high-grade tumors.
2. Larger ovarian tumors typically were spread

to the bladder and rectum.

3. The results of lymph nodes and peritoneal carcinomatosis showed that CT had moderate sensitivity, NPV, and accuracy, but it had high specificity. According to the pathological lymph nodes, PPV was average, but high according to peritoneal carcinomatosis.

4. The evaluation of ascites showed that CT sensitivity, specificity, PPV, NPV, and accuracy were high.

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