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ORIGINAL ARTICLE

Diagnostic value of endosonography scoring systems in the detection of ovarian and endometrial carcinoma

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Summary

Purpose: *To evaluate the diagnostic significance of sonographic scoring systems in the diagnosis of ovarian and endometrial carcinoma.*

Patients and methods: *357 women with different malignant and benign diseases of the ovary and uterus were divided into 4 groups according to histopathological findings: group A: ovarian carcinoma (n=71); group B: benign ovarian tumors (n=106); group C: endometrial carcinoma (n=60); and group D: benign endometrial diseases in menopause (hyperplasia, polyps, submucosal myoma; n=120). Women were examined using 7 MHz endovaginal probe and were evaluated using 2 different sonographic scoring systems, separately for ovarian and for endometrial carcinoma. Particular morphological characteristics of ovarian carcinoma (tumor size, echo-characterization: solid-cystic, presence of septum, characteristics of tumor capsule and presence of ascites) were evaluated with points 0-2 (total score: 0-10). For endometrial carcinoma we used a clinico-sonographic scoring system, which included evaluation of the endometrial thickness, isthmus-fundus diameter of uterus, number of years in menopause and the presence of risk factors, using scores 0-2 (total score: 0-8).*

Results: *The average age in group A was 48.1 years, and the arithmetic mean of total score 7.25 points. In group C the average age was 64.1 years, and the arithmetic mean of total score 6.38 points. Using both scoring systems, a total score of 6 points had the highest diagnostic reliability in both ovarian (sensitivity 87.3%, specificity 97.5%, test accuracy 91.6%) and endometrial carcinoma (sensitivity 80%, specificity 91.5%, test accuracy 90.9%).*

Conclusion: *A total score of 6 and more points presents the gold standard according to which it is possible to diagnose with high accuracy the existence of ovarian and endometrial carcinoma. Shifting towards higher criteria, specificity and positive predictive value rise, but sensitivity, negative predictive value and test accuracy decrease. Shifting towards lower values of total score increases sensitivity and positive predictive value, but decreases specificity, negative predictive value and test accuracy.*

Key words: endometrial cancer, ovarian cancer, scoring systems, ultrasonography

Introduction

When assuming the presence of a tumor in the pelvis, the following information gained by using ultrasound (size, shape and texture of the tumor, attachment to specific organ, relations with surrounding structures and presence of free fluid in the Douglas pouch) [1] are of extreme importance to the clinician. More information gained in a short period of time and precision during examination makes endovaginal sonography more preferable compared to abdominal sonography in the diagnosis of benign and malignant tumors of the ovaries and uterus. Most mistakes are thought to be caused by incorrect technique of handling the ultrasound probe, brief examination, misinterpretation of findings and disturbances in the intestinal system [2]. Ovarian carcinoma, with an incidence of about 15/100.000, constitutes about 25% of all malignant tumors of the female genital system and is the leading cause of death in this group of patients [3,4]. Ovarian carcinoma has the worst prognosis among all malignant tumors of the female genital system, partly because the disease is diagnosed in advanced stages (III and IV) in over 70% of patients [5]. Early diagnosis and proper surgical

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therapy are imperative when treating these patients [6]. Endometrial carcinoma is the most common malignant tumor of the female genital system (40%), representing 10% of all newfound cases of malignant tumors in women in Western Europe and 6% in USA [7]. It usually occurs after menopause, with highest incidence in the 6th decade of life (80% of all cases) [8]. About 75% of endometrial carcinomas are diagnosed in the first stage of the disease, while 15-25% of all cases are found in advanced stages, when the disease has spread to other pelvic and abdominal organs as well [9]. Normal ultrasound image of the endometrium depends on patient's age and period during the menstrual cycle. The risk of carcinoma in menopause with endometrial thickness < 4 mm is 1% [10]. Evaluating certain morphological characteristics of ovarian and uterine tumors using ultrasound examinations which are characterized by points 0-2, we tried to create a mathematical evaluation of the ultrasound image.

The aim of this study was to evaluate the diagnostic significance of sonographic scoring systems (Novi Sad score I and II) in the diagnosis of ovarian and endometrial carcinoma.

Patients and methods

At the Department of Obstetrics and Gynaecology, Medical Faculty in Novi Sad (Vojvodina, Serbia), 357 women with different malignant and benign diseases of the ovary and uterus were included in prospective ultrasound examinations. 7 MHz endovaginal ultrasound probes (Aloka SSD 1200 and Siemens Sonoline Prima devices) were used during these examinations.

All patients were classified into 4 groups according to definite histopathological results: group A- ovarian carcinoma (n=71); group B- benign ovarian tumors (n=106); group C- endometrial carcinoma (n=60); and group D-benign endometrial diseases during menopause: endometrial hyperplasia, submucosal myoma, endometrial polyps (n=120).

Basic criteria for entering the trial in groups A and B were the presence of cystic or solid ovarian tumor, where surgical treatment was recommended after gynecological, ultrasound or imaging examination (CT, MRI). All patients underwent surgery, and the definite diagnosis was given based on the histopathological examination of the removed material. Immediately prior to the ultrasound examination, the patients completed a questionnaire that included general information (age, clinical and, later, histopathological diagnosis).

Table 1 shows the sonographic scoring system (Novi Sad score I) concerning ovarian tumors, where 5 morphological characteristics were evaluated by points 0-2, giving a total score ranging from 0 to 10 points.

In groups C and D with endometrial tumors, basic criteria for entering the trial were irregular genital bleeding and menopausal status longer than 12 months. All patients were evaluated by the clinicosonographic scoring system (Novi Sad score II), shown in Table 2. This scoring system consisted of 2 sonographic and 2 clinical parameters, scored according to the abovementioned criteria by points 0-2, giving a total score ranging from 0 to 10 points. Evaluated risk factors for endometrial carcinoma included obesity (body weight over 85 kg), diabetes mellitus, hypertension, nulliparity and smoking.

After the ultrasound examination, all patients underwent hysteroscopy with punch biopsy of endo-

Table 2. Clinicosonographic scoring system for endometrial cancer (Novi Sad II)

Characteristics	*Score 0*	*Score 1*	*Score 2*
Endometrial thickness (mm)	up to 3	4-10	over 10
Diameter: isthmus-fundus of the uterus (cm)	up to 5	6-7	over 7
Duration of menopause (years)	up to 5	6-10	over 10
Risk factors	1	3	3 and more

Risk factors: obesity (over 85 kg), diabetes, hypertension, nulliparity, smoking

Table 1. Sonographic scoring system for ovarian tumors (Novi Sad I)

Sonographic characteristics	*Number of points* Score 0	Score 1	Score 2
Tumor size (cm)	up to 3	4 - 10	over 10
Morphological characteristics	cystic or solid	mixed composition inside cystic tumor	solid plaques and papillae
Septa	without	of equal thickness	non equal thickness
Characteristics of tumor capsule	of equal thickness	non equal thickness	uneven, with proliferations
Ascites	without	minimal	massive

Table 3. Histologic classification of ovarian cancer

Histologic classification	*Number*	*%*
Epithelial tumors		
Serous cystadenocarcinoma	29	50.0
Mucinous cystadenocarcinoma	10	14.2
Endometrioid carcinoma	6	8.4
Clear cell carcinoma	3	4.2
Brenner malignant tumor	1	1.4
Undifferentiated carcinoma	1	1.4
Germ cell tumors		
Dysgerminoma	3	4.2
Sex cord-stromal tumors		
Granulosa cell tumor	2	2.8
Sertoli-Leydig cell tumors	7	9.8
Gynandroblastoma	1	1.4
Secondary (metastatic) tumors		
Adenocarcinoma (Krukenberg tumor)	4	5.6
Malignant melanoma	1	1.4
Unclassified tumors		
Anaplastic carcinoma	3	4.2
Total	71	100

metrium. All patients were divided into 2 groups (endometrial carcinoma and benign uterine diseases), based on the histopathological results. Each patient was separately evaluated using the aforementioned scoring systems.

Analysis of the results obtained was carried out using the methodology applied for evaluating diagnostic tests in medicine [11,12]. The diagnostic significance of the sonographic scoring systems included sensitivity, specificity, positive and negative predictive values and test accuracy. Calculation of the diagnostic values for ovarian tumors (groups A and B) was done for a total score of 4-10 points, while in endometrial diseases (groups C and D) for a total score of 5-7 points. When calculating the diagnostic significance of the scoring systems, groups A and C were labeled as oncological, while groups B and D as healthy regarding the absence of malignant disease.

Results

The average patient age in group A was 48.1 years (range 19-75), and in group B 38.3 years (range 14-76). Histopathological classification of malignant and benign ovarian tumors is shown in Tables 3 and 4. Table 5 shows the diagnostic significance of the sonographic scoring system in ovarian carcinoma (Novi Sad score I). The arithmetic mean (x) of the total score in group A was 7.25, and in group B 3.16 points. Figure 1 shows the sonographic image of a stage III ovarian carcinoma and the total evaluated score.

In group C, the average patient age was 64.1 years (range 48-76), and in group D 59.7 years (range 44-82). Benign conditions found in group D were: endometrial hyperplasia 56%, submucosal myoma 30.8%, and endometrial polyps 13.2%. The diagnostic significance of clinicosonographic scoring system (Novi Sad score II) is shown in Table 6. Figure 2 shows the sonographic image of an endometrial carcinoma extending to the cervix uteri, and the total evaluated score. The arithmetic mean (x) of the total score in group C was 6.38, and in group D 3.41 points.

Table 4. Histologic classification of benign ovarian tumors

Histologic classification	*Number*	*%*
Epithelial tumors		
Serous cystadenoma	12	11.3
Mucinous cystadenoma	21	19.8
Germ cell tumors		
Dermoid cysts	14	13.2
Stromal tumors		
Fibroma	2	1.9
Fibrothecoma	3	2.8
Functional cysts		
Follicular cysts	5	4.7
Theca lutein cysts	6	5.6
Corpus luteum cysts	8	7.6
Pelvic inflammatory tumors		
Tuboovarian abscess	12	11.3
Ovarian abscess	2	1.9
Mixed condition		
Endometriomas	14	13.2
Hemorrhagic cysts	2	1.9
Paraovarian cysts	5	4.8
Total	106	100

Table 5. Diagnostic value of sonographic scoring system for ovarian cancer

Diagnostic tests	*Total score (%)*						
	≥4	*≥5*	*≥6*	*≥7*	*≥8*	*≥9*	*10*
Sensitivity	100.0	95.7	87.3	70.4	46.4	21.1	4.2
Specificity	66.0	81.1	91.5	97.1	99.0	100.0	100.0
Positive predictive value	66.3	77.2	87.3	70.4	97.0	100.0	100.0
Negative predictive value	100.0	96.6	91.5	83.0	73.4	65.4	60.9
Test accuracy	79.6	87.0	90.9	86.4	77.9	68.3	61.5

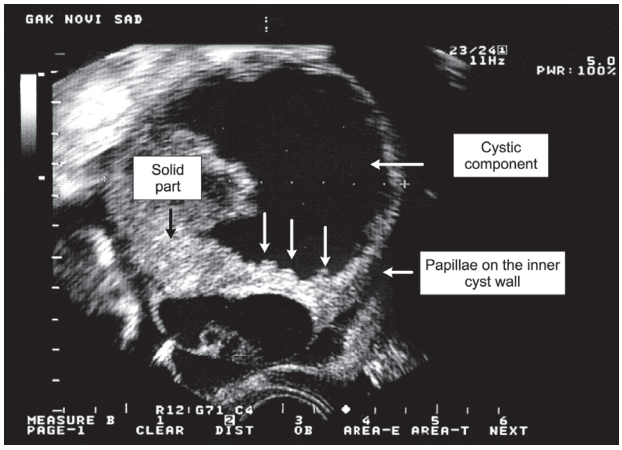

Figure 1. Poorly differentiated papillary serous cystadenocarcinoma, FIGO stage III. Total sonographic score: 8.

Table 6. Diagnostic value of clinicosonographic scoring system for endometrial cancer

Diagnostic tests	*Score (%)*		
	> 5	*> 6*	*> 7*
Sensitivity	95.0	80.0	50.0
Specificity	86.6	97.5	99.1
Positive predictive value	78.0	94.1	96.7
Negative predictive value	97.1	90.6	79.8
Test accuracy	89.4	91.6	82.7

Discussion

Usage of imaging diagnostic methods (CT and MRI), as well as color Doppler in the early diagnosis of ovarian and endometrial carcinoma has not provided the desired results, so additional contribution is expected from the usage of PET scan [13,14]. The fact that these are expensive diagnostic procedures, available only in well-equipped diagnostic centres, leads to an increased interest in applying endovaginal sonography in ovarian and endometrial carcinoma diagnosis.

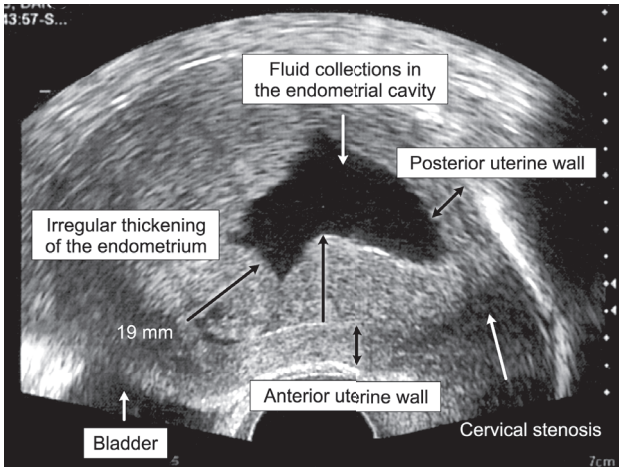

Figure 2. Endometrial carcinoma with cervical involvement, FIGO stage II. Total clinicosonographic score: 7.

Ultrasound findings with increased suspicion of malignancy in ovarian carcinoma include the following morphological characteristics: papillary proliferations and prominences on the inner side of the tumor's wall, more septa of unequal thickness, tumors with complex structure, multicystic parts inside the solid tumor and presence of ascites in the abdomen [15]. According to several authors, the diagnostic value of the above listed sonographic characteristics confirming malignancy is: sensitivity 62-100%, specificity 52-100% [16,17]. In early stages ovarian cancer does not always display characteristic sonographic appearance, while in advanced stages it manifests as large mixed or solid tumor masses [18].

The aim of implementing scoring systems is to discriminate less reliable information and focus on relevant and important parameters. Up to now, several different sonographic scoring systems which were evaluating certain tumor characteristics have emerged in order to point to the malignant nature of the disease as objectively as possible. One of the most commonly used scoring systems was published in 1991 by Seassone et al. [19]. According to this system, 4 sonographic characteristics of ovarian carcinoma (inner structure of the capsule, wall thickness, number of septa and echogenicity) are scored by 1-5 points. The highest level of reliability was recorded when the total score was 9 and more points (sensitivity 100%, specificity 83%, positive predictive value 37%). Foglia et al. constructed a scoring system which included serum concentration of tumor marker CA 125 besides the sonographic evaluation of the tumor characteristics [20]. In that system, 4 characteristics (size, external tumor appearance, presence of ascites and serum concentration of CA 125) were evaluated by 1-3 points. A total score of 10 and more points indicated malignant nature of the disease with high reliability (sensitivity 91.3%, specificity 97.8%, positive predictive value 91.3% and prevalence 19.5%), but the relatively small number of examinees and low prevalence caused less frequent practical implementation of that system.

We presented herein the original scoring system (Novi Sad score I) which evaluated 5 different sonographic characteristics of ovarian carcinoma. With a maximum number of points (2 points) we separately evaluated the morphological features characteristic for ovarian carcinoma. High sensitivity (95.7%) in diagnosing ovarian carcinoma was present with a total score of 5 and more points, but the somewhat lower specificity

(81.1%) and test accuracy (87%) made the total score of 6 and more points more advantageous with higher reliability (sensitivity 87.3%, specificity 91.5% and test accuracy 90.9%). Shifting to higher criteria (total score 7-10 points), specificity and positive predictive value rise, but sensitivity, negative predictive value and test accuracy fall. Problems are malignant ovarian tumors with solid and compact composition without significant difference in echo-characterization of certain morphological characteristics which leads to lower grade of the total scoring system. In 3 (4.2%) patients with ovarian carcinoma (anaplastic carcinoma 2, dysgerminoma 1) the total score was only 4 points, which caused decrease of specificity, positive predictive value and test accuracy. In the group of benign ovarian tumors 3 (2.8%) of the patients with mucinous cystadenoma had a total score of 7 and 8 points, resulting in a negative impact on sensitivity and test accuracy.

During menopause, special significance should be given to the ultrasound examination of the endometrium to diagnose early a carcinoma. Endometrium must be examined in its full length, and absence of uniform image, appearance of irregularity or vagueness of certain parts require further diagnostic procedures [21]. When setting the diagnosis, the tumor rarely exceeds the borders of the endometrium, but it is necessary to keep in mind that sometimes endometrium presents more difficulty in case of invasive compared to superficially localized carcinoma because of its tendency for endophytic growth [22]. In the literature it is widely accepted that endometrium thickness over 5 mm in postmenopausal women is considered as critical sonographic finding, which can indicate the presence of carcinoma (sensitivity 68%, specificity 96%) without clinical symptoms [23,24]. Characteristic sonographic findings which may indicate the presence of endometrial carcinoma in postmenopause include: endometrial thickness over 8 mm, defects in endometrial structure, subendometrial hypoechoic halo, border between endometrium and myometrium which is not sharp, infiltration of myometrium, moderate uterine enlargement in longitudinal diameter of more than 7 cm, widened-diffusely changed uterine cavity and presence of exophytic proliferation in the uterine cavity [25].

In our study we presented the original clinicosonographic scoring system, aimed to enhance non-invasive diagnosis of endometrial carcinoma in women with postmenopausal bleeding by scoring certain sonographic and clinical characteristics. We did not find any similar scoring system in the literature, as greater importance is given to the evaluation of the thickness of the endometrium and the depth of invasion into the uterine wall.

Our sonographic parameters (Novi Sad scoring system I and II) were highly expected to point to additional hysteroscopy and endometrial biopsy [26]. When evaluating the value of the aforementioned diagnostic methods, it is important to clarify that exact sonographic assessment of the depth of endometrial carcinoma invasion into the uterine wall or applying hysteroscopy in women with senile colpitis or stenosis of the vaginal fornix and cervical canal is not always possible [27]. The highest degree of reliability in endometrial carcinoma diagnosis was present when the total score was 6 and more points (sensitivity 80%, specificity 97.5%, test accuracy 91.6%). In all patients with total score of 6 and more points, it is essential to carry out additional diagnostic methods, e.g. target biopsy of the endometrium. With a total score of 5 and less points, histological examination of the endometrium is indicated in all cases when its thickness is over 5 mm.

Conclusion

Sonographic scoring systems are fast, simple, cheap and easily available non-invasive diagnostic methods in diagnosing ovarian and endometrial carcinoma, which can already be applied during the first ultrasound examination and, therefore, can positively contribute to the reduction of the total treating costs. A total score of 6 and more points should be used as the gold standard, based on which the existence of ovarian (sensitivity 87.3%, specificity 91.5% and test accuracy 90.9%) and endometrial carcinoma (sensitivity 80%, specificity 97.5% and test accuracy 91.6%) can be indicated with a high degree of certainty. Shifting towards higher criteria, specificity and positive predictive value rise, but sensitivity, negative predictive value and test accuracy decrease. Shifting towards lower values affects sensitivity and negative predictive value increase, but at the same time specificity, positive predictive value and test accuracy decrease. Controlled multicentric randomized studies with more patients can additionally validate or deny the use of the mentioned scoring systems in ovarian and endometrial carcinoma non-invasive diagnosis.

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