Multiparametric Ultrasound Examination in Tumor-Like Formations of the Ovaries

Iryna Dmytrivna Stasiv1*, Valeryan Mykolayovych Ryzhyk1, Vasyi Hryhorovych Mishchuk2, Petro Fedorovych Dudiy1, Tetyana Ivanivna Salzhyn3

1. Department of Radiology and Radiation Medicine, Ivano-Frankivsk National Medical University, Ivano-Frankivsk, Ukraine
2. Department of General Practice (Family Medicine), Physical Rehabilitation and Sports Medicine, Ivano-Frankivsk National Medical University, Ivano-Frankivsk, Ukraine
3. Department of Internal Medicine No. 1, Clinical Immunology and Allergology E.M. Neyka, Ivano-Frankivsk National Medical University, Ivano-Frankivsk, Ukraine

* Corresponding Author:
Iryna Dmytrivna Stasiv,
Department of Radiology and Radiation Medicine of Ivano-Frankivsk National Medical University, 2 Halytska, 76000, Ivano-Frankivsk, Ukraine,
E-mail: irman@meta.ua,
Phone: +380976063629

Received: May 18th, 2020 – Accepted: August 2nd, 2020

Abstract

Properly diagnosed tumor-like formations of the ovaries facilitate the correct selection of patients who may not require surgery, or choose surgery with minimal access if such intervention is required. Subjective assessment of the features of tumor-like formations with the help of ultrasound diagnostics, including compression elastography, proved to be highly effective in the differential diagnosis of bulky ovarian formations. All tumor-like formations have their sonographic features that allow making a reliable diagnosis of a particular formation. The article reveals data on the diagnostic significance of multiparametric ultrasound imaging in the detection of ovarian tumor-like formations. A detailed sonographic picture of tumor-like formations in B-mode, color, and pulse Doppler mode and compression sonoelastography mode was analyzed. This examination was especially relevant for women of reproductive age, as it depended on the further tactics of treatment of each patient. For all types of tumor-like formations ovaries, a qualitative feature was determined - elastotype on the Ueno scale and the index of stiffness (Strain Ratio) - a quantitative indicator. Follicular cysts, endometrioid and periovarian cysts were found to belong to the 0 elastotype. Cysts of the corpus luteum belonged to the II elastotype on the Ueno scale. The lowest values of the stiffness index were seen in follicular and periovarian cysts, and the highest value was observed in endometrioid cysts. Our results have shown that ultrasound examination of ovarian tumors is an accurate and highly informative method.

Keywords: Ovarian tumor-like formations, ultrasound examination, compression elastography.

Introduction

Space-occupying tumor-like masses in the ovaries are one of the most frequently identified formations in gynecological practice. Early differential diagnostics is a key factor in the medical management of every woman [1]. This pathology is especially relevant for women of reproductive age. In most cases, the presence of cysts is associated with infertility problems. In many women, there is a pain syndrome and ovarian-menstrual cycle irregularities, leading to a necessity of consultation with obstetrician-gynecologists or reproductive specialists [2-4].

The peculiarities of ovarian tumor-like formations and differential diagnosis between benign, tumor-like and malignant formations are important both to reduce excessive anxiety in patients and to decide on the choice of treatment tactics options, which, in turn, increases and improves patient survival and reproductive function in women [5, 6].

Each menstrual cycle ends with the development of one Graafian follicle. It protrudes above the ovary’s surface, there is a rupture of its wall, and the egg cell enters the abdominal cavity. When the development of the follicle, and function of ovulation and corpus luteum is disturbed, pathological formations in the form of cysts are possible [7].

Tumor-like formations of the ovaries have different ultrasound characteristics [8]. Some cystic formations may be complex cysts with exfoliation, hemorrhage, or thick walls. Differential diagnosis between tumor-like, benign, and malignant ovarian lesions is quite difficult and transvaginal, and transabdominal ultrasonography becomes a tool of primary imaging [8, 9]. According to the classification of the International Ovarian Tumor Analysis group,
multilocular cysts with a solid component have the highest risk of malignancy [8]. Multiparametric ultrasound examinations allow making a more accurate differential diagnosis between tumor-like, benign, and malignant masses.

The grayscale ultrasonography in B-mode of ovarian neoplasms is known to have similar characteristics often, so this modality of ultrasound diagnosis is quite subjective. Differential diagnosis of ovarian formations is facilitated by Doppler regimens. It has been proven that benign and malignant ovarian masses have intranodular blood flow, and tumor-like ones are characterized by extranodular blood flow [10-12]. However, there are cases when Doppler regimens do not register low-velocity blood flow in ovarian masses. In this case, it is advised to move on to the next ultrasound modality – sonoelastography, which serves as a new method of assessing tissue stiffness and is widely used to distinguish between benign and malignant pathology of the mammary and thyroid glands. It is becoming an increasingly popular component of gynecological ultrasonography. To conduct this study, it was necessary to switch the scanner to real-time sonoelastography [13-18]. The advantage of using this method in the diagnostic algorithm of patients with ovarian tumor-like formations is its lower cost compared to magnetic resonance imaging (MRI) [19].

Our study aims to improve the diagnosis of tumor-like formations of the ovaries using multiparametric ultrasonography with particular attention to real-time compression sonoelastography, which gives additional characteristics of the elasticity of these pathological conditions.

Despite the frequent use of magnetic resonance imaging and computed tomography to characterize ovarian pathology, qualitative images of ovarian masses can be obtained using multiparametric ultrasonography, which is based on the use of standard B-mode, color Doppler mapping, energy and spectral Doppler mode and thus simplifying the process of diagnosing this pathology [8, 9].

Material and Methods

The mean age of patients was (34.77 ± 2.07) years. The most common complaint of the examined patients was pain syndrome – 42 (84%) cases and menstrual irregularities – 34 (68%) cases. Bloody discharge and infertility were diagnosed in 21 (42%) and 10 (20%) cases, respectively. According to the medical history of the patient, nonsteroidal anti-inflammatory drugs and antibiotics were taken by patients before the diagnostic search. This group of patients included 8 (61.5%) patients with endometriomas and 28 (56%) have not given birth to children. Surgery due to ovarian tumor-like formations was performed in 13 (26%) patients, including 8 (61.5%) patients with endometriomas and 5 (38.5%) with parovarian cysts. Bimanual gynecological examination revealed a painful three-dimensional ovarian formation in 33 (66%) women and an increase in uterine size in 34 (68%) cases. Signs of inflammation in the cytological examination of a smear from the cervix were seen in 24 (48%) women.

The obtained data were processed using the STATISTICA (Stat Soft Statistic v.6.0) software package. The reliability of the obtained results was evaluated by the bidirectional non-parametric Student’s t-test. The threshold level of statistical significance was taken as p<0.05.

Results

According to the research results, in 39 (78%) examined patients, tumor-like formations were detected for the first time, and in 11 (12%) – repeatedly. At the same time, the reproductive function was maintained in 22 (44%) women, and 28 (56%) have not given birth to children. Surgery due to ovarian tumor-like formations was performed in 13 (26%) women, including 8 (61.5%) patients with endometriomas and 5 (38.5%) with parovarian cysts. Bimanual gynecological examination revealed a painful three-dimensional ovarian formation in 33 (66%) women and an increase in uterine size in 34 (68%) cases. Signs of inflammation in the cytological examination of a smear from the cervix were seen in 24 (48%) women.
As a result of dynamic observation of patients, the following types of tumor-like formations of ovaries were revealed (Figure 1).

![Diagram representing the distribution of tumor-like formations of ovaries.](image)

**Figure 1:** The structure of the distribution of tumor-like formations of the ovaries.

As can be seen from the data shown in the diagram, follicular and corpus luteum cysts were most often diagnosed, and endometrioid and paraovarian cysts were somewhat less frequently diagnosed. Peculiarities of follicular and paraovarian cysts are as follows: anechogenic formation, with a clear, smooth contour, regular inner surface, homogeneous content, unaltered ovarian tissue was detected on the periphery of the cyst, peripheral blood supply (Figure 2).

![Sonogram of a follicular cyst with Doppler ultrasonography.](image)

**Figure 2:** Sonogram of a follicular cyst with Doppler ultrasonography.

Mode of sonoelastography: a limitation for this type of study were large anechogenic formations, the size of which exceeded 40 mm, because such formations are not mapped at all, or is determined only in the upper third of the formation. With a smaller size, cysts were mapped in blue-green-red colors, which corresponds to the 0 elastotype, and their stiffness index ranged from 0.219 to 1.23 units (Figure 3).

![Sonoelastogram of a follicular cyst.](image)

**Figure 3:** Sonoelastogram of a follicular cyst.

In 10 women, there were formations with fine-grained content, with clear, smooth contours. However, in 5 cases, the inner wall was irregular, papillary growths were not detected, and extranodular blood flow was seen in all cases detected. In these formations, the blood supply was determined at the periphery, which, in turn, allows differentiation of hemorrhage into the cyst from a solid component (Figure 4). These formations in the mode of sonoelastography are mapped in green with admixtures of blue, which is characteristic of the 2 elastotype (Figure 5). Their index of stiffness (Strain Ratio) ranges from 0.98 to 3.08 relative units.

![Sonogram of a corpus luteum cyst with Doppler ultrasonography.](image)

**Figure 4:** Sonogram of a corpus luteum cyst with Doppler ultrasonography.

![Sonoelastogram of a corpus luteum cyst.](image)

**Figure 5:** Sonoelastogram of a corpus luteum cyst.

In 15 women (30%), heterogeneous formations, with smooth, clear contours, inhomogeneous due to arachnoid septa, and unaltered ovarian tissue on the periphery were
When choosing the mode of sonoelastography, all formations were mapped in blue-green-red colors, which corresponds to the 0 elastotype. The stiffness index strain ratio ranged from 0.819 to 3.23 relative units (Figure 7).

Quantitative indices of Doppler ultrasonography in women with tumor-like formations of the ovaries are characterized by an average value of Vmax (39.08 ± 2.51) cm/sec, 2.16 ± 0.061 Standard Deviation (SD) relative units, 0.59 ± 0.01 Resistive Index (RI) relative units.

Compression elastography has become a helpful tool for ultrasound diagnosis of three-dimensional formations. A potential application of this technique is its association with grayscale and Doppler modes, i.e., multiparametric ultrasound examination, which is helpful in complicated diagnostic cases.

**Conclusions**

In the structure of tumor-like pathology of the ovaries, the frequency of follicular cysts is 36%, corpus luteum cysts – 30%, endometrioid cysts – 20% and paraovarian cysts – 14%.

Ultrasound examination, as the least invasive method of diagnosis, allows diagnosing follicular and endometrioid cysts of the ovary with accuracy up to 100%.

Since ovarian tumor-like formations in most cases occur in women of fertile age, the maximum efforts of gynecologists and reproductive specialists should be aimed at timely diagnosis and treatment of this pathology, which will preserve the reproductive capacity and reduce the percentage of unnecessary surgical invasions. The innovative technology of sonoelastography provides qualitatively new information about the elasticity of tissues and allows assessing the stiffness of ovarian tumor-like formations.

Compression sonoelastography can be recommended in the algorithm of a comprehensive ultrasound examination of the ovaries.

**Conflict of Interest**

The authors declare that there is no conflict of interest.

**References**

1. Muto M. Patient education: Ovarian cysts (Beyond the Basics). Section Editors: Barbara Goff, William J Mann. Deputy Editor: Sandy J Falk.https://www.uptodate.com/contents/ovarian-cysts-beyond-the-basics. Accessed December 2017.[Google Scholar].
2. Zvarych LI, Lutsenko NS, Shapoval OS. Frequency of functional ovarian cysts in women of reproductive age in the structure of gynecological pathology. Modern medical technologies. 2015; 2 (3): 79–83.
3. Shapoval OS. Clinical and sonological features in tumor-like formations of the ovaries in women of reproductive age. Women’s health. 2016; 1 (107): 137–141.
4. Shapoval OS. Clinical and sonological features in tumor-like formations of the ovaries in women of reproductive age. Women’s health. 2016; 1 (107): 137–141.

5. Sahilhögü KN, Dilbaz B, Cinik DA. Short-term impact of laparoscopic cystectomy on ovarian reserve tests in bilateral and unilateral endometriotic and nonendometriotic cysts. J Minim Invasive Gynecol. 2016; 23:719–25. [PubMed] [Google Scholar].

6. Ionescu CA, Matei A, Navolod D, Dimițriu M, Bohâltea R, Neacșu A, Ilincă C, Ples L. Correlation of ultrasound features and the Risk of Ovarian Malignancy Algorithm score for different histopathological subtypes of benign adnexal masses. Medicine (Baltimore). 2018 Aug; 97(31): e11762. doi: 10.1097/MD.0000000000011762. PMID: 30075600; PMCID: PMC6081138.

7. Gerasimova TV. Optimization of diagnosis and treatment of functional ovarian cysts. Reproductive endocrinology. 2015; 5(25): 14-20 issn 23094117.

8. Choi JI, Park SB, Han BH, Kim YH, Lee YH, Park HJ, et al. Imaging features of complex solid and multicystic ovarian lesions: proposed algorithm for differential diagnosis. Clin Imaging. 2016; 40: 46–56. doi: 10.1016/j.clinimag.2015.06.008 [PubMed] [CrossRef] [Google Scholar].

9. Dias DS, Bueloni-Dias FN, Delmanto A, Tonaf AF, Tayfour NM, Traiman P, et al. Clinical management of incidental findings on pelvic adnexal masses. Rev Assoc Med Bras. 2015; 61: 469–73. doi: 10.1590/1806-9282.61.05.469 [PubMed] [CrossRef] [Google Scholar].

10. Jokubkiene L, Slađekvečius P, Valentīn L. Does three-dimensional power Doppler ultrasound help in discrimination between benign and malignant ovarian masses? Ultrasound Obstet Gynecol. 2007; 29: 215–25. doi: 10.1002/uog.3922 [PubMed] [CrossRef] [Google Scholar].

11. Guerriero S, Ajossa S, Risalvato A, Lai MP, Mais V, Angiolucci M, et al. Diagnosis of adnexal malignancies by using color Doppler energy imaging as a secondary test in persistent masses. Ultrasound Obstet Gynecol. 1998; 11: 277–82. doi: 10.1046/j.1469-0705.1998.11040277.x [PubMed] [CrossRef] [Google Scholar].

12. Tailor A, Jurkovic D, Bourne TH, Collins WP, Campbell S. Sonographic prediction of malignancy in adnexal masses using multivariate logistic regression analysis. Ultrasound Obstet Gynecol. 1997; 10: 41–7. doi: 10.1046/j.1469-0705.1997.10010041.x [PubMed] [CrossRef] [Google Scholar].

13. Gweon HM, Youk JH, Son EJ, Kim JA. Clinical application of qualitative assessment for breast masses in shear-wave elastography. Eur J Radiol. 2013; 82: e680–5. doi: 10.1016/j.ejrad.2013.08.004 [PubMed] [CrossRef] [Google Scholar].

14. Yoon JH, Ko KH, Park YS, Hong JY, Cheon JS, Lee JT. Qualitative pattern classification of shear wave elastography for breast masses: how it correlates to quantitative measurements. Eur J Radiol. 2013; 82: 2199–204. doi: 10.1016/j.ejrad.2013.08.047 [PubMed] [CrossRef] [Google Scholar].

15. Lacout A, Chevenet C, Thariat J, Figl A, Marcy PY. Qualitative ultrasound elastography assessment of benign thyroid nodules: patterns and interobserver acquisition variability. Indian J Radiol Imaging. 2013; 23: 337–41. doi: 10.4103/0971-3026.125612 [PMC free article] [PubMed] [CrossRef] [Google Scholar].