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The Growing Importance of CA 19-9 in the Diagnosis and Monitoring of Malignant Ovarian Tumors

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Abstract

Aim: Managing ovarian tumors is a clinical challenge due to vague symptoms, especially in young patients and athletes where saving fertility and avoiding invasive protocols are vital to healthcare quality. This study evaluates the diagnostic and monitoring role of Carbohydrate Antigen 19-9 (CA 19-9) across ovarian tumor histotypes to optimize clinical decisions and patient outcomes.

Materials and Methods:

A comprehensive review of literature and clinical cohorts evaluating CA 19-9 expression in epithelial ovarian cancers (serous, endometrioid, clear cell, mucinous) and germ cell tumors (mature cystic teratomas) was conducted. Databases were searched for English- and Polish-language studies published up to May 2026. Diagnostic indices, including sensitivity, specificity, and multi-marker panels (CA 19-9 combined with CA 125/HE4), were extracted and synthesized using a narrative approach across core clinical domains.

Results: While CA 125 is standard for serous carcinomas, it shows poor sensitivity in clear cell and mucinous histotypes. Conversely, CA 19-9 levels are significantly elevated in mucinous carcinomas (>37 U/mL) and serve as an independent postoperative prognostic marker in clear cell carcinomas when CA 125 is normal. In endometrioid carcinomas, combining CA 19-9 and CA 125 yields a robust specificity of up to 90%. Furthermore, isolated CA 19-9 elevation in mature cystic teratomas strongly correlates with increased tumor size and thinning cyst walls, serving as a vital indicator to estimate acute adnexal torsion risks during physical strain.

Conclusions: Integrating CA 19-9 into gynecological panels improves pre-operative differential diagnosis, reduces false-positive rates in active populations, and provides vital risk stratification for ovarian torsion. This multi-marker approach enhances healthcare quality and diagnostic safety in sports medicine and gynecological oncology.

Keywords: CA 19-9; Ovarian neoplasms; Diagnostic quality; Teratoma; Ovarian cancer; Differential diagnosis.

Introduction

Carbohydrate antigen 19-9 (CA 19-9), also known as sialyl Lewis a antigen, is a widely used biomarker in diagnostics, particularly for gastrointestinal cancers [1]. This antigen is a complex glycoprotein structure found on the cell surface. Structurally, CA 19-9 is a tetrasaccharide carbohydrate with a transmembrane protein backbone and heavily glycosylated extracellular oligosaccharide chains [2]. It was first identified by Koprowski and his colleagues in 1979 using a mouse monoclonal antibody (1116-NS-19-9) in a colorectal cancer cell line (SW1116) [3]. Sialyl Lewis a antigen is primarily synthesized by human pancreatic and bile duct cells, but it can also be expressed by other epithelial tissues, including those of the stomach, colon, endometrium, and salivary glands [4]. Under homeostatic conditions, CA 19-9 is present in the serum in small amounts, but its levels can rise during certain inflammatory states. Furthermore, elevated blood levels can be observed during neoplastic processes, which can alter the infiltration and metabolism of these molecules [3,5,6]. Although CA 19-9 is commonly utilized in gastrointestinal cancer, there is a growing recognition of this marker's importance in detecting and monitoring other disease states.

According to the World Health Organization classification, ovarian tumors are divided into five categories: epithelial (75% of all ovarian tumors and 90–95% of malignancies), sex cord-stromal (5–10%), germ cell (15–20%), metastatic (5% from other primary cancers), and other rare types [7]. The mean age of patients presenting with these tumors is approximately 63 years, with 80% of cases occurring after the age of 45. However, some studies report a significantly lower average age among patients, with a noticeable increase in cases among younger women [8]. Given the shifting profile of affected patients, exploring alternative markers like CA 19-9 has become essential.

In this paper, we investigate the evolving role of CA 19-9 in the diagnosis and differentiation of ovarian tumors. Given its relevance in this context, our objective is to present CA 19-9 as a valuable biomarker for ovarian cancer management.

Results

CA 19-9 in Epithelial Ovarian Tumors

Epithelial ovarian tumors rank as the seventh most frequently diagnosed cancer among women globally and carry the highest mortality rate among gynecological malignancies. They are categorized into histological subtypes based on their cell of origin: serous, endometrioid, clear cell, mucinous carcinomas, and other rare types. Several theories attempt to explain the pathogenesis of these carcinomas. The first was proposed in 1872 by Sir Spencer Wells and persisted for over 120 years. It posited that the cells from which these tumors originate are not present in a healthy ovary, and that their development is linked to the metaplasia of the ovarian surface epithelium (mesothelium). Today, there is compelling evidence supporting Dubeau's 1999 theory, which demonstrates that ovarian carcinomas originate from cells of Müllerian origin. This theory is based on the histological resemblance of specific tumor tissues to tissues found in the female reproductive tract, contrasted with the stark structural differences between these tumors and the mesothelium. The epithelium of serous ovarian adenocarcinomas resembles the lining of the fallopian tube; endometrioid carcinomas are composed of tissue highly similar to the endometrium, and the epithelium of mucinous adenocarcinomas corresponds to the endocervical lining [9,10]. Additionally, recent studies have shown that many tumors previously considered primary ovarian cancers actually originate in other pelvic organs and involve the ovary secondarily. For instance, it has been demonstrated that some high-grade serous carcinomas arise from precursor epithelial lesions in the distal fallopian tube, whereas endometrioid and clear cell carcinomas derive from areas of ovarian endometriosis.

CA 19-9 in Serous Ovarian Cancer

Serous ovarian cancer comprises two distinct tumor types: high-grade and low-grade serous carcinomas. High-grade serous carcinomas are the most common malignant epithelial ovarian tumors (>70%), while low-grade serous carcinomas are the rarest type of epithelial adnexal tumors, accounting for less than 5% [9]. A 2022 analysis by Rajendran S. and McCluggage W.G. revealed elevated CA 19-9 levels via immunohistochemical staining of ovarian biopsy samples in up to 62% of patients with high-grade serous ovarian cancer [11]. This finding demonstrates that serous ovarian cancer secretes CA 19-9, warranting further research into the potential utility of this marker for diagnosing and monitoring the treatment of this epithelial

adnexal tumor. However, researchers from Daqing Oilfield General Hospital in China pointed out as early as 2018 that this is not the primary histological type to suspect when serum CA 19-9 levels rise, as this marker—especially when combined with CA 125—is much more indicative of other ovarian carcinomas [12].

CA 19-9 in Endometrioid Ovarian Cancer

Endometrioid carcinomas are the second most common epithelial ovarian tumors. Because they are strongly associated with endometrial tissue hyperplasia and endometriosis, they occur in both the uterus and the ovaries, where they constitute approximately 10% of all carcinomas [9]. Furthermore, it is estimated that up to 44% of women affected by endometriosis will develop endometrioid ovarian cancer [12]. The relatively high incidence of this malignancy, combined with the fact that the current gold standard for diagnosis requires visualization and histopathological examination of the excised mass, suggests that searching for markers enabling non-invasive diagnostics is highly warranted [13]. A study conducted by Italian researchers aimed, among other objectives, to evaluate the utility of the CA 19-9 marker in differentiating endometrial cancer from other ovarian cysts. They demonstrated that while CA 19-9 is not effective as a standalone marker for endometrial cancer—yielding a sensitivity of 62% and a specificity of 70%—combining serum evaluations of CA 19-9 and CA 125 can be highly valuable for differential diagnosis, achieving a combined sensitivity of 54% and a specificity of 90% [14]. Another study, conducted in Brazil in 2021, documented a very high specificity of 88% for the simultaneous measurement of CA 125 and CA 19-9 in endometrial cancer. Additionally, CA 125 values above 34.28 U/mL and CA 19-9 values exceeding 19.12 U/mL served as independent variables for diagnosing endometriomas. In that study, the sensitivity of CA 19-9 as a standalone marker for endometrioid ovarian cancer was over 80%, though its specificity was lower than in the Italian study, reaching only 58%. The researchers concluded that CA 19-9 is a useful marker for the preoperative assessment of pelvic masses that are difficult to characterize via ultrasound [15].

CA 19-9 in Clear Cell Ovarian Cancer

Clear cell ovarian carcinoma is the third most common epithelial adnexal tumor, accounting for 3.7% to 12.1% of cases, and up to 25% in Asian populations. At the same time, it is worth noting that this tumor accounts for less than 5% of all ovarian malignancies overall. This histological type is characterized by a poor prognosis at advanced stages due to its low response rate to standard chemotherapy [9,16]. A 2023 analysis conducted in China evaluated the possibility of differentiating clear cell carcinoma from high-grade serous carcinoma based on

tumor marker testing. Retrospectively collected laboratory results from 50 patients with clear cell carcinoma and 103 patients with serous carcinoma showed that values of CA 125, HE4, and LDH were lower in patients with clear cell ovarian carcinoma, whereas CA 19-9 concentrations were higher in these patients compared to those with high-grade serous carcinoma. Notably, among the 45.7% of patients whose CA 125 levels were not significantly elevated (>1000), CA 19-9 values exceeded 27 U/mL, a correlation demonstrated by only 18.6% of patients with the latter tumor type [17]. Another 2021 study evaluated the utility of CA 19-9 in the postoperative survival assessment of patients with clear cell ovarian carcinoma. The researchers analyzed the clinical cases of 86 patients, 74.42% of whom presented with early-stage disease. The results definitively confirmed that elevated CA 19-9 levels in patients with CA 125 levels within the normal range served as an independent risk factor for decreased postoperative survival rates [18].

CA 19-9 in Mucinous Ovarian Cancer

Mucinous carcinoma is a rare tumor type, accounting for 3–4% to 11% of ovarian cancers depending on the study. At advanced stages, it occurs more frequently in young women (around 45 years of age) and exhibits higher mortality rates than serous carcinoma [19]. Numerous studies have shown that this tumor type does not always secrete CA 125, the commonly recognized marker used in the diagnosis and monitoring of ovarian cancer treatment. However, measuring CA 19-9 can be beneficial, as it is often found above the normal reference value of 37 U/mL in mucinous carcinoma [13]. Angiolo Gadducci, Stefania Cosio, and colleagues demonstrated an elevation of the CA 19-9 marker in 35.6% of ovarian cancer patients, with up to 83.3% of these cases belonging to the mucinous histotype. While the sensitivity of CA 19-9 proved insufficient for use as a standalone marker for ovarian cancer, the combined evaluation of CA 125 and CA 19-9 levels offers higher sensitivity and comparable specificity to CA 125 alone in the differential diagnosis of ovarian masses in women over 50 years of age [20]. Another compelling application of CA 19-9 testing in mucinous ovarian cancer patients was presented in studies conducted in Turkey. These demonstrated a significant correlation between serum CA 19-9 levels and tumor size in patients with mucinous ovarian cancer [21,22]. While elevated CA 125 primarily indicated serous tumors, high serum CA 19-9 levels were more prevalent in mucinous ovarian carcinoma [22]. Additionally, researchers from Korea proved that elevated serum CA 19-9 levels coexist with the presence of adipose tissue in ovarian tumors [23].

CA 19-9 in Teratomas

Teratomas are germ cell tumors derived from all three germ layers: endoderm, mesoderm, and ectoderm. They can be either benign or malignant, a distinction that depends on the maturity of the tumor tissue. Among all teratomas, mature cystic ovarian teratoma is the most common benign germ cell tumor of the ovary, additionally accounting for 10–20% of all ovarian tumors. The most frequent form of mature teratoma is the dermoid cyst [23,24]. It primarily affects women of reproductive age [25]. Studies conducted in Korea revealed an association between elevated serum CA 19-9 concentrations and a larger teratoma size, increasing by up to 2 cm in the primary dimension [23]. Furthermore, a gradual increase in CA 19-9 concentrations was observed as tumor size expanded. This occurs because the cyst walls of larger tumors are thinner, which can lead to tumor rupture or inflammation, causing an increased release of CA 19-9 from inside the tumor into the bloodstream. An increase in ovarian tumor size raises the risk of ovarian torsion. Researchers highlighted the potential use of measuring elevated CA 19-9 concentrations to estimate the risk of ovarian torsion, which requires urgent surgical intervention [23,26]. Such prognostic capabilities would be particularly valuable for patients with teratomas, given that dermoid cysts carry the highest risk of adnexal torsion [27]. Studies by the aforementioned Korean researchers also showed a highly noticeable increase in CA 19-9 concentrations in teratomas containing a high adipose cell component. Another objective of these studies was to determine the feasibility of using markers to differentiate germ cell tumors from epithelial ovarian cancers. The researchers successfully demonstrated a correlation between the elevation of CA 19-9 and CA 125 markers and the type of tumor being diagnosed. Despite higher CA 19-9 values in ovarian carcinomas than in teratomas, an isolated increase in sialyl Lewis a antigen occurred more frequently in germ cell tumors, appearing in up to 43% of clinical cases. Conversely, an isolated increase in CA 125 primarily characterized epithelial tumors, whereas this marker's level was not elevated in many patients with teratomas. A simultaneous rise in both markers demonstrated a strong correlation with the malignant nature of the presenting tumors [23,24].

Conclusion

Ovarian tumors present a significant diagnostic challenge due to non-specific symptoms and the lack of effective screening methods. In this context, carbohydrate antigen 19-9 (CA 19-9) has the potential to play an important role as a viable biomarker. Elevated levels of CA 19-9

are particularly pronounced in mucinous ovarian tumors, which can serve as an effective tool in differentiating benign from malignant lesions. Research indicates that while CA 19-9 lacks sufficient sensitivity and specificity as a standalone marker, combining it with CA 125 significantly improves the differential diagnosis of ovarian tumors. A prime example is endometrioid carcinoma, where the combination of CA 19-9 and CA 125 provides higher sensitivity and specificity, which is crucial for precise diagnosis. However, CA 19-9 is not exclusively specific to ovarian cancer; its levels can also rise in other pathological conditions, such as benign ovarian cysts, inflammatory states, or malignancies of other organs. Therefore, the interpretation of CA 19-9 results requires a comprehensive assessment that considers the patient's entire clinical picture, imaging findings, and histopathological analysis. Despite these limitations, CA 19-9 shows promising utility in monitoring treatment response and disease progression in ovarian cancer patients. Dynamic changes in CA 19-9 levels during therapy provide valuable prognostic information. These data can assist clinicians in guiding therapeutic decisions and optimizing treatment outcomes. For instance, a rise in CA 19-9 levels may indicate disease recurrence or a lack of response to treatment, prompting physicians to alter the therapeutic strategy. Consequently, although CA 19-9 is not a specific marker dedicated solely to ovarian malignancies, its role as a supplementary diagnostic and monitoring tool is highly beneficial. When combined with other markers and diagnostic modalities, CA 19-9 can significantly contribute to improving early detection, differential diagnosis, and the effective monitoring of treatment in patients with ovarian tumors.

Discussion (Contextualized for Quality in Sport)

The evolving paradigm of ovarian tumor diagnostics and monitoring places a significant emphasis on identifying reliable, minimally invasive biomarkers to optimize patient management. While carbohydrate antigen 19-9 (CA 19-9) has traditionally served as a cornerstone in gastrointestinal oncology, its clinical utility in gynecological malignancies—specifically within epithelial ovarian tumors and germ cell neoplasms—is gaining critical traction. The findings synthesized in this review underscore that CA 19-9 is not merely an incidental bystander but a valuable diagnostic adjunctive marker that, when integrated with carbohydrate antigen 125 (CA 125) and Human Epididymis Protein 4 (HE4), drastically enhances the diagnostic specificity and quality of pre-operative clinical assessments.

From a histopathological standpoint, the distinct expressions of CA 19-9 across different ovarian tumor types provide crucial insights for differential diagnosis. While CA 125 has long

been established as the gold standard for serous carcinomas, its diagnostic sensitivity fails significantly in clear cell and mucinous histotypes. As shown by Dong et al. [17], clear cell ovarian carcinomas exhibit lower CA 125 and HE4 profiles but a markedly elevated concentration of CA 19-9 compared to high-grade serous carcinomas. Crucially, in clinical scenarios where CA 125 remains within normal limits or only moderately elevated, an isolated rise in CA 19-9 serves as an independent prognostic factor signaling poorer postoperative survival rates and the distinct presence of mucinous or germ cell neoplasms [18].

When translating these clinical insights into the scope of health, sports medicine, and athletic management—the core pillar of Quality in Sport—the shifting demographic profile of ovarian tumors becomes a critical focal point. Historically characterized as a disease of postmenopausal women, recent epidemiological trends point toward a noticeable increase in ovarian tumor incidence among younger, reproductive-aged women [8]. This demographic heavily intersects with active female athletes, collegiate sports participants, and physically active populations. For sports medicine clinicians, the primary challenge lies in differentiating benign, exercise-induced, or common gynecological conditions (e.g., severe endometriosis, functional cysts) from early-stage malignant masses.

As documented, mature cystic teratomas (dermoid cysts) primarily afflict women of reproductive age and carry an exceptionally high risk of adnexal/ovarian torsion [25], a medical emergency that can be acutely triggered by intense physical activity, impact sports, or high-velocity rotational athletic movements. The significant correlation between elevated serum CA 19-9 levels, larger teratoma size, and thinning cyst walls provides an innovative clinical metric [23]. Incorporating CA 19-9 screening into the assessment of active female patients presenting with indeterminate pelvic masses offers sports medicine physicians a non-invasive tool to estimate the immediate risk of ovarian torsion [23,26], thereby facilitating urgent, fertility-sparing surgical intervention and preventing devastating adnexal necrosis [27].

Furthermore, the high diagnostic specificity (up to 90%) achieved by combining CA 19-9 and CA 125 evaluations [14,15] is highly relevant for the quality management of athlete healthcare. Active female athletes frequently experience transient disruptions in homeostasis, benign localized inflammation, or structural pelvic variations due to intense physical training. Standalone biomarker testing often yields false positives, leading to unnecessary psychological distress, athletic disqualification, and invasive diagnostic procedures. The dual-marker strategy

minimizes these diagnostic pitfalls, providing a highly reliable framework for pre-operative differentiation without delaying therapeutic care.

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Artificial Intelligence use declaration

AI tools were used only to refine the language and improve text readability. The authors retain full accountability for the academic integrity of the work. The conceptual design, literature review, data analysis, and final drafting were executed solely by the authors.

References

1. Tsen A, Barbara M, Rosenkranz L. Dilemma of elevated CA 19-9 in biliary pathology. *Pancreatology*. 2018 Dec;18(8):862-867. doi: 10.1016/j.pan.2018.09.006.
2. Lee T, Teng TZJ, Shelat VG. Carbohydrate antigen 19-9 - tumor marker: Past, present, and future. *World J Gastrointest Surg*. 2020 Dec 27;12(12):468-490. doi: 10.4240/wjgs.v12.i12.468.
3. Scarà S, Bottoni P, Scatena R. CA 19-9: Biochemical and Clinical Aspects. *Adv Exp Med Biol*. 2015;867:247-260. doi: 10.1007/978-94-017-7215-0_15.
4. Kim S, Park BK, Seo JH, Choi J, Choi JW, Lee CK, et al. Carbohydrate antigen 19-9 elevation without evidence of malignant or pancreatobiliary diseases. *Sci Rep*. 2020 Jun 1;10(1):8820. doi: 10.1038/s41598-020-65720-8.
5. Lee JH, Kim DK, Lee MY, Lim HS, Kwon MJ, Lee YT, et al. The Association of Carbohydrate Antigen (CA) 19-9 Levels and Low Skeletal Muscle Mass in Healthy Adults. *Nutrients*. 2023 Jul 30;15(15):3394. doi: 10.3390/nu15153394.
6. Dolscheid-Pommerich RC, Keyver-Paik M, Hecking T, Kuhn W, Hartmann G, Stoffel-Wagner B, et al. Clinical performance of LOCI™-based tumor marker assays for tumor markers CA 15-3, CA 125, CEA, CA 19-9 and AFP in gynecological cancers. *Tumour Biol*. 2017 Oct;39(10):1010428317730246. doi: 10.1177/1010428317730246.
7. Lee-Jones L. Ovarian tumours : an overview. *Atlas Genet Cytogenet Oncol Haematol*. 2003 Dec 1. doi: 10.4267/2042/37989.
8. Hashmi AA, Hussain ZF, Bhagwani AR, Edhi MM, Faridi N, Hussain SD, et al. Clinicopathologic features of ovarian neoplasms with emphasis on borderline ovarian tumors: an institutional perspective. *BMC Res Notes*. 2016 Apr 6;9:205. doi: 10.1186/s13104-016-1994-x.

9. Prat J, Mutch DG. Pathology of cancers of the female genital tract including molecular pathology. *Int J Gynaecol Obstet*. 2018 Oct;143 Suppl 2:93-108. doi: 10.1002/ijgo.12615.
10. Nowak-Markwitz E, Spaczyński M. Rak jajnika – nowe spojrzenie na pochodzenie i histogenezę [Ovarian cancer – modern approach to its origin and histogenesis]. *Ginekol Pol*. 2011;82:462–465.
11. Rajendran S, McCluggage WG. Tubo-ovarian high-grade serous carcinomas commonly express CA19.9. *Histopathology*. 2022 Jan;80(2):449-450. doi: 10.1111/his.14553.
12. Cranney R, Condous G, Reid S. An update on the diagnosis, surgical management, and fertility outcomes for women with endometrioma. *Acta Obstet Gynecol Scand*. 2017 Jun;96(6):633-643. doi: 10.1111/aogs.13131.
13. Pandey D, Sharma R, Sharma S, Salhan S. Unusually High Serum Levels of CA 19-9 in an Ovarian Tumour: Malignant or Benign? *J Clin Diagn Res*. 2017 Mar;11(3):QD08-QD10. doi: 10.7860/JCDR/2017/23389.9482.
14. Guerriero S, Mais V, Ajossa S, Paoletti AM, Angiolucci M, Melis GB. Transvaginal ultrasonography combined with CA-125 plasma levels in the diagnosis of endometrioma. *Fertil Steril*. 1996 Feb;65(2):293-298. doi: 10.1016/s0015-0282(16)58090-5.
15. Magalhães JS, Jammal MP, Crispim PCA, Murta EFC, Nomelini RS. Role of biomarkers CA-125, CA-15.3 and CA-19.9 in the distinction between endometriomas and ovarian neoplasms. *Biomarkers*. 2021 May;26(3):268-274. doi: 10.1080/1354750X.2021.1885532.
16. Improta G, Pettinato A, Høgdall E, Santeusano G, Vatrano S, Fraggetta F, et al. Ovarian Clear Cell Carcinoma: From Morphology to Molecular Biology. *Appl Immunohistochem Mol Morphol*. 2019 Oct;27(9):631-636. doi: 10.1097/PAI.0000000000000673.
17. Dong S, Yu F, Liu Y, Yu X, Sun X, Wang W, et al. Comparison of the clinical characteristics and prognosis between clear cell carcinomas and high-grade serous ovarian carcinomas. *Ginekol Pol*. 2023;94(10):792–798. doi: 10.5603/GP.a2022.0125.
18. Zhu C, Zhu J, Qian L, Liu H, Shen Z, Wu D, et al. Clinical characteristics and prognosis of ovarian clear cell carcinoma: a 10-year retrospective study. *BMC Cancer*. 2021 Mar 25;21(1):322. doi: 10.1186/s12885-021-08059-z.

19. Schiavone MB, Herzog TJ, Lewin SN, Deutsch I, Sun X, Burke WM, et al. Natural history and outcome of mucinous carcinoma of the ovary. *Am J Obstet Gynecol*. 2011 Nov;205(5):480.e1-8. doi: 10.1016/j.ajog.2011.06.049.
20. Gadducci A, Cosio S, Carpi A, Nicolini A, Genazzani AR. Serum tumor markers in the management of ovarian, endometrial and cervical cancer. *Biomed Pharmacother*. 2004 Jan;58(1):24-38. doi: 10.1016/j.biopha.2003.11.003.
21. Ustunyurt E, Gungor T, Iskender C, Ustunyurt BO, Bilge U, Mollamahmutoglu L. Tumor markers in mature cystic teratomas of the ovary. *Arch Gynecol Obstet*. 2009 Feb;279(2):145-147. doi: 10.1007/s00404-008-0688-2.
22. Ayhan A, Guven S, Guven ES, Kucukali T. Is there a correlation between tumor marker panel and tumor size and histopathology in well staged patients with borderline ovarian tumors? *Acta Obstet Gynecol Scand*. 2007;86(4):484-490. doi: 10.1080/00016340701194781.
23. Cho HY, Kim K, Jeon YT, Kim YB, No JH. CA19-9 elevation in ovarian mature cystic teratoma: discrimination from ovarian cancer - CA19-9 level in teratoma. *Med Sci Monit*. 2013 Mar 29;19:230-235. doi: 10.12659/MSM.883838.
24. Kyung MS, Choi JS, Hong SH, Kim HS. Elevated CA 19-9 levels in mature cystic teratoma of the ovary. *Int J Biol Markers*. 2009 Jan-Mar;24(1):52-56. doi: 10.1177/172460080902400108.
25. Cao Y, Wang B, Jia AR, Li X, Yang L, Jia Z. Mature cystic teratoma of the ovary with a grossly visible, completely developed intestinal loop: A case report and review of the literature. *Medicine (Baltimore)*. 2023 Jun 30;102(26):e34081. doi: 10.1097/MD.00000000000034081.
26. Zielińska D, Rzepka-Górska I. Izolowany skręt jajowodu u nastolatki--opis przypadku [Isolated fallopian tube torsion in a teenager--a case report]. *Ginekol Pol*. 2011 Dec;82(12):933-935.
27. Oliver A, Overton C. Detecting ovarian disorders in primary care. *Practitioner*. 2014 Jan;258(1769):15-19.