THE IMPORTANCE OF MRI (MAGNETIC RESONANSE IMAGING) IN GYNECOLOGY

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Abstract. *This paper provides a systematic analysis of the clinical value of magnetic resonance imaging (MRI) in gynecology, focusing on diagnostic accuracy and its impact on clinical decision-making. The aim is to assess how MRI contributes to evaluation of uterine, cervical, and ovarian disorders in terms of reproducibility and treatment planning. The methodology follows an evidence-informed narrative review of publications from 2018–2025 and an integrated appraisal of multiparametric protocols used in routine practice, including T2-weighted imaging, diffusion-weighted imaging, and dynamic contrast-enhanced sequences. Scientific novelty is formulated as a set of practical principles for standardized MRI interpretation, improved staging of gynecologic malignancies, refined mapping of endometriosis, and organizational criteria for selecting MRI in preoperative planning while balancing safety and cost-effectiveness. The analysis demonstrates that MRI complements ultrasound and CT, and in specific scenarios it can serve as a first-line modality due to superior soft-tissue contrast and functional imaging capabilities that directly inform personalized management.*

Keywords. *MRI; gynecologic imaging; endometriosis; uterine tumors; ovarian tumors; multiparametric protocol; staging*

Introduction. Imaging diagnostics in gynecology plays a central role not only in diagnosing the disease, but also in choosing a treatment strategy, determining the extent of surgery, clarifying oncological staging, and justifying follow-up tactics. Although ultrasonography remains the first-line imaging modality in many clinical situations, the complex anatomy of the pelvic organs, deep infiltration of the process,

multifocality, or heterogeneity of tissue composition limit the capabilities of ultrasound. Computed tomography, on the other hand, lags behind MRI in terms of soft tissue contrast and has limitations associated with ionizing radiation. Against this background, MRI is increasingly becoming a clinical standard as a method that allows phenotyping of gynecological pathology through high soft tissue contrast, multiplanar imaging, and functional sequences. In particular, the clinical value of MRI is highly valued in issues such as deep infiltrative forms of endometriosis, assessment of the level of myometrium invasion, indirect assessment of parametrial spread or lymph node status in cervical and endometrial cancer, differentiation of benign and malignant processes in ovarian tumors [1; 2].

However, the implementation of MRI into practice is determined not only by technical advantages, but also by the standardization of protocols, reproducible interpretation of results, and the reliability of clinical decisions based on the diagnosis. In gynecological MRI, parameters that seem simple at first glance, such as the orientation of T2-weighted cross-sections, the choice of B-values for diffusion, the time resolution of Dynamic Contrast Enhancement, or artifact reduction strategies can have a significant impact on diagnostic errors. The literature emphasizes that although MRI has high sensitivity and specificity in mapping endometriosis, there is a risk of false-positive interpretations in the presence of small foci, infiltration close to the intestinal wall, or postoperative scarring. Likewise, the intersection of signs of diffusion and perfusion in ovarian tumors with certain borderline tumors, as well as complications in assessing the invasion of endometrial cancer against the background of endometrial or adenomyotic changes caused by hormonal exposure, remain an urgent problem [3; 4].

The purpose of this work is to provide systematic coverage of the Diagnostic and tactical importance of MRI in gynecology in IMRAD logic, justification of the clinical benefit of the multiparametric approach, and to indicate the limits and optimization paths of the method in terms of the point of practical decision-making. The tasks are: firstly, to interpret the main components of gynecological MRI protocols and their pathophysiological basis; secondly, to compare and analyze the

diagnostic value in uterine, cervical and ovarian pathologies; Third, it was determined to formulate practical criteria for the use of MRI in the preparation for surgery and monitoring of treatment. As a scientific innovation, a clinical-technical synthesis focused on a standardized interpretation of MRI findings, that is, an approach that directly links image markers to clinical decision points, is proposed; while the practical significance is explained by reducing invasive manipulations, more accurately drawing up a surgical plan and, in some cases, lowering the risk of over-operations [5].

Materials and Methods. The study design was an evidence-based analytical review, and the content of authoritative clinical guidelines, consensus documents, and original research published between 2018 and 2025 was analyzed. Three main areas of gynecological MRI were identified when selecting data: endometriosis and benign proliferative diseases; gynecological oncology (endometrium, cervix, ovary); and preoperative planning and treatment monitoring. In the methodological approach, the concept of multiparametric MRI was put in the center, where morphological images (high resolution T2-weight sequences) are interpreted together with functional images (DWI and ADC maps, as well as DCE). The diagnostic logic of fat suppression techniques, T1-weighted sequences to detect hemorrhagic components, and anti-breathing and anti-peristaltic approaches to reduce artifacts was also evaluated, depending on the clinical situation. The scientific basis of the analysis was that in gynecological pathology, tissue architecture and the degree of cellavity (diffusion restriction), as well as microcirculation (contrast enhancement dynamics) give clinically important distinguishing signs; therefore, it was considered advisable not to be limited only to morphological assessment, but to increase diagnostic accuracy through multi-parameter integration [6].

Results. The analysis results showed that MRI significantly increased diagnostic accuracy in a number of clinical situations. In endometriosis, MRI gave high informativity in showing particularly deep infiltrative foci, a relationship with the uterosacral vertebrae, rectovaginal septum, and intestinal wall; a combined interpretation of hemorrhagic component in T1-weighted images, fibrosis in T2-

weighted images, and drag marks clarified the foci map. In adenomyosis, a combination of junctional zone thickening, small cystic changes within the myometrium, and diffuse heterogeneity was noted as a stable radiological pattern associated with clinical symptoms.

The main advantage of MRI in cervical pathology is the ability to assess in multiple planes factors that determine operability, such as tumor stromal invasion, parametrial spread, and extension to the upper part. In endometrial tumors, assessment of the depth of myometrial invasion, cervical stromal involvement, and, in some cases, lymph node enlargement has been shown to be a key factor in determining surgical strategy. DWI and ADC maps were characterized by stronger diffusion restriction due to higher cellularity in malignant foci, which served as an additional diagnostic support even in situations where contrast could not be used.

The most important result of MRI in ovarian tumors was observed in the stratification of complex cystic-solid structures, i.e., improving the differentiation between benign endometrioma, teratoma, fibroma, and malignant epithelial tumors. It was noted that when the T2 signal intensity, diffusion restriction of the solid component, and contrast dynamics of the septa and papillary growths were assessed together, clinical decision-making was more accurate for tumors that were unclear on ultrasound. Preoperative planning was highlighted as a result of the MRI showing anatomical landmarks, close proximity to the ureters and intestines, fibrosis, and scar tissue, allowing for a preoperative assessment of surgical risks.

Discussion. The results obtained show that the value of MRI in gynecology is mainly explained by three mechanisms: the predominance of soft tissue contrast, multi-planar anatomically adapted imaging, and indirect assessment of biological properties through functional sequences. The literature notes the importance of mapping endometriosis using MRI in planning surgery, especially when the relationship with the intestinal wall and ureters is determined, which can reduce the risk of complications; Our analysis also showed that preoperative anatomical accuracy dramatically increased the practical benefit of MRI [1]. However, the hypersensitivity of MRI can also increase the likelihood of false positive

interpretations: postinflammatory fibrosis, scarring, and other conditions that give endometriosis-like signals lead to radiological experimentation as well as a false conclusion without a standard protocol. Therefore, the importance of MRI is determined not only by the hardware level, but also by the culture of interpretation, integration with clinical information, and probabilistic thinking.

The strength of MRI in gynecologic oncology lies in its ability to provide parameters that serve to stage and assess operability. In cervical cancer, the detection of parametrial invasion and vaginal spread is a critical point in determining the choice between radiotherapy and surgery; therefore, MRI often becomes the center of the clinical algorithm [2]. In endometrial cancer, the depth of myometrial invasion directly affects the issues of lymphadenectomy and adjuvant treatment; Here, the combination of DCE and DWI, especially in the background of hormonal changes or adenomyosis, can reduce uncertainties in morphological assessment. In ovarian tumors, however, the main benefit of MRI is more accurate stratification of the abnormal ultrasound finding, but the intersection of diffusion signs in borderline tumors and some benign solid tumors complicates diagnosis; in such situations, decision-making along with clinical laboratory indicators, tumor markers, and observational dynamics becomes more dominant [7].

A limitation of this work is that it was performed in the form of an analytical review rather than a meta-analysis; therefore, the focus was on the practical aspects of clinical logic and protocolization, rather than on the numerical combined sensitivity and specificity indices. It is advisable to prospectively assess the concordance of MRI results with surgical and histological verification in the future, in a local setting, using the same protocol and the same interpretation criteria. Additionally, while segmentation and radiomics approaches using artificial intelligence have the potential to improve reproductive outcomes in gynecological MRI, their clinical validation and ethical and legal aspects should also be studied in parallel [6].

Conclusion. MRI has become an important link in the diagnosis and treatment planning in gynecology due to its ability to provide high-resolution

imaging of soft tissues, assess the spread of the pathological process in multiple planes, and indirectly analyze tissue characteristics through functional sequences. Multiparametric protocols provide the greatest clinical benefit in mapping foci and anticipating surgical risks in benign diseases such as endometriosis and adenomyosis, in staging and operability clarification in cervical and endometrial tumors, and in stratification of erratic conditions in ovarian tumors. The practical value of MRI is directly related to the standardization of protocols, the consistency of radiological interpretation, and integration with clinical data, which are the factors that increase diagnostic accuracy and patient safety by reducing unnecessary invasive interventions.

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