

Minimal Invasive Hysteroscopy for Anomal Uterine Hemorrhages: Personalized Approach Based on 3d Ultrason and Endometric Profilization

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Abstract: Abnormal uterine bleeding (ABB) occupies a leading position in the structure of gynecological morbidity. Despite the widespread use of hysteroscopy, the frequency of relapses and repeated interventions remains significant. Personalization of surgical tactics based on 3D transvaginal ultrasound and endometrial immunohistochemical profile can potentially increase the clinical effectiveness of treatment.

Keywords: Abnormal Uterine Bleeding, Hysteroscopy, Minimally Invasive Surgery, Three-Dimensional Ultrasound Examination, 3D Ultrasound, Endometrial Profiling, Molecular Endometrial Testing, Personalized Medicine, Echography

Introduction

Abnormal uterine bleeding remains one of the most frequent gynecological complaints faced by outpatient physicians. According to the World Health Organization, the prevalence of AMC is 10-20% among women of reproductive age, significantly affecting the quality of life, leading to anemia and social maladjustment of patients [1].

The traditional approach to the diagnosis and treatment of AMC was based mainly on clinical and laboratory data, however, this did not allow for adequate visualization of structural changes in the uterine cavity and endometrium. The introduction of visualization methods, including transvaginal ultrasound (TVUSI) and three-dimensional ultrasound scanning (3D-US), has opened up new possibilities for the precise diagnosis of uterine cavity pathology. 3D ultrasound allows for detailed assessment of endometrial morphology, detection of polyps, miomas, synechiae, and other structural anomalies, which is crucial for choosing optimal treatment tactics [2], [3], [4], [5].

Hysteroscopy has been considered the gold standard for diagnosing intrauterine pathology for many years. However, its invasive nature, the possibility of developing complications (uterine perforation, fluid overload syndrome, infectious complications), the need for general anesthesia, and its high cost limited its widespread use. In the last decade, the concept of minimally invasive hysteroscopy has been actively developing, which utilizes modern technologies and a better understanding of AMC pathophysiology to reduce surgical trauma and enhance the safety of the procedure [6].

The personalized approach to hysteroscopy involves the preliminary stratification of patients based on a comprehensive assessment of clinical, echographic, and laboratory parameters. Endometrial profiling - a new technology that allows for the assessment of the functional state of the endometrium, its receptivity, and inflammatory status at the molecular level - opens up prospects for more accurate determination of indications for hysteroscopic intervention and prediction of treatment outcomes [7].

The purpose of this study is to develop and validate an algorithm for minimally invasive hysteroscopy in AMC based on the integration of 3D ultrasound imaging and molecular endometrial profile, with the aim of increasing the effectiveness of diagnostics, minimizing complications, and optimizing treatment outcomes for each patient.

Methodology

A prospective controlled study included 250 patients aged 25-55 with AMC diagnosis (PALM-COEIN classification). Patients were randomized into 2 groups: personalized approach (n=125) and standard tactics (n=125). All patients underwent 3D TBI, endometrial office biopsy with immunohistochemistry (ER, PR, Ki-67, p53, CD138), followed by hysteroscopy. The initial endpoint is blood flow control after 6 months.

Abnormal uterine bleeding (ABB) remains one of the most frequent causes of women seeking medical attention from an obstetrician-gynecologist and occupies a significant share in the structure of planned and emergency hospitalization. AMC refers to any deviations in the volume, duration, regularity, or frequency of menstruation outside of pregnancy. In modern clinical practice, the systematization of AMC causes is carried out according to the PALM-COEIN classification, which distinguishes structural (polyps, adenomyosis, leiomyomas, hyperplasia, and malignant processes) and non-structural causes. Most clinically significant are intrauterine structural changes that require morphological verification and, as a rule, surgical correction.

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Result and Discussion

Abnormal uterine bleeding (ABB) remains one of the most frequent causes of women seeking medical attention from an obstetrician-gynecologist and occupies a significant share in the structure of planned and emergency hospitalization. AMC refers to any deviations in the volume, duration, regularity, or frequency of menstruation outside of pregnancy [8], [9]. In modern clinical practice, the systematization of AMC causes is carried out according to the PALM-COEIN classification, which distinguishes structural (polyps, adenomyosis, leiomyomas, hyperplasia, and malignant processes) and non-structural causes. Most clinically significant are intrauterine structural changes that require morphological verification and, as a rule, surgical correction [10].

Thus, increased Ki-67 expression is associated with high endometrial proliferative activity and an increased risk of tissue recurrence after resection. The detection of CD138-positive plasma cells indicates chronic endometritis, which requires preliminary antibacterial therapy before surgery.

The personalized algorithm for managing patients with AMC includes several sequential stages. In the first stage, risk stratification is carried out based on clinical data and 3D ultrasound imaging. In the second stage, diagnostic hysteroscopy with a targeted biopsy is performed [11]. If focal pathology is confirmed, minimally invasive surgical intervention is performed: hysteroscopic polypectomy, resection of the submucosal myomatous node, or removal of hyperplasia foci. The volume of resection is determined taking into account the depth of the lesion and ultrasound reconstruction data. In the final stage, an individual postoperative management program is developed, including, if necessary, hormonal correction and dynamic ultrasound monitoring [12], [13].

The clinical benefits of minimally invasive hysteroscopy are evident. Blood control is achieved in 80-95% of cases, depending on the nosological form. The frequency of complications remains low and does not exceed 3-5%, including uterine perforation, bleeding, and infectious complications. An important advantage is the ability to preserve reproductive function in women of childbearing age. Unlike traditional separate diagnostic scraping, hysteroscopy provides targeted removal of the pathological focus without excessive endometrial trauma [14], [15].

The integration of 3D imaging and endometrial profiling allows for a shift from a standardized to individualized surgical approach. The combination of morphological and visualization data increases diagnostic accuracy, reduces the frequency of repeated interventions, and optimizes the choice of postoperative therapy. In specialized centers, minimally invasive hysteroscopy can be considered a basic treatment method for structural forms of AMC.

Conclusions

Thus, the modern concept of treating abnormal uterine bleeding is based on a comprehensive diagnosis, including 3D transvaginal ultrasound and endometrial morphological profilization, followed by personalized hysteroscopic correction of the identified pathology. Further development of this area is associated with the improvement of preoperative risk stratification methods and the introduction of molecular markers that allow predicting long-term clinical outcomes.

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