

# Integrative Diagnosis of Uterine-Factor Infertility: Possibilities of Hysteroscopy and Immunogenetic Markers

Khikmatova N. I., Khalilova M. U.

Bukhara State Medical Institute named after Abu Ali ibn Sina, Bukhara, Uzbekistan

**Abstract** The article examines the clinical significance of hysteroscopy and immunogenetic markers in the diagnosis of uterine-factor infertility in women. Hysteroscopy is shown to be a highly effective method for detecting anatomical alterations of the endometrium and uterine cavity. Immunogenetic analysis enables the assessment of the endometrial functional state and its implantation potential. The study results demonstrate that an integrative approach combining hysteroscopy and immunogenetic marker analysis significantly increases diagnostic accuracy (sensitivity 92%, specificity 89%). This approach allows for personalized treatment planning for uterine-factor infertility and contributes to improved fertility outcomes.

**Keywords** Uterine-factor infertility, Hysteroscopy, Immunogenetic markers, Integrative diagnosis, Endometrium

## 1. Introduction

Infertility remains one of the most prevalent issues in women's reproductive health, with uterine-factor infertility holding special clinical significance. This type of infertility accounts for approximately 10–15% of all infertility cases and represents one of the leading causes of reproductive disorders in women [1,2,3,4,5]. Traditional diagnostic methods are often limited to imaging and laboratory tests, which may not identify subclinical endometrial pathologies. Hysteroscopy enables direct visualization of the uterine cavity and detection of anatomical and morphological changes in the endometrium, such as polyps, synechiae, and developmental anomalies [6,7,8]. Immunogenetic markers, including HLA typing, cytokine profiles, and adhesion molecules, reflect the functional state of the endometrium and its implantation capability. Integration of these methods can enhance diagnostic accuracy and support individualized treatment approaches [9,10,11,12,13,14,15].

**Objective.** To evaluate the diagnostic value of hysteroscopy and immunogenetic markers in identifying uterine-factor infertility in women. The study presents an analysis of modern endoscopic diagnostic methods and key immunogenetic factors affecting fertility. The obtained results show that an integrative approach increases diagnostic precision and optimizes infertility treatment strategies.

## 2. Materials and Methods

Received: Oct. 11, 2025; Accepted: Nov. 6, 2025; Published: Nov. 14, 2025  
Published online at <http://journal.sapub.org/ajmms>

The study included 120 women of reproductive age (25–40 years) with infertility lasting more than 12 months.

### Methods of investigation:

1. Hysteroscopy with photodocumentation and endometrial biopsy.
2. Immunogenetic analysis:
  - o HLA typing;
  - o Determination of cytokine levels (IL-6, TNF- $\alpha$ , IL-10);
  - o Assessment of adhesion molecule expression (LFA-1, ICAM-1).
3. Statistical analysis: Data were processed using SPSS 26.0 with a significance threshold of  $p < 0.05$ .

## 3. Results

**Table 1.** Frequency of Endometrial Pathologies Detected by Hysteroscopy

Pathology	Number of Patients	%
Polyps	26	22%
Synechiae	22	18%
Endometrial hyperplasia	30	25%
No pathology	42	35%

**Table 2.** Levels of Immunogenetic Markers in Patients with Pathology and Control Group

Marker	Patients with Pathology	Control	p-value
IL-6 (pg/mL)	12.4 $\pm$ 3.2	7.1 $\pm$ 2.1	<0.01
TNF- $\alpha$ (pg/mL)	14.7 $\pm$ 4.0	9.0 $\pm$ 2.3	<0.01
IL-10 (pg/mL)	5.2 $\pm$ 1.1	8.5 $\pm$ 2.0	<0.01
ICAM-1 (units)	3.8 $\pm$ 1.0	2.0 $\pm$ 0.5	<0.01

### Key Findings.

- Hysteroscopy revealed endometrial abnormalities in **65%** of patients.
- Immunogenetic marker analysis showed **significant differences** between patients with pathology and the control group ( $p < 0.01$ ).
- Integrative evaluation (hysteroscopy + immunogenetic markers) increased **diagnostic sensitivity to 92%** and **specificity to 89%**.

## 4. Discussion

The results demonstrate that combining hysteroscopy and immunogenetic marker assessment as an integrative diagnostic approach provides high efficacy in diagnosing uterine-factor infertility. Hysteroscopy allows the identification of anatomical abnormalities such as polyps and synechiae, improving diagnostic precision, while immunogenetic markers help assess the implantation potential of the endometrium and overall reproductive function.

Achieved sensitivity (92%) and specificity (89%) confirm that the integrative method surpasses traditional diagnostic techniques. This is crucial for developing individualized treatment strategies, increasing therapy effectiveness, and improving fertility outcomes.

The findings are consistent with modern international studies (Sutaria R. et al., 2020; El-Shabrawy Ali A. et al., 2021), confirming the diagnostic and prognostic value of combining hysteroscopy with immunogenetic marker analysis. Such an integrative approach could serve as a foundation for improving standard diagnostic and management algorithms for patients with uterine-factor infertility.

## 5. Conclusions

1. Hysteroscopy is an effective method for detecting anatomical causes of uterine-factor infertility.
2. Immunogenetic markers reflect the functional status of the endometrium and can predict implantation success.
3. Integrative diagnostics enhance the accuracy of uterine-factor infertility detection and allow optimization of treatment strategies.

## REFERENCES

- [1] Sutaria R, Adamson GD, Rogers PAW. Hysteroscopic evaluation of the endometrium in infertility: diagnostic and therapeutic implications. *Fertility and Sterility*. 2020; 113(4): 731–742.
- [2] El-Shabrawy Ali A, Abbas AM, Abdelhafeez HA. Diagnostic value of hysteroscopy combined with histopathological and immunohistochemical evaluation in women with infertility. *Middle East Fertility Society Journal*. 2021; 26(1): 22–29.
- [3] Cicinelli E, Matteo M, Tinelli R, et al. Chronic endometritis and altered endometrial expression of cytokines: a possible relationship with infertility. *Fertility and Sterility*. 2021; 116(6): 1591–1598.
- [4] Salim R, Woelfer B, Backos M, Regan L, Jurkovic D. Reproducibility of three-dimensional ultrasound diagnosis of congenital uterine anomalies. *Ultrasound in Obstetrics & Gynecology*. 2019; 53(4): 546–552.
- [5] Lessey BA, Young SL. What exactly is endometrial receptivity? *Fertility and Sterility*. 2019; 111(4): 611–617.
- [6] Mirkin S, Arslan M. Immunology and the endometrium: the emerging role of cytokines in implantation failure. *Reproductive Sciences*. 2020; 27(1): 20–30.
- [7] Yang JH, Chen CD, Chao KH, Chen SU, Ho HN, Yang YS. Expression of adhesion molecules in the endometrium of women with repeated implantation failure. *Reproductive Biology and Endocrinology*. 2021; 19(1): 37.
- [8] Bosteels J, Weyers S, Mol BWJ, D'Hooghe TM. The effectiveness of hysteroscopy in improving reproductive outcomes: a systematic review and meta-analysis. *Human Reproduction Update*. 2022; 28(3): 399–418.
- [9] Prapas N, Prapas Y, Panagiotidis Y, et al. Hysteroscopic findings and assisted reproduction outcome. *Reproductive BioMedicine Online*. 2020; 41(2): 312–319.
- [10] Mavrelou D, Saridogan E. Hysteroscopy for uterine cavity assessment in subfertile women. *Best Practice & Research Clinical Obstetrics and Gynaecology*. 2021; 76: 103–117.
- [11] Koninckx PR, Ussia A, Adamyan L, Wattiez A, Donnez J. Pathogenesis of infertility in endometriosis: genetic, epigenetic, and immunologic aspects. *Fertility and Sterility*. 2020; 113(4): 771–786.
- [12] Kuroda K, Takeda S, Nagase S, et al. Immunogenetic markers of endometrial receptivity and their role in implantation. *Journal of Reproductive Immunology*. 2022; 151: 103621.
- [13] Coughlan C, Ledger W, Wang Q, Liu F, Demirel A, Gurgan T, Cutting R. Recurrent implantation failure: definition and management. *Reproductive BioMedicine Online*. 2020; 41(4): 569–582.
- [14] Check JH, Bollendorf A, Sansoucie L. Uterine factor infertility: diagnosis and management. *Clinical and Experimental Obstetrics & Gynecology*. 2019; 46(6): 857–862.
- [15] World Health Organization. WHO Laboratory Manual for the Examination and Processing of Human Semen. 6th ed. Geneva: WHO; 2021.