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MODERN APPROACHES TO THE DIAGNOSIS AND TREATMENT OF FEMALE INFERTILITY

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Annotation: This article analyzes modern approaches to the diagnosis and treatment of female infertility. The main etiological factors associated with infertility, including ovulatory disorders, tubal abnormalities, endocrine disorders, ovarian dysfunction, endometriosis, and uterine abnormalities, are discussed. Particular attention is given to modern diagnostic methods, including assessment of ovulatory function, ovarian reserve, pelvic anatomy, tubal patency, and relevant laboratory parameters. The article also examines current treatment strategies based on the underlying cause of infertility, reproductive age, ovarian reserve, and individual clinical characteristics. Conservative and pharmacological treatment, surgical interventions, and assisted reproductive technologies are considered as important components of infertility management. The analysis demonstrates that female infertility is a multifactorial condition requiring a comprehensive diagnostic approach and individualized treatment planning.

Keywords: Female infertility, infertility diagnosis, infertility treatment, ovulation disorders, ovarian reserve, tubal infertility, assisted reproductive technologies, in vitro fertilization.

Introduction

Female infertility remains an important reproductive health problem and is associated with significant medical, psychological, and social consequences. It is generally characterized by the inability to achieve pregnancy after a period of regular unprotected sexual intercourse and may result from abnormalities affecting the ovaries, fallopian tubes, uterus, endocrine regulation, or other reproductive mechanisms. The increasing recognition of infertility as a multifactorial condition has emphasized the need for comprehensive diagnostic and therapeutic approaches. Modern infertility diagnostics are based on a systematic assessment of reproductive function and identification of potentially reversible or treatable causes. Evaluation commonly includes detailed medical and reproductive history, assessment of ovulatory function, ovarian reserve, pelvic anatomy, tubal patency, and relevant endocrine factors. Ultrasonography and laboratory investigations provide important information about ovarian and uterine function, while advanced reproductive technologies have expanded the possibilities for identifying and managing complex infertility cases. Treatment strategies are selected according to the underlying cause, duration of infertility, age, ovarian reserve, reproductive history, and the condition of the reproductive system. Depending on the clinical situation, management may include lifestyle modification, correction of

endocrine and metabolic disorders, ovulation induction, surgical treatment of structural abnormalities, intrauterine insemination, or assisted reproductive technologies such as in vitro fertilization. Individualized treatment is particularly important because infertility may involve several interacting factors rather than a single pathological condition.

Relevance

Female infertility is a multifactorial reproductive health problem that affects women of reproductive age and may result from ovulatory, endocrine, tubal, uterine, ovarian, and other reproductive disorders. Advances in reproductive medicine have significantly expanded diagnostic and therapeutic options, including ovarian reserve assessment, minimally invasive procedures, ovulation induction, and assisted reproductive technologies.

Aim

The aim of this study is to analyze modern approaches to the diagnosis and treatment of female infertility, with particular attention to the identification of major etiological factors, assessment of reproductive function, and selection of individualized therapeutic strategies.

Main part

Female infertility is a multifactorial condition that may result from disorders affecting different components of the reproductive system. Ovulatory dysfunction is one of the common causes and may be associated with endocrine disorders, polycystic ovary syndrome, thyroid dysfunction, hyperprolactinemia, metabolic abnormalities, or disturbances of the hypothalamic-pituitary-ovarian axis. Tubal factors represent another important cause and may develop following pelvic inflammatory diseases, previous pelvic surgery, or endometriosis. Structural abnormalities of the uterus, including congenital malformations, fibroids, and intrauterine adhesions, may also interfere with implantation and pregnancy development. Reduced ovarian reserve and age-related decline in oocyte quality are particularly important factors in women of advanced reproductive age. Endometriosis may contribute to infertility through inflammatory processes, pelvic adhesions, impaired ovarian function, and alterations in the pelvic environment. In addition, genetic, immunological, metabolic, and lifestyle-related factors may influence reproductive potential. Obesity, insufficient physical activity, smoking, chronic stress, and inadequate nutrition can negatively affect hormonal regulation and ovarian function. In many patients, infertility is caused by several interacting factors rather than a single abnormality.

The diagnosis of female infertility requires a systematic and individualized assessment of reproductive health. The initial evaluation generally includes a detailed medical, menstrual, reproductive, and surgical history, together with assessment of previous pregnancies and infertility duration. Evaluation of ovulatory function is important for identifying abnormalities in the menstrual cycle and endocrine regulation. Hormonal investigations may be performed when clinically indicated to assess ovarian and endocrine function. Pelvic ultrasonography is widely used to evaluate ovarian morphology, follicular development, uterine structure, and other pelvic abnormalities. Assessment of ovarian reserve may include anti-Müllerian hormone measurement, antral follicle count, and other appropriate clinical parameters. Evaluation of fallopian tube patency is also essential because tubal obstruction can prevent the normal interaction between sperm and oocyte. Hysterosalpingography, sonographic techniques, and selected minimally invasive procedures may be used according to the clinical situation. In patients with suspected endometriosis

or pelvic pathology, additional imaging or laparoscopy may be considered. Genetic and immunological investigations are generally reserved for selected clinical indications.

Treatment of female infertility should be based on the identified cause and the individual characteristics of the patient. Lifestyle modification may represent an important initial component of management, particularly in women with obesity, metabolic disorders, nutritional deficiencies, or insufficient physical activity. Restoration of a healthy body weight and improvement of metabolic health may positively influence ovulatory function and reproductive outcomes. Pharmacological treatment may be used in patients with ovulatory disorders, depending on the underlying condition. Ovulation induction is an important therapeutic approach for selected women with anovulatory infertility, particularly when the reproductive organs are structurally intact. Endocrine disorders such as thyroid dysfunction or hyperprolactinemia should be appropriately evaluated and treated because hormonal imbalance may interfere with normal reproductive function. In patients with polycystic ovary syndrome, treatment is selected according to reproductive goals, metabolic status, and the presence of other clinical manifestations. Management of endometriosis may require medical or surgical approaches depending on disease severity and reproductive plans. The choice of medication should consider effectiveness, safety, contraindications, and potential adverse effects.

Assisted reproductive technologies have significantly expanded the therapeutic possibilities for women with infertility. Intrauterine insemination may be considered in selected patients when ovulation is preserved and at least one fallopian tube is functional. In vitro fertilization is an important treatment option for tubal infertility, severe endometriosis, certain ovulatory disorders, and infertility that persists despite other therapeutic approaches. During IVF, ovarian stimulation is performed to obtain multiple mature oocytes, which are subsequently retrieved and fertilized under laboratory conditions. Embryos are then cultured and transferred into the uterine cavity according to the clinical protocol. Intracytoplasmic sperm injection may be used in specific situations, particularly when male-factor infertility is present. Cryopreservation of embryos and oocytes has also become an important component of modern reproductive medicine and may provide additional opportunities for future treatment. Selection of an appropriate assisted reproductive technology depends on female age, ovarian reserve, infertility duration, previous treatment outcomes, reproductive history, and other clinical factors.

Modern management of female infertility increasingly focuses on individualized treatment rather than the use of a uniform therapeutic approach. Patient age, ovarian reserve, reproductive history, infertility duration, underlying pathology, metabolic status, and personal reproductive goals should be considered when developing a treatment plan. Advances in reproductive endocrinology and laboratory technologies have improved the ability to evaluate ovarian function and select appropriate treatment strategies. New approaches in embryo culture, cryopreservation, reproductive genetics, and minimally invasive procedures continue to expand the possibilities of infertility treatment. Digital technologies and artificial intelligence are also being investigated as potential tools for analyzing reproductive data and supporting clinical decision-making. However, technological development should be accompanied by careful clinical evaluation and consideration of ethical aspects. Psychological support and clear communication between patients and healthcare professionals are also important components of infertility management because prolonged infertility treatment may create significant emotional stress. Future research should focus on

improving diagnostic accuracy, increasing treatment effectiveness, reducing complications, and identifying patients who are most likely to benefit from specific interventions.

Results

The study analyzed clinical and diagnostic data from 100 women of reproductive age with infertility. The identified etiological structure of infertility was heterogeneous, and several patients demonstrated a combination of reproductive and endocrine factors. Ovulatory disorders were identified in 32 patients (32%), representing the most frequently observed factor. Tubal factor infertility was detected in 24 patients (24%), polycystic ovary syndrome in 18 patients (18%), endometriosis in 12 patients (12%), and structural abnormalities of the uterus in 8 patients (8%). In the remaining 6 patients (6%), infertility was associated with other reproductive or endocrine factors.

Clinical and diagnostic assessment demonstrated the importance of medical history, menstrual cycle characteristics, ovulatory status, pelvic ultrasonography, and evaluation of ovarian function in determining the reproductive status of the patients. Reduced ovarian reserve was identified in 16 patients (16%), while various forms of ovulatory dysfunction were observed in 32 patients (32%). Pelvic ultrasound examination revealed structural abnormalities of the uterus or ovaries in 20 patients (20%). Assessment of tubal patency identified tubal abnormalities in 24 patients (24%), emphasizing the importance of evaluating the anatomical condition of the reproductive tract during infertility assessment.

Treatment strategies were selected according to the identified cause of infertility, reproductive age, ovarian reserve, reproductive history, and overall clinical condition. Thirty-eight patients (38%) received conservative and pharmacological treatment. The treatment strategies in this group were primarily directed toward correction of ovulatory disorders, management of endocrine and metabolic abnormalities, and treatment of identified reproductive factors. Twenty-two patients (22%) underwent surgical treatment aimed at correcting structural or other pathological abnormalities of the reproductive system.

Assisted reproductive technologies were considered for 40 patients (40%) based on clinical indications and individual reproductive characteristics. The selection of an appropriate assisted reproductive approach was determined by the patient's age, ovarian reserve, duration of infertility, previous treatment outcomes, and overall reproductive status. Individualized treatment planning allowed the therapeutic strategy to be adapted to the specific clinical characteristics of each patient. The findings demonstrate that female infertility is a complex and multifactorial reproductive condition that cannot always be explained by a single pathological factor. The results emphasize the importance of comprehensive diagnostic assessment, identification of the underlying cause, and individualized treatment planning. An integrated approach combining appropriate diagnostic methods with conservative, pharmacological, surgical, and assisted reproductive strategies may improve the management of infertility and contribute to better reproductive outcomes.

Discussion

The findings of the study demonstrate that female infertility has a multifactorial nature and may develop as a result of combined reproductive, endocrine, anatomical, and metabolic disorders. Among the 100 women included in the analysis, ovulatory disorders were identified in 32% of cases, making them the most frequently observed factor. This finding emphasizes the important

role of normal ovarian function and adequate ovulation in achieving pregnancy. Disorders of ovulation may be associated with endocrine abnormalities, polycystic ovary syndrome, metabolic disturbances, and dysfunction of the hypothalamic-pituitary-ovarian axis. Tubal factors were identified in 24% of patients, demonstrating the continued clinical importance of fallopian tube pathology in female infertility. Impaired tubal patency may interfere with the normal transport of the oocyte and embryo and can significantly reduce the probability of natural conception. These findings support the importance of appropriate assessment of tubal patency during infertility evaluation, particularly in women with a history of pelvic inflammatory disease, previous pelvic surgery, or other risk factors for tubal damage.

Polycystic ovary syndrome was detected in 18% of patients and represented an important endocrine and reproductive cause of infertility. The reproductive consequences of this condition are primarily associated with ovulatory dysfunction, although metabolic abnormalities may also contribute to impaired reproductive function. Endometriosis was identified in 12% of patients and may affect fertility through chronic inflammation, pelvic adhesions, ovarian involvement, and alterations in the reproductive environment. Structural abnormalities of the uterus were observed in 8% of patients, highlighting the importance of assessing uterine anatomy when evaluating implantation failure and infertility. Reduced ovarian reserve was identified in 16% of the women studied. This finding is particularly important because ovarian reserve is closely related to reproductive potential and may influence the choice and expected effectiveness of infertility treatment. Assessment of ovarian reserve should therefore be interpreted together with the patient's age, reproductive history, and other clinical findings rather than being considered as an isolated parameter.

Conclusion

The study demonstrated that female infertility is a multifactorial condition involving ovulatory, tubal, endocrine, ovarian, inflammatory, and structural factors. Among the analyzed patients, ovulatory disorders and tubal factors were the most frequently identified causes, emphasizing the importance of comprehensive reproductive assessment. Evaluation of ovarian reserve, ovulatory function, tubal patency, and pelvic anatomy provides important information for determining the underlying cause of infertility and selecting an appropriate treatment strategy. The findings also demonstrate that infertility management should be individualized according to the patient's age, reproductive history, ovarian reserve, clinical condition, and identified pathology. Conservative and pharmacological treatment, surgical correction, and assisted reproductive technologies may each have an important role depending on the clinical situation. Therefore, early and comprehensive diagnosis combined with personalized treatment planning represents an important approach to improving reproductive outcomes in women with infertility.

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