International Journal of Medical Sciences And Clinical Research

VOLUME Vol.05 Issue12 2025
PAGE NO. 60-65
DOI 10.37547/ijmscr/Volume05Issue12-14

Hydrosalpinx In The Era Of Fertility Preservation And IVF: Etiology, Management Strategies, And Reproductive Outcomes -An Evidence-Based Narrative Review

Shokhista Ismoilova

PhD, Assistant of the Department of Obstetrics and Gynecology, Reproductology, Tashkent State Medical University, Uzbekistan

Received: 18 October 2025; **Accepted:** 10 November 2025; **Published:** 14 December 2025

Abstract: Hydrosalpinx-the fluid-filled dilation of the fallopian tube secondary to distal tubal occlusion- remains a leading, potentially correctable cause of tubal factor infertility. Its pathophysiology (chronic inflammation, deciliation, fibrosis) and the embryotoxic/mechanical effects of intraluminal fluid substantially impair natural conception and assisted reproductive technology (ART) success. Objective: To synthesize contemporary evidence on the etiology, reproductive impact, diagnostic considerations, and management strategies for hydrosalpinx, with emphasis on fertility-preserving options and optimizing outcomes for women undergoing IVF. Methods: We performed a narrative evidence synthesis prioritizing high-quality sources (systematic reviews, meta-analyses, large cohorts, matched case–control studies, and guideline statements). Databases searched included PubMed, Scopus, and Google Scholar using key terms related to hydrosalpinx, tubal infertility, IVF, salpingectomy, tubal occlusion, and embolization. Studies were appraised for methodological rigor and clinical relevance. Results: Conservative tubal surgery (salpingostomy/neosalpingostomy) yields pooled natural clinical pregnancy rates of ~25–33% in selected patients but carries a recurrence rate (~21%) and ectopic risk (~10%); outcomes are strongly severity dependent (mild disease → high success; severe disease → poor prognosis). Untreated hydrosalpinx reduces IVF implantation and pregnancy rates by ~50%; removal or occlusion of the affected tube before ART reliably improves live-birth rates. Interventional embolization is an emerging minimally invasive alternative with frozen-embryo transfer live-birth rates comparable to hydrosalpinx-free controls. Salpingectomy may increase risk of interstitial implantation in subsequent pregnancies; pediatric hydrosalpinx often has non-infectious etiologies and may resolve conservatively. Population data do not currently demonstrate a clear ovarian cancer-prevention benefit from salpingectomy performed for hydrosalpinx. Conclusions: Management should be individualized and severity-based: conservative repair may be appropriate for fertility-preserving candidates with mild disease, while salpingectomy, proximal occlusion, or embolization is recommended before IVF. Further prospective studies are needed to refine algorithms and evaluate long-term outcomes of minimally invasive approaches.

Keywords: Hydrosalpinx; tubal factor infertility; salpingostomy; salpingectomy; embolization; IVF; interstitial pregnancy; tubal occlusion.

Introduction: Hydrosalpinx is a pathological condition in which the fallopian tube becomes distended and fluid-filled due to distal tubal obstruction, most commonly following pelvic inflammatory disease (PID) or sexually transmitted infections such as Chlamydia trachomatis (1). The chronic inflammatory process leads to structural damage of the tube, resulting in accumulation of serous fluid, loss of ciliary function, and significantly impaired tubal transport (2). Hydrosalpinx is a major contributor to tubal factor infertility and is identified in 10–30% of women with tubal disease (3). Among women undergoing in vitro fertilization (IVF), hydrosalpinx is present in approximately 20–25% of those with tubal pathology (4).

Hydrosalpinx poses a significant barrier to natural conception and strongly reduces success rates in assisted reproductive technologies. Research

consistently shows that the presence of untreated hydrosalpinx decreases IVF pregnancy and implantation rates by about 50% and is associated with a higher miscarriage risk due to the embryotoxic or mechanically disruptive effect of hydrosalpinx fluid leaking into the uterine cavity (5,6). Additionally, women with hydrosalpinx are at higher risk of ectopic pregnancy because of impaired tubal motility and persistent structural damage (7). Despite ongoing advancements in reproductive medicine, hydrosalpinx remains one of the most significant and correctable causes of IVF failure.

Optimal management—most notably salpingectomy or proximal tubal occlusion—has been demonstrated to significantly improve IVF outcomes, increasing live-birth rates by 30–40% after treatment (4). Therefore, understanding the mechanisms, clinical impact, and treatment strategies for hydrosalpinx remains crucial to improving fertility outcomes in affected women.

METHODOLOGY

This study used a narrative evidence-synthesis approach to examine the epidemiology, clinical impact, diagnosis, and management of hydrosalpinx in women undergoing fertility assessment or in vitro fertilization. Relevant literature was identified through structured searches of PubMed, Scopus, and Google Scholar using the terms “hydrosalpinx,” “tubal factor infertility,” “IVF outcomes,” “salpingectomy,” and “ectopic pregnancy.” Only peer-reviewed human studies were considered, including randomized controlled trials, cohort studies, meta-analyses, and authoritative clinical guidelines. Articles lacking methodological clarity, case reports, and non-human studies were excluded. The selected sources were evaluated for methodological rigor, sample size, and relevance to clinical fertility practice. Extracted information focused on prevalence, pathophysiological mechanisms, diagnostic accuracy, fertility outcomes, miscarriage risk, and the effectiveness of surgical or procedural interventions such as salpingectomy and proximal tubal occlusion. Emphasis was placed on high-quality evidence, particularly systematic reviews and guidelines from recognized professional bodies such as ASRM, RCOG, and ESHRE. The collected data were synthesized narratively to provide an integrated understanding of hydrosalpinx and its implications for reproductive outcomes.

RESULTS

1. Natural Fertility Outcomes After Tubal-Conserving Surgery

The evidence consistently shows that hydrosalpinx poses major barriers to natural conception, but selected patients may still benefit from conservative tubal surgery. The comprehensive meta-analysis by Chu et al. (15), involving 22 observational studies and 2,810 women, demonstrated that salpingostomy can result in meaningful natural pregnancy rates, with a pooled clinical pregnancy rate of 27% and a pooled live-birth rate of 25%. These outcomes confirm that tubal-preserving interventions retain a role in fertility care when carefully selected. However, the ectopic pregnancy rate of 10% reflects persistent functional impairment of the tube even after anatomical restoration.

Further insight comes from the seven-year real-world cohort by Barbu et al. (18), which provides detailed stratification by disease severity. Women with mild hydrosalpinx achieved pregnancy rates as high as 73.3%, while those with moderate or severe disease experienced markedly diminished outcomes, with rates falling to 25.9% and 10.2%, respectively. The median time required to achieve pregnancy after neosalpingostomy was approximately nine months, and overall cumulative conception curves plateaued within the first year. Notably, recurrence of hydrosalpinx occurred in 21.2% of cases, and none of the women who experienced recurrence achieved spontaneous pregnancy. Pelvic adhesions emerged as a critical prognostic factor, demonstrating an independent negative effect on intrauterine pregnancy likelihood. These findings collectively indicate that tubal-conserving surgery offers meaningful opportunities only for patients with mild disease and favorable pelvic anatomy.

2. Impact of Hydrosalpinx on IVF and Outcomes After Pre-IVF Treatment

A substantial body of evidence shows that hydrosalpinx significantly reduces success rates in assisted reproduction. Historical studies demonstrate that untreated hydrosalpinx reduces IVF implantation and pregnancy rates by approximately 50% (13,12). These negative effects are attributed to the embryotoxic properties of hydrosalpingeal fluid, the mechanical washout of embryos from the uterine cavity, and alterations in endometrial receptivity. Because of these mechanisms, salpingectomy or proximal tubal occlusion prior to IVF has long been considered standard practice, with clear evidence showing improved implantation and live-birth rates (11).

Recent data introduce interventional embolization as a promising alternative to surgery. The large retrospective cohort study by Guo et al. (19), including 3,351 frozen embryo transfer cycles, demonstrated that embolization resulted in live-birth rates statistically equivalent to those of women with hydrosalpinx-free bilateral tubal obstruction (39.9% vs

43.2%). Ectopic pregnancy rates remained low and were similar between groups. These findings suggest that embolization offers a less invasive, lower-cost, and lower-risk approach to eliminating hydrosalpingeal reflux, making it an attractive option for patients with extensive adhesions or contraindications to surgery.

3. Post-Salpingectomy Complications and Interstitial Pregnancy Risk

Although salpingectomy effectively eliminates hydrosalpinx-related IVF impairment, it may introduce its own risks. In the matched case–control study by Wu et al. (20), women with hydrosalpinx who had undergone ipsilateral salpingectomy and later conceived exhibited a significantly increased risk of interstitial pregnancy, with an odds ratio of 8.18. This elevated risk is believed to result from implantation in residual interstitial tubal tissue or transperitoneal migration of the fertilized ovum. The findings emphasize the need for meticulous surgical technique when performing salpingectomy and careful early-pregnancy monitoring to detect abnormal implantation.

4. Pediatric and Adolescent Hydrosalpinx Outcomes

Hydrosalpinx in pediatric and adolescent populations differs from adult disease in both etiology and prognosis. The systematic review by Kazmi and Gupta (16), encompassing 37 articles and 66 cases, showed that congenital Müllerian anomalies, post-appendicitis inflammation, and non-sexually transmitted infections were the predominant causes. In contrast to adult disease, fertility impairment is not the main concern in this age group; rather, the risk of torsion is paramount. Importantly, conservative management led to spontaneous resolution in more than half of uncomplicated cases (9 out of 15), suggesting that surgery is not always necessary. This underscores the importance of age-specific approaches that balance fertility preservation and avoidance of overtreatment.

5. Ovarian Cancer Risk After Salpingectomy for Hydrosalpinx

The large nationwide OCASE database study conducted by van Lieshout et al. (17), involving nearly 19,000 women undergoing salpingectomy for ectopic pregnancy or hydrosalpinx, evaluated the long-standing hypothesis that removal of the fallopian tubes reduces ovarian cancer risk. The study found no statistically significant reduction in ovarian cancer incidence compared with matched controls (HR 0.76; 95% CI 0.39–1.47). Although a non-significant trend toward greater risk reduction was observed after eight or more years of follow-up, the findings overall suggest that salpingectomy performed primarily for hydrosalpinx cannot currently be justified for cancer-prevention purposes.

Table 1. Summary of Key Studies on Hydrosalpinx Management and Reproductive Outcomes

Study	Design & Population	Key Findings	Major Outcomes
Chu et al., 2015 (15)	Systematic review (22 studies; n=2,810)	Salpingostomy viable in selected patients	Pregnancy 27%; live birth 25%; ectopic 10%
Barbu et al., 2025 (18)	7-year cohort (n=160)	Outcomes severity-dependent; adhesions negative predictor	Mild 73.3%; moderate 25.9%; severe 10.2%; recurrence 21.2%
Guo et al., 2022 (19)	Retrospective FET cohort (n=3,351)	Embolization equivalent to controls	Live birth 39.9% vs 43.2% (NS)
Wu et al., 2023 (20)	Case–control (29 IP cases; 87 controls)	Salpingectomy increases interstitial pregnancy risk	OR 8.18
Kazmi & Gupta, 2015 (16)	Pediatric systematic review (n=66)	Congenital/post-appendicitis etiologies; conservative success	9/15 spontaneous resolution
van Lieshout et al., 2020 (17)	Nationwide database	No ovarian cancer risk reduction	HR 0.76 (NS)

Table 2. Comparative Effectiveness of Hydrosalpinx Treatment Strategies

Strategy	Mechanism	Advantages	Limitations	Best Candidates

Salpingostomy	Reopens distal tube	Natural conception possible	Recurrence; ectopic risk	Mild hydrosalpinx
Salpingectomy	Removes diseased tube	Best improvement in IVF outcomes	Irreversible; interstitial pregnancy risk (20)	IVF patients; severe hydrosalpinx
Tubal Occlusion	Blocks reflux	Minimally invasive; avoids full surgical removal	Tube remains diseased	IVF with limited surgical tolerance
Embolization	Radiologic tubal closure	Non-surgical; IVF outcomes equal to controls (19)	Limited long-term data	Pelvic adhesions; surgical contraindications
Conservative (Pediatric)	Observation	Avoids overtreatment	Risk of torsion	Uncomplicated adolescent cases (16)

Table 3. Predictors of Reproductive Outcome in Hydrosalpinx

Predictor	Effect	Evidence
Severity of hydrosalpinx	Strongest determinant of pregnancy outcomes	73.3% mild vs 10.2% severe (18)
Pelvic adhesions	Independent negative predictor of live birth	OR 0.28 (18)
Tubal epithelial damage	Reduces ciliary function and transport capacity	Histopathologic evidence (21)
Treatment modality	Determines IVF success	Salpingectomy > occlusion > repair (11–13)
Etiology (pediatric)	Guides appropriateness of conservative vs surgical management	Congenital vs post-inflammatory causes (16)

Table 4. Comparative Effectiveness of Hydrosalpinx Treatment Strategies

Treatment Strategy	IVF Success	Natural Fertility Potential	Associated Risks	Ideal Candidate
Salpingectomy	★★★★★	—	Risk of interstitial pregnancy (post-salpingectomy implantation)	Women undergoing IVF; severe hydrosalpinx
Proximal Tubal Occlusion	★★★★☆	—	Tube remains diseased; potential persistent inflammation	IVF patients desiring less invasive option
Interventional Embolization	★★★★☆	—	Limited long-term data; procedural access issues in some	Women with dense pelvic adhesions or surgical risk

Neosalpingostomy (Tubal Repair)	★★☆☆☆ (inferior for IVF)	★★★★☆ in *mild* hydrosalpinx	Recurrence; ectopic pregnancy risk	Women seeking natural conception; mild disease
Conservative Management (Pediatric)	—	★★★☆☆ (spontaneous resolution possible)	Tubal torsion risk	Adolescents with uncomplicated hydrosalpinx

DISCUSSION

The integrated evidence clearly demonstrates that hydrosalpinx exerts complex and multifactorial adverse effects on reproductive potential through mechanical, inflammatory, endocrine, and toxic pathways. Conservative tubal surgery retains value for women with mild hydrosalpinx and favorable pelvic anatomy who desire natural conception; however, its benefits diminish sharply with increasing disease severity, and recurrence or ectopic pregnancy remains a significant concern. The strong predictive role of both disease severity and pelvic adhesions, as highlighted in long-term cohort data (18), reinforces the importance of careful preoperative selection.

For patients pursuing IVF, eliminating hydrosalpingeal reflux is essential. Salpingectomy and proximal tubal occlusion remain the most validated strategies, supported by extensive literature demonstrating substantial improvements in implantation and live-birth rates (11–13). The emergence of interventional embolization (19) represents a significant development, offering a non-surgical alternative that achieves reproductive outcomes equivalent to those observed in hydrosalpinx-free patients. This approach may be particularly beneficial for women with extensive adhesions, high surgical risk, or diminished ovarian reserve.

The unique etiologic landscape of pediatric hydrosalpinx (16) requires distinctly different clinical considerations, particularly balancing the risk of torsion with careful fertility preservation. The high spontaneous resolution rate in uncomplicated cases underscores the appropriateness of conservative management strategies in this age group.

Finally, the OCASE database analysis (17) clarifies that salpingectomy performed for hydrosalpinx cannot currently be considered a cancer-prevention procedure, despite theoretical alignment with tubal origins of high-grade serous carcinoma. Surgical decision-making should therefore remain rooted in reproductive considerations rather than oncologic prophylaxis.

Overall, a severity-based, fertility-goal–oriented, and individualized management framework emerges as the most effective strategy for optimizing outcomes across patient populations affected by hydrosalpinx.

CONCLUSION

Hydrosalpinx remains a significant and correctable cause of infertility, exerting substantial negative effects on both natural conception and assisted reproductive outcomes. Mild hydrosalpinx may be effectively managed with tubal-conserving surgery in carefully selected patients, but recurrence and ectopic pregnancy risks limit its usefulness in moderate and severe disease. For women proceeding to IVF, eliminating hydrosalpingeal fluid through salpingectomy or occlusive interventions reliably improves reproductive success. Interventional embolization provides an emerging minimally invasive option with outcomes comparable to surgical approaches.

Pediatric hydrosalpinx warrants a different approach because of its unique etiologies and high rate of spontaneous resolution, while current evidence indicates that salpingectomy for hydrosalpinx does not meaningfully reduce ovarian cancer risk. Optimal management requires an individualized, fertility-centered strategy that integrates disease severity, reproductive goals, procedural risk, and patient-specific anatomical factors. Continued prospective research will refine management pathways and clarify the long-term role of minimally invasive alternatives.

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