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ADHESIVE DISEASE IN GYNECOLOGY: EPIDEMIOLOGY, PATHOGENESIS, CLINICAL IMPACT, AND CURRENT CHALLENGES IN PREVENTION AND MANAGEMENT

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Abstract:

Adhesive disease in gynecology represents one of the most persistent and clinically relevant challenges in abdominal and pelvic surgery. It is characterized by abnormal fibrous connections between peritoneal surfaces that develop after tissue injury and surgical intervention. Unlike simple postoperative scarring, adhesions constitute a dynamic biological process involving inflammation, fibrin deposition, fibroblast proliferation, and extracellular matrix remodeling, ultimately leading to permanent anatomical distortion of pelvic organs.

The clinical importance of this condition extends beyond surgical morphology. Adhesions are strongly associated with tuboperitoneal infertility, chronic pelvic pain syndromes, bowel obstruction, and increased complexity of repeat surgical procedures. In reproductive-age women, even limited adnexal adhesions may significantly impair fertility by disrupting ovum capture, tubal motility, and tubo-ovarian alignment.

Epidemiologically, postoperative adhesions remain extremely common despite the evolution of minimally invasive surgery. Large cohort analyses suggest that intra-abdominal adhesions develop in up to 60–90% of patients after major abdominal or pelvic surgery, with gynecological procedures being among the most affected. Importantly, adhesions are not static findings; they contribute to long-term morbidity, repeated hospitalizations, and reoperations over many years.

Although laparoscopic surgery has significantly reduced tissue trauma compared to open surgery, it

has not eliminated adhesion formation. Risk persists due to multiple interacting factors, including peritoneal ischemia, endometriosis-related inflammation, intraoperative bleeding, thermal injury from energy devices, and repeated surgical exposure.
Therefore, adhesive disease should be considered a multifactorial, chronic, and system-wide surgical problem rather than a simple postoperative complication

Keywords : abdominal and pelvic surgery, fibrin deposition, tubo-ovarian alignment

Introduction

Introduction

Epidemiology and Disease Burden

Postoperative adhesions are widely recognized as a near-universal biological response to peritoneal injury. Following open gynecological surgery, adhesion formation rates may reach 80–95%, while laparoscopic procedures demonstrate lower but still substantial rates, often ranging from 50–80% depending on indication and complexity [1], [2].

High-risk gynecological procedures include:

a. Myomectomy (especially multiple or deep intramural fibroids)
b. Endometriosis surgery
c. Ovarian cystectomy
d. Adnexal surgery with bleeding or infection
e. Repeat pelvic surgery

The severity of adhesions is influenced not only by surgical access but also by biological and perioperative factors such as:

a. Ischemia-reperfusion injury
b. Peritoneal desiccation
c. Presence of blood and fibrin in the peritoneal cavity
d. Foreign body reaction (sutures, mesh, talc contamination)
e. Inflammatory burden (endometriosis, pid)

Even minimally invasive approaches cannot fully neutralize these mechanisms, explaining persistent adhesion formation rates in modern surgical practice [3], [4].

Long-term clinical burden

Adhesive disease is increasingly recognized as a chronic postoperative condition rather than an acute complication. Clinical manifestations may emerge months to years after surgery, often in unpredictable patterns [5].

Long-term cohort data demonstrate:

a. Repeated hospital admissions for adhesion-related complications
b. Progressive increase in surgical complexity over time
c. Cumulative risk of reoperation across decades of follow-up

Importantly, adhesion-related morbidity is not limited to symptomatic patients; a significant proportion of individuals develop clinically relevant adhesions that remain silent until secondary surgery or complication occurs [6].

Economic and healthcare burden

From a healthcare system perspective, adhesive disease represents a major source of hidden surgical costs. These include:

a. Prolonged operative time during repeat surgery
b. Increased anesthesia duration
c. Higher risk of conversion from laparoscopy to laparotomy
d. Increased icu and hospital stay in complicated cases
e. Cost of adhesion prevention materials and surgical time loss

In addition, adhesions significantly increase medicolegal risk due to bowel or urinary tract injuries during reoperation [7], [8].

Clinical Significance

One of the most important consequences of pelvic adhesions is impairment of fertility. Tubo-ovarian adhesions can:

a. Prevent fimbrial pickup of oocytes
b. Distort fallopian tube anatomy
c. Impair ciliary function and tubal motility
d. Alter peritoneal fluid dynamics necessary for gamete transport

Clinical studies demonstrate a clear association between severe adnexal adhesions and reduced spontaneous pregnancy rates, particularly in patients with endometriosis or prior pelvic infection [9], [10].

However, fertility outcomes are heterogeneous, and not all adhesions lead to infertility, reflecting the importance of location, density, and functional impact rather than morphology alone.

Methodology

Chronic pelvic pain

The relationship between adhesions and chronic pelvic pain remains controversial. While adhesions may cause pain through:

a. Traction on visceral organs
b. Restricted organ mobility
c. Nerve entrapment
d. Localized ischemia

pain severity does not consistently correlate with adhesion extent or density.

Randomized trials evaluating adhesiolysis for pain relief have produced mixed results, with some showing benefit in selected patients and others demonstrating no significant difference compared to diagnostic laparoscopy alone.

This suggests that chronic pelvic pain is multifactorial, and adhesions represent only one potential

contributing mechanism.

Results and Discussion

Bowel obstruction and severe complications

Postoperative adhesions are the leading cause of small bowel obstruction worldwide, accounting for approximately 60–70% of cases [11]. In gynecology, the risk is particularly relevant after hysterectomy and extensive adnexal surgery.

Key clinical characteristics:

delayed presentation (often 4–10 years after surgery)

recurrent episodes in some patients

risk of strangulation requiring emergency surgery

significant morbidity and mortality in severe cases

Thus, adhesions represent a long-term surgical risk extending far beyond the gynecological field.

Surgical complexity and iatrogenic injury risk

Repeat pelvic surgery in the presence of adhesions is significantly more hazardous. Adhesions distort normal anatomy, making identification of critical structures difficult [12], [13].

Major intraoperative risks include:

bowel injury (often during initial entry)

bladder and ureteral injury

vascular injury during adhesiolysis

increased conversion rates to open surgery

Importantly, studies show that a substantial proportion of bowel injuries occur during the entry phase of laparoscopy, particularly in patients with prior abdominal surgery [14,15], [16], [17], [18].

Pathogenesis

Adhesion formation is a biologically regulated but pathologically dysbalanced healing process.

Initial injury phase

Peritoneal injury triggers:

mesothelial cell disruption [19], [20]

capillary leakage

inflammatory cell recruitment

fibrin-rich exudate formation

Normally, fibrin deposits are cleared within 72 hours via fibrinolysis. However, surgical trauma and hypoxia reduce fibrinolytic activity, leading to persistent fibrin scaffolds [21], [22], [23], [24].

Persistent fibrin matrices allow:

fibroblast migration

collagen deposition

angiogenesis

transformation into fibrous adhesions

Key molecular drivers include:

TGF-β signaling (pro-fibrotic pathway)

oxidative stress

macrophage activation

impaired mesothelial regeneration

Endometriosis further amplifies this process through chronic inflammatory stimulation and angiogenic activity.

Surgical Technique and Operative Environment

Modern evidence strongly suggests that adhesion formation is not only disease-related but also technique-dependent [25], [26], [27].

Key influencing factors include:
duration of surgery
thermal spread from energy devices
tissue handling quality
intraperitoneal dryness and temperature
pneumoperitoneum pressure and gas composition
Low-pressure pneumoperitoneum [28]
Lower insufflation pressures may reduce:
postoperative pain
cardiopulmonary stress
possibly peritoneal ischemia
However, current evidence remains limited and insufficient to confirm a consistent reduction in adhesion formation [29].
CO_2 conditioning
Experimental and clinical studies suggest that:
dry cold CO_2 increases mesothelial injury
humidified and warmed CO_2 may reduce inflammation and pain
clinical impact on adhesion prevention remains uncertain
Thus, surgical environment optimization remains a promising but not yet definitive strategy [30], [31], [32], [33].

Unresolved Issues

Despite decades of research, major gaps remain:
No reliable non-invasive diagnostic method for adhesions
Poor correlation between adhesion morphology and symptoms
Lack of standardized classification systems linking severity to clinical outcomes [34]
Limited evidence that anti-adhesion barriers improve fertility or pain outcomes
Insufficient high-quality long-term randomized trials

Conclusion

Adhesive disease in gynecology is a complex, multifactorial, and chronic condition with significant implications for reproductive health, pain syndromes, bowel complications, and surgical safety. Despite advances in minimally invasive techniques, its incidence remains high and clinically relevant.

Current preventive and therapeutic strategies provide only partial control of the problem. Therefore, adhesive disease should be considered an unresolved surgical and biological challenge requiring further translational and clinical research.

Future progress will depend on:

a. Improved preoperative diagnostic tools
b. Standardized clinical scoring systems
c. Better understanding of peritoneal biology
d. Optimization of surgical techniques and intraoperative environments
e. High-quality trials focused on patient-centered outcomes

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