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Management and complications of tubo-ovarian abscesses: a brief literature review

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ABSTRACT

Tubo-ovarian abscesses (TOAs) are identified as a severe and complex form of inflammatory disorder, marking an advanced progression of pelvic inflammatory disease (PID), mainly resulting from the escalation of polymicrobial infections within the female genital tract. This literature review is dedicated to elucidating the contemporary management strategies and associated complications of TOAs, amalgamating the current scholarly discourse while spotlighting the emerging therapeutic trends. The inherent complexity of TOAs, manifesting through a broad array of clinical presentations from mild symptoms to acute pelvic discomfort and fever, necessitates a comprehensive, multidisciplinary approach to achieve effective management. Traditional management has predominantly focused on antibiotic therapy, the cornerstone of initial treatment modalities. Nonetheless, this review expands on the increasing acknowledgment of minimally invasive surgical interventions, like ultrasound-guided drainage, especially in scenarios where medical therapy falters or in the presence of sizable abscesses, underscoring scenarios where antibiotic treatment may be insufficient. The discourse further explores the pivotal decision-making concerning surgical interventions, juxtaposing the benefits of abscess resolution against potential risks and complications, such as damage to adjacent structures and implications for future fertility. The review emphasizes the criticality of addressing PID's risk factors and root causes to avert TOA development. It also ventures into the ramifications of the emergence of antibiotic-resistant bacterial strains for empirical antibiotic therapy selection, highlighting the imperative for continuous research and the adaptation of therapeutic guidelines. The complications associated with TOAs, including sepsis, infertility, and chronic pelvic pain, are meticulously examined to underscore the potential for significant long-term morbidity. Advocating for prompt diagnosis and encompassing management strategies to curtail these adverse outcomes, the review ultimately calls for intensified, quality research to refine TOA management further, particularly against the backdrop of evolving microbial resistance and the advancements in minimally invasive surgical technologies.

Keywords: Tubo-ovarian abscess, pelvic inflammatory disease, minimally invasive surgical intervention, infertility

Tubo-Ovarian Abscess (TOA) is an inflammatory disease of the uterine tubes, ovaries, and surrounding adnexal tissues [1]. TOAs result from recurrent infections of the adnexal organs. As the infection progresses, involvement can extend to the intestines, uterus, omentum, and bladder. A Douglas ab-

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scess can also occur due to the spread from a TOA through contiguous structures [2]. TOAs may also arise secondary to the use of intrauterine devices, granulomatous infections, pelvic or intrauterine surgeries, and perforations of other intraabdominal organs [3].

Clinical presentations can vary. Tubo-ovarian abscesses typically emerge as complications following acute or chronic pelvic inflammatory disease (PID), which is more commonly observed in women of reproductive age. Annually, 1 million women receive treatment for PID, and approximately 200,000 patients require hospitalization [4]. Symptoms of TOA include pelvic and abdominal pain, nausea, vomiting, high fever, and tachycardia. A detailed pelvic examination may be challenging due to generalized abdominal defense. During a bimanual examination, an adnexal mass can often be palpated [5]. Ultrasound (USG), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI) are imaging methods used to monitor treatment response and complications in patients [6].

In recent years, the mortality associated with TOAs has decreased. However, morbidity, including infertility, ectopic pregnancy, chronic pelvic pain, ovarian vein thrombosis, and pelvic thrombophlebitis, remains significant. Although antibiotic therapy is widely accepted for treatment, outcomes are often suboptimal due to the difficulty of antibiotic penetration through the abscess wall. Following antibiotic therapy, surgical intervention is required in 25% of cases [7]. Therefore, removal of the abscess or adnexa via laparotomy or laparoscopy is recommended [8]. For young patients, fertility-preserving surgery is prioritized, making laparoscopy the gold standard [9].
Untreated TOA can rupture, leading to life-threatening peritonitis and sepsis. Emergency surgery is indicated if TOA rupture is suspected. Untreated TOA poses a significant health problem in the long term due to its detrimental effects on chronic pain and fertility [10].

Based on the presented review of TOA management, the outlined introduction offers a comprehensive overview of TOA's etiology, clinical presentation, diagnostic approaches, and current treatment paradigms. This underscores the complex nature of TOAs, the diversity in clinical manifestations, and the criticality of a nuanced, multidisciplinary management strategy to mitigate the associated morbidity and improve patient outcomes. However, despite advances in diagnostic modalities and treatment options, significant gaps remain in our understanding of optimal management strategies, particularly in balancing antibiotic therapy with the need for surgical intervention, and in tailoring treatment to preserve fertility without compromising the efficacy of abscess resolution. The primary objective of this research is to further elucidate the optimal management strategies for TOAs, focusing on the efficacy and outcomes of different treatment modalities, including the role of minimally invasive surgical techniques and the impact of novel antibiotic regimens. Additionally, this study aims to explore the long-term outcomes of TOA treatment, particularly regarding fertility preservation and the prevention of recurrent infections, which represent critical concerns for affected individuals. The significance of this research lies in its potential to contribute valuable insights to the existing body of literature on TOAs, addressing critical gaps in knowledge and practice. By providing evidence-based recommendations for TOA management, this study seeks to enhance clinical decision-making, improve patient outcomes, and reduce the morbidity associated with this condition. Given the implications of TOAs on reproductive health and the potential for life-threatening complications, advancing our understanding of their management is of paramount importance. This research endeavors to pave the way for future studies, fostering a deeper comprehension of TOA treatment strategies that can significantly impact women's health worldwide.

TUBO-OVARIAN ABSCESS (TOA)

Tubo-ovarian abscesses (TOAs) are characterized as inflammatory masses involving the fallopian tubes, ovaries, and sometimes extending to other pelvic organs such as the bladder and intestines. Arising predominantly from infections within the upper genital tract, these abscesses are notably prevalent among women of reproductive age, frequently emerging as a severe complication of pelvic inflammatory disease (PID]. The condition necessitates urgent medical and sometimes surgical intervention due to its potential to progress to sepsis. Historically, before the advent of broad-spectrum antibiotics and advanced surgical techniques, TOA-associated mortality rates were reported to exceed 50% [11, 12].

The therapeutic approach to managing TOAs encompasses a spectrum of strategies, including the administration of broad-spectrum antibiotics, minimally invasive drainage procedures, and more invasive surgical interventions, with some cases requiring a combination of these modalities. Notably, for a majority of TOAs, particularly those of smaller to medium size (<9 cm), antibiotic therapy alone is deemed sufficient [12].

EPIDEMIOLOGY AND RISK FACTORS

Limited epidemiological studies have been conducted on TOAs. It has been reported that, in the United States, approximately 200,000 women were hospitalized due to PID from 1983 to 2000. It's imperative to acknowledge that not all TOAs are directly related to PID. Nonetheless, about 33% of patients presenting with PID are found to have TOAs, suggesting an estimation of around 66,000 cases annually in the U.S. A study in Norway highlighted a decrease in PID diagnoses from 1990-1992 to 2000-2002, with TOAs constituting a growing majority of these cases, indicating an increase from 26% to 43%. This surge could potentially be attributed to variations in PID management practices, which are predominantly outpatient for current PID treatments, reserving hospitalization for severe cases, including TOAs [13-16].

Although the majority of TOA cases are observed in women aged between 15-40, age does not exclude the diagnosis. The risk factors for TOA closely mirror those associated with PID, including: Age between 15-25 years, History of intrauterine surgical procedures, Intrauterine device (IUD) use, Multiple sexual partners, Previous pelvic surgery, Intraabdominal surgeries Immunosuppression. Undergoing IVF treatment While modern IUDs have been associated with a slight increase in PID risk, their use has been linked to an increased risk of TOAs (typically unilateral), though such associations have yet to be firmly supported by well-conducted studies [17, 18]. IUDs have been in existence since the late 1990s and play a minor role in PID development. The risk of PID is notably higher in the first three weeks following IUD insertion. Additionally, some research indicates that women with HIV may have a higher risk of developing TOAs [19-21].

PATHOGENESIS

The pathogenesis of TOA development remains not fully elucidated. Most commonly resulting from PID, TOAs typically originate from infections in the upper genital tract. They can also develop secondary to infections of the intestines and appendix, post-adnexal surgery, or through hematogenous spread. It's important to note that pelvic abscesses, which have a different etiology and management approach from TOAs, are not included in the tubo-ovarian complex. In rare cases, TOAs can be observed in women who have undergone a hysterectomy, arising from non-gynecological organs through hematogenous or local spread.
In instances stemming from the lower genital tract, sexually transmitted pathogens or the endogenous flora of women are usually implicated. The infection ascends to the fallopian tubes, damaging the endothelium, secretory, and ciliary cells, leading to edema. Previous infections disrupting tubal structure also predispose individuals to TOA formation.

The progressively invasive tubal infections result in increasing tissue edema and the production of purulent exudate. Occasionally, tubal structures may adhere to ovarian ligaments, forming a complex wherein necrosis develops, leading to one or more abscess cavities and facilitating the proliferation of a multitude of endogenous pelvic flora bacteria.

TOAs are predominantly polymicrobial in nature. The bacterial groups identified in TOAs and uncomplicated PID cases are generally the same. Occasionally, causative agents of bacterial vaginosis can also proliferate in women with TOAs, although a direct link between TOA and bacterial vaginosis has not been established [22-24].

Cultures from TOA patients can yield growth of aerobic, facultative anaerobic, and anaerobic bacteria, commonly including species such as Bacteroides Fragilis, Prevotella, Escherichia Coli, Group B Streptococcus, and Peptostreptococcus. Less frequently, Candida, Pasteurella Multocida, Salmonella, and Streptococcus Pneumoniae can be isolated. In immunosuppressed patients, Mycobacterium Tuberculosis often causes TOAs. For long-term IUD users, Actinomyces Israelii represents a specific anaerobic pathogen responsible for TOAs. *N. gonorrhoeae* and *C. trachomatis* are rarely cultured from TOA abscess

cavities, typically being associated with PID and cervicitis. In a series involving 232 women, N. gonorrhoeae was isolated from the endocervix in 33% of cases, yet less than 4% were linked to TOAs. Some data suggest N. gonorrhoeae's progression from the lower to upper genital tract may contribute to invasive infection [25, 26].

CT is preferred in cases where it's necessary to exclude pathologies related to the Gastrointestinal System (GIS), such as appendicitis, phlegmon associated with inflammatory bowel disease, abscess, etc. Several studies have demonstrated that CT possesses a higher sensitivity compared to USG. However, CT is significantly more expensive than USG. Additionally, for CT to achieve its high sensitivity, the administration of both IV and oral contrast is required, which may not be feasible for some patients due to various reasons [27-30].

The specific CT appearance of a TOA is that of a thick-walled adnexal mass, contrasting with the thin-walled appearance typical of non-inflammatory masses. Inflammatory masses are often multilocular and usually contain increased fluid in the form of purulent exudate [31]. In some patients with TOA, CT imaging may reveal thickened tubes (pyosalpinx), regional bowel thickening, and mesenteric nodes. Additionally, CT (and sometimes USG) can typically display signs of abscess ruptures, such as free fluid in the abdomen due to pus accumulation and abscess foci on the pelvic wall. Other imaging methods for diagnosing TOA include MRI and radionuclide imaging, though their clinical utility is limited and not preferred for routine use. Surgical evaluation in cases of TOA is indicated in the following scenarios [31-33]:

- Suspected abscess ruptures presenting with signs of acute abdomen or sepsis
- In postmenopausal women, where there is a TOA that could be confused with gynecological malignancy.

DIAGNOSIS

The diagnosis of TOA is established through the classic diagnostic criteria for PID (lower abdominal tenderness, adnexal tenderness, tenderness on cervical motion during bimanual examination, fever >38.3°C, abnormal vaginal discharge, elevated erythrocyte sedimentation rate, increased CRP, presence of N. gonorrhoeae and C. Trachomatis in vaginal cultures) combined with imaging revealing an adnexal mass. Drainage accompanied by imaging may be necessary for pelvic masses containing purulent material, as anatomical localization may not always be accurately determined. Sometimes, a definitive diagnosis of TOA requires direct observation during invasive surgery (L/T: Laparotomy, L/S: Laparoscopy] [26, 27].

Differential Diagnosis

A broad range of conditions that can cause lower quadrant abdominal and pelvic pain resembling PID includes [34-37]:

Reproductive system: ovarian mass, ruptured ovarian cyst, ovarian torsion, degenerated uterine fibroid, dysmenorrhea, ectopic pregnancy, septic abortion GIS system: appendicitis, AGE (acute gastroenteritis), inflammatory bowel, irritable bowel, diverticulitis, constipation, cholecystitis Urinary system: cystitis, pyelonephritis, nephrolithiasis, urethritis It's crucial to note; the absence of fever does not rule out TOA. Women with TOA may have or develop sepsis. Vital signs, physical examination, and laboratory tests can collectively exclude sepsis.

Drug choice for TOA; the outcome of blood culture and tubo-ovarian abscess culture is beneficial in selecting the treatment. If a blood culture is to be taken, it should be done before antibiotic therapy.

MANAGEMENT AND COMPLICATIONS OF TUBO-OVARIAN ABSCESSES

Choosing the Treatment Method

Depending on the character of the abscess and the patient's condition, treatment can be with antibiotic therapy alone or combined with drainage – surgical treatment. In some cases, emergency surgery may be necessary.

Emergency surgical indications include; suspected intraabdominal TOA ruptures that are life-threatening, necessitating urgent surgery [13]. Clinical signs such as hypotension, tachycardia, tachypnea, acute peritonitis, or acidosis suggest an intraabdominal rupture. Surgery or medical treatment is recommended for women with large abscesses or signs of sepsis, suspected of abscess rupture, but treatment often leans towards sur-

gery in acute onset cases. Antibiotics should be initiated as swiftly as possible during or before surgery in women undergoing surgical treatment. Crucially, in unstable patients, surgery should be swiftly planned without waiting for antibiotic treatment [17].

Who Should Receive Only Medical Treatment?

In most cases, antibiotic therapy is sufficient without the need for surgical treatment. Based on numerous studies, antimicrobial agents have been observed to be effective in approximately 70% of cases.

Only antibiotic therapy is recommended in the following situations: patients without signs of toa rupture (acute abdomen, sepsis) whose hemodynamics are stable, abscesses smaller than 9 cm, those who respond adequately to antibiotics and premenopausal women, signs of sepsis and USG follow-ups should be conducted approximately every 3 days or less frequently if clinical improvement is observed [18, 20].

Minimal invasive drainage is employed in patients who do not worsen but do not respond distinctly to antibiotic therapy. No studies compare minimal invasive drainage or surgical intervention in such cases. Surgery should be preferred if minimal invasive drainage is not possible (multiloculated mass, poor abscess localization, or lack of experience) [34].

Antibiotic therapy is the cornerstone of TOA treatment. Antibiotics must be administered before or after drainage and surgery. If the patient with TOA has a sexually transmitted disease, the partner must be identified and treated [33, 34].

Treatment Management

Antibiotic therapy is fundamental in TOA treatment. In some women, antibiotics should be combined with minimal invasive drainage and surgery. The excellent antimicrobial activity of broad-spectrum antibiotics, due to their penetration into the abscess cavity, has made them the primary treatment for non-ruptured TOAs. Before the 1970s, due to the inadequacy of antibiotic therapies, drainage was required for all abscesses [37-39]. At that time, non-surgical interventions were insufficient, necessitating extirpation of all affected organs during surgery (usually total abdominal hysterectomy and bilateral salpingo-oophorectomy [TAH+BSO]]. The morbidity associated with surgery, wound site infections, and premature menopause made this method less satisfactory for patients.

Antibiotic therapy; experts agree on the in-hospital and IV treatment of TOA, as recommended by the CDC [40]. Antibiotic therapy alone, as mentioned above, is effective in approximately 70% of affected women [41-45]. This treatment modality can be insufficient depending on the abscess's characteristics (relatively avascular structure, inadequate antibiotic penetration, low pH]. The high effectiveness of antibiotic therapy alone is also due to the high vascularization of the ovaries. The treatment of TOA is the same as that for PID. Although their pathophysiologies are not clear, TOA and PID originate from similar conditions. The first-line treatment for PID (most TOAs) is second-generation cephalosporins with anaerobic efficacy. The benefit of adding a second anaerobic-effective antibiotic to this treatment is still debated. Therefore, according to the CDC, only metronidazole should be used as an additional treatment for PID [44, 45].

Medical Treatment

The treatment algorithm for the medical management of TOA is not definitive. If antibiotic therapy is to be employed as the sole treatment modality, it should be continued for at least 2 weeks, aligning with the CDC's guidelines for PID treatment [46]. Additionally, many experts recommend continuing antibiotic therapy until the abscess is resolved on subsequent imaging, which could extend the treatment duration to 4-6 weeks. In cases where the abscess does not resolve with antibiotic therapy alone, outpatient antibiotic treatment may be provided. If routine therapy fails to resolve the abscess, a collaborative effort with Infectious Diseases and Clinical Microbiology should be initiated [45].

There is no specific duration recommended for the combination of abscess drainage or surgery with antibiotic therapy. According to studies, using antibiotics for 10-14 days has been found effective for the healing process. Each patient should be evaluated based on their unique clinical scenario [42-44].

For patients selected for outpatient oral antibiotic therapy, the ability to tolerate oral medications and adhere to follow-ups are crucial criteria for regular clinical improvement.

All treatments should be administered in accordance with the bacteria involved (similar to the treatment for PID]. Moreover, the treatment should also

cover sexually transmitted pathogens (*N. Gonorrhea*, *C. Trachomatis*-even though they may be isolated from TOA) and anaerobes [48, 49]. The chosen antibiotic should be able to penetrate the abscess wall and be active within the cavity (e.g., clindamycin, metronidazole, cefoxitin) [50].

If sexually transmitted pathogens are isolated in a patient with TOA, specific treatment for these pathogens should be added. Various antibiotic treatments have been found effective for the medical management of TOA. The first-choice medications are listed in Table 4, based on clinical data (Table 4]. First-choice treatment agents have been observed to have nearly equal effects [51, 52].

Cefotetan and Cefoxitin are primary treatment options for TOA. Resistance of the intestinal flora against Cefotetan and Cefoxitin is on the rise, which often plays a role in the pathogenesis of TOA. New agents are being incorporated into TOA treatment, including Ertapenem (1g IV every 24 hours) or Piperacillin-Tazobactam (3.375g IV every 6 hours]. A randomized controlled trial has shown Ertapenem to be significantly more effective than Cefotetan in preventing surgical site infections in patients undergoing elective intestinal surgery [53]. Additionally, according to the latest guidelines by the American Society of Infectious Diseases, cefoxitin is a viable option for treating moderate intraabdominal abscesses [54].

Some studies indicate that triple antibiotic therapy is more effective than dual therapy. Small series have shown that triple therapy (Ampicillin + Clindamycin + Gentamicin) is more effective compared to dual therapy (Clindamycin + Gentamicin or Cefotetan + Doxycycline) (Triple therapy efficacy: 88%, Clindamycin+Gentamicin: 47%, Cefotetan + Doxycycline: 34%) [55]. Despite the high efficacy observed in patients receiving triple therapy, the small size of the study and the lack of a direct comparison necessitate further research. Drug hypersensitivity or aminoglycoside toxicity (renal failure) should be considered when selecting the treatment.

Clinical trials have also indicated the necessity of adding pathogen-specific drugs in TOA cases where *Actinomyces Israelii* is isolated. In these patients, β-lactam antibiotics (Ampicillin-Sulbactam) should be standardly added to the treatment [21]. After completing the standard treatment, Penicillin should be continued for at least one more month. Doxycycline can be used in patients allergic to penicillin. There's no definitive data on the treatment duration; however, most experts recommend a Penicillin treatment duration of 3-6 months.

Several studies have also identified the rare occurrence of pathogens such as *Candida* species, *Pasteurella multocida*, and *Salmonella* as causes of TOA [40-42]. These pathogens are not typical endogenous agents of the genital flora and are not known etiological factors of TOA. Consultation with the Infectious Diseases department is advised for these cases [42].

Due to the potential for rapid clinical deterioration, the possibility of abscess rupture, and the development of sepsis, patients should be closely monitored for 48-72 hours [29, 50-54].

Minimal Invasive Drainage

Since the 1970s, various methods have been successfully employed to drain intraabdominal abscesses without the need for surgery [30, 34, 45]. There are diverse anatomical approaches for drainage documented in studies, including percutaneous, transvaginal, transrectal, and transgluteal methods. The success of drainage is influenced by the abscess localization, the adequacy of imaging technology, and the practitioner's experience. All aspirated fluids should be sent to the microbiology laboratory for aerobic and anaerobic culture. Various studies have shown success rates ranging from 70% to 100% for TOA drainage performed using CT or USG [43, 44]. For instance, a study involving the USG-guided drainage of 49 women with TOA found a definitive treatment rate of 74% without the need for surgical intervention [48]. Additionally, a separate retrospective study showed that adding antibiotic treatment to percutaneous drainage guided by USG or CT was more effective and shortened the treatment duration compared to antibiotic treatment alone [47]. Controlled studies are needed for definitive conclusions.

Generally, higher success is achieved with small, unilocular fluid collections (achieving clinical improvement without the need for surgery) [48]. For multilocular TOAs, clinical success with drainage treatment is lesser. The success rate in treatment increases with the experience and skill level of radiologists and the advancement of radiological imaging equipment.

As modern drainage procedures have evolved, gy-

necologists can now drain pelvic abscesses via the transvaginal route using the posterior colpotomy method. This method is most suitable for abscesses formed post-hysterectomy at the vaginal cuff. The procedure involves dissecting the rectovaginal septum. Cases of peritonitis and sepsis have been reported following this procedure [34]; hence, it must be conducted with great caution in cases of TOA [46].

Surgery

Intraabdominal TOA rupture is a life-threatening condition that requires emergency surgery [26]. A combination of antibiotic therapy and surgery should be performed in these cases.

Laparotomy is the most commonly used method for treating TOAs. The choice of incision for optimal pelvic visualization is crucial, with the Maylard transverse or vertical midline incision typically employed. Some data suggest laparoscopy as a successful option for patients without abscess rupture [49, 50]. Although laparoscopy has been suggested in small case series as an alternative to laparotomy, data are insufficient. The choice between laparoscopy and laparotomy largely depends on the surgeon's skill. Even without abscess rupture, laparoscopy should only be attempted by experienced surgeons. Surgical treatment of TOA involves extensive and complex procedures involving inflamed tissues and various intraabdominal organs.

The importance of experienced surgeons cannot be overstated. Both laparotomy and laparoscopy for TOA are challenging due to the anatomical distortions caused by inflammation and the fragile nature of the tissues. Involvement of an experienced colorectal surgeon is common practice in these operations. Preoperative considerations should account for these conditions, and if the clinical scenario permits, preoperative bowel preparation should also be undertaken [47-50]. The surgical procedure for TOA includes:

- Confirming the diagnosis of TOA
- Draining as much infected and inflamed fluid and debris from the abscess cavity as possible
- Irrigating the peritoneal cavity extensively to reduce the patient's infection and inflammation load

Cultures for aerobic and anaerobic bacteria should be taken from the abscess material and the peritoneal cavity itself. Tissue pathology should be sent from the abscess cavity to confirm microbiological findings. All removed materials should be sent for pathology, as TOAs, especially in postmenopausal women, can sometimes be associated with malignancy.

Total Abdominal Hysterectomy + Bilateral Salpingo-Oophorectomy (TAH + BSO) as a means to remove all infected tissues is an old method. While this may sometimes be the best method, unilateral salpingo-oophorectomy (USO) is considered sufficient treatment for unilateral TOA [26, 29, 34]. USO is preferred over TAH + BSO due to its preservation of fertility and hormonal functions and lower morbidity. Especially in premenopausal women, USO is chosen to preserve fertility.

TAH+BSO is the preferred method for patients with acute abdomen and sepsis who have completed their fertility. This aggressive approach speeds recovery compared to other less invasive surgical procedures. Moreover, TAH + BSO eliminates the 10-20% chance of abscess recurrence seen with other surgical methods [26, 29, 49]. In complicated TOA cases, treatment should be combined with clinical experience whenever possible.

The risk of wound site infection due to surgical field contamination from abscess rupture is high. During closure, a drain should be placed subcutaneously, monitored until minimal output is observed, and clinical improvement is achieved.

Complications

Abscess rupture is observed in 15% of TOAs [30]. Rupture is a life-threatening situation requiring emergency surgery.

Sepsis is observed in 10-20% of TOAs. Immediate surgical intervention is strongly recommended if a sepsis scenario is observed in TOAs, as delaying surgery can lead to more severe clinical outcomes [46]. Another complication is the development of postoperative wound site infections. Patients with systemic diseases (such as diabetes mellitus) are more prone to developing wound site infections [50].

Gastrointestinal system injuries are among the complications that can occur intraoperatively. Therefore, if surgery is planned for patients with TOA, having a preoperative colorectal surgery team on standby is recommended [51].

Special Clinical Situations in TOA Treatment

In patients with TOA who have an IUD, removal of the IUD is recommended along with the adminis-

tration of antibiotic therapy based on the severity of the disease. *Actinomyces Israelii* is typically the specific agent in TOA cases with IUDs. There is no evidence to suggest that removing the IUD has a positive effect on the treatment of A. Israelii or other pathogens in TOA treatment. However, since *Actinomyces Israelii* proliferates on foreign bodies, removal of the IUD is advised [46, 47].

Although most women with TOA are of reproductive age, TOA can also occur in postmenopausal women. Various case series have shown that a significant portion of TOAs observed in the postmenopausal period are associated with malignancy [46-49]. In one series, genital system malignancy was observed in 8 out of 17 postmenopausal women, while only 1 out of 76 premenopausal women had a genital system malignancy [36]. Therefore, if TOA is detected in the postmenopausal period, patients should be thoroughly evaluated for malignancy, and surgical treatment rather than antibiotic therapy or minimal invasive drainage should be recommended. Intraoperative frozen section consultation is also advised. Additionally, evaluation for pelvic and abdominal metastasis should be conducted. Surgical staging should be performed if the patient consents and sufficient expertise for proper staging is available.

TOA is rare in pregnant women [55, 56]. The approach to a pregnant woman with TOA is similar to that for a non-pregnant woman. Care should be taken to avoid antibiotics with teratogenic effects (such as quinolones) in the treatment.

CONCLUSION

The management of Tubo-Ovarian Abscesses (TOAs) presents a challenging dilemma in gynecological practice, reflecting a critical intersection of infectious disease, reproductive health, and surgical intervention. This review has traversed the multifaceted landscape of TOA management, from epidemiological insights to therapeutic strategies and the complex considerations surrounding minimally invasive techniques and surgical interventions. The evolution of management paradigms, underscored by the increasing reliance on broad-spectrum antibiotics and the strategic integration of minimally invasive procedures, marks a significant stride towards optimizing patient outcomes while minimizing procedural morbidity.

Despite these advancements, TOAs continue to pose significant risks, including the potential for severe complications such as sepsis, infertility, and chronic pelvic pain. The critical balance between the effective resolution of abscesses and the preservation of fertility, particularly in the context of surgical decision-making, remains a pivotal concern. Moreover, the emergence of antibiotic-resistant strains necessitates a vigilant, dynamic approach to empirical therapy selection, emphasizing the importance of ongoing research and the adaptation of treatment protocols to meet evolving microbial challenges.

The significance of early diagnosis cannot be overstated, as it serves as a cornerstone for effective management, potentially mitigating the progression to severe complications. A multidisciplinary approach, incorporating the expertise of gynecologists, radiologists, infectious disease specialists, and, when necessary, colorectal surgeons, is essential for the comprehensive management of TOAs. This collaborative framework facilitates a nuanced understanding of each patient's unique clinical scenario, enabling tailored treatment strategies that optimize therapeutic efficacy while considering individual fertility goals and risk profiles.

Looking forward, there is a pressing need for high-quality, evidence-based research to further refine the management of TOAs. Future studies should aim to elucidate the optimal timing and selection criteria for surgical intervention, assess the long-term outcomes of current treatment modalities, and explore the potential of emerging therapies. Additionally, investigations into the pathophysiology of TOAs, particularly in the context of microbial resistance patterns, could yield valuable insights, paving the way for innovative therapeutic approaches.

In conclusion, the management of TOAs demands a judicious, evidence-based approach, underscored by a commitment to patient-centered care. As we navigate the complexities of this condition, the pursuit of enhanced diagnostic techniques, more effective treatments, and comprehensive management strategies remains paramount. Through continued research and interdisciplinary collaboration, we can aspire to improve the quality of life for affected individuals and mitigate the long-term morbidity associated with TOAs.

Authors' Contribution

Study Conception: GEA; Study Design: GEA, TB; Supervision: TB, HZG; Funding: N/A; Materials: N/A; Data Collection and/or Processing: GEA; Statistical Analysis and/or Data Interpretation: TB, HZG; Literature Review: GEA; Manuscript Preparation: GEA and Critical Review: GEA, TB.

Conflict of interest

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