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Review

Diagnosis and management of tubo-ovarian abscesses

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Key content

- Tubo-ovarian abscesses represent a severe form of pelvic inflammatory disease and carry high morbidity.
- Diagnosis is made by combining the clinical picture (fever, pelvic pain and pelvic adnexal mass) with raised inflammatory markers and radiological findings demonstrating an abscess.
- Initial management with intravenous antibiotics may not be successful.
- Surgical intervention may be indicated but the optimal timing is not clear and image-guided drainage can be a possible alternative to surgery.
- Surgery may be conservative or involve pelvic clearance and will depend on the clinical situation.

Learning objectives

- To be able to recognise and initiate prompt treatment of pelvic inflammatory disease and tubo-ovarian abscesses.
- To understand appropriate antibiotic treatment and/or radiological drainage.
- To be able to identify indications for timely surgical intervention and explore the optimal surgical approach of laparoscopic versus open surgery.

Ethical issues

- Delays in treatment may have adverse effects on future fertility.
- Who is appropriate for fertility-preserving treatment?

Keywords: pelvic inflammatory disease / pelvic sepsis / subfertility / tubo-ovarian abscess

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Introduction

Tubo-ovarian abscess (TOA) is a recognised and serious complication of untreated pelvic inflammatory disease (PID). It most commonly affects women of reproductive age and nearly 60% of women with TOA are nulliparous.[1] TOA is defined as an inflammatory mass involving the tube and/or ovary characterised by the presence of pus. The most common cause is ascending/upper genital tract infection when purulent material can discharge through the tube directly into the peritoneal cavity causing initial PID and progression to form a TOA.[2] The infection can occasionally involve other adjacent organs such as the bowel and bladder. TOA carries a high morbidity and can be life threatening. When associated with severe systemic sepsis, the mortality rate is reported to be as high as 5–10%.[3] The diagnosis is made when the clinical findings are associated with raised inflammatory markers and radiological findings demonstrating a mass. Surgical intervention may be indicated but optimal timing and the most appropriate procedure is unclear. Techniques include laparoscopic versus open surgery and drainage of abscess versus radical excision. Potential long-term consequences of a TOA include infertility, an increased risk of ectopic pregnancy and chronic pelvic pain.[4,5]

Aetiology

PID and TOAs can be caused by a variety of organisms (Table 1).[2,6] Studies demonstrate that in 30–40% of cases, PID is polymicrobial.[7] PID and TOAs can also occur secondary to other intra-abdominal pathology such as appendicitis, diverticulitis or pyelonephritis and may be caused by direct or haematogenous spread of infection.

Risk factors

TOAs occur most frequently in women of reproductive age. There are a number of associated risk factors for developing PID and a subsequent TOA: non-use of barrier contraception,[2] intrauterine contraceptive devices, previous episode(s) of PID, earlier age at first intercourse, multiple sexual partners, diabetes and an immunocompromised state.[8] Interestingly, TOAs have been reported in women who are not sexually active.[9]

Around 15–35% of women being treated for proven PID will be diagnosed with a TOA.[2,10,11] It is not clear why there is a progression from PID to a TOA; a delay in treatment of PID is highly likely but virulence of the causative pathogen might make a TOA more likely.[2] Halperin et al.[12]

Table 1. Causative organisms of pelvic inflammatory disease and tubo-ovarian abscesses

Organism	Comments
Chlamydia trachomatis	Sexually transmitted
Neisseria gonorrhoeae	Sexually transmitted
Escherichia coli	Enterobacteriaceae
Bacteroides	Anaerobe
Peptococcus	Anaerobe
Peptostreptococcus	Anaerobe
Actinomyces	Usually associated with the presence of an intrauterine device
Pelvic tuberculosis	Rare – reported with co-existing HIV
Gardnerella vaginalis	
Streptococccus agalactiae	
Mycoplasma genitalium	
Haemophilus influenzae	
Streptococcus pyogenes	

demonstrated that women aged around 45 years are more likely to have a larger abscess with higher inflammatory markers than younger women who paradoxically have more risk factors. Women with co-existing endometriosis are more likely to have more severe PID and TOA. Kubota et al.[13] found that the incidence of a TOA was 2.3% in women with co-existing PID and endometriomas compared with 0.2% in women without endometriomas. The aetiology of endometriosis may be in part immune dysfunction; this could explain the association between TOAs and endometriosis. Alternatively, it could be possible that the walls of endometriomas are more susceptible to bacterial invasion than healthy ovarian cortex or that the presence of blood in an endometrioma acts a good culture medium for pathogens. There is a risk of a TOA secondary to oocyte retrieval in women with endometriomas undergoing in vitro fertilisation but the European Society of Human Reproduction and Embryology suggests that this risk is low and that antibiotic prophylaxis is not essential.[14]

Diagnosis

The British Association for Sexual Health and HIV provides guidance on the diagnosis and management of PID;[15] however, there are no national guidelines on the management of TOAs.

Symptoms and signs of PID and/or a TOA include some or all of the following:

- Adnexal tenderness (bilateral or unilateral)
- Cervical excitation
- Pyrexia
- Abnormal cervical or vaginal discharge
- Elevated white cell count
- Elevated erythrocyte sedimentation rate
- Elevated C-reactive protein
- *Neisseria gonorrhoeae* and/or *Chlamydia trachomatis* test positive
- An adnexal mass on abdominal palpation/bimanual examination or seen by imaging (TOA only).

Other indicators of systemic sepsis (tachycardia, hypotension, increased respiratory rate, raised lactate) may be present in severe cases. Fever and diarrhoea are more common in women with TOA than in women with PID (90% versus 60%, respectively).[11] Demirtas et al.[16] studied 52 women with PID: all those with a TOA had white cell count of more than 10.0 x 10^9/l and 90% had a white cell count greater than 15.0 x 10^9/l. High C-reactive protein associated with clinical signs is the most sensitive predictor of a TOA.[17] Chan et al.[7] also showed that those with a TOA had a higher white cell count on admission and a higher erythrocyte sedimentation rate than those with PID without TOA; this might raise the suspicion of a TOA. The absence of a raised white cell count or pyrexia does not exclude TOA. A serum lactate and blood cultures are essential if the woman is systemically unwell (pyrexia, tachycardia, increased respiratory rate). A screen for sexually transmitted disease such as *N. gonorrhea* and *C. trachomatis* is important, although in the UK may only be positive in one-quarter of cases.[18] Immunodeficiency, for example, HIV, should also be considered. A pregnancy test should be performed in women of reproductive age.

It can be difficult to diagnose a TOA. Differential diagnoses include an appendicular mass, an endometrioma (or other ovarian cyst), an extrauterine pregnancy, diverticulitis or underlying malignancy. Adjacent structures such as the omentum and bowel can sometimes contain the inflammatory process within the pelvis.[2] A TOA is characterised by clinical findings and radiological abnormality. It is not necessary to perform a laparoscopy on all women with suspected PID. A laparoscopy may be non-specific/inconclusive (endometritis or salpingitis display subtle signs only at laparoscopy). If the woman is clinically stable, she will usually respond to antibiotics. Women with PID are often treated in the primary care setting and careful clinical evaluation and treatment may prevent hospital admission.

Imaging

Ultrasound

A TOA can be diagnosed by ultrasound, appearing as a complex solid/cystic mass. This can be unilateral or bilateral. A pyosalpinx may be seen as an elongated, dilated, fluid-filled mass with partial septae and thick walls. Incomplete septae within the tubes is a sensitive sign of tubal inflammation or

an abscess.[18] There may be a 'cogwheel' sign resulting from thickened endosalpingeal folds (Figure 1).[19] This cogwheel sign is a sensitive marker of a TOA; indeed, Timor-Tritsch et al.[20] believe that this sign is pathognomonic of acute tubal inflammation. The inflamed ovary can acquire a reactive polycystic appearance (because of oedema), and eventually become adherent to the tube. This is termed a tubo-ovarian complex (Figure 2). This complex usually lies in the pouch of Douglas POD compared with ovarian tumours which are often located anterior and superior to the uterus.[19] There may be complex free fluid in the pouch of Douglas, often with an echogenic appearance.[2] The uterus can appear enlarged with ill-defined margins and endometrium.

Other imaging

Further imaging may need to be considered if ultrasound is inconclusive or symptoms suggest other pathology such as appendicitis. A complex adnexal mass without pyrexia could represent an ovarian malignancy and should be considered.

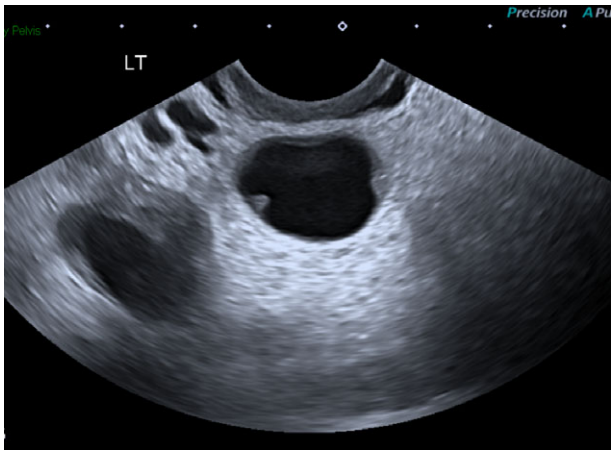

Figure 1. Cogwheel sign resulting from thickened endosalpingeal folds.

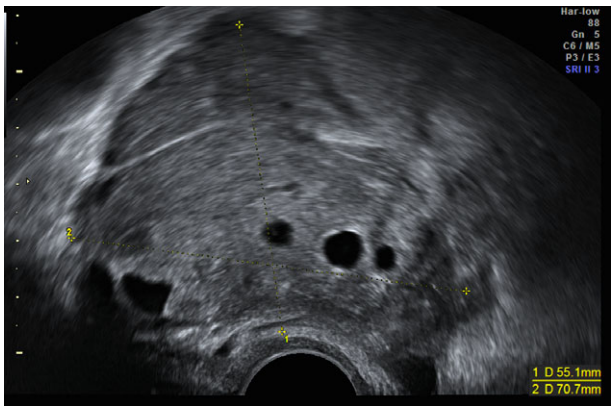

Figure 2. Tubo-ovarian complex.

Computed tomography (CT) imaging is useful when there is a suspicion of gastrointestinal pathology such as an appendix mass.[2] When a TOA is present, a common finding on CT is a thick-walled, fluid-dense mass in the adnexa(e), often with internal septations. There may be anterior displacement of the thickened mesosalpinx.[21] Internal gas bubbles are usually specific for bowel-associated abscesses on CT and this sign is unusual with a TOA.[22] There may also be rectosigmoid involvement. This is a result of the posterior spread of inflammation (and consequent fibrosis) from the nearby TOA. Pararectal fat may be infiltrated.[22] The ureter is the other most commonly involved structure and there may be associated hydroureter/hydronephrosis.[21] These findings highlight why surgery for TOAs can be complex and carry increased surgical risks**.** In a study of 33 women with a TOA the presence of the ovarian vein entering the adnexal mass on a CT scan had a sensitivity and specificity of 94% and 100%, respectively and was used to successfully differentiate a TOA from a periappendicular abscess.[10] A CT scan with contrast may identify mild thickening of the uterosacral ligaments and peritoneum, as well as haziness of pelvic fat (resulting from the presence of oedema).[22] However, thickened uterosacral ligaments are also not uncommonly noted on imaging in women with endometriosis without TOA.

Magnetic resonance imaging (MRI) has the advantage over CT of being a non-irradiating mode of imaging. A TOA on MRI tends to have a low signal intensity on T1-weighted imaging and a high signal intensity on T2-weighted imaging.[21] MRI has been found to have a higher sensitivity and specificity than ultrasound for the diagnosis of TOA: 95% and 89% compared with 81% and 78%, respectively.[23] However, MRI is a more limited resource and may not be readily available/accessible. Ultrasound should still be considered as the first-line imaging to guide diagnosis and treatment. CT and MRI may help to refine the diagnosis but may cause delays in treatment.

Management

Initial management of the woman with a suspected TOA is dictated by clinical findings and ultrasound. In the presence of systemic sepsis (Table 2), appropriate resuscitation and prompt surgery, with concurrent commencement of broad-spectrum intravenous antibiotics, may be considered. The 'sepsis six' protocol should be followed: administer oxygen, take blood cultures prior to commencing antibiotics, commence intravenous antibiotics, measure serum lactate, commence intravenous fluids and accurately measure urine output.[25] In the event of an acute abdomen where rupture of an abscess is suspected, surgery may be necessary. If the woman is systemically well and/or clinically stable then

Table 2. Sepsis definitions[24]

Systemic inflammatory response syndrome (SIRS)*	Severe sepsis	Septic shock
Temperature >38°C or <36°C Heart rate >90 bpm Respiratory rate >20 or $PaCO_2$ <32 mmHg WCC >12 or <4	SIRS + lactic acidosis or hypotension	Severe sepsis + hypotension (despite adequate fluid resuscitation)

*Two or more.
WCC = white cell count.

Box 1. Possible antibiotic regimens for a tubo-ovarian abscess

IV ofloxacin 400 mg twice-daily plus intravenous (IV) metronidazole 500 mg three times a day
IV clindamycin 900 mg three times a day plus IV gentamicin
IV cefoxitin 2 g three times a day plus IV/PO doxycycline 100 mg twice-daily
IV ciprofloxacin 200 mg twice-daily plus IV/PO doxycycline 100 mg twice-daily plus IV metronidazole 500 mg three times a day

consideration can be given to initial treatment with antibiotic therapy with delayed or possible avoidance of any surgical intervention. Figure 3 shows a flowchart with a suggested approach to the management of a woman with a TOA.

Medical treatment

Medical treatment of a TOA with antibiotics (Box 1) can be effective in up to 70% of patients but is associated with a high recurrence rate.[26] Initially, intravenous broad-spectrum antibiotics that cover the commonest causative pathogens are required. Successful antibiotic therapy is based on the ability to penetrate the abscess cavity, remain active within the abscess environment and be active against the commonest pathogens. Intravenous clindamycin, metronidazole and cefoxitin have higher abscess cavity penetration and have been shown to reduce abscess size.[27] Reed et al.[28] looked at antibiotic regimens in a series of 119 women with a TOA. They demonstrated that extended-spectrum antibiotic coverage, including single-agent broad-spectrum antibiotics such as cefoxitin, in conjunction with doxycycline has efficacy that is equivalent to that of clindamycin-containing regimens. McNeeley et al.[29] reported that treatment with clindamycin, gentamicin and ampicillin was effective in 87.5% of women with a TOA but in those treated with clindamycin and gentamycin alone the efficacy was only 47%. The British Association for Sexual Health and HIV[15] provides guidance on possible antibiotic regimens but additional advice from microbiology can be helpful.

Once clinical improvement is noted and pyrexia has resolved, antibiotics should be changed to an oral preparation and continued for 14 days. Evidence for TOA treatment duration is lacking; however, in the presence of a large abscess or after gynaecological intervention a longer course might be considered depending on the clinical response.

Poor prognostic factors associated with a lack of response to medical treatment include the size of abscess (larger than 5 cm), age (older women above the age of 40 years) higher initial white cell count and smoking.[2,30,31] Larger TOAs, resulting from chronic untreated PID, may lead to a scarred anaerobic environment resistant to antibiotic penetration. Dewitt et al.[32] suggested that an abscess larger than 8 cm requires surgical intervention and is associated with a longer hospital stay and an increase in complications.

In addition to initial antibiotic therapy, it is vital to consider acute care of the woman with a TOA. Careful monitoring of observations with a standardised early warning system chart is mandatory: pulse, blood pressure, temperature, respiratory rate and oxygen saturations. Fluid balance and urine output must be carefully monitored and consideration must be given to a urinary catheter to carefully assess fluid balance. Blood parameters should be checked daily, particularly the white cell count and the C-reactive protein levels. Prophylaxis against venous thromboembolism should be initiated with compression stockings. Low-molecular-weight heparin should be considered if surgery is unlikely to be imminent. The woman should be reviewed at least twice every 24 hours by a senior clinician. A multidisciplinary approach is likely to result in the best outcomes for the woman, liaising with colleagues in anaesthetics, microbiology and radiology. A higher level of care in a high-dependency unit or intensive care unit may be needed if the woman becomes systemically unwell.

Surgical treatment

Early diagnosis and modern broad-spectrum antibiotic therapy has reduced the requirement for complex and occasionally radical surgery for many women. When surgery is required, optimal timing is challenging. Should

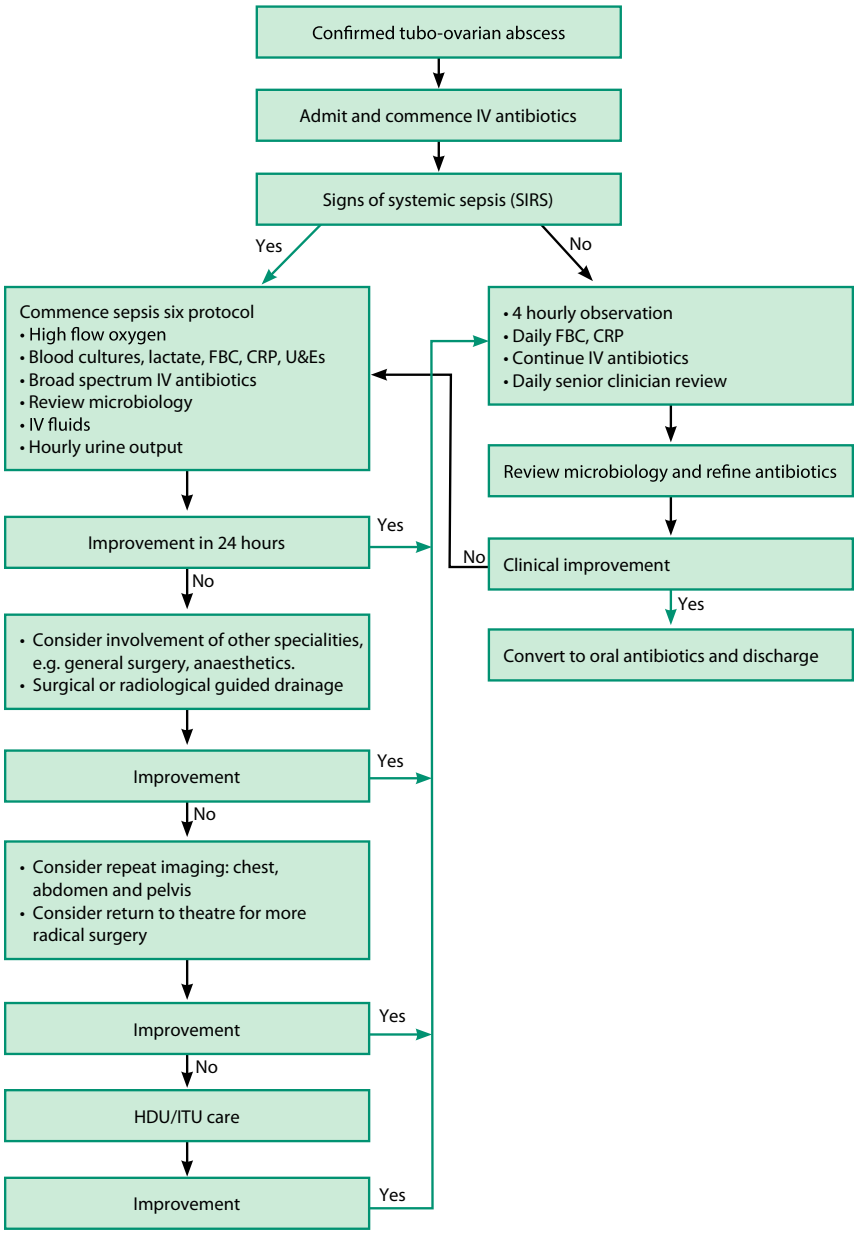

Figure 3. Suggested approach to the management of a woman with a tubo-ovarian abscess. CRP = C-reactive protein; FBC = full blood count; HDU = high-dependency unit; ITU = intensive care unit; IV = intravenous; SIRS = systemic inflammatory response syndrome; U&Es = urea and electrolytes.

surgery be performed promptly to avoid prolonged exposure to pus, which may exaggerate or worsen fibrosis and adhesions? Treatment with antibiotics may be unsuccessful and failure to respond (clinical signs and blood markers) will necessitate surgical intervention or image-guided drainage of the TOA. The optimal duration of antibiotic therapy before deciding to proceed with surgical or image-guided drainage is variable. In clinical practice, consideration is usually given to this after 24 hours (and certainly after 48 hours) of intravenous antibiotics if no improvement in clinical condition is demonstrated. Rapid clinical deterioration may need prompt surgical intervention in up to 25% of women.[33] Surgery for TOAs can be technically difficult; necrotic tissue is difficult to handle as it is fragile, resulting in tissues collapsing and haemorrhaging. There is also often oedema of tissues such as the peritoneum, making visualisation of important structures such as the ureter(s) very challenging. The bowel is commonly found to be adherent to structures in the pelvis when there is a TOA, therefore increasing the risk of visceral injury.

There are various options for the approach to surgical intervention for TOA: laparoscopy or laparotomy with drainage of the abscess, unilateral or bilateral salpingo-oopherectomy or pelvic clearance. There are a number of factors that influence the decision including previous surgical history, fertility wishes and size of the abscess. If the woman is suitable for a laparoscopic procedure and the surgeon has suitable laparoscopic skills then this has the obvious benefits of a quicker recovery time. However, despite the well-known benefits of laparoscopic surgery, a midline laparotomy for a TOA may be the preferred approach for some women (Table 3). Such situations could include previous significant abdominal surgery, a particularly large abscess or a co-existing condition such as inflammatory bowel disease.

Drainage of the pelvic abscess with copious irrigation of the abdominal cavity can be considered if fertility is to be preserved. A large drain should be considered to allow any remaining pus or wash to be expelled. If the woman has completed her family, consideration should be given to salpingo-oophorectomy, thereby reducing the chance of recurrence and the consequent need for potential further surgery. Resection may not be possible and can be associated with increased surgical risk. Unfortunately, removal of the adnexa may still be necessary, even in those women wishing to maintain fertility, depending on the findings at laparoscopy or if a drainage and washout has previously been performed and the woman has failed to improve with this more conservative approach. If conservative surgery is felt to be appropriate in women wishing fertility conservation then this should be considered. Although outcomes from pelvic clearance results are good, there is significant morbidity in terms of surgical risks, infertility and premature menopause.

Henry-Suchet[34] carried out laparoscopic adhesiolysis and drainage of abscess with antibiotic cover. In 90% of women, the approach was successful, with only 10% needing further surgery. Buchweitz et al.[35] compared laparoscopic drainage and adhesiolysis with more radical procedures such as laparoscopic salpingectomy or salpingo-oophorectomy. They found a significantly high incidence of intraoperative and postoperative complications with the radical approach, such as bowel perforation, internal iliac artery lacerations, higher postoperative fever, bowel obstruction and postoperative pelvic pain.

Table 3. Some potential benefits of different approaches to surgery

Laparoscopy	Laparotomy
Quicker recovery	More thorough exploration of the pelvis and loops of bowel (ability to palpate rather than just visualise tissues)
Smaller incisions	Thorough wash out of pelvis and abdomen, with possible reduction in pus remnants
Less postoperative pain	Advanced laparoscopic skills not required

There should be a lower threshold for consideration of surgical intervention in postmenopausal women because of the risk of underlying malignancy. Protopapas et al.[36] showed that the incidence of associated malignancies was 47%; these included cervical, endometrial, ovarian and fallopian tube malignancies. TOAs in postmenopausal women are rare, with an incidence of 1.7% of all TOAs.

Postoperatively, intravenous antibiotics should be continued. A swab of the pus should be taken at all surgical interventions to optimally guide subsequent antibiotic therapy. Pyrexia may persist requiring close discussions with microbiology colleagues and alterations in antibiotic selection. Women may develop an ileus following a midline laparotomy or even after a laparoscopy as a result of the irritation of the pus in the abdominal cavity and perhaps also the prolonged placement of a drain. Furthermore, these women are commonly nauseated and have had reduced or no appetite for some days. Microbiology results must be assessed as contact tracing will be indicated if sexually transmitted infections have been diagnosed in the woman. Indeed, the British Association for Sexual Health and HIV advises offering all partners of women with PID/TOA infection screening to avoid reinfecting the patient.[15] If the woman does not show continued improvement following surgery or if there is sustained fluctuating pyrexia, further imaging may be required to exclude rare complications such as a subphrenic abscess or, more rarely, an intrathoracic abscess.

It may be psychologically challenging for some women who wish to maintain fertility, for whom removal of one or both fallopian tubes or ovaries has been deemed necessary. Even if only a drainage and washout has been performed, the woman needs to be aware of potential difficulties she may face with fertility in the future, which will understandably be distressing for many.

Some women will need to be considered for elective surgery later. This could be because of symptoms such as chronic pain, a persistent adnexal mass or repeated admissions/antibiotic courses for a TOA. The first 6 weeks after an acute episode of a TOA should be avoided as inflammation and tissue quality will be particularly poor at this time.

Ultrasound/CT-guided drainage

Several studies have described image-guided drainage of TOAs. When successful, there is likely to be rapid symptom improvement, resolution of pyrexia and a decreased length of hospital stay. This can be performed via the transabdominal, transvaginal, transrectal or transgluteal route.[37] The success rate is reported between 83% and 100%.[38] Levenson et al.[39] assessed image-guided drainage of 49 women with a TOA with either genitourinary or gastrointestinal origin. TOAs with genitourinary origin were less likely to need surgery and

to resolve with drainage alone (88%). Image-guided drainage is minimally invasive, appears to be well tolerated, offers a reduced length of stay in hospital and avoids the risks associated with surgery and anaesthesia. Casola et al.[40] found that 81% of women with a TOA managed by image-guided drainage avoided surgery because they were treated with percutaneous drainage. TOAs can be drained by ultrasound-guided aspiration or drainage with catheter placement. The transvaginal approach provides a direct route from the vagina into the pouch of Douglas or adnexal regions where TOAs are usually found. Lee et al.[41] compared aspiration with catheter drainage. Small, single abscesses with clear fluid usually needed only aspiration. There were no complications with aspiration alone and a 100% success rate. Catheter placement was needed for larger, bilateral, multiloculated abscesses with thick viscous material. There were minor complications in 10% of catheter placements including bladder pain and infection, with an 80% success rate.[42] Gjelland et al.[43] suggested that transvaginal aspiration with antibiotic cover should be the first line of treatment of TOAs after reporting a high success of 93% (282 out of 302 women) with no major complications. Residual disease or pain necessitated surgery in 6.8% of women.

Special circumstances of TOA

Pregnancy

There are few reported cases of TOAs in pregnancy.[44] TOAs can lead to adverse pregnancy outcomes including miscarriage, preterm labour, chorioamnionitis, fetal or maternal death.[45] Optimal treatment (and surgical approach if needed) in pregnancy depends on the severity of the infection and the gestation of pregnancy. It is also important to consider in a pregnant woman with a suspected TOA that an appendix abscess is much more common. MRI is safe in pregnancy and could help to establish the correct diagnosis. Early delivery of the baby or risking a potential miscarriage (by performing surgery in pregnancy) may be necessary to benefit or even save the life of the mother.

Intrauterine devices

Intrauterine devices are considered to be associated with TOAs.[21] Removal of an intrauterine device or intrauterine system should be considered as it may be associated with better short-term clinical outcomes.[46] The decision to remove the intrauterine device needs to be balanced against the risk of pregnancy in those who have had intercourse in the preceding five days. Hormonal emergency contraception may be appropriate for some women in this situation.

There is a relationship with intrauterine devices and *Actinomyces*. Tubo-ovarian actinomycosis is a chronic suppurative condition with *Actinomyces israelii* often forming multiple abscesses, granulation tissue and fibrosis.[21] On imaging, it frequently has a predominantly solid appearance with prominent contrast enhancement in the solid portion. On MRI there is often direct inflammatory extension by solid and linear lesions.[21] *Actinomyces* tends to respond well to penicillin.

Long-term complications

Complications of TOAs arise from tissue damage, scarring, adhesions and fistulae.

Chronic pelvic pain

Chronic pelvic pain is a potential long-term complication in around one-third of women with TOAs and is related to severity and number of episodes.[2] The incidence of chronic pelvic pain has been shown to be 12% after one episode, 30% after two episodes and 67% after three or more episodes of PID or TOA.[20] Crespo et al.[46] showed that there were no statistical differences observed between those treated with antibiotics and those managed surgically in terms of chronic pelvic pain.

Subfertility

Subfertility is a potential long-term complication of TOA. Rosen et al.[1] showed that 32–63% of women achieved a pregnancy following laparoscopy and drainage of abscess versus 4–15% in women treated with antibiotics alone. Laparoscopy and drainage of abscesses should be considered for all women with TOAs who desire future fertility. In women presenting with subfertility who have a history of TOAs, consideration should be given to assessment of fallopian tubes. Women with persistent hydrosalpinges and subfertility may be offered occlusion of their fallopian tubes or bilateral salpingectomies in an attempt to optimise outcomes with in vitro fertilisation. This should be undertaken in liaison with the fertility team.

Conclusion

TOAs are a serious complication of PID. In women with suspected PID, there should be a low threshold for commencing treatment promptly in an attempt to avoid progression to a TOA and its potential long-term consequences including subfertility. Women with TOAs can develop severe sepsis and must be resuscitated promptly and effectively, including immediate commencement of antibiotics, be monitored and reviewed regularly and have senior clinicians involved in their care from the outset, with a multidisciplinary approach including high-dependency unit/intensive care unit support where indicated. In those failing to respond to antibiotics, surgical intervention may be

indicated. Surgery can be challenging and the optimal timing and approach is unclear.

Disclosure of interests
There are no conflicts of interest.

Author contributions
SN, AG and KM reviewed the literature, drafted the abstract and the manuscript. CM reviewed the manuscript and provided comments. All authors approved the final version before publication.

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Supporting Information

Additional supporting information may be found in the online version of this article at http://wileyonlinelibrary.com/journal/tog

Infographic S1: Diagnosis and management of tubo-ovarian abscesses.

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