Clinical factors and surgical decision-making when managing premenopausal women with adnexal torsion

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Abstract
Purpose The primary objective of this study is to identify if and which clinical factors may influence surgical decision-making when managing premenopausal women who present emergently with adnexal torsion (AT).

Methods This retrospective cohort study was conducted at a single tertiary hospital. Medical records for all admissions for AT between 1 January 2010 and 30 June 2020 were reviewed and data regarding patient demographics, history of torsion, and the index admission were collected. Conservative surgery was defined as detorsion only or detorsion with cyst decompression. Interventional surgery was defined as ovarian cystectomy, salpingectomy, oophorectomy or salpingo-oophorectomy.

Results 126 women were included for final analysis. Of the 109 women diagnosed with AT at emergency surgery, 12 were postmenopausal (all had interventional surgery). In the 97 premenopausal women, 50 (52%) underwent conservative surgery. Pregnant women were more likely to undergo conservative surgery than non-pregnant women (Relative Risk [RR] 0.20, 95% confidence interval [CI] 0.5, 0.75, \( p = 0.001 \)). Women having laparoscopies were also more likely to undergo conservative surgery (RR 0.08, 95% CI 0.01, 0.53, \( p = 0.001 \)) than if they had laparotomies. Although not reaching statistical significance, women were more likely to undergo laparotomy if they were febrile or if a senior gynecology consultant was involved in their care. History of torsion, age, parity and ovarian size did not alter the risk of interventional surgery.

Conclusion This study identified that premenopausal women who presented emergently with AT were significantly more likely to have conservative surgery if they were pregnant or if they underwent laparoscopic surgery.

Keywords Ovarian torsion · Conservative surgery · Emergency surgery · Fertility · Detorsion · Ovarian sparing

Introduction

Adnexal torsion (AT) is the fifth most common surgical emergency in women accounting for 2.7% of gynecologic surgeries [1]. It should therefore be considered in all women presenting with acute abdomino-pelvic pain due to the potential implications on fertility and hormonal function. It is estimated that the incidence of AT is 5.9 per 100,000 women with the majority being diagnosed in pre-menopausal women [2]; however this number may actually be higher as some cases may undergo spontaneous detorsion prior to surgical diagnosis. Currently there are no recommended guidelines for the management of AT in adults; however, in 2019, the American College of Obstetricians and Gynecologists (ACOG) published an opinion statement for adolescent patients. This advises detorsion, with cyst decompression only if a large cyst is easily identifiable, to preserve the adnexal structures and fertility [3]. It also recommends a progress pelvic ultrasound at least 6 weeks post-operatively to re-evaluate any cysts. This statement is in line with research, including Way’s landmark paper, proving that conservative management of AT is safe [4–9] and has slowly shifted practice towards ovarian-conserving surgery instead of traditional salpingo-oophorectomy for women of child-bearing age. Despite this shift, Mendelbaum found that oophorectomy rates for young women and girls with AT...
were still as high as 74.9% in some institutions in the United States of America in 2015 [10].

The primary objective of this study is to identify which, if any, factors influence surgical decision-making when managing premenopausal women who present emergently with AT. The secondary objective is to assess if there are any differences between cases of AT who are diagnosed at emergency surgery compared to those found incidentally at elective surgery. By better understanding how clinicians manage AT in premenopausal women, the ultimate goal of this study is to encourage relevant governing organizations to publish guidelines or recommendations promoting conservative surgical management of AT in this cohort to preserve fertility and hormonal function.

Materials and methods

This retrospective cohort study was conducted at a single tertiary hospital. The hospital Clinical Analytics department identified all admissions between 1 January 2010 and 30 June 2020 with diagnosis code N83.5 torsion of ovary, ovarian pedicle and fallopian tube. Paper and electronic medical records for these patients were reviewed and data regarding patient demographics, history of AT, and the index admission were collected. Women were included if AT was confirmed at the time of surgery. Exclusion criteria were women who did not undergo surgery during the index admission, were found not to have AT at surgery, had missing or incomplete medical records, or were not managed at our hospital. Ethics approval was given by the Western Sydney Local Health District Human Research Ethics Committee (2010–13 QA).

Emergency surgery cases are defined as women who presented to the emergency department (ED) with acute symptoms and underwent emergency surgery during the same admission, at which time AT was confirmed or diagnosed. Elective surgery cases are defined as women who presented to hospital on their planned surgery date, usually for suspected gynecology pathology, during whose operation AT was incidentally found. In line with the ACOG statement [3], conservative surgery is defined as detorsion only or detorsion with cyst decompression. Interventional surgery is defined as ovarian cystectomy, salpingectomy, oophorectomy or salpingo-oophorectomy. It is standard practice that all women who undergo any emergency gynecology surgery at the study hospital are given a follow-up outpatient gynecology clinic appointment 6 weeks post-operatively.

The hospital in which the study took place is a teaching hospital for obstetrics and gynecology. Consultant gynecologists are involved in all decision-making with regards to taking the patients for surgery, as well as what operation the patients undergo. Junior consultants are defined as gynecologists who have been consultants for 5 years or fewer, whereas senior consultants are defined as gynecologists who have been consultants for more than 5 years. In-hours surgery is defined as surgery occurring between 0800 and 1700 h from Monday to Friday, excepting public holidays. Out-of-hours surgery is defined as surgery occurring between 1701 and 0759 h from Monday to Friday, as well as weekends and public holidays. This distinction is made because staffing levels on gynecology, anesthesiology, and operating theatre nursing teams are different in- versus out-of-hours.

Continuous variables were assessed for normality and equality of variance and were compared with a t-test. The binary risks were assessed with a χ2 test using a Fishers exact test when appropriate. Statistical analysis was performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

A total of 150 women were identified for the study, where one was discharged home without surgery, 13 did not have adnexal torsion identified at the time of surgery, and 10 had missing medical records. 126 women were included for final analysis.

Management of AT at emergency surgery

Of the 109 women diagnosed with AT at emergency surgery, 12 were postmenopausal and underwent interventional surgery (11 oophorectomy and 1 cystectomy). In the 97 premenopausal women, 50 (52%) underwent conservative surgery. The median age of women managed conservatively was 29.1 years (Interquartile range [IQR] 26.8, 31.4 years) compared to 28.9 years (IQR 25.9, 31.9 years) for those who had interventional surgery (p=0.91). Women who were pregnant were more likely to undergo conservative surgery than their non-pregnant counterparts (Relative Risk [RR] 0.20, 95% CI 0.5, 0.75, p=0.001) (Table 1). Women who had laparoscopies were also more likely to undergo conservative surgery (RR 0.08, 95%CI 0.01, 0.53, p=0.001) than those who had laparotomies. There were no other statistically significant differences between women who had conservative versus interventional surgery for their AT, including age, parity, history of AT, history of abdomino-pelvic surgery, median maximum ovarian diameter (MOD), being febrile, timing of surgery, and seniority of the gynecology consultant involved.

While not reaching statistical significance, patients were more likely to undergo laparotomy if a senior consultant was involved in their management (RR 1.29, p=0.06), and if they were febrile at presentation (RR 0.62, p=0.07) (Table 2). There were no other statistically significant
differences between women who had laparoscopic versus laparotomy surgery for their AT including age, parity, history of AT, history of abdomino-pelvic surgery, current pregnancy status, MOD, and timing of surgery.

Among the women who had conservative surgery, two had second emergency presentations for AT on the ipsilateral side where one underwent another detorsion 8 weeks after the index surgery, and the other had an oophorectomy 2 days later. Both women had different management teams between their first and second surgeries as different gynecology emergency teams were on-shift each time. Only four women followed-up with our hospital’s outpatient gynecology clinic service and all proceeded to elective surgeries, including three cystectomies for adnexal

| Table 1 Patient, presentation and surgical factors and the relative risk for interventional (n = 49) vs conservative (n = 48) surgery at the time of emergency surgery to manage adnexal torsion in premenopausal women |
|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------|-----------------|
| Patient, presentation and surgical factors                                              | Interventional surgerya | Conservative surgery | RR (95% CI)     | p value |
| Age ≥ 40 years                                                                              | Yes (N = 13)                                      | 9 (69%)                                      | 4 (31%)         | 1.49 (0.97, 2.29) | 0.15c |
|                                                | No (N = 84)                                       | 39 (46%)                                      | 45 (54%)        |                  |       |
|                                                | < 20 years                                        | 12 (60%)                                      | 8 (40%)         |                  |       |
|                                                | 20–29 years                                       | 13 (39%)                                      | 20 (61%)        |                  |       |
|                                                | 30–39 years                                       | 14 (45%)                                      | 17 (55%)        |                  |       |
| Nulliparous                                   | Yes (N = 48)                                      | 26 (54%)                                      | 22 (46%)        | 1.19 (0.79, 1.79) | 0.41  |
|                                                | No (N = 46)                                       | 21 (46%)                                      | 25 (54%)        |                  |       |
| Previous torsion                              | Yes (N = 4)                                       | 1 (25%)                                       | 3 (75%)         | 0.49 (0.09, 2.73) | 0.62c |
|                                                | No (N = 93)                                       | 47 (51%)                                      | 46 (49%)        |                  |       |
| Past abdominopelvic surgery                   | Yes (N = 30)                                      | 12 (40%)                                      | 18 (60%)        | 0.74 (0.46, 1.22) | 0.21  |
|                                                | No (N = 67)                                       | 36 (54%)                                      | 31 (46%)        |                  |       |
| Pregnantb                                      | Yes (N = 17)                                      | 2 (12%)                                       | 15 (88%)        | 0.20 (0.05, 0.75) | 0.001 |
|                                                | No (N = 79)                                       | 46 (58%)                                      | 33 (42%)        |                  |       |
| MOD ≥ 50 mm                                   | Yes (N = 53)                                      | 29 (55%)                                      | 24 (45%)        | 1.32 (0.61, 2.87) | 0.48c |
|                                                | No (N = 5)                                        | 2 (40%)                                       | 3 (60%)         |                  |       |
| MOD ≥ 100 mm                                  | Yes (N = 23)                                      | 14 (61%)                                      | 9 (39%)         | 1.31 (0.72, 2.40) |       |
|                                                | No (N = 35)                                       | 17 (49%)                                      |                |                  |       |
| Febrile                                       | Yes (N = 8)                                       | 5 (63%)                                       | 3 (38%)         | 1.28 (0.72, 2.28) | 0.71c |
|                                                | No (N = 88)                                       | 43 (49%)                                      | 45 (51%)        |                  |       |
| Laparoscopy                                   | Yes (N = 76)                                      | 29 (38%)                                      | 47 (62%)        | 0.08 (0.01, 0.53) | 0.001c |
|                                                | No (N = 21)                                       | 20 (95%)                                      | 1 (5%)          |                  |       |
| In-hours surgery                              | Yes (N = 48)                                      | 24 (50%)                                      | 24 (50%)        | 0.96 (0.65, 1.42) | 0.84  |
|                                                | No (N = 50)                                       | 26 (52%)                                      | 24 (48%)        |                  |       |
| Junior consultant                             | Yes (N = 19)                                      | 11 (58%)                                      | 8 (42%)         | 1.17 (0.75, 1.83) | 0.50  |
|                                                | No (N = 79)                                       | 39 (49%)                                      | 40 (51%)        |                  |       |

RR relative risk, 95% CI 95% confidence interval, MOD mean ovarian diameter on pelvic ultrasound or computer tomography scan

aInterventional surgery includes salpingectomy, salpingo-oophorectomy, oophorectomy and cystectomy. Conservative surgery includes detorsion only and detorsion with cyst decompression

bPregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage

cFishers p value
masses after 2, 4 and 5 months, and one oopheropexy after 6 months. In all cases who proceeded to cystectomy, follow-up pelvic ultrasound scans had found masses in the ovary that had AT—the timing of their second surgeries were based on elective surgery list availability. The woman who had the oopheropexy had a history of recurrent AT and had already had a unilateral oophorectomy (for torsion) prior to torsion occurring in the remnant ovary. This woman was premenopausal, hence the decision for an oopheropexy to try to preserve ovarian hormonal function.

### Presentations of AT

The 109 women who had AT diagnosed at emergency surgery all presented through the emergency department. In addition, 17 women had AT incidentally diagnosed at the time of elective surgery (Table 3). Women who had torsion diagnosed at emergency surgery were younger at 32.4 years (IQR 29.8, 35.0 years) versus 39.5 years (IQR 31.9, 47.1 years, \( p = 0.05 \)). Emergency cases were also significantly more likely to have nausea/vomiting (RR 1.15, 95% CI 1.0, 1.3).

#### Table 2: Patient, presentation and surgical factors and the relative risk for laparotomy (\( n = 21 \)) vs laparoscopic (\( n = 76 \)) surgery at the time of emergency surgery to manage adnexal torsion in premenopausal women

| Factor                                | Laparotomy | Laparoscopy | RR (95% CI) | \( p \) value |
|---------------------------------------|------------|-------------|-------------|---------------|
| **Age ≥ 40 years**                    |            |             |             |               |
| Yes (\( N = 13 \))                    | 2 (15%)    | 11 (85%)    | 1.09 (0.84, 1.42) | 0.15\(^b\)  |
| No (\( N = 84 \))                     | 19 (23%)   | 65 (77%)    |             |               |
| **< 20 years**                        |            |             |             |               |
| Yes (\( N = 42 \))                    | 4 (20%)    | 16 (80%)    |             |               |
| No (\( N = 27 \))                     | 7 (21%)    | 26 (79%)    |             |               |
| **20–29 years**                       |            |             |             |               |
| Yes (\( N = 18 \))                    | 3 (17%)    | 15 (83%)    |             |               |
| No (\( N = 58 \))                     | 8 (26%)    | 23 (74%)    |             |               |
| **Nulliparous**                       |            |             |             |               |
| Yes (\( N = 48 \))                    | 9 (19%)    | 39 (81%)    | 1.10 (0.84, 1.42) | 0.39         |
| No (\( N = 46 \))                     | 12 (26%)   | 34 (74%)    |             |               |
| **Previous torsion**                  |            |             |             |               |
| Yes (\( N = 4 \))                     | 1 (25%)    | 3 (75%)     | 0.96 (0.54, 1.7) | 1.0\(^c\)  |
| No (\( N = 93 \))                     | 20 (22%)   | 73 (78%)    |             |               |
| **Past abdominopelvic surgery**       |            |             |             |               |
| Yes (\( N = 30 \))                    | 7 (23%)    | 23 (77%)    | 0.97 (0.77, 1.22) | 0.79         |
| No (\( N = 67 \))                     | 14 (21%)   | 53 (79%)    |             |               |
| **Pregnant**                          |            |             |             |               |
| Yes (\( N = 17 \))                    | 3 (18%)    | 14 (82%)    | 1.07 (0.83, 1.37) | 0.76\(^b\)  |
| No (\( N = 79 \))                     | 18 (23%)   | 61 (77%)    |             |               |
| **MOD ≥ 50 mm**                       |            |             |             |               |
| Yes (\( N = 51 \))                    | 16 (31%)   | 35 (69%)    | 0.26 (0.02, 3.84) | 0.33\(^b\)  |
| No (\( N = 5 \))                      | 0 (0%)     | 5 (100%)    |             |               |
| **MOD ≥ 100 mm**                      |            |             |             |               |
| Yes (\( N = 23 \))                    | 9 (39%)    | 14 (61%)    | 0.54 (0.24, 1.25) | 0.15         |
| No (\( N = 33 \))                     | 7 (21%)    | 26 (79%)    |             |               |
| **Febrile**                           |            |             |             |               |
| Yes (\( N = 8 \))                     | 4 (50%)    | 4 (50%)     | 0.62 (0.31, 1.25) | 0.07\(^b\)  |
| No (\( N = 88 \))                     | 17 (19%)   | 71 (81%)    |             |               |
| **In-hours surgery**                  |            |             |             |               |
| Yes (\( N = 48 \))                    | 12 (25%)   | 36 (75%)    | 0.94 (0.76, 1.16) | 0.55         |
| No (\( N = 50 \))                     | 10 (20%)   | 40 (80%)    |             |               |
| **Junior consultant**                 |            |             |             |               |
| Yes (\( N = 19 \))                    | 1 (5%)     | 18 (95%)    | 1.29 (1.09, 1.53) | 0.06\(^b\)  |
| No (\( N = 79 \))                     | 21 (27%)   | 58 (73%)    |             |               |

\(^a\)Pregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage
\(^b\)Fishers \( p \) value

\( RR \) relative risk, 95% CI 95% confidence interval, \( MOD \) mean ovarian diameter on pelvic ultrasound or computer tomography scan
in terms of imaging, 98 (88%) of our emergency AT cases had any imaging (ultrasound [US] or computed tomography [CT]) pre-operatively. Of them, 80 had doppler flows reported of whom 28 (35%) had normal flows.

**Discussion**

This study suggests that mode of surgery and pregnancy status are the biggest factors in determining how premenopausal women with AT are managed at the time of emergency presentation. Pregnant women and women having

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**Table 3** Patient and presentation factors and the relative risk of having adnexal torsion diagnosed at the time of emergency (n=109) vs planned surgery (n=17)

| Factor                        | Emergency surgery | Planned surgery | RR (95% CI) | p value |
|-------------------------------|-------------------|-----------------|-------------|---------|
| Age ≥ 40 years                |                   |                 |             |         |
| Yes (N=31)                    | 24 (77%)          | 7 (23%)         | 0.87 (0.71, 1.06) | 0.13b   |
| No (N=95)                     | 85 (89%)          | 10 (11%)        |             |         |
| Nulliparous                   |                   |                 |             |         |
| Yes (N=54)                    | 49 (91%)          | 5 (9%)          | 0.94 (0.82, 1.07) | 0.34    |
| No (N=67)                     | 57 (85%)          | 10 (15%)        |             |         |
| Previous torsion              |                   |                 |             |         |
| Yes (N=4)                     | 4 (100%)          | 0               | 1.0b        |         |
| No (N=122)                    | 105 (86%)         | 17 (14%)        |             |         |
| Past abdominopelvic surgery   |                   |                 |             |         |
| Yes (N=43)                    | 37 (86%)          | 6 (14%)         | 0.99 (0.86, 1.15) | 0.91    |
| No (N=83)                     | 72 (87%)          | 11 (13%)        |             |         |
| Postmenopausal                |                   |                 |             |         |
| Yes (N=14)                    | 11 (79%)          | 3 (21%)         | 0.90 (0.68, 1.19) | 0.40b   |
| No (N=112)                    | 98 (88%)          | 14 (13%)        |             |         |
| Pregnant*a                    |                   |                 |             |         |
| Yes (N=18)                    | 17 (94%)          | 1 (6%)          | 1.08 (0.94, 1.23) | 0.69b   |
| No (N=104)                    | 91 (88%)          | 13 (13%)        |             |         |
| Undergoing ART                |                   |                 |             |         |
| Yes (N=4)                     | 4 (100%)          | 0               | 1.0b        |         |
| No (N=122)                    | 108 (88%)         | 14 (12%)        |             |         |
| Abdominal pain                |                   |                 |             |         |
| Yes (118)                     | 107 (91%)         | 11 (9%)         | 2.72 (0.55, 13.5) | 0.03    |
| No (3)                        | 1 (33%)           | 2 (67%)         |             |         |
| Nausea/vomiting               |                   |                 |             |         |
| Yes (78)                      | 74 (95%)          | 4 (5%)          | 1.15 (0.99, 1.34) | 0.043   |
| No (40)                       | 33 (83%)          | 7 (17%)         |             |         |
| Fever                         |                   |                 |             |         |
| Yes (8)                       | 8 (100%)          | 0 (0%)          | 1.11 (1.04, 1.18) | 1.0     |
| No (110)                      | 99 (90%)          | 11 (10%)        |             |         |
| MOD ≥ 100 mm                  |                   |                 |             |         |
| Yes (N=26)                    | 20 (77%)          | 6 (23%)         | 0.83 (0.66, 1.04) | 0.14b   |
| No (N=40)                     | 37 (93%)          | 3 (8%)          |             |         |

*RR relative risk, 95% CI 95% confidence interval, ART assisted reproductive technologies, MOD mean ovarian diameter on pelvic ultrasound or computer tomography scan*

*aPregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage

*bFishers p value

$p = 0.043$ and abdominal pain warranting emergency presentation (RR 2.72, $p = 0.03$). The MOD was smaller for emergency diagnoses at 81 mm (IQR 65, 108 mm) versus 111 mm (IQR 87, 160 mm) although this did not reach statistical significance ($p = 0.08$). For histopathology, there was one Brenner tumour, one mucinous borderline tumour and one serous borderline tumor (Table 4). All other specimens removed were benign. Of note, ten of the specimens removed from premenopausal women at emergency surgery were normal pathology, i.e., functional cysts or normal but torted ovaries.
In our study, 52% of premenopausal women were conservatively managed at the time of emergency surgery for AT which is comparable to published rates of 20.6–65.4% [6, 10–15]. This is despite a difference in the definition of “conservative surgery”. If cystectomies were included in conservative surgery to be consistent with the published literature, our rate would increase to 72%. While cystectomy is ovarian-preserving surgery, it is still traumatic in that tissue planes are more difficult to differentiate within edematous ovarian tissue. This could potentially reduce the number of follicles or even lead to oophorectomy if hemostasis cannot be achieved, thereby affecting fertility and ovarian function. There is evidence that cystectomy at detorsion does impair ovarian function [6] and even stronger evidence for good ovarian recovery and function in almost all conservatively managed AT cases based on ultrasound findings post-operatively [8, 9, 16–19]. Some practitioners may argue that performing the cystectomy at the time of the AT surgery is beneficial as it avoids a second surgery to manage the adnexal mass—in our cohort, three women went on to have cystectomies for persistent ovarian masses in the ipsilateral ovary during their follow-up for the AT. ACOG recommends that a progress pelvic US is performed 6 weeks post-surgery to look for persistent ovarian masses [3] and this would also be recommended by the authors. Waiting until after the follow-up ultrasound allows any oedema from the torsion to resolve meaning that in the subsequent cystectomy the cyst planes will be easier to find and overall the surgery should be easier and less traumatic to perform. Waiting also gives an opportunity for some cysts to resolve spontaneously. As shown in our cohort and by Oelsner and Moro, there is the potential that the cyst excised is simply a functional cyst and that the ovarian trauma inflicted was therefore unnecessary [8, 15].

Our rate of conservative surgery for the decade of 2010–2020 is higher than the 30.8% rate reported in an Australian tertiary hospital from 1990 to 2000 [19], and the 20.6% reported in the United States also for 1990–2000 [14]. This may reflect the trend that Mandelbaum showed in the United States where the rate of conservative surgery significantly increased from 18.9% in 2001 to 25.1% in 2015 [10]. However, that study also noted that rates varied between areas and sizes of hospitals [10] further emphasizing that care for AT is not standardized.

We hypothesized that conservative surgery would be preferred in younger, nulliparous/low-parity patients to preserve fertility and hormonal health. We also hypothesized that larger ovarian masses would be more likely to have interventional surgery due to technical reasons. Surprisingly, factors such as parity, age and MOD were not shown to be statistically significantly different between the patients managed with conservative versus interventional surgery, or whether they had a laparoscopy or laparotomy. Only Ogburn’s paper attempted to identify differences between patients managed conservatively with those managed with salpingo-oophorectomy and it too found no difference in age or ovarian size [14]. Our study did show, however, that pregnancy and mode of surgery were statistically significant factors in deciding between conservative vs interventional surgery, with pregnant women and women having laparoscopy being more likely to have conservative surgery. This may stem from a desire to minimize ovarian handling and trauma to
the pregnancy. Laparotomy was associated with a higher likelihood of interventional surgery and our study goes on to show that laparotomy was more likely to occur where there was a senior gynecology consultant involved in the patient’s care. Flin noted in 2007 that “experienced surgeons may rely more on intuitive, pattern matching techniques” [20]. It is possible that the senior consultants may have operated along these lines on two fronts. Firstly, they may have trained when ovarian-sparing surgery and laparoscopic techniques were not yet as widely adopted. Secondly, they may have been more likely to perform oophorectomies if the color of the ovary looked like and the patient’s symptoms. This would be consistent with another study that identified that surgeons preferred to perform oophorectomies if the color of the adnexa was still blue-black at 10 min after detorsion [12]. However, as previously mentioned, there is strong evidence for good recovery of ovarian function despite how they may appear at the time of surgery. There is also evidence for laparotomy over laparotomy in general, including but not limited to shorter operating time, fewer post-operative complications, and shorter lengths of stay [6, 21].

As yet there are no diagnostic clinical or imaging criteria for AT. The most common symptoms of AT are sudden-onset abdominal pain that is intermittent, non-radiating, and associated with nausea and vomiting [4, 16, 19]. In our study, women had AT diagnosed in two settings—one group presented to the ED with acute symptoms such as pain, nausea and vomiting, requiring urgent management, whilst the other group had pain but not severe enough to need ED presentation and could therefore wait for their elective surgery dates. This is consistent with Way’s description that there are two different types of presentations for AT with two correspondingly different surgical findings, including “loosely twisted” pedicles that did not obstruct any of the ovarian vessels and therefore only had vague lower abdominal symptoms, and the “typical twisted ovarian” where “infarction was always seen” which presented as emergency cases with severe colicky pain [4]. It was not within the scope of this study to explore false positive cases.

Of the women in our cohort who had any pre-operative imaging with doppler flows, 35% had normal flows which is similar to published pre-operative diagnostic rates of 36.6–55.8% [5, 15, 22]. Other studies have found that US diagnosis of AT has low sensitivity 70% and specificity 87% [23], where abnormal dopplers only have 61% sensitivity and 98% specificity [22]. Budhram has suggested using MOD on US to help diagnose AT instead of dopplers as there is high sensitivity and specificity where MOD is greater than 5 cm, at 91% and 92%, respectively [22]. However, 9% of our images reported MOD < 5 cm. This is consistent with two other studies that cited 11% [5] and 55% [24] of cases having no ovarian masses on pre-operative imaging. Furthermore, Shalev reported that in cases where the AT was less than 360° at surgery, the mean MOD was 47.5 mm compared to 29.6 mm on the normal contralateral side mean [25].

The main strength of our study is its large cohort especially for a condition with infrequent diagnosis. Our data also cover the most recent decade and therefore provides a useful insight into current practice. In addition, as a single center study at a tertiary institution, the decision-making processes are not confounded by differences in access to resources or local protocols that may be in play across multiple locations.

The retrospective nature of this study is its primary limitation as it is inherently associated with data collection issues and dependent on the quality of documentation. Imaging reporting was not standardized with ovarian size sometimes reported by volume instead of diameter. Older images were not accessible for review. In addition, the potential for misclassification of cases or coding errors may have meant some AT cases were missed potentially leading to selection bias. Incidental findings of AT at elective surgery may not necessarily be documented in a way that can be easily identified through the hospital medical record coding system. Furthermore, the vast majority of patients who underwent conservative surgery did not attend their follow-up appointments with our gynecology service, thereby limiting our outcomes data.

This study identifies that premenopausal women who presented emergently with AT were statistically significantly more likely to have conservative surgery if they were pregnant or had their surgery via laparoscopy. This study also suggests that women were more likely to have a laparotomy if senior gynecology consultants were involved in their care or if they were febrile at presentation. These factors are important to identify so as to understand the decision-making process behind AT management for this cohort. Gynecologists should strongly consider applying the principles of conservative management of AT, as recommended by ACOG for adolescent patients, to premenopausal women presenting with AT emergently given that fertility and hormonal health preservation should be key considerations. Relevant organizations should also consider putting forth a set of consensus opinions or recommendations promoting conservative surgical management of AT to encourage this practice amongst clinicians.

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Declarations

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