Clinical Factors and Surgical Decision-Making when Managing Premenopausal Women with Adnexal Torsion

Albert Vu (albertduclam.vu@health.nsw.gov.au)
Westmead Hospital https://orcid.org/0000-0002-4578-3550
Amy Goh

Research Article

Keywords: Ovarian torsion, Conservative surgery, Emergency surgery, Fertility, Detorsion, Ovarian sparing

Posted Date: March 22nd, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1448035/v1

Version of Record: A version of this preprint was published at Archives of Gynecology and Obstetrics on April 24th, 2022. See the published version at https://doi.org/10.1007/s00404-022-06580-7.

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-oopherectomy.

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.

Introduction

Adnexal torsion (AT) is an uncommon emergency that is predominantly diagnosed in pre-menopausal women. It should therefore be considered in all women presenting with acute abdomino-pelvic pain [1] due to the potential implications on fertility and hormonal function. While some risk factors have been identified, the overall incidence of AT is unknown [2] as some cases spontaneously detort. 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.

Methods And Materials

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 five years or fewer, whereas senior consultants are defined as gynecologists who have been consultants for more than five years. In-hours surgery is defined as surgery occurring between 0800-1700h from Monday to Friday, excepting public holidays. Out-of-hours surgery is defined as surgery occurring between 1701h-0759h 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 chi-square 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 one 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% Confidence Interval [95% CI] 0.5, 0.75, $p = 0.001$) (Table 1). Women who had laparoscopic surgery were also more likely to undergo conservative surgery (RR 0.08, 95%CI 0.01, 0.53, $p = 0.001$). There were no other statistically significant differences between women who had conservative versus interventional surgery for their AT, including age, parity, history of AT and median maximum ovarian diameter (MOD).

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 pre-menopausal women.

	Interventional surgery[a]	**Conservative surgery**	**RR (95% CI)**	***p*-value**
Age ≥ 40 years				
Yes (N = 13)	9 (69%)	4 (31%)	1.49 (0.97, 2.29)	0.15[c]
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)	0.62[c]
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

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

[a]Interventional surgery includes salpingectomy, salpingo-oophorectomy, oophorectomy and cystectomy. Conservative surgery includes detorsion only and detorsion with cyst decompression.

[b]Pregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage

[c] Fischers p-value

	Interventional surgery[a]	Conservative surgery	RR (95% CI)	*p*-value
No (N = 67)	36 (54%)	31 (46%)		
Pregnant[b]				
Yes (N = 17)	2 (12%)	15 (88%)	0.20 (0.05, 0.75)	0.001
No (N = 79)	46 (58%)	33 (42%)		
MOD ≥ 50mm				
Yes (N = 53)	29 (55%)	24 (45%)	1.32 (0.61, 2.87)	0.48[c]
No (N = 5)	2 (40%)	3 (60%)		
MOD ≥ 100mm				
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)	0.71[c]
No (N = 88)	43 (49%)	45 (51%)		
Laparoscopy				

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

[a]Interventional surgery includes salpingectomy, salpingo-oophorectomy, oophorectomy and cystectomy. Conservative surgery includes detorsion only and detorsion with cyst decompression.

[b]Pregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage

[c] Fischers p-value

	Interventional surgery[a]	Conservative surgery	RR (95% CI)	*p*-value
Yes (N = 76))	29 (38%)	47 (62%)	0.08 (0.01, 0.53)	0.001[c]
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%)		

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

[a]Interventional surgery includes salpingectomy, salpingo-oophorectomy, oophorectomy and cystectomy. Conservative surgery includes detorsion only and detorsion with cyst decompression.

[b]Pregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage

[c] Fischers p-value

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.

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 pre-menopausal women.

	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	*4 (20%)*	*16 (80%)*		
20–29 years	*7 (21%)*	*26 (79%)*		
30–39 years	*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[a]				
Yes (N = 17)	3 (18%)	14 (82%)	1.07 (0.83, 1.37)	0.76[b]

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

[a]Pregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage

[b] Fischers p-value

	Laparotomy	Laparoscopy	RR (95% CI)	*p*-value
No (N = 79)	18 (23%)	61 (77%)		
MOD ≥ 50mm				
Yes (N = 51)	16 (31%)	35 (69%)	0.26 (0.02, 3.84)	0.33[b]
No (N = 5)	0 (0%)	5 (100%)		
MOD ≥ 100mm				
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%)		

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

[a]Pregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage

[b] Fischers p-value

Among the women who had conservative surgery, two had second emergency presentations for AT on the ipsilateral side where one underwent another detorsion only, and the other had an oophorectomy. Only

four women followed-up with our hospital's outpatient gynecology clinic service and all proceeded to elective surgeries, including three cystectomies and one oopheropexy.

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, $p = 0.043$) and abdominal pain warranting emergency presentation (RR 2.72, $p = 0.03$). The MOD was smaller for emergency diagnoses at 81mm (IQR 65, 108mm) versus 111mm (IQR 87, 160mm) although this did not reach statistical significance ($p = 0.08$).

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).

	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)	0.13[b]
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		1.0[b]
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)	0.40[b]
No (N = 112)	98 (88%)	14 (13%)		
Pregnant[a]				
Yes (N = 18)	17 (94%)	1 (6%)	1.08 (0.94, 1.23)	0.69[b]

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

[a]Pregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage.

[b] Fischers p-value

	Emergency surgery	Planned surgery	RR (95% CI)	*p*-value
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 ≥ 100mm				
Yes (N = 26)	20 (77%)	6 (23%)	0.83 (0.66, 1.04)	0.14b
No (N = 40)	37 (93%)	3 (8%)		

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

[a]Pregnant includes pregnant at time of surgery and within 6 weeks of giving birth or miscarriage.

[b] Fischers p-value

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, 10 of the specimens removed from pre-menopausal women at emergency surgery were normal pathology, i.e. functional cysts or normal but torted ovaries.

Table 4
Histopathology of torted adnexae, from oophorectomy or cystectomy

Histopathology	Planned surgery (N = 17)	Emergency – Postmenopausal (N = 12)	Emergency – Pre-menopausal (N = 97) *(Oopherectomy only)*
Conservative surgery	2	0	49
Tubal/Para-tubal pathology[a]	4	0	3
Functional ovarian cyst/No pathology[b]	1	3	10 *(1)*
Benign tumor[c]	9	5	28 *(11)*
Borderline tumor[d]	1	0	1
Other[e]	0	0	3 *(2)*
No result available	0	4	3 *(1)*

[a]Tubal/Para-tubal pathology includes hydrosalpinx, paratubal cyst, and torted tube

[b]Functional ovarian cyst/No pathology includes corpus luteum, follicular cyst, hemorrhagic cyst, and normal or necrotic ovarian tissue

[c]Benign tumor includes Brenner tumor, dermoid cyst, endometrioma, fibroma, mucinous cystadenoma, simple serous cyst, serous inclusion cyst, seromucinous cystadenoma, serous cystadenoma, and serous cystadenofibroma

[d]Borderline tumor includes mucinous borderline tumor and serous borderline tumor

[3]Other includes para-ovarian cysts and mesothelial inclusion cyst

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 laparoscopy are more likely to have conservative surgery. Our study also suggests that seniority of the consultant gynecologist involved, and being febrile at presentation, influence management decisions.

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, 17–20]. In addition, 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 1990–2000 [20], 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" [21]. 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 oophorectomy based on what 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 minutes 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 laparoscopy over laparotomy in general, including but not limited to shorter operating time, fewer post-operative complications, and shorter lengths of stay [6, 22].

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, 17, 20]. 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.

With regards to imaging, 98 (88%) of our emergency AT cases had any imaging (ultrasound or computed tomography) pre-operatively. Of them, 80 had doppler flows reported of whom 28 (35%) had normal flows, similar to published pre-operative diagnostic rates of 36.6–55.8% [5, 15, 23]. Other studies have found that ultrasound (US) diagnosis of AT has low sensitivity 70% and specificity 87% [24], where abnormal dopplers only have 61% sensitivity and 98% specificity [23]. 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 5cm, at 91% and 92% respectively [23]. However, 9% of our images reported MOD < 5cm. This is consistent with two other studies that cited 11% [5] and 55% [25] 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 47.5mm compared to 29.6mm on the normal contralateral side mean [16].

The main strength of our study is its large cohort especially for a condition with infrequent diagnosis. Our data also covers 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.

Declarations

Author Contribution

A Vu: Project development, data collection, data analysis, manuscript writing/editing

A Goh: Project development, data collection, data analysis, manuscript writing/editing

Funding

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript

Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Ethics approval

Ethics approval was given by the Western Sydney Local Health District Human Research Ethics Committee (2010-13 QA).

References

1. Tarraza HM, Moore RD (1997) Gynecologic causes of the acute abdomen and the acute abdomen in pregnancy. Surg Clin North Am 77(6):1371–1394
2. Laufer MR (2014) In: UpToDate, Post TW (ed) Ovarian and fallopian tube torsion. UpToDate, Waltham, MA
3. Adnexal torsion in adolescents (2019) ACOG Committee Opinion No. 783. American College of Obstetricians and Gynecologists. Obstet Gynecol 134:e56–63
4. Way S (1946) Ovarian Cystectomy of the Twisted Cysts. The Lancet 248(6411):47–48

5. Asfour V, Varma R, Menon P (2015) Clinical risk factors for ovarian torsion. J Obstet Gynaecol 35(7):721–725
6. Cohen S, Wattiez A, Seidman D (2003) Laparoscopy Versus Laparotomy for Detorsion and Sparing of Twisted Ischemic Adnexa. J Soc Laparosc Robotic Surg 7(4):295–299
7. Göçmen A, Karaca M, Sari A (2007) Conservative laparoscopic approach to adnexal torsion. Arch Gynecol Obstet 277(6):535–538
8. Oelsner G, Bider D, Goldenberg M, Admon D, Mashiach S (1993) Long-term follow-up of the twisted ischemic adnexa managed by detorsion. Fertil Steril 60(6):976–979
9. Cohen S, Oelsner G, Seidman D, Admon D, Mashiach S, Goldenberg M (1999) Laparoscopic detorsion allows sparing of the twisted ischemic adnexa. J Am Assoc Gynecol Laparosc 6(2):139–143
10. Mandelbaum R, Smith M, Roman L, Paulson R, Matsuo K (2019) Conservative surgery for ovarian torsion in young women: perioperative complications and national trends. Fertil Steril 112(3):e40
11. Yamashita Y, Sowter M, Ueki M, Gudex G (1999) Adnexal Torsion. The Australian and New Zealand Journal of Obstetrics and Gynaecology 39(2):174–177
12. Wang Y, Deng S (2020) Clinical characteristics, treatment and outcomes of adnexal torsion in pregnant women: a retrospective study.BMC Pregnancy and Childbirth. ; 20(1)
13. Daponte A, Pournaras S, Hadjichristodoulou C, Lialios G, Kallitsaris A, Maniatis A et al (2006) Novel serum inflammatory markers in patients with adnexal mass who had surgery for ovarian torsion. Fertil Steril 85(5):1469–1472
14. Ogburn T, Wurzel J, Espey E, Espey D (2006) Adnexal Torsion: Experience at a Single University Center. Obstet Gynecol Surv 61(2):95–96
15. Moro F, Bolomini G, Sibal M, Vijayaraghavan S, Venkatesh P, Nardelli F et al (2020) Imaging in gynecological disease (20): clinical and ultrasound characteristics of adnexal torsion. Ultrasound in Obstetrics & Gynecology 56(6):934–943
16. Shalev J, Mashiach R, Bar-Hava I, Girtler O, Bar J, Dicker D et al (2001) Subtorsion of the ovary: sonographic features and clinical management. J Ultrasound Med 20(8):849–854
17. Huchon C, Panel P, Kayem G, Schmitz T, Nguyen T, Fauconnier A (2012) Does this woman have adnexal torsion? Hum Reprod 27(8):2359–2364
18. Karayalcin R, Ozcan S, Ozyer S, Var T, Yesilyurt H, Dumanli H et al (2011) Conservative laparoscopic management of adnexal torsion. J Turkish German Gynecol Association 12(1):4–8
19. Ding D, Huang C, Hong M (2017) A review of ovary torsion. Tzu Chi Medical Journal 29(3):143
20. White M, Stella J (2005) Ovarian torsion: 10-year perspective. Emerg Med Australas 17(3):231–237
21. Flin R, Youngson G, Yule S (2007) How do surgeons make intraoperative decisions? Qual Saf Health Care 16(3):235–239
22. Balci O, Icen M, Mahmoud A, Capar M, Colakoglu M (2010) Management and outcomes of adnexal torsion: a 5-year experience. Arch Gynecol Obstet 284(3):643–646

23. Budhram G, Elia T, Dan J, Schroeder M, Safain G, Schlech W et al (2018) A Case–Control Study of Sonographic Maximum Ovarian Diameter as a Predictor of Ovarian Torsion in Emergency Department Females With Pelvic Pain. Academic Emergency Medicine
24. Grunau G, Harris A, Buckley J, Todd N (2018) Diagnosis of Ovarian Torsion: Is It Time to Forget About Doppler? J Obstet Gynecol Can 40(7):871–875
25. Bar-On S, Mashiach R, Stockheim D, Soriano D, Goldenberg M, Schiff E et al (2010) Emergency laparoscopy for suspected ovarian torsion: are we too hasty to operate? Fertil Steril 93(6):2012–2015