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Excision of adnexal teratomas: Minimally invasive removal versus laparotomy

Cynthia Abraham and Nataliya Vang*

Hofstra University, Northwell Health System, Staten Island University Hospital, Staten Island, New York

Abstract

Background and objectives: In the past decade, use of minimally invasive surgery for removal of teratomas has increased significantly. However, there have been no studies performed in the United States comparing outcomes between minimally invasive removal and resection via laparotomy.

Methods: Retrospective chart review. Following collected: age, body mass index, ethnicity, presence of co-morbidities, adnexal teratoma size, surgery duration, estimated blood loss, hospital stay length, presence of cyst rupture and recurrence, complications.

Results: 130 underwent minimally invasive removal, 25 underwent excision via laparotomy. Body mass index and incidence of co-morbidities were not significantly different between groups. Overall, mean cyst diameter (10.5 centimeters versus 5.6 centimeters, $p < .01$), cyst recurrence rate (16% versus 1.6%, $p < .05$) and hospital stay length (2.6 days versus 1 day, $p < .01$) were significantly greater in those who underwent laparotomy than in those who underwent minimally invasive surgery. Overall, estimated blood loss, surgery duration, incidence of cyst rupture and incidence of complications were not significantly different between groups. In those with teratomas greater than or equal to 10 centimeters in size (minimally invasive removal: n = 14, average size: 12.1 centimeters; laparotomy: n =15, average size: 13.2 centimeters), cyst recurrence rate and hospital stay length and continued to be lower in those undergoing minimally invasive removal versus laparotomy.

Conclusion: Minimally invasive removal of teratomas is associated with a lower cyst recurrence rate and hospital stay length than with excision via laparotomy. No cases of chemical peritonitis or malignancy were identified.

Introduction

Teratomas are the most common germ cell tumors. Patients can be asymptomatic or present with severe pain due to torsion or cyst rupture. Laparoscopy is the standard approach for surgical management of benign adnexal masses. It is associated with a reduction in the incidence of infection, postoperative complications, hospital stay duration and total cost [1]. In the past decade, implementation of laparoscopy in adnexal teratoma removal has increased significantly due to multiple reports supporting its safety and efficacy [2-13]. Yet concerns related to sequelae associated with intraabdominal spillage of teratoma contents remain. These adverse outcomes involve the risk of chemical peritonitis leading to adhesive disease and that of intra-abdominal spread of cancer cells in the setting of malignant teratoma transformation, providing the impetus for providers to continue to remove adnexal teratomas via laparotomy. However, only three studies comparing outcomes between minimally invasive removal of adnexal teratomas and removal via laparotomy have been published.

In a Mexican study performed by Briones-Landa *et al.* [9] of patients who underwent adnexal teratoma excision (102 via laparoscopy, 67 via laparotomy), laparoscopy did not significantly increase the risk of complications compared to laparotomy and was associated with less bleeding and shorter hospital stay. Similar findings were reported in two other studies that assessed surgical approaches in the management of adnexal teratoma excision: a Romanian study performed by Tarcoveanu *et al.* [11] that enrolled 38 patients (25 underwent excision via laparoscopy and 13 via laparotomy) and a Greek study performed by Milingos *et al.* [13] that enrolled 222 patients (187 underwent excision via laparoscopy and 35 via laparotomy), But to date, there has been no study performed in the United States comparing outcomes between minimally invasive removal and resection via laparotomy of adnexal teratomas.

Materials and methods

This study was an Institutional Review Board approved retrospective chart review of 155 patients between the ages of 18 and 75 who underwent excision of adnexal teratoma at Hofstra University – Northwell Health System – Staten Island University Hospital between January 1, 1999 and December 31, 2015. All procedures were performed by gynecologists. Transvaginal ultrasonography was performed in all patients and the preoperative diagnosis was adnexal teratoma. 130 patients underwent minimally invasive removal and 25 underwent removal of adnexal teratoma via laparotomy. Preoperative diagnosis of adnexal teratoma was based on transvaginal sonographic presence of echogenic areas (suggestive of nodules), fluid-fluid levels (suggestive of sebum floating above aqueous fluid) and thin echogenic bands (suggestive of strands of hair) [14-16]. Operative approach was based on surgeon preference. All patients had a postoperative diagnosis of adnexal teratoma that was confirmed on final pathologic evaluation. Patient's medical records were examined for the following: age, body mass index, ethnicity, presence of co-morbidities, adnexal teratoma

Correspondence to: Cynthia Abraham, Hofstra University, Northwell Health System, Staten Island University Hospital, Staten Island, New York, E-mail: cynthia.abraham@mssm.edu

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size, duration of surgery and associated estimated blood loss, length of hospital stay and presence of cyst rupture, adnexal torsion and teratoma bilaterality, performance of lysis of adhesions, presence of complications and recurrence of teratoma up to two years after surgery. Short-term and long-term complications were evaluated.

Descriptive statistics (frequencies for categorical data; mean ± standard deviation for continuous data) and univariate analyses using the chi-square test or Fisher's exact test, as deemed appropriate, were performed. A p value of less than 0.05 was deemed as statistically significant.

Results

Baseline characteristics are outlined in Table 1. Those who underwent minimally invasive removal were significantly older than those who underwent laparotomy (35.6 years versus 27.8 years, p < .01), There was no significant difference in body mass index between groups (26.8 versus 29.5, p = .06). There was no significant difference in presence of co-morbidities and ethnicity distribution between groups. All patients over the age of 48 underwent oophorectomy. All other patients underwent adnexal cystectomy.

Overall operative outcomes are outlined in Table 2. Overall, mean cyst diameter (10.5 centimeters versus 5.6 centimeters, p < .01), cyst recurrence rate (16% versus 1.6%, p < 0.05), presence of adnexal torsion (36% versus 6.1%, p < .01) and hospital stay length (2.6 days versus 1 day, p < .01) were significantly greater in those who underwent laparotomy than in those who underwent minimally invasive surgery. Overall, estimated blood loss (43 milliliters versus 100 milliliters, p = .16), surgery duration (1.9 hours versus 1.7 hours, p = .26), incidence of complications (1.6% versus 8%, p = 0.06), incidence of cyst rupture (42% versus 52%, p = .33) and performance of lysis of adhesions (12.3% versus 24%, p = .12) at time of procedure were not significantly different between those undergoing minimally invasive surgery versus laparotomy. 20% of those who underwent laparotomy had bilateral adnexal teratomas compared to 0% in those who underwent minimally invasive surgery. There were no cases of chemical peritonitis or malignancy. Complications that occurred in this study were small bowel obstruction, hernia formation, fever and foreign body reaction.

Operative outcomes pertaining to those with adnexal teratomas greater than or equal to 10 centimeters in size are outlined in Table 3. 14 of those who underwent minimally invasive removal and 15 of those who underwent removal via laparotomy had teratomas greater than or equal to 10 centimeters in size. In this subgroup, mean cyst diameter (12.1. centimeters versus 13.2 centimeters, p = .39), cyst recurrence rate (0% versus 7%), incidence of cyst rupture (28% versus 33%, p = .78), presence of teratoma bilaterality (0% versus 25%), performance of lysis of adhesions (7.1% versus 20%, p = .32), estimated blood loss (57 milliliters versus 70 milliliters, p = .47), hospital stay length (1 day versus 2.7 days, p < .01) and incidence of postoperative complications (0% versus 7%) were lower in those who underwent minimally invasive surgery than in those who underwent laparotomy. In this subgroup, surgery duration (1.7 hours versus 1.7 hours, p = .87) and incidence of adnexal torsion (29% versus 13%, p = .31) at time of procedure were not significantly different between those undergoing minimally invasive surgery versus laparotomy.

Table 1. Baseline characteristics

	Minimally invasive removal (n = 130)	**Laparotomy (n = 25)**	**p Value**
Age (years)	35.6 ± 11.8	27.8 ± 6.5	<0.01
Body Mass Index	26.8 ± 6.6	29.5 ± 6.0	0.06
Co-Morbidities			0.24
Obesity only	25 (19%)	7 (28%)	
Hypertension only	4 (3%)	1 (4%)	
Hypertension and type 2 diabetes mellitus	3 (2%)	0	
Obesity, hypertension, and Type 2 diabetes mellitus	0	1 (4%)	
Ethnicity			0.52
Caucasian	87 (66.9%)	12 (24%)	
African-American	12 (9%)	7 (28%)	
Hispanic	2 (1.5%)	4 (8%)	
Other	29 (22.6%)	2 (4%)	

Continuous variables are presented as mean ± standard deviation. Categorical variables are presented as number and associated percentage.

Table 2. Overall operative outcomes

	Minimally invasive removal (n = 130)	Laparotomy (n = 25)	P Value
Size of teratoma (centimeters)	5.6 ± 3.1	10.5 ± 4.5	<0.01
Duration of surgery (hours)	1.7 ± 0.6	1.9 ± 1.0	0.26
Estimated blood loss (milliliters)	43 ± 55	103 ± 156	0.16
Length of hospital stay (days)	1.0 ± 0.2	2.6 ± 0.8	< 0.01
Subsequent cyst recurrence	4 (1.6%)	2 (16%)	< 0.05
Presence of: Adnexal torsion	8 (6.1)	9 (36%)	< 0.01
Bilaterality	0	5 (20%)	
Cyst rupture	54 (42%)	13 (52%)	0.33
Performance of lysis of adhesions	16 (12.3%)	6 (24%)	0.12
Complications			0.06
Small bowel obstruction	1 (0.8%)	0	
Hernia	1 (0.8%)	0	
Fever	0	1 (4%)	
Foreign body reaction	0	1 (4%)	

Continuous variables are presented as mean ± standard deviation. Categorical variables are presented as number and associated percentage.

Table 3. Operative outcomes with teratoma size equal to or larger than 10 cm

	Minimally invasive removal (n = 14)	Laparotomy (n = 15)	P Value
Size of teratoma (centimeters)	12.1 ± 3.1	13.2 ± 3.8	0.39
Duration of surgery (hours)	1.7 ± 0.6	1.7 ± 0.5	0.87
Estimated blood loss (milliliters)	57 ± 36	70 ± 52	0.47
Length of hospital stay (days)	1 ± 0	2.7 ± 0.7	< 0.01
Subsequent cyst recurrence	0	1 (7%)	0.94
Presence of: Adnexal torsion	4 (29%)	2 (13%)	0.31
Bilaterality	0	3	
Cyst rupture	4 (29%)	5 (33%)	0.78
Performance of lysis of adhesions	1 (7%)	3 (20%)	0.32
Complications	1 (7%)	2 (13%)	0.58

Continuous variables are presented as mean ± standard deviation. Categorical variables are presented as number and associated percentage.

Conclusion

In the past decade, the use of laparoscopy to remove adnexal teratomas has increased substantially. Innovations in ultrasound technology have aided in improving outcomes associated with

minimally invasive removal through early detection and subsequently, timely surgical intervention in the suspicion of adnexal torsion. Adnexal torsion is a gynecologic emergency that occurs in approximately 3-4% of cases of adnexal teratomas [17]. However, in spite of technological advancements that have been made and findings supporting minimally invasive removal, there is a concern for intraoperative rupture of adnexal teratomas, regardless of size, which has been reported to occur in 18-93% of cases according to the literature [18]. Chemical peritonitis associated with teratoma rupture has been reported in 2% of cases, a risk that has detracted many providers from attempting laparoscopic removal [19]. Additionally, there is a risk of malignancy which occurs in 0.9-2.4% of adnexal teratomas leading to concern for dissemination of cancerous cells in the presence of teratoma rupture [20]. However, there has been no study to date performed in the United States comparing outcomes between minimally invasive removal and removal via laparotomy, especially focusing on these adverse outcomes. Additionally, the last extensive review evaluating the literature comparing for surgical approaches for benign adnexal masses was published in 2009 [1]. Furthermore, there have only been three studies addressing this topic specifically in relation to teratomas with the more recent study performed being published in 2012 [11]. Since the publication of these reports, resident training and operator experience in laparoscopy have increased substantially. But remaining concern for adverse sequelae associated with teratoma rupture, in the presence of advancements made in the field of minimally invasive surgery, provided the motivation for the authors to re-explore this topic.

In our study, minimally invasive removal of adnexal teratomas was associated with a lower cyst recurrence rate, cyst rupture rate, length of hospital stay, estimated blood loss and incidence of complications when compared with removal via laparotomy. The similarity in cyst rupture rates between surgical approaches in our study is compelling and is in stark contrast to prior research indicating that there a significantly higher rate of inadvertent adnexal cyst rupture on minimally invasive removal compared to laparotomy [21,22].

The findings in our study not only contribute to data that have a significant impact on patient care but also on national healthcare costs. Moreover, these benefits of minimally invasive removal over laparotomy in relation to adnexal teratomas persisted in the presence of adnexal teratomas measuring greater than or equal to 10 centimeters. There were no cases of chemical peritonitis or malignancy. Our findings of significantly less blood loss and shorter hospital stay in those who underwent laparoscopic teratoma removal versus removal via laparotomy mimic the findings published by Briones-Landa *et al.* [9], Tarcoveanu *et al.* [11] and Milingos *et al.* [13] There were no cases of chemical peritonitis in the study performed by Briones-Landa *et al.* [9]

Strengths of this study are not only its somewhat large cohort but its presentation of recurrence rate of adnexal teratomas up to two years after surgery as current literature on recurrence rates after surgical intervention for adnexal teratomas is very limited. Published studies have indicated recurrence rates of approximately 4% when laparoscopy is implemented [23,24]. Additionally, of note, one study indicated a recurrence rate of 4.2% in cases of minimally invasive removal and 0% in cases in which laparotomy was performed [25]. This study was published in 2006 and its findings differ markedly from ours in which recurrence rates were 16% and 1.6% in those who underwent laparotomy and those who underwent minimally invasive removal, respectively. Our findings though may be due to a higher percentage of patients in those who underwent laparotomy who had bilateral adnexal teratomas (20%) compared to those who underwent minimally invasive removal (0%). Moreover, it has been noted that a key predictive factor in recurrence of adnexal teratomas is age [20] and in our study, those who underwent laparotomy were significantly younger than those who underwent minimally invasive removal. Nonetheless, we feel that another strength of our study is its presentation of more contemporaneous data and its continued support of laparoscopy in the removal of adnexal teratomas. Of note, in the study performed by Briones-Landa *et al.* [9], which was published in 2010, mean hospital length in those who underwent laparoscopic adnexal teratoma removal was 1.6 days. The mean hospital length in our study was 1 day. This may be attributed to increased utilization of a minimally invasive approach to adnexal teratoma removal over the past decade leading to procedural proficiency and better outcomes. Weaknesses of this study are the big difference in the number of patients who underwent minimally invasive removal versus removal laparotomy and its retrospective design. However, we did not feel a randomized controlled trial would be feasible given the well-documented advantages of performing laparoscopy over laparotomy. Moreover, laparoscopy has become the standard approach to surgical treatment of adnexal masses unless malignancy is suspected in which case laparotomy is the favored surgical approach.

In conclusion, minimally invasive removal should be favored over laparotomy in the surgical management of adnexal teratomas. The risk of chemical peritonitis and dissemination of cancerous cells at time of minimally invasive removal of adnexal teratomas is exceedingly low.

Statement of disclosure

The authors declare that they have no conflicts of interest and nothing to disclose.

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