

The Clinicopathological Features And Surgical Procedure of Adnexal Mass With Abdominal Pain In Pediatric And Adolescent Patients

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Abstract

Objective: To investigate the clinicopathological features and surgical procedures of adnexal masses with abdominal pain in pediatric and adolescent patients.

Methods: A total of 212 pediatric and adolescent adnexal masses with abdominal pain who underwent surgery were retrospectively reviewed. The patients were divided into two groups, namely, the emergency surgery (EMS, n=96) group and the elective surgery (ELS, n=116) group, according to whether they had been surgically diagnosed with emergency conditions. EMS group refers to patients who had been surgically diagnosed with emergency conditions including adnexal masses torsion, corpus luteum rupture, and rupture of ectopic pregnancy. ELS group refers to patients with adnexal mass without emergency condition. The differences between the two groups were compared using the chi-squared test.

Results: At the surgery evaluation, the median age was 14.5 ± 3.6 years. A total of 175 patients (82.5%, 175/212) had menstruation, and 37 patients (17.5%, 37/212) had not yet begun menstruating. A total of 126 (59.4%, 126/212) patients presented with an abrupt onset of abdominal pain. Pelvic abdominal ultrasound was the first imaging modality used in all the patients (n = 212/212; 100%). Tumor markers were abnormally elevated in 26 patients.

Compared with the ELS group, the proportion of patients with emergency onset of pain, pain duration less than 3 months, persistent and intense of pain were significantly higher than those in ELS group ($P < 0.05$). There were significantly more patients without menarche in the EMS group than in the ELS group ($p < 0.05$). The average tumor size in the ELS group was larger than that in the EMS group ($p < 0.05$). In the EMS group, 78 cases (81.3%, 78/96) had adnexal mass torsion, 16 cases (16.7%, 16/96) had mass rupture, and 2 cases (2.1%, 2/96) had ectopic pregnancy. Of the 78 patients with adnexal mass torsion, 49 cases (62.8%, 49/78) underwent ovary-preserving surgery, and 24 cases (30.8%, 24/78) underwent adnexectomy. The most common pathologic types of adnexal torsion were mature teratoma cysts and simple cysts, accounting for 29% and 26%, respectively.

Conclusions: Adnexal masses combined with abdominal pain in pediatric and adolescent patients, especially for patients presented as acute pain which characterized by emergency pain onset, persistent pain that cannot be relieved or recurrent pain, should be considered due to the possibility of adnexal mass combined with acute complications, and emergency surgery should be performed immediately. For patients with suspected malignant lesions, a comprehensive evaluation of the lesions should be conducted preoperatively to select the appropriate surgical method and strategy. After the discovery of an adnexal mass, evaluation should be performed quickly, and long-term management should be implemented.

Introduction

The incidence of ovarian tumors increases with age, from 0.43 in 100000 cases at 1 year of age to 152 in 100000 cases in 35-year-old patients¹. The clinical presentation and outcomes of ovarian disorders in

adolescent and pediatric populations differ from those in adults and require different diagnostic and management approaches^{2,3}. Young patients with ovarian tumors often complain of acute or chronic abdominal pain, vomiting, nausea, increased abdominal volume or other symptoms induced by compression of the surrounding organs⁴. The current study found that either acute or chronic abdominal pain was the most frequent symptom. However, whether the presence of an adnexal mass accompanied by abdominal pain in pediatric patients and adolescents is consistent with surgical indication and the timing of surgery has seldom been reported. The study investigated the characteristics of all children and adolescents surgically confirmed to have adnexal masses with symptoms of pain. We preferred to differentiate cases requiring immediate emergency surgery from those requiring operation at a scheduled time. Descriptive studies of these populations can be helpful in adding to the breadth of the literature on managing adnexal masses.

Materials And Methods

We conducted a retrospective chart review at Peking Union Medical College Hospital (PUMCH), and 212 cases were queried from March 2012 to December 2019 in the Department of Obstetrics and Gynecology.

The study flow diagram is shown in Figure 1. Detailed records of the history of abdominal pain, clinical presentation, physical exam, laboratory findings, operative procedure, pathology report, and follow-up were available for all eligible patients. When a mass effect was observed, tumor markers (α -fetoprotein, β -human chorionic gonadotrophin, CA125) and imaging studies (ultrasonography, US) were assessed, and computerized tomography (CT) or magnetic resonance imaging (MRI) was performed when malignancy was suspected. The data are expressed as the mean (\pm SD).

Results

1. Basic patient information

During the 7-year period, 212 patients were surgically evaluated for ovarian lesions with symptoms of abdominal pain. At the surgical evaluation, the median age of the patients was 14.5 ± 3.6 years; 155 patients (73.1%, 155/212) had regular menstruation, 20 patients (9.4%, 20/212) had irregular menstruation, and 37 patients (17.5%, 37/212) had not yet begun menstruating.

126 (59.4%, 126/212) patients presented with an abrupt onset of abdominal pain. In addition to pain, subjects presented with other symptoms and objective findings. The incidence rates of symptom of vomiting, nausea, fever, diarrhea, frequent urination, and abnormal vaginal bleeding were 26.9%, 6.6%, 3.3%, 0.9%, 1.8%, respectively. One patient presented with clinical characteristics of precocious puberty. No patients presented with abnormal skin pigmentations or other known syndrome markers at physical examination.

Pelvic abdominal ultrasound was the priority imaging modality used in all the patients (n 100%, 212/212) to characterize the ovarian disease as simple, complex, or solid lesions. US examination showed an

adnexal mass in all our patients: simple ovarian masses in 188 (88.7%), complex ovarian masses in 20 (9.4%), and solid lesions in 4. An additional abdominal Computed Tomography scan(CT) or Magnetic resonance imaging (MRI) was performed for 39 patients (18.4%) to exclude suspected malignant pathologies.

Serum levels of the tumor markers CA-125, CA-199, α -fetoprotein, and β -human chorionic gonadotropin were detected in 105 cases. The tumor markers were abnormally elevated in 26 patients, and AFP, CA125, CA199 and β -HCG were abnormal in 6, 12, 7 and 1 patients, respectively.

2. Comparison of the clinical information between the EMS and ELS groups

The patients were divided into two groups, namely, the emergency surgery (EMS, n=96) group and the elective surgery (ELS, n=116) group. In the EMS group, pain often presented as acute pain. Compared with the ELS group, the proportion of patients with emergency onset, persistent pain, duration less than 3 months was significantly higher in the EMS group ($p < 0.05$). There were significantly more patients without menarche in the EMS group than in the ELS group ($p < 0.05$). The average tumor size in the ELS group was larger than that in the EMS group ($p < 0.05$) (Table 1).

Table 1
Comparison of patient characteristics in the EMS and ELS groups

	EMS (n=96)	ELS (n=116)	Sum (n=212)	P value
Age (years)	14.2±3.9	14.9±3.2	14.5±3.6	0.071
Onset of pain				0.045
Emergency onset	64(66.7%)	62(53.5%)	126(59.4%)	
Non-emergency onset	32(33.3%)	54(46.5%)	86(40.6%)	
Duration of pain				0.000
≤3 months	81(84.4%)	45(37.8%)	126(59.4%)	
>3 months	15(15.6%)	71(61.2%)	86(40.6%)	
Frequency and intensity				0.000
Persistent/intense	88(91.7%)	49(42.2%)	137(64.6%)	
intermittent	8(8.3%)	67(57.8%)	75(35.4%)	
Location				0.143
right or left quadrant	58(60.4%)	49(42.2%)	107(50.5%)	
not accurate and/or referred pain	38(39.6%)	67(57.8%)	105(49.5%)	
Ultrasound				0.886
simple	84(87.5%)	104(89.7%)	188(88.7%)	
complex	10(10.4%)	10(8.6%)	20(9.4%)	
solid	2(2.1%)	2(1.7%)	4(1.9%)	
Menstruation				0.022
menarche	74(77.1%)	103(88.8%)	177(83.5%)	
no menarche	22(22.9%)	13(11.2%)	35(16.5%)	
Surgical approach				0.263
laparoscopy	84(87.5%)	95(81.9%)	179(84.4%)	
laparotomy	12(12.5%)	21(18.1%)	33(15.6%)	
Tumor size (unilateral)	8.2±3.2	8.8±5.1	8.5±5.9	0.001
Side of the tumor				0.161
left side	40(41.7%)	49(42.2%)	89(42.0%)	

	EMS (n=96)	ELS (n=116)	Sum (n=212)	P value
right side	54(56.3%)	58(50.0%)	112(52.8%)	
bilateral side	2(2.0%)	9(7.8%)	11(5.2%)	

3. The surgical procedure and pathological results of the EMS and ELS groups.

Among the 212 patients, 179(84.5%, 179/212) underwent laparoscopic surgery with an average tumor size of 7.7 ± 3.4 cm, and there were no intraoperative or postoperative complications. The average tumor size of 33 patients (15.6%, 33/212) who underwent laparotomic surgery was 12.9 ± 5.6 cm. The mean tumor size of patients undergoing laparotomic surgery was significantly higher than that of patients undergoing laparoscopic surgery ($P=0.000$). A total of 81.1% (172/212) of the subjects had performed adnexal conservative surgery, and 78.8% (167/212) of these patients had an adnexal mass removed. In the EMS group, the proportion of unilateral adnexectomy was 20.5% (25/96), significantly higher than that in the ELS group (20.5% vs 5.2%, $P=0.000$). Nine patients with suspected malignant tumors underwent lateral adnexectomy and biopsy at the suspected site (Table 2).

Table 2 Surgical procedure of the patients

	EMS (n=96)	ELS (n=116)	Sum (n=212)
Cystectomy	62	105	167
Laparoscopic	59	95	154
Laparotomic	3	10	13
Adnexectomy	25	6	31
Laparoscopic	20	0	20
Laparotomic	5	6	11
Laparotomic adnexectomy± greater omentum resection +biopsy	4	5	9
Laparoscopic tubal fenestration	2	0	2
Laparoscopic salpingectomy	3	0	3

Pathologic examination demonstrated adnexal mass with abdominal pain being mature cystic teratoma (34.0%, 72/212), simple cyst (19.8%, 42/212), mucinous or serous cystadenoma (9.4%, 20/212), corpus luteum cyst (9.4%, 20/212), para-ovarian cyst (8.5%, 18/212), endometriosis cyst (8.0%, 17/212), malignant germ cell tumor (3.3%, 7/212) and sexual cord stromal cell tumor (2.4%, 5/212) (Table 3). Among the 14 patients with complex lesions suspected malignancy indicated by preoperative ultrasound, 6 were confirmed to be malignant germ cell tumors and 3 were sex cord stromal tumors.

Table 3
Pathological results of adnexal mass in the two groups

	EMS (n=96)	ELS (n=116)	Sum (n=212)
Simple cyst	21	21	42
Para-ovarian cyst	12	6	18
Mature cystic teratoma	24	48	72
Endometriosis cyst	6	11	17
Enlarged ovary	4	1	5
Corpus luteum cyst	14	6	20
Malignant germ cell tumor	3	4	7
Mucinous/Serous cystadenoma	4*	16	20
Sexual cord stromal cell tumor	3	2#	5
Inflammation	0	1	1
Tubal torsion	3	0	3
Ectopic pregnancy	2	0	2
*one case of borderline mucinous cystadenoma			
#one case of foam fibroma			

There were 7 cases of malignant germ cell tumors, including 3 cases of endodermal sinus tumors, 1 case of mixed germ cell tumors (endodermal sinus tumor complicated with immature teratoma tumor), 2 cases of immature teratoma, and 1 case of dysgerminoma. The postoperative treatment of the seven cases was supplemented with 3-6 cycles of PEB/PEV chemotherapy. There were 5 cases of sex cord stromal cell tumors, including 2 cases of juvenile granulosa cell tumors, 1 case of malignant steroid cell tumors, and 1 case of moderately differentiated Sertoli-Leydig cell tumors. Juvenile granulosa tumors and malignant steroid cell tumors were treated with adjuvant chemotherapy after the operation.

4. Clinicopathological characteristics of adnexal mass with acute complications

Of the 96 patients, 78 (81.3%) had adnexal torsion, including adnexal mass-enlarged ovaries, and fallopian tubes 16 (16.7%) had mass rupture, and 2 (2.08%) had ectopic pregnancy. Among the 78 patients with adnexal torsion, 72 patients had adnexal mass. The average diameter of adnexal mass was 8.7 ± 3.1 cm, of which 97.2% patients were larger than 5 cm. The average torsion degree was 653.2 ± 419 . Torsion occurred on the right side in 43 cases and 33 cases on the left. Cysts were bilateral and torsion occurred on one side in 2 cases. The most common pathologic types were mature teratoma and simple cyst, accounting for 29% and 26%, respectively, followed by para-ovarian cyst, serous/mucinous

cystadenoma, and endometriosis cyst. Three patients presented with ovarian enlargement and torsion, 3 with fallopian tube torsion, 3 with malignant germ cell tumor, and 2 with sex cord stromal tumor. Of the 78 patients with torsion, 49 underwent ovary-preserving surgery, and 24 underwent adnexectomy. 23 patients (29.5%) underwent adnexectomy due to necrosis. 3 patients underwent salpingectomy for tubal torsion

(Table 4)

Table 4
Surgical method for patients with adnexal torsion

	Number of patients
Adnexectomy	24
mature cystic teratoma	6
serous/mucinous cystadenoma	1
simple cyst	9
para-ovarian cyst	5
corpus luteum cyst	0
enlarged ovary	2
sexual cord stromal cell tumor	1
Cystectomy	49
mature cystic teratoma	17
serous/mucinous cystadenoma	3
simple cyst	11
Para-ovairan cyst	7
corpus luteum cyst	5
endometriosis cyst	3
enlarged ovary	1
sexual cord stromal cell tumor	0
malignant germ cell tumor	2
Salphingectomy	3
tubal torsion	3
Adnexectomy ± greater omentum resection +biopsy	2
granulosa cell tumor	1
immature teratoma	1

Discussion

Due to the variety of underlying causes, acute abdominal pain in children poses a diagnostic challenge. Conditions manifested by acute abdominal pain vary in incidence according to age and sex.

Accompanying symptoms and signs are inconsistently present, especially in young children; however, these signs/symptoms can guide the selection of appropriate diagnostic tests, imaging, and definitive treatment. Thus, accurate and timely diagnosis is sought to avoid both inappropriate operations, as many causes of acute abdominal pain are nonsurgical^{5,6}, and diagnostic delays that increase morbidity. We enrolled patients with abdominal pain and analyzed their clinicopathological characteristics to identify surgical indications for these patients and further identify patients requiring emergency surgical treatment.

It is difficult to determine the exact risk of acute complications in patients with an asymptomatic ovarian mass since torsion and rupture of the mass are usually diagnosed when a symptomatic patient undergoes surgery. Our study summarized the pain characteristics of adnexal masses with abdominal pain. Among the 212 cases of adnexal mass with abdominal pain, 96 had acute complications of adnexal mass confirmed by surgery, accounting for 45.3%. Based on this criterion, the characteristics of pain in the two groups were analyzed. In the EMS group, the proportion of patients with emergency onset of pain, pain duration less than 3 months, persistent and intense of pain were significantly higher than those in ELS group ($P < 0.05$). The proportion of patients with clear pain localization in the EMS group was higher than that in the ELS group, but the difference was not statistically significant (60.4% vs 42.2%, $P = 0.143$).

According to our research, in patients with abdominal pain, the assessment of pain is particularly important, especially for patients presented as acute pain which characterized by emergency pain onset, a duration of pain shorter than 3 months, persistent pain that cannot be relieved or recurrent pain. Clinicians should remain vigilant of the possibility of adnexal mass combined with acute complications. If the pain location is fixed and the physical examination positive signs are obvious, the possibility of acute complications is more likely. However, in this study, the average time from the onset of pain symptoms to the consultation was 91 hours, suggesting the importance of early consultation to exclude related pathological lesions requiring urgent attention. Pain assessment in children and adolescents is difficult, especially in infants and young children. Qualitative assessment of pain includes pain quality, location and extent, time, degree, and neurophysiological function. Quantitative assessment of pain can be performed by various methods and assessment scales. This study failed to include the degree of pain in children, and various scales should be included in future studies to accurately assess the characteristics of pain and to provide a basis for guiding clinical decision-making.

Adnexal torsion and rupture are typically not primary considerations for differential diagnoses of a child with acute abdominal pain, given previous estimates that torsion accounts for only 2.7% of acute abdominal pain in the pediatric population⁷. However, ovarian disorders such as cyst rupture and torsion must be considered when evaluating girls with sudden onset abdominal pain^{8,9}. Abdominal pain may be intermittent and recurrent and accompanied by emesis^{8,10}. In this study, among the patients with torsion, 88.5% had acute onset of abdominal pain, 98.7% had an acute pain course longer than 3 months, and 93.6% had persistent pain that could not be relieved or occurred repeatedly. When the adnexal mass is

combined with the above pain characteristics, clinicians should be on high alert for the possibility of torsion and rupture, indicating the need for emergency surgical exploration.

Adnexal torsion is usually unilateral and presents as simple ovary or fallopian tube torsion, but simultaneous ovary and fallopian tube torsion is most common. It has been reported that 46% of adolescent cases have only ovarian torsion without ovarian cysts¹¹. In this study, the incidence of ovarian torsion without ovarian cysts was 3.8%, which was lower than the data reported in the literature. The size and type of mass seem to be important contributing factors. Three retrospective reviews found that at least 80% of ovarian torsion occurs when the ovary is enlarged by >5 cm¹²⁻¹⁴. The most common histologic subtypes were benign hemorrhagic cysts, mature teratomas, and serous cystadenomas¹². Ovarian malignancy is rarely associated with ovarian torsion (<2% of cases). Our results were consistent with the data reported in the literature. In our study, the average tumor size was 8.7 cm, and 97.4% of adnexal torsion masses were larger than 5 cm. The probability of ovarian malignant tumor torsion was 6.4%, and the most common pathologic types of ovarian cyst torsion were mature teratoma cysts and simple cysts, accounting for 29% and 26%, respectively. The reason for torsion may be related to the weight and center of gravity of the mass and the relatively long ovary tube and ligaments during the development of children and adolescence. In this study, 23 patients (29.5%) underwent adnexectomy due to ovarian necrosis. Patients with necrosis had more torsion cycles than those without necrosis, and the proportion of patients with pain lasting more than 72 hours was higher than that of patients without necrosis. However, there was no significant difference in pain characteristics, indicating that pain characteristics would not change with/without necrosis after torsion. The occurrence of necrosis may be related to the number of turns, tightness and duration of torsion, but multivariate analysis showed that the pathological results, pain duration and tumor size were not related to necrosis. Therefore, it is necessary to expand the sample size and improve the information evaluated for further study.

Surgical indications for adnexal mass in pediatric and adolescent patients, although not absolute, include cysts greater than 5 cm in diameter, a failure of the cyst to resolve or decrease in size spontaneously, complex or solid cysts indicative of suspected malignancy, severe persistent abdominal pain, and complications such as ovarian torsion, hemorrhage or infarction^{15,16}. In our study, we enrolled patients diagnosed with an adnexal mass accompanied by abdominal pain, and the average size of the adnexal mass was 8.5±5.9 cm at the time of admission. Among the 212 patients, benign and malignant tumors accounted for 94.8% and 5.2%, respectively. The most common pathological type was mature teratoma cyst, accounting for 34.0%. Although benign masses are more common in patients with adnexal masses accompanied by abdominal pain, the occurrence of acute complications such as torsion will greatly increase the risk of ovarian resection, and aggressive surgical treatment should be performed once a comprehensive evaluation is made.

Laparoscopy is now commonly utilized as both a diagnostic and therapeutic tool and has a broad range of indications within pediatric and adolescent gynecology. The literature has found gynecologic laparoscopy to be equally well tolerated in younger premenarcheal females as well as in older

adolescents¹⁷⁻¹⁹. In our study, among the 212 patients, 179 (84.4%) underwent laparoscopic surgery, and there were no intraoperative or postoperative complications. A total of 15.6% (33/212) of the patients underwent laparotomic surgery. The average tumor diameter of 14 patients undergoing laparotomic surgery was 13 cm (5-30 cm), which could not exclude the possibility of malignant lesions. Postoperative pathological results indicated that 40.6% of the tumors were mature teratomas with large volumes, followed by malignant germ cell tumors and sex cord stromal cell tumors. Although minimally invasive surgical techniques represent a safe and well-tolerated method for treating a wide variety of pelvic pathologies in both younger children and older adolescent females, preoperative evaluation of the lesion suspected to be malignant should be conducted.

Conclusion

According to our research, in patients with abdominal pain, the assessment of pain is particularly important, especially for patients presented as acute pain which characterized by emergency pain onset, a duration of pain shorter than 3 months, persistent pain that cannot be relieved or recurrent pain. Clinicians should remain vigilant of the possibility of adnexal mass combined with acute complications and perform emergency surgery immediately. For patients with suspected malignant lesions, a comprehensive evaluation of the lesions should be conducted preoperatively to select the appropriate surgical method and strategy.

Declarations

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Authors'contributions

Qian Liu carried out the studies, participated in collecting data, performed the statistical analysis and drafted the manuscript. Huimei Zhou performed the statistical analysis and participated in its design, carried out the studies , participated in acquisition, analysis, or interpretation of data, and draft the manuscript .Dongyan Cao participated in acquisition, analysis, or interpretation of data. Jiaxin Yang participated in acquisition, analysis, or interpretation of data. Keng Shen participated in acquisition, analysis, or interpretation of data. All authors read and approved the final manuscript.

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Availability of data and materials

Patient level data can be made available from the corresponding author after discussion with the trial management committee.

Ethics approval and consent to participate

This study received ethics approval from the Institutional Review Board (IRB) of Peking Union Medical College Hospital (PUMCH).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

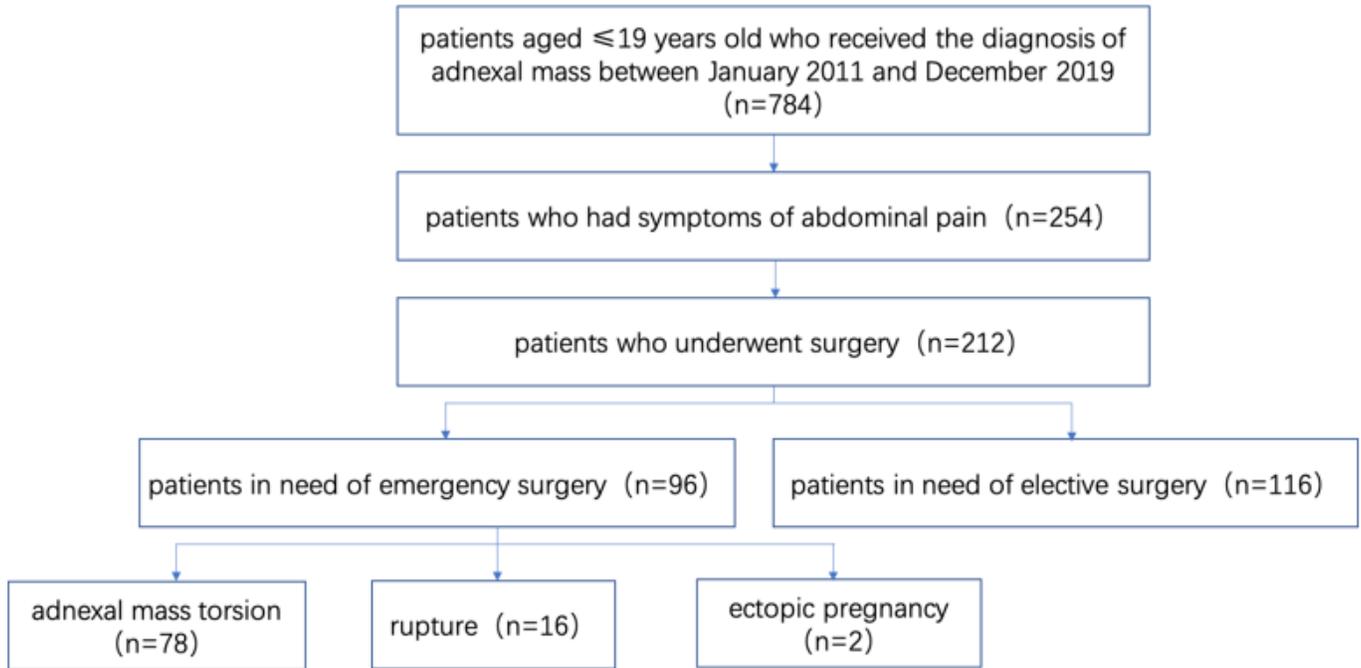


Figure 1

Flow chart of this study.