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CLINICAL CASE REPORT

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Growing Teratoma Syndrome Secondary to Ovarian Giant Immature Teratoma in an Adolescent Girl

A Case Report and Literature Review

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Abstract: Growing teratoma syndrome (GTS) is a rare clinical entity first described by Logothetis et al in 1982. Although it is unusual for GTS to be located in the ovary, this report is of a case of an adolescent girl who underwent a complete surgical resection of the mass. Histopathology confirmed only an immature teratoma had originated from the ovary and so she received adjuvant chemotherapy with blemycin, etopside, and cisplatin over 4 cycles. Results from an abdominal enhanced CT (computed tomography) 9 years later revealed a giant mass had compressed adjacent tissues and organs. Laparotomy was performed and a postoperative histopathology showed the presence of a mature teratoma, and so the diagnosis of ovarian GTS was made. One hundred one cases of ovarian GTS from English literature published between 1977 and 2015 were collected and respectively analyzed in large samples for the first time.

The median age of diagnosis with primary immature teratoma was 22 years (range 4–48 years, n = 56). GTS originating from the right ovary accounted for 57% (27/47, n = 47) whereas the left contained 43% (20/47, n = 47). Median primary tumor size was 18.7 cm (range 6–45 cm, n = 28) and median subsequent tumor size was 8.6 cm (range 1–25 cm, n = 25). From the primary treatment to the diagnosis of ovarian GTS, median tumor growth speed was 0.94 cm/month (range 0.3–4.3 cm/month, n = 21). Median time interval was 26.6 months (range 1–264 months, n = 41). According to these findings, 5 patients did have a pregnancy during the time interval between primary disease and GTS, making our patient the first case of having a pregnancy following the diagnosis of ovarian GTS. Because of its high recurrence and insensitiveness to chemotherapy, complete surgical resection is the preferred treatment and fertility-sparing surgery should be considered for women of child-bearing age.

Anyhow GTS of the ovary has an excellent prognosis. Patients with GTS had no evidence of recurrence or were found to be disease free during a 40.3-month (range 1–216 months, n = 48) median follow-up. Moreover, regular follow-ups with imaging and serum tumor markers are important and must not be neglected.

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Abbreviations: AFP = alpha fetoprotein, BEP = blemycin etopside and cisplatin, CA = carbohydrate antigen, CT = computed tomography, GP = gliomatosis peritonei, GTS = growing teratoma syndrome, HCG = human chorionic gonadotropin, HE = hematoxylin-eosin, NSGCT = nonseminomatous germ cell of the testis.

INTRODUCTION

The growing teratoma syndrome (GTS) was originally defined by Logothetis et al in 1982 as the phenomenon of subsequent growth of a benign tumor, following the removal of a primary malignant tumor during or after chemotherapy.[1] Growing teratoma syndrome (GTS) is a rare entity related to both testicular and ovarian carcinoma. The incidence of GTS in a nonseminomatous germ cell of the testis is 1.9% to 7.6%, while it has been reported to occur in 12% of ovarian germ cell tumors.[2,3] Generally speaking, ovarian GTS typically occurs in young adults and adolescents.[4] Some researchers have recommended 3 criteria according to the Logothetis definition. The criteria of GTS includes (1) normalization of serum tumor markers, alpha fetoprotein (AFP), and human chorionic gonadotropin; (2) enlarging or new masses despite appropriate chemotherapy for nonseminomatous germ cell tumors; (3) the exclusive presence of mature teratoma in the resected specimen.[5] Herein, we report a rare case of an adolescent girl with ovarian GTS, and 101 cases of ovarian GTS from English literature published between 1977 and 2015 were collected and respectively analyzed in large samples for the first time. This contributed to the understanding of the clinical features of this disease.

CASE REPORT

A 16-year-old girl was presented in August 2005 with intermittent abdominal pain and distention for half a year. Ultrasonography revealed a right ovarian tumor that occupied the whole right upper abdominal cavity. She received the right oophorectomy and the giant tumor was completely resected, showing about a 40 cm × 25 cm × 15 cm mass with intact capsule. Histopathology revealed skin, cartilage, and a malignant immature teratoma. After surgery, she was treated with 4 cycles of blemycin, etopside, and cisplatin (BEP) chemotherapy

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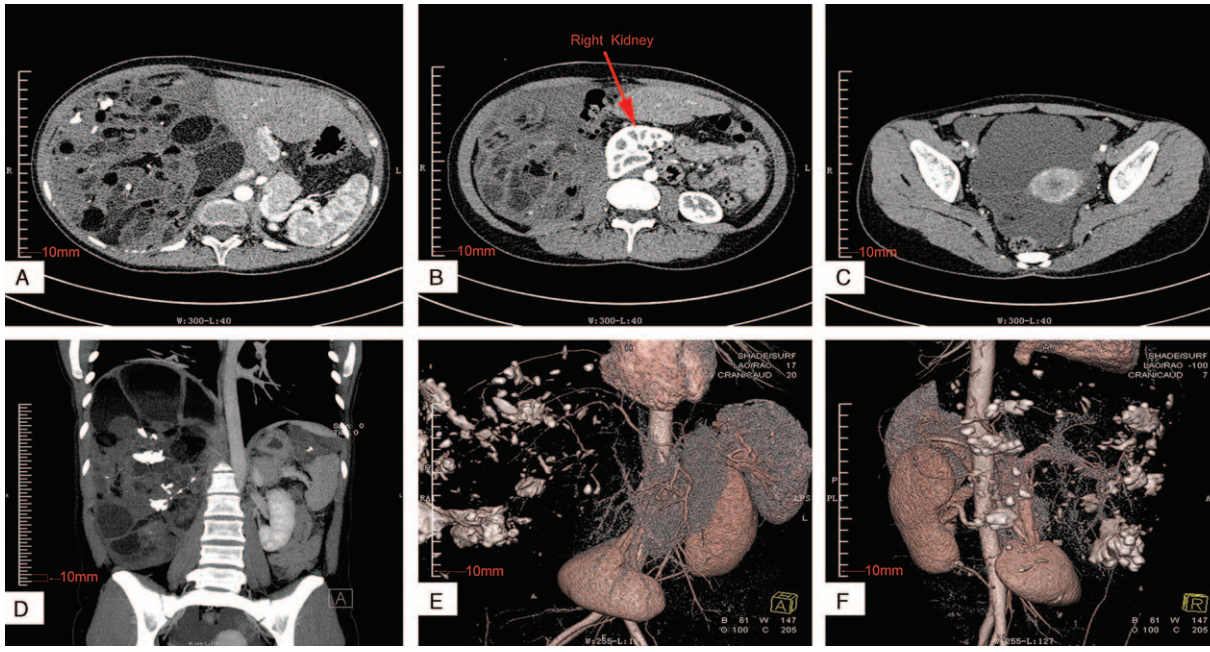

FIGURE 1. CT showed the mass occupying the right upper abdominal cavity, revealing multiple new masses containing cystic and necrotic elements surrounding the liver (A, D, E). Because of tumor compression, the giant mass had compressed the postcava, liver, pancreas, and the right kidney (B, C). The portal vein, right renal artery, superior mesenteric artery, and celiac trunk shifted to the left and was not invaded by the tumor through the technique of 3-dimensional CT image reconstruction (D, E, F). CT = computed tomography.

but refused any further treatment and missed her follow-up. In the following years, she had not felt any discomfort until August 2014. A mass in the whole right abdomen could be touched about 30 cm × 20 cm, without a clear boundary between surrounding tissues. Abdominal-enhanced CT revealed a giant mass in the retroperitoneum that compressed the postcava, the right hepatic vein, liver, pancreas, and the right kidney. Because of the compression, the portal vein, right renal artery, superior mesenteric artery, and celiac trunk had shifted to the left (Figure 1). Tumor markers, AFP, and human chorionic gonadotropin were normal while the carbohydrate antigen 125 level was 412.30 u/mL (normal, 0–35.00 u/mL), and carbohydrate antigen 199 level was over 7000 u/mL (normal, 0–37.00 u/mL). The rest of the laboratory tests were found to be negative. After a discussion by the departments of general surgery, obstetrics gynecology and urology, the patient underwent a resection of abdominal and pelvic lesions, around the liver and spleen. The giant tumor was completely resected and gross examination revealed a giant mass (29 cm × 24 cm × 12 cm) containing lipid, hair, gelatinous material, and a few nodules (Figure 2). Histopathology revealed only a mature teratoma (Figure 3). Hence, a final diagnosis of ''growing teratoma syndrome (GTS)'' was made. During the 14-month follow-up, no evidence of recurrence or metastasis was observed and she became pregnant 2 months after her last follow-up.

DISCUSSION

This is an unusual case in which there were increasing masses 9 years after chemotherapy for an ovarian immature teratoma, but all the masses subsequently resected were shown to contain only mature teratoma. In 1977, DiSaia firstly reported 3 cases of ''chemotherapeutic retroconversion'' in which benign distant metastasis appeared following adjuvant chemotherapy for immature teratoma of the ovary.[6] However, the term GTS was originally defined by Logothetis in 1982, when he described 6 patients with nonseminomatous germ cell tumors who subsequently developed growing metastatic masses despite appropriate systemic chemotherapy and normal range of serum tumor markers.[7] The histopathology revealed benign mature teratoma without viable germ cell elements.[1]

GTS is characterized by an increase in metastatic mass after complete eradication of a primary malignant ovarian germ cell tumor and by normalization of serum tumor markers, either during or after chemotherapy.[8,9] Some researchers considered that these 2 characters are in fact the same entity.[7,8] There are 2 major inferences of GTS formation. The first hypothesis is that chemotherapy transforms malignant cells into ''benign'' teratomatous elements. The second hypothesis is that chemotherapy can only destroy malignant cells leaving chemoresistant teratoma behind.[3,10] It remains, that there is much uncertainty around GTS due to the limited number of cases, and that either of the inference is in fact possible or that both can play an important roles in the development of GTS.

To the best of our knowledge, ovarian GTS is only 101 cases in published English literatures (Table 1). Most of the patients had abdominal symptoms, such as abdominal pain and distension when they first sought medical advice. In our study, the median age of the diagnosis of primary immature teratoma was 22 years (range 4–48 years, n = 56) (Table 1). While Bentivegna et al[5] reported the median age at diagnosis was 26 years (range 8–41 years, n = 38). Because of the existence of 10 gliomatosis peritonei cases in 38, this data would not be

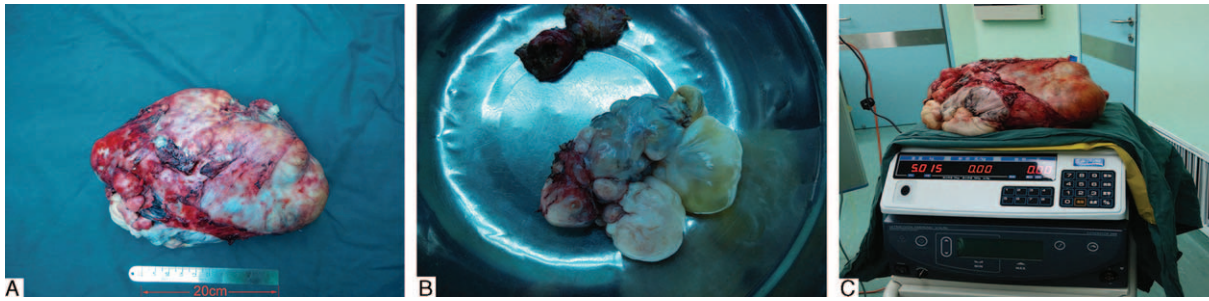

FIGURE 2. The whole abdominal lesion reached 29 cm × 24 cm × 12 cm in size (A, the ruler is 20 cm long), 5.015 kg in weight (C). A part of pelvic lesions, lesions in the hepatic envelop, and around the spleen (B).

suitable for pure GTS. GTS originating from the right ovary accounted for 57% (27/47, n = 47) and the left contained 43% (20/47, n = 47) (Table 1). Median primary tumor size was 18.7 cm (range 6–45 cm, n = 28) and median subsequent tumor size was 8.6 cm (range 1–25 cm, n = 25) (Table 1). Growing teratomas have a rapid expansion rate, with a median linear growth of 0.5 to 0.7 cm/month and volume increase of 9.2 to 12.9 cm^3/month.[11,12] While from the results of our study, the tumor growth was 0.94 cm/month (range 0.3–4.3 cm/month, n = 21) (Table 1). The discrepancy could be explained by different sample sizes.

This behavior is unpredictable because of aggressive local spread as well as GTS having the potential for malignant degeneration.[11,13,14] The GTS nodules can appear at any stage during or after chemotherapy, and in some cases can be delayed anything up to 8 years, with an average interval of 8 months.[5,7,14] In our study, median time interval was 26.6 months (range 1–264 months, n = 41) (Table 1) and our patient was delayed up to 9 years. Therefore regular follow-ups contributed to early detection, diagnosis, and treatment. It is reported that the retroperitoneum is the most common site for GTS, followed closely by the lung, cervical lymph nodes, and mediastinum.[7,15] To date, there is no reliable indicator for GTS. Close attention should always be paid to an enlarged tumor and/or normalization of serum tumor markers during chemotherapy.[16–18]

The preferred treatment is complete surgical resection, because of GTS having a high recurrence rate of 72% to 83% in patients with partial resection, against 0% to 4% in those who undergo complete resections, as teratomas are resistant to chemotherapy and radiation therapy.[11] Early detection and reasonable complete resection of the primary lesion and implantation or metastasis are essential. Adjuvant chemotherapy with blemycin, etopside, and cisplatin was recommended for patients when diagnosed with immature teratoma following primary surgery. Palbociclib (PD0332991) is reported that it can stabilize the vascularization of the tumor in pediatric patients with an intracranial teratoma.[19] But further investigation of the use of Palbociclib in patients with growing teratoma syndrome should be carried out.[19] From these literatures, tumor markers AFP usually returned to within the normal range, with the exception of 2 cases reported by Pendlebury et al and Lorusso et al.[18,20]

So far, no standardized management protocol has been established to diagnose and treat GTS.[5] However it has shown, GTS has an overall good prognosis with a 5-year overall survival rate of 89% in patients who undergo surgery.[3,7] This study has shown, patients with GTS had little or no evidence of recurrence or indeed were disease free for 40.3 months (range 1–216 months, n = 48) median follow-up (Table 1). According to our study, 5 patients had a pregnancy during the time interval between primary disease and GTS, with our patient being the first case of having a pregnancy following the diagnosis of ovarian GTS. Therefore fertility-sparing surgery is recommended for women of child-bearing age if conditions allow. Until now, the mechanism of GTS is still unclear and the diagnosis of it has proven difficult. Consequently, the accumulation of additional data from more cases would be necessary to further elucidate this type of tumor and standardize optimal therapy.

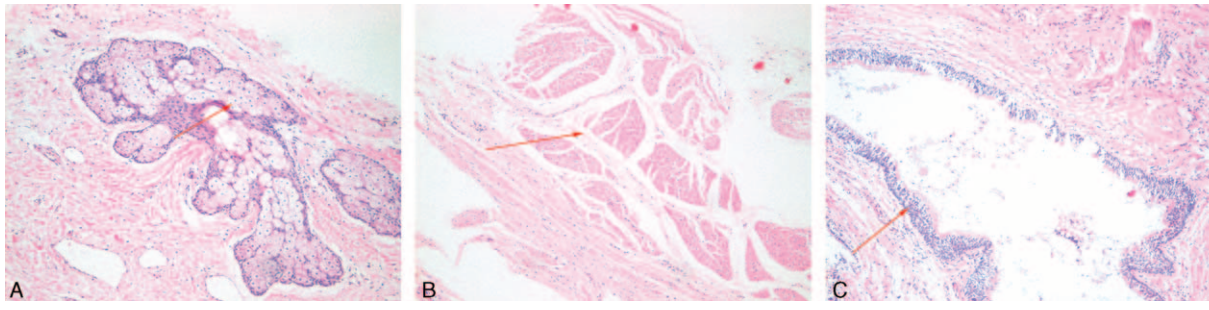

FIGURE 3. Histopathology of mature teratoma of the abdomen cavity at the age of 24. The carcinoids are distributed in various mature tissues derived from 3 germ cell layers (HE × 100). (A) sebaceous gland (red arrow); (B) muscular tissue (red arrow); (C) bronchus tissue (red arrow). HE = hematoxylin-eosin.

TABLE 1. Growing teratoma syndrome of ovary

Author	Year	No. cases	Age	Presentation	Right or Left ovary	Primary main tumor size, cm	Tumor markers before first treatment	Primary main treatment	Tumor markers after primary treatment	Time interval, mo	Subsequent main treatment	Subsequent main tumor size, cm	Postoperative course	Follow-up after the diagnosis of GTS, mo	Successful preganancy
Bentivegna et al[5]	2015	28	N/A	N/A	N/A	N/A	N/A	Fertility-preserving surgery, dubulking surgery; chemotherapy for 27 patients except 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shigeta et al[21]	2015	1	20	Abdominal distention	Left	17	Elevated AFP and CA-125	LSO, 3 cycles of BEP	Negative	17	Laparoscopic surgery	5	No evidence of recurrence	12	N/A
Pendlebury et al[18]	2015	1	21	Subacute pelvic pain	Left	12 × 9.5 × 8	Elevated AFP and CA-125	Laparotomy, 2 cycles of EP	Elevated AFP	2	Laparotomy, EP	3.6 × 3.0	No evidence of recurrence	36	N/A
Merard et al[22]	2015	2	27	Abdominal and back pain	Left	19.4 × 10.3 × 15.3	Elevated CA-125	LSO, 3 cycles of BEP, and 4 cycles of EP	N/A	N/A	Hysterectomy, RSO	N/A	The patient developed a subcapsular liver deposit 8 months later, which was being monitored closely and has not been resected	8	Yes
			22	Behavioral changes, memory problems	Right	20 × 12 × 9.2	Elevated AFP and CA-125	RSO, 4 cycles of BEP	Negative	5	Resection of the subcapsular liver lesion, 2 cycles of BEP	2	No further tumor recurrences have been identified on regular follow-up MRI scans over 9 years	108	No
Daher et al[7]	2015	1	4	Vomiting, increasing abdominal girth	Left	17 × 12 × 7	Elevated AFP and HCG	Laparotomy; 4-months IEP	Negative	8	Three times' laparotomy	N/A	The patient remained healthy and was regularly monitored	N/A	No
Panda et al[10]	2014	1	29	Abdominal distension	Right	6 × 5.5 × 4	Elevated AFP and HCG	RSO, 3 cycles of BEP	Negative	12	N/A	N/A	The patient kept on clinical and biochemical follow-ups	N/A	N/A
Han et al[23]	2014	5	13	N/A	Right	N/A	Elevated AFP	RSO, BEP	Negative	5	Second operation	N/A	N/A	N/A	N/A
			13	N/A	Left	N/A	Elevated AFP	LSO, BEP	Negative	16	Second operation	N/A	No evidence of recurrence	24	N/A
			37	N/A	Right	N/A	Elevated AFP	RSO, BEP	Negative	83	Second operation	6.4	The patient was in remission	36	N/A
			16	N/A	Right	N/A	Elevated AFP	RSO, BEP	Negative	22	Second operation	3.3	No evidence of recurrence	72	N/A
			21	N/A	Left	N/A	Elevated AFP	LSO, BEP	Negative	21	Second operation	5.5	A new mass was found	12	N/A
De Cuypere et al[24]	2014	1	19	Abdominal and pelvic discomfort	Left	20	Elevated AFP and LDH	Laparoscopic surgery, 4 cycles of BEP	Negative	13	Peritonectomy, omentectomy, appendicectomy, splenectomy, and RSO	N/A	The patient remained in complete remission for the next following 4 years	48	N/A
Shibata et al[25]	2013	1	14	Abdominal fullness	Left	15	Elevated AFP and CA-125	LSO, 6 cyles of BEP	Negative	60	Laparotomy	3	The patient remained disease free 11 months after the second surgery	11	N/A
Kato et al[26]	2013	2	30	N/A	Right	N/A	N/A	Fertility-sparing surgery, BEP	Negative	96	Laparoscopical surgery	5	The patient remained with no recurrence 6 years after her last surgery	72	Yes
			22	Acute abdominal symptoms	Right	N/A	N/A	Tumorectomy, CVA	Negative	264	Surgical resection, chemotherapy with PEP	8	The patient had no further treatment and was alive without recurrence 11 years after her last surgery	132	Yes

Author	Year	No. cases	Age	Presentation	Right or Left ovary	Primary main tumor size, cm	Tumor markers before first treatment	Primary main treatment	Tumor markers after primary treatment	Time interval, mo	Subsequent main treatment	Subsequent main tumor size, cm	Postoperative course	Follow-up after the diagnosis of GTS, mo	Successful preganancy
Byrd et al[9]	2013	5	48	N/A	N/A	N/A	N/A	TAH, BSO, BEP	N/A	1	Suboptimal debulking	N/A	Uneventful follow-up for the following 18 months	18	N/A
			24	N/A	Left	N/A	N/A	LSO, suboptimal debulking, BEP	N/A	6	IEP, hepatic resection, cholecystectomy, optimal debulking	N/A	The patient remained disease-free over the ensuing 7 years.	84	N/A
			25	N/A	Left	N/A	N/A	LSO, suboptimal debulking, BEP	N/A	1	Suboptimal debulking	N/A	The patient remained disease-free for the following 15 months	15	N/A
			48	N/A	Left	N/A	N/A	LSO, BEP	N/A	132	Optimal debulking	N/A	1-year disease-free	12	N/A
			19	N/A	Right	N/A	N/A	RSO, BEP	N/A	12	Laparoscopic surgery	N/A	1-year stable disease	12	N/A
Kampan et al[17]	2012	1	17	Noticeable pelvic mass	Left	N/A	Elevated CA-125	LSO	Elevated CA-125	12	6 courses of CP, staging laparotomy	N/A	The patient remained with no recurrence 8 months after her last surgery	8	N/A
Al-Jumaily et al[27]	2012	1	12	Lower abdominal pain and distension	Right	N/A	Elevated AFP and HCG	RSO, BEP and VAC	Negative	6	Laparotomy	N/A	The patient was in complete remission 32 months after resentation	32	N/A
Mrabti et al[28]	2011	1	18	Abdominal pain	Right	22 × 18	Elevated AFP	Hysterectomy, oophorectomy, 6 cycles of EP	Negative	6	Laparotomy with an optimal cytoreduction	25 × 21 × 11.5	The patient remained healthy 60 months after the second surgery	60	N/A
Lorusso et al[20]	2011	2	33	Abdominal volume and pelvic pain	Right	11.4 × 9.9 × 9.6	N/A	Fertility-sparing surgery, 4 courses of BEP	Negative	N/A	Surgical excision of liver masses	5	The patient remained disease-free at median follow up of 6 months	6	N/A
			19	Pelvic pain	Left	N/A	N/A	Fertility-sparing surgery, 4 courses of BEP	Elevated AFP	N/A	Surgical excision of liver masses	5	The patient remained disease-free at median follow-up of 6 months	6	N/A
Kikawa et al[29]	2011	1	36	Lower abdominal pain	Left	12 × 7	Elevated AFP, CA-125, and CA-199	LSO, 3 cycles of BEP	Negative	6	3 cycles fo BEP, laparotomy	8.1	The patient remained disease-free 6 months after her last surgery	6	N/A
Sengar et al[30]	2010	1	26	Abdominal pain	Right	N/A	Elevated AFP and CA-125	Laparoscopic RSO	N/A	4	3 courses of BEP, surgical salvage with fertility preservation	17	The patient was disease-free at 6 months follow-up	6	N/A
Rashmi et al[31]	2010	1	19	Abdominal distension	Left	25 × 20	Elevated AFP and CA-125	LSO, chemotherapy	N/A	36	Laparotomy	22 × 21 × 10	The patient remained disease-free 20 months after her last surgery	20	N/A
Matsushita et al[32]	2010	1	30	Increas ing abdominal girth	Right	15	Elevated AFP and CA-125	Fertility-sparing surgery, RSO, 4 cycles of BEP	Negative	97	Laparoscopic surgery	5 × 3.3 × 2.5	The patient survived without evidence of disease 6 months after the second surgery	6	Yes
Tzortzatos et al[33]	2009	1	20	Lower abdominal pain	Right	7 × 5	N/A	Laparoscopic surgery, RSO, 3 cycles of BEP	Negative	24	Second operation	1	The patient gave birth once and remained no recurrence 6 years after the last surgery	72	Yes
Hsieh et al[34]	2009	1	29	Abdominal discomfort, abdominal mass	Left	21 × 21 × 13	N/A	Laparotomy, LSO, 3 cycles of BEP	Negative	N/A	Laparotomy	8	The patient remained no recuurence 6 months after the second debulking operation	6	N/A
Hariprasad et al[35]	2008	3	18	N/A	Right	N/A	N/A	RSO	N/A	8	4 cycles of BEP, complete debulking surgery	N/A	The patient remained disease-free 3 years after her last surgery	36	N/A
			26	Abdominal pain	Right	15.3 × 14.3	N/A	TAH, 4 cycles of BEP	Negative	N/A	Laparotomy	N/A	The patient remained disease-free 5 years after her last surgery	60	N/A

Author	Year	No. cases	Age	Presentation	Right or Left ovary	Primary main tumor size, cm	Tumor markers before first treatment	Primary main treatment	Tumor markers after primary treatment	Time interval, mo	Subsequent main treatment	Subsequent main tumor size, cm	Postoperative course	Follow-up after the diagnosis of GTS, mo	Successful preganancy
			27	Abdominal pain, distension	N/A	8.8 × 8	N/A	Laparotomy, 4 cycles of BEP	Negative	N/A	Laparotomy	N/A	The patient remained disease-free 9 months after her last surgery	9	N/A
Djordjevic et al[14]	2007	1	38	Abdominal pressure and weight loss	Right	45	Elevated AFP	RSO, debulking surgery chemotherapy	Negative	7	Debulking surgery, LSO, chemotherapy	N/A	18 years later, a trabecular carcinoid tumor developed in a mature teratoma as s ociated with the liver	216	N/A
Zagame et al[2]	2006	12	Median 15.5, range 9–29	N/A	N/A	N/A	Elevated AFP	Laparotomy, chemotherapy	Negative	Median 9, range 4–55	N/A	N/A	N/A	Median 144, range 9–198	N/A
Tangjitgamol et al[36]	2006	1	5	Abdominal pain	N/A	11	N/A	SO, 2 cycles of BEP, 2 cycles of VAC	Negative	N/A	Surgical resection	16	The patient remained disease-free 24 months after her last surgery	24	N/A
Dewdney et al[37]	2006	1	19	Abdominal pain, distention	Right	30	N/A	Laparotomy, 3 cycles of BEP	N/A	8	Laparotomy	25	The patient remained well with a new mass not resected	N/A	N/A
Umekawa et al[38]	2005	1	34	Abdominal mass	Right	30	Elevated AFP and CA-125	Laparotomy, 5 cycles of BEP	Negative	6	Laparotomy	N/A	The patient was alive for 18 months after the last operation	18	N/A
Rekha et al[39]	2005	1	26	Acute abdominal pain	Left	N/A	N/A	Laparotomy, 3 cycles of BEP	N/A	N/A	Laparotomy	N/A	The patient was disease-free at 3-year follow-up	36	N/A
Nimkin et al[40]	2004	1	12	Abdominal girth	Right	25 × 25 × 20	Elevated AFP and CA-125	Laparotomy, chemotherapy	Negative	12	Laparotomy	N/A	3 times' laparotomy for the next 12 years	144	N/A
Amsalem et al[8]	2004	1	12	Abdominal pain and swelling	Left	30	Elevated AFP, CA-125 and LDH	Left adnexectomy, 3 courses of BVP	Negative	7	Complete infracolic omentectomy and paraortic lymph nodes dissections	3	The patient remained no sign of recurrence during 2 years follow-up	24	N/A
Inaoka et al[41]	2003	1	5	Abdominal bloating	Right	N/A	Elevated AFP and CA-125	Surgical resection, chemotherapy	Negative	6	Surgical resection	N/A	The disease remained stable for 3 years	36	N/A
Itani et al[42]	2002	1	24	Abdominal distention	Right	16	N/A	Surgical resection, 3 cycles of PEP	Negative	15	Cytoreductive surgery	11 × 6	The patient presented no evidence of disease for 17 months after the last surgery	17	N/A
David et al[43]	2002	1	24	Abdominal mass	Right	19 × 16 × 9.5	Elevated AFP and CA-125	Laparotomy, RSO, 4 cycles of BEP	Negative	8	Debulking surgery	4	The patient remained no evidence of recurrence 12 months after the last surgery	12	N/A
Andre et al[16]	2000	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	The patient died 65 months after diagnosis	65	N/A
			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Geisler et al[44]	1994	3	20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17	N/A
			22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	28	N/A
			20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A
Kattan et al[45]	1993	1	38	Abdominal tenderness	Right	20	Elevated AFP	Laparotomy, left ovariectomy, chemotherapy	N/A	N/A	N/A	N/A	N/A	12	N/A
Jumean et al[46]	1992	1	30	N/A	N/A	17	N/A	Laparotomy, chemotherapy	N/A	N/A	N/A	N/A	N/A	84	N/A
Moskovic et al[47]	1991	4	33	N/A	Right	N/A	N/A	TAH, BSO, chemotherapy	N/A	6	Laparotomy, chemortherapy	N/A	The patient remained well	N/A	N/A
			34	N/A	Left	N/A	N/A	LSO	N/A	14	Laparotomy	5	The patient remained well	N/A	N/A
			12	N/A	Right	N/A	N/A	RSO	N/A	N/A	Laparotomy	N/A	N/A	N/A	N/A

Author	Year	No. cases	Age	Presentation	Right or Left ovary	Primary main tumor size, cm	Tumor markers before first treatment	Primary main treatment	Tumor markers after primary treatment	Time interval, mo	Subsequent main treatment	Subsequent main tumor size, cm	Postoperative course	Follow-up after the diagnosis of GTS, mo	Successful preganancy
			23	N/A	N/A	N/A	N/A	Laparotomy, chemotherapy	N/A	5	Laparotomy	N/A	The patient remained well	N/A	N/A
Aronowitz et al[48]	1983	2	14	Lower abdominal pain	Right	16	N/A	Laparotomy, RSO, chemotherapy	Negative	N/A	Laparotomy	N/A	The patient presented no evidence of disease for more than a year	12	N/A
			15	Lower abdominal pain	Left	N/A	N/A	LSO, chemotherapy	N/A	12	RSO	12	The patient presented no evidence of disease	N/A	N/A
DiSaia et al[6]	1977	3	Range 18–20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Range 18–42	N/A

AFP = alpha-fetoprotein, BEP = bleomycin + etoposide + cisplatin, BSO = bilateral salpingooophorectomy, BVP = bleomycin + VP-16 + cisplatin, CA-125 = carbohydrate antigen 125, CA-199 = carbohydrate antigen 199, CP = carboplatin + paclitaxel, CVA = carbonin + vincristin + actinomycin D, EP = etoposide + cisplatin, GTS = growing teratoma syndrome, HCG = human chorionic gonadotropin, IEP = ifosfamide + etoposide + cisplatin, LDH = lactate dehydrogenase, LSO = left salpingo-oophorectomy, N/A = not available, PEP = peplomycin + etoposide + cisplatin, RSO = right salpingo-oophorectomy, SO = salpingooophorectomy, TAH = total abdominal hysterectomy, VAC = vincristine + actinomycin + cyclophosphamide.

PATIENT CONSENT

Patient consent was obtained for this study.

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