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 refused adjuvant chemotherapy with bleomycin, 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 insensitivity 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 = bleomycin 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 bleomycin, etopside, and cisplatin (BEP) chemotherapy...
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. 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. The histopathology revealed benign mature teratoma without viable germ cell elements.

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. Some researchers considered that these 2 characters are in fact the same entity. There are 2 major inferences of GTS formation. The first hypothesis is that chemotherapy transforms malignant cells into “benign” teratoma elements. The second hypothesis is that chemotherapy can only destroy malignant cells leaving chemoresistant teratoma behind. 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 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
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 cm³/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.7,13 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.7,13 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.25 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 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).

**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.
| Author                  | Year | No. cases | Age | Presentation                  | Right or Left ovary | Primary main tumor size, cm | Primary tumor markers before first treatment | Primary tumor markers after primary treatment | Time interval, mo | Subsequent main tumor size, cm | Subsequent tumor markers after primary treatment | Postoperative course | Follow-up after the diagnosis of GTS, mo | Successful pregnancy |
|------------------------|------|-----------|-----|-------------------------------|--------------------|-----------------------------|---------------------------------------------|---------------------------------------------|-----------------|-----------------------------|-----------------------------------------------|-------------------|-----------------------------|-------------------|
| Bentivegna et al       | 2015 | 28        | N/A | Abdominal distention         | Right              | N/A                         | Elevated AFP and CA-125                    | Elevated AFP and CA-125                      | N/A             | Elevated AFP and CA-125    | Laparoscopic surgery                             | Fertility-preserving surgery, adjuvant surgery, chemotherapy for 27 patients except 1 | 12               | N/A                         | Yes               |
| Shigeta et al          | 2015 | 1         | 20  | Abdominal distention         | Left               | 17                          | Elevated AFP and CA-125                    | Elevated AFP and CA-125                      | 17              | Elevated AFP and CA-125   | LSO, 3 cycles of BEP                              | 5                 | No evidence of recurrence | 12               | N/A                         |
| Pendlebury et al       | 2015 | 21        | 21  | Abdominal and pelvic pain    | Left               | 12 × 9.5 × 8                 | Elevated AFP and CA-125                    | Elevated AFP                                 | 2              | Elevated AFP               | Laparotomy, EP                                    | 2                 | No evidence of recurrence | 36               | N/A                         |
| Merard et al           | 2015 | 2         | 27  | Abdominal and back pain      | Left               | 19.4 × 10.3 × 1.53           | Elevated CA-125                            | Elevated CA-125                              | N/A             | Elevated CA-125           | LSO, 3 cycles of BEP                              | N/A               | N/A                         | 8                 | Yes                         |
| Dieter et al           | 2015 | 1         | 4   | Vomiting, increasing abdominal girth | Right              | 20 × 12 × 9.2                | Elevated AFP and CA-125                    | Elevated AFP and CA-125                      | 5              | Elevated AFP and CA-125   | RSO, 4 cycles of BEP                              | 5                 | Reaction of the subcapsular liver lesion, 2 cycles of BEP | 108              | N/A                         |
| Panda et al            | 2014 | 1         | 29  | Abdominal distension         | Right              | 6 × 5.5 × 4                  | Elevated AFP and HCG                       | Elevated AFP and HCG                        | 12             | Elevated AFP and HCG      | RSO, 3 cycles of BEP                              | N/A               | N/A                         | N/A               | N/A                         |
| Han et al              | 2014 | 5         | 13  | Abdominal distension         | Right              | N/A                         | Elevated AFP and HCG                       | Elevated AFP and HCG                        | 5              | Elevated AFP and HCG      | RSO, BEP                                       | 5                 | Second operation            | N/A               | N/A                         |
|                        |      |           |     |                               | Right              | N/A                         | Elevated AFP and HCG                       | Elevated AFP and HCG                        | 16             | Elevated AFP and HCG      | LSO, BEP                                       | 16                | Second operation            | N/A               | N/A                         |
|                        |      |           |     |                               | Right              | N/A                         | Elevated AFP and HCG                       | Elevated AFP and HCG                        | 8              | Elevated AFP and HCG      | LSO, BEP                                       | 8                 | Second operation            | N/A               | 6.4                         |
|                        |      |           |     |                               | Right              | N/A                         | Elevated AFP and HCG                       | Elevated AFP and HCG                        | 2              | Elevated AFP and HCG      | LSO, BEP                                       | 2                 | Second operation            | 3                 | 5.5                         |
|                        |      |           |     |                               | Right              | N/A                         | Elevated AFP and HCG                       | Elevated AFP and HCG                        | 21             | Elevated AFP and HCG      | LSO, BEP                                       | 21                | Second operation            | 2                 | N/A                         |
| De Cuyper et al        | 2014 | 1         | 19  | Abdominal and pelvic discomfort | Left              | 20                          | Elevated AFP and LHI                       | Elevated AFP and LHI                        | 13             | Elevated AFP and LHI      | Laparoscopic surgery, 4 cycles of BEP            | N/A               | N/A                         | 48                | N/A                         |
|                        |      |           |     |                               | Left               | 15                          | Elevated AFP and CA-125                    | Elevated AFP and CA-125                      | 60             | Elevated AFP and CA-125   | LSO, 6 cycles of BEP                              | 60                | Laparotomy                  | 11                | N/A                         |
| Shibata et al          | 2013 | 1         | 14  | Abdominal fullness           | Left               | 15                          | Elevated AFP and CA-125                    | Elevated AFP and CA-125                      | N/A             | Elevated AFP and CA-125   | LSO, 6 cycles of BEP                              | N/A               | N/A                         | 11                | N/A                         |
| Kato et al             | 2013 | 2         | 30  | Abdominal symptoms           | Right              | N/A                         | Elevated AFP and CA-125                    | Elevated AFP and CA-125                      | Negative        | Elevated AFP and CA-125   | Surgical resection, chemotherapy with PEP        | 96                | Laparoscopic surgery        | 5                 | Yes                         |
|                        |      |           |     |                               | Right              | N/A                         | Elevated AFP and CA-125                    | Elevated AFP and CA-125                      | Negative        | Elevated AFP and CA-125   | Surgical resection, chemotherapy with PEP        | 264               | Surgical resection           | 8                 | Yes                         |

**Note:** LSO = Laparoscopic surgery, BEP = Bevacizumab, Etoposide, cisplatin.
| Author                   | Year | No. cases | Age | Presentation                                                                 | Right or Left ovary | Primary main tumor size, cm | Primary markers before first 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 pregnancy |
|-------------------------|------|-----------|-----|-------------------------------------------------------------------------------|---------------------|-----------------------------|---------------------------------------|--------------------------------------|-----------------|----------------------------|---------------------------|-------------------------|-----------------------------|---------------------|
| Byrd et al             | 2013 | 5         | 48  |                                                                             | N/A                 | N/A                         | N/A                                   | TAH, BSO, BEP                         | N/A             | 1 Suboptimal debulking    | N/A                       | N/A                     | 18                         | N/A                 |
|                         |      |           |     |                                                                             | Left                | N/A                         | N/A                                   | LSO, suboptimal debulking, BEP         | N/A             | 6 IEP, hepatectomy, cholecystectomy, optimal debulking, suboptimal debulking | N/A                       | N/A                     | 84                         | N/A                 |
|                         |      |           |     |                                                                             | Left                | N/A                         | N/A                                   | LSO, suboptimal debulking              | N/A             | 1 Suboptimal debulking    | N/A                       | N/A                     | 15                         | N/A                 |
|                         |      |           |     |                                                                             | Left                | N/A                         | N/A                                   | LSO, BEP, RSO, BEP                    | N/A             | 12 Optimal debulking Lape    | N/A                       | N/A                     | 12                         | N/A                 |
|                         |      |           |     |                                                                             | Left                | N/A                         | N/A                                   | Elevated CA-125                        | 12              | 1 IEP, hepatic resection, cholecystectomy, optimal debulking | N/A                       | N/A                     | 18                         | N/A                 |
| Kampan et al           | 2012 | 1         | 17  | Noticable pelvic mass                                                      | Right               | N/A                         | N/A                                   | Elevated CA-125                        | 12              | 6 courses of CP, staging laparotomy | N/A                       | N/A                     | 12                         | N/A                 |
| Al-Jumaily et al       | 2012 | 1         | 12  | Abdominal pain and distension                                             | Right               | 22 × 18                      | Elevated AFP                          | Negative                              | 6               | Laparotomy                 | N/A                       | N/A                     | 32                         | N/A                 |
| Meubri et al           | 2011 | 1         | 18  | Abdominal pain                                                              | Right               | 11.4 × 9.9 × 9.6             | Elevated AFP                          | Negative                              | 6               | Laparotomy with an optimal cytoreduction | N/A                       | N/A                     | 60                         | N/A                 |
| Lommao et al           | 2011 | 2         | 33  | Abdominal volume and pelvic pain                                           | Right               | 11.4 × 9.9 × 9.6             | Elevated AFP                          | Negative                              | N/A             | Surgical excision of liver masses | N/A                       | N/A                     | 5                          | N/A                 |
|                         |      |           |     |                                                                             | Left                | N/A                         | N/A                                   | Fertility-sparing surgery, 4 courses of BEP | N/A             | Surgical excision of liver masses | N/A                       | N/A                     | 5                          | N/A                 |
| Kikawa et al           | 2011 | 1         | 36  | Lower abdominal pain                                                        | Left                | 12 × 7                       | Elevated AFP, CA-125                   | Negative                              | 6               | 3 cycles to BEP, laparotomy | N/A                       | N/A                     | 6                          | N/A                 |
| Sanogu et al           | 2010 | 1         | 26  | Abdominal pain                                                              | Right               | Elevated AFP, CA-125, and CA-199 | Elevated AFP                          | Negative                              | 6               | 3 courses of BEP, laparotomy | N/A                       | N/A                     | 6                          | N/A                 |
| Radhime et al          | 2010 | 1         | 19  | Abdominal distension                                                        | Left                | 25 × 20                      | Elevated AFP, CA-125, and CA-199       | LSO, chemotherapy                      | N/A             | Laparotomy                  | N/A                       | N/A                     | 20                         | N/A                 |
| Matsuboto et al        | 2010 | 1         | 30  | Increasing abdominal girth                                                  | Right               | 15                          | Elevated AFP, CA-125                   | Fertility-sparing surgery, 4 courses of BEP | Negative | 97 Laparoscopic surgery 5.3 | N/A                       | N/A                     | 6                          | Yes                 |
| Tavrantzis et al       | 2009 | 1         | 20  | Abdominal pain                                                              | Right               | 7 × 5                        | Elevated AFP                          | Lape, surgery with fertility preservation | Negative | 24 Second operation | N/A                       | N/A                     | 72                         | Yes                 |
| Heish et al            | 2009 | 1         | 29  | Abdominal discomfort, abdominal mass                                        | Left                | 21 × 21 × 13                 | Elevated AFP, CA-125                   | Lape, surgery with fertility preservation | Negative | 8 Laparotomy                  | N/A                       | N/A                     | 6                          | N/A                 |
| Harip and et al        | 2008 | 3         | 18  |                                                                                | Right               | N/A                         | RSO                                    | 4 cycles of BEP                        | N/A             | Laparotomy                  | N/A                       | N/A                     | 36                         | N/A                 |
|                         |      |           |     |                                                                                | Left                | 15.3 × 14.3                  | TAH, 4 cycles of BEP                    | Negative                              | N/A             | Laparotomy                  | N/A                       | N/A                     | 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 pregnancy |
|-----------------|------|-----------|-----|------------------------------------|---------------------|----------------------------|-------------------------------------|----------------------------------------|-------------------------------|-----------------|----------------------------------------|---------------------------|---------------------|-------------------------------|---------------------|
| Djordjevic et al | 2007 | 1         | 38  | Abdominal pain and weight loss     | Right               | 8.8 × 8                    | N/A                                 | Elevated AFP                         | Negative                     | 45              | RISO, debulking surgery, doxorubicin | Negative               | N/A                               | 9                             | N/A                         |
| Zagame et al    | 2006 | 12        | Median 15.5, range 9–29 | N/A | N/A                              | Elevated AFP         | N/A                                 | Laparotomy, doxorubicin              | Negative                     | Laparotomy               | N/A                       | Median 9, range 4–55 | N/A                          | N/A                      |
| Tangjitgamol et al | 2006 | 1         | 5   | Abdominal pain                     | N/A                 | 11                         | N/A                                 | Surgical resection                   | Negative                     | 25              | N/A                       | N/A                       | 16                             | 16                           | N/A                      |
| Dewdney et al   | 2006 | 1         | 19  | Abdominal pain, distention         | Right               | 30                         | N/A                                 | Laparotomy, 3 cycles of BEP          | N/A                          | 8               | Laparotomy               | N/A                       | 18                             | 18                           | N/A                      |
| Umeda et al     | 2005 | 1         | 34  | Abdominal mass                     | Right               | 30                         | Elevated AFP and CA-125             | Laparotomy, 5 cycles of BEP          | Negative                     | 6               | Laparotomy               | N/A                       | 36                             | 36                           | N/A                      |
| Rikha et al     | 2005 | 1         | 26  | Acute abdominal pain               | Left                | N/A                        | Elevated AFP and CA-125             | Laparotomy, 3 cycles of BEP          | Negative                     | 12              | Laparotomy               | N/A                       | 144                            | 144                          | N/A                      |
| Nimkin et al    | 2004 | 1         | 12  | Abdominal girth                    | Right               | 25 × 25 × 20                | Elevated AFP and CA-125             | Laparotomy, doxorubicin              | Negative                     | 12              | Laparotomy               | N/A                       | 3                             | 3                            | N/A                      |
| Amsalem et al   | 2004 | 1         | 12  | Abdominal pain and swelling        | Left                | 30                         | Elevated AFP and CA-125             | Laparotomy, 3 cycles of BEP          | Negative                     | 7               | Complete infracolic omentectomy and para-aortic lymph node dissection | Surgical resection         | N/A                             | 24                           | N/A                      |
| Inokusa et al   | 2003 | 1         | 5   | Abdominal bloating                 | Right               | 30                         | Elevated AFP and CA-125             | Laparotomy, doxorubicin              | Negative                     | 6               | Surgical resection         | N/A                       | 36                             | 36                           | N/A                      |
| Irmie et al     | 2002 | 1         | 24  | Abdominal distention               | Right               | 16                         | Elevated AFP and CA-125             | Laparotomy, 3 cycles of PEP          | Negative                     | 15              | Cytoreductive surgery        | 11 × 6                   | 17                             | 17                           | N/A                      |
| David et al     | 2002 | 1         | 24  | Abdominal mass                     | Right               | 19 × 16 × 9.5               | Elevated AFP and CA-125             | Laparotomy, 4 cycles of BEP          | Negative                     | 8               | Debulking surgery          | 4                         | 12                             | 12                           | N/A                      |
| Andre et al     | 2000 | 3         | N/A | N/A                                | N/A                 | N/A                        | N/A                                 | N/A                                    | N/A                          | N/A             | N/A                        | N/A                       | 65                             | 65                           | N/A                      |
| Geider et al    | 1994 | 3         | N/A | N/A                                | N/A                 | N/A                        | N/A                                 | N/A                                    | N/A                          | N/A             | N/A                        | N/A                       | N/A                             | 43                           | N/A                      |
| Kates et al     | 1993 | 1         | 38  | Abdominal tenderness               | Right               | 20                         | Elevated AFP                      | Laparotomy, left omentectomy, doxorubicin | Negative                 | 20              | RISO, debulking surgery, doxorubicin | Negative               | N/A                             | 28                           | N/A                      |
| Janecu et al    | 1992 | 1         | 30  | N/A                                | N/A                 | 17                         | N/A                                 | Laparotomy, doxorubicin              | Negative                     | 17              | Laparotomy, chemotherapy    | N/A                       | N/A                             | 12                           | N/A                      |
| Moskovic et al  | 1991 | 4         | 33  | N/A                                | Right               | N/A                        | TAH, BSO, doxorubicin              | Laparotomy, chemotherapy             | N/A                          | 6               | Laparotomy, chemotherapy    | N/A                       | 84                             | 84                           | N/A                      |
|               |      |           | 34  | N/A                                | Left                | N/A                        | LSO                                | Laparotomy                           | 14                           | Laparotomy               | N/A                       | 5                             | 5                             | N/A                      |
|               |      |           | N/A | N/A                                | Right               | N/A                        | RISO                               | Laparotomy                           | N/A                          | 8               | N/A                        | N/A                       | 12                             | 12                           | N/A                      |

The patient remained disease-free 9 months after her last surgery.

The patient remained well with a new mass not resected.

The patient was alive for 18 months after the last operation.

The patient was disease-free at 3-year follow-up.

The patient presented no evidence of disease for 17 months after the last surgery.

The patient remained no evidence of recurrence 12 months after the last surgery.

The patient died 65 months after diagnosis.

The patient died at 12 months after surgery.
Follow-up after the diagnosis of GTS,
Successful Subsequent pregnancy
Subsequent Time Tumor markers after primary treatment

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PATIENT CONSENT
Patient consent was obtained for this study.

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