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ORIGINAL ARTICLE

Pediatric Malignant Ovarian Tumors: 15 Years of Experience at a Single Institution

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Background: Malignant ovarian tumors in children are relatively rare. We reviewed our 15-year experience to understand their clinical presentations, managements, and prognoses.
Methods: There were 15 children who were diagnosed to have malignant ovarian tumors from January 1994 to June 2009 in our hospital. The presenting symptoms, treatments, and outcomes were obtained retrospectively from the medical records.
Results: The median age at presentation was 13 years. The most common presenting symptom was abdominal pain, occurring in 10 patients (66.7%). The tumors were in the left side in 10 patients (66.7%). The pathologic diagnoses were yolk sac tumors in four patients, immature teratomas in four, dysgerminomas in three, malignant mixed germ cell tumors in three, and carcinosarcoma in one patient. According to the Federation Internationale de Gynecologie Oncologique classification, seven girls had Stage I, one had Stage II, and seven had Stage III disease. Thirteen patients received chemotherapy with platinum-based regimens. Three patients died of their disease: one of yolk sac tumor, one of malignant mixed germ cell tumor, and one of carcinosarcoma. They all had Stage III disease at diagnosis. The 10-year overall survival and disease-free survival rates were 77% and 69%, respectively.
Conclusions: Pediatric malignant ovarian tumors were highly curable disease if they were not in the advanced stage at presentation. Earlier consideration of malignant ovarian tumor in the differential diagnosis of young girls with abdominal pain is important.

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1. Introduction

Ovarian cancer is the fifth leading cause of death from cancer in women and the leading cause of death from gynecological cancer. It is thought of as a killer because early disease cause minimal, nonspecific, or even no symptoms so that most patients are diagnosed at an advanced stage. In adult women, most primary ovarian tumors arise from epithelial cells. This typically occurs in postmenopausal women. Epithelial ovarian cancer includes serous tumor, endometrioid tumor, and mucinous cystadenocarcinoma.[1] The 5-year survival rate for all stages of ovarian cancer is 45%.[2] In contrast, in children, malignant ovarian tumors are rare, germ cell tumors comprise most of them, and prognosis is better than for adult women.[3] There is limited information about such tumors in children. Thus, we reviewed medical records to understand the clinical behavior of this tumor.

2. Materials and Methods

From January 1994 to June 2009, 15 consecutive pediatric patients were diagnosed to have malignant ovarian tumors by histology in our institution. We recorded their symptoms, related examinations, surgical treatments, histopathology, treatment regimens, and responses. We used the Federation Internationale de Gynecologie Oncologique classification system for staging: Stage I, disease limited to ovaries; Stage II, tumor extended to the pelvis; Stage III, intraperitoneal dissemination; and Stage IV, distant metastases. Disease-free survival and overall survival (OS) estimates were calculated by Kaplan-Meier analysis. Disease-free survival period was defined from the date of complete remission to the date of recurrence, death, or last disease-free visit (months). OS period was defined from the date of registration to the date of death or last visit (months). Data were updated to December 31, 2009.

3. Results

The patient data are summarized in Table 1. The median age at presentation was 13 years (range, 3—17 years). The most common presenting symptoms, in descending order, were abdominal pain in 10 patients (66.7%), abdominal fullness in 6 (40%), abdominal mass in 3 (20%), fever in 3 (20%), and body weight loss in 2 (13.3%). Other symptoms included decreased appetite, pale face, and constipation. Ten patients (66.7%) had left ovarian involvement, and five patients (33.3%) had right ovarian involvement.

Tumor markers of alpha-fetoprotein (AFP) and β-human chorionic gonadotropin (β-hCG) were measured at diagnosis in 11 patients. The serum AFP and β-hCG were tested by radioimmunoassay. We found that seven patients had high AFP levels (range, 54.2—more than 10,000 ng/mL; five of them had more than 10,000 ng/mL, three of those five had 20,334 ng/mL, 79,658 ng/mL, 397,160 ng/mL, respectively; for two patients, no further dilution was done). There were three patients who had high β-hCG levels (range, 23.9—165 mU/mL). Two patients had normal AFP and β-hCG levels. Diagnostic imaging, including abdominal echogram and abdominal computed tomography, was performed in all patients.

All patients received surgery. Ten patients had received unilateral salpingo-oophorectomy. Three patients had received excision of tumor, and one patient received unilateral oophorectomy. Bilateral salpingo-oophorectomy was performed in one patient. The pathologic diagnoses were yolk sac tumor in four, immature teratoma in four, dysgerminomas in three, malignant mixed germ cell tumors in three, and carcinosarcoma in one patient. Germ cell tumors comprised 93% of all malignant tumors. According to the Federation Internationale de Gynecologie Oncologique staging system, seven girls were classified as Stage I, one as Stage II, and seven as Stage III.

Thirteen of 15 patients received chemotherapy with platinum-based regimens. Twelve of them received bleomycin, etoposide, and cisplatin regimen, and the patient who had the diagnosis of carcinosarcoma received ifosfamide and cisplatin regimen. Number of cycles for chemotherapy was ranging from two to six. No major acute toxicity and no treatment-related deaths were observed.

One patient who was diagnosed with Stage I yolk sac tumor was found to have relapsed with peritoneal seeding after being off of chemotherapy for 25 months. She received further chemotherapy with cisplatin, ifosfamide, and etopisde for six cycles and had no evidence of disease till the date we analyzed. Three patients died of their disease: one of yolk sac tumor, one of mixed germ cell tumor, and one of carcinosarcoma. They were all in Stage III at diagnosis. Two of them received bleomycin, etoposide, and cisplatin regimen for four cycles, and the other received ifosfamide and cisplatin for three cycles. The 10-year OS and disease-free survival rates were 77% and 69%, respectively (Figure 1).

4. Discussion

Malignant ovarian tumors in children are relatively rare, representing approximately 1% of all childhood malignant tumors.[3] There were only 15 pediatric malignant ovarian tumor patients treated in our institution during the 15-year study period. These tumors were mostly diagnosed in adolescents between 16 years and 20 years.[4] In our study, the median age at presentation was 13 years.

The presenting symptoms are often nonspecific. The most common presenting symptoms in our patients were abdominal pain, followed by abdominal fullness and abdominal mass. Patients will become acutely symptomatic if they undergo hemorrhage, torsion, or rupture.[5,6] Most of the malignant ovarian tumors presented as unilateral masses. Metastasis at diagnosis and bilateral involvement were rare, consistent with other reports.[7]

Most malignant ovarian tumors in childhood and adolescence are germ cell tumors. Norris and Jensen[8] reviewed 353 ovarian tumors in young females and found germ cell tumors composed 80% of the preadolescent malignant ovarian tumors. Hassan et al[9] reported germ cell tumors comprised 49.1% of all malignant ovarian tumors in girls through age 19. Schultz et al[10] found that 67.5% of pediatric malignant ovarian tumors were germ cell tumors. In our study, germ cell tumors comprised 93% of all

Table 1 Clinical characteristics of pediatric malignant ovarian tumor patients

Patient	Age (y/o)	S/S	Tumor site	Tumor marker (before operation)	Pathology	Treatment	OP method	C/T regimen (cycles)	Stage	Current status	Survival (mo)
1	14	Pain	R	A↑, B↑, C↑, CEA N	YST	S + C/T	ATH+ BSO	PEB (4)	III	DOD	10
2	13	Fullness	L	A↑, B N, C↑, CEA N	YST	S + C/T	LSO	PEB (4)	III	Alive	>173
3	14	Fullness, anorexia	L	A↑, B N, C↑, CEA N	YST	S + C/T	LSO	PEB (5)	I	Alive, relapse 25 mo later	>76
4	8	Pain	L	NA	YST	S + C/T	LSO	PEB (4)	I	Alive	>77
5	5	Pain, body weight loss	L	A↑, B NA, C↑, CEA↑	Immature teratoma	S + C/T	LSO	PEB (4)	II	Alive	>7
6	3	Pain, mass	L	A↑, B NA, C NA, CEA NA	Immature teratoma	S	LSO	No	I	Alive	>36
7	15	Pain	R	NA	Immature teratoma	S + C/T	RO	PEB (6)	I	Alive	>109
8	8	Pain, mass, body weight loss, anorexia	R	A N, B N, C NA, CEA N	Immature teratoma	S	Excision	No	I	Alive	>87
9	14	Fullness	L	A N, B↑, C↑, CEA N	Dysgerminoma	S + C/T	LSO	PEB (3)	I	Alive	>172
10	11	Mass	R	A N, B↑, CN, CEA N	Dysgerminoma	S + C/T	RSO	PEB (4)	I	Alive	>82
11	17	Pain	L	NA	Dysgerminoma	S+ C/T	LSO	PEB (2)	III	Alive	>2
12	11	Fullness, fever	R	NA	MMGCT	S + C/T	Excision	PEB (4)	III	DOD	21
13	15	Pain, fullness, fever	L	A↑, B N, C NA, CEA NA	MMGCT	S + C/T	Excision	PEB (6)	III	Alive	>51
14	6	Pain, fullness, fever	L	A↑, B NA, C NA, CEA NA	MMGCT	S + C/T	LSO	PEB (6)	III	Alive	>24
15	13	Pain	L	A N, B NA, C↑, CEA NA	Carcinosarcoma	S + RTO + C/T	LSO	IP (3)	III	DOD	6

A = alpha-fetoprotein; ATH = abdominal total hysterectomy; B = beta-human chorionic gonadotropin; BSO = bilateral salpingo-oophorectomy; C = CA-125; CEA = carcinoembryonic antigen; C/T = chemotherapy; DOD = died of disease; IP = ifosfamide and cisplatin; L = left; LSO = left salpingo-oophorectomy; MMGCT = malignant mixed germ cell tumor; mo = months; N = normal; NA = not available; OP = operation; PEB = platinum, etoposide, and bleomycin; R = right; RO = right oophorectomy; RSO = right salpingo-oophorectomy; RTO = radiotherapy; S = surgery; S/S = symptoms/signs; y/o = year old; YST = yolk sac tumor.

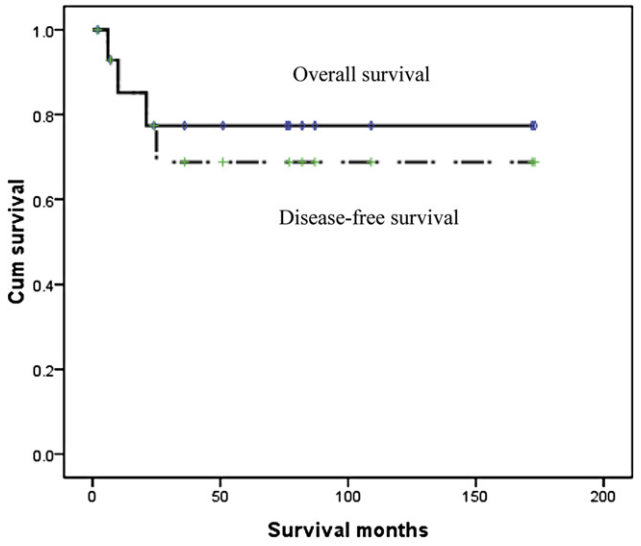

Figure 1 Overall survival and disease-free survival in 15 children with malignant ovarian tumors.

malignant tumors, and more than 80% of the patients were aged 15 or less. Therefore, germ cell tumor tends to occur in younger girls and nongerm cell tumor proportion is increased as the age increases.

Tumor markers are important for evaluating malignant ovarian tumors for diagnosis, relapse, and follow-up.[11] Various tumor markers have been used for monitoring the clinical status of malignant germ cell tumors, including AFP, β-hCG, human placental lactogen, pregnancy-specific β_1 glycoprotein, fibronectin, transferrin, α-antitrypsin, carcinoembryonic antigen, alkaline phosphatase, lactate dehydrogenase, cancer antigen-125, and neuron-specific enolase.[12,13] Among these tumor markers, AFP and β-hCG are the most used. AFP can be used as a tumor marker for endodermal sinus tumor, embryonal carcinoma, and malignant mixed germ cell tumor. Elevated levels of β-hCG can be seen in some patients with pure dysgerminoma, mixed germ cell tumor, embryonal carcinoma, and ovarian choriocarcinoma.[14]

There were five patients who had AFP level more than 10,000 ng/mL at diagnosis in our study. Three patients were diagnosed as having yolk sac tumor, and the other two were diagnosed as having malignant mixed germ cell tumor. Four of these five patients were classified as Stage III. The number of patients was small, yet high AFP at diagnosis seemed to mean higher stage. The levels of AFP after treatment were reported to reflect the treatment response.[15] Most patients in our study had AFP levels declined to normal range within 3 months after treatment. Nevertheless, one patient whose AFP increased rapidly 3 months after discontinuation of chemotherapy died 2 months after relapse, and another had AFP level elevated to 114 ng/mL before she was found to have relapsed tumor.

The treatment of ovarian tumors is complete surgical staging, followed by chemotherapy in cases beyond Stage I. Total tumor resection when possible is recommended by all studies, and salpingo-oophorectomy is the suggested surgical resection because cancer cells may spread to the fallopian tube through ovarian lymphatics.[7,16,17] Whether adjuvant chemotherapy can improve outcomes for patients with resected Stage I tumor containing immature neural elements and presence of foci of yolk sac tumor remains controversial. Marina et al[18] reported that 1 of the 13 girls with immature ovarian teratoma and microscopic foci of yolk sac tumor developed recurrent disease, whereas Williams et al[19] suggested that three courses of adjuvant cisplatin-based chemotherapy should be given to all well-staged patients with completely resected ovarian germ cell tumors to prevent recurrence. In our study, there were three patients diagnosed with Stage I immature teratoma who received complete resection. Of them, two did not receive chemotherapy, whereas one did receive chemotherapy; all were in continuous disease-free state till the date when we analyzed.

The combination of cisplatin, etoposide, and bleomycin has been used with excellent cure rates.[20–22] Rogers et al[21] reported patients with Stage I tumors had 6-year OS and event-free survival of 95.1% and 95.1%, respectively, and patients with Stage II disease had OS and event-free survival of 93.8% and 87.5% when treated with four cycles of cisplatin, etoposide, and bleomycin. In the St. Jude's experience, the response to treatment of malignant ovarian tumors of low stage was excellent when compared with patients with advanced disease.[23] In addition to achieving higher cure rates, platinum-based combination therapies were reported to be able to preserve normal menstrual function and maintain fertility with healthy offspring.[24,25] In this aspect, we lacked sufficient data to analyze.

We also analyzed various factors, including age, histology, stage, and levels of tumor marker, to see which one(s) could determine prognosis. There was no conclusive result, which maybe because of the limited number of patients. Cushing et al[22] reported that AFP greater than 10,000 ng/mL and β-hCG greater than 5000 mU/mL at diagnosis were unfavorable prognostic factors, whereas Murugaesu et al[26] stated that increasing stage and elevated AFP and β-hCG at presentation were independent adverse prognostic factors and elevated AFP during treatment meant high risk of treatment failure.

In conclusion, pediatric malignant ovarian tumor is a highly curable disease if not in the advanced stage at presentation. Earlier consideration of malignant ovarian tumor in the differential diagnosis of young girls with abdominal pain seems important.

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