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Demographic characteristics and prognostic factors in pediatric-type sarcomas; A 7 year single institutional experience and comprehensive review of the current literature

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► ***Original article***

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ABSTRACT

Background: Due to limited clinical data in pediatric-type sarcomas (rhabdomyosarcoma, Ewing's sarcoma, PNET, and desmoplastic small round-cell tumor), the aim of this study was to evaluate the demographic characteristics and identifying prognostic factors for survival. ***Materials and Methods***: We retrospectively reviewed 110 patients with pediatric-type sarcomas. Overall and disease free survival was analyzed with the Kaplan-Meier method and log rank test. To identify prognostic factors for overall and disease free survival, multivariate survival analyses using a Cox's proportional-hazard regression model was performed. ***Results:*** In this study mean age of patients were 20.30 years (SD=13.61; range, 1–83 years). The survival data of 54 patients (49.1%) were obtained with median survival of 27 months. 3 and 5-year survival rate of these patients were 41.5% and 28.3% respectively. Recurrence of disease (P=0.006) and Ewing sarcoma subtype (P=0.018) were significantly associated with poor overall survival and location of the lesion in the upper extremities (P=0.007) and trunk (P=0.005) were significantly associated with a lower disease free survival. ***Conclusion:*** With multivariate analysis, the authors determined that recurrence of disease and Ewing's sarcoma subtype are poor prognostic factors for overall survival and site of origin for disease free survival among patients with pediatric-type sarcoma. In addition, gender, patient's age, and size of tumor had no significant impact on overall and disease free survival.

Keywords: *Cancer, prognostic factor, sarcoma, small round cell, survival.*

INTRODUCTION

The family of small round-cell tumors (SRCTs) is aggressive and heterogeneous group of neoplasm that occurs mostly in children and young adults. Small round cell tumors comprise approximately 20% of the solid tumors in children [1,2]. This group of sarcomas, that is usually called pediatric-type sarcomas, includes rhabdomyosarcoma (RMS), Ewing sarcoma (EWS), primitive neuroectodermal tumor (PNET), and desmoplastic small round-cell tumor (DSRCT).

Ewing sarcoma is a typical round cell sarcoma with neuroectodermal differentiation that originates from bone and soft tissues [1]. Ewing sarcoma represents a spectrum of lesions described separately that include Ewing sarcoma, Askin tumor, and peripheral primitive neuroectodermal tumor (PNET) or peripheral neuroepithelioma, which designated collectively as Ewing sarcoma Family of Tumors (ESFT) [3,4]. ESFT may originate from osseous or non-osseous tissues and in multiple locations [5].

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Ewing sarcoma begins most often from the diaphysis of long bones in children and young adults and common site of origin are lower extremity (40-45%), pelvic bones (20-25%), Chest wall (15-20%), and upper extremity (10%). about 80% of patients with ESFT are younger than 20 years at diagnosis [6,7,8,9]. Soft tissue lesions are more common in older patients, and often involve deep soft tissues in central locations [10]. The primary tumors are typically painful, and may be confused with inflammatory and infectious lesions [11].

About 25% of Ewing sarcoma cases initially are metastatic [12,13]. The most frequent sites of metastases are the lungs, bones, and bone marrow. Other sites of metastases such as the lymph nodes, liver, or brain are relatively rare, unless in end-stage of disease [9].

Multimodality treatment with the use of systemic therapy in combination with local treatment, surgery, radiotherapy or both, has improved the overall survival to approximately 70% for localized disease and 30% for metastatic disease at 5-years [14,15]. For appropriate management and to minimize the risk of relapse of ESFT, Treatment guidelines consider several factors, such as site, size and stage of the tumor, and extent of response to neoadjuvant therapy in treatment protocol [16,17].

Desmoplastic small round cell tumor (DSRCT) is a better known aggressive mesenchymal malignancy that mainly involves children and young adults, who usually present with widespread involvement of the abdominal or peritoneal lined cavities [18,19]. DSRCT is a very aggressive malignancy, most often lethal, and only rarely responds to aggressive multimodality therapy [20,21].

Rhabdomyosarcoma is the most common soft tissue sarcoma in children, accounting for 3% to 4% of all cases of childhood cancer [22,23]. Rhabdomyosarcoma is more common in males and whites, and two-thirds of cases occur in patients under the age of 10 years [24,25]. Because rhabdomyosarcoma arises from a primitive mesenchymal cells, it can be found in multiple areas of the body, but the most common anatomic regions that involved by order of decreasing frequency are the head and neck (including the orbit and parameningeal areas), 35%, genitourinary tract (including the bladder, prostate, vagina, vulva, uterus, and paratesticular area), 22 %, and extremities, 18% [23]. Rhabdomyosarcoma has been traditionally classified into three histology, consisting of embryonal (including botryoid), alveolar, and pleomorphic subtypes [10,26]. The two major histologic subtypes are embryonal (60%) and alveolar (21%). Embryonal tumors affect younger male patients and most commonly arise in the head, neck, and genitourinary regions [24].

Due to limited clinical data in pediatric-type sarcomas, the aim of this study was to evaluate the characteristics of these tumors, identifying factors influencing clinical outcome, and to assess prognostic factors for survival. The current retrospective analysis is a series of patients of all ages who were treated for pediatric-type sarcomas at the Iran cancer institute (the most important referral cancer center) over a 7-year period.

MATERIALS AND METHODS

Upon Ethical committee approval at Tehran University of Medical Sciences, we retrospectively reviewed the medical records of all 110 patients with pediatric-type sarcomas (RMS, EWS, PNET, and DSRCT) who were treated at Iran cancer institute between 2001 and 2008 and we called them for follow up. From medical records and phone call follow-up, Specific data were collected with regard to the demographic data, histopathologic subtype, tumor site and size, clinical stage, surgical procedure, adjuvant treatment including chemotherapy and radiotherapy, and treatment outcome. Overall survival (OAS) was calculated from the time of diagnosis until the date of death or until the date of phone call follow-up if the patient was alive. Disease free survival (DFS) was calculated from the time of treatment completion until the date of disease recurrence in those with no residual tumor. Patients were considered to have negative margin(s) if the margins of surgery was 1 cm or greater. Prognostic factors such as gender, age,

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histological sub-type, primary tumor site, type of surgery and adjuvant therapy, including chemotherapy and radiotherapy, were analyzed.

Statistical analysis was performed using SPSS Version 21. All reported p-values are two-tailed. Overall and disease free survival was analyzed with the Kaplan-Meier method. Survival differences between subgroups assessed through the log rank test with $p<0.05$ considered significant. For comparison of various clinical factors in adults and children, chi -square test was used. Multivariate survival analyses using a Cox's proportional-hazard regression model were performed in order to identify prognostic factors for overall and disease free survival.

RESULTS

Clinical characteristics

In this study, 110 patients with pediatric-type sarcoma, including RMS, EWS, and PNET, were analyzed retrospectively. There were 68 male (61.8%) and 42 female (38.2%) patients with mean age of 20.30 years (SD=13.61; range, 1–83 years). Table1 shows demographic and clinical characteristics information in adults and children with pediatric-type sarcoma. Results of Chi-square test to compare various clinical factors in children and adults can be also seen in this table. We can see here that there is no statistically significant difference about distribution of variables between children and adults; this means that variables are equally distributed between children and adults. There was also no statistically significant correlation between tumor size and recurrence rate (P=0.59). The mean tumor size was 5.48±5.67 cm (with a range of 2 to 27cm) in greatest diameter. The tumor size at presentation was equal to or less than 5cm in 53 (48.2%), greater than 5cm in 34 (30.9%), and was unknown in 23 patients (20.9%). Of the patients, 103 were treated with radiotherapy; 92 of them (83.6%) were treated with curative and 11 (10%) with palliative radiotherapy. The mean radiation dose was 53.32Gy with a standard deviation of 9.28Gy (with a range of 22 to 66Gy).

Treatment outcome

Of 110 patients, the survival data of 54 patients (49.1%) were obtained with median survival of 27 months. At the time of the study, 12 (22.2%) of 54 patients were alive and 42 patients (77.8%) had died. 3-year and 5-year survival rate of these patients were 41.5% and 28.3% respectively. In addition, data of recurrence in 82 of 110 patients (74.5%) were obtained through their medical records and phone calls. Of these, 54 patients (65.9%) had experienced of local and systemic recurrence and 28 of them (34.1%) had experienced no recurrence at the time of study. 3 and 5-year DFS rates were 33.8 and 15.6% respectively. Table 2 shows 3 and 5-year overall and disease free survival rates according to pathological subtypes.

Table 3 shows overall and disease free survival rate based on various patient, tumor, and treatment factors. There was no statistically significant difference between adults and children in terms of OAS and DFS (P=0.695 and P=0.534 respectively) (figure 1). In addition, there was no significant difference between male and female (P=0.127), tumor size less than 5cm and greater than 5cm (P=0.525), radical surgery and surgical biopsy (P=0.129), performance of chemotherapy (P×0.768), and different site of origin (P=0.267) in terms of OAS rate. Palliative radiotherapy (P×0.005), recurrence of disease (P=0.005), and Ewing sarcoma/PNET subtypes (P=0.049) were significantly associated with worse OAS rate. The site of origin had no significant effect on OAS (P=0.267) but had significant impact on DFS rate (P=0.008).

Table 4 shows multivariate analysis using Cox regression hazard model to identify prognostic factors for overall and disease free survival. As shown in this table, recurrence of disease (HR, 2.535; 95% CI, 1.313 to 4.894; P=0.006) and Ewing sarcoma subtype (HR, 3.311; 95% CI, 1.208 to 7.507; P=0.018) were significantly associated with a lower OAS and location of the lesion in the upper extremities (HR, 3.647; 95% CI, 1.434 to 9.279; P=0.007) and trunk (HR, 4.748; 95% CI, 1.606 to 14.034; P=0.005) were significantly associated with a lower DFS.

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Table 1. Demographic and Clinical Characteristics of pediatric-type sarcomas in adults and children.

Clinical Characteristic	Children n(%)	Adults n(%)	Total n(%)	P-value*
Subtype				
Ewing's sarcoma	19(38.8)	30(61.2)	49(44.5)	0.231
PNET	10(41.7)	(58.3)14	24(21.8)	
Rhabdomyosarcoma	21(56.8)	(43.2)16	37(33.6)	
Gender				
Male	31(45.6)	37(54.4)	68(61.8)	0.971
Female	19(45.2)	23(54.8)	42(38.2)	
Site of origin				
Head and neck	11(50)	11(50)	22(20.2)	0.752
Trunk	3(33.3)	6(66.7)	9(8.3)	
Upper limb	12(57.1)	9(42.9)	21(19.3)	
Lower limb	15(41.7)	21(58.3)	36(33)	
pelvis	7(36.8)	12(63.2)	19(17.4)	
Other sites	1(50)	1(50)	2(1.8)	
Tumor Size				
=<5cm	27(50.9)	26(49.1)	53(48.2)	0.347
>5cm	12(35.3)	22(64.7)	34(30.9)	
unknown	11(47.8)	12(52.2)	23(20.9)	
Chemotherapy				
yes	43(44.3)	54(55.7)	97(88.2)	0.482
no	4(44.4)	5(55.6)	9(8.2)	
unknown	3(75)	1(25)	4(3.6)	
Radiotherapy				
Curative	42(45.7)	50(54.3)	92(83.6)	0.990
Palliative	5(45.5)	6(54.5)	11(10)	
no	3(42.9)	4(57.1)	7(6.4)	
Intention of surgery				
Curative	23(43.4)	30(56.6)	53(48.2)	0.914
Biopsy only	26(47.3)	29(52.7)	55(50)	
unknown	1(50)	1(50)	2(1.8)	
Local Recurrence				
Yes	13(38.2)	21(61.8)	34(30.9)	0.309
No	37(48.7)	39(51.3)	76(69.1)	
Systemic Recurrence				
Yes	(41.4)12	(58.6)17	29(26.4)	0.608
No	(46.9)38	(53.1)43	81(73.6)	
Sign and Symptoms				
Palpable mass	27(46.6)	31(53.4)	58(52.7)	0.634
Pain	13(39.4)	20(60.6)	33(30)	
Other	10(52.6)	9(47.4)	19(17.3)	

Data are presented as *n(%)*.
*Chi-square test.

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Table 2. Three and 5-year survival and DFS rate according to pathological subtype.

	3-ear survival (%)	5-year survival (%)	3-year DFS (%)	5-year DFS (%)
RMS	69.3	38.5	45.4	22.7
Ewing sarcoma	31.3	25	31.6	13.2
PNET	44.4	22.2	23.6	11.8

RMS = Rhabdomyosarcoma; PNET = primitive neuroectodermal tumor, DFS = disease free survival

Table 3. Analysis of OAS and DFS using the Kaplan-Meier method.

Factor	OAS		DFS	
	n	P-value*	n	P-value*
Gender				
Female	18	0.127	34	0.880
Male	36		43	
Age				
<18yr	25	0.695	31	0.534
>=18yr	29		46	
Site of Origin				
Head and Neck	11	0.267	13	0.008
Upper Limb	9		16	
Trunk	4		8	
Pelvis	7		12	
Lower Limb	20		25	
Surgical Intention				
Radical	26	0.129	37	0.374
Biopsy	27		38	
Radiotherapy				
No	4	<0.005	3	0.001
Curative	42		64	
Palliative	8		10	
Chemotherapy				
No	7	0.768	7	0.842
Yes	45		67	
Recurrence				
No	27	<0.005		
Yes	26			
Size of Tumor				
>5cm	27	0.525	37	0.515
<=5cm	16		24	
Pathologic subtype				
RMS	13	0.049	22	0.351
Ewing sarcoma	32		38	
PNET	9		17	

* Log Rang test

RMS = Rhabdomyosarcoma; PNET = primitive neuroectodermal tumor; OAS = overall survival; DFS = disease free survival; n = the number of patients who could be evaluated

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Table 4. Multivariate analysis of prognostic Factors for OAS and DFS.

Risk Factor	OAS		DFS	
	HR	P-value*	HR	P-value*
Gender				
Female	1.00		1.00	
Male	1.739 (0.852-3.552)	0.129	0.985 (0.548-1.676)	0.881
Age				
<18yr	1.00		1.00	
>=18yr	1.129 (0.608-2.094)	0.701	1.195 (0.676-2.112)	0.540
Site of Origin				
Head and Neck	1.00		1.00	
Upper Limb	2.370 (0.747-7.521)	0.143	3.648 (1.434-9.279)	0.007
Trunk	3.181 (0.846-11.967)	0.087	4.748 (1.606-14.034)	0.005
Pelvis	2.390 (0.727-7.859)	0.151	1.973 (0.686-5.677)	0.208
Lower Limb	2.062 (0.751-5.659)	0.160	1.671 (0.669-4.169)	0.271
Recurrence				
No	1.00			
Yes	2.535 (1.313-4.894)	0.006		
Surgery				
Radical	1.00		1.00	
Biopsy	1.609 (0.851-3.042)	0.143	0.776 (0.440-1.370)	0.382
Chemotherapy				
No	1.00		1.00	
Yes	1.168 (0.442-2.958)	0.783	1.110 (0.394-3.125)	0.843
Size of Tumor				
>5cm	1.00		1.00	
<=5cm	1.244 (0597-2.592)	0.559	0.811 (0.428-1.539)	0.522
Pathologic subtype				
RMS	1.00		1.00	
Ewing sarcoma	3.011 (1.208-7.507)	0.018	0.755 (0.395-1.445)	0.397
PNET	2.198 (0.733-6.588)	0.160	1.239 (0.582-2.638)	0.579

* Cox Regression test

RMS = Rhabdomyosarcoma; PNET = primitive neuroectodermal tumor; OAS = overall survival; DFS = disease free survival; HR = hazard ratio

DISCUSSION

We retrospectively evaluated 110 patients with pediatric-type sarcomas including RMS, EWS, PNET, and DSRCT. During these years, no cases of DSRCT have been reported. As shown in table 1, there are no significant differences in distribution of various factors related to the patients, tumor, and treatment among children and adults.

Ewing's sarcoma was the most common pathological sub-type in this study (44.5%) that is consistent with the findings of similar studies [27,28]. In this investigation, the most common site of origin was lower extremity (33%) and the most common presenting sign was palpable mass (52.7%) that unlike soft tissue non small cell sarcomas, in 30% of cases were associated with pain. These findings are also consistent with results reported about Ewing sarcoma in other investigations [6,7,8,27]. Second most common site of origin was head and neck (20.2%) that is due to a higher incidence of RMS in head and neck region [23].

Several studies have been conducted to investigate the prognostic factors in pediatric-type sarcomas, but all of them have some limitations that are mentioned ahead [6,7,10,

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14,15,25,27-37):

1. Almost all of these studies are retrospective and to the best of our knowledge, there is no prospective trial to investigate these factors in children and adults or based on various pathological subtypes.
2. With the exception of two investigations [27,28], other studies have not examined all sub-types of small round cell sarcoma of children and in all of these investigations, only one subtype of disease has been studied.
3. Many of these studies included a small number of patients with pediatric-type sarcoma; therefore, have insufficient statistical power to detect significant difference between subgroup of patients in term of OAS or DFS.

These limitations associated with non-homogeneity of the studies, have led to different and sometimes contradictory results in various reports; consequently, makes it difficult to conclude about the prognostic factors of pediatric–type sarcomas in children and adults.

As shown in table 2, the 5 year survival in our study is lower than other reports [14, 15]. One reason for lower survival rate in this study may be our institute that is a referral center and more complex, recurrent and metastatic cases are referred to it. Another reason is nature of the study that is retrospective and a significant number of patients (50.9%) did not return for follow up and we could not be able to determine their survival status even with phone call.

In our study, there was no significant difference between men and women in terms of OAS (HR, 1.739; 95% CI, 0.852 to 3.552; P= 0.129) and DFS (HR, 0.982; 95% CI, 0.548 to 1.676; P=0.881); these results means that gender had no significant effect on patient's outcome (table 4). In other studies that have been done retrospectively, the gender is not mentioned as a prognostic factor with the exception of two retrospective studies that first performed by Bacci *et al*. who have reported male gender had adverse prognostic effect in metastatic Ewing's sarcoma in terms of event-free survival (EFS) [29]. In the second retrospective study that performed by Jawad *et al*. on 5317 Ewing® sarcoma patients from SEER database, authors reported that women had a survival benefit only in Caucasian patients [7].

Several retrospective studies in patients with pediatric-type sarcoma have shown different, and sometimes contradictory, effect of age on patient's outcome. A number of these studies have reported that results of treatment in children are better than adult patients. In a retrospective study that performed by Lee *et al*. on 725 patients with Ewing's sarcoma, the authors have reported that adult age is adverse prognostic factor in terms of OAS [30]. In another study that performed by Baldini *et al*. on 37 patients with Ewing's sarcoma/PNET, the authors have reported that patients with 26 years old or higher are at higher risk of death [10]. In analysis of 2600 patients with RMS from SEER database, Sultan *et al*. have reported that adult patients with similar tumors compared with children had lower survival rate [25]. In another retrospective study that performed by Bacci *et al*. on 402 non-metastatic osseous Ewing's sarcoma patients, authors reported that age greater than 14 years, had adverse prognostic effect on EFS [29]. In a study conducted by Gupta *et al*. on 53 localized EWS patients, adults had worse outcome compared with children with localized EWS [31]. In retrospective study by Babaei *et al*. on 30 patients with RMS, authors demonstrated that age is key prognostic factor for 5-year survival [32]. There are several reasons that may explain the worse prognosis in adults with pediatric-type sarcoma. In adults with RMS, tumors are more likely located in unfavorable anatomical regions and unusual subtypes, particularly pleomorphic subtype and not otherwise specified, are more common [25]. Another reason cited is the difference in the systemic and local treatment in adults and children which may cause a difference in the outcome of patients with EWS/PNET [31]. For this reason, some authors recommend the same treatment protocol for adults and children particularly in patients with RMS [33]. On the other hand, in retrospective study that performed by Lim *et al.* on 220 patients with pediatric-type sarcoma, no statistical significant difference was reported between pediatric and

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adult patients in terms of OAS and EFS [27]. In another retrospective study by Smorenburg *et al*. on 27 patients higher than 16 years old with EWS/PNET, authors reported that 5-year survival of patients in that small series was comparable with pediatric study results [34]. In our study, multivariate analysis demonstrated that adult age had no statistically significant impact on OAS (HR, 1.129; 95% CI; 0.608 to 2.094; *P*= 0.701) or DFS (HR, 1.195; 95% CI; 0.676 to 2.112; *P*=0.540) (table 4, figure 1).

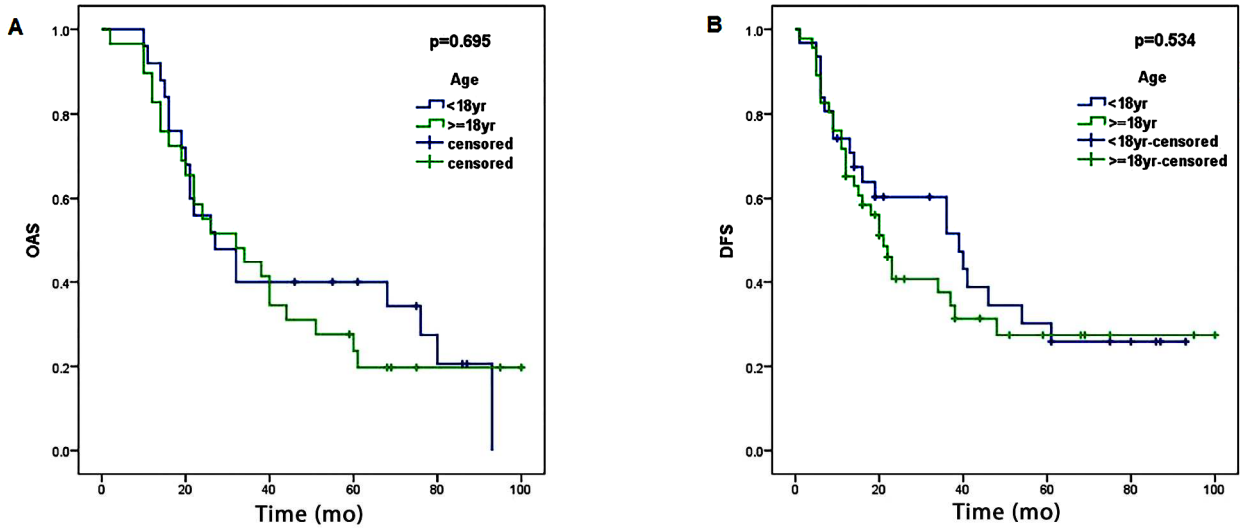

Figure 1. Kaplan-Meier curves showing comparison of overall survival (A) and disease free survival (B) between young ages (<18yr) and adults (>=18yr).

In various retrospective studies, prognostic effect of anatomic location of the tumor in patients with pediatric-type sarcoma has been evaluated. By evaluation of 150 patients with extremity and trunk RMS, Iriel *et al*. reported that patients with RMS of the trunk have the lowest survival rate [35]. In analysis of 2600 patients with RMS from SEER database, Sultan *et al*. have reported that unfavorable sites in adult patients is not predictor of poor outcome [25]. In retrospective study that performed by Bacci *et al*. on 846 non-metastatic osseous Ewing's sarcoma patients, authors reported that axial location of the tumor had adverse prognostic effect on EFS [29]. In another retrospective study by Ahn *et al*. on 84 patients with pediatric–type sarcoma, authors reported that favorable locations were associated with a longer EFS rate [28]. In Cotteril *et al*. study, authors have reported that primary site is a prognostic factor for overall and relapse-free survival [6]. With multivariate analysis we found that primary site had statistically significant effect on DFS but not on OAS rate (table 4) which is consistent with the findings of some mentioned studies. In our investigation, the lowest rate of DFS was for trunk (HR, 4.748; 95% CI; 1.606 to 14.034; *P*=0.005) and then for the upper extremity tumors (HR, 3.648; 95% CI; 1.434 to 9.279; *P*=0.007) (table 4). Perhaps one reason for the low rate of DFS in tumors of trunk, is limitation to perform a surgery with wide surgical margins in this anatomical region.

In our study, multivariate analysis showed that disease recurrence was associated with a significant reduction in OAS (HR, 2.535; 95% CI; 1.313 to 4.894; *P*=0.006) which this finding is also consistent with results from other studies [6,10,27,28,30,36].

Treatment of pediatric-type sarcoma consists of systemic and local therapy. Local treatment of these tumors includes surgery, radiation therapy, or a combination of both modalities. Results of several retrospective studies suggest that surgery has a statistically significant impact on patient's outcome. In the study performed by Bacci et al, authors reported that use of radiotherapy alone without surgery was adverse prognostic factor for EFS [29]. In retrospective study by Lim et al, authors reported that no

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surgery treatment is a poor prognostic factor in children and adults with pediatric-type sarcoma in term of OAS [27]. In our study, multivariate analysis suggests that surgery has no statistically significant impact on OAS (HR, 1.609; 95% CI; 0.851 to 3.042; P= 0.143) and DFS rate (HR, 0.776; 95% CI; 0.440 to 1.370; P=0.382) (table 4). One important reason for non-significant effect of surgery on OAS, possibly is the use of radiotherapy in patients who underwent incomplete surgery or biopsy without surgery. However, to evaluate the effect of surgery on patient's outcome, prospective phase III randomized clinical trial is needed to compare it with radiotherapy alone or with combination of surgery and radiotherapy as local treatment.

Although the impact of chemotherapy on survival of patients with pediatric-type sarcoma has been established [14,15], with multivariate analysis in study by Lim *et al*. [27] and in our study, the use of chemotherapy has no significant effect on OAS and DFS (table 4). It seems that main reason for this lack of difference is the low number of patients who had not received chemotherapy as systemic treatment (8.2%) (table 1) and comparing of them with those who received chemotherapy has insufficient statistical power to detect significant difference between these two groups. In the case of radiotherapy, although with survival analysis using Kaplan-Meier method, OAS and DFS was significantly better in those who had received radiotherapy, given the small number of patients who did not receive radiotherapy, we cannot judged on the results and it is necessary to examine these results in a prospective randomized clinical trial.

With multivariate analysis in our study, tumor size has no significant effect on OAS and DFS rate (table 4). In few retrospective studies it has been reported that tumor size is a prognostic factor for survival [27,30,37]. Few studies have addressed the pediatric-type sarcoma and have been compared its various subtypes (RMS, PNET, EWS, DSRCT) in terms of OAS or EFS [27, 28]. In retrospective study that performed by Ahn *et al*. on 84 patients with pediatric-type sarcoma, effect of pathological subtypes on patients outcome have not been reported. The only study we found that have compared the different subtypes of pediatric-type sarcoma in terms of OAS and EFS is Lim *et al*. study [27]. In this retrospective study that performed on 220 patients with pediatric-type sarcoma, except for PNET subtype in children that had statistically significant impact on OAS, there was no significant difference between other subtypes (RMS, EWS, DSRCT) among adults and children in terms of OAS and RFS. In our study with multivariate analysis, pathologic subtype had significant impact on OAS but had no significant effect on DFS (table 4). In this case, RMS was associated with best survival rate.

Finally, it can be noted that, as in other investigations for pediatric-type sarcoma, our study has some limitations. First, this study is also a retrospective review of patients with pediatric-type sarcoma and is dependent on the data of patient's medical record. In some cases, the information and details of patient's record were incomplete. Second, duration of follow-up of patients was short and many of patients have not returned for follow-up or have returned for short period of time. Therefore, we had to evaluate theme in terms of overall and disease free survival with follow-up phone call; this is why we could not be able to assess some of them in terms of survival even by phone call follow-up.

CONCLUSION

With multivariate analysis, the authors determined that recurrence of disease and Ewing's sarcoma subtype are poor prognostic factors for overall survival and site of origin is a poor prognostic factor for disease free survival among patients with pediatric-type sarcoma. In addition, gender, patient's age, and size of tumor had no significant impact on overall and disease free survival.

Conflicts of interest: *Declared none.*

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