© Curr Gynecol Oncol 2019, 17 (4), p. 168–172
DOI: 10.15557/CGO.2019.0021

Gulsah Selvi Demirtas[1], Ibrahim Gülhan[1], Mehmet Gokcu[1], Ibrahim Uyar[1], Ulas Solmaz[1], Duygu Ayaz[2], Muzaffer Sancı[1]

Received: 05.12.2019
Accepted: 18.12.2019
Published: 31.12.2019

Malignant ovarian tumors in adolescents: a single center study

Złośliwe nowotwory jajnika u nastolatek: badanie jednoośrodkowe

[1] Department of Gynecology and Obstetrics, Tepecik Education and Research Hospital, İzmir, Turkey
[2] Department of Pathology, Tepecik Education and Research Hospital, İzmir, Turkey
Correspondence: Gulsah Selvi Demirtas, Department of Gynecology and Obstetrics, Tepecik Research and Education Hospital, 35000 İzmir, Turkey, tel.: +905337271512, e-mail: drg.selvi@gmail.com

Abstract

Objectives: To investigate the incidence, clinical manifestations, treatment methods, accuracy of frozen section analyses, histopathological properties, and outcomes of malignant ovarian tumors in adolescents. **Materials and methods:** Adolescent females <21 years old with malignant ovarian tumors who were treated between January 2000 and December 2016 were reviewed retrospectively. Patient demographics, clinical characteristics, complaints, cancer antigen 125 (CA-125), alpha-fetoprotein (AFP) and stages of malignant ovarian tumors according to the International Federation of Gynecology and Obstetrics, surgical pathological features, treatments and recurrences were evaluated. **Results:** A total of 964 patients, 22 of which were <21 years of age (2.2%) with primary ovarian tumors, were evaluated. The highest percentage of tumors were germ cell tumors and epithelial tumors (n = 9 and n = 9 both, 45%). Two germ cell tumors and 1 sex cord tumor, but no epithelial tumors, were diagnosed in patients <17 years of age. Eight of 9 epithelial tumors were borderline ovarian tumors, a well-differentiated serous cystadenocarcinoma was detected in 1 patient. The median follow-up period was 103.4 ± 40.06 months. **Conclusions:** In contrast to previous reports, this study shows no difference in the occurrence of germ cell and epithelial tumors in patients <21 years of age when compared with adult patients. Fertility-sparing surgery with or without chemotherapy had favorable outcomes.

Keywords: ovarian tumors, germ cell tumors, borderline ovarian tumors, adolescent

Streszczenie

Cel badania: Analiza częstości występowania, objawów klinicznych, metod leczenia, dokładności analizy skrawków mrożonych, cech histopatologicznych oraz wyników leczenia złośliwych nowotworów jajnika u nastoletnich pacjentek. **Materiał i metody:** Oceną retrospektywną objęto kobiety poniżej 21. roku życia leczone w okresie od stycznia 2000 do grudnia 2016 roku z powodu złośliwych guzów jajnika. W ocenie uwzględniono dane demograficzne, cechy kliniczne, dolegliwości, stężenie markera CA-125 (CA-125) i alfa-fetoproteiny (AFP) oraz stopień zaawansowania raka jajnika według Międzynarodowej Federacji Ginekologii i Położnictwa (International Federation of Gynecology and Obstetrics), cechy histopatologiczne, metody leczenia i występowanie nawrotów. **Wyniki:** Analizą objęto łącznie 964 pacjentki, w tym 22 w wieku poniżej 21 lat (2,2%), u których rozpoznano pierwotne nowotwory jajnika. Największy odsetek nowotworów stanowiły nowotwory germinalne i nabłonkowe (w obu przypadkach n = 9, 45%). U pacjentek w wieku poniżej 17 lat rozpoznano 2 guzy germinalne oraz 1 guz sznurów płciowych, ale żadnych nowotworów nabłonkowych. Osiem spośród 9 nowotworów nabłonkowych stanowiły guzy o granicznej złośliwości, natomiast u 1 pacjentki wykryto dobrze zróżnicowanego surowiczego torbielakogruczolakoraka. Średnia czasu obserwacji wynosiła 103,4 ± 40,06 miesiąca. **Wnioski:** W przeciwieństwie do poprzednich doniesień, w obecnym badaniu wykazano brak różnicy w występowaniu guzów germinalnych i nabłonkowych u chorych poniżej 21. roku życia w porównaniu z pacjentkami dorosłymi. Odnotowano korzystne wyniki chirurgicznego leczenia oszczędzającego zachowującego płodność z lub bez chemioterapii.

Słowa kluczowe: guzy jajnika, guzy germinalne, guzy o granicznej złośliwości, nastolatki

INTRODUCTION

Adolescent and young adult age is defined as 10–19 and 19–24 years of age according to the World Health Organization. The exact prevalence of adnexal masses in adolescents and young adults is unknown, but they are relatively uncommon in this population. Most ovarian masses are benign neoplasms[1,2]. Malignant ovarian tumors in adults and adolescents are rare, accounting for 0.9% of all malignancies[3]. These tumors constitute a special group of gynecologic tumors due to their clinical and histopathological features[4]. Malignant germ cell tumors are the most frequent malignant tumors in adolescents and young adults, but are the rarest in the reproductive age group. They account for approximately 5% of all malignant ovarian tumors[5]. Protection of ovarian tissue in these patients is necessary for normal physical development and fertility. In this study, we describe clinicopathological features of malignant ovarian tumors diagnosed in patients <21 years of age between January 2000 and December 2016. The objective of the study was to evaluate malignant ovarian tumors in adolescents and young adults who were treated at Tepecik Education and Research Hospital with regards to surgical procedures, adjuvant therapies, restaging, recurrence, and the possible use of this database for future clinical studies.

MATERIALS AND METHODS

This retrospective study included ovarian cancer patients ≤20 years of age who were treated at Tepecik Education and Research Hospital Gynecologic Oncology Clinic between January 2000 and December 2016. The study was approved by the Ethics Committee of Tepecik Education and Research Hospital. Medical files of 22 patients were analyzed, but data was only available for 20 patients. Data for the other 2 patients were missing and thus excluded from the study. Patient demographics, clinical characteristics, complaints, cancer antigen 125 (CA-125), alpha-fetoprotein (AFP) and stages of malignant ovarian tumors according to the International Federation of Gynecology and Obstetrics (FIGO), surgical pathological features, treatments and recurrences were evaluated. The follow-up period was from the end of treatment to the date of the last contact. All patients underwent comprehensive surgical staging, including unilateral salpingo-oophorectomy, omentectomy, pelvic and/or para-aortic lymph node biopsy, peritoneal washing and peritoneal biopsy, and appendectomy for mucinous tumors. Statistical analyses were performed using SPSS 15.0 software package.

Histopathological type	<17 years	≥17 years
Germ cell	2	7
Epithelial	0	9
Sex cord-stromal	1	1
Total	**3**	**17**

Tab. 1. Number and distribution of malignant ovarian tumors in patients <17 years of age and ≥17 years of age

RESULTS

Twenty-two of 964 patients <21 years of age with primary ovarian tumors were treated between 2000 and 2016 at our clinic (2.2%). Prevalence rates of germ cell tumors and epithelial tumors were similar (n = 9 and n = 9, respectively; 45% and 45%). Sex cord-stromal tumors were observed in 2 patients (10%). The mean age of patients was 17.9 ± 2.5 years. The mean age was 18.7 ± 1.4 years for patients with epithelial tumors, 17.4 ± 3.2 years for patients with germ cell tumors, and 17.5 ± 3.5 years for patients with sex cord-stromal tumors. Patients were followed-up for an average of 103.4 ± 40.06 months (89.55 ± 24.7 for germ cell tumors, 116 ± 47.1 for borderline tumors). There were no patients <17 years of age with epithelial tumors in our study (Tab. 1). Among 9 patients diagnosed with epithelial tumor, there were 8 borderline ovarian tumors (BOTs), and a well-differentiated serous cystadenocarcinoma was detected in 1 patient (Tab. 2). Four of 9 germ cell tumors were diagnosed as pure dysgerminoma: 3 were mixed germ cell tumors, 1 was endodermal sinus tumor, and 1 was immature

Age [years] (18.7 ± 1.4)	Histopathological type	CA-125 levels (68.33 ± 4.6)	Follow-up [months] (116 ± 7.1)	FIGO stage	Recurrence	Chemotherapy
17	Serous BOT	12	137	IB	No	+
20	Serous BOT	65	160	IA	No	No
20	Serous BOT	16	162	IA	No	No
20	Serous BOT	274	50	IC	No	+
20	Serouscystadenoca	9	65	IA	No	No
17	Mucinous BOT	118	72	IA	No	No
17	Mucinous BOT	25	148	IA	No	No
18	Mucinous BOT	35	165	IC	No	+
19	Mucinous BOT	61	85	IA	No	No

CA-125 – cancer antigen 125, reference range: 0–35 U/mL; **FIGO** – International Federation of Obstetrics and Gynecology; **BOT** – borderline ovarian tumor; **serouscystadenoca** – well differentiated serous cystadenocarcinoma.
Values represent the mean ± standard deviation (*SD*).

Tab. 2. Clinical and pathological features of patients with epithelial ovarian tumors

 DOI: 10.15557/CGO.2019.0021

Age [years] (17.4±3.2)	Histopathological type	AFP levels (1.7 ± 1.1)	Follow-up [months] (89.55 ± 24.7)	FIGO stage	Recurrence	Chemotherapy
19	Dysgerminoma	0.6	65	IA	No	No
20	Dysgerminoma	-	118	IA	Yes	No
15	Dysgerminoma	3.5	74	IC	No	VAC
20	Dysgerminoma	-	120	IC	No	BEP
20	Mixed germ cell[1]	2.5	120	IC	No	BEP
18	Mixed germ cell[2]	2.2	74	IC	No	BEP
17	Mixed germ cell[3]	0.8	66	IA	No	No
10	Endodermal s.t.[4]	0.83	68	IC	No	BEP
18	Immature teratoma	-	101	IA	No	No

AFP – alpha-fetoprotein, reference range: 0–7 ng/mL; **FIGO** – International Federation of Obstetrics and Gynecology; **VAC** – vincristine + actinomycin D + cyclophosphamide; **BEP** – bleomycin + etoposide + cisplatin.
[1] embryonic + yolk sac; [2] yolk sac + endodermal sinus tumor + embryonic; [3] embryonic + dysgerminoma; [4] endodermal sinus tumor.
Values represent the mean ± standard deviation (*SD*).

Tab. 3. Clinical and pathological features of patients with germ cell tumors

teratoma (Tab. 3). There were 2 sex cord-stromal tumors (15 and 20 years old), both of which were juvenile granulosa cell tumors. Both patients were stage IC. Correlation between diagnoses using frozen sections versus pathology results was 88.8% for germ cell tumors, 77.7% for epithelial tumors, and 100% for sex cord-stromal tumors. All tumors in 3 patients under 17 years of age (100%) were malignant.

DISCUSSION

We evaluated adolescents and young adults <21 years of age with malignant ovarian tumors who were treated and followed-up in our clinic. In the literature, germ cell tumors are the most common type of pediatric ovarian tumors, followed by surface epithelial stromal tumors and sex cord-stromal tumors, whereas epithelial stromal tumors most commonly occur in adults[6,7]. In contrast to the literature, we found that the prevalence of epithelial and germ cell tumors was the same (n = 9 and n = 9, respectively; 45% and 45%).

Rathore et al. showed that abdominal pain (46.4 %) was the most common complaint followed by abdominal lump (24%) and abdominal distension (10.7%)[8]. In our study, the initial symptoms in most patients (85%) were pelvic pain and abdominal distension.

BOTs are heterogeneous noninvasive tumors with uncertain malignant potential occurring in younger females and have an excellent prognosis, but symptomatic recurrence and mortality may occur after the first treatment. In a study in patients <19 years, 10-year overall survival for these patients was 97.3%[9]. Compared to adult patients, BOTs in younger females have been reported to occur more frequently[10,11]. In several studies, borderline ovarian epithelial tumors were reported to account for 30–53% of all epithelial tumors[12,13]. In adults, this prevalence is approximately 10–20%[12]. In our study, 8 of 9 epithelial tumors (88.8%) in patients >16 years of age were BOTs. Furthermore, 2 patients with preoperative ruptured FIGO stage IC serous and mucinous borderline and 1 patient with stage IB serous borderline tumor received adjuvant three cycle platin-based chemotherapy in the years 2000–2005. Past studies have reported that adjuvant therapy did not improve survival in stage I–II disease. Instead, there was increased toxicity, with overall survival rates of 99% and 94% with no adjuvant therapy, respectively[14]. Based upon recent studies, our current clinical management for stage 1 and 2 tumors includes no adjuvant chemotherapy.

Zanetta et al. suggested that patients must be monitored using clinical examinations, vaginal ultrasound, and CA-125 measurements[15]. In our study, we followed-up patients with borderline tumors every 3 months during the first 2 years and every 6 months after 2 years. No recurrences were observed during the follow-up period.

In the present study, 1 patient with bilateral serous borderline tumor underwent unilateral salpingo-oopherectomy and cystectomy for a contralateral borderline serous tumor and no recurrence was detected. In a meta-analysis by Vasconcelos and de Sousa Mendes, bilateral cystectomy was suggested for patients with bilateral serous borderline tumors who wished to preserve fertility, because no significant difference was seen in the recurrence rate compared with unilateral salpingo-oophorectomy with contralateral cystectomy[16]. Restaging surgery was performed in 2 patients with borderline tumors and in 1 patient whose frozen tumor sections were reported as borderline tumor; this patient's diagnosis was serous cystadenocarcinoma.

Previous retrospective studies conducted to evaluate restaging surgery for borderline tumors showed no effect on survival[17,18]. An upstaging rate of 14.8% was reported by Fauvet et al., but there was no difference in recurrence rates in their study[18]. Similarly, Snider et al. reported that staging surgery for patients with mucinous tumors did not require a second surgery[19]. In contrast, du Bois et al. reported that incomplete staging surgery showed an elevated risk for recurrence and restaging after the initial surgery, and had a beneficial effect on progress-free survival[20]. In the present study, 4 of 9 germ cell tumors were pure dysgerminomas. In one study, 35% of the observed ovarian neoplasias were malignant[21], and in another, dysgerminoma was the most frequent tumor[22]. Similarly, in other studies

DOI: 10.15557/CGO.2019.0021

in this age group, germ cell tumors were predominant pathological type[23,24].

In another study, immature teratoma was the most common malignant tumor in adolescents <20 years old[8]. Without peritoneal dissemination, tumors that are sensitive to radiotherapy can metastasize to the para-aortic lymph nodes, lung, liver, and bone[25]. Due to organ-sparing treatments, the recurrence rate is between 17–35%, and postoperative chemotherapy is recommended. Ertas et al. suggested that unnecessary use of adjuvant chemotherapy in the early stages will remain a contentious issue due to concerns about the long-term effects of this treatment[26]. In a study, 7 of 43 patients with germ cell tumors did not undergo comprehensive surgical restaging, and were staged clinically as FIGO stage IA. Three (43%) of these patients experienced disease recurrence. These tumors were dysgerminoma and endodermal sinus tumors. Recurrences were treated with chemotherapy and/or surgery[27]. In an early stage malignant ovarian germ cell tumor study, the median follow-up time was 26.1 (range 1.9–88.5) months, with a mean of 35.5 ± 26.2 months. The rate of loss to follow-up was 18.4% (7 of 38 patients)[28]. In our study, the average follow-up time for germ cell tumors was 89.5 ± 24.7 months. Four of 9 germ cell tumors were pure dysgerminoma, with tumor stages of IA, IA, IC and IC. Stage IC dysgerminoma patients received adjuvant chemotherapy. In one of these patients, sacral vertebral metastasis was diagnosed 12 months after the initial diagnosis. This patient received chemotherapy and radiotherapy.

Hassan et al. reported that ovarian sex cord-stromal tumors accounted for 12.3% of all tumors in patients 0–19 years old[29]. Similarly, we found that 10% of ovarian tumors in patients <21 years of age were sex cord neoplasms. Juvenile granulosa cell tumors account for 90% of all granulosa cell tumors in this age group. This type of tumor can secrete steroid hormones[30–33]. The most common symptom is abnormal uterine bleeding[34]. In 10% of cases, the tumors rupture, and an acute abdomen may be the most common symptom. Ascites occurs in approximately 10% of cases and pleural effusion rarely develops[35]. In our study, we detected juvenile granulosa cell tumors in 2 patients with stage IC tumors. Both cases were admitted to our clinic after reports of pelvic pain.

Analyses of frozen sections are especially important in this patient group for a correct diagnosis. In the present study, only 1 of the frozen section results of germ cell tumors was reported as benign. An epithelial tumor reported as a serous carcinoma based on its definitive pathology was reported as BOT based on the analysis of frozen sections, and 1 musinous tumor was reported as benign using the same method. All sex cord-stromal tumors were correctly diagnosed using frozen sections. Tempfer et al. reported agreement between diagnoses using frozen sections and histological examination in 62.8% of patients[36]. Song et al. reported that due to low accuracy, sensitivity, and positive predictive value, surgical decisions for borderline tumors based on frozen sections should be made carefully[37]. In the present study, the correlation between diagnoses using frozen sections versus pathology results was 88.8% for germ cell tumors, 77.7% for epithelial tumors, and 100% for sex cord-stromal tumors. In conclusion, standard procedures for the diagnosis of ovarian tumors in symptomatic adolescents and young adults involve ultrasound and tumor markers, CA-125 and AFP in particular. In our study, borderline tumors were found at a similar prevalence as germ cell tumors, and the prognosis of stage 1 patients was very good. In this group, fertility-sparing comprehensive surgery reduced recurrences and was a useful tool for risk assessment and follow up of patients without salvage chemotherapy related to morbidity. Contrary to our past experience, our current clinical management for borderline stage 1 and 2 tumors involves no adjuvant chemotherapy, as indicated in the studies. We have no consensus regarding restaging, similar to previous reports, but based upon our clinical judgment, in terms of actual staging, restaging should be a standard management procedure.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organizations, which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

References

1. Zhang M, Jiang W, Li G et al.: Ovarian masses in children and adolescents – an analysis of 521 clinical cases. J Pediatr Adolesc Gynecol 2014; 27: e73–e77.
2. Templeman CL, Fallat ME: Benign ovarian masses. Semin Pediatr Surg 2005; 14: 93–99.
3. Deligeoroglou E, Eleftheriades M, Shiadoes V et al.: Ovarian masses during adolescence: clinical, ultrasonographic and pathologic findings, serum tumor markers and endocrinological profile. Gynecol Endocrinol 2004; 19: 1–8.
4. Fotiou SK: Ovarian malignancies in adolescence. Ann N Y Acad Sci 1997; 816: 338–346.
5. Park JY, Kim DY, Suh DS et al.: Outcomes of pediatric and adolescent girls with malignant ovarian germ cell tumors. Gynecol Oncol 2015; 137: 418–422.
6. Morowitz M, Huff D, von Allmen D: Epithelial ovarian tumors in children: a retrospective analysis. J Pediatr Surg 2003; 38: 331–335; discussion 331–335.
7. Schultz KA, Sencer SF, Messinger Y et al.: Pediatric ovarian tumors: a review of 67 cases. Pediatr Blood Cancer 2005; 44: 167–173.
8. Rathore R, Sharma S, Arora D: Spectrum of childhood and adolescent ovarian tumors in India: 25 years experience at a single institution. Open Access Maced J Med Sci 2016; 4: 551–555.
9. Nasioudis D, Alevizakos M, Holcomb K et al.: Malignant and borderline epithelial ovarian tumors in the pediatric and adolescent population. Maturitas 2017; 96: 45–50.
10. Menczer J, Sadetzki S, Murad H et al.: Childhood and adolescent ovarian malignant tumors in Israel. A nationwide study. Acta Obstet Gynecol Scand 1999; 78: 813–817.
11. Morris HB, La Vecchia C, Draper GJ: Malignant epithelial tumors of the ovary in childhood: a clinicopathological study of 13 cases in Great Britain 1962–1978. Gynecol Oncol 1984; 19: 290–297.
12. Tsai JY, Saigo PE, Brown C et al.: Diagnosis, pathology, staging, treatment, and outcome of epithelial ovarian neoplasia in patients age < 21 years. Cancer 2001; 91: 2065–2070.

13. Deprest J, Moerman P, Corneillie P et al.: Ovarian borderline mucinous tumor in a premenarchal girl: review on ovarian epithelial cancer in young girls. Gynecol Oncol 1992; 45: 219–224.
14. Cadron I, Leunen K, Van Gorp T et al.: Management of borderline ovarian neoplasms. J Clin Oncol 2007; 25: 2928–2937.
15. Zanetta G, Rota S, Lissoni A et al.: Ultrasound, physical examination, and CA 125 measurement for the detection of recurrence after conservative surgery for early borderline ovarian tumors. Gynecol Oncol 2001; 81: 63–66.
16. Vasconcelos I, de Sousa Mendes M: Conservative surgery in ovarian borderline tumours: a meta-analysis with emphasis on recurrence risk. Eur J Cancer 2015; 51: 620–631.
17. Camatte S, Morice P, Thoury A et al.: Impact of surgical staging in patients with macroscopic "stage I" ovarian borderline tumours: analysis of a continuous series of 101 cases. Eur J Cancer 2004; 40: 1842–1849.
18. Fauvet R, Boccara J, Dufournet C et al.: Restaging surgery for women with borderline ovarian tumors: results of a French multicenter study. Cancer 2004; 100: 1145–1151.
19. Snider DD, Stuart GC, Nation JG et al.: Evaluation of surgical staging in stage I low malignant potential ovarian tumors. Gynecol Oncol 1991; 40: 129–132.
20. du Bois A, Ewald-Riegler N, de Gregorio N et al.; Arbeitsgmeinschaft Gynäkologische Onkologie (AGO) Study Group: Borderline tumours of the ovary: a cohort study of the Arbeitsgmeinschaft Gynäkologische Onkologie (AGO) Study Group. Eur J Cancer 2013; 49: 1905–1914.
21. Breen JL, Maxson WS: Ovarian tumors in children and adolescents. Clin Obstet Gynecol 1977; 20: 607–623.
22. van Winter JT, Simmons PS, Podratz KC: Surgically treated adnexal masses in infancy, childhood, and adolescence. Am J Obstet Gynecol 1994; 170: 1780–1786; discussion 1786–1789.
23. Liang P, Zhang X, Zhang Z et al.: Treatment approach and prognosis of pediatric and adolescent nonepithelial malignant ovarian tumors: a retrospective prognosis analysis. J Pediatr Adolesc Gynecol 2018; 31: 304–310.
24. Akyüz C, Varan A, Büyükpamukçu N et al.: Malignant ovarian tumors in children: 22 years of experience at a single institution. J Pediatr Hematol Oncol 2000; 22: 422–427.
25. Merino MJ, Jaffe G: Age contrast in ovarian pathology. Cancer 1993; 71 (Suppl): 537–544.
26. Ertas IE, Taskin S, Goklu R et al.: Long-term oncological and reproductive outcomes of fertility-sparing cytoreductive surgery in females aged 25 years and younger with malignant ovarian germ cell tumors. J Obstet Gynaecol Res 2014; 40: 797–805.
27. Lin KY, Bryant S, Miller DS et al.: Malignant ovarian germ cell tumor – role of surgical staging and gonadal dysgenesis. Gynecol Oncol 2014; 134: 84–89.
28. Chatchotikawong U, Ruengkhachorn I, Leelaphatanadit C et al.: 8-year analysis of the prevalence of lymph nodes metastasis, oncologic and pregnancy outcomes in apparent early-stage malignant ovarian germ cell tumors. Asian Pac J Cancer Prev 2015; 16: 1609–1613.
29. Hassan E, Creatsas G, Deligeorolgou E et al.: Ovarian tumors during childhood and adolescence. A clinicopathological study. Eur J Gynaecol Oncol 1999; 20: 124–126.
30. Sehouli J, Drescher FS, Mustea A et al.: Granulosa cell tumor of the ovary: 10 years follow-up data of 65 patients. Anticancer Res 2004; 24: 1223–1229.
31. Bouffet E, Basset T, Chetail N et al.: Juvenile granulosa cell tumor of the ovary in infants: a clinicopathologic study of three cases and review of the literature. J Pediatr Surg 1997; 32: 762–765.
32. Scully RE: Juvenile granulosa cell tumor. Pediatr Pathol 1988; 8: 423–427.
33. Cronjé HS, Niemand I, Bam RH et al.: Granulosa and theca cell tumors in children: a report of 17 cases and literature review. Obstet Gynecol Surv 1998; 53: 240–247.
34. Malmström H, Högberg T, Risberg B et al.: Granulosa cell tumors of the ovary: prognostic factors and outcome. Gynecol Oncol 1994; 52: 50–55.
35. Cronjé HS, Niemand I, Bam RH et al.: Review of the granulosa-theca cell tumors from the Emil Novak Ovarian Tumor Registry. Am J Obstet Gynecol 1999; 180: 323–327.
36. Tempfer CB, Polterauer S, Bentz EK et al.: Accuracy of intraoperative frozen section analysis in borderline tumors of the ovary: a retrospective analysis of 96 cases and review of the literature. Gynecol Oncol 2007; 107: 248–252.
37. Song T, Choi CH, Kim HJ et al.: Accuracy of frozen section diagnosis of borderline ovarian tumors. Gynecol Oncol 2011; 122: 127–131.

DOI: 10.15557/CGO.2019.0021 CURR GYNECOL ONCOL 2019, 17 (4), p. 168–172