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Evaluation of clinical and neonatal outcomes of cancer in pregnancy and patients in remission

Burcu Bozkurt Ozdal [a,*], Atakan Tanacan [b], Ayse Altindis Bal [a], Ece Atalay [a], Esra Karatas [a], Sukru Bakirci [a], Fatma Doga Ocal [b], Dilek Sahin [b]

[a]Republic of Turkey Ministry of Health, Ankara City Hospital, Clinic of Perinatology, Ankara, Türkiye
[b]Republic of Turkey Ministry of Health, Ankara City Hospital, Clinic of Gynecology Obstetrics, Division of Perinatology, Ankara, Türkiye
*Corresponding author: burcu_bzkrt@hotmail.com (Burcu Bozkurt Ozdal)

MAIN POINTS

- It was conducted for the first time in Türkiye to examine the clinical problems and treatment treatments in patients receiving cancer treatment in detail and to create permanence in this field.
- It is compatible with clinical practices in Türkiye and adds new and local data to the literature by showing that maternal and neonatal pregnancies can be managed safely with treatment.
- The management of patients diagnosed with cancer during pregnancy by expert multidisciplinary teams, early diagnosis and adoption of appropriate treatment strategies are of great importance for both maternal and infant health

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ABSTRACT

Aim: To retrospectively examine patients diagnosed with cancer during pregnancy and compare the maternal and natal outcomes of these patients with those in cancer remission and healthy pregnant women.

Materials and Methods: This study was designed at a single tertiary care center. A total of 99 patients were included, of whom 18 were diagnosed with cancer during pregnancy, 21 had a pregestational history of cancer and were in remission, and 60 were healthy controls.

Results: Breast cancer was the most frequently detected malignancy during pregnancy. The average cancer during pregnancy was seen at the 21st week. Diagnostic methods included various biopsy methods and magnetic resonance imaging. Some patients underwent cancer-related surgery and chemotherapy during pregnancy. Two patients diagnosed with cancer during pregnancy died. Neonatal and maternal intensive care requirements were found to be higher in patients diagnosed with cancer during pregnancy compared to the other two groups. Additionally, neonatal birth weight was lower than that observed in healthy pregnancies.

Conclusion: We consider the monitoring and management of patients diagnosed with cancer during pregnancy to be a critical issue for ensuring optimal maternal and fetal health outcomes, and we emphasize the need for further research in this field.

Keywords: Active cancer during pregnancy, Maternal mortality, Neonatal intensive care requirements

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INTRODUCTION

A portion of cancers observed in women of reproductive age manifests during pregnancy [1], and cancers in this age group are among the leading causes of maternal mortality [1,2]. However, cancers diagnosed during pregnancy are exceedingly rare, with an incidence of approximately 0.38–0.50 per 1,000 patients [3]. The most common malignant neoplasms during pregnancy include breast cancer, thyroid cancer, cervical cancer, melanoma, Hodgkin's lymphoma, ovarian cancer, and leukemia [4].

The incidence of cancer during pregnancy is increasing due to the tendency of women to delay childbearing [5]. The care of pregnant women diagnosed with cancer is both medically and ethically challenging [6] and necessitates a multidisciplinary approach. The coexistence of maternal and fetal life raises concerns among physicians regarding the use of diagnostic and therapeutic modalities such as magnetic resonance imaging (MRI), computed tomography, positron emission tomography, surgery, chemotherapy, and radiotherapy. In recent years, surgical interventions during pregnancy have been more safely performed, as they do not pose significant risks to the fetus [5]. While earlier data suggested that chemotherapy and radiotherapy could have long-term adverse effects on the fetus, recent studies indicate that when administered after the first trimester, these treatments improve short-term pregnancy outcomes [7,8]. Consequently, patients diagnosed

with cancer during pregnancy undergo a risk-benefit assessment to determine the appropriateness of chemoradiotherapy [9].

This study aimed to evaluate patients diagnosed with cancer during pregnancy and compare their fetal and maternal outcomes with those of patients who had a history of cancer but achieved remission before pregnancy, as well as with healthy pregnancies.

MATERIALS AND METHODS

Study population

This retrospective study was conducted in a tertiary care center between January 2021 and March 2025. The study included patients diagnosed with cancer during pregnancy and those with a history of cancer who had achieved remission before conception. The names and diagnoses of newly admitted patients were recorded in a Microsoft Excel database maintained by our clinic. Additionally, patients with cancer were identified through the hospital records of pregnant women hospitalized in various departments and ICUs. Patient information was obtained from the hospital's database.

This retrospective study was approved by the Ethics Committee of Ankara City Hospital (TABED 1-25-868). Data were collected from electronic medical records in strict adherence to patient confidentiality, and all identifying information was anonymized. Informed consent was obtained from patients when necessary. All study procedures adhered to the principles of the Declaration of Helsinki.

The recorded data included the patients' age, gravida, parity, gestational week at cancer diagnosis, mode of cancer diagnosis, cancer type, cancer stage, cancer treatment received during pregnancy, maternal ICU requirement, maternal survival status, fetal outcomes, neonatal outcomes (gestational age at birth, birth weight, first- and fifth-minute Apgar scores, neonatal ICU [NICU] admission requirements), and remission duration for pregnant patients with a history of cancer.

The case group included patients diagnosed with cancer during pregnancy and those diagnosed with cancer before pregnancy that were in remission. The control group consisted of randomly selected pregnant women.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences version 22.0 (SPSS Inc., Chicago, IL, USA). The normality of continuous variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Variables showing a normal distribution were compared using Tukey's post hoc test with one-way ANOVA. Categorical variables were compared using the chi-square exact test as appropriate. A p-value of 0.05 was considered statistically significant.

RESULTS

A total of 99 patients were included in this study, comprising 18 patients diagnosed with cancer during pregnancy, 21 patients with a pregestational history of cancer who were in remission, and 60 healthy controls.

The patients diagnosed with cancer during pregnancy were examined first. The distribution of cancer types diagnosed during pregnancy is summarized in. Breast cancer was the most common (27.7%), followed by thyroid cancer (22.2%).

Clinical data related to cancer types and maternal outcomes are summarized in Table 1. The mean gestational age at cancer diagnosis was 21 weeks (range: 8–40 weeks).

Cancer diagnoses were established via various methods: breast and thyroid cancers through fine-needle aspiration biopsy, ovarian cancer via ultrasound-guided biopsy, gastric cancer through endoscopic biopsy, and acute myeloid leukemia M3 (AML-M3) through frozen section analysis following splenic rupture.

Among these patients, metastasis was detected in nine cases, while cancer remained localized in nine cases. Eleven patients underwent cancer-related surgery during pregnancy, six received chemotherapy.

Maternal intensive care unit (ICU) admission was necessary for 11 patients, and seven did not require ICU care. There were two maternal deaths in this group.

Of the patients who received surgery and chemotherapy, only one did not require neonatal intensive care unit (NICU) admission, whereas nine required NICU support.

Among pregnant patients diagnosed with cancer, three had preterm deliveries, two underwent medical termination, and 11 delivered at term.

The distribution of cancer types among patients with a pregestational history of cancer in remission is provided in Table 2. In this group, thyroid and breast cancers were the most common. Metastatic relapse was observed in only one patient, who was previously diagnosed with borderline mucinous tumor. Gastric metastasis was observed.

The remission duration ranged from 3 to 180 months. Two patients in remission opted for elective pregnancy termination, while 18 pregnancies resulted in live births.

Table 3 compares the clinical and demographic differences between those diagnosed with cancer during pregnancy, neonatal outcomes, and maternal outcomes those in remission, and those with healthy pregnancies. Intra-group and inter-group differences for the variables of interest are presented in Table 4.

According to the post-hoc Tukey test, a difference was observed between the active cancer group and the control group in terms of maternal age ($p=0.041$), while no difference was observed between the cancer and remission groups ($p>0.05$). A difference was observed between the remission and control groups ($p=0.006$). Age was higher in the active cancer and remission groups.

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Table 1. Clinical data and maternal outcomes by cancer type.

Variable	Breast cancer	Thyroid cancer	Lymphoma	Thymoma	Cervical cancer	Leukemia	Ovarian cancer	Bladder cancer	Gastric cancer
	n = 5	n = 4	n = 1	n = 1	n = 2	n = 1	n = 2	n = 1	n = 1
Gestational week at diagnosis (median)	14 w	17 w	30 w	12 w	12w	Postpartum first day	15 w	8 w	20 w
Diagnosis method	FNAB	FNAB	FNAB	MRI	Cervical biopsy	Postpartum splenic rupture frozen section	USG intraoperative frozen section	TUR biopsy	Endoscopic biopsy
Type of invasion									
Metastasis	2	0	1	1	1	2	1		1
Localized	3	4					1	1	
Surgery	3	3	0	0	2	1	2	0	0
Chemotherapy	3	0	1	0	0	0	2	0	0
Maternal ICU requirement	3	2	1	0	1	1	2		1
Maternal death	1	0	0	0	0	0	0	0	1
Medical termination	0	0	0	1 (23 w)	2 (18 w, 19w)	0	0	1 (14 w)	0
Preterm birth	1 (25 w)		1 (30 w)	0	0	0	0	0	1 (24 w)

w: week, FNAB: fine-needle aspiration biopsy, MRI: magnetic resonance imaging, USG: ultrasonography, TUR: transurethral resection.

Table 2. Cancer diagnoses of patients in remission*.

Tumor type	n	%
Thyroid cancer	9	42.8
Breast cancer	5	23.8
Lymphoma	3	14.2
Leukemia	2	9,5
Brain tumor	1	4.7
Metastatıc relaps(musınos borderline over carcinoma)	1	4.7
Total	21	100.0

*Remission durations ranged from 3 to 180 months.

Table 3. Clinical and demographic characteristics of patients and maternal and neonatal outcomes.

Variable	Pregnant women with active cancer (n = 18)	Pregnant women in cancer remission (n = 21)	Healthy pregnant women (controls) (n = 60)	p-value
Age	32.0±6.9[a]	33.0±6.9[a]	28.0±4.5[b]	**0.005**[1]
Gravida	2.8±1.0	3.5±2.4	2.0±1.3	0.650[1]
Parity	0.8±0.9[a]	1.6±1.3[b]	0.9±0.9[a]	**0.019**[1]
Gestational age at birth (week)	36.3±2.8[a]	37.6±1.1[b]	37.7±2.1[b]	**0.049**[1]
Birth weight (g)	2613.0±626.0[a]	3028.0±407.0[a]	3266.0±560.0[b]	**<0.001**[1]
First-minute Apgar score	8.4±0.7	8.7±0.7	8.9±0.5	0.585[1]
Fifth-minute Apgar score	7.1±0.9	7.2±0.9	7.4±1.3	0.535[1]
NICU requirement	8 (44.0%)	2 (9.5%)	0 (0.0%)	**<0.001**[2]
Medical Termination	4 (22.0%)	3 (14.2%)	0 (0.0%)	**<0.001**[2]
Spontaneous preterm labor	4 (22.0%)	0 (0.0%)	0 (0.0%)	**<0.001**[2]
Maternal ICU requirement	11 (61.0%)	0 (0.0%)	0 (0.0%)	**<0.001**[2]
Maternal outcome	16 (88.8%) survived 2 (11.2%) died	21 (100.0%) survived	60 (100.0%) survived	**<0.001**[2]

NICU: neonatal intensive care unit, ICU: intensive care unit. Quantitative variables are summarized as mean±sd, qualitative data as frequency (percentage).
1: One Way ANOVA test. 2: Pearson Chi-Square test. Note: Means not sharing subscripts differ significantly at a=0.05 as indicated by Tukey's HSD.

According to the post-hoc Tukey test, a difference was observed between the active cancer group and the remission group in parity (p= 0.042), while no difference was observed between cancer patients and the control group. A difference was observed between the remission group and the control group (p=0.041).

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Table 4. ANOVA test results for meaningful variables

Variable	Source	df	SS	MS	F	p	$\eta 2$
Maternal Age	Between Groups	2	431.3	215.8	5.82	0.005	0.183
	Within Groups	52	1926.4	37.47			
	Total	54	2358.1				
Parity	Between Groups	2	9.969	4.985	4.309	0.019	0.102
	Within Groups	50	57.842	1.157			
	Total	52	67.811				
Gestational age at birth	Between Groups	2	65.841	32.920	6.510	0.002	0.138
	Within Groups	81	409.615	5.057			
	Total	83	475.456				
Birth weight	Between Groups	2	5181397.01	2590598.5	8.436	<0.001	0.172
	Within Groups	81	24875835.1	307109.0			
	Total	83	30057232.1				

P-value <0.05 is significant.

According to the post-hoc Tukey test, no difference was observed in birth weight between active cancer patients and patients in remission (p>0.05). A difference was observed between cancer patients and control patients (p=<0.001). A difference was observed between patients in remission and control patients (p=0.008). Birth weight was lower in the active cancer group and the remission group.

According to the post-hoc Tukey test, a difference was observed between patients in the cancer and remission groups in terms of gestational age (p= 0.029). A difference was observed between cancer patients and control patients (p=0.002). No difference was observed between remission and control patients (p>0.05). The active cancer group was found to have an earlier gestational age (Table 3).

A higher rate of premature birth and NICU requirement was also detected in this group. The need for NICU was determined to be 44.4%, while this rate was 0.0% in the control group (p<0.001). Similarly, maternal ICU requirement was significantly increased in the active cancer group, and the maternal mortality rate was also determined to be 11.2%; this was found to be significantly higher compared to the other groups (p<0.001).

DISCUSSION

In this study, we examined patients diagnosed with cancer during pregnancy and compared the fetal and maternal outcomes among pregnant women with a pregestational history of cancer in remission and healthy pregnant women. Breast cancer was the most frequently detected malignancy during pregnancy. Cancer diagnoses were made as early as eight weeks of gestation and as late as 40 weeks, with a mean gestational age at diagnosis of 21 weeks. Diagnostic methods included fine-needle aspiration biopsy, ultrasound, transurethral resection (TUR) biopsy, and MRI. Some patients underwent cancer-related surgery and chemotherapy during pregnancy. Two patients diagnosed with cancer during pregnancy died. However, when compared with other patient groups, no statistically significant difference was detected. NICU admission and maternal ICU requirements were found to be higher in patients diagnosed with cancer during pregnancy than in the other two groups. Additionally, neonatal birth weight was lower compared to healthy pregnancies.

Cancer during pregnancy is a complex condition that necessitates a multidisciplinary approach aimed at safeguarding the health of both the mother and the fetus. Based on this premise, we retrospectively analyzed cases of cancer diagnosed during pregnancy at one of Turkey's leading referral hospitals, which receives a high volume of patients from other provinces.

When considering the incidence of cancer during pregnancy, including diagnoses made up to 12 months postpartum, the rate is approximately 1 in 1,000 births; however, the incidence of cancer strictly during pregnancy is reported to be between 0.38% and 0.50% [10]. Breast cancer is the most frequently diagnosed malignancy [11], a finding that was consistent with our study.

In earlier periods, the management of cancer during pregnancy often involved either pregnancy termination or postponement of cancer treatment, as no standardized treatment approach was available [12]. Due to concerns about fetal harm, chemotherapy was administered reluctantly by physicians [13]. The absence of a standardized treatment protocol had adverse effects on both maternal and fetal health. However, in recent years, accumulating evidence from research has led to a shift in clinical practice [14]. Case-based data suggest that chemotherapy administered after the first trimester does not pose significant risks to the fetus [15]. Nevertheless, children exposed to cytotoxic treatment before birth should be monitored for long-term developmental follow-up [16]. Amant et al. showed in their study that children exposed to cytotoxic treatment in utero developed moderate cognitive developmental changes [17]. There is increasing evidence that abdominal surgery can be performed with relative safety in pregnant women [18]. Surgery is important

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in the management of gynecological malignancies. However, surgical procedures performed during pregnancy should be performed by a surgical team with more experience in this area [18]. Despite all precautions, adverse obstetric outcomes such as preterm delivery, miscarriage, and fetal distress may occur after surgery during pregnancy [18]. Perioperatively, the mother's hemodynamic parameters should be closely monitored to ensure optimal fetal perfusion [18]. Additionally, the mother's risk of aspiration increases due to pregnancy-related gastroesophageal reflux [18]. In our study, some patients underwent chemotherapy and cancer-related surgical procedures during pregnancy, and no fetal loss was observed among these patients; however, their neonates required intensive care following birth.

The diagnostic methods used during pregnancy are also a source of concern for both patients and physicians. However, studies indicate that with appropriate protective measures, scattered radiation does not pose a significant risk to the fetus [19]. In our hospital, diagnostic procedures such as fine-needle aspiration biopsy, TUR biopsy, endoscopic biopsy, cervical biopsy, and MRI were utilized.

Maternal mortality among pregnant women diagnosed with cancer is closely associated with cancer type and stage [5]. In our study, the maternal mortality rate was 11.1%, a figure consistent with findings from a study conducted at another major hospital in Turkey [20]. The patients who died due to their illness had advanced-stage breast cancer and gastric cancer. In both cases, spontaneous labor occurred before death.

Cancer during pregnancy can influence the timing of delivery. A cohort study conducted in Italy found that cancer was associated with iatrogenic preterm birth, resulting in lower birth weight, reduced Apgar scores, and higher NICU admission rates [21]. Similarly, in our study, when comparing pregnant women diagnosed with cancer to those in remission and healthy pregnant women, neonates in the cancer group had lower birth weights and a higher need for intensive care.

Appropriate diagnostic and treatment approaches in patients diagnosed with cancer during pregnancy can be effective in protecting maternal and fetal health. Surgery and chemotherapy can be applied safely, especially in the second and third trimesters. Multidisciplinary teamwork and patient information positively affect treatment success and outcomes. Pregnancy follow-up and neonatal care services are critical in the management of these patients.

There is a pressing need for additional studies aimed at collecting more data on the diagnosis and treatment of cancer during pregnancy, which would help bridge existing knowledge gaps and contribute to improvements in clinical practice.

Single-center design, relatively small patient sample size, inability to match groups by age, lack of long-term follow-up data on newborns, and limited number of variables analyzed can be considered limitations of our study. This has constrained the depth of the statistical analysis. Furthermore, different cancer types and stages, as well as treatment methods, may have different effects on neonatal outcomes. The study data did not include information on the socioeconomic status of the mothers. This is one of the limitations of our study, and further research is needed to assess the impact of socioeconomic factors on neonatal and maternal outcomes. The retrospective design of the study resulted in some information being missing or limited in the data collection process. In particular, the limited data on socioeconomic status, detailed clinical stages, and treatment protocols are significant limitations of our study. Future prospective studies aim to address these shortcomings.In our study, these differences were not evaluated in detail; this is among the limitations of our study and is an important topic that should be investigated in future research.

Despite these limitations, this study provides valuable information about cancer incidence and outcomes during pregnancy in Turkey, is consistent with findings from recent studies, and contributes to the existing literature. In this study, clinical characteristics and maternal and fetal outcomes of cancer patients diagnosed during pregnancy or in remission were analyzed. Breast cancer is the most common malignancy and is usually diagnosed in mid-pregnancy. Treatment modalities such as surgery and chemotherapy during pregnancy can be safely performed with appropriate timing and multidisciplinary approach and have favorable or at least acceptable maternal-fetal outcomes. However, the need for neonatal intensive care and maternal intensive care is higher in pregnant women diagnosed with cancer, which is an important indicator for neonatal outcomes and maternal survival. It has been observed that maternal mortality is more common in advanced and aggressive tumors. In cases where cancer is diagnosed during pregnancy, multidisciplinary teamwork and personalized treatment plans are of vital importance. Early diagnosis and appropriate treatment can contribute to improved outcomes for both the mother and newborn.

CONCLUSION

This study highlights the need for caution in managing pregnancies undergoing oncological procedures, while emphasizing that multicenter studies can provide a broader data set and make significant contributions to future research.

Ethics Committee Approval: This study was approved by the Ethics Committee of Ankara City Hospital (TABED 1-25-868).

Informed Consent: Not necessary because the study is retrospective.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors state no conflicts of interest.

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Conceptualization, Investigation, Drafting the article, Methodology, Visualization; AAB: Investigation, Data curation, Drafting the article; EA: Visualization; ŞB: Formal Analysis; ÖK: Data curation; EK: Visualization, Writing – original draft; DS: Analysis and interpretation of data, Validation, Visualization, Writing – review & editing.

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