Özgün Araştırma / Original Article

Jinekoloji - Obstetrik ve Neonatoloji Tıp Dergisi
The Journal of Gynecology - Obstetrics and Neonatology

DOI:10.38136/jgon.1363734

Sperm Cryopreservation in Cancer Patients: 13 Years Experience

Kanser Hastalarında Sperm Kriyoprezervasonu: 13 yıllık Tecrübe

YASEMİN YUKSEL [1] Orcid ID: 0000-0003-3343-7957
MUZEYYEN GULNUR OZAKSİT [2] Orcid ID: 0000-0001-9117-9728
DERYA ÖZDEMIR-TAS [1] Orcid ID: 0000-0001-6968-6379
HANİFE NURDAN OLCAR [1] Orcid ID: 0000-0002-1241-5698
AHMET DENİZ TUZLUOGLU [3] Orcid ID: 0009-0008-8171-1002
SEBNEM OZYER [2] Orcid ID: 0000-0002-1326-4246
ZEHRA KURDOGLU [4] Orcid ID: 0000-0001-5191-1072
OZLEM MORALOGLU-TEKİN [2] Orcid ID: 0000-0001-8167-3837

[1] Ministry of Health Ankara Bilkent City Hospital, Department of Assisted Reproductive Technologies, Embryology, Ankara, Turkey.

[2] University of Health Sciences, Ankara Bilkent City Hospital, Department of Assisted Reproductive Technologies, Obstetrics and Gynecology, Ankara, Turkey.

[3] Ministry of Health Ankara Bilkent City Hospital, Department of Assisted Reproductive Technologies, Urology, Ankara, Turkey.

[4] Ankara Yıldırım Beyazıt Unıversity, Ankara City Hospital, Department of Assisted Reproductive Technologies, Obstetrics and Gynecology, Ankara, Turkey

ÖZ

Amaç: 13 yıldır farklı kanser tanılarıyla sperm kriyopreservasyonu yaptığımız hastaların semen parametreleri YUT-ICSI (Yardımcı Üreme Teknolojileri-intrasitoplazmik sperm enjeksiyonu) siklusla rında kullanımı ve mevcut depolanma durumlarının araştırılması.

Gereç ve Yöntemler: Ankara Bilkent Şehir Hastanesi Üremeye Yardımcı Tedavi Merkezine (Kasım 2019-Nisan 2023) ve Zekai Tahir Burak Kadın Sağlığı Eğitim ve Araştırma Hastanesi Üremeye Yardımcı Tedavi Merkezine (Ocak 2010- Eylül 2019 arası) başvuran 318 malignite tanısı konulan hastaya fertilitesinin korunması amacıyla sperm kriyoprezervasyonu yapılmıştır. Yaş, kanser türü, semen hacmi, sperm sayısı, sperm hareketliliği, örneklerin saklama ve ART siklusla rında kullanım durumları kaydedilerek analiz edilmiştir.

Bulgular: 13 yılda 318 hastaya sperm dondurma yapıldı. Hastalarda sıklıkla testis kanseri (%54,7), lenfoma (%17,3) ve lösemi (%10,1) görüldü. En yüksek ortanca semen hacmi değeri lösemide (3,1 (1,5-6,0)), en düşük ortanca semen hacmi değeri ise üriner sistem tümöründe (1,5 (1,0-2,0)) izlendi. Ortanca sperm konsantrasyonları testis kanserinde 12,5 (1,0-100,0)x10^6/mL; lenfomada 40,0 (1,0-140,0)x10^6/mL; lösemide 24,5 (1,0-130,0) x10^6/mL'dir. Testis kanserli erkeklerde sperm konsantrasyonunun önemli ölçüde azaldığı görüldü. En yüksek sperm motilitesi nazofaringeal tümör grubunda (40,0 (20,0-60,0)) görüldü. Merkezimizde dört hastaya dondurulmuş spermleri çözdürülerek beş adet YUT (ICSI) siklusu yapıldı. Embriyo transferi dört hastaya uygulandı. Hastalardan birisinde anormal fertilizasyon, bir hastada ise ikiz klinik gebelik saptandı. Üç hasta dondurulmuş spermlerini başka bir merkeze nakletti.

Sonuç: Kanser tedavisinde kullanılan cerrahi yöntemler, kemoterapi ve radyoterapinin, spermatogenez ve fertilite sağlığı üzerinde olumsuz etkilere sahip olmasından dolayı, sperm kriyoprezervasyonu bu hastalarda altın standart olup, kanser hastalarının tedavi öncesi doğurganlık potansiyelinin korunması için pratikte giderek daha fazla önerilmekte ve uygulanmaktadır.

Anahtar Kelimeler: Kriyoprezervasyon, fertilite korunması, sperm kriyoprezervasyonu, testis kanseri, malignite

ABSTRACT

Aim: The study represents 13 years experience of sperm cryopreservation for different cancer types by researching the semen parameters, the use of frozen-stored samples in ART-ICSI (Assisted Reproductive Technologies-intracytoplasmic sperm injection) cycles, and their current storage status.

Material and Methods: Sperm cryopreservation in order to fertility preservation was conducted on 318 patients who had different malignancies applied to the Reproductive Center of Ankara Bilkent City Hospital (from November 2019 to April 2023) and Zekai Tahir Burak Women's Health Hospital (from January 2010 to September 2019). The age, cancer type, semen volume, sperm count, sperm motility, samples storage status, and usage of banked sperm in ART cycles were recorded and analyzed.

Results: Sperm cryopreservation was applied to a total of 318 patients for 13 years. The major cancer types are testicular cancer (54.7%), lymphoma (17.3%), and leukemia (10.1%). 11% (n=35) of patients. The highest median semen volume was detected in leukemia (3.1 (1.5-6.0)), and the lowest mean semen volume was in the urinary system tumor (1.5 (1.0-2.0)). The median sperm concentration in testicular cancer is 12.5 (1.0-100.0)×10^6/mL; in lymphoma is 40.0 (1.0-140.0)×10^6/mL and in leukemia is 24.5 (1.0-130.0)×10^6/mL. Sperm concentration significantly decreased in men with testicular cancer. The highest median of sperm motility was observed in nasopharyngeal tumor group (40.0 (20.0-60.0)). Four patients applied to our center to use their frozen sperm. The patients underwent five ART (ICSI) cycles and four embryo transfers. One of the patients had abnormal fertilization and one of the patients had twin clinical pregnancy. Three patients transferred their banked sperm to another center.

Conclusion: Since surgical methods, chemotherapy and radiotherapy treatments used for cancer treatment have intense negative effects on spermatogenesis and fertility health, sperm cryopreservation is the gold standard and increasingly being recommended in clinical practice for preserving the fertility potential of cancer patients before treatment.

Keywords: Cryopreservation, fertility preservation, sperm cryopreservation, testicular cancer malignancy

Sorumlu Yazar/ Corresponding Author: Yasemin Yuksel
Adres: Ministry of Health Ankara Bilkent City Hospital, Department of Assisted Reproductive Technologies, Embryology, Ankara, Turkey.
E-mail: dryuksely@gmail.com

Başvuru tarihi:20/09/2023
Kabul tarihi:24/09/2023

INTRODUCTION

Cancer is a general health problem seen worldwide. In the 1980s, the primary objective for both patients and physicians was survival. However, thanks to advancements in surgical techniques, chemotherapy, and radiotherapy, coupled with improved early diagnosis, the odds of curing and prolonging the lives of patients have markedly improved. The survival rate especially in lymphoma and testicular cancers has reached over 90% (1). Accordingly, the phenomenon of reproduction, which is associated with the quality of life, has come to the fore. The increased awareness of both patients and their relatives as well as physicians has led to increase importance of sperm cryopreservation in the last 10 years over all the world (2). Sperm cryopreservation is the most precious and effective method to preserve fertility potential in cancer patients (3). Efforts to fight against fertility impair the mental health of couples, so sperm freezing has great importance in couples to reduce stress about infertility (4). Recent technological developments, and innovations in freezing techniques and media, led to close values of motility and morphology similar to normal patients in thawing sperms, as well as making it safe to refer (5). Surgical methods, chemotherapy, and radiotherapy treatments effect on spermatogenesis by damaging germinal tubule epithelium caused oligozoospermia or azoospermia and also disrupt neural signals regulating the erection and the ejaculation (6). Dose and frequency of treatment can be determined for fertility health, but it cannot be clearly predicted in which patient's spermatogenesis will be impaired in a what proportion (7). For this reason, sperm cryopreservation is recommended especially before treatment for all patients who are single or married want to have children. Unfortunately, the use of frozen sperm in cancer patients is very low in Turkey.

We represent our 13 years of experience in the study by determining cancer types, patient ages, semen parameters (volume, concentration, motility), and the use and storage status of sperm samples who applied to our fertility center.

MATERIAL AND METHODS

1. Subject and study design

Sperm cryopreservation was conducted on a total of 318 patients who applied to the Department of Gynecological Endocrinology and Reproductive Medicine of Ankara Bilkent City Hospital (from November 2019 to April 2023) and Zekai Tahir Burak Women's Health Hospital (from Janbuary 2010 to September were collected retrospectively. Patients who have azoospermia or insufficient motile spermatozoa in semen samples were not frozen and not included in to study. Data of patients included the following: age, diagnosis, day of sexual abstinence, semen volume, sperm count and motility, current banking status and also usage of the frozen spern ART cycles.

2. Ethics statement and legal procedure

The study protocol was approved by the Ethical Committee of Ankara Bilkent City Hospital (E2-23-4587). To be sperm frozen legally in our country, there must be a report signed by three physicians stating the diagnosis of patient and recommendation of sperm cryopreservation. Sperm cryopreservation consent form was informed and signed by patients. The information form was signed by the parents in patients under the age of 18.

Frozen sperm samples are legally stored for one year in our country. After one year, the patient's confirmation for storage or annihilation needs to be taken at the end of each subsequent year. Also, patients have option to use their sperm samples in our fertility center or have the option of moving to another center for ART cycles. If the patient dies, all samples are destroyed after the death report is obtained.

3. Sperm preparation and cryopreservation

Patients were advised to come with 3-5 days of sexual abstinence. Sperm cryopreservation was admitted immediately, regardless of sexual abstinence in patients with urgency to prevent disruption of treatment. Semen samples were collected in sterile plastic containers through masturbation in our center. Samples were allowed to liquefy for 30-45 minutes at 37C. After liquefaction, a drop of semen sample was taken to Makler counting chamber. Concentration and percentage of motile spermatozoa were determined according to World Health Organization guidelines (8). The semen samples were transferred into a conical bottom tube (BD Bioscience, San Jose, CA, USA) and diluted 1:1 with sperm rinse solution (Vitrolife, Gothenburg, Sweden) and then centrifugated two times. After the supernatant was discarded, 0.2–0.5 ml of sperm rinse medium was added to sperm pellet and mixed with the same volume of sperm freezing medium (Vitrolife, Gothenburg, Sweden), and the mixture was taken to High Security cotton-plugged sperm straws (Cryo Bio System, L'Aigle, France). The prepared straws were kept in nitrogen vapor for 30 minutes and then storaged in liquid nitrogen tanks (-196°C).

4. Statistical analysis

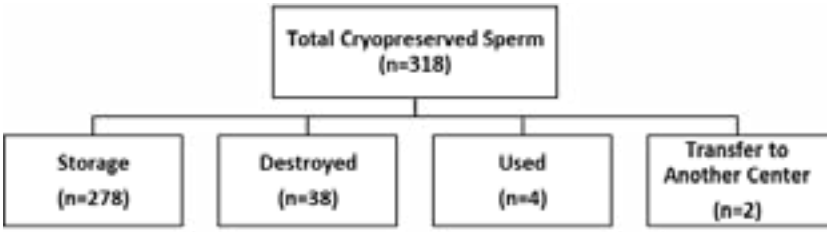
IBM SPSS Statistics 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) and MS-Excel 2007 programs were used for statistical analyzes and calculations. Statistical significance level is accepted as $p<0.05$. The suitability of the continuous variables to normal distribution was evaluated graphically and with the Shapiro-Wilks test. It was determined that none of the continuous variables followed a normal distribution. Mean±SD (standard deviation) and Median (Minimum-Maximum) values were given to display the descriptive statistics of the variables. Kruskal Wallis non-parametric analysis of variance was used to compare the parameters. Bonferroni correction was made for pairwise comparisons.

RESULTS

Characteristics of patients

Sperm cryopreservation has been made in this center since 2010. Figure 1 represents study chart. There was a total of 318 men had cryopreservation due to different malignancies. A total of 38 sperm samples were legally destroyed until now. Some of them were due to destruction requests of the patients, death of the patient, and some of them were he fact that the patients could not be reached for years or the patient did not come to the sperm extension procedure for extension of storage. Sperm samples of three patients were transferred to another center in 13-years period. Also, Five ICSI cycles were performed in four patients by using thawed sperms. The remaining sperm straws of one of the four patients who underwent ICSI are waiting to be destroyed due to patient death, one patient transferred his samples to another center, and the remaining straws of two patients are still stored after thawing.

Figure 1. Flow chart of the study



The types of cancers were presented in Table 1. Of men (n=318) who underwent sperm cryopreservation; 54.7% (n=174) had testicular cancer, 17.3% (n=55) had lymphoma, 10.1% (n=32) had leukemia, and 6.6% (n=21) had soft tissue tumor, 3.5% (n=11) had osteosarcoma, 3.8% (n=12) had gastroenterological tumor, 1.9% (n=6) had nasopharyngeal tumor, 1.2% (n=4) had brain tumor, 0.9 % (n=3) had urinary system tumor. The highest number of indications for sperm cryopreservation were in testicular cancer. Lymphoma and then leukemia followed testicular cancer, respectively. The lowest diagnosis was observed in urinary tumor.

Table 1. Cancer type of patients before sperm cryopreservation

Cancer type	No. of patient (%)
Testicular cancer	174 (54.7)
Lymphoma	55 (17.3)
Leukemia	32 (10.1)
Nasopharyngeal tumor	6 (1.9)
Soft tissue sarcoma	21 (6.6)
Brain tumor	4 (1.2)
Osteosarcoma	11 (3.5)
Urinary system tumor	3 (0.9)
Gastroenterological tumor	12 (3.8)

Age at cryopreservation and sexual abstinence of patients are shown in Table 2. The lowest sperm cryopreservation age was 14 years old in four patients. 11% (n=35) of all patients (n=318) are adolescents under the age of 18. The mean age of men with testicular cancer is 26.26±5.67, with lymphoma is 25.20±7.03, with leukemia is 26.47±7.13, with nasopharynx tumor is 20.17±6.05,

with soft tissue sarcoma is 24.19±6.90, with brain tumor is 22.00±5.89, with osteosarcoma is 22.73±8.01, with urinary system tumor is 25.00±11.79, with gastroenterological tumor is 33.83±7.99 years old. The highest average age was observed in the gastroenterological tumor group and the lowest age group was observed in the nasopharynx group. A significant difference was detected the mean age at sperm cryopreservation between nasopharynx tumors (20.17±6.05) and gastroenterological tumors (33.83±7.99) (=23.546, p=0.003).

Table 2. Semen characteristics and details of patients according to cancer type.

Diagnosis	Age at Cryopreservation (year)	Sexual Abstinence (day)	Semen Volume (mL)	Sperm Concentration (X106)	Sperm Motility (a+b motil)
	M±SD Median	M±SD Median	M±SD Median	M±SD Median	M±SD Median
Testicular cancer	26.26±5.67	5.80±7.61	3.32±1.34	18.66±18.70	31.72±16.49
	25.0 (16.0-45.0)	4.0 (1.0-67.0)	3.0 (0.4-10.0)	12.5 (1.0-100.0)	30.0 (3.0-70.0)
Lymphoma	25.20±7.03	7.00±9.10	2.73±1.13	44.13±33.08	29.84±14.86
	24.0 (14.0-41.0)	4.0 (1.0-60.0)	2.8 (0.2-5.5)	40.0 (1.0-140.0)	30.0 (2.0-70.0)
Leukemia	26.47±7.13	8.09±5.46	3.44±1.24	29.91±26.31	21.97±14.84
	26.0 (14.0-42.0)	7.0 (1.0-25.0)	3.1 (1.5-6.0)	24.5 (1.0-130.0)	20.0 (2.0-55.0)
Nasopharyngeal tumor	20.17±6.05	3.17±2.04	3.22±0.93	63.33±46.44	41.17±14.70
	17.5 (16.0-32.0)	3.0 (1.0-7.0)	3.1 (2.0-4.5)	60.0 (11.0-124.0)	40.0 (20.0-60.0)
Soft tissue sarcoma	24.19±6.90	5.76±6.26	2.89±1.31	44.86±34.65	30.33±13.27
	23.0 (14.0-40.0)	4.0 (1.0-30.0)	2.8 (0.7-6.0)	40.0 (1.0-120.0)	30.0 (7.0-55.0)
Brain tumor	22.00±5.89	5.75±1.50	2.12±1.18	23.50±12.04	26.00±6.98
	22.0 (16.0-28.0)	6.0 (4.0-7.0)	2.3 (0.5-3.3)	21.0 (12.0-40.0)	25.5 (18.0-35.0)
Osteosarcoma	22.73±8.01	6.54±2.21	2.57±0.99	44.18±37.83	30.64±15.76
	24.0 (14.0-38.0)	7.0 (3.0-10.0)	3.0 (1.0-4.0)	32.0 (4.0-120.0)	30.0 (5.0-60.0)
Urinary system tumor	25.00±11.79	11.33±16.17	1.50±0.50	35.33±40.46	23.00±27.73
	22.0 (15.0-38.0)	2.0 (2.0-30.0)	1.5 (1.0-2.0)	14.0 (10.0-82.0)	8.0 (6.0-55.0)
Gastroenterological tumor	33.83±7.99	6.67±7.76	2.91±1.76	34.17±29.53	30.83±16.35
	36.0 (18.0-43.0)	4.5 (2.0-30.0)	2.7 (0.7-6.0)	29.0 (2.0-100.0)	35.0 (10.0-60.0)
	=23.546; p=0.003	=21.560; p=0.006	=21.561; p=0.006	=47.561; p<0.001	=13.185; p=0.106

Sperm parameters

Semen parameters (volume, concentration, motility) of patients are shown in Table 2. Even if the duration of sexual abstinence was preferred to be between 3-5 days, sperm freezing was performed regardless of the duration of sexual abstinence, in patients who had emergency to be done chemotherapy and radiotherapy. The highest median (min-max) sexual abstinence was detected in leukemia (7.0 (1.0-25.0)) and osteosarcoma (7.0 (3.0-10.0)). Statistically significant difference was found between testicular cancer and leukemia in terms of sexual abstinence (p<0.05).

The highest median (min-max) semen volume was detected in leukemia (3.1 (1.5-6.0)), and the lowest mean semen volume was in the urinary system tumor (1.5 (1.0-2.0)). In the pairwise comparison of malignancies in terms of semen volumes, a statistically significant difference was detected between urinary system tumor and testicular cancer, urinary system tumor and leukemia,

lymphoma and testicular cancer (p <0.05).

The lowest sperm concentration median (min-max) was observed in patients with testicular tumor (12.5 (1.0-100.0), followed by urinary system tumor (14.0 (10.0-82.0)), brain tumor (21.0 (12.0-40.0), leukemia (24.5 (1.0-130.0), gastroenterological tumor (29.0 (2.0-100.0)), osteosarcoma (32.0 (4.0-120.0)), soft tissue sarcoma (40.0 (1.0-120.0), lymphoma (40.0 (1.0-140.0)), nasopharyngeal tumor 60.0 (11.0-124.0), respectively. It was observed that sperm concentration was not prominently affected by lymphoma (40.0 (1.0-140.0)). In the pairwise comparison of the groups in terms of sperm concentrations, statistically significant differences were found between lymphoma and testicular cancer and also between soft tissue tumor and testicular cancer (=47.561, p<0.001), (Table 2).

The highest median (min-max) of sperm motility was observed in the nasopharyngeal tumor group (40.0 (20.0-60.0)). Leukemia (20.0 (2.0-55.0)) and urinary system tumors (8.0 (6.0-55.0)) showed lower sperm motility than other cancers (Table 2). But no statistically significant difference was detected in terms of sperm motility (in the rate of progressive motile spermatozoa (a+b)) (p>0.05).

The outcome of ICSI cycles made with thawed sperms

Reproductive outcomes of thawed sperms are represented in Table 3. Four patients (one of them is lymphoma, one of them is osteosarcoma, and two of them are testicular cancers) applied to thawing sperm in their ART cycles. A total of five ICSI cycles were performed to patients. Twin clinical pregnancy occurred in one of the patients, had two embryo transfer, made in the second ICSI cycle. The pregnant patient was the wife of patient with testicular cancer. Unfortunately, the pregnancy ended at the 18th week. No live birth was observed. Abnormal fertilization was observed in another patient. Embryo transfer was cancelled. Pregnancy results were negative in the other two patients.

DISCUSSION

The ability to successfully freezing and storing reproductive cells and thawing them has great importance for the development of ART. Cryopreservation has not only increased the success of ART cycles, but also contributed to the preservation of fertility health before testicular surgery, chemotherapy and radiotherapy (7). Depending on the type and dose of the agent used in chemotherapy and radiotherapy, spermatogenesis may be permanently, temporarily, or long-term damaged and cause sperm DNA damage (7). Spermatogonia is highly affected due to their intense mitotic activity from radiotherapy. Spermatids are very sensitive to therapeutic agents because they do not have DNA repair ability (9). Especially in patients used high doses of alkylating and cytostatic agents azoospermia may become (10). Before treatments, spermatogenesis can be disrupted, oligospermia can be seen in 60% of patients because of testicular tumors, leukemia, and lymphoma. When chemotherapy or radiotherapy is given to these patients in this condition, spermatogenesis can sometimes be damaged in a way that can only return to normal in 4-5 years or disrupted permanently (1,3,11). In this case, it is important to inform the patient and determine the type of treatment. Sperm cryopreservation in a such patient is gold standard for preserving fertility health in the future. The American Society of Reproductive Medicine Ethics Committee (12) and the American Society of Clinical Oncology (13) both recommended that physicians should inform all cancer patients about the option for fertility preservation. Experts recommended sperm freezing before gonadotoxic treatments to protect sperm from DNA damage caused by therapeutic agents and ensure to freeze with better sperm parameters. Although it is an undesirable situation, the patient may apply for sperm freezing in the middle or after the treatment (14). Although sperm freezing is frequently performed, the rate of use sperm thawing by cancer patients is low through assisted reproductive techniques and varies between 10% and 60% (14), 3% and 10% (15) in worldwide. One of the reasons why sperm banks are rarely used in cancer patients is that some patients can regain spermatogenesis after treatments and natural conception has been reported to be 23–47% in these cases (16). Pregnancy rates achieved with frozen sperm vary between 12% and 35.2% (17).

The general principle in gamete cryopreservation is cooling the material after equilibrating with cryoprotectants, and then storing it in liquid nitrogen at -196°C. After this process, gonad cells have been stored for decades (18). If sperm storage conditions are optimal, storage time does not have a negative impact on sperm quality. Conducted studies has demonstrated no relationship between post-thawing sperm parameters and the duration of storage time (19). During thawing process, the cryoprotectants are removed from the samples and transferred back into physiological environments where maintain their vitality (18). Cryoprotectant agents reduce the freezing point while replacing water, reduces the solute and salt ratio of the cell, and protect the cells from high osmolarity and provide controlled water loss. The main purpose of these procedures is to return

the sperm cells with as little damage as possible when thawed. Different methods in freezing and thawing mediums are currently being developed to protect sperm against the negative effects of freezing and thawing process' (18, 20).

Song et al., (1) conducted a study at 21 years of sperm cryopreservation, examined the diagnosis and sperm parameters of 721 cancer patients, and found that the sperm count in patients with testicular cancer was significantly lower than others, similar to our study. This may be caused by freezing after unilateral orchiectomy in patients with testicular cancer. They detected that 44 patient (6.1%) used their stored sperm via ART cycles. 22 clinical pregnancy was confirmed by ultrasound. In another study, conducted by Vomstein and colleagues (21) in 545 patients who had different cancers, showed that the lowest sperm values were in testicular tumors, in parallel to our study, 29 (5.3%) patients used their banked sperm in 48 ART cycles, and 15 clinical pregnancies were achieved. Fu et al., (22) showed that sperm parameters were negatively affected by testicular tumor and leukemia in 145 patients who underwent sperm cryopreservation (from 2006 to 2017). They conducted ART cycles to 9.7% (n=14) of patients returned to use for banked sperm and a total of 33 ART cycles were performed. Pregnancy occurred in 51.5% (17 out of 33 cycles) of patients. 71.4% of patients had a baby (10 out of 14).

In the present study, a total of 318 men performed to sperm cryopreservation had different malignancies. In parallel with previous studies (1, 21,22), the lowest sperm concentrations were observed in patients with testicular tumor. Although the most common group of patients who underwent sperm cryopreservation was testicular cancer followed by lymphoma, sperm parameters were found to be less affected than other cancers in lymphoma. Leukemia is the third common malignancy sperm cryopreserved and the second malignancy negatively affected in terms of sperm concentration. No statistically significant difference was detected in terms of progressive motility among all cancer types. The lowest sperm cryopreservation age was 14 years old in four patients who had leukemia, lymphoma, osteosarcoma, and soft tissue tumor. The storage period in the sperm bank depends on the patient's survival, patient's marriage status, recovery of spermatogenesis and the patient's application to continue storing of the samples. The longest duration time of stored sperm is 13 years in our center. In 13 years, 38 sperm samples were destroyed because of the patient died, had a spontaneous child, applied for destruction, or the patient could not be reached for a long time. Three patients' samples were transferred to another center upon application of the patients. The use of cryopreserved sperm due to oncological malignancy is very low in our center. Only four patients (1,25%) applied to use frozen sperms to have a baby. Five ICSI cycles were made with thawed sperm. Embryo transfer was made in four patients. Abnormal fertilization occurred in a patient and embryo transfer was canceled. Twin clinical pregnancy occurred in a patient's second cycle. Unfortunately, the babies were lost in the 18th pregnancy week. There was no live birth. The limitation of this study is that since the number of patients who applied to the ART cycle with frozen sperm is very small, it needs to be conducted for a longer period of time and with a larger number of patients in order to determine the effects of cancer type and semen values on ART outcomes.

According to these data, we emphasize that the use of frozen sperm should be encouraged. Sperm cryopreservation is a significant hope and it is worth to use for the patient before gonadotoxic treatments.

CONCLUSION

Since surgical methods, chemotherapy and radiotherapy treatments used for cancer treatment have intense negative effects on spermatogenesis and fertility health, Sperm cryopreservation is the gold standard and increasingly being recommended in clinical practice for preserving the fertility potential of cancer patients before treatment especially in testicular cancer and leukemia. Thanks to the developing assisted reproductive techniques today, sperm cryopreservation is done more safely and successfully to preserve fertilization patients diagnosed with cancer before chemotherapy or radiotherapy that will affect spermatogenesis.

Acknowledgement

No potential conflict of interest relevant to this article.

There is not any funding used for this manuscript.

REFERENCES

1. Song SH, Kim DK, Sung SY, Her YS, Lee OH, Choi MH, et al. Long-term experience of sperm cryopreservation in cancer patients in a single fertility center. World J Mens Health. 2019 May;37(2):219-225.

2. Yumura Y, Tsujimura A, Okada H, Ota K, Kitazawa M, Suzuki T, et al. Current status of sperm banking for young cancer patients in Japanese nationwide survey. Asian J Androl. 2018;20(4):336-341.

3. Siegel R, DeSantis C, Virgo K, Stein K, Mariotto A, Smith T, et al. Cancer treatment and survivorship statistics, 2012. CA Cancer J Clin. 2012;62(4):220-41.

4. Saito K, Suzuki K, Iwasaki A, Yumura Y, Kubota Y. Sperm cryopreservation before cancer chemotherapy helps in the emotional battle against cancer. Cancer. 2005;104(3):521-4.

5. Zhang HL, Mao JM, Liu DF, Zhao LM, Tang WH, Hong K, et al. Clinical outcomes of microdissection testicular sperm extraction-intracytoplasmic sperm injection with fresh or cryopreserved sperm in patients with nonobstructive azoospermia. Asian J Androl. 2021;23(2):211-214.

6. Loren AW, Mangu PB, Beck LN, Brennan L, Magdalinski AJ, Partridge AH, et al. Fertility preservation for patients with cancer: American Society of Clinical Oncology clinical practice guideline update. J Clin Oncol. 2013;31(19):2500-10.

7. Meistrich ML. Effects of chemotherapy and radiotherapy on spermatogenesis in humans. Fertil Steril. 2013;100(5):1180-6.

8. Luis F, Moncayo G. World Health Organization. (2010). WHO laboratory manual for the examination and processing of human semen,. World Health Organization. World Health Organization. 2010, 5th ed.

9. Trottmann M, Becker AJ, Stadler T, Straub J, Soljanik I, Schlenker B, et al. Semen Quality in Men with Malignant Diseases before and after Therapy and the Role of Cryopreservation. Eur Urol. 2007;52(2):355-67.

10. Van Der Kaaij MAE, Van Echten-Arends J, Simons AHM, Kluin-Nelemans HC. Fertility preservation after chemotherapy for Hodgkin lymphoma. Hematol Oncol. 2010;28(4):168-79.

11. Tunalı G. Sperm kriyoprezervasyon teknikleri ve fertilizasyon başarısındaki rolü. Androloji Bülteni Dergisi. 2014;16(57):123–8.

12. Ethics Committee of the American Society for Reproductive Medicine. Fertility preservation and reproduction in cancer patients. Fertil Steril. 2005;83(6):1622-8.

13. Lee SJ, Schover LR, Partridge AH, Patrizio P, Wallace WH, Hagerty K, et al. American Society of Clinical Oncology recommendations on fertility preservation in cancer patients. J Clin Oncol. 2006;24(18):2917-31.

14. Ferrari S, Paffoni A, Filippi F, Busnelli A, Vegetti W, Somigliana E. Sperm cryopreservation and reproductive outcome in male cancer patients: a systematic review. Reprod Biomed Online. 2016;33(1):29-38.

15. Muller I, Oude Ophuis RJA, Broekmans FJM, Lock TMTW. Semen cryopreservation and usage rate for assisted reproductive technology in 898 men with cancer. Reprod Biomed Online. 2016;32(2):147-53.

16. Girasole CR, Cookson MS, Smith JA, Ivey BS, Roth BJ, Chang SS. Sperm banking: Use and outcomes in patients treated for testicular cancer. BJU Int. 2007;99(1):33-6.

17. Erdemir F. Sperm dondurma: Güncel gelişmeler. Androl Bul 2019;21:14−21.

18. Cıncık M. Sperm kriyoprezervasyonu. Gülhane Tıp Dergisi. 2003;45(1):100–6.

19. Keros V, Rosenlund B, Hultenby K, Aghajanova L, Levkov L, Hovatta O. Optimizing cryopreservation of human testicular tissue: Comparison of protocols with glycerol, propanediol and dimethylsulphoxide as cryoprotectants. Hum Reprod. 2005;20(6):1676-87.

20. Cayan S, Lee D, Conaghan J, Givens CA, Ryan IP, Schriock ED, et al. A comparison of ICSI outcomes with fresh and cryopreserved epididymal spermatozoa from the same couples. Hum Reprod. 2001;16(3):495-9.

21. Vomstein K, Reiser E, Pinggera GM, Toerzsoek P, Deininger S, Kriesche T, et al. Sperm banking before gonadotoxic treatment: Is it worth the effort? Asian J Androl. 2021;23(5):490-494.

22. Fu L, Zhou F, An Q, Zhang K, Wang X, Xu J, et al. Sperm cryopreservation for male cancer patients: More than 10 years of experience, in Beijing China. Med Sci Monit. 2019;25:3256-3261.