Fertility preservation in men with oncologic diseases

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Review Article

Abstract Over the last two decades, the survival rates of oncologic patients have risen. This rate increase in patients under 20 years of age has had an influence on adopting semen preservation practices. Cancer treatments, especially chemotherapy and radiotherapy can affect fertility. Chemotherapy has a negative effect on spermatogenesis that is either transitory or permanent and radiotherapy directly damages DNA. In the majority of cases, both the cancer and its treatments reduce sperm quality and protocols that include radiation and/or chemotherapy do so even more. Cryopreservation techniques and the use of these cells in assisted reproduction have been reported on an individual basis, with different and contradictory results.

Semen cryopreservation is the main option for fertility preservation. Assisted reproduction centers need to be created so that special programs can be developed for these cases. The final recommendation is to carry out cryopreservation immediately, even before beginning any treatment. The recovery of normal physiologic processes such as spermatogenesis is slow - often taking years - and sometimes is not achieved. Therefore prevention, along with these services, should be fomented.

PALABRAS CLAVE
Preservación de la fertilidad en varones con padecimientos oncológicos

Resumen En las últimas 2 décadas, las tasas de sobrevivencia de pacientes oncológicos han aumentado. El aumento de tasa de pacientes oncológicos menores de 20 años ha influenciado en adopción de prácticas de conservación seminal. Los tratamientos para cáncer, principalmente, la quimio y radioterapia pueden afectar la fertilidad. La quimioterapia afecta...
Introduction

In the last 2 decades survival rates of oncologic patients have increased, due to the substantial treatment advances using safer medications, earlier detection, and care in not unnecessarily exposing areas of the body to radiation. This rate increase in patients under 20 years of age has influenced the adoption of conservation practices. The increase of cancer in young patients is considerable, but so are the possibilities of survival; there are many options for the preservation of genetic material that has a high probability of being damaged, whether by the type of cancer itself or the treatment involved, and therefore assisted reproduction centers in Mexico and all over the world have redoubled their conservation techniques so that these samples of extreme value are of the best quality and can be used in the future, guaranteeing procreation preservation in cancer survivors.

Many men with cancer and their partners wish to have a family, and through awareness of the aspects of their disease they arrive at the decision to preserve their germ cells (spermatozoids). Preservation has been widely reported on in the literature because of the consequences that antineoplastic medication, radiation, and chemotherapy have on fertility. This type of infertility in men can be temporary or permanent, varying with each individual, and its prediction is practically impossible. Therefore semen cryopreservation is the main preventive measure to be taken before beginning treatment. It is not practiced very extensively in Mexico, due to a lack of information provided by general physicians and oncologists about these services; the American Society of Clinical Oncology (ASCO)\textsuperscript{1} guidelines clearly point out the flow chart to be followed when treating the male cancer patient, making him aware of the options so he can choose preservation or not, before initiating treatment. This should be obligatory in all countries with educated societies.

The impact of cancer as an “illness” on semen quality

The reduction of semen quality is multifactorial. The physiologic response to the “abnormal” appearance of a cellular event, whether cancer or another disease, is an immediate decrease in functions, including those of reproduction, so that the spread to other organs can be stopped and the paraneoplastic syndrome prevented or diminished. Hence many metabolic systems adjust to the new changes or simply stop functioning; endocrine and immune system disorders and the physical effects of tumors cause sperm dysfunction, and authors report that reproduction is the first function sacrificed.

The results in relation to cancer’s negative effect on sperm quality are contradictory, and are presented in table 1, displaying different conclusions as to the impact on reproductive function. Variables such as the type of cancer and its location were evaluated in these studies.

Different authors provided a variety of results. Ragni et al. reported that 11.6% of the men seen at their center that wished to have sperm cryopreservation presented with azoospermia.\textsuperscript{9} A total of 3.9% of the patients with lymphoma had azoospermia, whereas 15.3% of the patients with testicular tumors had the condition, in addition to reduction in the other parameters.\textsuperscript{4} Lass et al. reported that 10.5% of the untreated men had azoospermia, including 9.6% of those with testicular tumors, 13.3% with leukemia or lymphoma, and 3.7% of the men with other malignant tumors.\textsuperscript{8} Only 40% of the men with lymphoma, 37% with testicular cancer, and 37% with other tumors were reported to have normal semen parameters in accordance with the World Health Organization (WHO) criteria.\textsuperscript{5} Men with Hodgkin’s disease generally had low quality parameters.\textsuperscript{11-15}

A study by Bahadurt in 2005 conducted on 776 men with cancer showed a significant reduction in the sperm concentration of patients with testicular cancer, but it was unchanged in other patients with malignant tumors. Another study demonstrated that patients with testicular cancer had sperm concentrations below the WHO parameters before
beginning treatment. DNA integrity has been shown to be greater in patients undergoing treatment than before it was begun. However, there is evidence suggesting that the type of cancer and its malignancy do not affect the quality of sperm DNA.

## Effects of cancer treatment on semen quality

Chemotherapy has a negative effect on spermatogenesis, whether transitory or permanent. These drugs damage cell proliferation directly, which is why spermatozooids in the early stages of differentiation are very sensitive to these agents. Nevertheless, the precursors of spermatogenesis can be damaged due to the cumulative effects of multiple chemotherapy doses. Germ cells in the advanced stage, that is, spermatocytes and spermatids, are less sensitive to chemotherapy because they are not dividing; this explains the finding of some spermatozooids immediately after chemotherapy, with a slow reduction in the sperm counts in the following months. Leydig cell function appears to be less affected by chemotherapy, unless the endocrine factor decreases testosterone production and the lack of this hormone is the consequence of reduced testicular size and poor functioning of the stroma.

Improvement in chemotherapy protocols has resulted in lower infertility rates, even though azoospermia after treatment continues to be a concern. Some studies have reported that only 20%-50% of the men becoming azoospermic after treatment will have certain spermatogenesis recovery, whereas other reports state that this can take place in up to 80%, depending on the type of cancer and the chemotherapy regimen.

The alkylating agents that include cisplatin are used in testicular cancer and have a high risk for azoospermia, particularly when combined with ifosfamide. The risk for permanent azoospermia appears to be dose-dependent.

**Table 1** Consequence of the type of cancer on reproductive function

<table>
<thead>
<tr>
<th>Author</th>
<th>N</th>
<th>Type of cancer</th>
<th>Results</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hallak J et al.,</td>
<td>342</td>
<td>Testicular cancer.</td>
<td>No significant differences were found among the types of cancer, but there was a decrease in quality</td>
<td>(0.66-0.99)</td>
</tr>
<tr>
<td>1998²</td>
<td></td>
<td>Hodgkin’s lymphoma. Other types of cancer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chang HC et al.,</td>
<td>75</td>
<td>Leukemia. Testicular cancer. Lymphoma</td>
<td>Significant reduction in patients with myeloid leukemia and with extragonadal germ cell tumor</td>
<td>(0.01)</td>
</tr>
<tr>
<td>2006³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Williams IV et</td>
<td>409</td>
<td>Testicular cancer.</td>
<td>Statistically, men with testicular cancer have lower quality semen compared with those presenting with other malignant tumors</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Jørgensen N et</td>
<td>858</td>
<td>Testicular cancer.</td>
<td>Quality depends on the age of the patient with testicular cancer</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Bizet P et al.,</td>
<td>1007</td>
<td>Hematologic cancers. Seminomas. Testicular cancer.</td>
<td>Decrease in all semen parameters, but the greatest in semen concentration</td>
<td>(0.05-0.001)</td>
</tr>
<tr>
<td>2012⁶</td>
<td></td>
<td>Other types of cancer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keene DJB et al.,</td>
<td>180</td>
<td>Non-Hodgkin’s lymphoma. Malignant bone tumor. Testicular cancer. Other types of cancer.</td>
<td>Semen quality depends on the type of cancer.</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>2012⁷</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degl’Innocenti S et al., 2013⁸</td>
<td>623</td>
<td>Hematologic cancer. Testicular cancer. Other types of cancer.</td>
<td>There were differences in the semen parameters, but even so there was no pattern among the different types of cancer; it was variable</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>
performing the radiation, are protected. This should be obligatory and routine, but even so, a small amount of scattered radiation is inevitable. Simply the amount of 0.15 Gy can produce deteriorated spermatozoids. Doses above 0.5 Gy usually result in reversible azoospermia. Semen parameters often reach their lowest point 4 to 6 months after treatment. Doses higher than 2.5 Gy can produce prolonged or permanent azoospermia. Leydig cell function is affected with doses above 15 Gy.28 Treatments for malignant tumors such as leukemia and testicular cancer, and total body irradiation before bone marrow transplants, usually cause irreversible damage to the spermatogonia and can produce permanent sterility.15,20,21 This is briefly explained in figure 1.

Another indicated treatment is partial or total resection of the affected organ, in this case, the testis, prostate, or other organs that directly affect reproductive performance, such as the bladder, and certain lymph nodes, for being the most common lymphatic pathway for cancerous cell propagation. This removal of lymph nodes is known as retroperitoneal lymph node dissection (RLND) and can cause infertility in men with testicular cancer as a result of ejaculatory dysfunction due to pelvic plexus damage;29 different studies have shown its advantages and disadvantages. Metastatic risks from cancer in the lower part of the abdominal cavity have been reported that can cause testicular dysfunction due to spread, or physical damage from obliteration of the blood flow and hormonal alterations.30

There have been various results with respect to sperm DNA fragmentation. McDowell et al. (2013) found no differences between the control group and the patients with testicular cancer;31 Meseguer also found no differences between patients with testicular cancer and other types of cancer.17 Other studies point out the mutagenic activity of radiations, particularly Y-chromosome deletions that have been associated with azoospermia (15%) and with severe oligospermia (5%-10%), due to the inability of the haploid genome to recombine and recover lost information, making the germ line defective, and so the sperm do not acquire the necessary maturation.32

Fertility in cancer survivors

Fertility in patients that had treatment for cancer is difficult to recover, and it has been widely reported on in the literature, as shown in table 2. This recovery progresses slowly and can take years; its quality is variable, making it essential to resort to the services of assisted reproduction. Approximately 15%-30% of child cancer survivors have permanent infertility.33 A slower recovery is influenced by many factors; the residuals of antineoplastic medication, the quantities of radiations, and the type of cancer appear to have an important role in fertility preservation.15 Close to 80% of testicular cancer survivors were able to achieve pregnancy, despite its taking several years, and 95% used some method of assisted reproduction.39 Unlike patients with seminomas, testicular cancer patients have a high probability of permanent azoospermia due to the damage to the epithelial cells and consequently to the germ cells; this damage is irreversible.15

Hodgkin’s lymphoma survivors usually experience azoospermia after treatment. In relation to chemotherapy

![Diagram of spermatogenesis deterioration in relation to radiation dose](image-url)

Figure 1  spermatogenesis deterioration in relation to radiation dose.
and radiotherapy regimens, many patients recover a certain degree of spermatogenesis, but it can take from 5 to 10 years. Non-Hodgkin’s lymphoma treatment protocols appear to be less toxic to the gonads than those used for treating Hodgkin’s disease. Life-saving bone marrow transplant strategies can also affect fertility, with azoospermia rates from 10% to 70%, depending on the agents, dose, and body irradiation used.

The patients with genitourinary cancer have more problems because the anatomic barriers and consequent loss of functionality directly affect reproductive function. The increase in cases of prostate tumors in the young population is of concern, given that total prostatectomy is indicated in 96% of the cases and the expectations of having a family have not been fulfilled in the majority of these patients. Spermatozoid cryopreservation is the immediate alternative for fatherhood that will be used after surviving treatment. New therapies for urothelial cell tumors have been studied, such as the use of bacillus Calmette-Guerin (BCG), which has demonstrated less counterproductive damage than protocols with mitomycin C; other treatments with reactive iodine have very high rates of testicular dysfunction.

### Semen collection

Semen is made up of 2 components, the cell group (spermatozoids) and the seminal plasma that is in charge of spermatozoid nutrition and metabolism. It is most commonly collected through masturbation, but for many men, especially very young men who have reached their physiologic but not their mental maturity, this is somewhat uncomfortable. Psychologic orientation and accompaniment by the parents are vitally important in the treatment of this young population.

Protocols vary according to the sperm bank, but internationally, the sample is maintained at 37°C. The semen can be collected at home, making sure that it is taken to the laboratory within 40 minutes. It must be deposited in special recipients that are analyzed in the laboratory, confirming its quality. In oncologic patient programs, the samples are treated with special care, due to their possibly being the sole existing samples.

<table>
<thead>
<tr>
<th>Author</th>
<th>N</th>
<th>Treatment</th>
<th>Time necessary for fertility recovery</th>
<th>Spermatogenesis recovery percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hansen PV et al., 1990</td>
<td>27 with seminoma. 24 with nonseminomatous germ cell tumor of the testis</td>
<td>Chemotherapy</td>
<td>5-9 years, depending on the type of cancer, type and quantity of chemotherapy</td>
<td>5 years: 61% 9 years: 84%</td>
</tr>
<tr>
<td>Hansen SW et al., 1990</td>
<td>31 with nonseminomatous testicular cancer</td>
<td>Chemotherapy</td>
<td>27% presented with azoospermia for more than 5 years</td>
<td>There was no significant recovery after 2 years. The majority presented with oligospermia up to 9 years post-treatment</td>
</tr>
<tr>
<td>Centola GM et al., 1994</td>
<td>56 with some type of testicular tumor</td>
<td>Radiotherapy</td>
<td>After one year depending on the quantity of radiation</td>
<td>1 year: 50% 2.5 years: 90%</td>
</tr>
<tr>
<td>Lampe H et al., 1997</td>
<td>Initial: 170 Final: 80</td>
<td>Chemotherapy</td>
<td>One year after treatment</td>
<td>2 years: 40% 5 years: 80%</td>
</tr>
<tr>
<td>Creha I et al., 2009</td>
<td>Initial: 619 Final: 545</td>
<td>Chemotherapy, Radiotherapy</td>
<td>14.7 months, depending on the type of cancer</td>
<td>Insemination 4 couples (12.5%) (9 cycles), 2 full-term pregnancies and ICSI for 28 couples (87.5%) ICSI (44 cycles), 13 pregnancies and 9 full-term</td>
</tr>
<tr>
<td>Fossa S et al., 2008</td>
<td>Initial: 35 Final: 20</td>
<td>Chemotherapy, cisplatin</td>
<td>One to 2 years, depending on the amount of treatment with cisplatin</td>
<td>14 pregnancies 50%-60% active spermatogenesis after 2 years</td>
</tr>
</tbody>
</table>

ICSI: intracytoplasmic sperm injection.
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giving hope to their children, helping them attain the emotional stability necessary for facing an event such as being diagnosed with cancer. In critically ill patients that have little or no mobility, testicular biopsy and resection of one or both testes are indicated options for sperm retrieval.

Sperm banks

Close to 50% of male cancer patients seek the possibility of being parents and the only alternative for this is to enter a cryopreservation program. Nevertheless, the large majority do not do so for lack of information. A decade ago, the number of sperm banks decreased due to high maintenance costs. Today andrology centers abound that offer both donor and sperm cryopreservation programs for oncology patients.

Gene mutations and deletions have been reported in animals at the beginning of chemotherapy and up to 2 years after treatment completion. Some studies recommend semen cryopreservation up to 10-15 days after treatment commencement and then waiting approximately 12 to 18 months after treatment completion to continue fertility treatments.

In 1995, Koeppel reported on 50,000 new cancer cases in men under 35 years of age. He realized that with the increased survival rates and the harmful effects of treatment on fertility, that he should focus on creating semen cryopreservation programs that could be offered to these patients. The author recognized the controversies in relation to the practicality and use of sperm banks, including the challenges health professionals face when discussing such delicate subjects with patients.

Training and strategies for discussing the subject with these patients are needed. Educational materials such as pamphlets and interactive tools for patients and relatives are useful. Programs should be developed in a clear and transparent manner; these patients are very fragile emotionally. In addition, as a preventive measure, centers should have easily accessible examination rooms where semen can be collected, in case of any emergency situation the patient might have.

The exact age at which sperm is produced varies with the individual. The enlargement of the testes takes place at Tanner stages I to II, after which spermatogenesis begins to be probable, even before adolescence. Nevertheless, good parameters for semen cryopreservation have been found in adolescents with cancer, from 14 to 17 years of age. In 2010, Hagenäs conducted a study on 86 male patients from the ages of 12 to 18 years that had undergone chemotherapy for different tumors; after treatment, 88.4% had spermatozoids, 93.4% of which were of sufficiently good quality for cryopreservation. The cryopreservation of gametes from children and adolescents is a critical subject that should be managed with the utmost professionalism. The decision to preserve or not is limited to many factors that include prognosis, type of cancer, and parental consent. In many cases the parents are responsible for authorizing these procedures, demonstrating the need for accompaniment programs for oncology patients and their relatives.

In patients presenting with permanent azoospermia for whatever reason, surgical retrieval is an option. This should be coordinated with the oncologist, urologist, surgeon, and assisted reproduction center, given that in the majority of cases treatment should begin as quickly as possible, and teamwork is essential. There are reports in the literature describing variations in the techniques for obtaining sperm, from sedating the patient to testicular microdissection, all for the same purpose. Testicular sperm extraction (TESE) involves a needle puncture; this type of retrieval can be contaminated with blood and therefore is a procedure requiring great care and experience. Even so, spermatozoids with fertilizing ability can be extracted. Other retrieval techniques are variations of the same, such as TESE with microdissection, which has a 50% success rate after chemotherapy. Obtaining sperm from the epididymis is indicated in cases of obstructive azoospermia, in patients with partial or total prostatectomy, and when tumor cells have appeared. These and other techniques are explained in table 3. In cases of advanced cancer, when the patient is unable to sit up, ejaculate, or presents with retrograde ejaculation, sperm retrieval techniques are based on electroejaculation and electrovibration; different pregnancy rates have been reported with the use of these cells.

Results of cryopreservation

In the majority of cases, both the cancer and its therapies reduce sperm quality; protocols that include radiation and/or chemotherapy reduce it even more. The use of cells in assisted reproduction has been reported individually, with differences and contradictions among the studies. Techniques in which the number of cells necessary for fertilization is minimum, as in the case of intracytoplasmic sperm injection (ICSI) and its variations, have increased the probabilities of procreation.

Some of the studies are shown in table 4. The results of these analyses are the scientific base for an option of hope, so to say, for oncology patients that are still undecided about cryopreservation. These studies are different in relation to the population studied and the study methods employed, and the pregnancy rates vary depending on the type of treatment and the type of cancer. The conclusion is that assisted reproduction techniques plus ICSI have a greater probability of success and should be considered an option carried out in cycles for cancer survivors.

Stem cell studies have opened the door to the possibility of having a new fertility preservation alternative. The transplantation of cultured in vitro germ cells and testicular grafts has given new hope for obtaining and preserving these gametes. The cryopreservation of 1n cells (spermatids and/or spermatocytes) has made significant advances in sperm maturation cultures and in autologous transplants separating affected spermatogonia; the latter would be indicated in boys that have not yet begun to produce spermatozoids. These studies have been conducted on primates and suggest good long-term results.

Genomics is another field of interest. The aim of cancer research groups such as The Cancer Genome Atlas (TCGA) is to produce genetic maps of cancer types and subtypes, of
<table>
<thead>
<tr>
<th>Technique</th>
<th>Indication</th>
<th>Complications</th>
<th>Extraction success</th>
<th>Success of assisted reproduction techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsurgical epididymal sperm aspiration (MESA)</td>
<td>Obstructive azoospermia. Congenital absence of the vas deferens</td>
<td>NR</td>
<td>74%-80% retrieval</td>
<td>MESA-ICSI Two pronuclei 45%. Pregnancy 50% (Silber S et al., 1994)</td>
</tr>
<tr>
<td></td>
<td>Obstructive azoospermia</td>
<td>4.7% local complications</td>
<td>77% retrieval</td>
<td>Pregnancy rate-ICSI 22.5% (Heidenreich A et al., 2000)</td>
</tr>
<tr>
<td></td>
<td>Obstructive azoospermia</td>
<td>NR</td>
<td>93% retrieval</td>
<td>Pregnancy rate-ICSI 45%-47% (Lin YM et al., 2000)</td>
</tr>
<tr>
<td></td>
<td>Vasectomy. Nonspecific azoospermia</td>
<td>NR</td>
<td>82% retrieval first time, after up to 3 PESA there was 87% retrieval</td>
<td>Pregnancy rate 38%(Glina S et al., 2003)</td>
</tr>
<tr>
<td>Percutaneous epididymal sperm aspiration (PESA)</td>
<td>Obstructive azoospermia</td>
<td>NR</td>
<td>61% retrieval</td>
<td>Pregnancy rate 39%-56% (Lin YM et al., 2000)</td>
</tr>
<tr>
<td></td>
<td>Obstructive azoospermia</td>
<td>NR</td>
<td>First time 26.3%. Repeat 36.4%</td>
<td>Pregnancy rate-ICSI 37.5% (Pasqualotto FF et al., 2003)</td>
</tr>
<tr>
<td></td>
<td>Obstructive azoospermia. Surgical testicular resection</td>
<td>Complications such as hematomas, abscesses, fibrosis</td>
<td>Hypospermatogenesis (79%). Maturation detention (47%). Seminoma (24%) (Su 1999)</td>
<td>43% ICSI, 29% implantation (Friedler S et al., 1997)</td>
</tr>
<tr>
<td></td>
<td>Cryptorchidism</td>
<td>NR</td>
<td>74% retrieval</td>
<td>ICSI fertilization 62%. Pregnancies 43% (Van Steirteghem A et al., 1998)</td>
</tr>
<tr>
<td>Testicular sperm extraction (TESE) or testicular biopsy</td>
<td>Non-obstructive azoospermia</td>
<td>NR</td>
<td>58% retrieval</td>
<td>ICSI fertilization 59%. Pregnancies 36% (Van Steirteghem A et al., 1998)</td>
</tr>
<tr>
<td></td>
<td>Obstructive azoospermia. Congenital absence of the vas deferens</td>
<td>Postoperative inflammation</td>
<td>74%-80% retrieval</td>
<td>TESE-ICSI Two pronuclei 46%. Pregnancy 43% (Silber S et al., 1994)</td>
</tr>
<tr>
<td></td>
<td>Obstructive azoospermia</td>
<td>Local complications were 3.9%</td>
<td>77% retrieval</td>
<td>Pregnancy rate-ICSI 19.5% (Heidenreich A et al., 2000)</td>
</tr>
<tr>
<td>Testicular sperm aspiration (TESA) or testicular sperm fine needle aspiration (TEFNA)</td>
<td>Obstructive azoospermia. Surgical testicular resection</td>
<td>General anesthesia</td>
<td>NR</td>
<td>11% ICSI, 13% implantation (Friedler S et al., 1997)</td>
</tr>
<tr>
<td>Percutaneous testicular aspiration with ultrasound guidance (USTSA)</td>
<td>Nonspecific azoospermia</td>
<td>General anesthesia</td>
<td>USTSA 94% vs. TSA (not ultrasound-guided) 83%</td>
<td>No differences in the pregnancy rate were found (Belenky A et al., 2001)</td>
</tr>
</tbody>
</table>
which there may be as many as 200. Understanding and detecting genetic error opens a new area in early diagnosis, which up to now has been the most relevant manner of cure, together with the medications presently available to us.85,86

Since the last decade, the detection of tumor markers has been the determining parameter in early diagnosis. Their predictive value has increased in post-treatment recurrences, giving them clinical importance; the markers are substances produced by normal cells whose concentration increases when the cells become cancerous, in both benign and malignant hyperplasia. Their differentiation is important and conclusive for establishing treatment. Different studies have produced contradictory results due to the variety of experimental designs, and the use of new technology makes their repeatability impossible. Even so, joint studies with the branches of genomics, such as proteomics, provide hope for advancememt in early detection. Studies carried out on stem cells have been limited by the risk for tumor cell reappearance. It is based on the theory of cell signaling 87 that is still under investigation; its deactivation would be the best test for the total eradication of cancer. Studies on the use of telomerases and restriction enzymes could provide good results.88-90

Conclusions

The humane management of the oncology patient of any age requires much patience and care. The strategies and approach for developing any procedure or option are of the utmost importance, whether dealing with a new treatment or, in this case, that of preserving fertility. The advances in assisted reproduction research and techniques are resulting in increasing rates of full-term pregnancies; various sperm retrieval techniques now exist that have been perfected in the last few years, forming the base from which this option is offered. Hope is a psychologic good for acceptance and the recovery of quality of life after a long treatment, in addition to strengthening the family ties that are so important in these cases, and even more so in young patients, including children.

Semen cryopreservation is the main option for preserving fertility and assisted reproduction centers should create special programs for these cases. The final recommendation is that the procedure be performed before undergoing any treatment. The recovery of normal physiologic processes such as spermatogenesis is slow, often taking years, and sometimes it is never attained. Prevention and the use of these services should be promoted.

Conflict of interest

The authors declare that there is no conflict of interest.

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References

Table 4  Pregnancy rates through the use of semen cryopreservation by oncology patients

<table>
<thead>
<tr>
<th>Author</th>
<th>N</th>
<th>Cryopreservation percentage</th>
<th>Percentage of semen cryopreservation use</th>
<th>Percentage of gametogenesis recovery</th>
<th>Pregnancy rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schmidt KLT et al., 200439</td>
<td>67</td>
<td>82%</td>
<td>58%</td>
<td>43% con SPZ móviles</td>
<td></td>
</tr>
<tr>
<td>Hourvitz A et al., 200722</td>
<td>118</td>
<td>169%</td>
<td>100% after 3 months up to 19 years</td>
<td>77.8% present with azoospermia</td>
<td></td>
</tr>
<tr>
<td>Van Casteren NJ et al., 200874</td>
<td>Initial: 557, Final: 466</td>
<td>749 samples were cryopreserved</td>
<td>ICSI: 53</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>Navarro P et al., 201003</td>
<td>101</td>
<td>99% suitable for cryopreservation</td>
<td>4%</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>Freour T et al., 201240</td>
<td>1,042</td>
<td>2,577</td>
<td>82 patients</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>Hsiao W et al., 201136</td>
<td>73</td>
<td>Retrieval TESE 37%-42.9%</td>
<td>NR</td>
<td>37% after TESE</td>
<td></td>
</tr>
<tr>
<td>Chung K et al., 201337</td>
<td>130</td>
<td>110 samples suitable for cryopreservation</td>
<td>4/110</td>
<td>11/34 presented with deterioration after treatment. 4/34 presented with azoospermia</td>
<td></td>
</tr>
<tr>
<td>Botchan A et al., 201338</td>
<td>682</td>
<td>682</td>
<td>70 pacientes lo usaron hasta después de 20 años</td>
<td>NR</td>
<td></td>
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<tr>
<td>Žáková J et al., 201439</td>
<td>523</td>
<td>523</td>
<td>34 patients (6.5%)</td>
<td>Azoospermia was diagnosed in 34 men (6.1%) after Tese.</td>
<td>16 pregnancies (34.8%)</td>
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| NR: not reported; ICSI: Intracytoplasmic Sperm Injection; IUI: intrauterine insemination; IVF: in vitro fertilization; FET: frozen embryo transfer.  

Fertility preservation in men with oncologic diseases


