Testicular Cancer Survivorship: Navigating Long-Term Health Consequences

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Authors' disclosures of conflicts of interest are found at the end of this article.

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https://doi.org/10.6004/jadpro.2026.17.7.26

Abstract

With the incidence of testicular cancer (TC) rising, understanding implications for long-term survivorship is essential. Advances in surgery, radiotherapy, and chemotherapy have turned this once deadly disease into a highly curable one. Advanced practice providers (APPs) must be well versed in the evaluation and management of long-term health consequences from multimodal therapy. This article provides an overview of TC, available treatments, and the role APPs play in the evaluation and management of late and long-term health consequences of the disease.

With the incidence of testicular cancer (TC) rising, understanding implications for long-term survivorship is essential. Although rare overall, TC remains the most common cancer in men ages 15 to 40, with an incidence rate of 3 to 11 cases per 100,000 males per year (Yazici et al., 2023). With an over 90% cure rate and a 5-year survival rate of 95%, the number of TC survivors is increasing worldwide (Yazici et al., 2023). Advances in surgery, radiotherapy, and chemotherapy have turned this once deadly disease into a highly curable one (Parekh et al., 2020). Advanced practice providers (APPs) must be well versed in the evaluation and management of long-term health consequences from multimodal therapy (Bagrodia et al., 2025). This article provides an overview of TC, available treatments, and the role APPs play in the evaluation and management of late and long-term health consequences of the disease.

DIAGNOSIS AND EVALUATION

Testicular cancer is classified as a germ cell tumor arising from abnormal fetal germ cell development. It is typically diagnosed after a patient reports a painless testicular mass or through an incidental ultrasound finding (Raggi et al., 2025). In

addition to evaluation with a testicular ultrasound, the diagnostic workup should include serum tumor markers (TMs), including alpha-fetoprotein (AFP), beta-human chorionic gonadotropin (β-hCG), and lactate dehydrogenase (LDH). Elevation in pre-orchiectomy serum TMs is critical in guiding diagnosis and management. Symptoms such as back pain, abdominal pain, or shortness of breath warrant a contrast-enhanced CT of the chest, abdomen, and pelvis to assess for metastasis. Histology is derived from pathology of the tumor after a radical inguinal orchiectomy. Testicular cancer is divided into two main histologic subtypes: seminoma germ cell tumor (SGCT) and nonseminoma germ cell tumor (NSGCT). The defining characteristics of SGCT and NSGCT are explained in Table 1 (Raggi et al., 2025).

OVERVIEW OF TREATMENT

The treatment of TC includes a multimodal approach, including orchiectomy, primary retroperitoneal lymph node dissection (RPLND), radiotherapy, and chemotherapy. Initial management involves a radical inguinal orchiectomy and measurement of post-orchiectomy TMs. Stage I disease is localized disease. Stage IS is defined by serum TMs that persist following orchiectomy in the absence of radiologic evidence of metastatic disease. Stage II is retroperitoneal (RP) lymph node involvement only. Stage III is involvement in other areas, including the pelvic nodes, lung, liver, and brain (National Comprehensive Cancer Network, [NCCN], 2025e). Treatment decisions incorporate histology, staging, disease sites, serum TMs, and International Germ Cell Cancer Collaborative Group (IGCCCG) risk classification (Table 2).

The main chemotherapeutic regimens in TC include bleomycin, etoposide, and cisplatin (BEP); etoposide and cisplatin (EP); etoposide, ifosfamide, and cisplatin (VIP); and paclitaxel, ifosfamide, and cisplatin (TIP; NCCN, 2025e). Based on staging and IGCCCG risk classification, the frequency of surveillance with a history and physical exam, serum TMs, and CT chest, abdomen, and pelvis or MRI of the abdomen and pelvis with a chest X-ray will vary. NCCN Guidelines recommend follow-up within the oncology practice for the first 5 years, with the decision to extend beyond 5 years as a shared decision-making process (NCCN, 2025e).

TREATMENT-RELATED ADVERSE EVENTS

Cardiotoxicity

Exposure to radiation and cisplatin-based chemotherapy (CBCT) increases the risk for cardiovascular disease (CVD). Cisplatin-related endothelial dysfunction contributes to long-term vascular injury and increased CVD risk (Lubberts et al., 2023). Metabolic syndrome, defined as a group of disorders including hypertension, dyslipidemia, obesity, and diabetes, is a well-known risk factor for CVD (Khan et al., 2024). Preexisting cardiometabolic

Table 1. Defining Features of Seminoma Germ Cell Tumor and Nonseminoma Germ Cell Tumor

Seminoma germ cell tumor (SGCT)	Nonseminoma germ cell tumor (NSGCT)
Type: Pure seminoma	Types: Pure or mixed • Embryonal carcinoma (ECA) • Yolk sac tumor (YST) • Choriocarcinoma • Postpubertal teratoma
Peak incidence: Bimodal • 30–39 years old • 65 years and older	Peak incidence: 25–29 years old
Tumor markers: Elevation in β-hCG and possibly LDH	Tumor markers: Elevation in AFP, β-hCG, and/or LDH
Risk factors (shared by both SGCT and NSGCT): • Cryptorchidism • Positive family history • Previous personal history of TC	

Note. AFP = alpha-fetoprotein; β-hCG = beta-human chorionic gonadotropin; ECA = embryonal carcinoma; LDH = lactate dehydrogenase; NSGCT = nonseminomatous germ cell tumor; SGCT = seminomatous germ cell tumor; TC = testicular cancer; YST = yolk sac tumor. Information adapted from Raggi et al. (2025).

Table 2. International Germ Cell Cancer Collaborative Group (IGCCCG) Risk Classification for Metastatic Germ Cell Tumors

Good risk	
Nonseminoma	**Seminoma**
Testicular/retroperitoneal primary tumor **and** No nonpulmonary visceral metastases **and** post-orchiectomy markers, all of the following: AFP < 1,000 ng/mL hCG < 5,000 IU/L LDH < 1.5 × ULN	Any primary site **and** No nonpulmonary visceral metastases **and** Normal AFP, any hCG, any LDH
5-year progression-free survival (PFS): 90% 5-year overall survival (OS): 96%	5-year PFS: 89% 5-year OS: 95%
Intermediate risk	
Nonseminoma	**Seminoma**
Testicular/retroperitoneal primary tumor **and** No nonpulmonary visceral metastases **and** post-orchiectomy markers, any of the following: AFP 1,000 ng/mL–10,000 ng/mL hCG 5,000 IU/L–50,000 IU/L LDH 1.5–10 × ULN	Any primary site **and** Nonpulmonary visceral metastases **and** Normal AFP, any hCG, any LDH
5-year PFS: 78% 5-year OS: 89%	5-year PFS: 79% 5-year OS: 88%
Poor risk	
Nonseminoma	**Seminoma**
Mediastinal primary tumor **or** Nonpulmonary visceral metastases **or** post-orchiectomy markers, any of the following: AFP > 10,000 ng/mL hCG > 50,000 IU/L LDH > 10 × ULN	No patients classified as poor risk
5-year PFS: 54% 5-year OS: 67%	

Note. AFP = alpha-fetoprotein; hCG = human chorionic gonadotropin; IGCCCG = International Germ Cell Cancer Collaborative Group; LDH = lactate dehydrogenase; OS = overall survival; PFS = progression-free survival; ULN = upper limit of normal. Adapted from Wallis (2020).

risk factors further increase CVD risk in survivors (Lubberts et al., 2023). The incidence of Raynaud phenomenon during treatment increases with cumulative doses of bleomycin and cisplatin. Raynaud phenomenon is a marker of endothelial damage, increases the risk of CVD, and negatively impacts quality of life (Khan et al., 2024). Early detection and management of cardiometabolic risk is essential for long-term health.

Pulmonary Dysfunction

Bleomycin can cause acute and chronic lung injury, triggering a cascade of inflammation and resulting in pulmonary fibrosis. Bleomycin should not be used in patients 50 years old and older, patients currently smoking or with a history of smoking, patients with extensive pulmonary metastases, or patients with significantly impaired renal function (creatinine clearance < 50 mL/min). Advanced practice providers should monitor for new or worsening cough, dyspnea, or findings of pneumonitis on chest imaging. Lubberts et al. (2023) reported on one Danish study that performed pulmonary function tests (PFTs) in TC survivors 5 years post treatment with bleomycin and found "restrictive disease in 4.1%, obstructive disease in 2.7%, and impaired diffusion capacity in 15.6% of 565 patients."

Hypogonadism and Infertility

The treatment of TC increases the risk for hypogonadism. Cisplatin damages Leydig cells of the testicles, decreasing testosterone production and impairing reproductive and sperm function. Radiation impairs spermatogenesis in a dose-dependent manner with doses up to 4 Gray (Gy), causing permanent germ cell damage (Parekh et al., 2020). Recovery occurs in roughly 18 months after 1 Gy, 30 months after 2 to 3 Gy, and more than 5 years after 4 Gy (Parekh et al., 2020). Retroperitoneal lymph node dissection may damage sympathetic nerves involved in ejaculation, although nerve-sparing techniques have reduced this risk (Parekh et al., 2020). Figure 1 outlines mechanisms of treatment-related male infertility (Yumura et al., 2023).

Hypogonadism is defined as "low serum testosterone (< 10 nmol/L), a high luteinizing hormone/follicle-stimulating hormone (LH/FSH), and clinical manifestations such as erectile dysfunction, low libido, and gynecomastia" (Khan et al., 2024). Five years post-treatment, about 25% of survivors remain hypogonadal, increasing the risk for osteopenia and osteoporosis (Khan et al., 2024). Testosterone replacement in TC survivors reduces whole-body and truncal fat, but no benefit in quality of life has been shown (Khan et al., 2024).

Given the risk for infertility, all patients should be counseled on and offered semen cryopreservation before treatment. Fertility outcomes vary by treatment modality. Khan et al. (2024) noted 50% of TC patients have "low sperm count (< 20 million/mL), low motility indices (< 40%), and a high percentage of abnormal cells (> 80%) prior to starting treatment." Pretreatment infertility may result from tumor-related testicular damage, cryptorchidism, testicular dysgenesis syndrome, hypothalamic-pituitary-gonadal-axis disruption, or inflammation. Elevated serum TMs can further suppress LH and FSH, reducing sperm concentration and spermatogenesis (Parekh et al., 2020).

Sexual Health and Psychological Issues

Treatment for TC increases the risk for sexual dysfunction related to erectile dysfunction, low libido, and poor body image. Parekh et al. (2020) studied 539 men treated for testicular cancer and noted "42% experienced decreased sexual activity, 35% experienced decreased libido, and 32% had erectile dysfunction." Sexual dysfunction is multifactorial, often driven by psychogenic factors such as anxiety, depression, or fear of recurrence. A systematic review of quantitative observational studies investigating psychological distress reported one in five TC survivors suffers from anxiety compared to one in eight in the general population (Smith et al., 2018). Psychological distress is associated with "single status, unemployment, low socioeconomic status, comorbidities, and the presence of side effects" (Khan et al., 2024, p. 8).

Second Malignant Neoplasms

After 5 years post-diagnosis, second malignant neoplasms (SMNs) are the leading cause of mortality in TC survivors (Khan et al., 2024). Risk factors for developing SMNs include age 35 years or older at diagnosis, treatment with chemotherapy and/or radiotherapy, and increasing cumulative doses of cisplatin or etoposide (Khan et al., 2024). Treatment with radiotherapy or chemotherapy, particularly etoposide and cisplatin, increases the risk of SMNs up to 13% to 20% for seminoma survivors and 10% for nonseminoma survivors over a 25-year period (Bagrodia et al., 2025). Cisplatin levels have been detected in urine and serum for up to 20 years post-treatment (Groot et al., 2018). This prolonged exposure may be responsible for increased SMNs. Infradiaphragmatic radiotherapy increases the risk of SMNs, including cancers of the stomach, pancreas, kidney, bladder, and colon, as well as melanoma and squamous cell carcinoma.

Ototoxicity and Neurotoxicity

Cisplatin-based chemotherapy frequently causes ototoxicity and chemotherapy-induced peripheral neuropathy (CIPN). Baseline audiometry testing should be performed prior to CBCT. Risk factors for cisplatin-related hearing loss include higher cumulative cisplatin dose, younger age at treatment, and use of other ototoxic drugs. Treatment with cisplatin can result in hearing loss and tinnitus persisting in up to 40% of TC survivors at 4 years of follow-up (Kerns et al., 2018). Up to 40% of survivors experience persistent CIPN of the hands and/or feet (Bagrodia et al., 2025). Symptoms of peripheral and autonomic neuropathy are known contributing factors to unemployment, decreased quality of life, and disability in survivors (Khan et al., 2024).

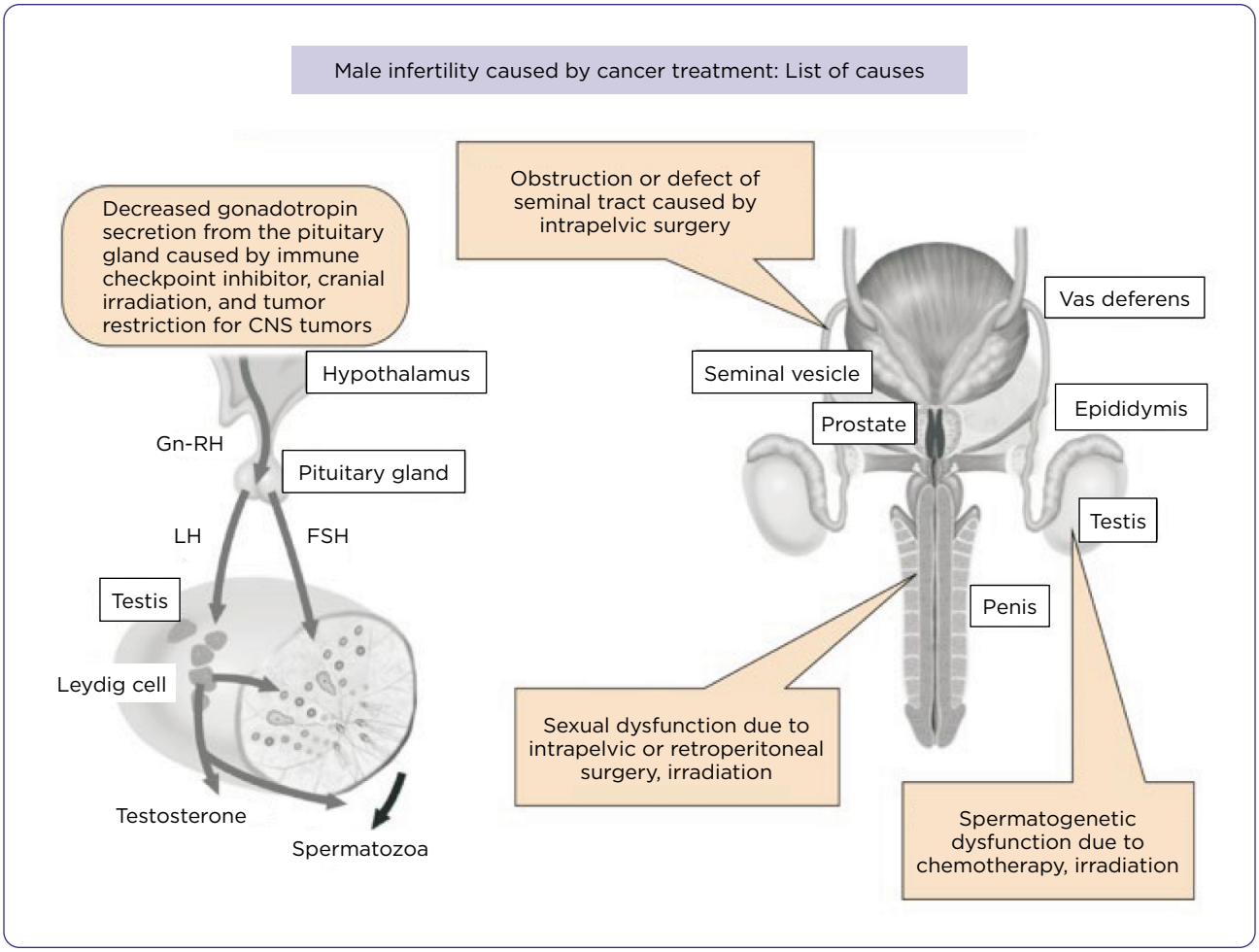

Figure 1. Classification of male infertility caused by cancer treatment. LH = luteinizing hormone; FSH = follicle-stimulating hormone. Reproduced from Yumura et al. (2023).

ROLE OF THE APP IN SURVIVORSHIP CARE

Cardiotoxicity

Advanced practice providers play a central role in evaluating and managing preexisting and emerging CV risk factors. NCCN Guidelines recommend the "ABCDEs of CVD Prevention" framework to tackle CV risk reduction (NCCN, 2025d). Care begins with annual assessment of CV risk factors through a history and physical exam. The APP should assess modifiable risk factors such as hypertension, hyperlipidemia, use of tobacco products, obesity, and diabetes (NCCN, 2025d). Advanced practice providers should counsel survivors on lifestyle interventions, including Dietary Approaches to Stop Hypertension (DASH) diet adherence, sodium restriction < 1,500 mg/day, tobacco cessation, weight management, regular physical activity, and limiting alcohol intake (NCCN, 2025d). The American College of Cardiology/American Heart Association (ACC/AHA) guidelines provide a framework to initiate pharmacologic management. Low-dose aspirin (75–100 mg orally daily) is recommended for secondary prevention in patients with established CVD and may be considered for primary prevention in select survivors ages 40 to 75 at high risk for atherosclerotic cardiovascular disease (ASCVD) events without bleeding risk (Arnett et al., 2019). Risk for ASCVD can be quantified using the ASCVD Risk Estimator Plus to determine aspirin initiation.

The ASCVD Risk Estimator Plus was studied in the general population, so APPs should individualize decisions for patients with cancer initiating

pharmacological treatment (NCCN, 2025d). The tool applies to adults 40 to 75 years of age without diabetes and low-density lipoprotein (LDL) 70 to 189 mg/dL (Michos et al., 2019). Statins are recommended for primary prevention in any individual with diabetes, an absolute LDL value ≥ 190 mg/dL, or a 10-year ASCVD risk ≥ 7.5% (Michos et al., 2019). A shared decision-making discussion should take place for borderline risk (5 to < 7.5%) survivors on whether to initiate statins. NCCN Guidelines do not specify lipid-monitoring frequency, instead recommending an individualized approach based on treatment exposures and CV risk factors (NCCN, 2025d). Referral to a nutritionist who may assist with hyperlipidemia management is recommended.

Hypertension is common in cancer survivors, with 53% affected in a national survey of more than 13,000 cancer survivors (Li et al., 2024). Because major hypertension trials exclude cancer survivors, management remains largely empirical along with the use of general guidelines (Li et al., 2024). The current European Cardio-Oncology guidelines, European Society of Cardiology, and American Hypertension guidelines do not specify a blood pressure (BP) target for cancer survivors. The Systolic Blood Pressure Intervention Trial (SPRINT) by Li et al. (2024) showed intensive SBP control (SBP ≤ 120/80 mmHg) reduced major CV events in survivors with > 2-year life expectancy (Li et al., 2024). Given survivors' high lifetime hypertension prevalence, closer in-office and home BP monitoring may be warranted. Treatment should follow best evidence and shared decision-making (Cohen et al., 2023). The ACC/AHA recommends initiating antihypertensives when SBP ≥ 140 mmHg or diastolic BP (DBP) is ≥ 90 mmHg with a first-line agent such as thiazide-type diuretics, long-acting dihydropyridine calcium channel blockers (CCBs), angiotensin-converting enzyme inhibitors (ACEIs), or angiotensin II receptor blockers (ARBs; Jones et al., 2025). Advanced practice providers can refer to the 2025 AHA/ACC guidelines for further explanation on choosing between pharmacological agents (Jones et al., 2025).

Advanced practice providers should counsel on tobacco cessation strategies, including nicotine replacement or medication, with referral to cessation programs. Maintaining a healthy body mass index (BMI) can decrease CV risk, as extra adipose tissue can retain cisplatin and prolong exposure (Lubberts et al., 2023). Dyslipidemia during surveillance increases CVD risk; long-term follow-up shows 86% of patients develop dyslipidemia, 50% hypertension, and 35% metabolic syndrome (Lubberts et al., 2023). Residual platinum can cause chronic endothelial damage, contributing to hypertension and microalbuminuria. More studies are needed to determine if measurements of markers of "endothelial damage" (presence of Raynaud phenomenon, albuminuria, and fibrinolytic markers) would help in the evaluation and management of CVD risk in TC survivors (Lubberts et al., 2023). Advanced practice providers should evaluate survivors annually with BP measurement, BMI, lipid panel, and hemoglobin A1c levels to mitigate the risk for CVD.

Pulmonary Dysfunction

Bleomycin-induced pulmonary dysfunction can occur with treatment for testicular cancer. Previous pulmonary surgery, pulmonary embolism, smoking, and kidney dysfunction can increase the risk for pulmonary toxicity (Khan et al., 2024). New respiratory symptoms or radiological changes on chest imaging should prompt further evaluation with complete PFTs, including a measurement of diffusing capacity of the lungs for carbon monoxide (DLCO). A decrease in DLCO is a sensitive indicator of subclinical pulmonary damage (Jayakrishnan et al., 2023). The Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2026 guidelines recommend referral to a pulmonologist for abnormal PFTs and a DLCO < 60% (GOLD, 2025).

Prior bleomycin exposure can have implications for surgery with general anesthesia. Oxygen administration, particularly in high amounts, along with liberal use of crystalloids can induce acute respiratory distress syndrome (ARDS), which can be fatal. The mechanism behind bleomycin pulmonary damage results from "oxidative damage, genetic deficiency of the deactivating enzyme bleomycin hydrolase, and release of inflammatory cytokines" (Jayakrishnan et al., 2023, p. 4). An increase in free oxygen radicals with high oxygen administration can exacerbate bleomycin lung

damage. Additional risk factors to consider in the perioperative setting are cumulative dose of bleomycin (> 300 U), timing of last dose, preexisting lung involvement, renal impairment, and smoking history. Pulmonary function tests and a CT scan of the chest may be performed prior to surgery (Jayakrishnan et al., 2023).

Hypogonadism, Fertility, and Sexual Health

The treatment of TC can impact testosterone levels, increasing the risk for hypogonadism and infertility. Advanced practice providers should routinely assess for symptoms of hypogonadism such as "fatigue, decreased libido, erectile dysfunction, decreased muscle mass and strength, mood disturbances, and cognitive changes" (Gallegos, 2024, p. 22). The NCCN Adolescent and Young Adult (AYA) Oncology Guidelines recommend screening for gonadal function in high-risk populations such as those with "unilateral orchiectomy, testicular radiation ≥ 12 Gy combined with alkylating agents, or cyclophosphamide conditioning for hematopoietic cell transplant" (NCCN, 2025a). If symptoms are present, it is recommended to screen with a fasting morning serum total testosterone level (NCCN, 2025a). If initial serum total testosterone is low, a second morning total testosterone along with free testosterone, LH, and prolactin should be repeated to confirm hypogonadism. Testosterone replacement can be considered if testosterone is less than 300 ng/dL or low normal with accompanying symptoms. In a study conducted by Walsh et al. (2019), testosterone replacement in young male cancer survivors improved body composition with a loss of body fat and an increase in muscle mass; however, it did not improve quality of life. Improvements in body composition can help decrease consequences of metabolic syndrome, reducing CV risk (Walsh et al., 2019). Testosterone therapy should be initiated through shared decision-making. Of note, NCCN Guidelines recommend against testosterone replacement in those actively trying to conceive, as short-term use of exogenous testosterone can affect sperm production. There has also been conflicting evidence in the literature of the long-term impact of exogenous testosterone supplementation on fertility (NCCN, 2025a). Referral to a fertility specialist should be placed for further discussion. Discussion on sexual health should be incorporated into history taking during survivorship care, as both hypogonadism and nerve damage from an RPLND can cause erectile dysfunction, contributing to psychological distress pertaining to body image and sexual health (Khan et al., 2024).

The APP should have a conversation with survivors of TC involving future wishes for paternity. All individuals with testicular cancer should be offered and undergo cryopreservation of sperm prior to treatment (NCCN, 2025a). Treatment with CBCT has an intermediate risk of causing infertility. During radiation, gonadal protective shielding is used; however, the radiosensitive testicles are still subjected to scattered radiation. The time to return of spermatogenesis depends on the treatment modality used. Those who received three to four cycles of BEP or radiotherapy saw a return in spermatogenesis by 24 months. If nonobstructive azoospermia occurs and paternity is desired, referral to a fertility specialist to discuss microdissection of testicular sperm extraction and subsequent intracytoplasmic sperm injection should occur (Parekh et al., 2020). The consensus is to wait to conceive at least 1 year after treatment.

Psychological Challenges

Anxiety, depression, and the fear of recurrence are common psychological issues among TC survivors. Rates of anxiety are particularly higher in the TC survivor population compared with the general population. The NCCN Survivorship Guidelines offer a management and treatment plan for addressing anxiety, depression, trauma, and distress. Advanced practice providers should screen for psychological distress at each visit and especially during "times of new diagnoses, transitions in care, cancer surveillance, significant loss, and other major life events" (NCCN, 2025d). Routine mental health screenings with validated screening tools such as the Generalized Anxiety Disorder 7-item (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) aid in assessment and intervention with either referral for mental health therapy, medicine management, or to a specialist (NCCN, 2025d). A score ≥ 10 on both the PHQ-9 and GAD-7 should prompt referral to a mental health professional who can discuss both cognitive behavioral therapy

(CBT) and pharmacological management (He et al., 2020; O'Connor et al., 2023). While the PHQ-9 includes the same symptoms as the Diagnostic and Statistical Manual of Mental Disorders (DSM), it does not account for a complete assessment of functional impairment and nonpsychiatric medical conditions causing similar symptoms. It should not be used to make a definitive diagnosis of major depressive disorder but instead serve as a prompt for appropriate referrals and resources. Table 3 outlines survivorship resources including websites and general help lines for further education and social support networks (NCCN, 2025d).

Survivors of TC have increased rates of suicide compared to the general population. A Norwegian population-based study evaluated the cause of death in 5,707 men with TC using the Cancer Registry and Cause of Death Registry of Norway, finding that those who received CBCT showed a 65% increased rate of suicide (Hellesnes et al., 2021). NCCN Survivorship Guidelines recommend performing a safety evaluation for survivors scoring ≥ 5 on the PHQ-9. This includes screening for symptoms of mania and psychosis, including increased energy or grandiosity, racing thoughts, decreased need for sleep, delusions or auditory hallucinations, and disorganized thinking/speech. If the survivor is deemed a safety risk, the APP must evaluate for suicidal thoughts/ideations and whether an organized plan for suicide or homicide exists. Evaluation of protective factors that may deem the survivor lower risk are

Table 3. Survivorship Resources for Health-Care Professionals and Survivors

National Coalition for Cancer Survivorship (NCCS)	https://canceradvocacy.org/
American Association for Cancer Research (AACR)	https://www.aacr.org/
American Cancer Society (ACS)	https://www.cancer.org/cancer/survivorship.html
American Institute for Cancer Research: Survivorship Information	https://www.aicr.org/cancer-survival/treatment-tips/after-treatment/
American Society of Clinical Oncology (ASCO)	https://www.asco.org/news-initiatives/current-initiatives/cancer-care-initiatives/prevention-survivorship/survivorship-compendium
Cancer Care: Free, professional support services for anyone affected by cancer	https://www.cancercare.org/
National Marrow Donor Program	https://www.nmdp.org/
Centers for Disease Control and Prevention (CDC): Survivorship Information	https://www.cdc.gov/cancer-survivors/
Leukemia & Lymphoma Society (LLS): Survivorship Information	https://bloodcancerunited.org/blood-cancer-care/adults
LIVESTRONG	https://livestrong.org/
National Cancer Institute: Office of Cancer Survivorship (OCS)	https://cancercontrol.cancer.gov/ocs
National Comprehensive Cancer Network (NCCN)	https://www.nccn.org/patientresources/patient-resources/guidelines-for-patients
MedlinePlus: Current accurate information by cancer site	https://medlineplus.gov/cancers.html
Oncology Nursing Society	https://www.ons.org/
Hodgkin's International	https://www.hodgkinsinternational.com/
American College of Lifestyle Medicine	https://lifestylemedicine.org/
General help lines	
ACS	1.800.227.2345
Cancer Support Community	1.888.793.9355
LIVESTRONG SurvivorCare	1.855.220.7777
National Cancer Institute's Cancer Information Service	1.800.4.CANCER

Note. Adapted from NCCN (2025d).

Table 4. Treatment Options for Chemotherapy-Induced Peripheral Neuropathy

Anticonvulsants

Gabapentin
- Initial dose 100–300 mg nightly, increase to 900–3,600 mg daily in divided doses 2 to 3 times daily.
- Dose increments of 50%–100% every 3 days; slower titration for elderly or medically frail
- Renal adjustment needed

Pregabalin
- Initial dose 50–75 mg nightly, increase to twice daily and then increase dose increments of 50%–100% every 3 days, maximum daily dose 600 mg
- Slower titration for elderly or medically frail
- Renal adjustment needed

Antidepressants

Duloxetine
- Initial dose 20–30 mg daily; after 1 week increase to 60 mg daily as needed/tolerated

Venlafaxine ER
- Initial dose 37.5 mg daily, increase every 4 days as needed, up to 75–225 mg daily
- Dose must be at least 150 mg per day to achieve SNRI effects/analgesia

Tricyclic antidepressants (TCAs)
- Amitriptyline, imipramine, nortriptyline, desipramine
- Use with caution in patients with conduction abnormalities, QTc prolongation or ischemic heart disease
- Caution in older adults due to anticholinergic adverse effects

Topical agents

Lidocaine patch 5%
- Apply daily to painful site
- Minimal systemic absorption

Topical NSAIDs
- Diclofenac gel 1% 4 times daily
- Minimal systemic absorption

Note. ER = extended release; NSAIDs = nonsteroidal anti-inflammatory drugs; QTc = corrected QT interval; SNRI = serotonin–norepinephrine reuptake inhibitor; TCAs = tricyclic antidepressants. Information from NCCN (2025b).

strong interpersonal bonds with family or community, cultural/spiritual beliefs about value of life, and a supportive social network. Factors that place a survivor at a higher risk include male sex, younger age, no spouse or live-in partner, and substance use disorder. For lower-risk individuals with suicidal ideations, no thoughts of harming others, and protective factors in place, the APP should create a safety plan, ensure immediate referral to a mental health specialist, and continue regular follow-up until psychiatric care is in place. If suicidal thoughts increase or change, the survivor agrees to contact the APP, call the 988 Suicide and Crisis Lifeline, call 911, or go to the nearest emergency room (NCCN, 2025d). Any survivor deemed a high safety risk and concern for harm to self or others should be sent to the emergency department for medical care (NCCN, 2025d).

Second Malignant Neoplasms

Effects from chemotherapy and radiation treatment increase the risk for second malignant neoplasms (SMNs). Second malignant neoplasms are the most common cause of death in TC survivors 5 years post diagnosis (Khan et al., 2024). Registry studies show increased rates of mesotheliomas, lung, thyroid, gastrointestinal (GI), genitourinary (GU), and skin cancers in TC survivors. Increased risk of abdominal and pelvic solid organ tumors has been noted in those who received infradiaphragmatic radiotherapy. In a study performed by Groot et al. (2018), a dose-dependent increase in the risk of GI SMN was demonstrated in those receiving platinum-based chemotherapy. Given that platinum residuals have been detected in urine and serum for up to 20 years post-treatment, an increased risk of cancers of the kidney and bladder has been noted. Limiting the radiation dose and field size along with a reduction in the number of platinum-containing chemotherapy cycles has decreased the risk of late effects from treatment. Also, in low-risk, early-stage seminoma and nonseminoma germ cell tumors, the option of active surveillance has reduced the use of treatments associated with an increased risk of SMNs.

The NCCN Colorectal Cancer Screening Guidelines recommend a colonoscopy at age 35 or 10 years after receiving chemotherapy, whichever occurs last, and continued every 5 years. For survivors with a history of abdominopelvic radiation, colonoscopies are recommended to start at age 30 or 5 years after treatment, whichever occurs last, and continued every 5 years (NCCN, 2025c). The NCCN AYA Oncology Guidelines

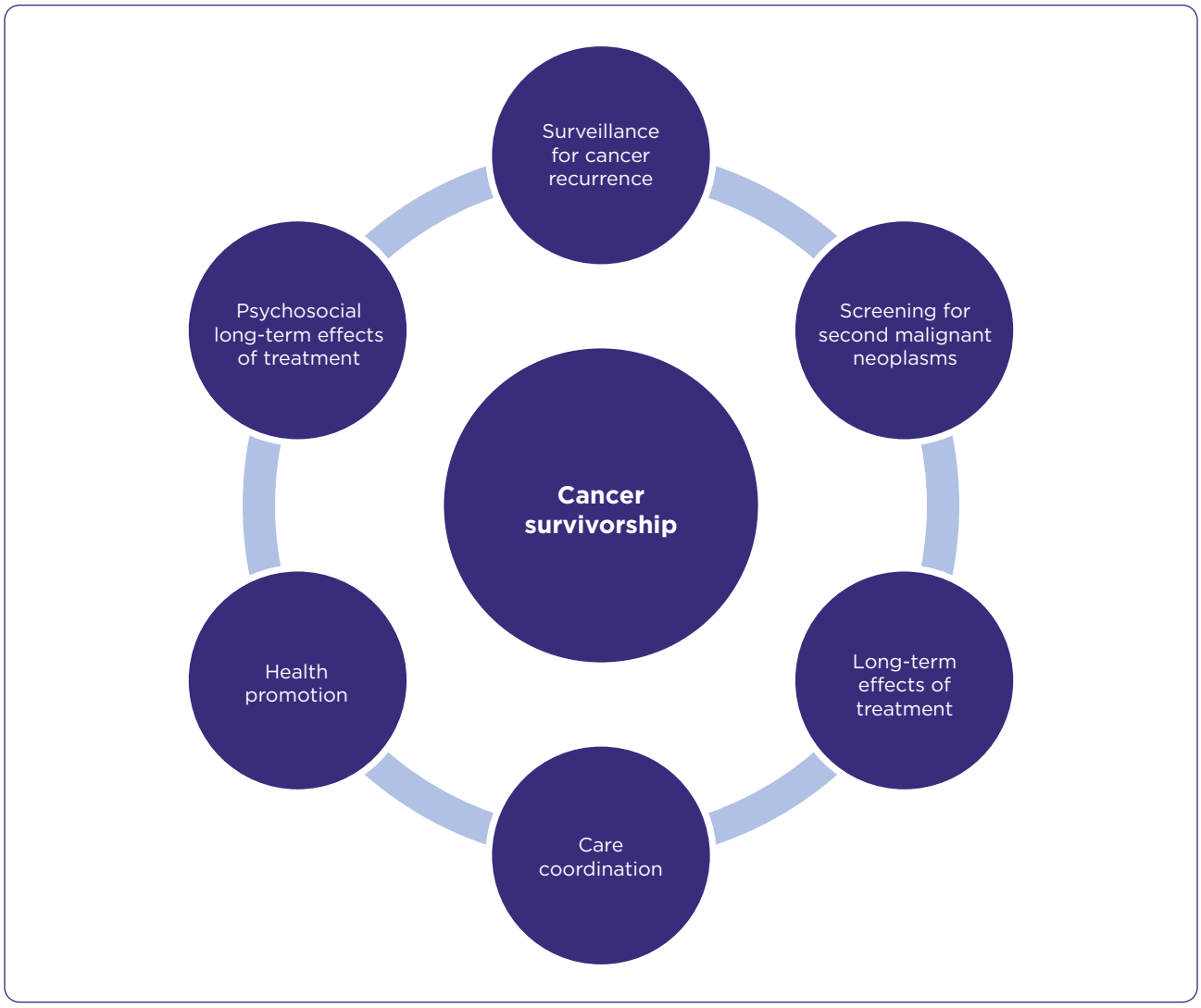

Figure 2. NCCN Standards of Survivorship Care. Reproduced from NCCN (2025a).

recommend annual skin examinations by a dermatologist if patients have previously received radiation therapy (NCCN, 2025a). Encouraging regular use and reapplication of sunscreen of SPF 30 or greater, wearing a hat and long sleeves, and avoiding peak sun times between 10:00 am and 2:00 pm are healthy skin practices. Survivors of TC should be educated to report any suspicious symptoms such as shortness of breath, cough, chest pain, nausea, abdominal pain, hematuria, melena, or unintentional weight loss, as this can be an indicator of a SMN. Advanced practice providers should also educate TC survivors on keeping regularly scheduled annual follow-up appointments with their primary care providers (PCP). Both CBCT and radiotherapy have been well documented to increase the risk of myeloid dysplasia and leukemia, although this risk decreases significantly after 10 years from exposure to chemotherapy (NCCN, 2025a). A change in symptoms along with an abnormal complete blood count (CBC) should initiate workup for myelodysplastic disorders. Currently, there are no recommendations on screening for lung, kidney, or bladder cancer in TC survivors.

Ototoxicity and Neurotoxicity

Hearing loss and tinnitus can be long-term consequences associated with CBCT. A baseline audiometry test should be performed prior to

initiating CBCT. Advanced practice providers should assess for symptoms of tinnitus and hearing loss periodically in TC survivors. Advanced practice providers can ask specific questions about having difficulty understanding conversations in a noisy place, trouble understanding over the phone, or needing to turn up the volume on the radio or TV, as these can be signs of hearing loss (CDC, 2026). If abnormalities exist, referral to an audiologist is warranted. Advanced practice providers should educate survivors with occupational or recreational noise exposure to use earplugs or earmuffs. Survivors should also receive counsel on hearing protection during concerts, music venues, lawn mowing, and power tool use. Additional protective behaviors include lowering the volume and taking breaks from noisy environments (Eichwald et al., 2023).

Cisplatin increases the risk of CIPN, contributing to decreased quality of life, unemployment, and disability (Khan et al., 2024). The NCCN Adult Cancer Pain Guidelines recommend first-line antidepressants and anticonvulsants for CIPN, which may be combined with opioids if pain persists (NCCN, 2025b). Treatment options for CIPN are outlined in Table 4. Although pregabalin and gabapentin are effective for diabetic and postherpetic neuropathy, evidence in cancer survivors is limited; gabapentin use is permissible after a shared discussion between the APP and survivor (NCCN, 2025b). Advanced practice providers may also refer survivors to integrative oncology for nonpharmacologic options such as acupuncture.

RISK-STRATIFIED SURVEILLANCE AFTER TREATMENT

For all stages of seminoma and nonseminoma germ cell tumors, NCCN Guidelines recommend follow-up with a history and physical exam, serum TMs, and imaging as indicated for 5 years post-treatment. NCCN Guidelines outline surveillance frequency based on treatment modality (surgery alone vs. surgery + chemotherapy vs. surgery ± chemotherapy ± radiation; NCCN, 2025b). Advanced practice providers should be familiar with NCCN's freely accessible resources. As shown in Figure 2, the NCCN Guidelines outline six core survivorship interventions (NCCN, 2025d).

A smooth transition from oncology to primary care is essential. Survivors should receive a care plan summarizing diagnosis, treatment, surveillance needs, and potential late effects. ASCO provides a general survivorship care plan template on their website (ASCO, n.d.). A list of late and long-term health effects of testicular cancer treatment is provided in Table 5. NCCN Guidelines supplement disease-specific recommendations and include resources on legal, employment, and psychosocial concerns (NCCN, 2025a).

DE-ESCALATION STRATEGIES AND EMERGING RESEARCH

Although CBCT contributes to long-term comorbidities, it remains central to TC cure rates. Current research aims to de-escalate chemotherapy exposure without compromising outcomes. Studies are ongoing to determine whether chemotherapy can be avoided altogether or the number of cycles reduced. For stage I seminomas, this can mean selecting more patients for active surveillance rather than one cycle of carboplatin. For stage I nonseminomas without risk factors, this can mean choosing active surveillance instead of one cycle of BEP. The GETUG SEMITEP trial evaluated de-escalation in good-risk seminoma using interim fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT). Patients with negative PET/CT after two EP cycles received only one cycle of carboplatin, reducing treatment duration and toxicity. Longer follow-up and standardized PET/CT criteria are still needed (Loriot et al., 2022). Long-term toxicity data for single-cycle carboplatin or BEP remain limited (Khan et al., 2024). Primary RPLND for IIA/IIb disease is also under investigation as a potential chemotherapy-sparing approach.

Emerging biomarkers, including microRNA (miRNA) miR-371a-3p and circulating tumor DNA (ctDNA), show promise for early recurrence detection. While use of miR-371a-3p demonstrated high sensitivity and specificity in detecting testicular cancer, further trials are needed before clinical adoption (Bagrodia et al., 2025). These tools may eventually reduce CT imaging, limit radiation exposure, detect recurrence earlier, and decrease reliance on systemic therapy (Bagrodia et al., 2025).

Table 5. Testicular Cancer Survivorship: Late and Long-Term Health Effects Summary

Late effects (begin after treatment has ended)	Long-term effects (begin during treatment and persist)
Surgical effects	
• Infertility (spermatogenesis and hypogonadism) • Sexual dysfunction	• Body image issues • Sexual dysfunction • Anejaculation and/or retrograde ejaculation • Nerve damage or chronic pain after RPLND
Radiation therapy effects	
• Fatigue • Infertility • Second malignant neoplasms • Cardiovascular complications (dyslipidemia, hypertension, early atherosclerosis and coronary artery disease, metabolic syndrome, Raynaud phenomenon, thromboembolic events)	• Fatigue • Nausea and vomiting • Diarrhea • Skin changes • Erectile dysfunction • Low blood counts
Chemotherapy effects	
• Infertility • Second malignant neoplasms • Cardiovascular complications • Pulmonary toxicity (restrictive lung disease or pulmonary fibrosis) • Peripheral neuropathy • Ototoxicity	• Ototoxicity • Peripheral neuropathy • Low blood counts • Pulmonary toxicity (pneumonitis or pulmonary fibrosis) • Renal insufficiency
General psychological long-term and late effects	
• Anxiety • Fatigue • Low libido • Fear of recurrence • Single status • Unemployment/disability	• Fatigue • Anxiety • Low libido/decreased sexual activity

Note. RPLND = retroperitoneal lymph node dissection. Information from Bagrodia et al. (2025); NCCN (2025a).

CONCLUSION

The treatment of TC carries significant long-term physical and psychological effects. With cure rates exceeding 90% and a 5-year survival of 95%, survivors are living longer, making the APP's role in managing late effects increasingly important. Advanced practice providers should prioritize risk identification, health promotion, and management of chronic toxicities (Raggi et al., 2025). Survivorship care must be proactive and multidisciplinary to ensure survivors can lead full lives without being burdened by treatment consequences.

Disclosure

The author has no conflicts of interest to disclose.

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