



Management of Radiation Side Effects

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Disclosures

- I have no disclosures

Objectives

- Understand the definition and goals of radiation therapy
- Review how radiation damages cancer cells
- Identify common acute and late side effects of radiation
- Understand mechanisms and risk factors
- Review prevention and management strategies

Overview of Radiation Basics:

- Radiation therapy works by damaging cellular DNA to prevent tumor replication and induce cell death.
- Normal tissues within or adjacent to the radiation field are also exposed → resulting in collateral injury.
- Radiation injury depends on multiple factors
 - Tissue type
 - Radiation dose and fractionation
 - Volume irradiated
 - Concurrent chemotherapy or immunotherapy
 - Patient-specific susceptibility factors
 - Age
 - Comorbidities
 - Nutrition
 - Smoking status

How does radiation induce toxicity?

- Direct damage to DNA
 - Ionizing radiation directly breaks chemical bonds in DNA
 - Single strand breaks
 - Double strand breaks
 - If damage is improperly repaired or severe, the cell may become dysfunctional or die
- Indirect damage through free radicals
 - Radiation interacts with water molecules inside cells, producing highly reactive molecules called free radicals (hydroxyl radicals)
 - Free radicals attack DNA, proteins, lipids and cellular membranes
 - Since the human body is made mostly of water, this indirect damage is a major contributor to radiation toxicity

What makes tissues radiosensitive or radioresistant?

Radiation mainly damages DNA which makes cells more vulnerable when they are replicating

- Tissue organization and cell division/turnover
 - Some tissues depend on a small population of stem cells to continuously replace/renew mature cells
 - Damage to the stem cell population can result in significant tissue injury because those mature cells cannot be adequately replaced - more sensitive to radiation
 - Cells that divide rapidly are also generally more sensitive to radiation
 - less time to repair DNA damage before attempting to divide
 - Examples: bone marrow, intestinal lining, skin, hair follicles
 - These tissues often show SE during treatment – low blood counts, diarrhea, skin irritation, hair loss
 - Differentiated/non-renewing tissues consist primarily of mature cells that function for long periods without frequent replacement
 - These slowly dividing cells are more resistant to radiation
 - These tissues can continue to function even when cell division is limited = less likely to show acute injury but at risk for late radiation effects
 - Examples: Brain cells, mature nerve cells, spinal cord, muscle tissue

What makes tissues radiosensitive or radioresistant?

- Oxygen enhancement effect
 - Radiation generates free radicals → Oxygen reacts with these free radicals and “fixes” the damage into permanent chemical changes → DNA damage becomes harder to repair
 - Well oxygenated tissues/tumors are more radiosensitive
 - Hypoxic tumors are more radioresistant
- DNA repair capacity
 - Cells differ in how effectively they repair DNA double-strand breaks
 - Some tissues are better at detecting and repairing radiation-induced DNA damage
 - Tissues with less efficient or defective repair pathways accumulate lethal damage more readily
 - Tissues with strong repair mechanisms can survive higher doses of radiation

It's worth noting that "radioresistant" does not mean immune to radiation

It simply means that more radiation is required before significant injury occurs

Very high doses of radiation can damage virtually any tissue

Acute Radiation Injury

Most often occurs during radiation treatment or within days to weeks after treatment

Causes:

- Loss of rapidly dividing cells
- Acute inflammation
- Edema

Effects are cumulative with most significant SE occurring near the end of the treatment course

- Often reversible
- Usually heal once stem-cell populations recover

Tissue	Acute Effect
Skin	Erythema, desquamation
Oral mucosa	Mucositis
GI tract	Diarrhea
Esophagus	Esophagitis
Bladder	Cystitis

Acute toxicities often peak 1–2 weeks AFTER radiation completion

Patients may mistakenly think treatment failure or related to infection

Chronic (late) Radiation Injury

Radiation stimulates fibroblast proliferation/activation

- Vascular insufficiency
- Chronic inflammation
- Collagen deposition
- Tissue stiffening & scarring

Consequences:

- Loss of organ compliance
- Reduced vascularity
- Progressive dysfunction

Organ	Late effect
Lung	Pulmonary fibrosis
Brain	Cognitive decline/radionecrosis
Heart	Accelerated CAD
Bowel	Strictures/fistulas
Bone	osteonecrosis
Soft tissue	Fibrosis/lymphedema

Typically occurs months to years later

Key Distinctions

Acute Injury

- Cell depletion/inflammation
- Peak 1-2 weeks after completion of treatment
- Often reversible

Chronic Injury

- Vascular damage/fibrosis
- Occur months to years later
- Often irreversible and progressive

Common Radiation Side Effects

Unlike systemic side effects from chemotherapy – radiation therapy usually only impacts the area that received radiation

- Side effects vary depending on the site of treatment

Modern radiation therapy techniques have decreased these side effects significantly



Breast and Skin Toxicities

- Acute
 - Erythema/irritation
 - Dry/moist desquamation
 - Alopecia – hair follicles shed – move into resting phase of cell cycle
 - Usually grows back in 3-5 months
- Subacute
 - Hyperpigmentation – due to melanocyte stimulation
 - as early as 2-3 weeks
 - usually resolves 3-12 months – although can become permanent
- Late
 - Hypopigmentation in the treatment field
 - Telangiectasias
 - Fibrosis

Management of Acute Skin Toxicity

Prevention:

- Avoid friction/trauma (e.g. shaving, scratching or sun exposure)
- Avoid cosmetics or harsh cleansers (especially if contain alcohol)

For erythema:

- Emollients (lotions, creams, or ointments)
- Gentle cleansing with mild soap and patted dry
- Topical corticosteroids if pruritic

For dry desquamation:

- Saline soaks with gentle debridement
- Aquaphor is then used to keep the skin well moisturized and as a protective barrier
- Nonstick dressing

For moist desquamation:

- Dilute H₂O₂ or 1% aqueous gentian violet to dry the lesion and prevent infection
- Silver sulfadiazine (Silvadene) 1% cream promotes healing.
- For minimally exudative wounds → Hydrogel or Hydrocolloid dressing
- For highly exudative wounds → burn pads, alginate, or foam dressing
- For infected wounds → ion silver pads or powder, topical antibiotics

Radiation Dermatitis



Grade 1 – Faint erythema and dry desquamation (*).

Very common (>75%)



Grade 2 – Moderate or brisk erythema; patchy moist desquamation (arrow) mostly confined to skin folds and creases.

Less common (10-15%)



Grade 3– Moist desquamation in areas other than skin folds and creases.

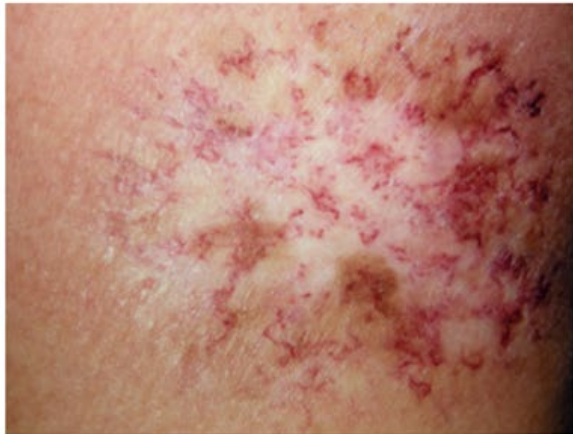
Uncommon (1-2%)

Risk of high grade dermatitis mainly among patients with locally advanced tumors involving skin who require bolus during RT in order to give full dose to skin.



Potential Long Term Skin Toxicity from Definitive RT

- Telangiectasia formation due to capillaries being reduced in number and dilated
- Destruction of melanocytes, hair follicles, and sebaceous/sweat glands in the RT field may lead to permanent hypopigmentation or alopecia
- Chronic dermatitis can develop months-years after RT

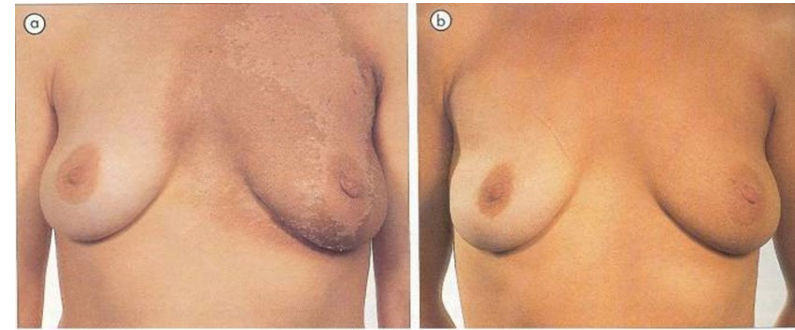


Toxicity from Breast Radiation: Acute Treatments

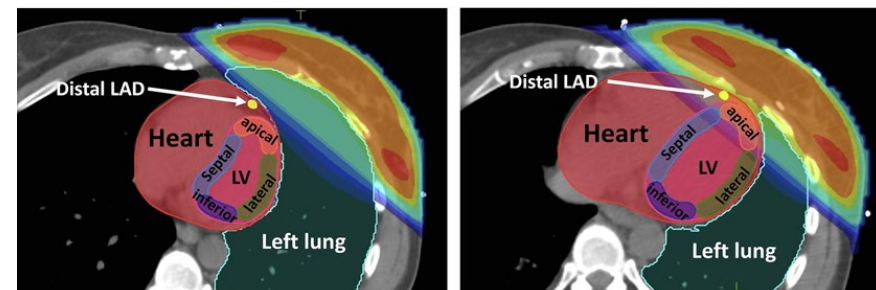
- Pain
 - Stepwise approach from NSAIDs → opioids if needed
 - Narcotics = last resort! (<10% of patients)
- Fatigue
 - Good sleep habits, rest when feeling tired
 - Decrease work hours and other responsibilities
 - Light exercise, adequate nutrition and hydration

Late Toxicities of Breast RT

- Skin hyperpigmentation, breast fibrosis or shrinkage
 - Vitamin E, pentoxifylline
 - Therapy for fibrosis/decreased ROM
- Lymphedema
 - 2-14% risk with BCS + SLNB + nodal RT
 - 13-28% risk with BCS + ALND + nodal RT
 - Lymphedema precautions, sleeves, pump, PT
- Cosmetic changes
 - Plastic surgery for symmetry
- Rib tenderness/fracture
 - Weakening of the bone due to RT - Very rare
 - Can occur with prone treatment
- Secondary cardiac events
 - Relative risk of heart disease/coronary events increases 4-7% for each 1 Gy in mean heart dose.
 - DIBH, prone positioning, smoking cessation, risk factor reduction
- Radiation-induced pneumonitis
 - lower risk if breast-only, higher risk if regional nodes
 - Reduced risk with prone positioning
 - Prednisone 1 mg/kg x 1 month slow taper
- Secondary malignancy
 - Real but rare
 - Can occur 10-30 years after treatment
 - Risk depends on age, dose, treated area



Appearance of radiated left breast at completion (A) and one month later (B)



Deep inspiration breath hold

Free breathing

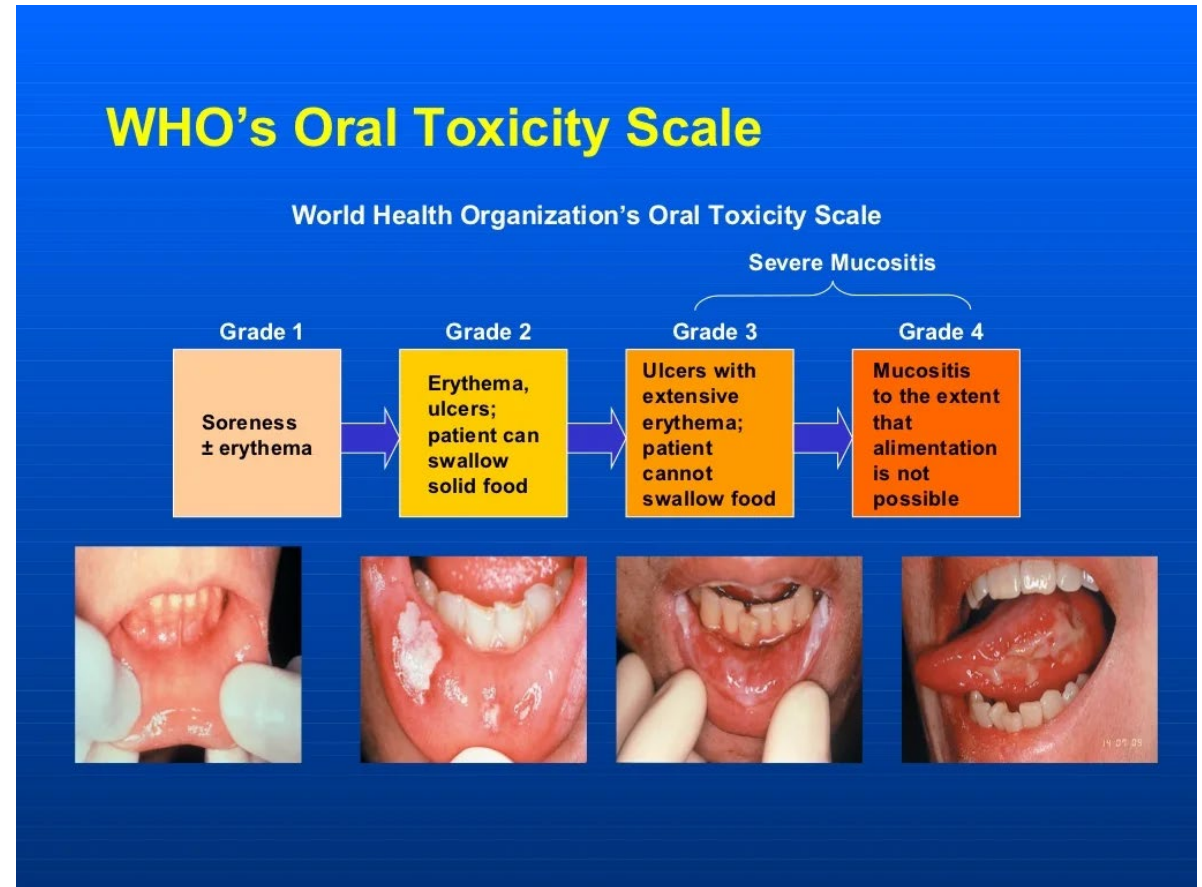
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 Donker, Milla, et al. *The Lancet Oncology* 15.12 (2014): 1303-1310.

Other Skin Toxicities

- Radiation Recall is an acute inflammatory response in a previously irradiated field following administration of a systemic drug (anthracyclines, taxanes, alkylating agents, anti-metabolites, gemcitabine, hormonal therapies, immunotherapy, antimicrobials, etc.)
 - May occur days to years after RT
 - Onset is days to 2 months after drug administration
 - Resolves within days to a few weeks (once triggering medication is stopped)

Toxicity of Head/Neck Radiation - Acute

- Oral mucositis
 - Avoiding spicy or acidic foods
 - Salt/baking soda rinses
 - Prescription mouth rinses
 - magic mouthwash
 - Pain medications
 - Dietician support
- Taste dysfunction
 - Foods may taste metallic or bland
 - Flavor experimentation
 - Nutrition counseling
 - Zinc supplementation – important for taste bud function & regeneration of taste cells. Improves salivary gland activity and nerve signaling in taste perception



Toxicity of Head/Neck Radiation - Acute

- Pain & odynophagia
 - Food sticking - soft or liquid diets
 - Dehydration - scheduled IVF during treatments
 - Weight loss – nutritional shakes, temporary feeding tube
- Xerostomia from damage to salivary glands
 - Thick saliva – utilize saliva substitutes & humidifiers
 - Difficulty speaking or swallowing
 - Pilocarpine (salagen) to help improve saliva production, oral moisture, swallowing comfort and speaking
 - Dental problems – practice good oral hygiene

Toxicity of Head/Neck Radiation - Late

- Permanent xerostomia
 - Replacement products
 - Artificial sprays, gels or rinses
 - Oral moisturizers & water-based lubricants to help reduce friction and discomfort
 - Frequent hydration
 - Always carry water – frequent sips throughout the day
 - Humidifier at night
 - Avoid alcohol-based mouthwashes
 - Sugar free gum and lozenges to help stimulate any remaining gland function
 - Xylitol gum/lozenge and citrus or mild flavor stimulation can increase reflex salivation
 - Dental Protection and good oral care
 - Gentle brushing with RX high fluoride toothpaste/gels, daily fluoride trays
 - Regular dental cleanings/exams (Q3-4 months)
 - Alcohol free mouth rinses
 - Treating fungal infections early
 - Diet adjustments
 - Moist, soft foods – use sauces or broths to help with swallowing
 - Avoid dry, sticky foods, spicy, acidic or very salty foods if irritating

Toxicity of Head/Neck Radiation - Late

- Soft tissue fibrosis
 - Neck stiffness, reduced jaw opening and swallowing difficulty
 - PT, strengthening exercises and jaw mobility devices
 - Intensive therapy with SLP: swallowing exercises, ROM exercises, compensatory strategies (chin tuck, head turn, posture change)
- Dysphagia & pharyngeal stricture
 - Caused by fibrosis in the pharynx and esophagus – strictures
 - Reduced muscle elasticity & coordination
 - Decreased saliva worsens bolus passage
 - Neuromuscular weakness from disuse or nerve injury
 - Treated with
 - Swallowing rehabilitation – strengthen pharyngeal muscles
 - Endoscopic dilation
 - Nutritional support and aspiration prevention
 - Surgery

Toxicity of Head/Neck Radiation - Late

- Osteonecrosis mandible - rare
 - Can occur after dental trauma or extraction
 - Treat with antibiotics, specialized mouth care
 - Hyperbaric oxygen therapy or surgery in severe cases
- Lymphedema
 - Therapy, compression techniques & massage
- Thyroid dysfunction – levothyroxine
- Hearing changes
 - Ear fullness – observation, steroid nasal sprays, ear tubes if severe
 - Chronic inflammation/ infections – steroid drops, antibiotics if infected
 - Hearing loss – audiology rehab, hearing aids or listening devices

Toxicity of Lung Radiation: Acute

- Esophagitis
 - Presents with painful/difficulty swallowing, heartburn, chest discomfort
 - Mucosal anesthetics (viscous lidocaine)
 - Agents that coat the surface (suspension or liquid antacids) - sucralfate
 - Liquid analgesics/topical numbing agents
 - Soft/bland food & nutritional supplements
 - Acid reducing medications
 - Pain medications
- Cough
 - Antitussives with or without codeine
- Skin Reaction
- Fatigue

Toxicity of Lung Radiation: Late

- Factors that increase risk of late toxicities
 - Larger lung radiation volumes
 - Higher mean lung dose
 - Combined chemotherapy or Immunotherapy
 - Pre-existing lung disease
 - Older age
- Modern IMRT and proton therapy can reduce risk by lowering dose to normal lung tissue

Toxicity of Lung Radiation: Late

- Pulmonary fibrosis
 - Chronic SOB & decreased exercise tolerance
- Radiation Pneumonitis
 - Symptoms include dry cough, SOB, fever, chest tightness, fatigue, low O2 levels
 - Most symptoms appear 6-12 weeks after treatment
 - Can resemble pneumonia, COPD flare, cancer progression, Immunotherapy flare
- Risk increased with chemoradiation & immunotherapy
- Decreased incidence with SBRT due to smaller lung volume treated
- Treatments include:
 - Mild cases
 - Observation/supportive care
 - Bronchodilators, cough suppressants
 - O2 if needed
 - Moderate or severe cases
 - Corticosteroids x several weeks to months with gradual tapering – most helpful in inflammatory phase
 - Supplemental O2
 - bronchodilators/inhalers
 - pulmonary rehab to improve exercise tolerance
 - treat any coexisting infection or concurrent lung disease
 - Advanced/progressive disease
 - long term O2 therapy
 - Referral to pulmonology

Toxicity of Lung Radiation: Late

- Esophageal stricture
 - 5-15% stenosis, ulceration, perforation & fistula formation
 - Worse with cisplatin-based chemotherapy
 - Treat with endoscopic stretching/dilation procedures and nutritional support
- Cardiac sequelae (RARE due to modern techniques)
 - Pericardial effusion/Constrictive pericarditis
 - Cardiomyopathy
 - CAD, Valvular disease, arrhythmias
- Spinal cord Myelopathy
 - Numbness/tingling, loss of coordination, difficulty walking/balance, electric shock sensation with neck movement – Lhermitte sign
 - Corticosteroids, bevacizumab, hyperbaric oxygen therapy, rehabilitation with PT/OT
- Brachial Plexopathy/nerve injury
 - About 1-5% overall with modern dose constraints (higher with older techniques or very high doses)
 - Weakness, numbness, pain syndromes
 - treat with PT/OT
 - Neuropathic medications: gabapentin, pregabalin
 - Corticosteroids in selective inflammatory cases
 - Rarely surgery for severe compression/fibrosis

Toxicity of Esophageal Radiation: Acute

- Esophagitis
 - Odynophagia, dysphagia
 - Burning chest pain
 - Feeling of food “sticking”
 - Treatment includes
 - Soft/liquid diet, high calorie supplements
 - Acid suppression with PPI
 - Topical anesthetic – swish and swallow
- Nausea/vomiting with secondary weight loss
- Modest skin tanning - posterior
- Fatigue

Toxicity of Esophageal Radiation: Early Delayed

- Persistent swallowing difficulties – due to inflammation & early scarring
 - Swallow therapy (SLP)
 - Gradual advancement of diet
 - Continued acid suppression
- Esophageal narrowing/stricture
 - Food sticking
 - Progressive dysphagia
 - Endoscopic dilation
 - May need repeated procedures

Toxicity of Esophageal Radiation: Late

- Esophageal stricture & stenosis(>60% pts)
 - Serial endoscopic dilations
 - Occasional steroid injections into stricture
 - Rarely stent placement
- Chronic esophageal dysfunction
 - Reduced motility – poor coordination of swallowing
 - Ongoing dysphagia even without visible narrowing
 - Treatments include:
 - Swallow rehabilitation
 - Dietary modifications with small frequent meals
- Radiation induced ulcers or bleeding
 - Presents with pain or anemia
 - Fistulas and perforation are rare
 - Treatment includes:
 - Acid suppression
 - Endoscopic evaluation
 - Supportive care +/- cauterizations if needed

Toxicity of Abdominal Radiation: Early

- Dyspepsia - PPI to reduce acid
- Nausea/Vomiting - prophylactic Zofran prior to treatment
 - oral electrolyte solution
 - IV fluids if severe dehydration develops
- Malabsorption of nutrients – Creon/pancrelipase
- Loss of appetite/weight loss – nutrition support
- Abdominal gas/bloating – simethicone, dietary changes
- Diarrhea
 - loperamide, bile acid binders (cholestyramine)
 - Low fat/low residue diet, hydration
- Temporary increase in LFTs – radiation hepatitis
 - Abdominal swelling, enlarged liver, ascites, jaundice
 - Supportive care – restrict Na⁺, diuretics, nutritional support, avoid ETOH
 - Monitor labs & treat complications
- Fatigue

Toxicity of Abdominal Radiation: Late

- Chronic nausea/indigestion
 - Ondansetron
 - Small frequent meals
 - Avoid ETOH, NSAIDS, irritating foods
- Gastric ulcers
- Persistent reflux/gastritis
 - Omeprazole
- Delayed gastric emptying
 - Gaviscon

Toxicity of Abdominal Radiation: Late

- Chronic diarrhea
 - Increased bowel urgency
 - Bloating/cramping
- Intestinal strictures leading to bowel obstruction
- Chronic malabsorption
- Radiation enteritis
 - Anti-inflammatories
 - Nutritional support
 - Vitamin replacement - B12, iron, D
- Liver inflammation/fibrosis
 - Increased LFT

Toxicity of Prostate Radiation - Early

- Diarrhea, urgent bowel movements,
 - Imodium, loperamide
 - low fiber/bland diet
 - Hydration with water and electrolytes
- Gas and bloating – simethicone, dicyclomine
- Rectal irritation/inflammation & bleeding
 - Barrier creams & topical anesthetics
 - Warm sitz baths
 - Steroid suppositories/enemas – help reduce inflammation
 - Sucralfate enemas – help coat and protect
 - Mesalamine suppositories/enemas to help reduce inflammation:

Toxicity of Prostate Radiation - Early

- Urinary symptoms
 - Frequency/urgency – tamsulosin, VESIcare, oxybutynin
 - Nocturia
 - Dysuria - AZO
 - Hematuria – check UA
 - Leakage/incontinence
 - Kegel exercises
 - Pelvic floor therapy
- Fatigue

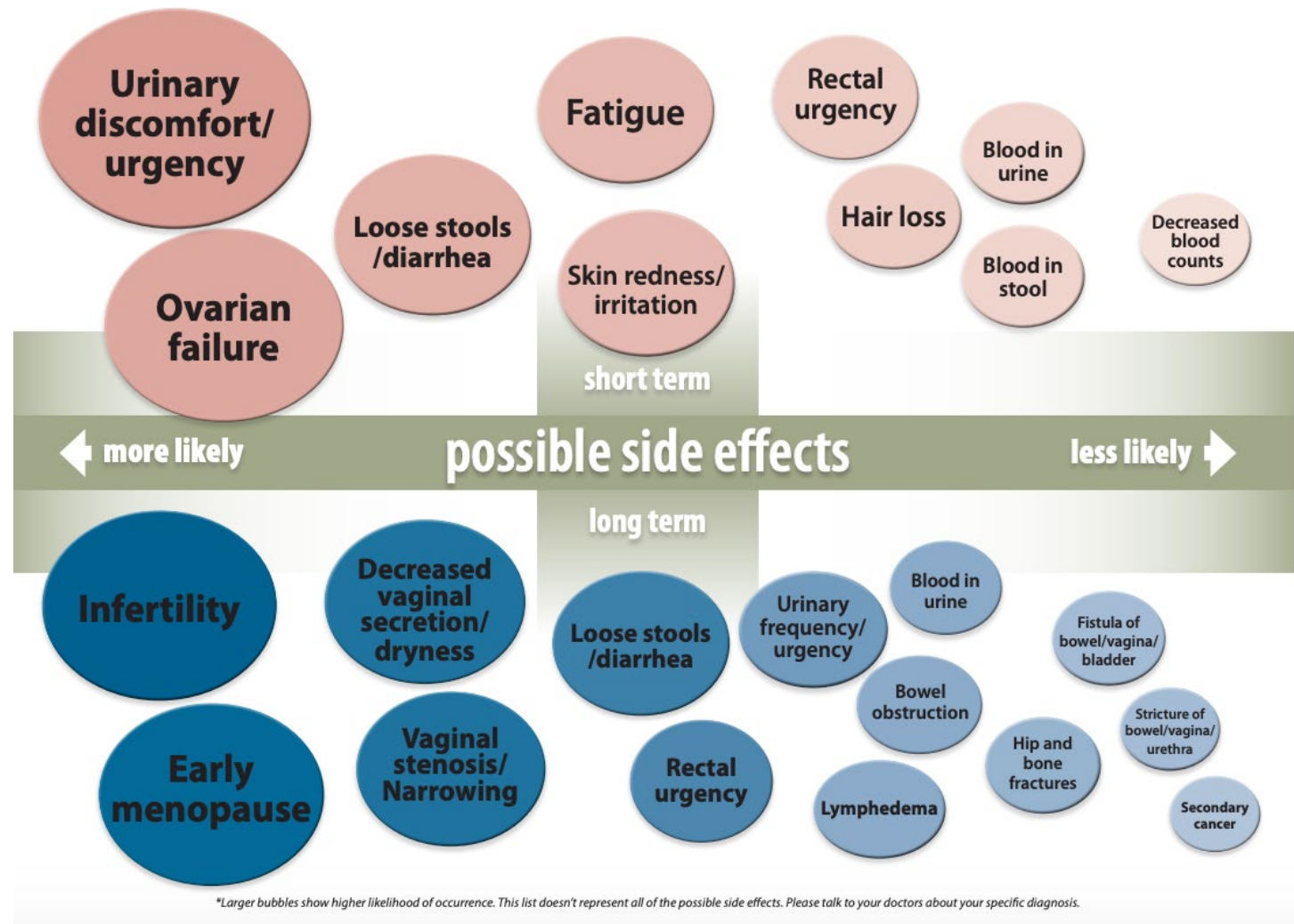
Toxicity of Prostate Radiation - Late

- Persistent urinary symptoms
 - LUTS/ BPH-type bladder obstruction: alpha 1 blocker (tamsulosin, terazosin)
 - Urgency/frequency, urge incontinence: add bladder relaxant
 - Beta 3 agonist (vibegron, mirabegron)
 - Antimuscarinics (oxybutynin, trospium)
 - May worsen retention risk
 - Weak stream/retention secondary to urethral stricture: catheter dilation
 - Hematuria: anticholinergics or beta 3 agonist for bladder spasms
 - Pelvic floor therapy
 - Artificial urinary sphincter for incontinence

Toxicity of Prostate Radiation - Late

- Persistent bowel symptoms
 - Urgency accompanied by tenesmus or rectal pain – sucralfate enema
 - Also consider pelvic floor therapy, biofeedback, bowel retraining programs
- Erectile dysfunction
 - Medications – sildenafil , tadalafil
 - Vacuum pump
 - Intracavernosal injections – phentolamine + papverine+ alprostadil
 - Overrides sympathetic vasoconstriction and relaxes cavernosal smooth muscle
 - Increases arterial inflow and reduces venous outflow to produce an erection
 - Penile implant

Toxicity of GYN Radiation



Toxicity of GYN Radiation: Early

- Vaginal & pelvic symptoms
 - Skin irritation/inflammation and pelvic discomfort
 - Gentle hygiene, loose cotton underwear, sitz baths, vaginal moisturizers
- GI symptoms
 - Diarrhea, bowel urgency, cramping and bloating
- Urinary symptoms
 - Dysuria, frequency, urgency
- Sexual/reproductive effects
 - Decreased lubrication and dyspareunia – temporary or long standing
- Blood count suppression – especially with large pelvic fields or concurrent chemotherapy
 - Neutropenia, anemia
 - Increased infection risk

Toxicity of GYN Radiation: Late

- Vaginal stenosis & fibrosis
 - Narrowing or shortening of the vagina
 - Scar tissue/fibrosis which can affect pelvic soft tissues, nerves, muscles
 - Treat with topical estrogen to improve elasticity and atrophy
 - Pain with intercourse or exams – treat with lubrication, pelvic floor therapy
 - Prevention with vaginal dilator therapy – use with lubricants
- Premature menopause and infertility
 - Hot flashes
 - Vaginal dryness – vaginal moisturizers & lubricants
 - Bone loss risk – pelvic insufficiency fractures
 - Ovarian failure and infertility

Toxicity of GYN Radiation: Late

- Chronic bowel problems
 - Chronic diarrhea
 - Rectal bleeding
 - Fecal urgency
 - Radiation proctitis
 - Rarely bowel obstruction or fistulas
- Chronic bladder problems
 - Persistent urinary frequency or urgency
 - Hematuria – radiation cystitis
 - Rarely reduced bladder capacity
- Lymphedema – legs/genitals

Toxicity of Brain Radiation: Early

- Fatigue – can last long after treatment
- Scalp/skin irritation
 - Redness, dry, itching, tenderness
 - Hair loss may be temporary or permanent
- Nausea/vomiting – ondansetron
- Headache
- Swelling/edema - dexamethasone
- Worsening of neurologic symptoms
 - Weakness, speech difficulty, balance problems, vision changes, memory issues
- Seizures
 - RT itself can irritate brain tissue & sometimes contribute to seizures - Levetiracetam

Late Toxicities of Brain Radiation

- Whole-brain radiation therapy (WBRT)
 - diffuse cognitive decline
 - fatigue
 - memory impairment
- Stereotactic radiosurgery (SRS -Gamma Knife/CyberKnife)
 - lower risk of generalized cognitive effects
 - but still possible focal necrosis or neurologic deficits near treated lesions
- Approximate timing of late effects
 - Months: early delayed cognitive changes, fatigue
 - 6–24 months: necrosis, endocrine issues
 - Years later: vascular disease, severe cognitive decline, secondary cancers
- Strategies used today to reduce late toxicity
 - hippocampal-sparing radiation
 - proton therapy
 - stereotactic techniques
 - lower-dose protocols
 - neuroprotective medications like memantine in some settings

Toxicity of Brain Radiation: Cognitive & Neurologic Symptoms

- Cognitive Symptoms:
 - Memory problems
 - Slower processing speed
 - Difficulty concentrating
 - Executive dysfunction (planning, multitasking)
 - Word-finding difficulty
- Memory/concentration
 - Forgetfulness
 - Slower thinking
 - Difficulty multitasking
 - Reduced attention
- Mood emotional changes
 - Irritability
 - Depression
 - Anxiety
 - Emotional lability
- Sleep disturbances
 - Excessive sleepiness
 - Insomnia
- Balance and coordination problems
 - Ataxia
 - Gait instability
 - Dizziness

Toxicity of Brain Radiation: Cognitive & Neurologic Symptoms

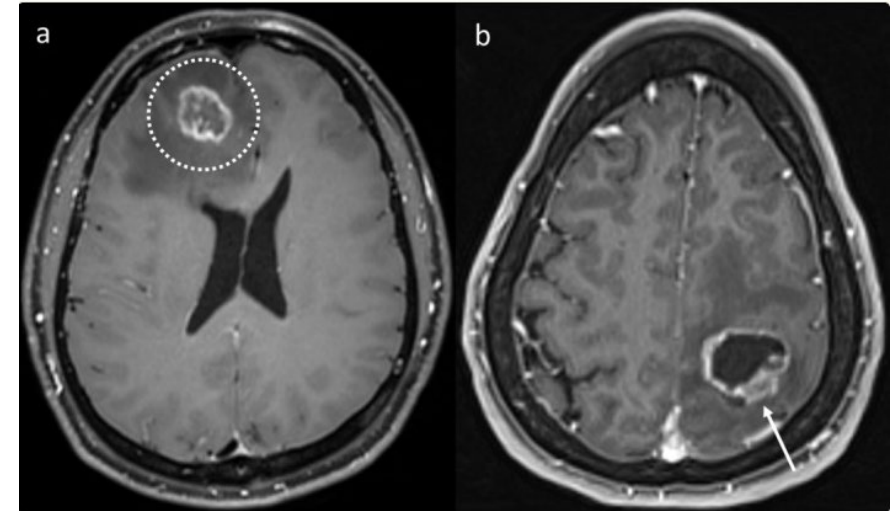
- Increased risk factors
 - whole-brain radiation
 - larger treated volumes
 - older age
 - higher doses
- Treatments
 - Cognitive rehabilitation therapy
 - Occupational therapy
 - Structured memory aids and routines
 - Exercise and sleep optimization
 - Management of depression/anxiety (which can worsen cognition)
- Medications
 - Memantine
 - Stimulants such as:
 - Methylphenidate
 - Modafinil

Toxicity of Brain Radiation

- Secondary tumors – rare long-term risk
 - Meningiomas
 - Gliomas
 - Sarcomas
- Pediatric – specific late effects
 - Reduced IQ
 - Learning disabilities
 - Delayed development
 - Hormonal dysfunction
 - Growth impairment
 - Social and behavioral difficulties

Toxicity of Brain Radiation: Radiation Necrosis

- Delayed and serious late side effect
 - Healthy tissue within the treatment field is damaged and dies
 - Typically occurs months to years after treatment
 - Can be difficult to distinguish from recurrence
- Symptoms depend on location:
 - Headaches
 - Seizures
 - Weakness
 - Speech or vision problems
 - Cognitive decline
- MRI may show swelling or mass-like changes



<https://pmc.ncbi.nlm.nih.gov/articles/PMC12120592/>

Toxicity of Brain Radiation: Radiation Necrosis

- Treatments include
 - Corticosteroids – 1st line
 - Dexamethasone reduces swelling & symptoms
 - Long term steroid use can cause major side effects – taper dose when possible
 - Bevacizumab
 - Very effective for symptomatic necrosis – reduces edema and MR changes
 - Surgery
 - When diagnosis is uncertain
 - Severe mass effect
 - Refractory symptoms
 - Laser interstitial thermal therapy (LITT)
 - Hyperbaric oxygen therapy

Clinical Pearls

- Radiation therapy works by damaging cellular DNA to prevent tumor replication and induce cell death
- Radiation therapy usually only impacts the area that received radiation
 - Side effects vary depending on the site of treatment
- Radiation toxicity is highly dependent on anatomy and dose distribution.
 - Acute toxicity reflects injury to rapidly dividing tissues.
 - Late toxicity is largely a vascular/fibrotic process.
- Combined chemoradiation significantly increases toxicity risk.
- Radiation effects may mimic:
 - Infection
 - Autoimmune disease
 - Tumor recurrence