

Side Effects of Radiotherapy

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BC Cancer Agency
CARE + RESEARCH

An agency of the Provincial Health Services Authority



Disclosures

- None

Objectives

- Describe common side effects of Radiation Therapy
- Discuss the management of these side effects
- Identify late effects and management thereof

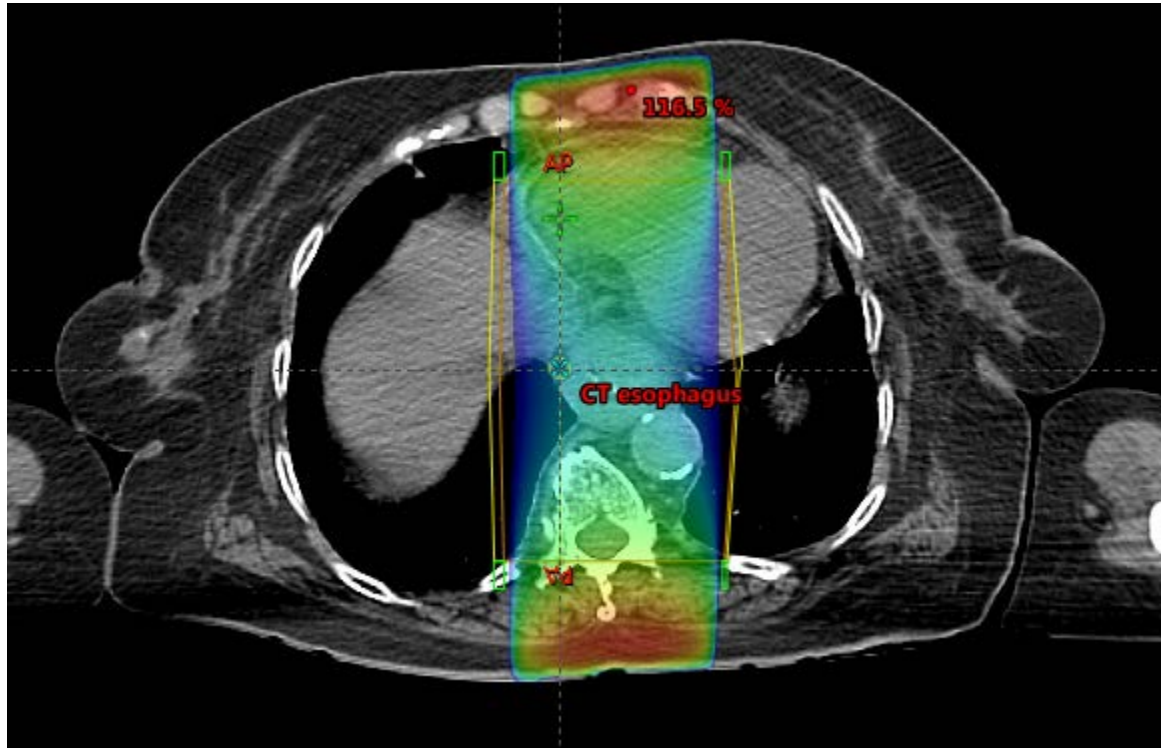
What's Radiation Therapy

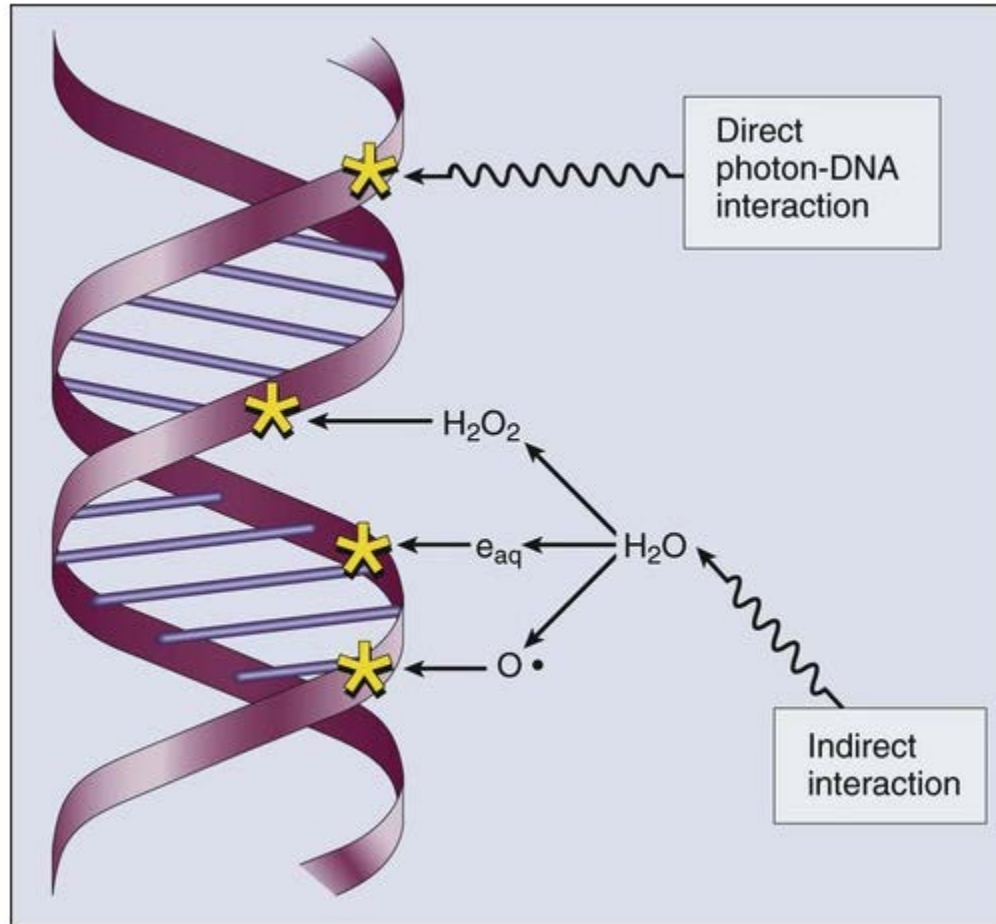
- Treatment delivered with Ionizing Radiation
- It can be delivered with
 1. Photons (Radioactive sources like Radium, Cobalt, Iridium, Iodine, etc. or X-rays generated by a Linear Accelerator)
 2. Particles Beams (Electrons, Protons, Carbon particles, Neutrons, etc.)

Biologic Basis of Radiation Therapy

- Radiation damages the DNA (with photons but mostly through creation of free radicals)
- All tissues/organs including tumor coming in the path of Radiation are effected
- Radiation effects depend upon the total dose, dose per fraction, treatment schedule, treatment duration, tissues in the path of Radiation, concurrent chemotherapy, medical comorbidities, etc.

Palliative Radiation for an Esophageal Carcinoma





4 Rs of Radiobiology/Radiation Effects

- Repair
- Repopulation
- Redistribution/Reassortment
- Reoxygenation

Repair

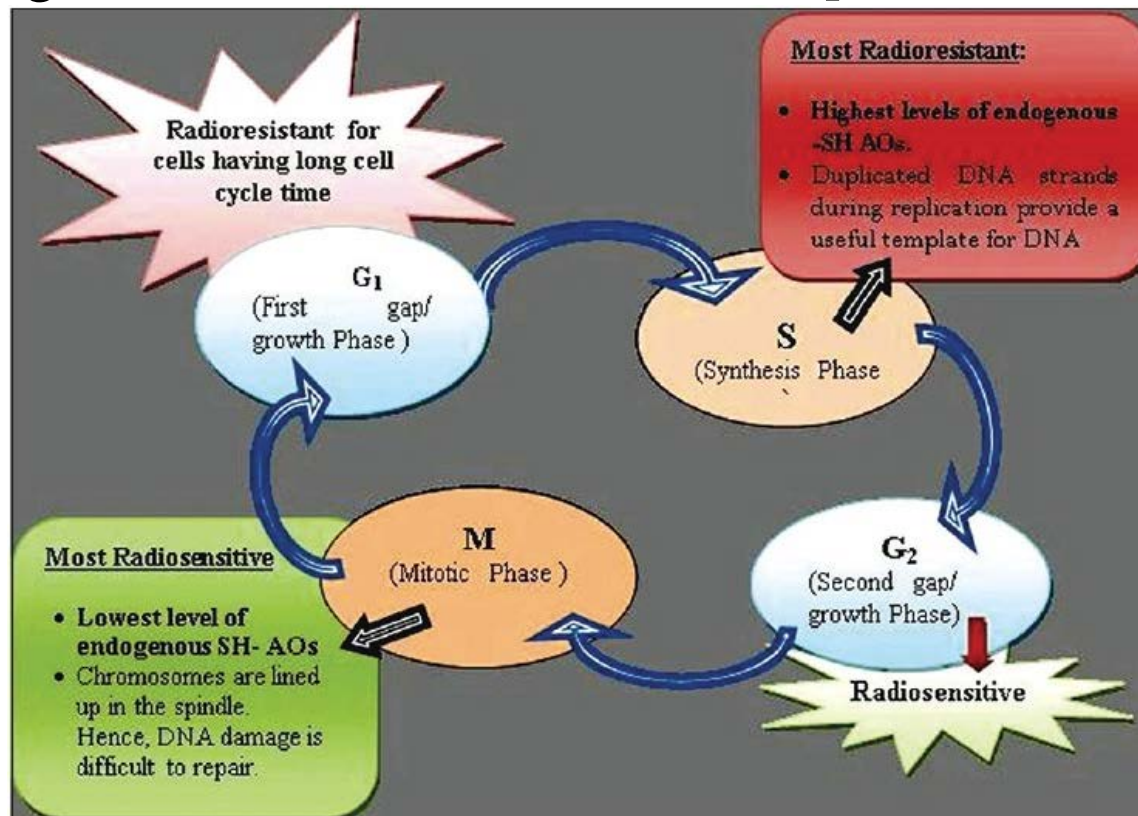
- Repair of sublethal damage is
 - Good for recovery of normal tissues
 - Decreases radiation effect on cancer cells

Repopulation

- Repair of normal tissues
- Decreased Radiation sensitivity/control of tumors

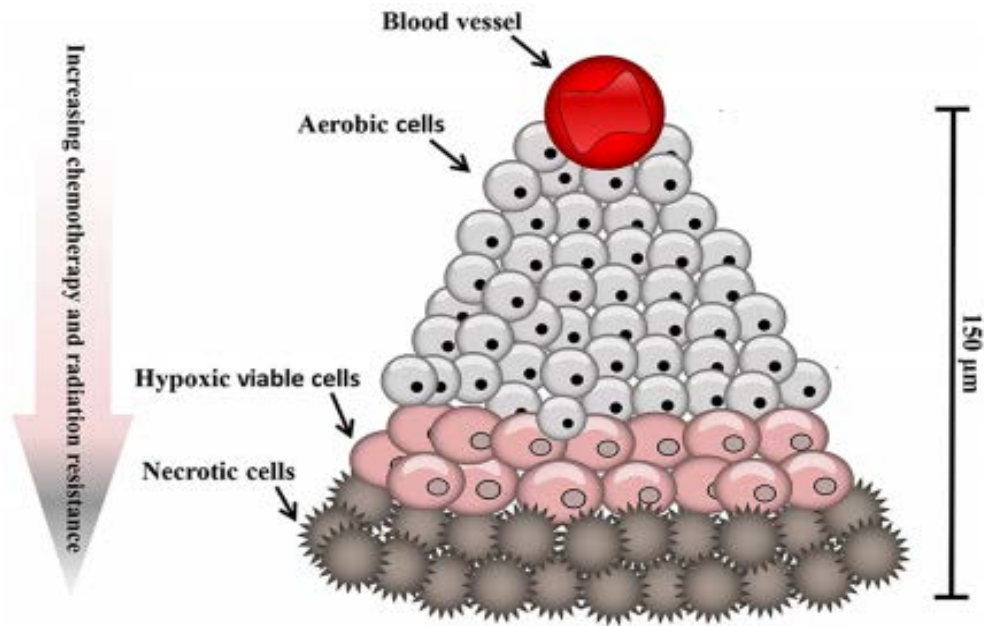
Redistribution/Reassortment

- Tumor cells become more radiation sensitive by cell cycle progression into radiation sensitive phases



Reoxygenation

- Hypoxic tumor cells are less sensitive.



Types of Organs in relation to Radiation Effects

- Parallel
- Serial
- Parallel: A small volume can be treated to high dose, even ablative like Lung, Liver, etc.
- Serial: Damage to small volume can be catastrophic like Spinal Cord, Esophagus, etc.

Types of radiation effects

- Stochastic
- Non-Stochastic

Stochastic: The probability increases with dose but without a change in severity like Radiation Induced Cancer, Hereditary effects, etc.

Non-Stochastic: Incidence and severity depend on dose like Radiation Proctitis, Dermatitis, Pneumonitis, etc.

Acute/Early Side Effects

- Start immediately after Radiation start and can last up to 3 months, e.g. nausea, vomiting, diarrhea, radiation dermatitis, mucositis, bone marrow suppression, etc.
- Mainly due to the effect on parenchymal cells

Late/Chronic Side Effects

- Start months to years later
- Mainly due to damage to blood vessels and connective tissues

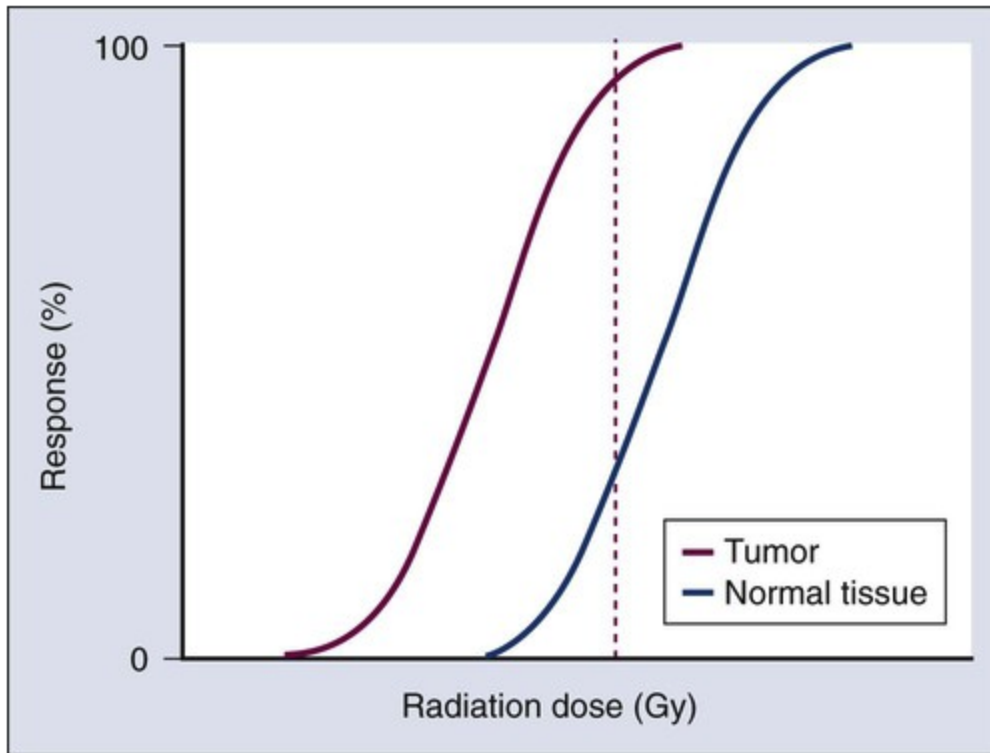
Treatment Intent

- Curative
- Palliative

Treatment Intent: Radical Versus Palliative

- Radical Radiation: Higher total dose and a longer duration of treatment > more side effects
- Palliative Radiation: Lower total dose and a shorter treatment time > fewer side effects

Therapeutic Ratio



General side effects

- Fatigue/Tiredness

- starts a few days to weeks after treatment start and can last for weeks to a few months after treatment completion

- More severe and lasts longer when combined with chemotherapy

- Other comorbidities (like diabetes), emotional stress and life style changes can also contribute

- Continuation of normal life style that's tolerable and light exercise are suggested but keeping a close attention to the energy level

- Rest as often as needed

Skin side effects

- Early
 1. Redness/hyperemia
 2. Dry desquamation
 3. Moist desquamation
 4. Alopecia
- Late
 1. Hyperpigmentation
 2. Depigmentation
 3. Fibrosis
 4. Telangiectasia
 5. Ulcers/Necrosis

Skin care

- Be gentle with skin
- Use mild unscented soap
- Apply unscented, water based cream (\geq twice daily)
- Don't use oil based products
- Avoid products with Parfum, Lanolin, PEG, Parabens, Petroleum and Astringents
- Deodorants and Antiperspirants can be used
- Use only Electric Razor to shave
- Don't use Perfume, Alcohol, and Adhesives
- Protect skin from direct sunlight and extremes of temperature (heating pad, ice packs, saunas, hot tubs, Jacuzzis, etc).
- OK to swim (unless radiation-related ulcers or blisters) but gently dry the skin and use water-based lotion

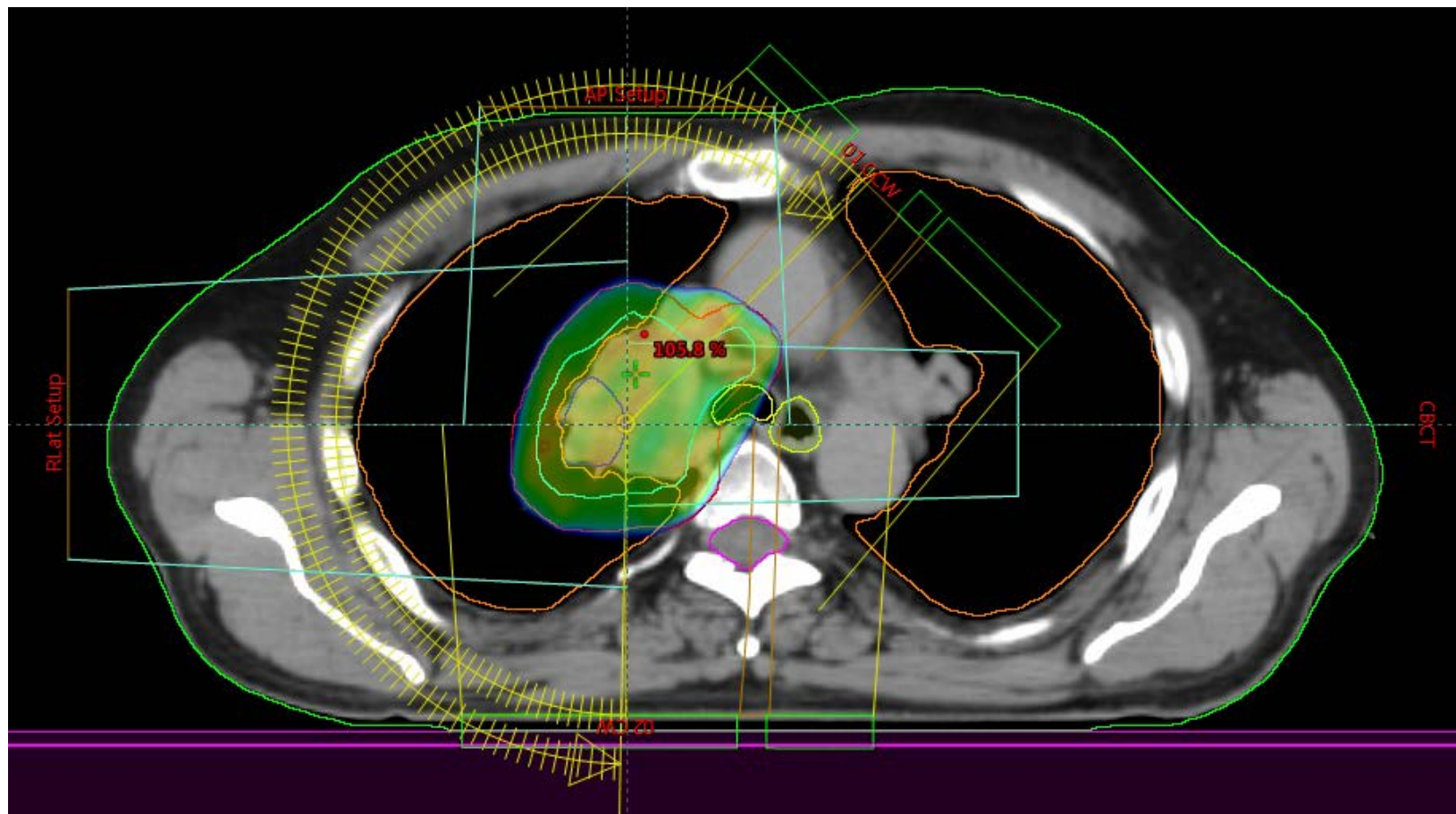
Treatment

- Hydrocortisone cream
- Flamazine (Silver Sulfadiazine) cream
- Fucidin cream (if allergy to Sulfa/Flamazine)
- Hydrogels
- Hydrocolloid dressings

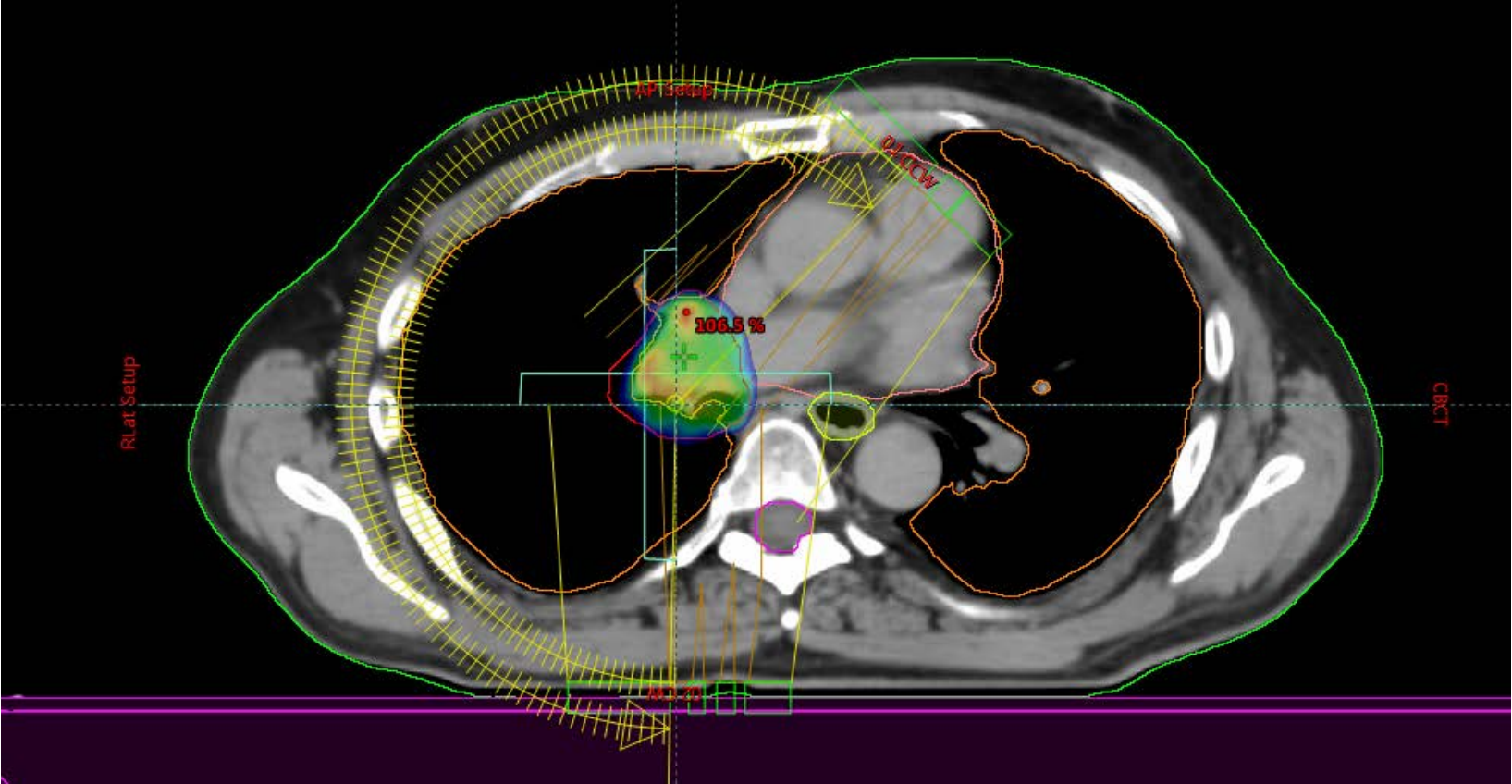
Lung

- Lungs are amongst most radiation sensitive structures
- Risk of radiation pneumonitis depends upon the radiation dose and volume of lungs in treatment fields
- Radiation pneumonitis can start within a few weeks to months after radiation
- Patients may present with dry cough, shortness of breath or fever
- Radiographically pulmonary infiltrate in the irradiated volume

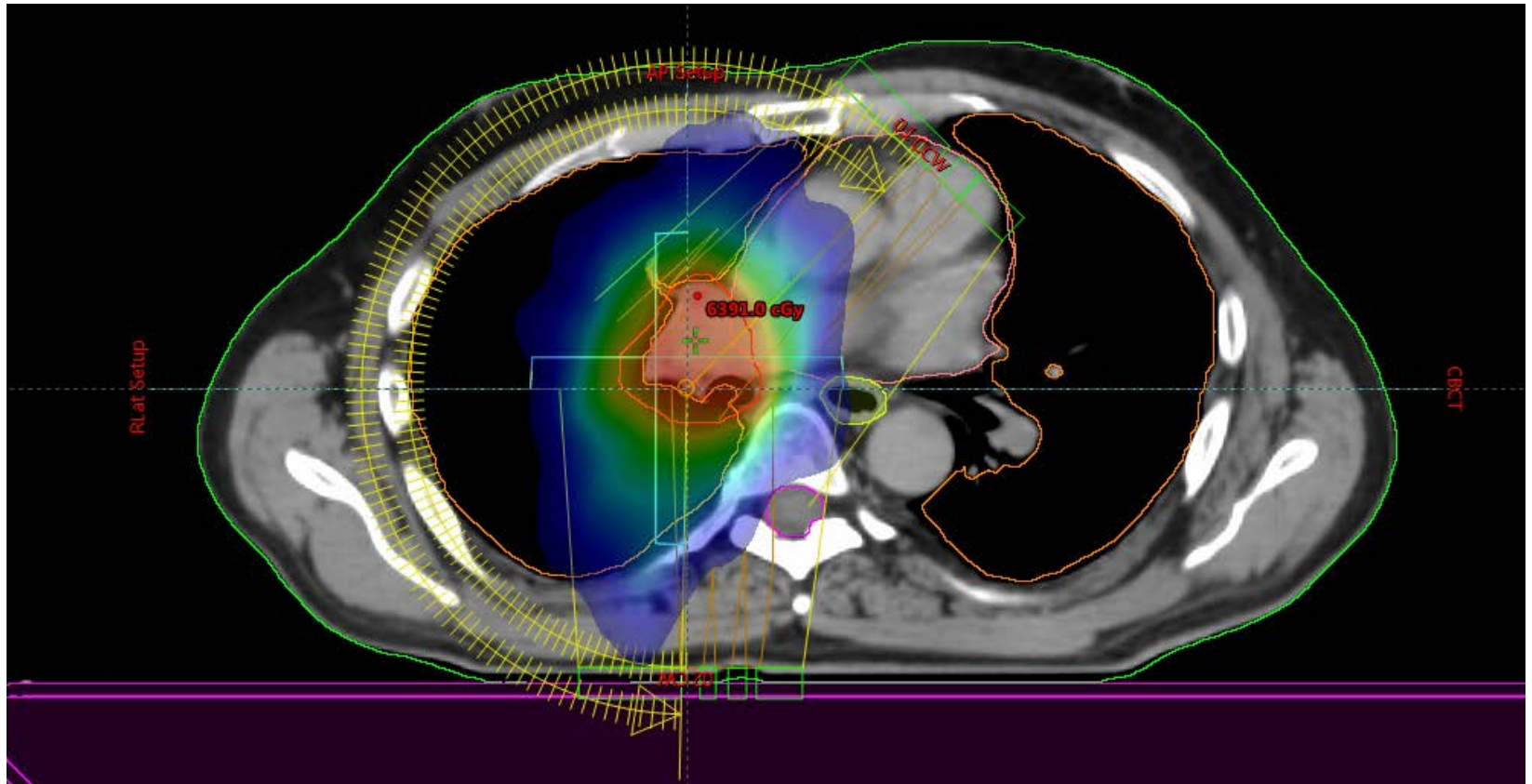
Radiation Portals



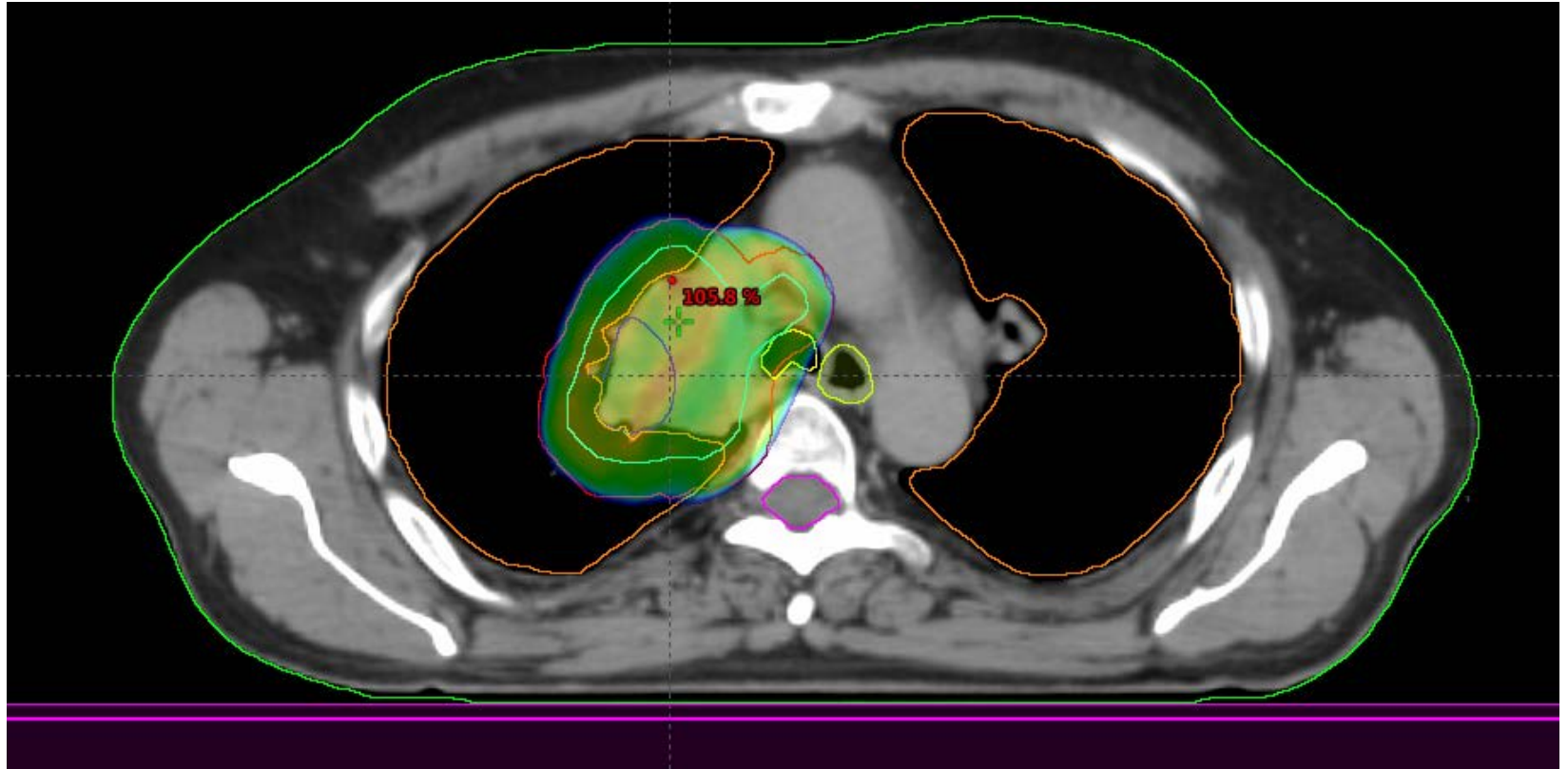
95% dose



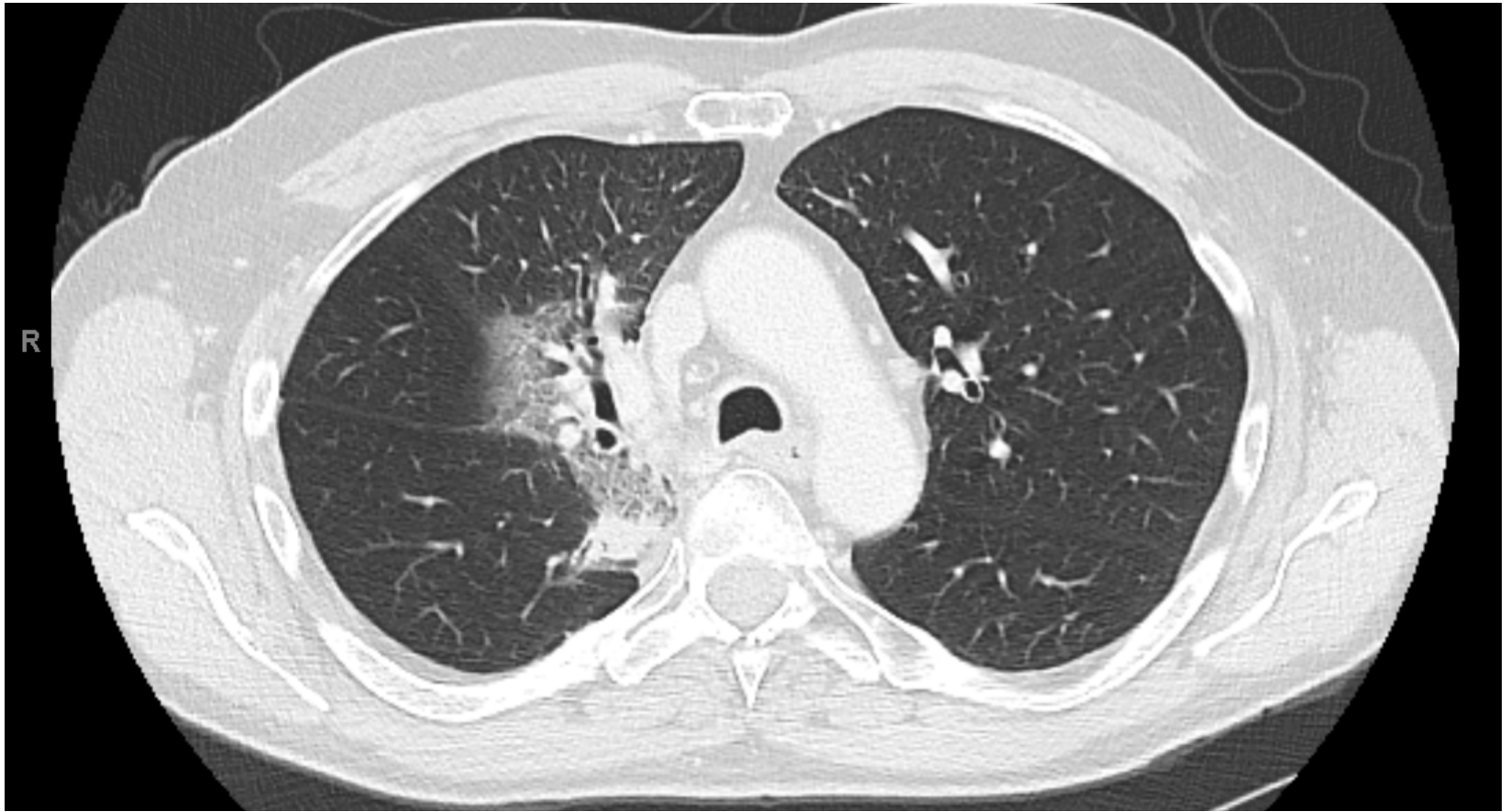
20 Gy (30% of the prescribed dose)



Dose painting with VMAT



Post-Radiation Pulmonary Fibrosis at about 5 months



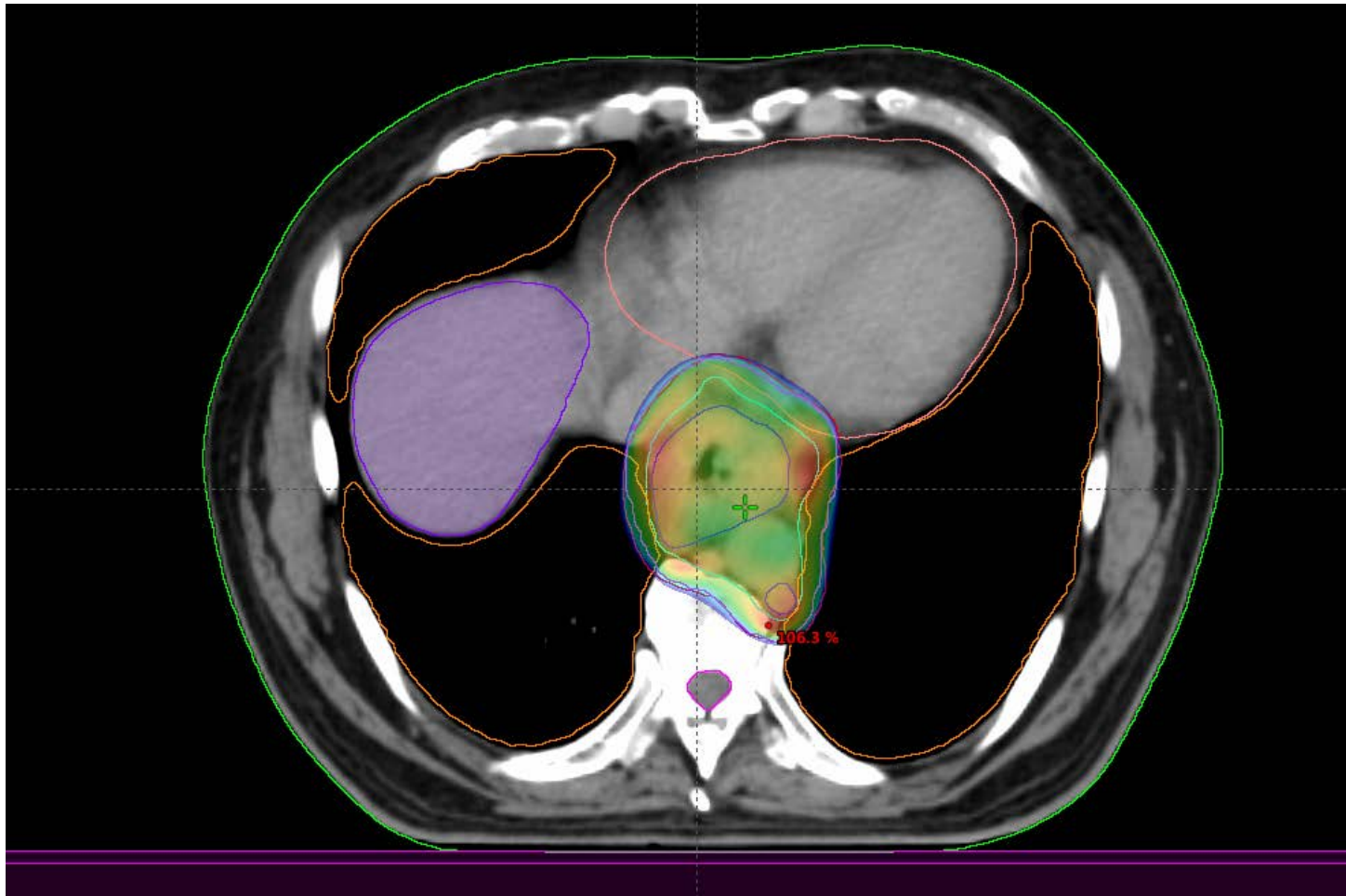
Treatment of Radiation Pneumonitis

- Exclude Infections
- Supportive Care like antitussives (like Tussionex), Oxygen
- Treatment of comorbidities like COPD or cardiac failure
- Mild symptoms can be managed with steroid inhalers
- Moderate to severe symptoms and/or impaired PFTs require oral glucocorticoids (Prednisone 40-60 mg/day for 2 to 4 weeks with tapering over 3 to 12 weeks)
- Prophylaxis for Pneumocystis Pneumonia suggested if Prednisone dose exceeds 20 mg/day for more than a month
- Supplemental Oxygen for patients with lung fibrosis

Cardiac side effects

- Pericarditis
- Ischemic heart disease
- Cardiomyopathy

Adenocarcinoma of the Esophagus with regional lymphadenopathy



Esophagus

- Early

1. Odynophagia
2. Dysphagia
3. Dehydration
4. Electrolyte Imbalance
5. Weight loss due to poor nutritional intake

- Late

1. Esophageal strictures
2. Tracheo-esophageal fistula

Management

1- Odynophagia is treated with

- Soft or liquid diet (avoiding extremes of temperature)

- Analgesics like Tylenol, Tylenol No. 3, Morphine, Hydromorphone, etc.

- Local Anesthetics like Xylocaine viscous

- Sucralfate

- Proton Pump Blockers

2- IV fluids

3- Dietitian assessment

4- NG tube may be considered in some patients

Bowel and Gastric

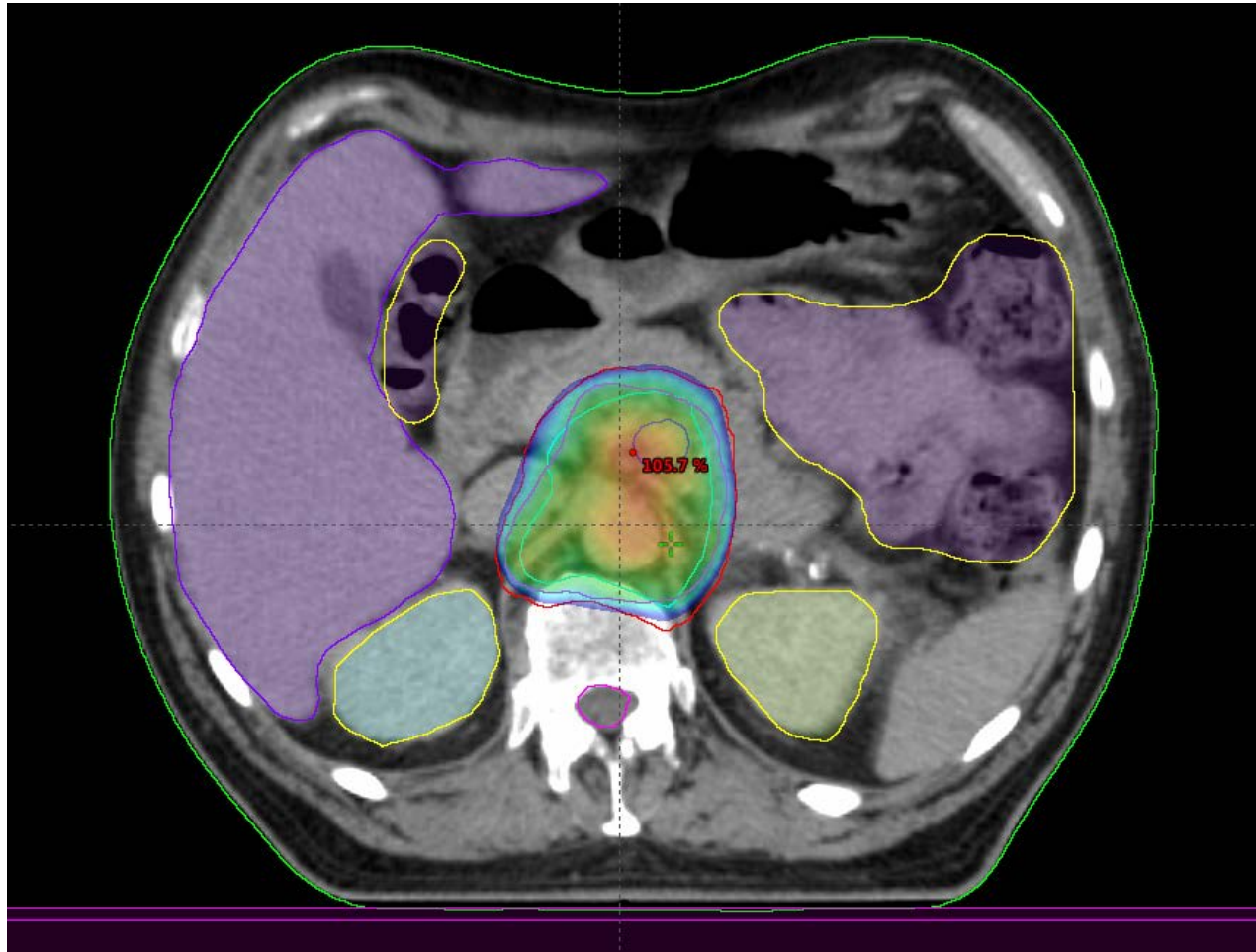
- Acute

1. Nausea
2. Vomiting
3. Diarrhea
4. Dyspepsia
5. Abdominal cramps
6. Dehydration and Electrolyte Imbalance
7. Reduced appetite and weight loss

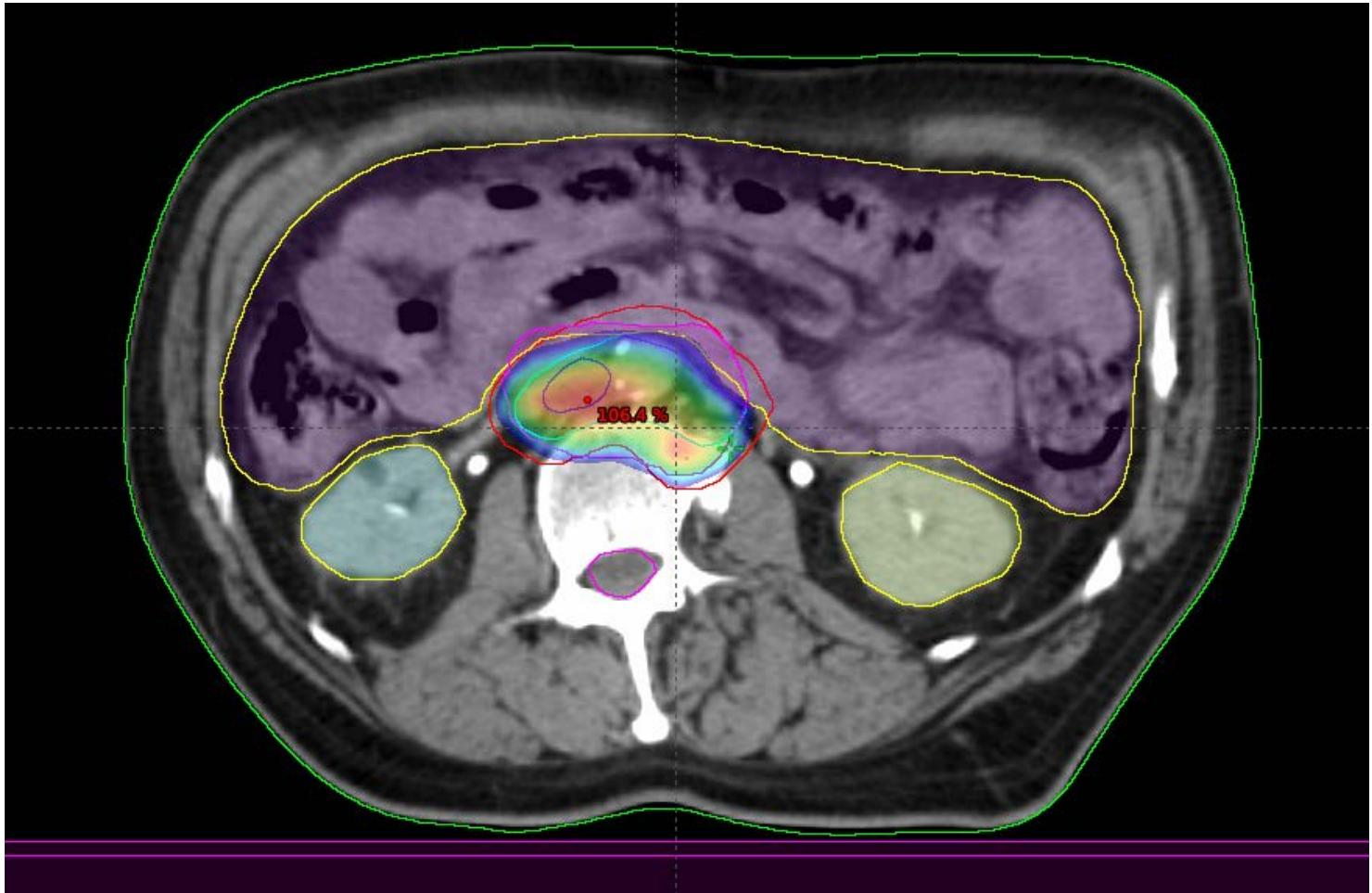
- Late

1. Gastric/duodenal ulcers
2. Bowel obstruction
3. Bowel fistulas

Adenocarcinoma of the Esophagus with regional lymphadenopathy



Adenocarcinoma of the Esophagus with regional lymphadenopathy



Spinal Cord

- Lhermitte's syndrome

- Due to temporary demyelination

- A painless electric shock-like sensation shooting down the spine on neck flexion

- Incidence is 4 to 10% at about 3 months post-radiotherapy

- Radiation Myelopathy

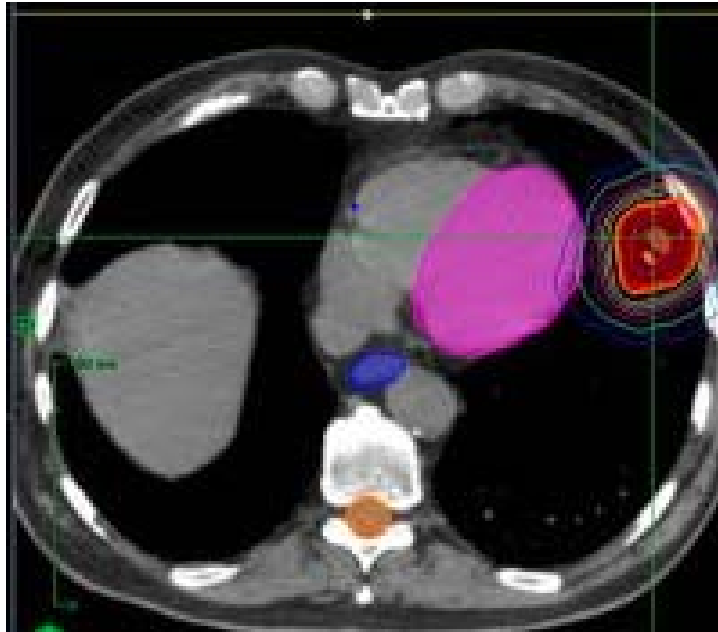
- Either due to permanent demyelination or vascular damage

- Risk with conventional fractionation is 0.2, 6 and 50% with total doses of 50 Gy, 60 Gy and 69 Gy respectively.

- Higher risk with hypofractionated radiotherapy (≥ 4 Gy/fraction) and reirradiation

Ribs and Vertebrae

- Pain
- Osteoradionecrosis



Nerve

- Plexopathy depending upon the dose, fractionation and technique

Bone Marrow

- Depends upon the volume of bone marrow exposed to radiation and concurrent chemotherapy
- Neutropenia and Thrombocytopenia
- Anemia after treatment of multiple sites

Radiation Induced Cancers

- The Cahan's Criteria
 1. A radiation-induced malignancy must have arisen in an irradiated field
 2. A sufficient latent period, preferably longer than 4 years must have elapsed between the initial radiation and the alleged induced malignancy
 3. The treated tumor must have been biopsied. The alleged induced tumor must have been biopsied. The two tumors must of different histologies
 4. The tissues in which the alleged tumor arose must have been normal (i.e. metabolically and genetically) prior to the radiation

Radiation Induced Cancers



Contact Information

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