

Radiation Therapy for Hodgkin's Disease and Other Lymphomas

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Radiation Therapy (RT): Who Is it For?

- Has played a role in different settings:
 - Curative:
 - Radiation alone
 - Historically for all types of Hodgkin's disease
 - “Non-classic” HD: Nodular Lymphocyte Predominant
 - After chemotherapy
 - Palliation:
 - To any part of the body to relieve symptoms
 - Pain, swelling, decreased function

Radiation Therapy: How Does It Work?

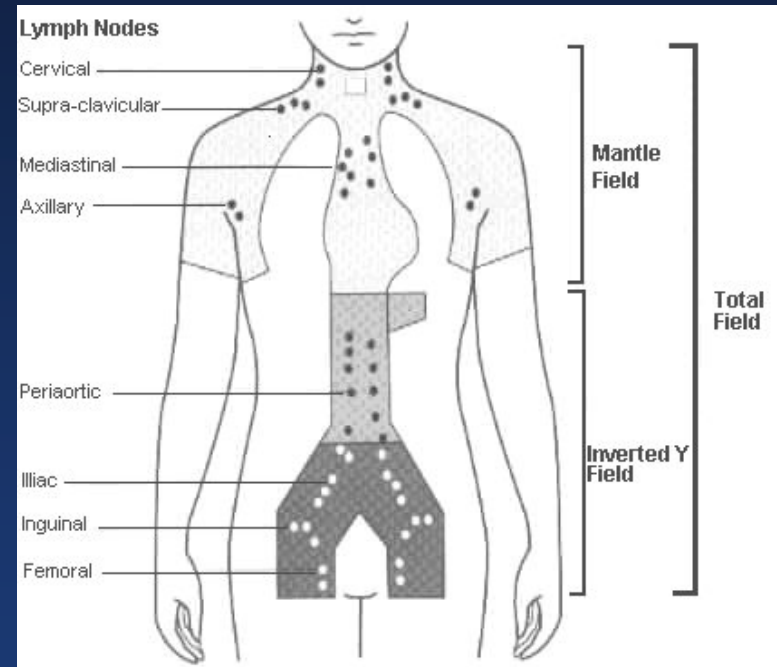
- High energy radiation - 1,000 times more energy than x-rays used in Radiology for chest x-rays, CAT scans, etc.
- Radiation damages DNA (genetic code) of cancer cells
- This DNA damage will cause cells to die:
 - When they try to divide before properly repairing the damage
 - Programmed Cell Death: Unique to hematologic malignancies
- Lymphoma cells are directly targeted while the normal organs are spared as much as possible
- Lymphoma cells divide more often than healthy normal cells → that's what makes cancer bad
- Lymphoma cells not as good at repairing DNA as normal cells
- Lymphoma cells are more vulnerable to RT than normal cells

Radiation Therapy: What are the Types?

- External Beam Radiation with **Photons** (X-rays)
 - **3-D Conformal RT**
 - IMRT (Intensity **M**odulated **R**adiation **T**herapy)
 - Stereotactic Radiosurgery
- External Beam Radiation with **Protons**
- Brachytherapy (i.e. “internal radiation”, using naturally occurring radioactive substances)
 - High-dose rate, temporary catheters

Why use chemotherapy and radiation both in patients with lymphoma?

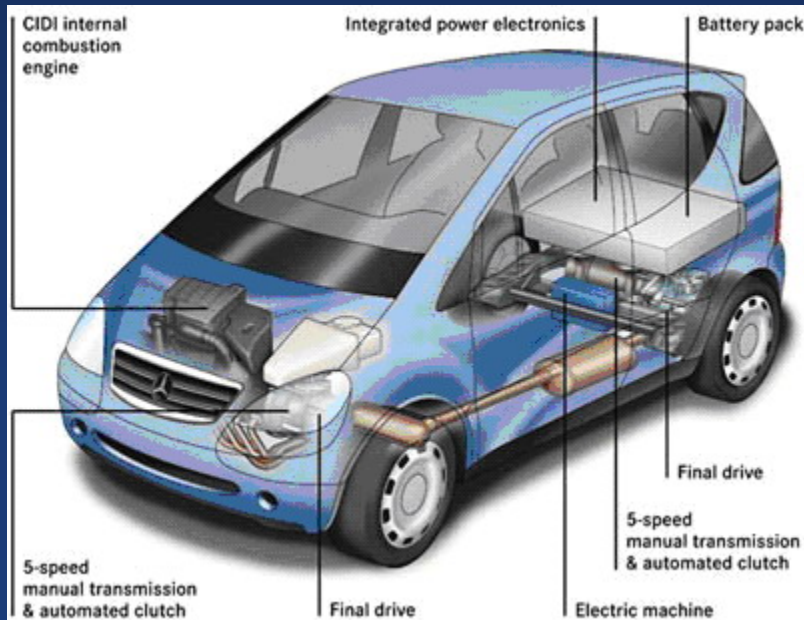
- If chemotherapy alone is used, if it recurs it tends to come back where it started
- If radiation alone is used, if it recurs, it tends to come back in unirradiated areas



Radiation to all lymph node regions can be toxic

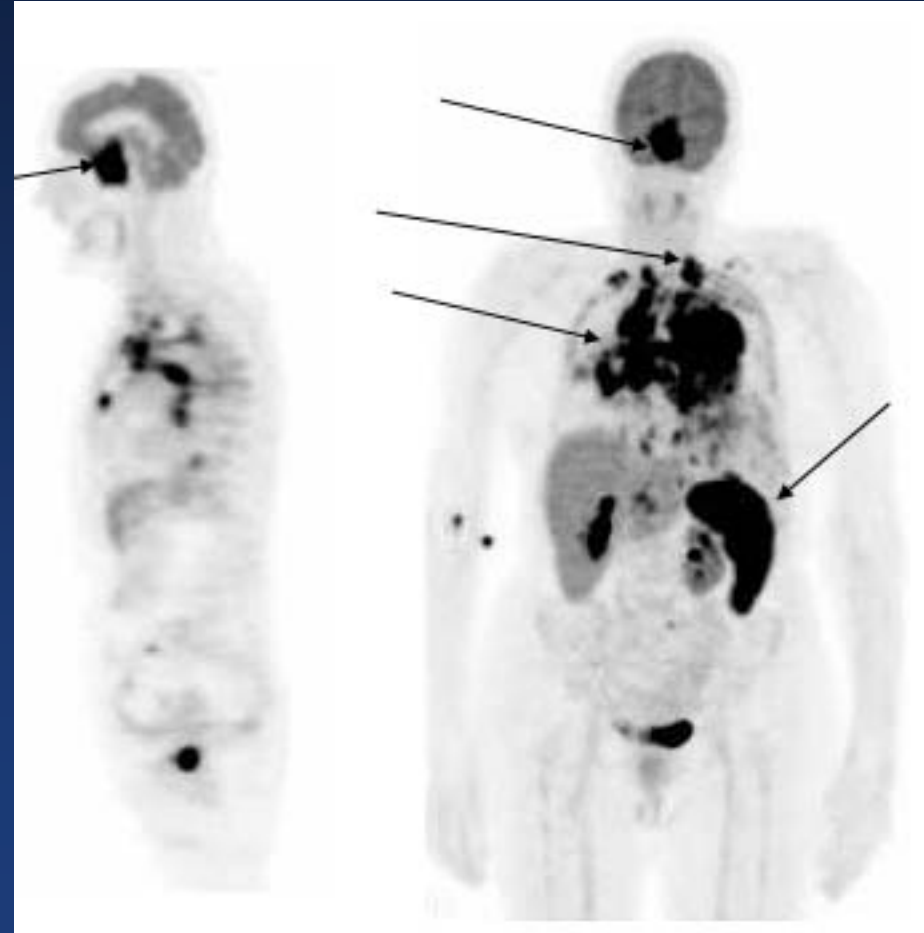
Why use chemotherapy and radiation both in patients with lymphoma?

- Combination allows less chemotherapy and less radiation (smaller volume treated and lower doses)



How is Radiation Given?

- First, need decide where to aim
- Historically, used to do surgery with spleen removal to see how extensive the stage was
- NOW: PET and CT imaging shows which lymph nodes are involved



5 REAL-TIME BEAM CONTROL STEERING SYSTEM

4 ACHROMATIC 3-FIELD BENDING MAGNET

6 FOCAL SPOT SIZE

2 ION CHAMBER

1 ASYMMETRIC JAWS

7 ENERGY SWITCH

3 MAP PROCESSOR

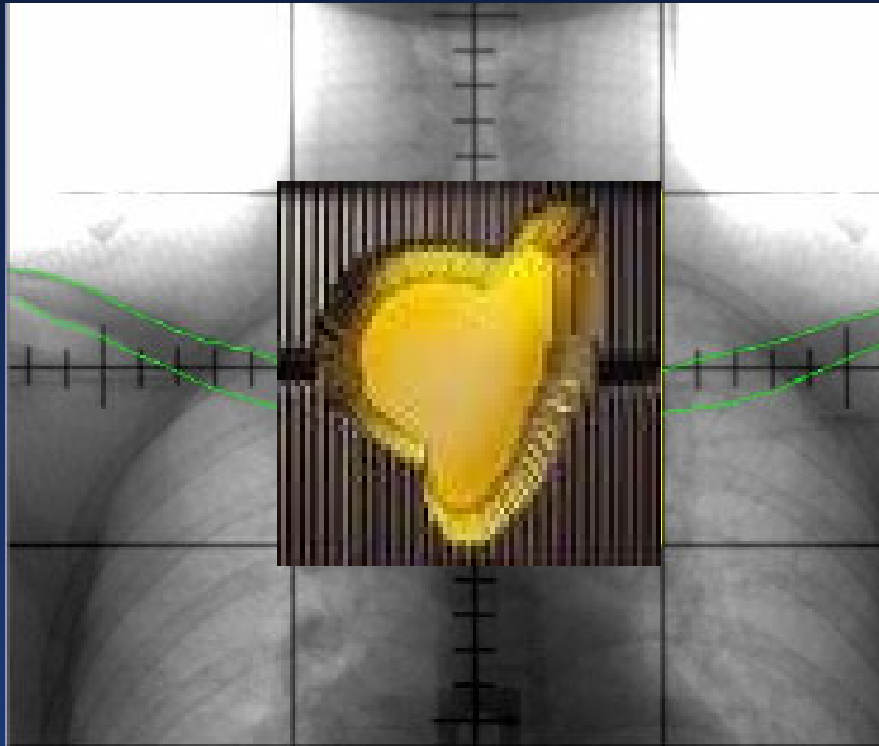
8 GRIDDED ELECTRON GUN

9 COMPUTERIZED MLC



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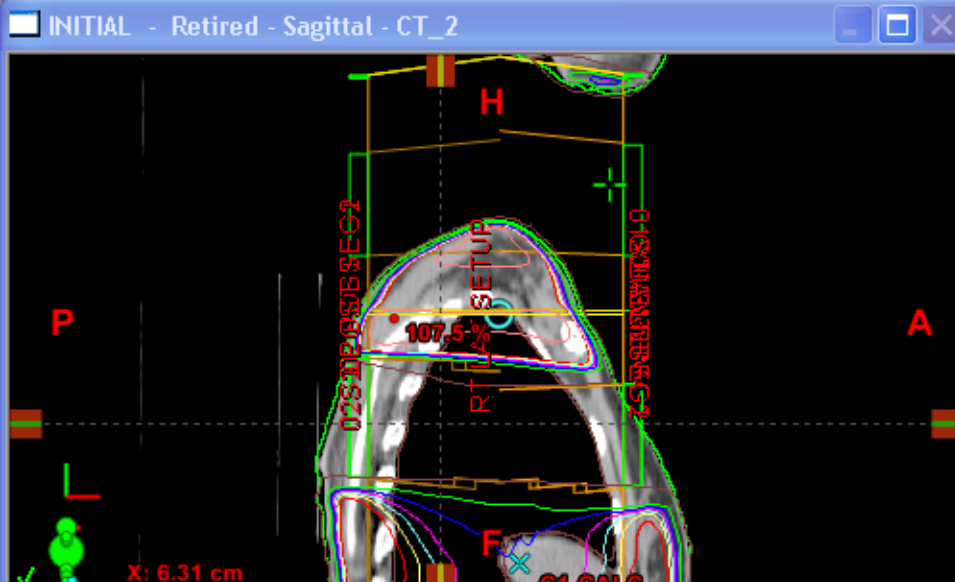
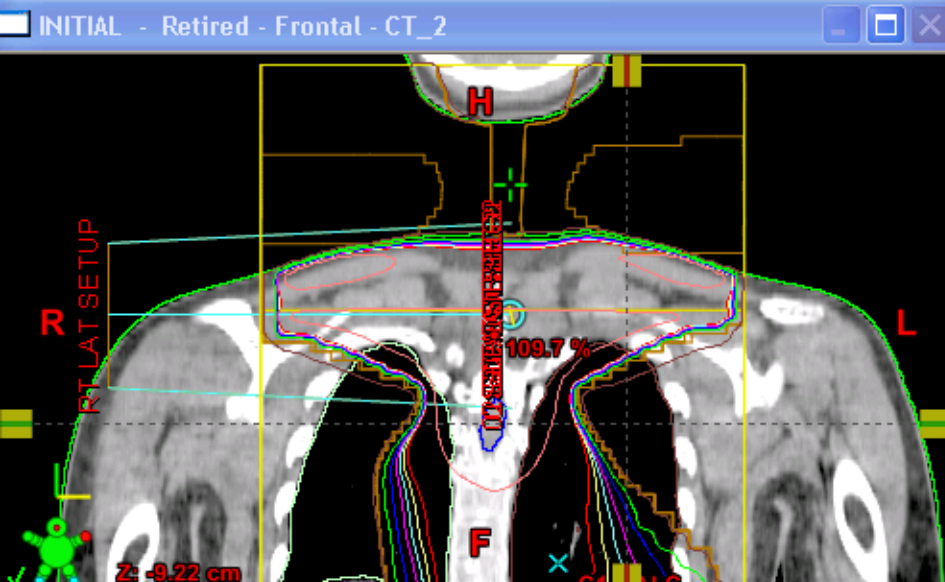
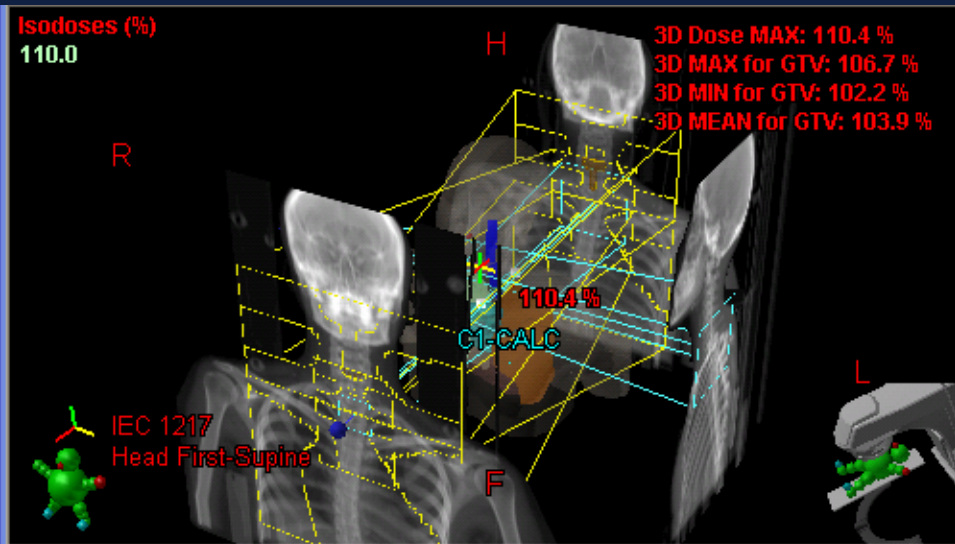
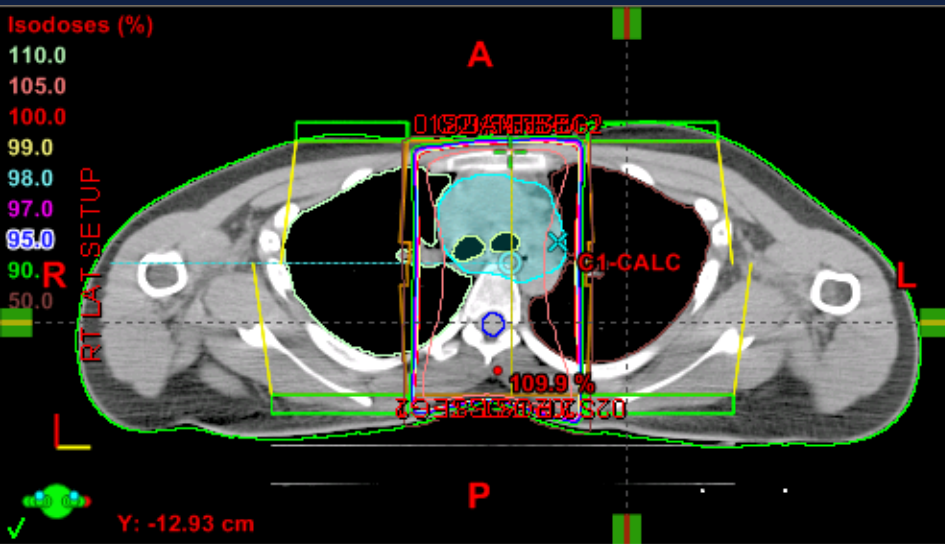
Conformal Radiation Therapy



- Square or rectangular beams sculpted with computer controlled blocks
- “Multileaf Collimator”



Customized Radiation Plan





Radiation and Normal Tissues

- Cross section of the esophagus.
 - The innermost layer replenishes itself, similar to skin





Radiation and Normal Tissues

- Radiation stops the replenishing cells from dividing



Side Effects: Short Term

- Side effects depend WHERE you radiate
- During Treatment and Months
 - Fatigue
 - Painful swallowing
 - Nausea/Vomiting/Heartburn/Diarrhea/Bloating
 - Radiation Pneumonitis: cough/shortness of breath
 - Skin redness/Hair loss in treatment field
 - Lowered blood counts
 - Lhermitte's syndrome: electric shock-like sensation

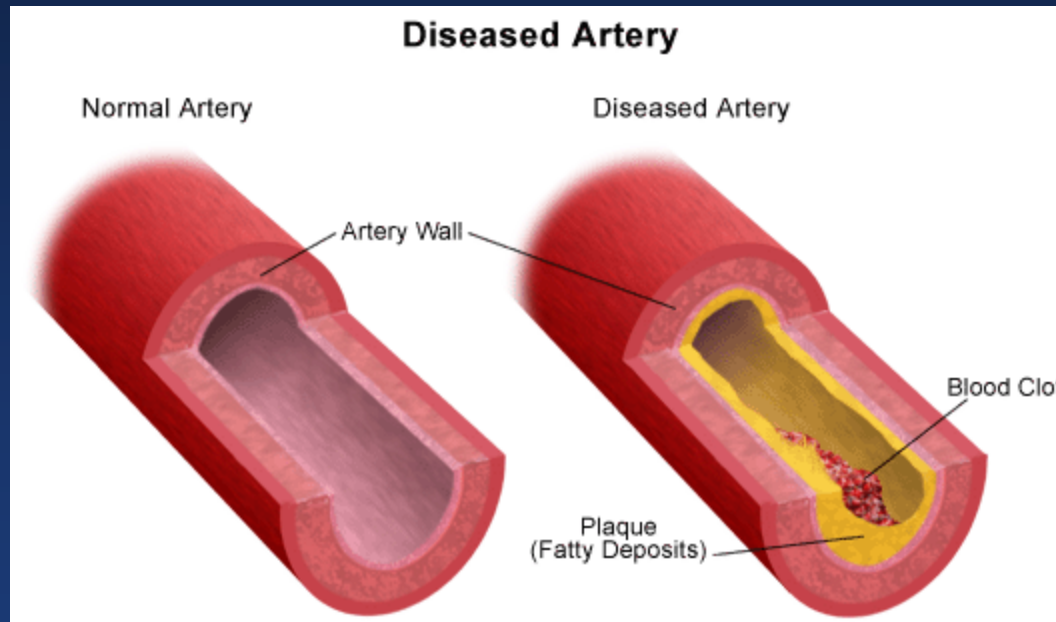
Side Effects: Long Term

- Months to Years:
 - Swelling, changes in skin texture
 - Dry mouth
 - GI: ulcers, bowel obstruction
 - Thyroid gland dysfunction
 - Damage to lung
 - **Cardiovascular risks**
 - **Second cancers**



Long Term Risks: Heart

- Radiation to heart vessels may speed atherosclerosis



- Doxorubicin and radiation both can affect ability of heart muscle to squeeze



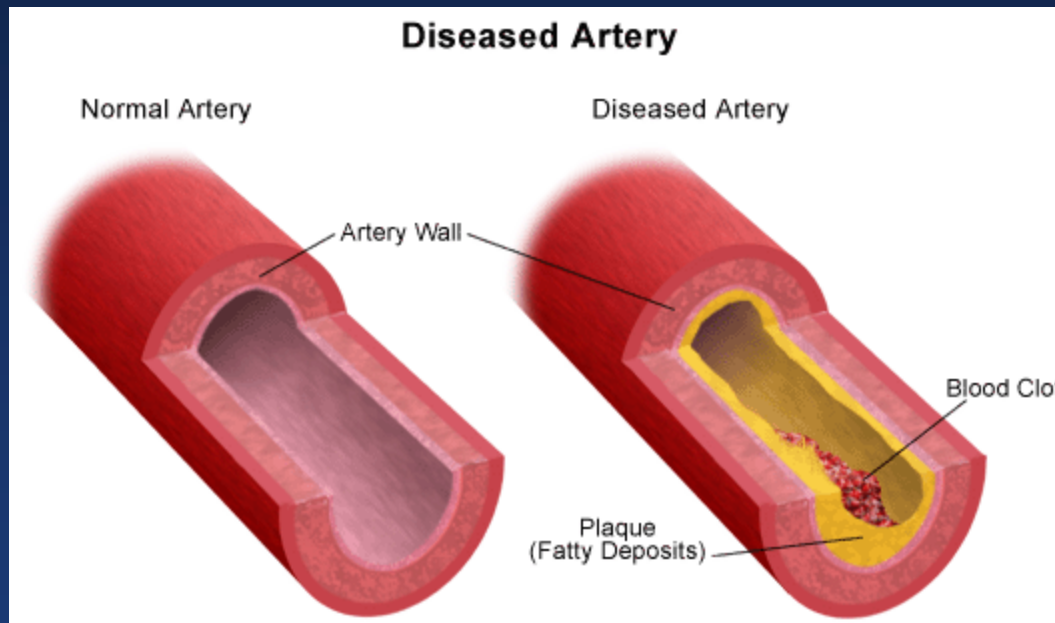
Long Term Risks: Heart

- How much does it actually affect long term survivors?
- Canadian study of 1,023 adult patients with Hodgkin's Disease treated from 1988-2003. Compared to random sample of 6,136 Ontario citizens matched on age and sex:
 - Studied hospitalizations for cardiovascular causes
 - Found that combination of doxorubicin and chest radiation increased rate of cardiovascular hospitalization by about 3-fold, which continued over decades
 - Effect was even more profound in patients with other heart risk factors (diabetes, high blood pressure, smoking, etc.)



Long Term Risks: Carotid Arteries

- Radiation to heart vessels may speed atherosclerosis



- Does radiation of the neck affect chances of stroke?



Long Term Risks: Carotid Arteries

- 2,201 5-year survivors of Hodgkin's disease treated Dutch hospitals from 1966-1995
- Risks of stroke and TIA (transient ischemic attacks):
 - 2- to 4-fold ↑ risks in 5-year survivors of HL treated < age 51, higher risk when treated at young ages (<21 years)
 - 9-10 excess cases per 10,000 patients/year
 - Risks remained ↑ after prolonged follow-up
 - Mainly related to neck RT

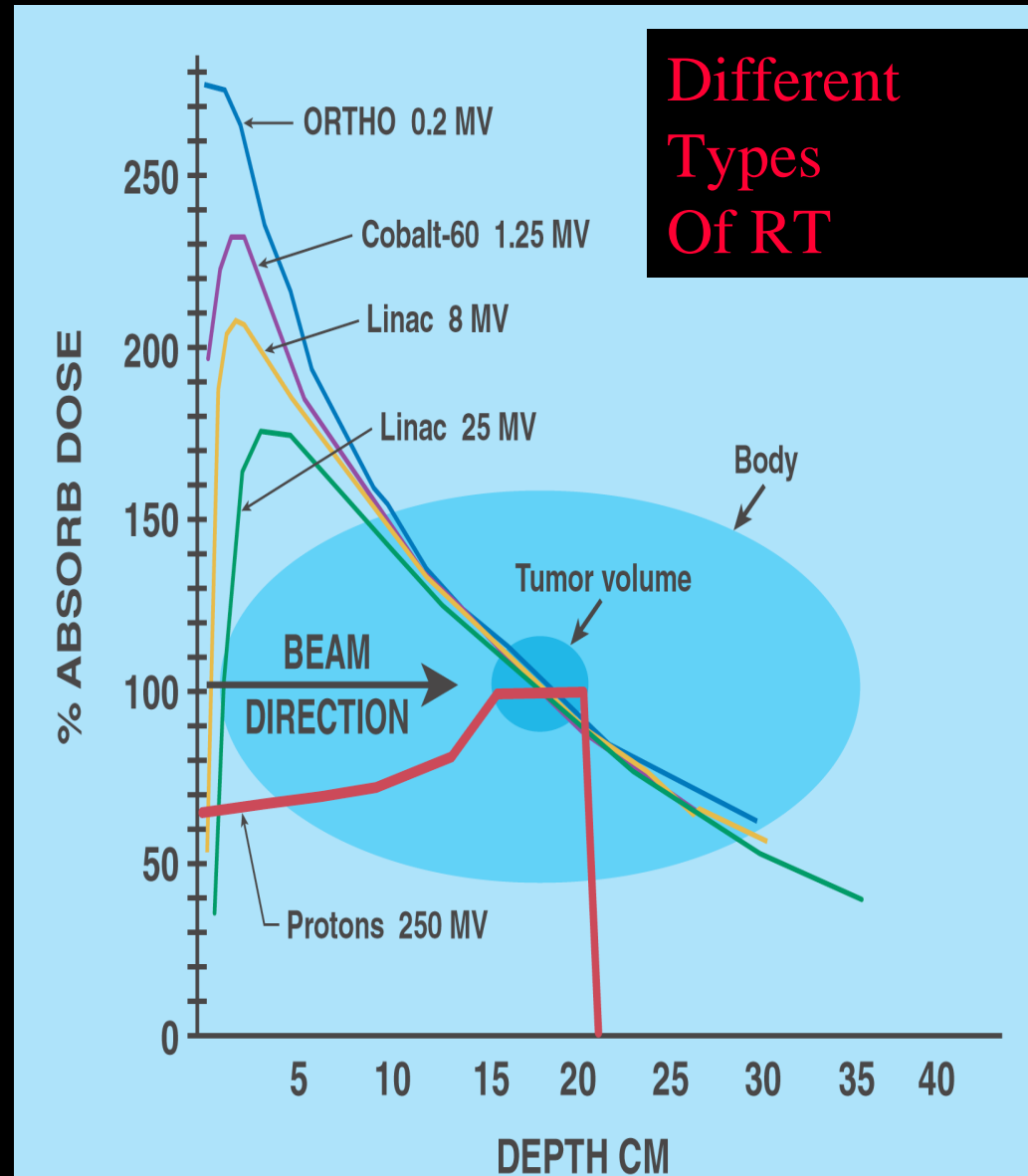
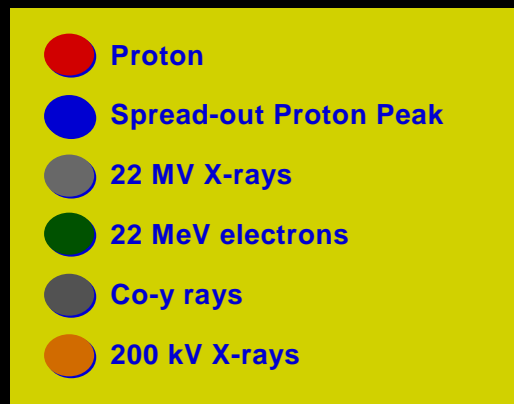


Late Effect Screening: NCCN

- Cardiovascular
 - Annual BP, lipids, reduce CV risk factors
 - Baseline stress test or echocardiogram at 10 yr
- Vaccinations: Flu, etc.
- Thyroid function testing
- Second Cancer Screening
 - CXR/CT chest
 - Breast cancer screening 8 yr after treatment or age 40
 - ACS: Add breast MRI to mammogram if radiation given between 10-30 yr of age
 - Routine colonoscopy, PSA testing

What are Protons, Anyway?

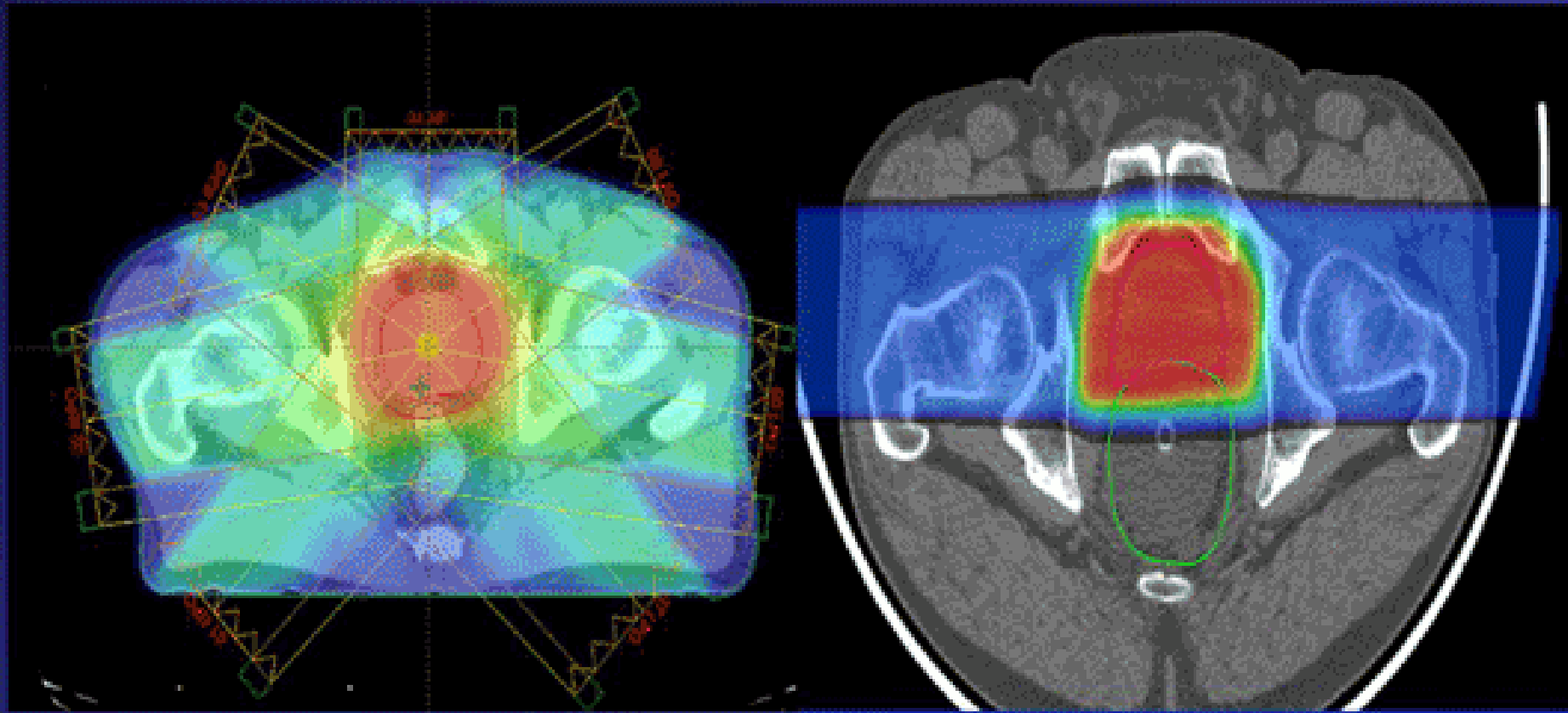
- Protons are radiation, too, but they are heavy charged particles
- Unlike x-rays (photons), which are waves
- OK, but so what?
- Bragg Peak Effect



What Advantages May Protons Have for Cancer Treatment ?

- Protons have the same tumor killing biologic properties that photons have, *but with*
 - Less dose to normal tissues (by 50-70%!)
 - Therefore potentially fewer side-effects
 - And the ability to increase radiation dose without increasing side effects
 - So possibly better long-term outcomes with the same or fewer side effects, but not studied in lymphoma... yet

Prostate Cancer-80 Gy



IMRT

PROTONS

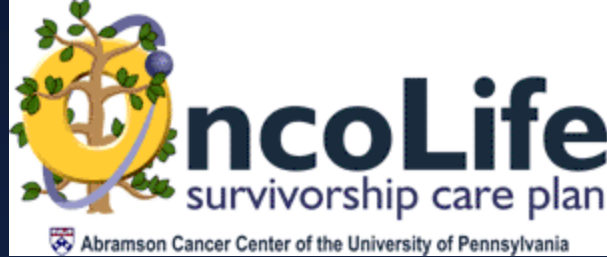
Red = High dose Green = Medium dose Blue = Low dose





Late Effect Prevention

- Modifiable risk factors:
 - Smoking
 - Blood pressure/Diabetes control
 - Exercise
- Survivorship Plans:
 - “Oncolife” at www.oncolink.com



- Estimated 10 million cancer survivors living in the US today
- Institute of Medicine (IOM) research found that very little guidance was available for survivors and healthcare providers to address the medical and psychosocial problems that may arise post treatment
- IOM thus proposed idea of a follow up "care plan"
- Care plan should summarize potential late effects; recommendations for cancer screening (recurrence or new); psychosocial effects (including relationships, sexuality/fertility); financial issues (work, insurance and employment); healthy lifestyle tips; genetic counseling (if appropriate); referrals for follow-up care, and more
- OncoLink has a brief online questionnaire to help survivors initiate the process of developing individualized "survivorship care plans"
- University of Pennsylvania Cancer Center Received a Two-Year \$500,000 Grant From Lance Armstrong Foundation to Establish Cancer Survivorship Program

Perelman Center for Advanced Medicine



Penn's NCI-designated Abramson Cancer Center and the Roberts Proton Therapy Center: 360,000+ sq ft facility

General Comments

- Get all the information you can from trusted and reliable sources
- Once you (& your loved ones) feel well- informed and make a decision, there is no wrong answer, just what is right for you
- High-volume, academic, NCI-designated cancer centers like Penn have the clinical experience, technological resources, and cutting edge advances that may make a difference for optimal cancer management

The Future of Penn Radiation Oncology

Thank you for your attention!

