RADIATION THERAPY IN 2018 AND BEYOND

Rex Hoffman, MD
Providence Saint Josephs Medical Center
Disney Family Cancer Center
Burbank, CA
RADIATION THERAPY IN 2018 AND BEYOND

- **Introduction**
  - **Focal Therapy**
    - Teletherapy: comes in from outside at a distance.
    - Brachytherapy: inside cavity (intra-cavitary) or into tissue (interstitial).
  - **Radio-embolization**
    - Theraspheres/SirSpheres: blood vessels feeding liver.
  - **Liquid Radiation**
    - Zevallin: Lymphoma.
    - Xofigo: Prostate Cancer.
RADIATION THERAPY IN 2018 AND BEYOND

- **History**
  - 1895: Roentgen discovered X-ray.
  - 1890s: Tuberculosis, Lupus (picture) and Cancer. Curies.
  - Early 1900s: Flouroscopy and Death of Mihran Kassabian, MD
  - Stanley Kaplan at Stanford.
  - Gilbert Fletcher at MD Anderson.
1890S:
X-RAY & RADIATION THERAPY

- German Physicist: William Roentgen.
- Film of Bertha Roentgen’s hand.
- Birth of “X-ray”

1896: JAMA: “There will doubtless be an extensive advertisement of cathode ray baths, X-ray treatments, etc., but it is to be hoped that any active exploitations of these will, until the matter is more elucidated by accurate scientific researches, be confined to the irregulars who have no standing in the regular medical profession.”
1950s: COBALT AT MD ANDERSON

Cobalt Units
Very superficial
Woman with abdominal tumor
MD Anderson
12 Pages on the Newest Methods to Save You From Malignancies

“Already saving one victim in three, science forges stupendous arsenal of new weapons.”

“To multiply cancer cures, gigantic radiation machines like that pictured here are just getting into general use.”

“The U.S. has thrown $25 million into a scientific dragnet to test out 40,000 chemicals, gambling heavily that among them they will be able to discover some new drug cures.”

Conclusion: “Cancer on the Brink”!
1950S AND 1960S

- **VARIAN**
- First Model of Linear Accelerator
- Opening 1 shape.
- Could not change shape
- Could rotate around patient
1960S AND 1970S

- Varian
- Manipulate beam of beam of radiation from different directions.
- High energy
- Multi-leaf collimator
- Teletherapy
LINEAR ACCELERATOR TODAY
LINEAR ACCELERATOR BASED SRS
GAMMA KNIFE

- Stereotactic radiosurgery
- 201 cobalt beams converge
- Brain tumors
- Arteriovenous malformation
BRACHYTHERAPY

Place sources of radiation directly in or immediately adjacent to tumors.

1890s and early 1900s.

Gynecologic tumors

Prostate cancer

Breast cancer

Sarcomas
RADIATION THERAPY IN 2018

- **Goal**: Treat tumor and spare normal tissues.

- **Teletherapy**:
  - Stereotactic Radiosurgery (SRS) – 1 fraction.
  - Stereotactic Body Radiation Therapy (SBRT) – 2-5 fractions
  - Intensity modulated radiation therapy (IMRT).
  - Image Guided radiation therapy (IGRT).
    - Lung
    - Prostate
  - Volumetric modulated radiation therapy (VMAT)
IMAGE GUIDED RADIATION THERAPY
RADIATION THERAPY IN 2018

- **Brachytherapy**
  - Gynecologic – cervix, uterine and vaginal cancers.
  - Prostate
  - Breast – Mammosite. Place source in breast.
  - Head and Neck (ie. oral tongue.)
  - Sarcomas
OTHER FORMS OF RADIOTHERAPY

- **Radio-embolization (Theraspheres and Sir-Spheres)**
  - Uses tiny glass beads, called microspheres, to deliver radiation directly to cancerous tumors in the liver.
  - Catheter into hepatic artery, the liver's main blood vessel. Once in place, microspheres are inserted into the catheter and enter the smaller blood vessels supplying the tumor and block the flow of blood. Then, the microspheres emit radiation to **destroy cancer cells in the tumor, while sparing normal tissue.**
OTHER FORMS OF RADIOTHERAPY

- **Liquid Radiation**
  - **Zevalin and Bexxar**
    - Zevalin and Bexxar use an anti CD-20 monoclonal antibody to target and destroy the normal and cancerous lymphocytes. Then emit radiation to zap nearby cells and thereby increase the destruction of the lymphoma cells.
    - The beta emissions from the Yttrium-90 have a path length of about 5mm. This is longer than the 1mm path length of the Iodine-131 used with Bexxar.
  - **Luthathera**
    - On January 26, 2018, FDA approved lutetium Lu 177 dotatate (LUTATHERA,) radiolabeled somatostatin analog, for treatment of somatostatin receptor-positive gastroenteropancreatic neuroendocrine tumors (GEP-NETs), including foregut, midgut, and hindgut neuroendocrine tumors in adults.
  - **Xofigo**
    - Radioactive drug used to treat hormone-refractory prostate cancer that has spread (metastasized) to the bones. Attaches to bone and emits radiation.
RADIATION THERAPY IN 2018

- **Number of treatments:**
  - **Teletherapy**
    - Standard: 10-43 fractions for most cancers.
    - Stereotactic Radiosurgery: 1 fraction.
    - Stereotactic Body Radiation Therapy: 3-5 fractions.
    - Hypo-fractionated Radiation Therapy: 5-21 fractions.
    - Palliative for metastases: 5-10 fractions. Sometimes even 1 fraction.
    - Breast: Down from 33 fractions to 21 fractions. (from Canada).
  - **Brachytherapy**
    - Gynecologic – 3 – 5 fractions.
    - Prostate - interstitial seeds: 1 fraction. Interstitial implant: 3 -5 fractions.
    - Breast – 10 fractions over 5 days.
CURRENT INDICATIONS - 2018

- **Cancer**
  - Brain
  - Head and Neck - #4 tongue or pharyngeal
  - Thorax (lung, esophagus) - #5 lung
  - Breast - #1 breast
  - Abdomen (stomach, bowel, pancreas, kidney)
  - Pelvis (Male and Female) - #3 prostate
  - Extremity sarcomas
  - Skin - #2 skin
CURRENT INDICATIONS IN 2018

- **Benign**
  - Arteriovenous malformations
  - Pituitary Adenomas
  - Meningiomas
  - Acoustic Neuromas
  - Pterygium
RADIATION THERAPY IN 2018

- **Multidisciplinary Approach:**
  - Work closely with surgeons and medical oncologists.

- **Radiotherapy options:**
  - **Pre-operative** – ie. Sarcoma.
  - **Concurrent with systemic therapy** – ie. Head/Neck and Lung Cancer.
  - **Consolidative** – ie. Lymphoma.
  - **Prophylactic** – ie. Small Cell Lung Cancer to brain.

- **Discuss prospectively at tumor conferences:**
  - Brain, Head & Neck, Lung, Gastrointestinal, Gynecologic, Breast and General Tumor Board (Just in Time)
SIDE EFFECTS

ACUTE (Up to first 2 weeks after completion):

- Brain – headaches or seizures – Decadron and Keppra.
- Head and Neck – mucositis, dry mouth, loss of taste.
- Lung – cough, blood tinged sputum.
- Esophagus – odynophagia, dehydration, weight loss.
- Stomach – nausea.
- Colorectal – diarrhea and abdominal cramping.
- Prostate – increased hesitancy, burning with urination.
- Skin – redness and desquamation.
SIDE EFFECTS

Long Term (2+ weeks out and beyond):

- Brain – Radiation necrosis.
- Head and Neck – dry mouth and altered taste.
- Breast – hypopigmentation.
- Lung – radiation pneumonitis/pulmonary fibrosis.
- Esophagus – dysphagia.
- Bowel – chronic diarrhea.
- Skin – hypopigmentation.
RADIATION THERAPY BEYOND 2018
1899:

“Everything that can be invented has been invented.”

Charles H. Duell, U.S. Commissioner of Patents.
1981:

“640,000 bytes of memory ought to be enough for anybody.”

Bill Gates
RADIATION THERAPY BEYOND 2018

- **Protons** – Bragg peak. More indications: pediatrics and cordomas.

- **MRI Linear Accelerators**
  - MRI solves both of the primary issues with CBCT — poor soft tissue contrast and difficulty capturing moving organs — while delivering no extra radiation dose to the patient. Th
  - Cancers often difficult to capture due to continuous motion from breathing or swallowing. MRI counteracts this challenge through respiratory gating, continuously monitoring the breathing cycle and taking the image at the optimal point in the cycle.

- Continued push towards **Hypo-fractionation**.

- **Radio-immunotherapy** – Luther, Xofigo, etc.

- **Clinical Trials**.
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Thank you