Continuing Medical Education

Physicians: VCU Health Continuing Medical Education is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians. VCU Health Continuing Medical Education designates this live activity for a maximum of 1 **AMA PRA Category 1 Credits**™.

Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Continuing Nursing Education: 1.5 CE Contact Hours

VCUHealth is approved as a provider of continuing nursing education by the Virginia Nurses Association, an accredited approver by the American Nurses Credentialing Center’s Commission on Accreditation.
Disclosures

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The following Planning Committee and Presenting Faculty Members report relevant financial relationships to disclose:

The following Planning Committee and Presenting Faculty Members report having no relevant financial relationships:

Christopher McLaughlin, PGY-5
Danielle Noreika, MD

No commercial or in-kind support was provided for this activity
Helpful Reminders

Right click the Zoom screen to rename your login; include your name and organization.
Helpful Reminders

- Turn on your microphone and video
- Activate chat
- Chat box: type here

If joining audio by telephone, press *6 to mute and unmute
What to Expect

I. Didactic Presentation
   20 minutes + Q&A

II. Case Discussions
   • Case Presentation
     5 min.
   • Clarifying questions from spokes, then hub
     2 min. each
   • Recommendations from spokes, then hub
     2 min. each
   • Summary (hub)
     5 min.

III. Closing and Questions

• Bi-weekly tele-ECHO sessions (1.5 hours)
• Didactic presentations developed by interprofessional experts in palliative care
• Website: www.vcuhealth.org/pcecho
• Email: pcecho@vcuhealth.org

Let’s get started!
# Hub Introductions

## VCU Team

| Clinical Directors | Egidio Del Fabbro, MD  
VCU Palliative Care Chair and Program Director  
Danielle Noreika, MD, FACP, FAAHPM  
   Medical Director/Fellowship Director VCU Palliative Care |
|-------------------|--------------------------------------------------------|
| Clinical Experts  | Candace Blades, JD, RN – Advance Care Planning Coordinator  
Brian Cassel, PhD – Palliative Care Outcomes Researcher  
Jason Callahan, MDiv – Palliative Care Specialty Certified  
Felicia Hope Coley, RN  
Diane Kane, LCSW – Palliative Care Specialty Certified  
Tamara Orr, PhD, LCP – Clinical Psychologist |
| Support Staff     | Teri Dulong-Rae & Bhakti Dave, MPH  
David Collins, MHA  
Frank Green |
| Program Manager   |                                                        |
| Telemedicine Practice Administrator |                       |
| IT Support        |                                                        |
Spoke Participant Introductions

Name and Institution
I just have one tattoo—it's six dots on my chest, done by my oncologist.

I need them for aligning the laser sights on a flesh-searing relativistic particle cannon.

So it will only kill the parts of me.

That are holding me back.

But your barbed wire bicep tattoo is pretty hardcore, too!

No, it's OK.

I'll just go put a shirt on.
Overview

- **What is radiation and how does it work?**
  - Types of Radiation
  - Treatment machines
  - Radiation oncology workflow

- **Radiation Oncology in the treatment of cancer**
  - Definitive treatment
  - Adjuvant treatment
  - Palliative treatment
How Does Radiation Therapy Work?

- Biologic effects of radiation are from DNA damage
- Direct DNA damage is when an electron interacts with DNA
- Indirect DNA damage is when an electron interacts with water to produce a hydroxyl radical which in turn damages the DNA

Direct and Indirect Actions of Ionizing Radiation (from Hall 1994)

- Low LET ~70% ~30%

Water Radiolysis Summary

\[
\text{H}_2\text{O} \rightarrow \text{H}_2, \text{H}_2\text{O}_2, \text{H}^-, \text{OH}, \text{•H}, \text{•OH}.
\]

DNAs are a primary target

- Microscopic temporary changes in the cell nucleus to become sensitized.
- Radiosensitive DNA, which becomes less sensitive than when in RNA or protein.
- DNA repair dependent cells are radiation sensitive; drugs that inhibit DNA repair are also radio-sensitizers.

Oxygen and LET modify survival, cytogenetic damage and biological activity of DNA in similar manner.
Types of Radiation

Electromagnetic Radiation
- X-rays
- Gamma rays
- Ultraviolet
- Visible Light
- Infrared
- Microwaves
- Radiowaves

Particulate Radiation
- Electrons
- Protons
- α particles
- Neutrons
- Heavy Charged Particle
How do we give radiation therapy?

- External beam radiation
- Brachytherapy
  - Intracavitary
  - Interstitial
- Stereotactic radiation therapy
Modern linear accelerator

**Modulator**
Modulator circuit supplies high-voltage pulses to cathode of microwave generator.

**Magnetron**
Generates + amplifies microwaves to be used for electron acceleration in the accelerator guide.

**Klystron**
Generates + amplifies microwaves to be used for electron acceleration in the accelerator guide.

**Accelerator Structure**
Microwave cavities propagating Electric fields used to accelerate electrons in a linear path.

**Bending Magnet**
Achromatic focusing of electron beam before striking target.

**Waveguide**
Hollow pipes that transport microwaves from klystron or magnetron to the accelerator structure.

**Linear Accelerators:**
- Elekta
- Varian Truebeam
- TomoTherapy
- BrainLab Novalis
- Cyberknife

Westerly, 2011
Linear Accelerators at VCU
Fractionation

- Radiation split into “fractions”
- Exploit difference in survival curves between normal tissue, tumor
- Target of RT = DNA
  - Tumor DNA repair mechanisms dysfunctional
  - Daily DNA damage repaired well by normal tissue, poorly by tumor
- If no adequate DNA repair before mitosis, “mitotic catastrophe”
  - Death is not instant!
Stereotactic Treatment

- Refers to 3D coordinate system that allows accurate correlation of a virtual target seen in patient’s diagnostic images with the actual target in patient anatomy
- 1-5 high dose treatments delivered with pin point accuracy
- Intracranial radiosurgery (SRS)
- Stereotactic body radiotherapy (SBRT)
What Does it Take to Irradiate?

1. Radiation oncologist orders treatment
2. CT simulation
3. Contouring (radiation oncologist)
4. Treatment plan (dosimetrist)
5. QA (physics)
6. Treatment delivery (therapists)
   1. Setup verification
   2. Beam on
The simulation is tailored to maximize:

- 1) Target/avoidance structure ratio
- 2) Visualization of the target
- 3) Patient safety/comfort
- 4) Reproducibility
CT simulation
CT simulation: Mask, BrainLab Spheres
Treatment Planning: Contouring
Treatment Planning

- **Dosimetry**
  - Image fusion
  - Target delineation
  - Modality and beam selection
Plan Evaluation

- Dose-volume histogram (DVH)
- Target coverage
- Critical structure dose tolerances
Patient’s First Day: Set-up Verification
Radiation oncology in the treatment of cancer

- **Definitive treatment**
  - To cure disease
  - Examples: Locally advanced cervical cancer, locally advanced lung cancer, head and neck cancer, prostate cancer, lymphoma

- **Adjuvant treatment**
  - To improve outcomes in conjunction with other therapies (surgery)
  - Examples: Pancreatic cancer, rectal cancer, esophageal cancer, breast cancer

- **Palliative treatment**
  - To decrease pain, improve QoL, prevent future problems
  - Examples: Bone mets, mediastinal masses, whole brain radiation
Palliative Radiotherapy

- Can treat any *focal* site of pain or other symptoms
  - Bleeding, airway obstruction, brain mets
- Time to effect varies
  - Typically at least 24 hours
  - Peak analgesia at 10-14 days
  - Pain flare uncommon, but beware
- Fewer/less intense side effects vs. definitive RT
  - Acutely responding tissues: skin, mucosa, marrow
Palliative Scenarios

• Bone pain
  ○ Most common utilization, often spine
  ○ Typically treated in 1-10 fractions (8/1, 20/5, 30/10)
  ○ Simple field designs, quick turnaround to treatment
  ○ If urgent, can start same day

• Visceral pain
  ○ Size relative to organs at risk can limit treatment
  ○ Similar dosing as bone pain

• Bleeding
  ○ Can treat with a single fx of 4 Gy
The Radiation Emergency

- **Spinal cord compression**
  - Typically severe back pain, with saddle anesthesia and/or LE weakness
  - Tissue confirmation, MRI spine ASAP
  - Start dexamethasone after diagnosis
  - Phase III data supports surgery first if possible
  - If more acute, more likely to recover ambulation
  - Goal to start radiation within 24 hours if no surgery
Not Quite Emergencies

- **Symptomatic brain metastases**
  - Headache, vision/hearing loss, weakness/numbness
  - Tissue confirmation, MRI brain ASAP
  - Start dexamethasone after diagnosis
  - If resectable, surgery first
  - If not, whole brain RT or SRS
• SVC syndrome
  ○ Horner’s syndrome, facial swelling, dyspnea
  ○ Previously considered an RT emergency, emphasis shifted to chemotherapy first, if possible
  ○ Resolution after RT delayed
Re-Irradiation

- Not all radiation damage is repaired over time
- Danger with re-treatment of additive toxicity
- Dangerous: spinal cord, lung, kidney, liver, small bowel, brainstem, optic pathway

Questions and Discussion
Case Presentation

Christopher McLaughlin, PGY-5
Case: RM

• 56M with widely metastatic lung adenoca
  • Initially p/w chest pain, SOB, 20 lb weight loss in August 2019
  • Staging imaging of the brain revealed 4cm enhancing mass in left frontoparietal lobes
  • Brain met resected 9/3/19, path: likely lung primary
  • Initial RT plan was for post-op SRS to cavity, primary SRS to smaller met in cerebellum
  • Did not tolerate port placement, no chemo to date
  • Inmate, released, lost to follow-up
Presented to ED on 10/13/19 with lethargy
• Multiple brain mets, requiring urgent start? “Clinical setup”
  • No simulation needed
  • Patient set up at treatment machine, tape placed over forehead for immobilization
  • Horizontal separation across cranium measured
  • Dose rate calculated
  • Standard lateral fields used
FIELD NUMBER(S): 1 1-1 2  
SITE: Whole Brain
SEPARATION AND DAILY DOSE: 14.5 CM / 300cGy

TREATMENT UNIT: MCV/HMP/SPMP CI21/6X

ISOCENTRIC TREATMENT, SSD = 92.75 CM  TUMOR DEPTH = 7.23 CM
COLLIMATOR SETTING = 22 X 18 CM  DOSE PER FIELD = 150 cGy
EQUIVALENT SQUARE AT ISOCENTER IS 19.8
BLOCKS: PLASTIC TRAY ONLY IN BEAM
TISSUE MAXIMUM RATIO = 0.883  TRAY FACTOR = 0.975
PHANTOM DOSE = 169.9 cGy  OUTPUT = 1.087 cGy/unit

***************************************************************************

MONITOR UNITS = 160
ECHO: 160
MCV/HMP/SPMP CI21/6X

***************************************************************************

CALCULATION BY: MBH
Accessing CME and CEU Credits
Claim CME / CEU at
www.vcuhealth.org/pcecho

VCU Health Palliative Care ECHO

Our VCU Health Palliative Care ECHO program partners with community practices caring for patients with serious illness and applies our interdisciplinary care team - a mix of physicians, nurses, social workers, psychologists, chaplains and more - to provide patient care support and education throughout Virginia.

We have a long-standing palliative care program with an inpatient unit, consult service and supportive care clinic to provide serious illness care. Many communities in Virginia do not have access to palliative care and we’re here to help.

- View Palliative Care ECHO sessions (CME/CEU available).
- Register now for an upcoming clinic.
- Submit a case study (registered participants only).
- **Live Session Participants: Claim CME/CEU**

Contact us for more information or help with any questions about our program.

About Palliative Care
Submit your evaluation to claim your CME

VCU Health Palliative Care ECHO Survey

Please complete the survey below.
Thank you!

Name
* must provide value

Credentials (MD, DO, NP, RN, ...)
* must provide value

Email Address
* must provide value

I attest that I have successfully attended the Virginia Palliative Care ECHO Clinic.
* must provide value

Options: Yes, No

reset
View recorded sessions at www.vcuhealth.org/pcecho

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About Palliative Care
Curriculum

Register now for an upcoming clinic on palliative care.

Upcoming Clinics

Mindfulness and Provider Self Care
June 13, 2019

Previous Clinics

Introduction to Palliative and Supportive Care
Feb. 14, 2019

Presented by Danielle Noreika, MD

Learning Objectives:
- Define palliative care and differentiate from hospice.
- Describe reasons for referral to palliative care.
- Describe basic structure of palliative care team.

View session for CME
View previously recorded ECHOs for CME

Click “Tests” to view video of the session and take a short quiz for continuing education credit.
View your CME/CEU transcript

• Go to vcu.cloud-cme.com and click “My CE”
• Log in with the email you used to register for our ECHO session
View your CME/CEU transcript

If you have never logged in before, you may be prompted to enter more information before you can view your transcript.
THANK YOU!
We hope to see you at our next ECHO