Oh no, it's not!!!

It's not what you may be thinking, so I'll tell you!

IT IS A VIETNAMESE PUMPKIN!

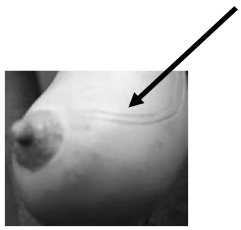
Oh yes, it is!

Objectives

- Explain radiation dose terminology
- Recognize 2D and 3D dose values
- Explain exposure and whole body dose
  - MQSA regulations
  - Radiation safety
- State the clinical benefits of Combo mode acquisition

Wonder what the neighbors will say when you plant some of these along the fence next year?

What are these lines?



Explanation of Radiation Dose Terminology

- **ACR Phantom Dose**
  - Regulatory dose limits are based on phantom dose - Mammography Quality Standards Act (MQSA)
- **Patient Breast Dose**
  - Dose calculated for each clinical image
- **Effective Dose**
  - Organ dose normalized to whole body exposure
  - Allows one to compare risks due to radiation

Radiation Dose

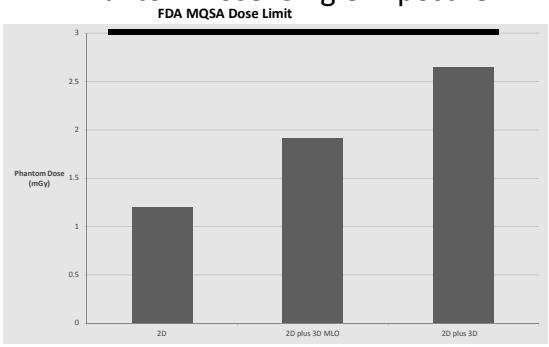
Dose (50/50 4.5 cm breast)

- MQSA = 3 mGy
- 2D~ 1.2 mGy (Tungsten Tube)
- 3D~1.45 mGy
- Combo ~2.65 mGy
- Selenia FFDM ~1.6 mGy (Molybdenum Tube)
- Screen/Film (ACRIN ~2.0 mGy average)

Dose

- First dose measurement
- Skin Erythema is the unit for measuring radiation exposure.

American College of Radiology Phantom Dose: Single Exposure



Dose

The Modern Era of Radiation Protection

•Tolerance dose replaced by maximum permissible dose (MPD) in early 1950s

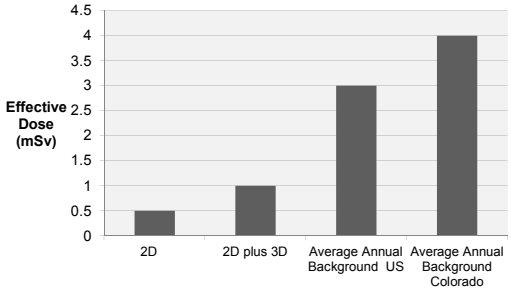
•Dose limits were calculated and established in the 1970s to ensure that the risk from radiation exposure acquired on the job did not exceed risks encountered in "safe" occupations

•ICRU adopted SI units for use with ionizing radiation in 1980

•NCRP adopted SI units for use

•ICRP adopted the term effective dose in 1991

Comparison of Cumulative Whole Body Doses



Dose

- Absorbed Dose defined as amount of energy per unit mass– ionizing radiation passes through an object, energy of the radiation is transferred to that biologic material and absorbed in the body and stays.

Dose

- Equivalent Dose – product of the average absorbed dose in tissue or organ. Remember stochastic effects are non-threshold, randomly occurring biologic effects from low dose radiation that can take a long time before damage can be demonstrated.

Radiation Dose Specification: Equivalent Dose (EqD)

•A radiation quantity used for radiation protection purposes when a person receives exposure from various types of ionizing radiation

•Attempts to numerically specify the differences in biologic harm that are produced by different types of radiation

•Enables the calculation of the effective dose (EfD)

•The SI unit of EqD is the sievert (Sv)

- In the traditional system, the corresponding unit is the rem
- 1 sievert equals 100 rem

Dose

- Effective dose – measure of overall risk of exposure to humans from ionizing radiation.
- Efd incorporates both the effect of type of radiation and the radio sensitivity of the specific organ or body part. This is the overall harm to those biologic components and risk.

Dose Response Curves

Threshold is where there is a point at which a response or reaction to an increasing stimulation first occurs in radiation.

This usually has a hypothetical sigmoid S –Shape curve and this is used in Radiation therapy for high dose cellular response.

Dose-Response Curves

- LNT – linear non-threshold curve of radiation.
- Both the response to radiation and biologic effects is directly proportional to the dose of radiation.
- Remember non-threshold means that any radiation dose has the capability for damage to biologic tissue starting at the cellular molecular component level.

Dose

- Radiation Hormesis
- What is it?

Dose

- Hormesis is where the background radiation levels are 1000 times stronger. Proven in Japanese atomic bomb survivors where they received 1.5 – 15 years equivalent background radiation and have reduced cancer death rate compared to normally exposed control population.
- Proven on mice who lived 11 days longer.

Summary of Radiation Dose: 2D plus 3D Tomosynthesis

- Additional effective dose of 3D is equivalent to about 2 months of annual natural background radiation in the United States.
- ACR Phantom Dose for both 2D and 3D combined is less than the FDA MQSA regulatory limit for a single 2D exposure.

Radiation Dose: *2D plus 3D* Tomosynthesis

- The additional effective dose of 3D tomosynthesis is equivalent to about 2 months of annual natural background radiation in the United States.
- This is less than natural variations in background radiation
- Risk from these levels of radiation is low
- For example, breast cancer incidence is lower in Colorado versus the average US, even though natural background radiation is higher

Background Radiation

- Radioactivity is present throughout the whole universe with radiation dose varying depending where you live.
- In the United states the dose of natural radiation can vary anywhere between 100 mrem to 1000 mrem per year depending on geographical regions.

BERT

Background Equivalent Radiation Time (BERT)

- A method that can be used to reduce patient fears and anxiety
- Compares the amount of radiation received with natural background radiation received over a given period of time (see Table 1-1 in the textbook)
- Based on annual U.S. population exposure of approximately 3 millisieverts per year (300 millirems per year)
- Advantages of the BERT method when it is used appropriately
  - BERT does not imply radiation risk; it is simply a means for comparison.
  - BERT emphasizes that radiation is an innate part of our environment.
  - The answer given in terms of BERT is easy for the patient to comprehend.

Diagnostic Procedure	Typical Effective Dose (mSv)[1]	Number of Chest X rays (PA film) for Equivalent Effective Dose[2]	Time Period for Equivalent Effective Dose from Natural Background Radiation[3]
Chest x ray (PA film)	0.02	1	2.4 days
Skull x ray	0.1	5	12 days
Lumbar spine	1.5	75	182 days
I.V. urogram	3	150	1.0 year
Upper G.I. exam	6	300	2.0 years
Barium enema	8	400	2.7 years
CT head	2	100	243 days
CT abdomen	8	400	2.7 years

Name some other man-made elements

Potassium
Smoke detectors
Bricks and granite
Fossil fuels (Coal, Oil, Natural Gas)
Fertilizers
Televisions

2D + 3D Tomosynthesis (Combo Mode) and Dose

putting it in perspective

FDA panel of experts voting, unanimously agreed the **benefits** of combo mode imaging outweigh the **risks**.

Recent News……..

- **FDA panel gives nod to 2D synthetic mode for Hologic breast tomo**
- By Kate Madden Yee, AuntMinnie.com staff writer

- October 25, 2012 -- A U.S. Food and Drug Administration (FDA) panel voted 9 to 1 on October 24 to recommend approval for a new imaging mode on the Selenia Dimensions 3D digital breast tomosynthesis (DBT) system from Hologic that creates synthesized 2D images from 3D data.
- The recommendation specifically addresses the use of synthesized 2D images generated by Hologic's C-View software module in place of traditional 2D images when used in conjunction with 3D mammography, Hologic said. C-View is designed to enable tomosynthesis to produce 2D mammography images without the higher radiation dose typically involved in combined 2D/3D studies.
- Since winning FDA approval in 2011, tomosynthesis has been promoted as a technology that could improve breast screening by collecting a range of data slices acquired as the mammography system's tube head pans around the breast. These slices are typically reconstructed into dynamic 3D volumes that enable radiologists to see around superimposed tissue in the breast.

Thank you!

Do you have questions?