RADIOLOGICAL PHYSICS 2011

Raphex

diagnostic examination

Adel A. Mustafa, Ph.D., Editor

PUBLISHED FOR:

RAMPS

(Radiological and Medical Physics Society of New York)

preface

The RAPHEX Diagnostic exam 2011 was prepared by members of the Radiological and Medical Physics Society of New York (RAMPS, Inc.), the New York chapter of the American Association of Physicists in Medicine (AAPM).

The exam format was changed in 2009 to match the syllabi for teaching Diagnostic Radiology and Radiation Oncology residents published by the AAPM's Subcommittee for Review of Radiation Physics Syllabi for Residents (RRPSR). The numbers of questions for each subject are approximately related to the number of teaching hours allocated to each subject.

Exam committee:

Adel Mustafa, Ph.D., Editor
Maynard High, Ph.D., Reviewer
Stephen Balter, Ph.D., Reviewer
John Humm, Ph.D., Reviewer
Lawrence Rothenberg, Ph.D., Reviewer
Pat Zanzonico, Ph.D., Reviewer
Barry Rosenstein, Ph.D., Contributor

If you are taking RAPHEX under exam conditions, your proctor will give you instructions on how to fill out your examinee and site IDs on the answer sheet.

- You have **3 HOURS** to complete the exam.
- Non-programmable calculators may be used.
- Choose the most complete and appropriate answer to each question.

We urge residents to review the exam with their physics instructors.

Any comments or corrections are appreciated and should be sent to:

Adel Mustafa, Ph.D.
Raphex Chief Editor
E-mail: adelmustafa@gmail.com

Copyright © 2011 by RAMPS, Inc., the New York chapter of the AAPM. All rights reserved. No part of this book may be used or reproduced in any manner whatsoever without written permission from the publisher or the copyright holder.

Published in cooperation with RAMPS by:

Medical Physics Publishing
4513 Vernon Boulevard
Madison, WI 53705-4964
1-800-442-5778
E-mail: mpp@medicalphysics.org
Web: www.medicalphysics.org

D1. What is a reasonable $CTDI_{vol}$ radiation dose from a CT perfusion scan?

ANSWER

A. 2.5 mGy
B. 25 mGy
C. 250 mGy
D. 2500 mGy

D2. A CT scanner displays a $CTDI_{vol}$ of 6 mGy for a typical 5-year-old abdomen technique. When the medical physicist measures the $CTDI_{vol}$ for the ACR accreditation, she finds it to be about 12 mGy. Why?

ANSWER

A. Physicist used 2× the normal slice width in the measurement.
B. Physicist used a 16-cm diameter phantom, but CT unit assumed 32-cm phantom.
C. Physicist used a lower kVp than normal.
D. Physicist used a different than normal reconstruction algorithm.
E. Physicist used a detector chamber that was too short to cover the unit multislice detector beam width.

D3. Other than in mammography, what is the target material in x-ray tubes?

ANSWER

A. Mo
B. Rh
C. Gd
D. W
E. Pb

D4. Thin, horizontal white streaks are seen in CT chest scans through the shoulders. How can these be reduced?

ANSWER

A. Use rotational modulation of mA.
B. Lower kVp.
C. Have service recalibrate detector.
D. Use thinner slices.
E. Use High Resolution Chest protocol.

D5. Which of the following will increase the appearance of noise seen on a CT image?

ANSWER

A. Change kVp from 120 to 140.
B. Change slice width from 2.5 mm to 5 mm.
C. Change viewing window from 250 HU to 50 HU.
D. Change pitch from 1.0 to 0.8.
E. Change reconstruction algorithm from Bone to Standard body.

D6. In a multislice detector CT the reconstructed slice width depends on:

ANSWER

A. Rotation time.
B. X-ray beam width.
C. Partial volume.
D. Reconstruction algorithm.
E. Detector width.

YOUR ANSWER

Use Vitalsource Bookshelf's button or hit "BACK"

D1. C

The typical $CTDI_{vol}$ for CT perfusion is between 100 and 500 mGy. It is much higher than routine brain CT because it is a cine series of scans done with patient stationary.

BACK

YOUR ANSWER

Use Vitalsource Bookshelf's Back button or hit "BACK"

D2. B

BACK

Some CT scanners incorrectly display the $CTDI_{vol}$ for pediatric abdomen studies, because they assume a 32-cm diameter patient whenever Body mode is chosen. The ACR accreditation calls for a 16-cm diameter phantom to be used, which is closer to a typical 5-year-old abdomen. $CTDI_{vol}$ does not change much with beam width, and even less with slice width. Lower kVp would give *lower* dose. Algorithm has no effect on dose. Too short detector chamber would give a too *low* dose.

YOUR ANSWER

Use Vitalsource Bookshelf's Back button or hit "BACK"

D3. D

CT requires high x-ray flux per mA (x-ray yield goes up with *Z*) and high mA, high kVp, which produces high heat. W has a high melting point and high *Z*. Pb has a low melting point. Mo and Rh are used for mammography targets. Gd is used for x-ray detectors.

BACK

YOUR ANSWER

Use Vitalsource Bookshelf's Back button or hit "BACK"

D4. A

BACK

These are noise streaks coming from photon starvation as the x-ray beam traverses the highly attenuating lateral views through the shoulders. Rotational modulation of mA AEC will increase the dose for those angular views where the patient is thick or dense. Lower kVp and thinner slices will result in lower dose per voxel, and noise will increase. High res chest uses very thin slice and high res algorithm, which will increase noise. Recalibration will only correct ring artifacts. There may also be thick dark streaks seen between highly attenuating bones—these are beam-hardening artifacts.

YOUR ANSWER

Use Vitalsource Bookshelf's  button or hit "BACK"

D5. C Narrowing the viewing window will increase displayed noise (and contrast) in image. All others will reduce noise.

BACK

YOUR ANSWER

Use Vitalsource Bookshelf's Back button or hit "BACK"

D6. E

BACK

In multislice CT, the slice width is determined by the width of the detector elements in the *z*-direction. Adjacent rings of detectors are combined to allow different slice widths. The beam width must be at least as wide as all the slices from a single rotation combined. Partial volume does not affect slice width; it is an effect of wide slice width.