Pediatric Imaging and Radiation Safety

Before 2001, most pediatric imaging was conducted by use of the same or similar techniques used for adult imaging. In 2001, several investigators reported that this approach was not necessary and resulted in estimated radiation doses to children to be as much as 3 times that given to an adult. The Image Gently Campaign was launched in January 2008 as an initiative of the Alliance for Radiation Safety in Pediatric Imaging. The goal of Image Gently was to change practice by increasing awareness of the opportunities to lower radiation dose in the imaging of children. Answer the following questions to test your awareness of computed tomography (CT) and radiation safety.

1. Approximately how many CT examinations are performed each year on children?
   A. 1,000,000  
   B. 3,000,000  
   C. 5,000,000  
   D. 7,000,000

2. How much has pediatric CT volume increased since 2005-2006?
   A. 10%-20%  
   B. 40%-50%  
   C. 60%-70%  
   D. 90%-100%

3. What term refers to the measurement of radiation dose based on phantom analysis at a central point and at 4 points located intermediate from the center and the periphery of the phantom?
   A. CT dose index (CTDI)  
   B. CT dose index volume (CTDIvol)  
   C. Dose length product (DLP)  
   D. Effective dose  
   E. Dose equivalent

4. What is the typical medical radiation dose in chest X-ray (CXR) equivalents for an abdomen CT in a 5 year-old patient?
   A. 5  
   B. 50  
   C. 100  
   D. 250

5. What is the approximate equivalent dose to the brain (in mSv) from a pediatric head CT (200 mA, neonate)?
   A. 20  
   B. 40  
   C. 60  
   D. 100

Answers

1. D. 7 million. The number of CT examinations performed per year for all ages in the United States is estimated to be 65 million.

2. B. 40%-50%. The rate of growth is estimated at approximately 10% per year. Factors influencing CT use include appropriate clinical indications, scientific data, vendor marketing, business pressures to offer certain examinations or latest model of equipment, public expectations, expectations of referring clinicians, and type of hospital (teaching vs non-teaching).

3. A. CTDI. This measurement takes into account the radiation dose (in mGy) within a slice and the values depend only on the selected CT parameters and do not reflect the dose to the individual patient being scanned. The CTDIvol takes into account the contribution of pitch in that slice (CTDI/pitch). DLP (in mGy cm) is the product of CTDI and scan length and values depend only on the selected CT parameters and do not reflect the dose to the individual patient being scanned. Effective dose is the dose to specific organs converted to an equivalent risk to the whole-body dose, as if the whole body had been exposed. It is calculated by the sum of specific tissue-weighting factors, taking into account the radiosensitivity of each tissue irradiated. An effective dose to the patient can be estimated with the use of conversion factors. Dose equivalent, expressed in Sievert (Sv), refers to the biological effect of a given type of radiation in relation to the gamma or X-ray and therefore takes into account the type of radiation.
is expressed as the product of the absorbed dose and a quality factor. Absorbed dose refers to the radiation dose concentration applied to a given unit or volume, in Gray (Gy), and applies to gamma radiation and X-rays. It is useful for general risk assessment but not practical for daily CT because of the interaction among the multiple adjacent slices.5

4. D, 250. One abdomen CT in a 5-year-old patient is equivalent to 250 chest radiographs. CXR equivalents for 3-view ankle, brain CT, chest CT, and Tc99m radionuclide bone scan are 1/14th, 100, 150, and up to 310, respectively.5

5. C, 60. This dose is an estimate using the same settings as for adults. The use of settings adjusted for body weight (100 mA) would result in an approximate equivalent dose of 30 mSv.5

References