NUSU

Radiography and medical imaging sciences

3rd year

CT Technique

TECHNICAL PARAMETERS-2

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Clinical aspects of setting the appropriate technical parameters:

- These parameters must be set according to the area of examination and clinical indication, as follows: • Nominal slice thickness is chosen according to the size of the anatomical structure or lesion that needs to be visualized. Staff should be aware of the implications of choice of slice thickness in relation to the image quality and radiation dose to the patient.

Helical or Spiral CT •

- The repeating of single scans, which sometimes results from lack of patient cooperation in serial CT, is reduced in spiral CT because of the shorter examination times involved.
- • For pitch >1 the dose will be reduced compared with contiguous serial scanning; there are no data missing as may be the case with the use of an inter slice interval in serial CT.
- • The practice of using overlapping scans or thin slices in serial CT for high quality 3D display or multiplane reconstructions is replaced by the possibility of reconstructing overlapping

Extremely shortened examination time:

- Makes it possible to acquire continuous patient data during a single breath-hold; problems with inconsistent respiration can thereby be avoided. •Disturbances due to involuntary movements such as peristalsis and cardiovascular action are reduced. •May optimize scanning with the use of intravenous contrast media.
- •Images can be reconstructed for any couch position in the volume of investigation:

- •Anatomical misregistration is avoided. .
- •The possibility of displaying the data volume in transverse slices reconstructed at intervals smaller than the X-ray beam collimation results in overlapping slices which, in combination with

- reduced or eliminated movement artifacts, makes it possible to perform high quality three dimensional (3D) and multi-planar reconstructions with smooth tissue contours. This is used especially in skeletal and vascular imaging (CT angiography).
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- Helical CT, however, has drawbacks such as:
  • Ease of performance may tempt the operator to extend the examination unjustifiably, either by increasing the imaging volume, or by repeated exposure of a region. • Although most image quality parameters are equivalent for contiguous serial CT and helical CT performed with a pitch = 1, the performance of helical CT with a pitch greater than 1.5 may imply lower and possibly insufficient diagnostic image quality due to reduced low contrast resolution •

- Spatial resolution in the z-direction is lower than indicated by the nominal slice width unless special interpolation is performed.
- •The technique has inherent artifact. When using helical CT in conjunction with intravenous injection of contrast media to provide optimally enhanced images, careful timing of exposure relative to intravenous injection is mandatory.

Image Viewing Conditions:

- It is recommended that initial reading of CT images is carried out from the TV monitor. Display of images and post-processing image reconstruction should be at a display matrix of at least 512 × 512.

- Brightness and contrast control on the viewing monitor should be set to give a uniform progression of the grey-scale from black to white. A calibrated grey-scale would be preferable. Settings of window width and window level dictate the visible contrast between tissues and should generally be chosen to give optimum contrast between normal structures and lesions.

Film Processing:

- Optimal processing of the film has important implications for the diagnostic quality of the image stored on film. Film processors should be maintained at their optimum operating conditions as determined by the manufacturer and by regular and frequent quality control procedures.

Physical Parameters: Physical Measures of Scanner Performance:

- The quality of the CT image may be expressed in terms of physical parameters such as uniformity, linearity, spatial resolution, low contrast resolution and absence of artifacts. It depends on the technological characteristics of the CT scanner, the exposure factors used and image viewing conditions. Quality may be assessed by quantitative measurement of the parameters listed above, using suitable test phantoms, and by the appearance of artifacts.

- These measurements should be conducted regularly, It is essential that such technical quality control has been performed when using the criteria presented in these guidelines.

Linearity:

- Linearity concerns the linear relationship between the calculated CT number and the linear attenuation coefficient of each element of the object. It is essential for the correct evaluation of a CT image and, in particular, for the accuracy of QCT. Deviations from linearity should not exceed +/- 5 HU over specific ranges (soft tissue or bone).

Uniformity:

- Uniformity relates to the requirement for the CT number of each pixel in the image of a homogeneous object to be the same within narrow limits over various regions of the object such as a cylindrical 20 cm diameter phantom of water-equivalent plastic. The difference in the mean CT number between a peripheral and a central region of a homogeneous test object should be < 8 HU. Such differences are largely due to the physical phenomenon of beam hardening.

Noise:

- Picture element (pixel) or image noise is the local statistical fluctuation in the CT numbers of individual picture elements of a homogeneous ROI. Noise is dependent on the radiation dose and has a marked effect on low contrast resolution. The magnitude of the noise is indicated by the standard deviation of the CT numbers over a ROI in a homogeneous substance. It should be measured over an area of about 10% of the cross-sectional area of the test object. Image noise diminishes with the use of a slightly flattened

Spatial Resolution:

- Spatial resolution at high and low contrast are interdependent and critical to image quality and good imaging of diagnostically important structures. The spatial resolution at high contrast (high contrast resolution) determines the minimum size of detail visualized in the plane of the slice with a contrast >10 percent. It is affected by the reconstruction algorithm, the detector width, the slice thickness, the object to detector distance, the X-ray tube focal spot size, and the matrix size.

- The spatial resolution at low contrast (low contrast resolution) determines the size of detail that can be visibly reproduced when there is only a small difference in density relative to the surrounding area. Low contrast resolution is considerably limited by noise. Dose and the corresponding image noise greatly affect low contrast resolution.

Any questions?