NEW HORIZONS

Spiral Computed Tomography

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Spiral computed tomography is considered a major advance in CT in the nineties. Spiral CT enjoys several technical advantages over conventional CT.

Major difference between conventional CT and Spiral CT is the faster data acquisition with the latter. It is a frustrating experience to obtain diagnostic CT scans in patients who are restless, uncooperative or unable to remain immobile during a scanning sequence. Spiral CT provides the ability to image the lung, liver and pancreas during a single breathhold. Thus it helps in avoiding misregistration of lesions and minimizes respiratory and other motion artifacts (i. e. there is no longer a risk that an examination will contain gaps or overlaps because of differences in the depth of inspiration between individual slices). Further contrast enhancement is also optimized because of volumetric acquisition of the region of interest in 20 to 60 seconds (1).

Spiral CT is also termed Helical or Volumetric CT as it returns a true volumetric data-set producing two major diagnostic advantages :

1. Thorough evaluation of a body part.
2. Improvement in multiplanar and 3–D renderings.

Principle

The introduction of continuously rotating CT measurement system provides the technological basis for CT. Three technical developments have made possible the technique of spiral CT scanning :

(a) Computer technology advancement which analyses and reconstru 's images to be performed using volume data sets, as opposed to a single slice in conventional CT scanning.

(b) Development of powerful X-ray tubes, which could remain on for long periods of upto 60 seconds.

(c) Technology of 'slip ring' electrical coupling which allows X-ray tube and detectors to rotate continuously.

Slip rings are used to tranfer the necessary electrical energy to the rotating gantry and to transmit the measured data from the rotating part to the computer system. "Spiral" in spiral CT refers to cylindrical and conical configurations and is a volume scanning procedure in which the patient is moved continuously through the gantry with simultaneous continuous rotation of the tube. The focal spot of the tube thus describes a "Spiral" about the patient.

The data obtained during continuous motion of the patient through a continuously rotating tube is a volume data set. From this data set using conventional back projection techniques after interpolation algorithms, multiple axial, oblique, sagital, coronal or three–dimensional images can be obtained.

ADVANTAGES

(a) Improved lesion detection due to elimination of respiratory misregistration.

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(b) Reduced amount of contrast. It is because of short time required for acquiring the data set. This has obvious benefits related both to cost as well as the incidence of adverse reactions. Reduction in amount of contrast required is upto half the volume used in conventional CT.

(c) Ability to scan a particular phase of contrast delivery.

(d) Reduced patient time.

(e) Higher quality of multiplanar and three–dimensional reformations. It is possible due to reduction of motion artifacts.

DISADVANTAGES

(a) Increased image noise. This is related to both the interpolation technique and the decreased power of the X–ray tube, necessitated by continuous scanning.

(b) Volume–averaging artifacts. As the pitch increases, partial volume averaging increases.

(c) Additional processing time. The large amount of raw data leads to an increase in the processing time, which can also termporarily interrupt patient scanning.

Because of the technical advantages of Spiral CT, clear indication for using it in the study of those areas in which breath-hold speed of acquisition and the need or opportunity to perform volumetric renderings are prominent. Specifically in examination of chest and abdomen, it leads to high quality, more meticulous examination with helical CT than with conventional CT. It is well suited for detection and evaulation of small lesions e. g. pulmonary or renal mass as small as 5 mm in size can be detected (2, 3).

It also helps to perform needle localization phase of CT guided interventional procedures more rapidly. It is also superior in CT angiography to produce extraordinary images of the abdominal vasculature (4) and organs as well as noninvasive evaluation of the carotid arteries and intracranial vasculature (5). 'Virtual endoscopy' is another most exciting prospect for spiral CT where 3D spiral CT data sets of a hollow viscus (e. g. colon or tracheobronchial tree) are obtained. 'Endoscopic' images of the viscus are then generated by a computer. One can visualize the smaller parts of tracheobronchial tree with 'virtual bronchoscopy' where the fibro-optic bronchoscope can not reach because of smaller size of airway or pathological stenosis.

Spiral CT is inferior to conventional CT in imaging of motionless structures like brain and musculoskeltal structures.

Scanning in spiral mode can be considered a mature technology. Further improvements in the technical scanning parameters, increase in X–ray power and refinements in data processing algorithms aimed at higher Z–axis resolution will lead to better images.

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