Computed Tomography (CT) involves using an X-ray tube coupled to a detector system, encased within a doughnut shaped gantry. There is a separate table, on which the patient lies, that can move smoothly in and out of the gantry. The X-ray tube emits a finely collimated X-ray beam as it rotates within the gantry around the patient. The detectors receive a series of data profiles depicting the degree of absorption encountered by the X-ray beam as it passes through the body at the different angles of rotation. This information is then transformed into a cross-sectional image after the application of complex mathematical algorithms.

Most studies are obtained in the trans-axial plane. The contrast resolution is superior to conventional radiography. Intravenous contrast may be given to outline vascular structures and assess the enhancement characteristics of pathological processes.

Helical CT has almost completely replaced non-helical CT. Helical refers to the ability of the X-ray tube to rotate continuously as the body moves through the gantry. The detectors thus record a continuous volume of data rather than single slices. This information can be processed to provide images in the sagittal and coronal planes. The data can also be manipulated to enhance thresholds of attenuation. This enables structures such as bones to be viewed with the soft tissues removed or provide 3D angiographic display of vascular structures. This facility has led to expansion of CT scanning to such applications as CT angiography, CT cholangiography, 3D reformation for reconstructive plastic surgery and virtual colonoscopy.

Helical CT also allows for faster scanning, often resulting in the imaging of a structure or organ in a single breath-hold. This facility overcomes previous problems of misregistration; that is of small lesions falling between slices when single slice breath-hold scans were obtained. This is of importance in situations such as the demonstration of small lesions in the liver, lung and adrenals. In addition, rapid helical scanning allows timing of imaging during maximal intravenous contrast enhancement, which is of particular importance in CT angiography and arterial-phase scanning of the liver. Indeed, with helical CT scanning it is possible to obtain images of the liver and other regions in multiple phases, for example in the arterial, portal venous and delayed phases of contrast enhancement in rapid succession.

Multidetector CT (also known as multislice, multidetector-row, multisection or multichannel CT) is the latest development in computed tomography technology. Single slice helical CT has a single detector that only allows one channel of image information to be recorded for every one rotation of the gantry. In multidetector CT, the single detector is replaced by multiple rows of detectors allowing for registration of more than one channel of variable width per gantry rotation. In modern machines the number of detectors can be 64, 128 and 256. In addition, these scanners have faster gantry rotation speeds allowing for large volumes to be imaged in a single breath-hold. Multidetector CT enables rapid scanning, with less motion artifact, and a reduction in IV contrast media doses.

The higher resolution of multidetector CT makes it superior to single slice helical CT for 3D-volume reconstructions. Multidetector CT has impacted mainly on applications that require high spatial and temporal resolution, such as CT angiography and trauma imaging where rapid scanning is ideal.

CT has traditionally used an algorithm known as filtered back projection to reconstruct the acquired CT data information into cross-sectional images. Although this was not the first algorithm used in commercial CT machines, it gained popularity due to ease of implementation and faster image reconstruction. The first
The general principle of iterative reconstruction is repeated processing cycles to reduce image noise, while maintaining contrast. The benefits are:

- Improved noise reduction (of around 30%). This will theoretically allow for radiation dose reduction of around 40%. This effect will work synergistically with other dose reduction methods.
- Less image artifacts.
- Better imaging of obese patients.
- Enables imaging at higher spatial resolutions.
- Enables re-interpretation of previous poor quality scans.

**Preparation for CT**

No special preparation is normally required for CT scanning other than for abdominal-pelvic scans. In addition to the frequent use of IV contrast agents, abdomino-pelvic scans may require contrast within the bowel. Very dilute barium or iodinated contrast (Gastrografin) is usually ingested at the instruction of the Radiologist. In addition, rectally administered contrast may be given. Water or air are alternative endoluminal contrast agents in some circumstances.

**Information for Consumers**

For information published at this website, please access the following: [Computed Tomography]

For information published by the Royal Australian and New Zealand College of Radiologists, please access InsideRadiology at: [www.insideradiology.com.au]

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