

## Quick history about the CT scanner and its use:



Bassam Tabshouri: has been in this field of medical/clinical engineering since 29 years. Also he has been the director of the medical Engineering Department at the American University of Beirut Medical Center since 1988.

The discovery of x-rays in 1895 was an important landmark in the development of medicine. However, a major limitation of conventional x-rays was that it lacks depth; therefore many internal structures were superimposed on each other.

With the help of computers, scientists developed methods to solve this problem. One such method was computed tomography (CT), which was developed in the early 1970's by Godfrey Hounsfield and Allen Cormack.

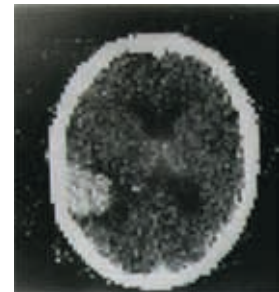
The first clinical CT scanners were installed between 1974 and 1976. The original systems were dedicated to head imaging only, but "whole body" systems with larger patient openings became available in 1976. CT became widely available by about 1980.

In the early 1980's a couple of hospitals in Lebanon (including AUBMC) acquired this technology.

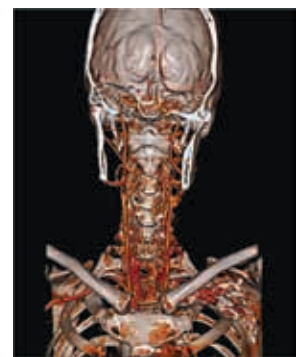
There are now more than 6,000 CT scanners installed in the U.S. and more than 30,000 installed worldwide.

How did it evolve?

During its more than 30-years history, the CT has made great improvements in speed, patient comfort, and resolution. The first CT scanner developed by Hounsfield took several hours to acquire the raw data for a single scan or "slice" and took days to reconstruct a single image from this raw data. Later the speed of these conventional scanners improved a lot.



**1974  
slice in 7 1  
minutes**



**2004  
Complete  
head scan in  
5 seconds**

Conventional CT scanners could only collect one slice per gantry rotation. Tremendous research and development has been made to provide excellent image quality for diagnostic confidence at the lowest possible x-ray dose. Now, multislice CT systems acquire multiple cross-sectional images simultaneously. They can scan the whole body within seconds and do a 3-D construction of the body. Faster scanning helps to eliminate

artifacts from patient motion such as breathing or peristalsis.

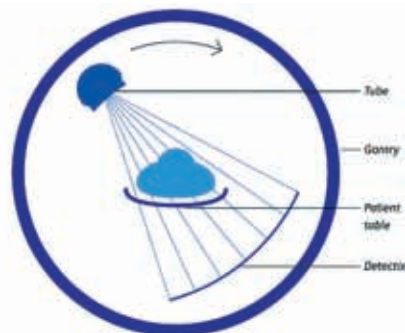


How does it work?

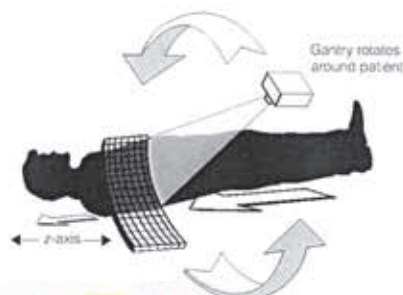
Like all other x-ray machines, CT scanners, employ x-rays to produce images of internal body structures. X rays are a type of radiation that is capable of penetrating solid materials to differing degrees, depending on their density and thickness. In conventional radiology, an image is produced by placing a detector, such as a photographic film, behind the patient and then directing a beam of x rays toward it. The radiation passes through the patient's body and interacts with the film. X rays that strike the film produce dark areas after processing, body structures that are easily penetrated by x rays, such as skin, show up as dark regions. Other structures such as muscle, soft tissue, and organs allow different amounts of x rays through them and show up as gray areas. Bones, which do not allow x rays to pass through them, show up as bright white areas.

In the single slice CT, a fine pencil like x-ray beam passes through the body and

is detected by a line of detectors. Both the x-ray tube and the detectors rotate fully around the patient, then x-ray is stopped and the patient table is slightly moved inward or outward and the process is repeated until all the needed area of interest is scanned. So scanning the head (or any other organ) is somehow similar to the way slices of cheese are cut at a certain sizes when we buy it in the supermarket.



In the multi slice CT, the x-ray beam is wider and is detected by an array i.e. many lines of detectors placed next to each other, thereby allowing the generation of more slices during one rotation. We talk now about multislice scanners that can generate at the same time 16 or 32 or 40 or 64 slices. Newer ones that can generate 256 slices are also coming soon. Another major difference from single slice CT scanners is that the x-ray can be kept on while the patient table is moved. This also increases the speed of scanning the patient.



Advantages vs. disadvantages of multislice CT's:

Does multislice CT have clinical advantages over single-slice?

In most instances, the answer to this question will be no. However, multislice's technical benefits make it valuable for certain patient groups, including pediatric



and geriatric patients. In addition, it increases the usefulness of CT in several specific applications.

Advantages

1. Obtain more information in less time
  - a. Scan the whole lung with narrow slices.
  - b. Cardiac imaging is possible.
  - c. Whole body imaging (trauma) in a single scan.
  - d. It allows more efficient contrast media use (Angiography)
  - e. 3-Dimensional imaging is possible (including virtual colonoscopy)

Disadvantages

- 1 Cost—Multislice Systems cost up 40% more than single slice CT's
- 1 A lot more data—A single exam can easily produce 500 to 1,000 slices, which must be stored, transferred, and read.

Concluding notes:

1. Some Lebanese Hospitals have already acquired the latest multislice CT's. The number of these CT's for our population is way more than what we find now in most of the European countries.
2. The use of these scanners requires a lot of training for the technicians and the doctors and it requires from them a different way of dealing with the generated information and analyzing it. Investing in training the staff is very vital.
3. Multislice CT's (especially cardiac applications) pose the need for radiologists and other doctors to collaborate in the analysis of he generated data.
4. Proper quality control checks for this equipment is a vital issue.
5. While multislice CT has many advantages, it is not a prerequisite for good patient care, since the information available from multislice images is usually also available from other sources, albeit more slowly.