Talk on Medical Imaging: Basic General X-ray (XR) and Computed Tomography (CT) Systems

by Ir. Shamila Ariaratnam

Ir. Shamila Ariaratnam is Consultant, Biomedical Engineering, RSD Hospitals Sdn Bhd – Subang Jaya Medical Centre and the Chairperson of the Healthcare and Biomedical Engineering Working Group.

Internal images of a human body can be extracted from XR and CT systems. For a change, on 4 August 2018 at 11:00 a.m. participants were given a detailed intrinsic view of both systems by Mr Bong Wee Thian, Senior Manager for the Sales Division at Canon Medical Systems (M) Sdn Bhd. The talk was organized by the Healthcare and Biomedical Engineering Working Group under the Electrical Engineering Technical Division.

Pictures of dense human tissues such as bones and teeth are taken from XR systems. On the other hand, a CT scan combines a series of XR images taken from different angles around the human body and uses computer processing to create cross-sectional images (slices) of the bones, blood vessels and soft tissues inside a human body. As compared to XR images, CT scan images provide more-detailed information. Mr Wee Thian started the talk on XR systems by giving a historical account and then moving on to advances of the system along the years. Next, he explained the production of XRs. XR is produced when Cathode ray or high-speed electron collide with an object. Its electromagnetic radiation has shorter wavelength and higher frequency than light. XRs are effective because it possesses certain characteristics enabling it to pass through matter, get attenuated as it passes through matter, produces secondary radiation in the matter through which it passes, ionize, cause various phosphor materials to fluoresce, blacken photographic emulation, be invisible, move in a straight line and cause biological changes. These characteristics make it an effective image provider for any dense matter.

Mr Wee Thian then went on to elaborate its uses in medical imaging giving emphasis on its use in a General X-ray System. Starting with its major components and detailing out the function of each ending with how the images are taken and produced. He also described the functions of some accessories and personal protective equipment as well as engineering controls available with General X-ray systems. He concluded the explanation on this medical device with the room design requirements.

Image of General X-ray system (Source: Pinterest)

Second part of Mr Wee Thian's talk was central around the CT systems which sometimes are also termed as Computerized Axial Tomography (CAT) scans. Starting with the history from the first to the current generation of the CT scanner and moving through the advances of the system from each generation. A CT scanner emits a series of narrow beams through the human body as it moves through an arc. This is different from an XR system, which sends just one radiation beam. A more detailed final picture is produced by the CT image as compared to an XR image. Hundreds of different levels of density can be seen from the CT scanner's XR detector. It can see tissues within a solid organ. This data is transmitted to a computer, which builds up a 3-D cross-sectional picture of the body part and displays it on the screen. Sometimes, a contrast dye is used because it can help show certain structures more clearly.

He then zoomed in on the use of CT Systems in medical imaging. Starting with its major components and detailing out the function of each ending with how the images are taken and produced. He also described the functions of some accessories. He concluded by explaining the CT number and/or Hounsfield number which is a normalized value of the calculated XR absorption coefficient of a pixel (picture element) in a computed tomogram, expressed in Hounsfield units, where the CT number of air is -1000 and that of water is 0. The figure is different depending on the type of internal organ being scanned.

Doctors use CT scans to look for broken bones, cancers, blood clots, signs of heart disease or internal bleeding just to name a few. During a CT scan, a patient lays still on a table. The table slowly passes through the center of a large XR machine. The test is painless. During some tests the patient receives a contrast dye, which makes parts of the body show up better in the image. On the other hand, XRs are also used to check for broken bones, but XRs are also used in other ways. For example, chest XRs can spot pneumonia. Mammograms use XRs to look for breast cancer. When doctors recommend the use of either systems it is to help them diagnose and treat or prevent an illness effectively.

Image of Computed Tomography System (Source: Pinterest)

Photos below summarise the second talk of the day.

Mr. Bong delivering his talk

Participants of the talk

Token of appreciation to Mr. Bong