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Emerging Field of Diagnostic Imaging Modality

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ABSTRACT:

Medical imaging or radiography is rapidly developing due to recent advancements in techniques for image processing. It includes image detection, analysis, enhancement etc. By image processing, the volume and percentage of the tissues detected are enhanced. In this article, the basic and advanced medical imaging techniques and their usage has been presented. Forensic imaging is an upcoming new field in forensic science and its application is increasing day by day with the advancement of different imaging modalities. The purpose of this article is to define diagnostic imaging applications. These methods consist of radiological methods like radiography, CT scan, MRI combination of CT scan and MRI. Post mortem computed tomography (CT) imaging is a useful method for forensic diagnosis, and it is now being introduced in the field of forensic medicine rapidly.

KEYWORDS: Imaging, USG, Magnetic resonance imaging

INTRODUCTION:

Importance of different imaging techniques are widely recognized. These different modalities are useful in different domains like in anthropology, archaeology, forensic medicine, odontology and many more. Wilhelm Roentgen in year 1895 discover unknown type of radiation and he named it X-rays. Later when he took the x ray of his wife's hand, he accidentally discovered the use of x ray in medical applications. The first use of x ray under clinical circumstances was done in England on January 1896 by John Hall Edward of a hand. Gray realized the importance of radiology in body identification when he examined mummies in Europe and Britain. Diagnostic radiology comprises of conventional radiography, ultra sound, computed tomography, magnetic resonance imaging, fluoroscopy, mammography etc. these imaging techniques use either ionizing radiation or nonionizing radiation. Conventional radiography, CT scan, Fluoroscopy and Mammography uses x rays. The community of forensic in general has been lazy and slow in the implementation of diagnostic modalities. May be due to financial crises or unawareness of the potential of these imaging modalities. But now slowly-slowly time is changing and techniques like CT and MRI are gaining their access in forensics. Investigation of the dead is important for the purpose of law, medical education and quality control.

Digital imaging is the way of generating optical images for scientific and medical research and concern about the inner structures of the body which gives an observable look at the functions body's interior tissues. It helps in recognition and treatment of disorders. To make it easy to recognise the abnormalities, this procedure uses a reference data bank of the normal anatomy and functioning of the organs. This approach involves conventional as well radioscopic imaging. It uses electromagnetic radiations like X-rays and gamma rays, ultrasound, magnetic imaging, thermal & isotope imaging. Other instruments are also used for the documentation of knowledge regarding the location and the functions of the organs of the body.

In contrast to those modules that generate images, these techniques have several limitations. Medical imaging, without insidious techniques, creates images of the human body's internal structures. These images are generated using fast processors and arithmetically and logically. Those signals are translated into digital images later on. The various kinds of tissues inside the body are represented by those signals. Digital images, on a regular basis, have a necessary function to play. Digital imaging processing in medical field refers to the managing of pictures with the help of a computer. There are several kinds of methods and practises needed for this processing, like image selection, its storage, demonstration, and communication. An image is a function which means the measurement of the characteristics of a viewed sight, such as illumination or colour. The use of computers to manipulate a digital image is called image processing technique. This method has a lot of advantages e.g. elasticity, adaptability, storage of data, communication. Film-based radiology which includes computerized radiography, digital radiography (flat-panel), computed tomography (CT), magnetic resonance imaging, digital mammography and digital fluoroscopy is now redundant and now has developed into various digital imaging modalities (MRI), nuclear medicine and surgical sonography for diagnosis. Thus, in radiology, digital image processing is now a routine skill for radiologists. Moreover, in radiation treatment preparation, the use of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) scanners is now an integral module of imaging.

With the help of various advance techniques of image resizing, the images can now be held efficiently. This approach has several sets of rules that can be synchronously applied in the images. Two dimensional and three-dimensional images can now be processed in different dimensions. The development of techniques related to Image processing dates back to 1960s. These techniques soon carved their niche in various fields, such as astronomy, medical

purposes, and television image enhancement. Cost of image processing came down and it became faster in the 1970s when the advent of computer system happened. The processing of images was much faster and cheaper in 2000s.

CT SCAN: Now days CT is broadly used for diagnostic and therapeutic procedures. Introduction of new procedures under guidance of CT in clinical practice has broaden the area of application and is promoting towards new research.

The term "COMPUTED TOMOGRAPHY", or CT, refers to a computerized x-ray imaging procedure in which a narrow beam of x rays is aimed at a patient and quickly rotated around the body. Hounsfield in 1967 surprised the entire medical world with the successful implementation of CT scan. The first CT of brain was done in 1971 in Wimbledon, England but it was not publicized in same year, a year later it was published. Producing signals that are processed by the machine's computer to generate cross-sectional images—or "slices"—of the body. These slices are called tomographic images and contain more detailed information than conventional x-rays. Once a number of successive slices are collected by the machine's computer, they can be digitally "stacked" together to form a three-dimensional image of the patient that allows for easier identification and location of basic structures as well as possible tumours or abnormalities. In 2008 new generation of CT scanner was developed that can take images of beating heart and coronary blood system in less than one second. CT angiography has shown high sensitivity with specificity for coronary artery disease.

The images are created in multiple dimensions instead of traditional radiography in this modality. The CT scanner creates several body tissue slices in various directions. The patient is placed within the aperture of the CT scanner and scanned in all directions by a revolving X-ray tube.

Application of CT scan:

- Determination of biological profile (age, stature, sex, socio-economic status etc)
- 3D multi-planar reconstruction (e.g., facial reconstruction)
- Demonstration of personal effects (e.g., jewellery to assist identification)
- Photo-superimposition

CT scan substitute the traditional modalities like plain x ray and fluoroscopy.

MAGNETIC RESONANCE IMAGING:

MRI is a non-invasive imaging technology that produces three dimensional detailed anatomical images. It is often used for disease detection, diagnosis, and treatment monitoring. It is based on sophisticated technology that excites and detects the change in the direction of the rotational axis of protons found in the water that makes up living tissues. MRI scanners are particularly well suited to image the non-bony parts or soft tissues of the body. They differ from CT; in that they do not use the damaging ionizing radiation of x-rays. The brain, spinal cord and nerves, as well as muscles, ligaments, and tendons are seen much more clearly with MRI than with regular x-rays and CT; for this reason, MRI is often used to image knee and shoulder injuries. Radio frequency pulse is used in MRI scanner and is applied to the subject which causes in spinning of energy. A radio frequency recorder is used to record the coming frequency and conerted into signal. When RF(radio frequency) pulse is removed the spin realign to the main field of magnet with a time constant T1 which is tissue specific. Second time constant is T2 which is always less thanT1 because the signal strength decreases with spin. This difference of spin density among various tissues allows excellent tissue contrast. Increasing magnetic field increases and improves resolution. But we cannot maximize the magnetic field as it may disturb visual and nervous simulation.

Minimally invasive autopsy (MIA) using post mortem magnetic resonance (PMMR) together with ancillary investigations has now been shown to be as accurate as conventional autopsy in foetuses, new born and infants and is particularly useful for cerebral, cardiac and genitourinary imaging. Unlike conventional autopsy, PMMR provides a permanent three-dimensional auditable record, with accurate estimation of internal organ volumes. MIA is becoming highly acceptable to parents and professionals, and there is widespread political support and public interest in its clinical implementation. In the short to medium term, it is desirable that a supra regional network of specialist centres should be established to provide this service within the current National Health Service framework.

APPLICATION OF MRI:

- MRI is very effective tool in assessment of violence in victims.
- MRI is highly specific for soft tissue examination so now days useful in examination of victims who survive from strangulation.
- To find out the cause of death after surgical errors, medical errors.
- Detection of foreign bodies, blunt traumas etc.

ULTRASOUND:

Ultrasound is a method that produces representations of the internal body structure with the help of returned echoes using high-frequency sound waves. Ultrasound is the same as the type of position determination used by certain species in nature such as bats and whales. Ultrasound is performed using a

transducer through which these high intensity waves pass through the tissues. A part of these waves is absorbed and the other is reflected out. Transducer receives and converts the reflected waves in to electric signals. These electrical signals, through the computer system, are converted into digital signals. In the ultrasonic method, every millisecond, thousands of pulses are sent. Many imaging methods are used to improve ultrasound images. Ultrasound scans are relatively safe because, instead of radiation, sound waves and their echoes to produce the image. Ultrasound scans are now routinely used to assess the development of fetus and problems in the functioning and structure of heart and vital abdominal organs. They can also be used while performing many types of biopsy. The output image is called a Sonogram.

Application:

Ultrasonography (USG) offers a non-invasion imaging technique as compare to conventional post mortem so it may be use as an alternative to invasive post mortem especially in case of infants where parents refuse to do any invasion. USG guided post mortem may help in identifying congenital deformities. Perinatal USG will be easy and easily accessible imaging tool. But USG performed on intra-uterine death are of low diagnostic quality in case prolonged time due to maceration related changes in the body. In a study conducted by Philippe Charlie et al two important limitations were noticed in using USG as a post mortem tool. First hyper echoic abdominal wall and second thoracic walls with gas distension in whole digestive and subcutaneous tissue limiting the role in post mortem findings as compare to conventional one.

FUTURE PERSPECTIVE:

Digitization of bodies is possible through imaging. As describe in this review article variety of modalities are available. Different researches have demonstrated that imaging techniques can be superior to routine autopsy so it should be applied with combination of earlier and new methods. From the above analysis it can be concluded that the conventional image processing methods which require single modality are slowly being replaced by techniques which involve data acquired from multiple modalities. The computational approaches are to integrate the imaging data with non-imaging data. To face this challenge the image processing methods like enhancement, segmentation, restoration morphological systems are integrated with expert systems like neural network and fuzzy logic. The interoperability of necessary integration of algorithms and support to standard techniques should pave way for physicians for future diagnosis.

REFERENCES:

1. Leth PM. Computerized tomography used as a routine procedure at postmortem investigations. Am J Forensic Med Pathol. 2009 Sep;30(3):219-22.
2. Poulsen K, Simonsen J. Computed tomography as routine in connection with medico-legal autopsies. Forensic Sci Int. 2007 Sep 13;171(2-3):190-7.
3. Leth P. CT-Scanning in Forensic Medicine. In: ; 2011. doi:10.5772/19719.
4. Ayoub T, Chow J. The conventional autopsy in modern medicine. J R Soc Med. 2008 Apr;101(4):177-81.
5. Butcher WD, Burnet J. Archives of the Roentgen Ray. *Br J Radiol*. 1973;46(550):878-884. doi:10.1259/0007-1285-46-550-878
6. Mittal S. Importance of Radiology in Forensic Medicine. *Indian J Appl Radiol*. 2016;3(1):110-113.
7. Kahana T, Hiss J (2005) Forensic Radiology. Forensic Pathology Reviews 3: 443-460.
8. Cormack AM. Reconstruction of densities from their projections, with applications in radiological physics. *Phys Med Biol*. 1973;18:195–207. [PubMed] [Google Scholar].
9. O'Donnell C, Iino M, Mansharan K, Leditscke J, Woodford N. Contribution of postmortem multidetector CT scanning to identification of the deceased in a mass disaster: Experience gained from the 2009 Victorian bushfires. Forensic Sci Int. 2010 Aug 4.
10. Silva RF, Botelho TL, Prado FB, Kawagushi JT, Daruge Júnior E, Bérzin F. Human identification based on cranial computed tomography scan - A case report. *Dentomaxillofacial Radiol*. 2011;40(4):257-261. doi:10.1259/dmfr/96080236