The History of Evolution of Magnetic Resonance Imaging in the Western Province of Sri Lanka

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INTRODUCTION

With the invention of X-rays by Professor Wilhelm C Roentgen in 1895 the foundation was laid to medical imaging technology. Computed tomography emerged in the 1960s and Mammography and Ultrasonography in 1970s. Invention of Magnetic Resonance Imaging can be considered as a remarkable milestone in diagnostic medical imaging technology. The development of magnetic resonance is attributed to the work of Felix Bloch and Edward Purcell in 1946, who independently discovered the presence of nuclear magnetic resonance in solids and liquids. In 1967, Paul Lauterbur, found that a photographic-style image could be generated using Nuclear Magnetic Resonance (NMR). At about the same time, Dr. Raymond Damadian, discovered that malignant body tissue had a different NMR spectrum than normal tissue and there by discovered the basis for using NMR as a tool for medical diagnosis. In 1976 he produced an image of the human body and introduced the Magnetic Resonance Imaging to the world. By 1977, Dr. Damadian completed construction of the first whole-body MRI (Magnetic Resonance Imaging) scanner.

Unlike most of other imaging modalities, MRI uses no ionizing radiation. Instead of ionizing radiation, it uses a powerful magnetic field to magnetize the Hydrogen atoms inside the body of the person being imaged. MRI produces an excellent soft tissue contrast of the anatomical structures leading it to be the best imaging modality to visualize brain, spinal cord, nerves, muscles, ligaments, tendons, shoulder joints and knee joints of the human body. MRI provides information that differs from other imaging modalities. A primary difference is that MRI process can selectively image several different tissue characteristics and can characterize and discriminate tissues using their physical and biochemical properties. MRI can produce sectional images of equivalent resolution in any projection without moving the patient. The ability to obtain images in multiple planes adds to its versatility and diagnostic utility and offers special advantages for radiation or surgical treatment planning. Because of the predominant advantages of MRI over other imaging modalities, its use in the medical imaging field has developed rapidly in the world. By 1977, Dr.Damadian completed the construction of the first whole body MRI scanner which he dubbed the 'INDOMITABLE'……The medical use of MRI has developed rapidly. The first MRI equipment in health was available at the beginning of early 1980s. In 2002 approximately 22000 scanners were in use worldwide. [1] By 1983 eight companies had completed prototypes, had multiple clinical placements outside the factory and had machines available for clinical placements; Bruker Instruments, Diasonics Inc., FONAR Corp., Philips medical systems, Technicare corp., Elscint Ltd. etc [2], which convinces how rapidly MRI had been introduced into the medical imaging field. But in case of Sri Lankan medical field, introduction of MRI technology has been delayed a lot compared to other countries.

According to Fernando T, MRI was not available in any of the government hospitals in Sri Lanka, including that of the Colombo General hospital and there were only two MRI scanners for the whole of Sri Lanka in two private hospitals in Colombo in 1997. [3] As pointed out by Gunarathne A, MRI was not available in any institute in public health sector in Sri Lanka and only the two main private hospitals in Colombo, had MRI scanners in 1999. [4] Review of literature revealed that no rigorous scientific studies have been carried out on the evolution of MRI technology in Sri Lanka. In order to explore the history of evolution of MRI in Sri Lanka this research topic was selected. General objective of this study was to describe the history of evolution of MRI in the Western province of Sri Lanka and the specific objectives were to find out how and when MRI was made available in private and government sector in Sri Lanka and to find out the expansion of clinical use and technological advancement of MRI in Sri Lankan diagnostic medical field.

METHODOLOGY

This descriptive study, aimed to explore the history of evolution of MRI in the Western province of Sri Lanka, was focused on the experiences of senior radiographers who had been practicing MRI as it was the only available source of information for this study. All the government and private hospitals which have the MRI facility in the Western province of Sri Lanka was selected as the study area. Study population was the most experienced radiographers in MRI, in all MRI units in the western province of Sri Lanka. With the permission of each hospital's administration, most experienced radiographer, who had been working with MRI, in each and every MRI unit in the Western province of Sri Lanka, was interviewed. Entire population was taken into account in order to prevent any loss of data.

Data were collected using face to face, semi structured interviews which composed of both open ended and closed ended questions. Data collection was done during the time period from August 2010 to March 2011. It was solely done by the researcher. With the permission and the written consent of the radiographer being interviewed, all the interviews were recorded using a voice recorder. Altogether seven interviews were carried out in seven hospitals in the Western province namely in National Hospital, Colombo 10, Nawaloka Hospitals plc, Colombo 02, Asiri Surgical Hospital, Colombo 05, Lanka Hospitals pvt ltd, Colombo 05, The Central Hospital, Colombo 10, Durdans Hospital, Colombo 03 and in Hemas Hospital, Waththala. Data analysis was done by using the 'Grounded Theory' – open coding method which was done manually by the researcher.

RESULTS AND DISCUSSION

According to Mr. M.G.G. Amarasinghe who had started MRI in private sector for the first time and Mr. L. Dissanayake who had started MRI in government sector for the first time, CT had been the cutting edge modality in pre MRI era. It had been the solution for most neurological problems. Although brain and spine could have been imaged with CT, the best results were expected from MRI. With the vast advancement of diagnostic imaging field there had been a big demand for MRI in Sri Lanka. Though there had been a demand and need for MRI technology, the introduction of MRI to Sri Lanka was delayed due to the high cost of the equipment and installation. In data analysis study results were emerged under three main themes and they are separately listed below under subheadings.

Chronology of development of MRI technology in the Western province of Sri Lanka:

1992: Nawaloka Hospitals plc - 0.2T HITACHI- permanent magnet MRI.

Before 1997: Asiri Hospitals plc - 0.5T GE MRI equipment

2000: Nawaloka Hospitals plc (the 2nd MRI equipment) -1.5T SIEMENS- SYMPHONY

2001: National Hospital, Colombo **-** 1T SIEMENS- HARMONY

2002: Apollo Hospitals plc (Lanka Hospitals) - 1.5T PHILIPS MRI equipment

2003: Asiri Surgical Hospital, Colombo **-** 1.5T GE - SIGNA EXCITE

2008: Hemas Hospital, Waththala - 0.2T GE – open magnet MRI

2009: National Hospital, Colombo (2nd MRI equipment) **-** 1.5T SIEMENS-AVANTO

2010: The central Hospital, Colombo **-** 1.5T GE - HXDT

2010: Durdans Hospital, Colombo **-** 1.5T SIEMENS - AVANTO

2011: Nawaloka Hospitals plc (3rd MRI equipment) **-** 3T SIEMENS- MAGNETOM SKYRA

How MRI had been introduced into Sri Lankan health sector:

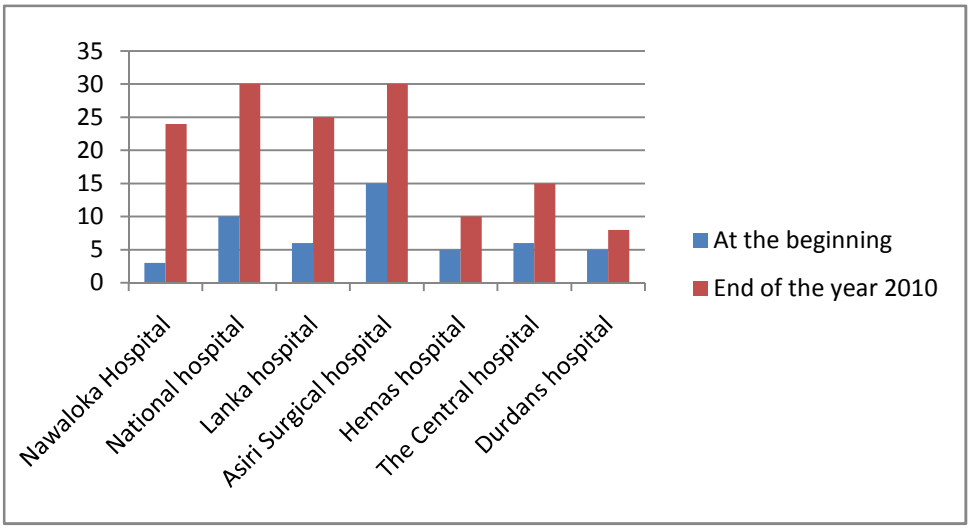
MRI had been first introduced into the private health sector of Sri Lanka. That was in the year 1992 and the Nawaloka Hospitals plc had been the pioneers of introducing this new technology to Sri Lanka. According to Mr. M.G.G. Amarasinghe, who had been working as the radiographer in charge of the Nawaloka hospital at that time, Nawaloka hospital had bought a hospital with all the medical equipments in Japan, that had been there for sale and he himself had gone to Japan and supervised removing all the medical equipments including the MRI and had witnessed shipping them to Sri Lanka. After that Nawaloka constructions had installed that 0.2T HITACHI permanent magnet MRI in Nawaloka hospital with the help of HITACHI Company.

Introduction of MRI technology to the government health sector in Sri Lanka had taken place after 9 years from the introduction of MRI to private sector. It was the year 2001 when MRI was made available for the general public in Sri Lanka. Procurement of the MRI scanner for the department of Neurosurgery at the National hospital, Colombo was a result of the untiring efforts and unwavering commitment of Senior Consultant neurosurgeon Dr. Colvin Samarasinghe, as the government had not fund for the procurement. According to Mr. L. Dissanayake, who had been the radiographer in charge in the National hospital in 2001, since the Sri Lankan government had not fund the procurement of the MRI equipment, Dr. Colvin Samarasinghe himself had collected money from the public, by selling caps and other charity works. As a result 1T SIEMENS – HARMONY MRI equipment had been installed in the Neurosurgery department of National hospital, Colombo in the 21st of January 2001.

Expansion of clinical use of MRI over time:

MRI technology had been introduced into Sri Lankan medical field in 1992 and its clinical use had been rapidly increased over the past 19 years. The following chart shows how the

number of MRI scans performed per a day had increased with time in each hospital in the Western Province of Sri Lanka.



The clinical use of MRI shows a remarkable increment in private sector. The number of private sector hospitals having MRI facility had been increased year by year. In the year 2010 two private hospitals have started new MRI units. And these hospitals shows gradual increment of the scans performed even for the little time period they had provided the service. Specially, Asiri Surgical Hospital had been doing 30 scans per day with single equipment while the National hospital had been doing 30 scans per day with two equipments. It is a clear fact that during the time period of data collection, in the private sector altogether around 100 MRI scans had been performed per a day while 30 scans had been performed in the government sector per a day in the Western province of Sri Lanka.

Technological advancements in the MRI field over time:

In 1992 Nawaloka hospital had introduced MRI to Sri Lankan health sector. The first MRI equipment they had was a 0.2T HITACHI permanent magnet MRI. The first technological advancement in MRI field also had been promoted by Nawaloka hospital by replacing this 0.2T permanent magnet MRI with 1.5T SIEMENS MRI equipment there by introducing the modern 1.5T MRI generation to Sri Lanka which has provided major advancements like reduced scan time, increased image quality, ability to change the sequences and protocols and to make new ones, ability to perform angiograms and MR Spectroscopy. Asiri hospitals plc also had promoted technological advancement in MRI field by replacing their first 0.5T MRI equipment with 1.5T GE equipment in 2003. National hospital, Colombo had contributed to the technological advancements in MRI field by introducing 1.5T SIEMENS AVANTO equipment to the Neuro Trauma unit in 2009 while having 1T SIEMENS HARMONY clinically used. The National hospital is the only place in Sri Lanka where two MRI equipments are practiced in one hospital at the same time. In the year 2008 with the introduction of the first open magnet MRI to Sri Lankan health sector, Hemas hospital had made a revolutionary step in the technological advancement in MRI field. This was 0.2T GE equipment and it had combined the power of MRI technology in a comfortable and spacious design that accommodates the need of all patients, including large patients and those suffering from claustrophobia and anxiety.

The most recent technological advancement in MRI field in Sri Lanka had been occurred in the May of 2011 and it was the introduction of 3T SIEMANS – MAGNETOM SKYRA MRI equipment to Sri Lankan diagnostic medical field by the Nawaloka hospitals plc. Advancements of 3T MRI equipment over 1.5T are ability to scan faster, high spatial resolution with more image details, extra contrast enhancement: twice the enhancement with1.5T for same contrast type and volume, high Signal to Noise Ratio value, better spectroscopy images due to the doubling of chemical shift, ability to produce Diffusion Tenor Imaging and BOLD (Blood Oxygen Level Dependant imaging) imaging.

There was sparse literature in the field of evolution of Magnetic Resonance Imaging in the world and no research study was found related to this topic. According to Terry Duggan-Jahns, introduction of 3T ultra high field MRI was the most recent evolutionary step in the MRI technology. [5] Comparatively this evolutionary step in MRI field had been introduced into Sri Lankan health sector in the year 2011. A two decade retrospective article written by J.P.Hornak on MRI hardware showed the advancements that had been occurred in the hardware of MRI over the last two decades in the world and according to Hornak so many developments had taken place in the hardware of MRI and the predominant clinical field strength has gone from fractions of a Tesla to 1.5 T in the late 80s to 3 T by the early 2000s. [6] When comparing this information with the results of the current study it is evident that all the above advancements in the MRI field had been occurred in the Sri Lankan diagnostic medical imaging field though there had been a delay of the introduction of MRI into Sri Lankan health sector.

CONCLUSION

When considering the history of evolution of MRI in the Western province of Sri Lanka it was found that MRI had been introduced to the Sri Lankan health sector in 1992 and up until year 2001 MRI was only available in the private health sector in Sri Lanka. After year 2000, the number of MRI units in the Western province had been increased in a great deal, including public health sector. In the year 2011, there were 2 MRI equipments clinically practiced in the public health sector and 6 MRI equipments in the private health sector in the Western Province of Sri Lanka. These equipments include 1T, 1.5T and the latest system available, the 3T MRI equipments. According to the study results the clinical use of MRI had been increased over time with wide variety of applications in neurology and there had been many technological advancements in MRI field in Sri Lanka.

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