

An audit of MRI in a teaching hospital in Nigeria: preliminary report

¹Charles C Ani; ¹Denen Atsukwei; ²Emmanuel O Adegbe; ¹Sunday D Pam;
¹John E Ekedigwe; ¹Blessed B Ukaonu

Abstract

Background: The advent of Magnetic Resonance Imaging (MRI) in Nigeria as a whole and in Jos in particular has added to the arsenal of valuable diagnostic tools in medical practice in this part of the world, with an increasing scope of its use. The aim of this study is to determine the indications, age range of patients investigated and findings on MRI at the Jos University Teaching Hospital.

Methods: A retrospective review of MRI investigations performed at the Jos University Teaching Hospital over an eighteen month period (May 2010-October 2011)

Results: There were 161 MRI investigations carried out during the study period. Of these, 136 were patients from within the index hospital while 25 were referrals from outside. A total number of 90 males (55.9%) and 71 females (44.1%) were investigated. The overall mean age

of patients was 42.5 ± 16.9 years with a range of 2-73 years. The major indications for MRI are seizure disorder: 17(10.6%), suspected lumbar spondylosis: 16(10%), suspected intracranial space occupying lesion: 14(8.8%), and cerebrovascular accident: 11(6.9%). The highest findings on MRI were normal: 48(30%) and degenerative disc disease: 26(16.1%).

Conclusion: Normal findings were mostly seen in MRI brain studies. Degenerative disc disease was mostly seen in MRI spine investigations.

Keywords: Magnetic Resonance Imaging, Brain, Spine, Degenerative disc disease.

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Introduction

Magnetic Resonance imaging (MRI) is a radiological technique that uses magnetism, radio waves and computer to produce images of structures in the human body. The MRI scanner is made up of a huge encased magnet. The patient is placed on a couch within the hollow of the magnet. The strong magnetic field produced aligns protons of hydrogen atoms in the body. A radio-frequency pulse is created through the application of alternating electric current and this radio-frequency pulse causes the protons of hydrogen nuclei to resonate to varying degrees thus generating a signal dependent on the hydrogen content of the tissue and setting of the magnet. This signal is detected by the receiving coil placed over the part of the body being examined and after complex data processing; an image is displayed on the monitor. Contrast agent such as gadolinium can also be injected intravenously to enhance better actualization of tissue differences.^{1,2}The image is generated ab-initio in various planes; sagittal,

coronal and axial, and thus can be displayed as such.

The image and resolution produced by MRI can be quite detailed depending on the strength of the magnet making it useful in defining brain anatomy and hence diagnosing structural abnormalities as stroke, brain tumors or aneurysms, and evaluating the integrity of the spinal cord following trauma. Degenerative and infiltrative changes in the vertebral column as well as problems in the intervertebral discs are best assessed using MRI. It also provides accurate information in the evaluation of the structures of the joints and the soft tissues of the body.³

MRI investigation commenced at the Jos University Teaching Hospital (JUTH) in 2009, with test run of the facility at the permanent site of the hospital. The Jos University Teaching Hospital as a tertiary health institution is presently one of the very few health facilities with this imaging modality in the North Central zone of the country. With the increasing scope of the use and application of MRI, this retrospective study was carried out to determine the indications for and findings on this imaging modality.

Materials and Methods

This was a retrospective study of MRI investigations performed at Jos University Teaching Hospital from May 2010 to October 2011. A Siemens Somatom 0.2Tesla Permanent Magnet MRI machine was used in

¹Department of Radiology, Jos University Teaching Hospital, PMB 2076, Jos; ²Support to National Malaria Control Programme, Abuja.

Corresponding Author

Dr Charles Ani, Department of Radiology, JUTH, Jos.
E-mail: dranicarles@yahoo.com, dranicarles@gmail.com

the study. The cost of MRI at the index hospital is presently about \$350 per investigation.

The duplicate reports of the patients who had the investigation were retrieved from the Radiology departmental records. The age, sex, Hospital number, indications for, part of the body studied as well as the findings from the reports were documented. Follow-up or repeat investigations of same body part in subjects who had MRI were screened out. The data was entered into a computer and analyzed using Epi-Info 2000 for windows 3.5.1. The results were presented in form of tables and graphs.

Results

Characteristics of subjects

There were 161 MRI investigations carried out on 136(84.5%) patients from within JUTH and 25(15.5%) referrals from outside over the study period. There were 90(55.9%) male patients and 71(44.1%) females with a mean age of 42.5±16.9 years (42.5±17.8 years versus 42.5±15.8 years for males and females respectively, p=0.98). The ages of the patients ranged from two to 73 years. The age group with the highest frequency was 40-49years (23%) followed closely by 30-39years (22.4%) and 50-59years (18.6%) (Fig 1)

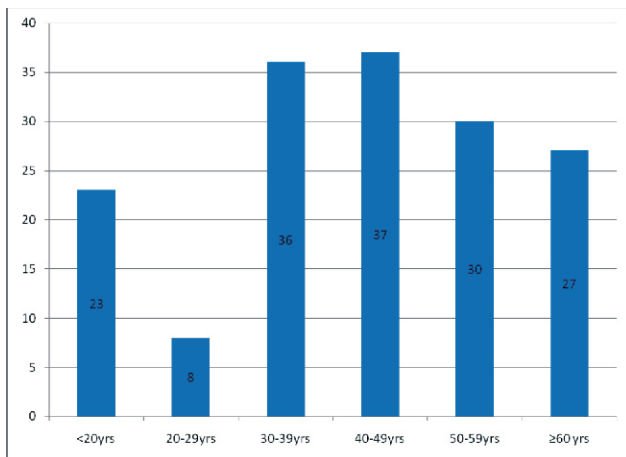


Figure 1. Percentage age distribution of patients who had MRI at the Jos university teaching hospital

Indications for MRI

Seizure disorders (17, 10.6%), lumbar spondylosis (16, 10%), intracranial space occupying lesion (14, 8.8%), and cerebrovascular accident (11, 6.9%) constituted the major indications for MRI. Other notable indications included cervical spondylosis, spinal cord compression, prolapsed intervertebral disc, headache, Pott's disease, dementia, pituitary mass and autism. A wide variety of minor indications for MRI classified as 'others' including sinusitis, Parkinsonism, hearing loss, microcephaly etc contributed to a total frequency of about 34(21.1%) and together constituted the largest

group of indications for MRI. In 18 cases (11.3%), the request cards were improperly filled and hence the indication for MRI was classified as 'unknown'.

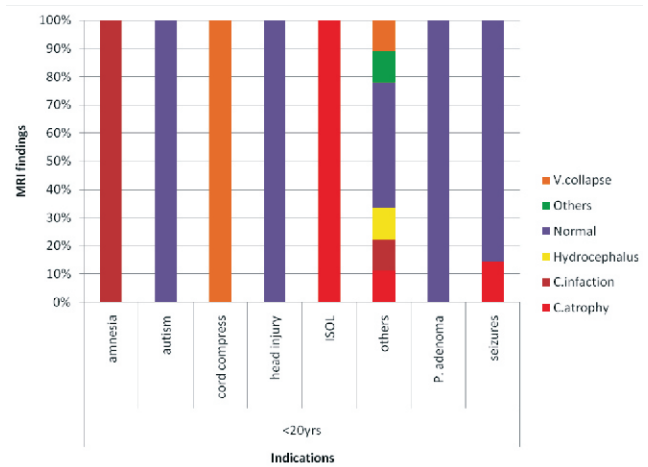


Figure 2: MRI Findings against Indications in patients less than 19years at the Jos university teaching hospital

Further analysis of the highest indications for MRI by age group showed the following; seizure disorders accounted for 30.4% inpatients less than 19yearsold, headaches (25%) in those 20-29years, suspected intracranial space occupying lesion(16.7%) in 30-39years, lumbar spondylosis (16.2% and 20% respectively) in 40-49years and 50-59years age groups, and dementia(15.4%) in patients 60years and above.(Fig 2- Fig 7)

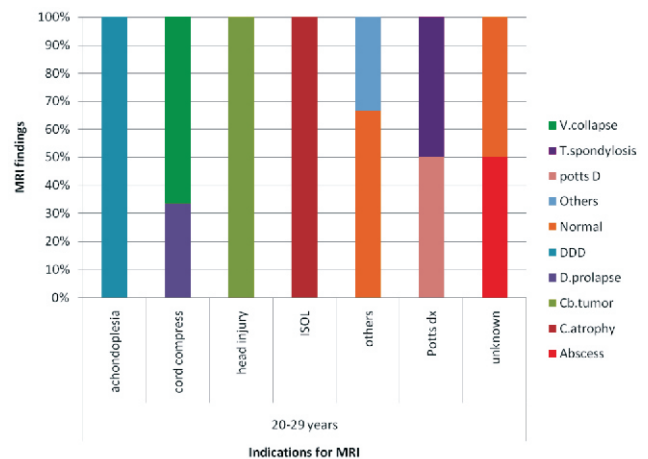


Fig 3: MRI Findings against Indications in patients aged 20-29yrs at the Jos university teaching hospital

MRI brain constituted 84(52.2%) of all the investigations done during the study period, MRI spine constituted 72(44.7%) while MRI of other parts of the body made up 5(3.1%). Of the 72 spine investigations, 35(48.6%) were for lumbar spine, 22(30.6%) were for cervical spine and 15(20.8%) were for thoracic spine.

Of the 25 referral cases, 15(60%) were for the MRI spine; 9(36%) for MRI brain and 1(4%) individual was for MRI of the elbow joint.

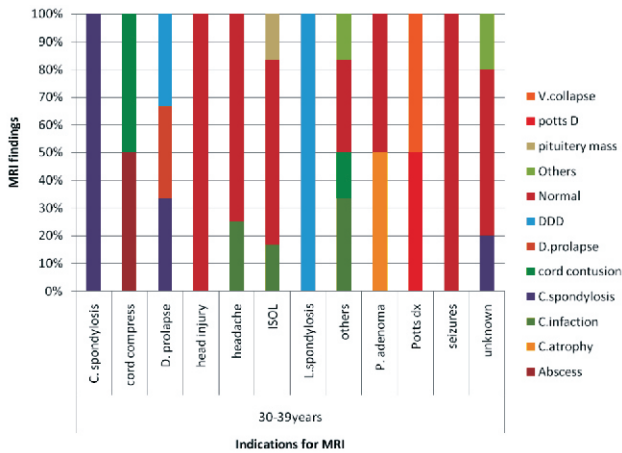


Figure 4: MRI Findings against indications patients aged 30-39years at the Jos university teaching hospital

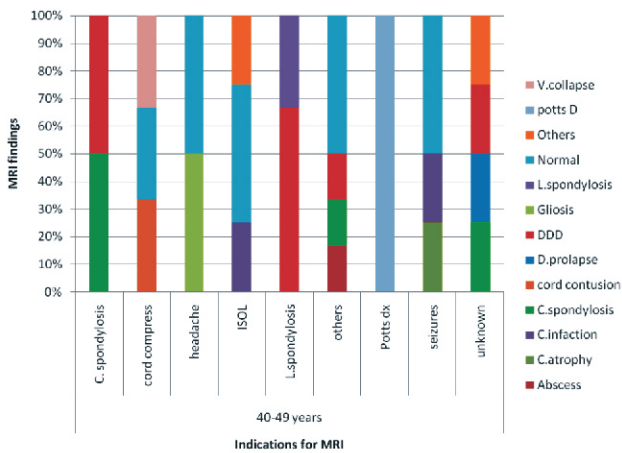


Figure 5. MRI findings against indications in patients aged 40-49years at the Jos university teaching hospital

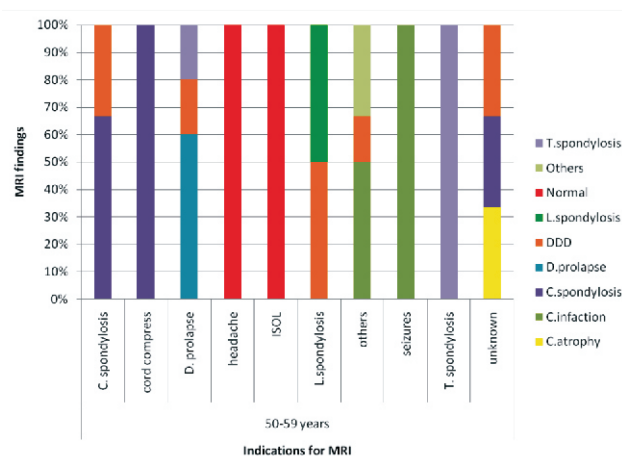


Figure 6. MRI findings against indications in patients aged 50-59years at the Jos university teaching hospital

Findings on MRI

The commonest findings on MRI were normal(48, 30%) and degenerative disc disease(26, 16.1%) as40(47.6%) of the MRI brain and 5(6.9%) of MRI spine were assessed to be normal respectively. Other key findings on MRI brain included cerebral atrophic changes (18, 21.4%) and cerebral infarcts (13, 15.4%). Degenerative disc disease involved more of the lumbar spine(18, 51.4%) than the cervical spine(8, 36.4%). Prolapsed lumbar intervertebral discs were found in 8(11.1%) individuals. The major findings in the thoracic spine were Pott's disease: 4(26.7%) and collapsed vertebrae: 4(26.7%) (Fig 2-7)

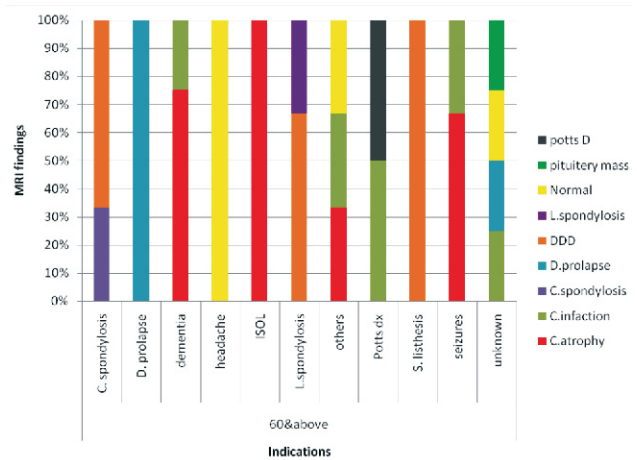


Figure 7. MRI findings against indications in patients aged 60years and above at the Jos university teaching hospital

Discussion

Magnetic Resonance Imaging as a radiological investigative technique is still novel in this part of the world. Its availability in our setting at the Jos University Teaching Hospital in recent years has provided another important focus for referrals to this tertiary health institution. The scope of use of MRI continues to be on the increase worldwide.⁴ It is widely used by Orthopedic surgeons in the diagnosis of bone and soft tissue pathology and Neurosurgeons for assessing the brain and spinal cord. However with its availability in only a few centers in our country, MRI can be said to still be at an evolving stage in our locality. The cost of an MRI investigation remains a global issue.⁵ It is presently the single most costly investigation in our center. The total number of MRI (161) done during the eighteen month study period is therefore encouraging considering also that this study was carried out prior to the establishment of a Neurosurgery unit in our center.

The age group with the highest frequency was 40-49years. This is followed by 30-39years and 50-59years,

comprising the late youth and the middle age groups. The middle age is often associated with onset of degenerative disease affecting the spinal column and other disease processes frequently presenting as back pain.^{6,7} Lumbar spondylosis therefore ranks high as an indication for MRI in these age range and this agrees with what is found in other studies. In a cross sectional study carried out with a large cohort including individuals in their middle age at randomly selected Ontario hospitals in Canada, You JJ et al⁸ established that back pain and radiculopathy were the most frequent indications for MRI of the spine. In a review of MRI of the spine of about 240 Mexican subjects divided according to age groups, Villareal-Arroyo et al⁹ found that the frequency of disc degeneration increased with age with patients above 50 years being the most affected.

A frequency peak is also seen in the less than 19 (pediatric and adolescent) age group with seizure disorder being the major indication for MRI for this age group. The major indication for MRI for those over 60 years was dementia. Accordingly, while MRI of the spine was frequently requested for middle age individuals, MRI of the brain was the mostly requested for the extremes of life.

MRI brain was most frequently carried out during the study period followed by MRI of the lumbar spine. The commonest indication for MRI was seizure disorder while the commonest findings on MRI were normal: 48(30%) and degenerative disc disease: 26(16.1%) in that order. Normal findings were seen more in MRI brain (40, 47.6%) than in the lumbar spine investigations (5, 6.9%). However, in a population based study involving 2000 subjects with a mean age of 63.3 years, using a 1.5T MRI machine, Vernooij MW et al¹⁰ discovered brain infarcts, cerebral aneurysms and meningiomas as incidental findings in MRI of the brain. The lower field strength MRI machines (including 0.2Tesla) are associated with lower signal-to-noise ratio (SNR) and lower contrast-to-noise ratio (CNR) and thus produce relatively lower quality images than are preferred by readers in image quality assessment studies.¹¹ It is also known however, that for the same bandwidth, the shift in water and fat signals is three times lower at 0.5T than at 1.5T (and even lower at 0.2T) and this amounts to improvement in image quality in regions of the body where a low shift between water and fat signal is preferable e.g. the spine and knee.¹² The above facts make it that while it is easier to make out subtle differences in tissue intensities in pathologies affecting the spine, subtle changes in the brain may require more focused training

to confidently elicit with low magnetic field strength MRI machine. This may account for the findings on MRI brain and MRI spine with the 0.2T machine presently available in our center.

The limitations to this study therefore include the association of lower field strength MRI machines as used in the study with relatively lower quality images which may have affected the findings especially with MRI of the brain. Also, a larger cohort to be analyzed in envisaged further studies should be more variedly inclusive than was seen in the preliminary study.

In conclusion, major indications for MRI over the study period were seizure disorder, lumbar spondylosis, suspected intracranial space occupying lesion and cerebrovascular accident. Normal findings were mostly seen in MRI brain investigations while degenerative disc disease was the commonest finding in MRI spine studies. Efforts should be made for further training of the Radiology staff on ground on the challenges of the newer imaging modality for more effective utilization and output while plans should commence on how to acquire higher Tesla equipment.

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