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EVALUATION OF LUMBAR DISC DEGENERATIVE DISEASE USING MRI IN PATIENTS WITH CHRONIC BACK PAIN: A CROSS-SECTIONAL STUDY CORRELATING IMAGING FINDINGS WITH CLINICAL HISTORY

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Abstract

The objective of this study was to evaluate the lumbar disc degenerative disease on MRI in patients with chronic back pain correlated with their key risk factors and clinicopathological history. The descriptive cross-sectional study was conducted at Ghurki Trust & Teaching Hospital Lahore, from June 2024 to November 2024. A sample size of 245 was chosen for this study. Subject patients with a history of chronic back pain were scanned under a 0.4-Tesla Magnetic Resonance Imaging machine. Multiple pathological findings were observed on MRI. Data were analyzed and frequency statistics were calculated using the Statistical Package for Social Sciences (SPSS) software version 20. A total of 245 patients with multiple presenting complaints, were studied for the evaluation of the lumbar spine on MRI. Of 245 patients, 129 (52.7%) were males and 116 (47.3%) were females. Multiple risk factors were evaluated including radiating or non-radiating pain, history of trauma and weight lifting. Regarding pathological involvement of lumbar discs, it was seen that LV1-LV2 disc level was affected in 21 (8.6%) patients, LV2-LV3 disc in 39 (15.9%) patients, LV3-LV4 disc in 88 (36.0%) patients, LV4-LV5 disc in 182 (74.5%) patients and LV5-S1 disc in 139 (56.8%). Regarding MRI findings disc degeneration was seen in 204 (83.3%) patients. As per the results of this study, the most common cause of chronic back pain was seen to be disc degeneration (83.3%), and the most affected disc level was LV4-LV5. It was also noted as an additional discovery that men (52.7%) suffer more from back pain due to their more strenuous lifestyle than women (47.3%). This study highlights the high prevalence of lumbar disc degeneration, particularly at the LV4-LV5 level, as the leading cause of chronic back pain, providing essential insights for targeted diagnostic and therapeutic strategies.

Keywords: *Chronic back pain, Disc degeneration, Radiating pain, Weight lifting*

INTRODUCTION

The lumbar spine consists of 5 vertebral bodies piled up on one another and separated by 5 cushioning discs (1). The vertebral bodies are usually named in 1 to 5 numbers, and the discs are named by the bones above and below. Therefore, the LV4 and LV5 vertebral bodies are separated by the LV4-5 disc. The sacrum lies immediately below the lumbar vertebrae. Behind the vertebral bones and discs is the column called spinal column which contains the nerves and fluid called cerebral spinal fluid (CSF) (2). The disc comprises two parts. Nucleus pulposus and Annulus fibrosus. Nucleus pulposus is the central softer part and annulus fibrosus is the outer layer which is little harder. The outer hard covering annulus fibrosus supports and keeps the central nucleus pulposus in its place and there is no contact with the nerve roots (3) The most common disease in the world is back pain. Back pain can be sudden, chronic, extremely painful, and debilitating, drastically affecting a person's quality of life. Lumbar vertebrae provide support to the back and spinal column and allow attachment to muscles and ligaments. Lumbar vertebrae bear body's whole weight

and responsible for maintaining the balance as well. Muscle and ligament attachments along with intervertebral joints provide flexibility to the body making movement easy and possible (4).

Back pain does not occur due to any disease in most cases but some groups of symptoms can be marked as diffused, sub-acute, or chronic pain. Patients who continue to have back pain beyond the acute period which lasts for about four weeks lead to sub-acute pain stage. If pain or symptoms are not resolved in this sub-acute phase, they lead to a chronic condition that has a longer duration (5). During this phase, patients may suffer from diffused pain. Chronic backache is a prolonged pain in one's back that can possibly be due to multiple underlying reasons or pathologies. These pathologies include degenerative disc, disc herniation, disc bulge, disc desiccation, osteophytes, spondylolisthesis, and radial tear (6). Intervertebral discs are shock- absorbing sponge cushions between the vertebral bodies. Degeneration of these discs can cause localized back pain and is considered to be the most common cause of low backache (7). Degenerative disc disease can also cause weakness, numbness, and burning (radicular pain) in the arms or legs depending on the affected spine region (8). When the intervertebral disc is pushed to the next level, a herniated disc appears and as a result, this blow puts pressure on the nerves, causing severe pain associated with numbness and tingling. In industrialized countries, the lifetime prevalence of nonspecific (common) chronic back pain is estimated to be 60% to 70% (an annual prevalence of 15% to 45% and an annual incidence of 5% in adults). Imaging tests, such as X-rays, CT scans, and MRI are needed to help determine the root cause of chronic back pain (9). Plain radiography is the initial way to diagnose the symptoms of chronic back pain in patients.

However, Magnetic Resonance Imaging (MRI) is the best modality to see and image the soft tissues. The main principle of MRI lies in the way Hydrogen protons present in the cellular fluids and adipose tissues respond to an external magnetic field instead of ionizing radiation, and multi-planar images with an excellent contrast resolution (10). The MRI software can distinguish between tissues according to their shades of grey which depend on the differences in recovery time of protons (11). The intensity of signal dependent on the number of protons that recover and their bonding between molecules within tissues or water molecules. Finally, the location and forms of water, fat, bones and other materials can be visualized according to their resonance which displays in the form of shades of grey. That is why MRI is considered to be radiation safe, sensitive and specific modality for the study of soft tissues and their pathologies. It provides information about the vertebral bodies, spaces between the disc, CSF, and spinal cord (12). Current studies lack comprehensive data linking lumbar disc degeneration on MRI with key risk factors like trauma and lifestyle. This study fills these gaps by identifying LV4-LV5 as the most affected level and disc degeneration as the primary cause of chronic back pain. The LV4-LV5 and LV5-S1 levels endure maximum stress, making them prone to degeneration. This study emphasizes the importance of MRI for early detection, aiding timely management of chronic back pain.

There is a need to conduct research on this topic in Pakistan because every second person here is a patient of back pain due to less information about this disease patients misjudge it and take irrelevant painkillers which cause just suppression of pain for some time but the root cause remains untreated and eventually becomes chronic disorder leading to multiple complications which further might need surgery.

MATERIALS AND METHODS

This was a descriptive cross-sectional study. A descriptive cross-sectional study is a study in which the disease or condition and potentially associated factors are measured at a particular point in time for a described population.6 The duration of the study was 6 months from 1st June 2024 to 30th November 2024 at Ghurki Trust & Teaching Hospital (GTTH) Jallo Mor, Lahore. A total of 245 patients with chronic back pain for the evaluation of lumbar spine were scanned using 0.4 Tesla MRI machine which is an open-type machine. All the observations were made by Radiologists. The sample size was determined using a convenient sampling technique. Convenient sampling is a method of collecting those samples which are conveniently located around a location or Internet service. Current study involved respondents who were "convenient" to be a part of this research.7 The Inclusion Criteria was set to take in patients with the history of chronic back pain for more than three months either radiating or non-radiating. All unwilling patients, patients with congenital spinal abnormality, and with metallic Implant like cochlear implant, pacemaker,

incompatible rods or shunts were excluded. The analysis of data was made using SPSS. Mean standard deviation was calculated for quantitative variables, including lumbar spine pathologies.

RESULTS

Total 245 patients with multiple presenting complaints, of which chronic back pain was most common, statistics were calculated as shown in Table 1. Regarding Subjects which were included in the study, all had the complaint of pain since the minimum of three months with a characteristic of radiating pain in 206 (84.1%) patients. Patients who suffered from numbness along with pain were 141 (57.6%) and who had normal bowel/bladder control were 208 (84.9%). Other risk factors like trauma and weight lifting were also included. There were 30 (12.2%) patients with the history of trauma and weight lifting caused pain in 30(12.2%) patients.

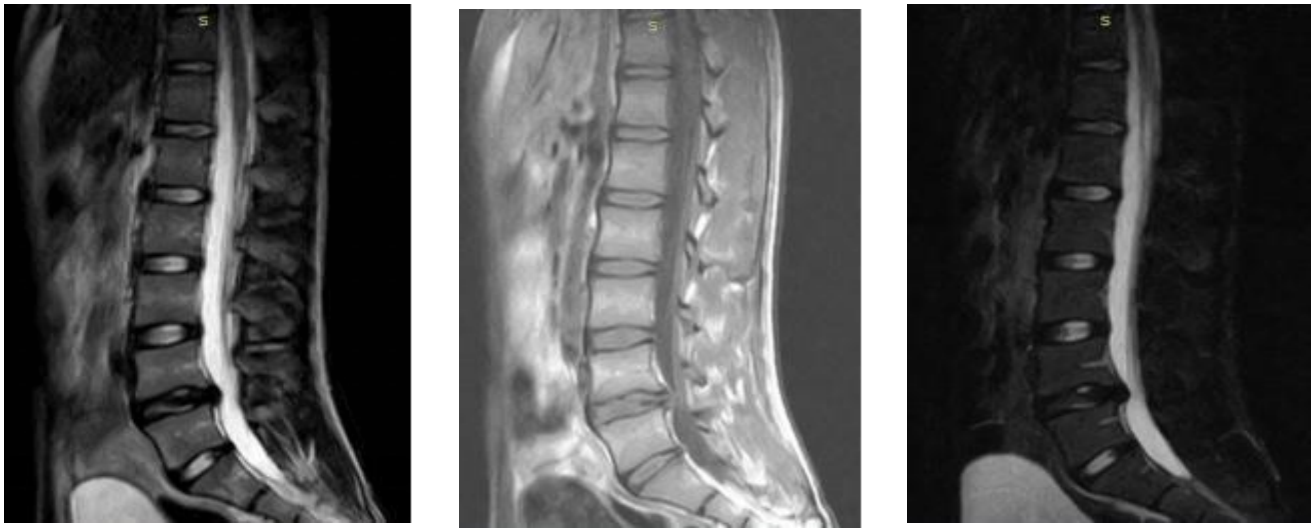
Table I. Collective data taken from patients

History	Frequency	Mean	STD Deviation
Pain Duration (Months)	245	19.2	37.193
Radiating Pain	207	84	367
Bowel and Bladder Control	208	85	359
Numbness	141	58	495
Date of Incidence (Months)	30	6.4	32.329
H/O Trauma	30	12	328
Weight Lifting	30	12	328
	Pathology		
Disc Degeneration	204	83	374
	Vertebral Disc Level		
L1-L2	21	9	281
L2-L3	39	16	367
L3-L4	93	38	486
L4-L5	207	84	363
L5-S1	157	64	481

Regarding MRI findings disc degeneration was seen in 204 (83.3%) patients. Regarding pathological involvement of lumbar discs, it was seen that LV1-LV2 disc level was affected in 21 (8.6%) patients, LV2-LV3 disc in 39 (15.9%) patients, LV3-LV4 disc in 88 (36.0%) patients, LV4-LV5 disc in 182 (74.5%) patients and LV5-S1 disc in 139 (56.8%) patients as shown in Figure 5. MRI Imaging prospects can be seen in Fig. 1 to Fig. 4.

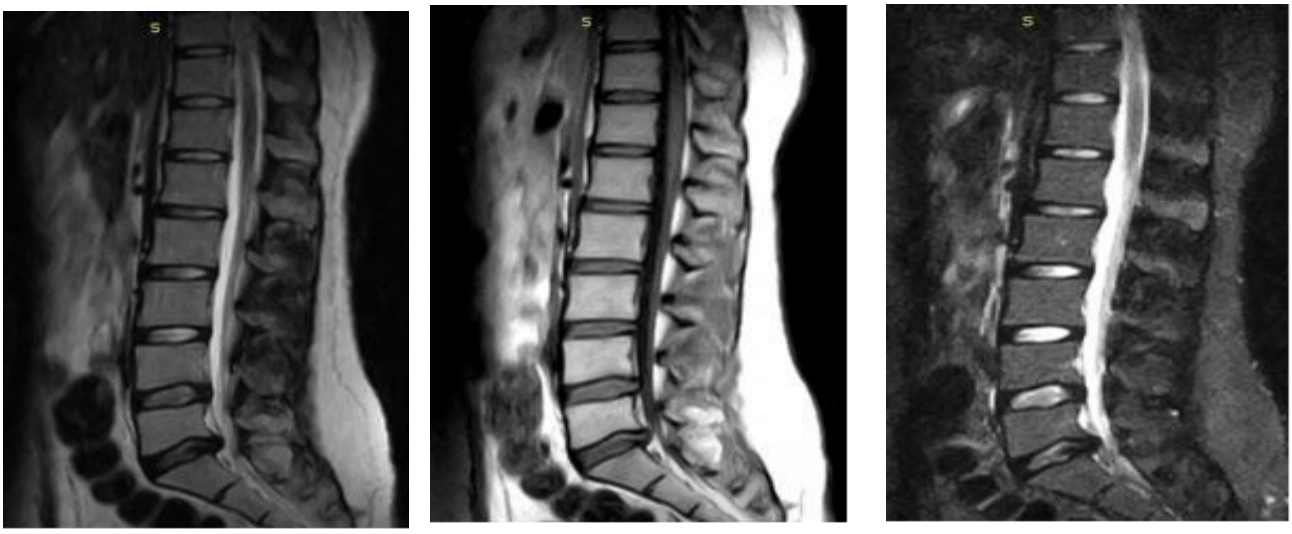
Normal Lumar Spine

Fig. 1. Sagittal T2 weighted MRI image



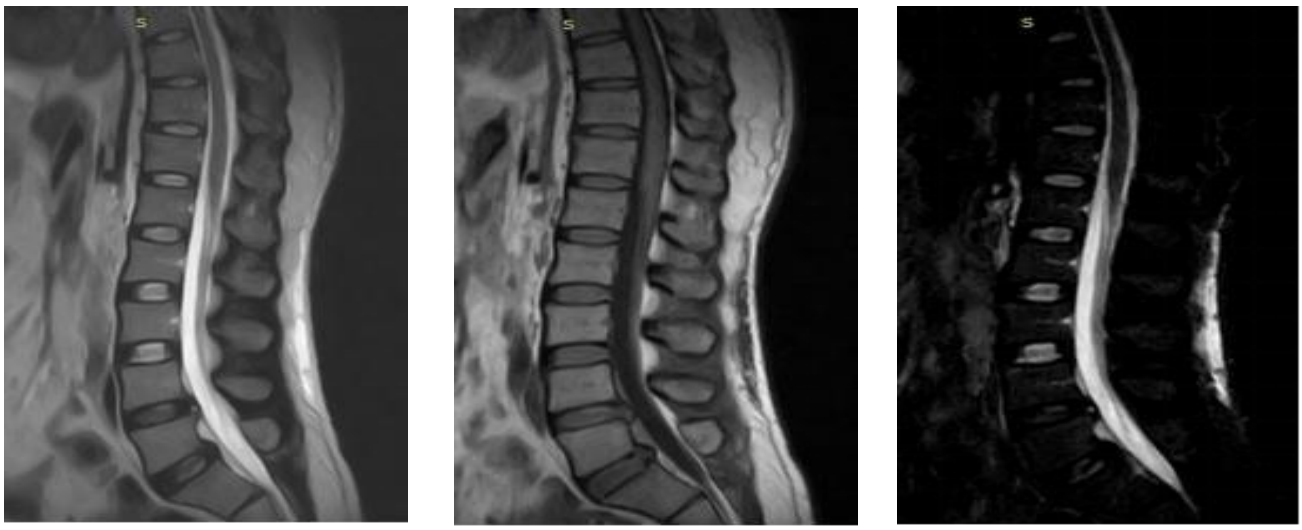
2A: T2 sagittal 2B: T1 sagittal 2C: STIR sagittal

Fig. 2. Degenerative changes are noted in adjacent end plates Posterioly at L4-5 disc level



3A: T2 sagittal 3B: T1 sagittal 3C: STIR sagittal

Fig. 3. Early degenerative changes are noted at L4-5 & L5-S1 disc level



4A: T2 sagittal 4B: T1 sagittal 4C: STIR sagittal

Fig. 4. Degenerative changes are noted at lower lamber disc levels. Tiny broad disc bulge is appreciated at L5-S1 level

Frequency of Frequency of disc degeneration in term of vertebral disc levels was calculated as shown in Fig. 5 and Comparative graph was plotted between pathological updates in term of disc degeneration.

Regarding pathological involvement of lumbar discs, it was seen that LV1-LV2 disc level was affected in 21 (8.6%) patients, LV2-LV3 disc in 39 (15.9%) patients, LV3-LV4 disc in 88 (36.0%) patients, LV4-LV5 disc in 182 (74.5%) patients and LV5-S1 disc in 139 (56.8%) patients as shown in Figure 5.

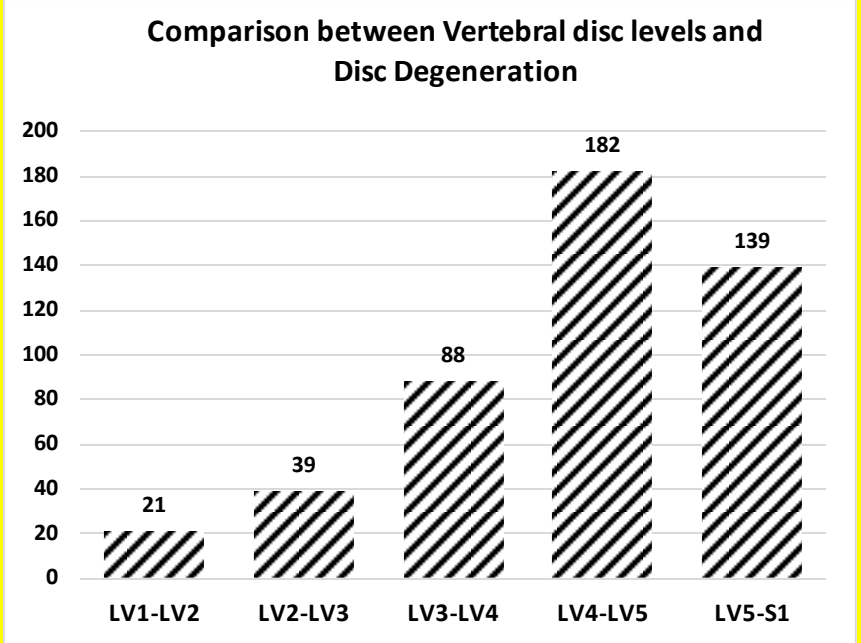


Fig. 5. Frequency of disc degeneration in term of vertebral disc levels

Regarding pathological involvement of lumbar discs, it was seen that LV1-LV2 disc level was affected in 21 (8.6%) patients, LV2-LV3 disc in 39 (15.9%) patients, LV3-LV4 disc in 88 (36.0%) patients, LV4-LV5 disc in 182 (74.5%) patients and LV5-S1 disc in 139 (56.8%) patients.

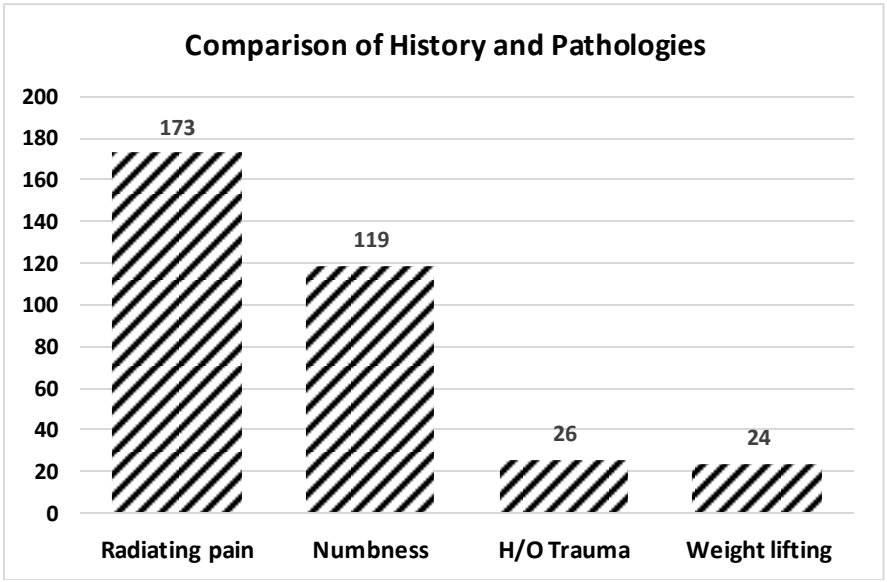


Fig. 6. Shows the frequency of history and pathologies

Estimating clinicopathological follow up, all had the complaint of pain since the minimum of three months with a characteristic of radiating pain in 173 patients. Patients who suffered from numbness along with pain were 119 and who had normal bowel/bladder control were 208. Other risk factors like trauma and weight lifting were also included. There were 26 patients with the history of trauma and weight lifting caused pain in 24 patients.

DISCUSSION

A cross-sectional study was conducted on 210 patients with lower back pain. L4-L5 and L5-S1 fusion Changes in disc degeneration were most noticeable at L4-L5 and L5-S1 (13). This study, which included 245 patients, discovered disc degeneration at the LV4-LV5 and LV5-S1 levels (14). According to a researcher it

was reported that degenerative spinal disorders disproportionately afflict men (15). At the L5-S1 level, reduced disc height was frequently observed. Per person, more than one disc was involved. The L4-L5 disc was most frequently affected (16). At the L4-L5 disc level, an annular disc tear, disc herniation, and disc extrusion were frequent. Bulging discs at the L3-L4 and L4-L5 disc levels were prevalent (17). At the L3-L4 and L5-S1 disc levels, osteophytes were frequent. Spondylolisthesis and L1-L2 disc involvement are less frequent. According to the findings of this study, which involved 245 patients, disc degeneration was observed at LV4-LV5 & LV5-S1 levels (18).

A researcher assesses the amount of disc degeneration by analyzing the lumbar disc degeneration patterns in individuals with low back pain (19). 1000 entire spines and lumbosacral spines in total were examined using MRI technology. L4-L5 disc degeneration was most prevalent (41.2%) and disc protrusion was most prevalent (69.4%). At L5-S1 level, disc height loss was frequent (32.2%) (20). The most frequent appearance (38.2%) is multidisc involvement, followed by continuous double level (34.7%), with disc bulges being recorded commonly at the L3-L4 (27.2%) and L4-L5 (26.9%) levels (21). 56.1 percent of discs showed modic alterations at prolapsed levels. At the L5-S1 level, and spondylolisthesis was often documented (87.5%). There were many posterior osteophytes at L3-L4 (31.1%) and L5-S1 (31.1%) levels. D12-L1 had the lowest incidence of disc degeneration (4.1%) (22). The results of this study, which involved 245 patients, showed that disc degeneration was seen at the LV4-LV5 & LV5-S1 levels (23). According to studies from 2021, 280 of the 590 athletes with a radiological diagnostic of spondylolysis and concurrent spondylolisthesis were athletes (47.45 percent) (24).

Although MRI may provide the most thorough evaluation of the lumbar spine, without the potential risks of gonad irradiation, the high prevalence of spondylolysis in athletes with low back pain compared to the general population suggests that it would be wise to include a radiological examination of the lumbar spine in symptomatic athletes engaged in sports who are considered to be at risk (25). Out of 245 individuals, 22 (or 9.1%) had spondylolisthesis at the level of LV4-LV5, and 44 (or 4.4%) had lumbar vertebral bodies at the LV5 body (26).

Keeping in mind the results of previously conducted studies the goal of this study was set to find results in coherence with previous ones so as to reduce the time of investigation and to provide the right pathway for diagnosis which can lead to timely treatment. As chronic back pain is the most common problem of today due to strenuous activities and it affects the lifestyle hindering in daily life dealings (27).

Convenient sampling was used to select participants, ensuring a practical and timely recruitment process. However, this approach may introduce selection bias, limiting the generalizability of findings. We have compared our study with past studies which show that most patients have a history of numbness, radiating pain, and weight lifting which mostly causes disc degeneration at L4-L5, L5-S1 Disc levels. The limitations of our study were time limitation and subject's limitation.

CONCLUSION

As per the results of this study, the most important cause of chronic back pain was disc degeneration (83.3%) is common at LV4-LV5 disc levels. Magnetic Resonance Imaging (MRI) is a well-known imaging system for detecting disc pathology due to its multi- planar imaging capability, excellent contrast of soft tissue of the spinal cord, the exact localization of intervertebral disc changes, and lack of radiation. But it is a time-consuming procedure and not cost-effective as well. So, by looking at the patient's presenting complaints and physical examination the most possible cause of the pain can be deduced and it can be managed timely without any delays in order to prevent severe outcomes.

Perhaps future studies coupling the knowledge from this research with both the patient's clinical history and physical exam may form fundamental avenues in early interventions to treat chronic back pain and its further advancement. Other diagnostic imaging techniques, which may include X-ray or ultrasound may be sought for initial diagnostics and effective and cheaper than MRI. With the help of these approaches, timely management can be put in place and the eminently fatal conditions and reduced, the QoL of the patients advanced.

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Disclaimer:

This study has been conducted for the purpose of our final year thesis during post-graduation.

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