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Research Paper

THE ROLE OF IMAGING IN EXAMINING NEUROLOGICAL DISORDERS; ASSESSING BRAIN, STROKE, AND NEUROLOGICAL DISORDERS USING CT AND MRI IMAGING

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ABSTRACT **Background: Neurological disorder is identified as a severe cause of mortality among the patients. Given the severity of the disorder, various tools have been developed for the effective scanning of the symptoms and causes. Objective: The study intends to compare the two advanced neuroimaging tools *i.e.* computed tomography (CT) and magnetic resonance imaging (MRI) for assessing the patients of the possible brain, stroke, and neurological disorders concern their neurological symptoms and signs. Method: The retrospective study was conducted and medical records of 151 patients were assessed statistically. Chi-square test was applied to the collected data. Results: The results of the study provided that multiple seizures (15.2%) served as the major cause of examination, followed by a headache (9.9%), visual complaint (7.9%), single seizure (5.3%), gait abnormality (3.3%) and altered consciousness (2.6%); whereas, speech difficulty remained low (1.3%). CT scan findings of the patients reported parieto-temporal area and development of acute hypo densities as the prime concerns, where its results remained insignificant (0.29). Using MRI, unremarkable MRI was majorly reported, followed by lateralized to one side, stable MRI feature, bilateral symptoms, and ischemic disease. The results of MRI were significant (0.00). Conclusion: The study concludes that magnetic resonance imaging is more effective for the evaluation of the neurological disorders as compared to CT scan.**

KEYWORDS :CT Scan, MRI, Neurological Disorder, Brain, Stroke

INTRODUCTION

In the healthcare system, the diagnosis, management, and treatment associated with the neurological disorder are considered to be most challenging based on its integrations of the complex nervous system [1]. It is also because it entails high accuracy, precision, and dedication for diagnosing the disease and suggesting treatment which ensures the provision of adequate neurological care. The intensity of the neurological diagnosis challenges has been mitigated given the increased dynamics and emergence of modern technology that supplements the providence of acute neurological care [2]. Association of the disorder with the nervous system gives rise to various changes in the structural, biochemical as well as electrical abnormalities in the spinal cord, brain and other nerves which consequences in a various range of symptoms. Assessment of the literature and medical record provides that the nervous system is vulnerable to about 600 diseases [1]. Some of these diseases are dementia, Alzheimer, epilepsy, and cerebrovascular. It also involves diseases like stroke, migraine, Parkinson's disease, multiple sclerosis, brain tumors, neuro-infections, and nervous system traumatic disorders such as autism and brain trauma [3].

As per earlier reporting of the World Health Organization, the people suffering from epilepsy alone exceeds the figure of 50 million [4]. The recent reporting of it states that there are about 35.6 million individuals who are suffering from dementia, where an increase of about 7.7 million takes place annually. The disease of Alzheimer which regarded as the most prevalent cause of dementia is considered a part of 60 to 70 percent cases of it [5]. The occurrence of this disease impacts the people across the world, regardless of age, sex, education, and income that individual possesses.

One of the deadly cases reported for cancer is brain cancer, which is exhibited as the most severe death threat and is mainly incurable [6]. The annual case reporting of brain cancer in the US is estimated to be 1520 affecting almost 100,000 individuals. The survival rate of patients suffering from brain cancer for 5 continuous years has remained stable i.e. 75% for the past ten years [7]. The metastasis of the brain has increased as well as its rising survival cases given the advancement of the therapies used for cancer treatment. Further, this has also resulted in the growth of better sensitive diagnostic imaging techniques [8].

The body imaging used in medical care can be drawn back to 1895 when the 1901 Nobel Laureate Wilhelm Conrad Röntgen discovered the x-ray [9]. With the evolution of technology and increased complexity of the neurological disorder, the conventional Radiology (Rx) has been added with various other techniques for body imaging. Though the conventional planar image continues to assess the clinical disorder, the advent of new diagnostic imaging such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and Nuclear Medicine (NM) has served to be of great significance. In contrast to the old techniques, these technologies are based on 3-D anatomical of the human body as well as their functional images.

The identification of the malignancies is crucial for the assessment of the neurological diseases, as it allows identifying and establishing the required course of action, followed by its outlining of the therapeutic plans for determining its prognosis. Reflecting upon the purpose of advanced techniques, MRI is used for the assessment of the cerebrovascular impairment and for eradicating the other prevalent causes of neurological disorder [10]. Moreover, the MRI of the brain allows supplementing the possible diagnosis of the particular AP form [11]. The advancement in MRI has expanded the understanding of the multifaceted neurobiological changes which are further expected to provide new neuroimaging tools [12]. Along with it, the use of computerized tomography (CT) is also frequently used with MRI based on the association of the two as the traditional techniques for identification of the metastatic disease. Generally, MRI is considered to be more effective as compared to CT based on its integration of better resolution of the soft tissues, strengthened contrast enhancement, decrease bone artifacts and volume effects partially and direct multi-planar imaging which permits it to detect the smallest metastases upon scanning [6]. However, the use of CT is considered to be prime when the stroke is to be diagnosed based on its better efficiency and practicality in contrast to MRI which further enables it to detect the high sensitivity of Intracranial Hemorrhage (ICH) [13].

Various coherent studies in epidemiologic research are found have assessed the implementation of the advanced imaging techniques [14]. Evaluation of the past studies provides that previously the focus has been on the evaluation of the clinical overt incidence constituting of stroke, myocardial infarction, or deceased in the course of the follow-up period [15]. The findings of these studies have extensively contributed to the evaluation of the growth of disease states, knowledge of the disease, as well as its understanding of the difficult disease processes. Some of these studies constitute of the Framingham Heart study [16], Rotterdam study [17], the Multi-Ethnic Study of Atherosclerosis [18], the Study of Health in

Pomerania [19], the Heinz Nixdorf Recall study [20], and the Atherosclerosis Risk in Communities study [21].

The integration of the technologies has enabled the physician to assess the presence of the neurological diseases as well as to rule out in case of their absence or other prevalent medical conditions [7]. Based on the severity of the neurological diseases and the increasing popularity of the three imaging tools, the research employs their use for gaining insight on their efficacy in the examination of the neurological disorder. The study assumes that the result of the study will assist the neurological care providers for yielding the highest diagnostics results at the initial stages when uncertainty remains high.

2. Methodology

2.1. Study Design and Patients

A cross-sectional, retrospective study has been conducted to evaluate the brain, stroke, and neurological disorders using MRI and CT imaging among hospital patients. The study has been conducted from July 2017 to June 2018 in several hospitals. The data was gathered from the medical records and detail history of the patients was gathered pertaining to their age, gender, and reason of examination. Along with it, CT scan and MRI scan findings were evaluated. All the patients were assessed using MRI; whereas, only a few patients underwent CT scanning. The imaging of CT was done followed by MRI for each of these patients. The study has identified 151 (male and female) patients with neurological disorder such as headache, seizures, visual impairment, speech difficulty, gait abnormality and etc. The patients were eligible if they (1) were reported with either one of the neurological disorders; and (2) were examined through either CT or MRI. Patients were excluded based on the age alone. The patients were evaluated by an experienced stroke neurologist at examination.

2.2. Imaging Protocol

The study has used fourth generation scanners to perform all CT scans that were considered to be sublime quality based on a standard CT scan protocol (120 kV, 180 mA at 2 s, filmed at appropriate window width and level setting of 80/40 HU). A 3 T scanner (General Electric Medical Systems, Waukesha, WI) was used to perform MRI equipped with a standard head quadrature imaging coil and high-speed gradients. The 3 T MRI had a better signal to noise ratio as compared to 1.5 T MRI. The MRI scanner utilized in this study is an effective system that is available for the immediate imaging of acute stroke patients and falls throughout the proximity of the emergency department (ED).

2.3. Statistical Analysis

The gathered data was assessed statistically using IBM SPSS Version 20.0. Descriptive statistics including frequencies and percentages were used for continuous variables. The cross-tabulation was performed on the collected data using Chi-square. The statistical significance value was set at 0.05.

3. Results

Initially, the gathered data was assessed for it's demographic. Its analysis provides that the majority of the patients who suffered from the neurological disorder were females i.e. 81; whereas, the number of males was 70 (as presented in Table 1). The age group in which the episodes of neurological disorder were found to be frequent was 0 - 15 years i.e. 30.5%. Following it was the two age groups i.e. 31 - 45 years (20.5%) and 46 - 60 years (20.5%) while the minimum individuals fall in the 76 - 90 years age bracket was (2%). The prime reason for examination of the individuals was found to be multiple seizures (15.2%), followed by headache (9.9%), visual complaint (7.9%), Single Seizure (5.3%), gait abnormality (3.3%) and altered consciousness (2.6%); whereas, speech difficulty remained low (1.3%). The multiple other reasons found to be present in 54.3% of the cases.

Variable	Participants (n = 151)	
	F	%
Gender		
Male	70	53.6
Female	81	46.4
Age		
0 - 15 years	46	30.5
16 - 30 years	22	14.6
31- 45 years	31	20.5
46 - 60 years	31	20.5
61 - 75 years	18	11.9
76 - 90 years	3	2.0
Reason for Examination		
Single Seizure	8	5.3
Multiple Seizure	23	15.2
Altered Consciousness	4	2.6
Speech Difficulty	2	1.3
Headache	15	9.9
Gait Abnormality	5	3.3
Visual Complaint	12	7.9
Multiple Other Reasons	82	54.3

Table 1. Demographics.

Evaluation of the patient's record provides that very few of the individuals underwent CT scans i.e. 2.6%; whereas, MRI scan was performed for the majority of the patients i.e. 98.1%.

Table 3 exhibits the findings of the CT scan. As per the patients' record, in the CT scan, no evidence for neurological disorder was found majorly in males i.e. 4; whereas, the number of females in it was 3. The same number of both male and female i.e. 5 had parieto-temporal area; whereas, development of acute hypos densities in males were 3 while in females it was 2. The overall findings of the CT scan were insignificant based on the achieved p-value i.e. 0.29.

Table 4 exhibits the findings of the MRI scan. MRI scanning of patient majorly found Unremarkable MRI among 23 males and 21 females. Followed by it was lateralized to one side in 10 males and 6 females. The same number of both male and female had stable MRI feature, bilateral symptoms and ischemic disease i.e. 8, 4 and 5 respectively; whereas, abnormal MRI in males was 7 while in females it was 6. The overall findings of the MRI scan were significant based on the achieved p-value i.e. 0.00. No MRI scanning was held for 1 male and female.

Variable	Participants (n = 151)	
	F	%
CT Scan		
Yes	4	2.6
No	6	3.97
No Scanning	141	93.4
MRI Scan		
Yes	148	98.1
No Scanning	3	1.9

Table 2. CT and MRI scan.

Variables	Gender		P-values
	Male	Female	
CT Scan			
No evidence	4	3	
Parieto-temporal area	5	5	0.29
Development of Acute hypo densities	3	2	

Table 3. CT scan findings.

Variables	Gender		P-values
	Male	Female	
MRI Scan			0.00
Unremarkable MRI	23	21	
Multiple Signs	4	2	
No Study Conducted	1	4	
Bilateral Symptoms	4	4	
Normal MRI	8	3	
Abnormal MRI	7	6	
Status post-OP one side	5	3	
Stable MRI feature	8	8	
Lateralized to one side	10	6	
Ischemic disease	5	5	

Table 4. MRI scan findings.

4. Discussion

The study has evaluated the neurological disorder using CT and MRI technologies. Based on the findings of the study, it was evaluated that the neurological disorder was mostly found in females. Similar results have been reported by Clayton [22] who assessed the neurological disorder among females based on their brain structure and connectivity using MRI. Consequently, Liu et al [23] used functional MRI and found that women with chronic migraines had more neurological dysfunctionality as compared to males.

The physicians are constantly confronted regarding the necessity of confirming the presence of neurological disorder. It becomes difficult to justify the presence of severe disease in a resource-restricted medical environment without appropriate and accepted clinical evidence. It is important to differentiate between headaches without cerebral abnormality and headaches associated with any brain pathology [3]. A study conducted by Holle and Obermann [3] showed that neuroimaging is likely to be performed among the individuals suffering from uncommon clinical features. A study similar to the present study compared the findings of the CT scan and MRI among patients to find neurological signs and symptoms. The results showed occipital lobe involvement associated with symptoms like loss of vision, visual blurring, and various ophthalmological signs. Moreover, it showed MRI to produce better imaging modality among eclampsia patients, when correlated with the clinical findings, as compared to CT.

Multiple seizure or epilepsy has been reported highest in the present study. Medvid et al. [24] endorsed these findings and suggests that the use of the MRI in the examination of the neurological disease provides a better result in contrast to other evaluation techniques. A headache has also been reported as one of the prime symptoms of the neurological disorder in the study. These findings are in line with the study of Holle & Obermann [3] which conducted a diagnosis of headache disorders using neuroimaging technology. It also supplemented the use of MRI for the accurate elimination of these secondary concerns associated with it. Degnan & Levy [25] have also endorsed the MRI as a better neuro-imaging tool in the study. Unremarkable MRI has been found frequently in the present study. The use of MRI and unremarkable findings has also been stated by Nagahama et al. [26] which assessed the patient with Rasmussen syndrome. Silva et al. [27] also found parallel results to the current findings which further evaluated the late-onset Lymph proliferative Disorder of the central nervous system post-transplantation. The present study also found lateralized to one side in the majority of the patients using the MRI technology. These are parallel to the findings of Jindal et al. [28] which also contrasted the efficiency of the MRI imaging with CT neuroimaging. The findings of Jindal et al. [28] have shown that MRI abnormalities correlate effectively with clinical findings in eclampsia than the CT and can be effective imaging modality in eclampsia patients. However, this study has included patients with stroke signs.

Another study conducted by Zhang et al. [29] showed similar results to the present study. The results showed that MRI was significantly advantageous in making a diagnosis of multiple cerebral infarctions among middle-aged patients as compared to CT findings. The site of cerebral infarction is deduced roughly based on the deficit related symptoms including aphasia, consciousness disorder, and hemiplegia that provide the basis for initial diagnosis. Mainly, the CT and MRI findings are used for distinguishing the pathological tissues from normal tissues, especially the brain tissues [30] [31]. The study conducted by Zhang et al. [29] also showed that MRI findings related to an infraction at parietal, frontal, and thalamus, and basal ganglia were significantly higher as compared to the CT findings. The present study has shown that MRI was the most suitable diagnosis method, clinically that helped in determining the actual situation of patients.

The neuroimaging techniques are capable of demonstrating tissue perfusion, strokes, and vessel patency [32]. The present study has helped in evaluating the effectiveness of both the techniques in diagnosing the neurological disorder. The patient outcome is likely to improve based on the imaging concepts for treating stroke, effectively. The neurological field is revolutionized by examining the disorders with CT and MRI. These findings have not only catalyzed the understanding of pathological processes but rather it has also paved the way towards effective treatment of neurological disorders. The present study has shown that these techniques are effective for cerebrovascular diseases as it is impossible to provide specific treatment of stroke without any radiological diagnosis.

Based on the current findings, visual impairment has also been reported to be highest as patients suffered from blurring of vision, nystagmus, cortical blindness and hemianopia. These findings are parallel to Jindal et al. [28] who also reported MRI as the more effective tool for assessing neurological disorder in contrast to CT.

CONCLUSION

CT and MRI scanning of the patients were compared in both male and female-for assessing the neurological disorder. The findings of the study reveal that the MRI scanning produces more effective outcomes as compared to CT scanning. At this juncture, the study concludes that the use of MRI image technology is integral for assessing the neurological basis. It serves as a valuable source for advancing the current neurological understanding of the major disease associated with the central nervous system. Additionally, it also aids medical professionals in devising tailored strategies for preventing imaging-driven disease.

The present study also reports several limitations such as it included only two neuro-imaging techniques i.e. CT and MRI. Based on it, the study directs future studies to evaluate the neurological disorder using the advanced imaging techniques such as Nuclear Medicine Imaging. Additionally, preventive strategies can also be assessed along with the practices which neurologist can adopt for providing quality neurological care.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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