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Causes of epilepsy: FLAIR MRIbased study

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Abstract: *Epilepsy is a neurological disorder in which brain activity becomes abnormal, causing seizures or periods of unusual behavior. Flair MRI was used to characterize the brain in 55 SA patients diagnosed with epilepsy in EEG,in100% of patients; 56% was unremarkable MRI, while 44% present with abnormal MRI findings.The patients whom diagnosed as lesion and brain atrophy was (21&10) respectively, and a significant correlation between them has been noted at p=0.01.Bilateral temporal lobes were the most common location of lesion in MRI (12.7%). Cystic lesion followed by ischemia(9.1% and 5.5% respectively) were the most common lesions type, a significant relationship was observe between lesions location and type in MRI at p=0.01.Study also found that all patients diagnosed with ventricular system dilatation, had lesions and increasing in brain volume at significant correlation equal to p=0.01 for both variables. MRI flair was not able to diagnose all causes of epilepsy, fMRI has been recommended for that epilepsy of unknown cause in flair MRI.*

Keywords: *Electroencephalography, Magnetic Resonance Imaging, functional Magnetic Resonance Imaging, Saudi Arabia.*

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I. Introduction

Epilepsy is a neurological condition that manifests in epileptic seizures as a result of an abnormal synchronous activity of a large group of neurons. Depending on the affected brain regions, seizures produce various severe clinical symptoms. [(2)]There are two main types of seizures, generalized seizures affect the whole brain. Focal, or partial seizures, affect just one part of the brain.The majority of patients with epilepsy suffer from focal epilepsy that can be either symptomatic (caused by an acute of chronic congenital or acquired brain lesion) or cryptogenic (a focal origin is suspected but the cause is unknown). Focal epilepsies are classified according to the affected hemisphere and lobe (left/right, frontal, temporal, parietal, occipital, insular).[(2)]

Epilepsy is a public health problem that afflicts more than 50 million people worldwide-developed societies with a high incidence in infants and in the elderly population. [(1)]

The diagnosis of epilepsy is typically made based on observation of the seizure onset and the underlying cause. Electroencephalogram is the most useful test when evaluating people with possible epilepsy. It may provide specific neurophysiological information to support the clinical diagnosis. [(7)]

MRI scanners use strong magnetic fields, magnetic field gradients, and radio waves to generate images of the body organs.MRI protocols can be extremely accurate in understanding the root cause and diagnosing certain types of epilepsy. In T2 FLAIR sequences, the CSF signal is suppressed and periventricular lesions are better visualized. T1 FLAIR sequences are also useful and compared with the conventional T1W image, the T1-FLAIR sequences produce better contrast between gray and white matter. [(4)]

Scan results are quite adept at pin-pointing potential physical causes for symptoms, such as scarring on the brain or tumors. However, not all epilepsy has a physical cause that shows up on scans. In some cases, providers may use the scans to view brain activity instead, looking for trends that might explain seizures. [(7)]

This research study which applied in 55 Saudi Arabian patientstries to cover the span ability of MRI flair to detect the causes of epilepsy. Systems are arranged as according to frequencies and correlations.

II. Materials And Methods

2.1Place and duration of the study:

This study was done at Qatif central hospital and Al Moosa specialist hospital MRI departments (Eastern region_ Saudi Arabia).Data were collected in the period spanned from January 2018 up to April 2019.The present study was approved by the ethics committee of the research council, Al-Ghad International Medical Science Colleges as well as the approval of the radiology departments. Verbal consent was obtained from all potential participants. The aims, benefits of the present study were explained to all participants in

details. Medical history of all study subjects were thoroughly reviewed directly from participants themselves or from their parents and those with conditions that may in any way, alter the findings of the current study were excluded.

2.2Study population:

A sample of (55) patients who were investigating as epilepsy, undergo for brain MRI examination complain of epileptic seizures as a result of an abnormal synchronous activity of neurons.

Patient's data were registered .27 patients were females, while the 28 were males and their ages are ranged from 1 month to 80 years old.

2.3Machine used*:*

MRI was performed using 1.5T General Electric (GE) scanners in Qatif Central Hospital and Al Moosa Specialist Hospital with quadrature head coils. GE 1.5 MRI completely refurbished in 2018 that has 9x software, 4 channel, ACGD high speed plus gradients, AK coach (refurbished in 2018) and medradspectris injector. MRI coils are used in GE MRI system including: quad head coil, torso array, small shoulder, large shoulder, T/R knee array and BRM-D body. GE MRI system has software options including: echo planner imaging, fast gradient echo, cine, fast spin echo and FLAIR, time of flight, phase contrast vascular imaging, DW EPI, FLAIR EPI, SSFSE, smart prep, three plane localizer (axial, sagital and coronal), and interactive vascular imaging.

2.3.1 Patient preparation:

The patient was prepared for the scan by making him or her to sign a consent form. Had the patient to go to toilet before the scan and to remove anything that contains metal include (nickels, hearing aids, keys and....etc). The patient wore a hospital gown and the procedure was explained. Offered to the patient earplugs or ear protector to prevent ear impairment.

Patients were excluded if any of the following were present: coma, pacemaker or other contraindication to MRI.

2.3.2 Patient position:

The patient was in supine position and head first with the head within the volume coil. The patient was positioned so that the longitudinal alignment light lied on the midline and horizontal alignment light passed through the nasion. Straps and pads were used for immobilization.

The scan range was from the base of the skull to vertex.

2.3.3 Protocol:

MRI epilepsy protocols were applied in the study are 3D T1-weighted spoiled gradient-recalled acquisition (repetition time/echo time = 14–33/3–7 ms, section thickness = 1.5–1.6 mm, field of view = 200–220 mm, matrix = 256 × 192), axial and oblique coronal FLAIR (repetition time/echo time = 10002–13000/20–133 ms, section thickness = 4–5 mm, field of view = 180–240 mm, matrix = 256 × 192–224), axial and oblique coronal fast spin echo T2-weighted images (repetition time/echo time = 3000–5800/76–105 ms, section thickness = 3–5 mm, field of view = 180–240 mm, matrix = 320–256 × 192–256), and axial gradient echo T2-weighted images (repetition time/echo time = 283–450/15–20 ms, section thickness = 5 mm, field of view = 210–240 mm, matrix = 256 × 224–256). Gadolinium contrast was used if there were concerns about tumor, vascular malformation, infection, and inflammation.

2.4 Images evaluation*:*

All images were evaluated by two radiologists and three technologists, and all patients were evaluated to identify any changes occurred within brain tissues and causedepileptic seizures.

2.5 Data Analyses:

The data were collect from MRI reports and then collected in data sheet which prepared specially for this task. Also MRI images were collect in CDs after each scan as documentation for that scan. Data analyzed by using Microsoft excel and Statistical Package for the Social Sciences (SPSS) IBM version 25.

III. Results

The study characterized the brain in a patient with epilepsy by using MRI techniques - flair protocol.

Table (1): Distribution of epilepsy region in frequencies and percentages %.

Region of epilepsy		
	Frequency	Percent %
Right temporal	1	1.8
Bilateral temporal	2	3.6
parietal	5	9.1
Temporal and frontal	7	12.7
Temporal and parietal	2	3.6
Temporal, frontal and occipital	3	5.5
Frontal and parietal	4	7.3
Unremarkable MRI	31	56.4
Total	55	100.0

Table (2): Distribution of brain volume in frequencies and percentages %.

Brain volume		
	Frequency	Percent %
Normal	43	78.2
Atrophy	10	18.2
Increase in brain size	2	3.6
Total	55	100.0

Table (3): Distribution of MRI findings of gray and white matter in frequencies and percentages %.

Gray and white matter findings		
	Frequency	Percent %
High signal intensity	3	5.5
Isotense signal	4	7.3
Normal differentiate	48	87.3
Total	55	100.0

Table (4): Distribution of sulci and gyri findings in frequencies and percentages %.

Sulci and gyri findings		
	Frequency	Percent
Nnormal	49	89.1
Prominent	3	5.5
High signal intensity	3	5.5
Total	55	100.0

Table (5): Distribution of ventricular system findings in frequencies and percentages%.

Ventricles findings		
	Frequency	Percent %
Normal	42	76.4
Dilated	9	16.4
High signal intensity	4	7.3
Total	55	100.0

Table (6): Distribution of presence of lesion in frequencies and percentages%.

Presence of lesion		
	Frequency	Percent%
Yes	21	38.2
No	34	61.8
Total	55	100.0

Table (7): Distribution of lesion type in frequencies and percentages %.

Type of lesion		
	Frequency	Percent %
Infarction	2	3.6
Ischaemia	3	5.5
Periventricular leukomalacia	3	5.5
Cystic lesion	5	9.1
Sclerosis	2	3.6
Glyosis	2	3.6
No lesion	34	61.8
Hematoma	2	3.6
Meningitis	2	3.6
Total	55	100.0

Table (8): Distribution of lesion location in frequencies and percentages %.

Location of lesion		
	Frequency	Percent %
Right temporal	1	1.8
Bilateral temporal	7	12.7
Frontal	5	9.1
parietal	3	5.5
Frontal and occipital	2	3.6
No lesion	37	67.3
Total	55	100.0

Table (9): Cross tabulation between brain volume and presence of lesion. P≤0.01**

Correlations			
	N	55	55
Presence of lesion	Correlation Coefficient	-.389-**	1.000
	Sig. (2-tailed)	.003	.
	N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).			

Table (10): Cross tabulation between epilepsy region and presence of lesion. P≤0.01**

Correlations			
Region of epilepsy	Correlation Coefficient	1.000	.868**
	Sig. (2-tailed)	.	.000
	N	55	55
Presence of lesion	Correlation Coefficient	.868**	1.000
	Sig. (2-tailed)	.000	.
	N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).			

Table (11): Relation between lesion type and location. P≤0.01**

Correlations			
Type of lesion	Correlation Coefficient	1.000	.758**
	Sig. (2-tailed)	.	.000
	N	55	55
Location of lesion	Correlation Coefficient	.758**	1.000
	Sig. (2-tailed)	.000	.
	N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).			

Table (12): Relation between brain volume and ventricle findings. P≤0.01**

Correlations			
Brain volume	Correlation Coefficient	1.000	.621**
	Sig. (2-tailed)	.	.000
	N	55	55
Ventricular findings	Correlation Coefficient	.621**	1.000
	Sig. (2-tailed)	.000	.
	N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).			

Table (13): Cross tabulation between ventricles findings and presence of lesion. P≤0.01**

Correlations			
Ventricular findings	Correlation Coefficient	1.000	-.520-**
	Sig. (2-tailed)	.	.000
	N	55	55
Presence of lesion	Correlation Coefficient	-.520-**	1.000
	Sig. (2-tailed)	.000	.
	N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).			

IV. Discussion

Random sample of (55) patients that include 50.9 %(28) male and 49.1 %(27) female are studied they are investigated as epilepsy in Almoosa Specialist Hospital and Qatif Central Hospital, and were undergo for MRI scan. The characteristics of all variables in the studied sample were described as frequencies, percentages and correlations.

Our study was applied in 55 patients ranged from (0-15) to (75-90) years old. We found that patients' age between (0-15) years old had the highest percentage (50.9%), while patients' aged between (60-75) years

old had the lowest percentage (5.5%). Furthermore, the study has showed that MRI findings in 24 patients (43.6%) were abnormal while 31 patients (56.4%) were normal. This finding was similar to the previous study done by (Joan K. Austin, in 2006). The most common region of epilepsy appeared in MRI in our study was temporal and frontal lobe (12.7%) and right temporal lobe was less common (1.8%) explained in table (1). The study also has showed that the most frequent abnormal MRI finding in brain volume was brain atrophy (18.2%) table (2), and this finding agreed with the previous study done by (S Amirsalari, A Saburi, R Hadi and S M Mirmohammad, in 2011). Moreover, the study revealed that the frequency of gray and white matter appearance were mostly isotonse signal in about (7.3%) table (3). However, the study exposed that there is a statically difference between the signals in sulci and gyri in abnormal MRI findings. The signals were prominent in about (5.5%), and were high signal intensity in about (5.5%) in sulci and gyri findings that represented in table (4). In addition, the study also revealed that the most frequent abnormal MRI finding in ventricular volume was ventricular dilatation in about (16.4%) table (5). Also, it showed that MRI detected potentially lesions in 21 patients (38.2%) whereas the rest of patients had no lesion (n= 34) 61.8% table (6). The most common lesion type caused epilepsy in MRI finding was cystic lesion (9.1%) followed by Ischaemia and periventricular leukomalacia (5.5%) table (7). This finding disagreed with previous study done by (Laurens De Cocker, FeliceD'Arco, Philippe Demaerel and Robin Smithuis, in 2012) due to their big sample size. Bilateral temporal lobe was the most common location of lesion finding in our study (12.7%) followed by frontal lobe (9.1%) table (8). This finding agreed with previous study done by (ShahinaBano, in 2011).

The study has represented a significant relation between the brain volume and the presence of lesion in MRI at p=0.01, most patients with brain atrophy had brain lesion (table 9). Furthermore, it has showed a significant relation between the type of lesion and the location of lesion at p=0.01 that represented in table (11). It also has explained a significant relation between region of epilepsy and presence of lesion at p=0.01table (10). It has proven also a significant relation between the brain volume and the ventricular findings at p=0.01 table(12), all patients diagnosed as ventricular dilatation were have increasing in brain volume. It has represented a significant correlation between the findings in ventricles and the presence of lesion at p=0.01 table (13).

V. Conclusion

Study found that MRI is the test applied for all patients with epilepsy to screen a potential structural cause of epilepsy.

The relationships between structural abnormalities identified on MRI provided an important information to assist in the assessment of patients with epilepsy that allow earlier discovering of the cause of epilepsy therefore, the effective treatment will be earlier considered.

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