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### RESEARCH ARTICLE

#### CLASSIFICATION AND DETECTION OF ACUTE STROKE USING MRI PROTOCOLS.

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#### Abstract

A retrospective study aimed to evaluate the role MRI protocol diagnosis in acute stroke, prevalence, distribution and co-factors in Sudia population during June 2017-December 2018. 120 patients male 92 and 28 female) were selected ,The data have been collected from the PACS from different hospitals, (Burydah Central, King Fahad specialized and King Saud hospitals) at Burydah and Uniza cities at Algassim region, as gender, age, weight smoking habits, residential states, Pathologies, , and symptoms The analysis showed that: the stroke diseases were predominant among old patients Men are more affected with stroke than women with 56% and peaked among 65-77 year old ( 48.3% ) Most patients are presented with hypertension and diabetes mellitus. In a study data showed that, both obesity and weight gain in males and females were important risk factors for ischemic and smoker patients. The study concluded that the MRI allows accurate diagnosis of the infarct detection of cerebral arterial occlusion or significant stenosis with evaluation of actual collateral flow and may display certain reversible ischemic changes. MRI is better for the detection of acute ischemia, and can detect acute and chronic hemorrhage; therefore, it should be the preferred test for accurate diagnosis of patients with suspected acute stroke.

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#### Introduction:-

Neuroimaging is essential for stroke diagnosis and assessment. Computed tomography (CT) / CT angiography or magnetic resonance (MR) / MR angiography imaging are used to determine the cause and mechanism of stroke, to define the extension of brain infarct and to identify the arterial occlusion. Imaging may identify the patients that will be benefit more from revascularization therapies independently of the conventional therapeutic time window allowing individualized treatment decisions and improving individual patient outcome. <sup>(1)</sup> Magnetic resonance imaging (MRI) is a procedure that uses a magnetic field and pulses of radio wave energy to take images of the head. In many cases, MRI gives information that cannot be seen on an X- ray, ultrasound, or computed tomography (CT) scan. The application of magnetic resonance imaging has evolved rapidly since its clinical development in the early 1980s. Presently, examinations of the brain are the second most commonly requested MR study following spine examinations (Radiology Dept Statistics, 2001) MRI is becoming one of the most important diagnostic tools in clinical decision making for the treatment and management of acute and chronic stroke <sup>(2)</sup>. Stroke is defined as a neurological deficit attributed to an acute focal injury of the central nervous system by a vascular cause, including cerebral infarction, intracerebral haemorrhage (ICH), and subarachnoid haemorrhage (SAH), Cerebral infarction

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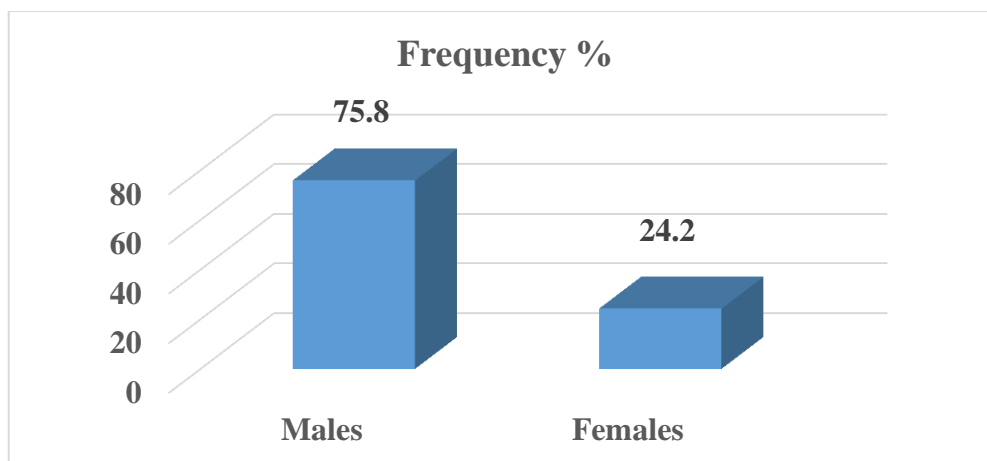
constitutes approximately 80% of all strokes <sup>(3)</sup>. Stroke is one of the most frequent causes of death and disability in Developed countries, having an estimated overall adult prevalence of 2.5%, which rises with increasing age, being estimated to be 45% for age group of more than 80 years if silent infarcts are also taken into Consideration <sup>(3)</sup>. Arterial ischemic stroke (AIS) is one the three leading causes of death in developed countries; with one death caused by stroke for each 15–18 total deaths <sup>(4)</sup>. Stroke represents also a tremendous Social burden, not only by the associate mortality but also by the Morbidity associated with this disease Most of the strokes are ischemic, more than 80% of cases, being thromboembolic due to large artery atherosclerosis, cardio-embolic, and small vessel occlusion the commonest causes of AIS <sup>(4)</sup>. The other causes of stroke include intracerebral haemorrhage (12%) and subarachnoid haemorrhage, accounting for approximately 9% and 3%, respectively <sup>(4)</sup>. The mortality rates associated with stroke have been decreasing over the last years due to better general clinical care and specific stroke treatment. Magnetic resonance imaging (MRI) is an excellent modality for diagnosis of acute ischemic stroke with sensitivity of 94%-100% <sup>(5)</sup>. on diffusion weighted imaging (DWI) sequences within 30 minutes of onset of ischemia <sup>(5)</sup>. Diffusion- weighted imaging (DWI) in which image contrast is based on water motion is remarkably sensitive to ischemic brain injury whereas other conventional imaging techniques such as CT and T1 and T2 MRI fail to detail such injury for at least a few hours, the anatomical mismatch between DWI and perfusion- weighted imaging (PWI) abnormality is indicative of tissue at risk that is potentially salvageable and is the primary target for therapeutic intervention .In addition to DWI and PWI, there are many exciting MRI modalities (such as diffusion tensor imaging, blood– brain barrier permeability imaging, pH MRI (slichter 1978). Stroke can cause a large number of sensorimotor sequelae including motor weakness and impairment of voluntary motor control (paresis), spasticity, incoordination (ataxia), apraxia, sensory loss/numbness, dysarthria, and dysphagia <sup>(6)</sup>, and can also lead to various cognitive and psychiatric deficits such as neglect, aphasia, and depression <sup>(7,8)</sup>. In addition to these impairments, stroke can produce maladaptive ‘positive’ symptoms including central neuropathic pain <sup>(9)</sup>, movement disorders (e.g., tremor, dystonia, or dyskinesia's) <sup>(10)</sup>, and epilepsy <sup>(11)</sup>, which develop in the months or years following stroke. For many patients, both the deficits and the maladaptive responses prove refractory to medical therapy. Current interventions for the management of acute stroke emphasize reperfusion and must be initiated within hours of symptom onset to ensure benefit <sup>(12)</sup>. Treatment options beyond this time window are largely rehabilitation-based; these depend largely on augmenting spontaneous motor recovery, which predominantly occurs within the ‘critical period’ 3-6 months post stroke <sup>(13)</sup> and reflects enhanced neuroplasticity and consequent structural and functional reorganization of surviving neural circuitry within the brain <sup>(14,15)</sup>. Despite these interventions, many stroke patients undergo incomplete recovery and suffer from impaired quality of life due to residual functional deficits and disturbances <sup>(16,17)</sup>

## Material and Methods:-

This is a retrospective study, a sample of 120 patients were included, with different genders and age groups who were referred to the radiology and imaging department in different hospitals in Alqassim region, patients with a suspected case of acute stroke, and had undergone MRI examinations, to evaluate each type of stroke according to their location. Children and patients with brain tumors were excluded from the study, a consent form for each patient was obtained before the exam and their information were used in this study, and the data were collected and interpreted by three radiologists. Data were analyzed using Microsoft Excel and statistical package for social sciences (SPSS) version and the results illustrated in tables, graphs, cross tabulation and t test to compare the variables. The difference was considered significant when p-value is less than or equal to 0.05. The following MRI techniques were used: - T1-weighted imaging (T1-WI) in which cerebrospinal fluid (CSF) had a low signal intensity in relation to brain tissue and appeared dark, T2-weighted imaging (T2-WI) in which CSF had a high signal intensity in relation to brain tissue and appeared bright, spin density–weighted imaging in which CSF had a density similar to brain tissue. Gradient echo imaging had the highest sensitivity in detecting early hemorrhagic changes in diffusion-weighted imaging (DWI), the images reflected the microscopic random motion of water molecules.

## Results:-

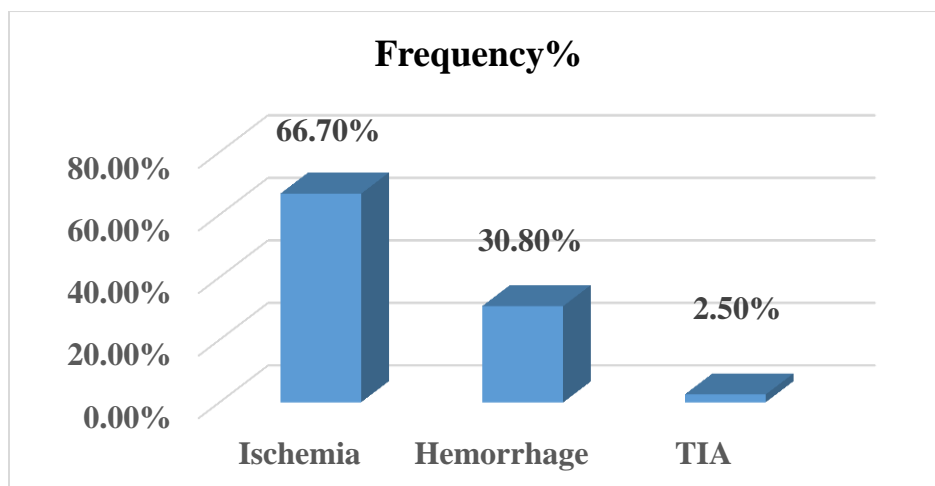
In the present study, a total number of 120 patients with stroke were studied to assess the role of MRI scanning in diagnosing stroke.



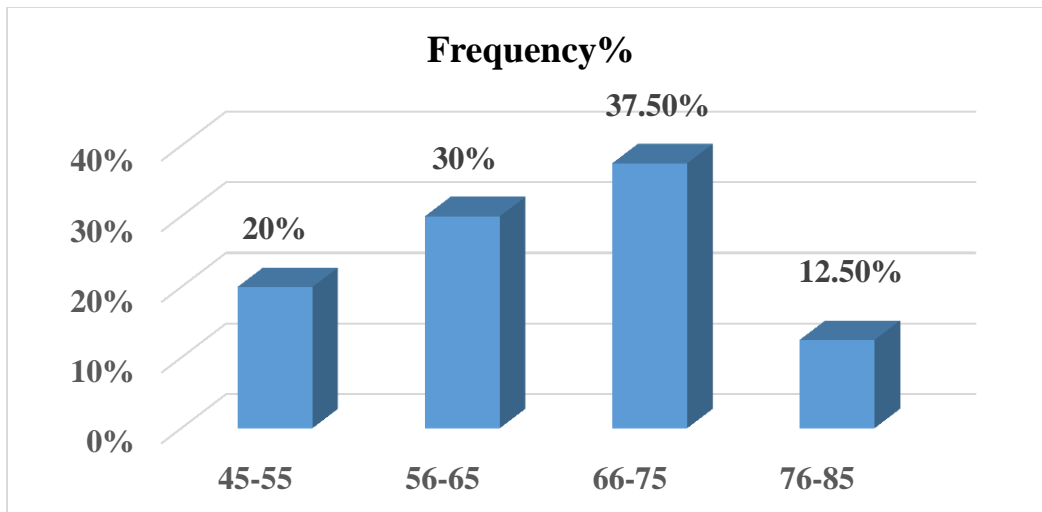
**Fig 1:-**shows the frequency of stroke according to Gender ( $\chi^2=32.03$   $p = 0.00$ )

**Table 1:-**frequency of stroke types according to gender

Type of stroke	Male	Female	Frequency%
Ischemia	61(50.8%)	19(15.8%)	66.7%
Hemorrhage	27(22.5%)	10(8.3%)	30.8%
TIA	3(2.5%)	0	2.5%



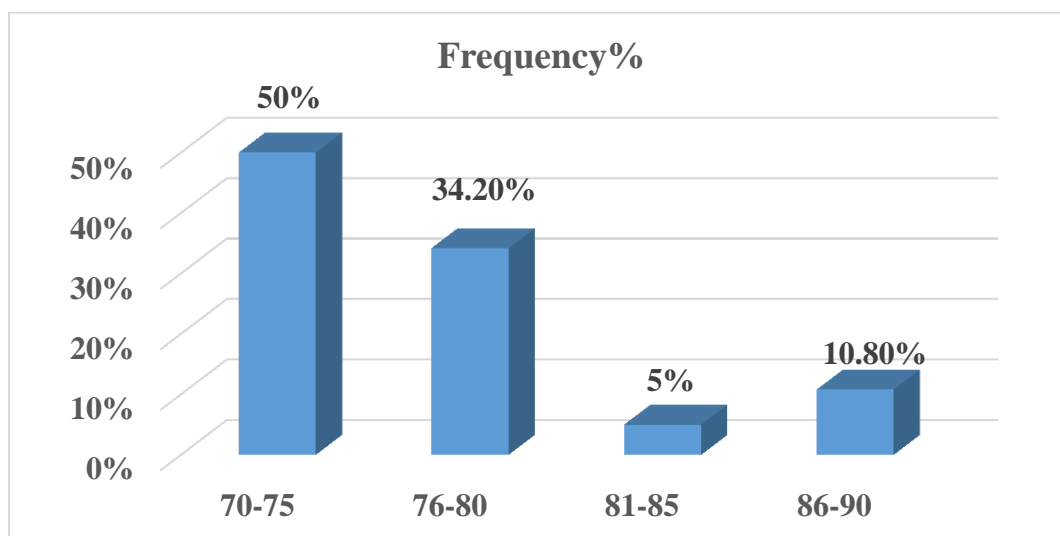
**Fig 2:-**shows the frequency of stroke patients according to final diagnosis (types of stroke) ( $\chi^2= 74.45$ ,  $p = 0.000$ )



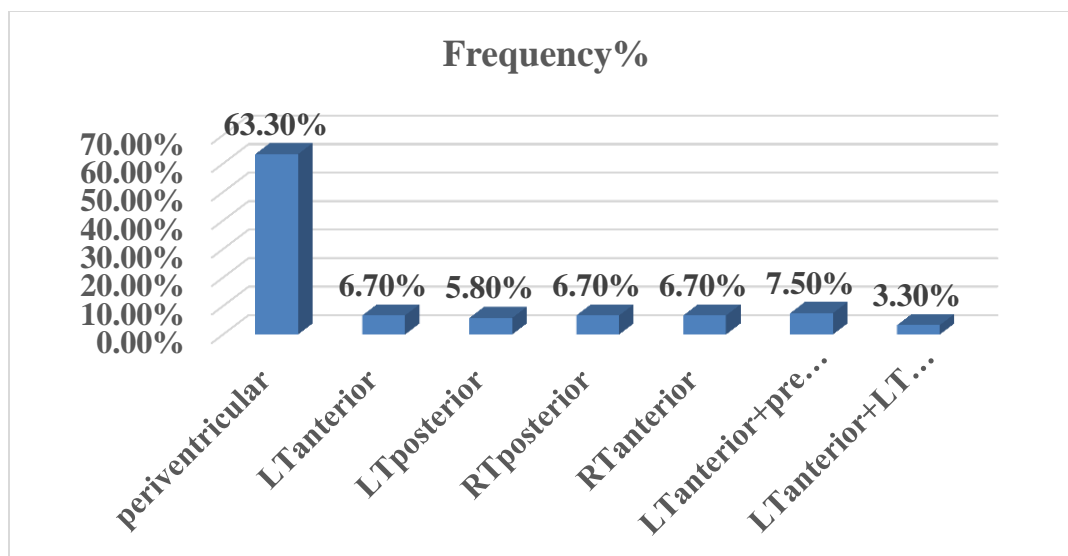
**Fig 3:-**shows the frequency and percentage of types of stroke according to age groups

**Table 2:-**Shows cross tabulation of age and stroke type (Chi squared = 15.85; p-value=0.01)

		Age group				
		45-55	56-65	66-75	76-85	Total
Final diagnosis	ischemia	11	22	35	12	80
		13.8%	27.5%	43.8%	15.0%	100.0%
	hemorrhage	13	11	10	3	37
		35.1%	29.7%	27.0%	8.1%	100.0%
	TIA	0	3	0	0	3
		0.0%	100.0%	0.0%	0.0%	100.0%
	Total	24	36	45	15	120
		20.0%	30.0%	37.5%	12.5%	100.0%



**Fig 4:-**show distribution of stroke subjects according to weight



**Fig 5:-**Illustrate frequency and common site of stroke

**Table 3:-**shows the correlation between stroke type and habits

Habits		Stroke type			Total
		ischemia	hemorrhage	TIA	
	smoking	44	30	2	76
	non-smoking	36	7	1	44
Total		80	37	3	120

### Discussion:-

The results obtained from this study showed that among the patients participated in this study; men were more affected than women in regards with stroke disease. Although this study included only 91 (74.8%) males and 29 females, (24.2%) (Fig.1) however, these results agreed with the remarks reported by (Kajstra J et al 1996), who postulated that the risk of stroke rises in males than females (Table.1), but disagreed with (Dr David M. Kent 2011), who found in his analysis of acute ischemic stroke that usually greater effect on women than men because women have more events and are less likely to recover. According to types of stroke in this study are presented as the following: ischemia 80 (66.7%), hemorrhage 37(30.8%), and TIA 3(2.5%) (Fig.2). The study showed that the patients with old ages were more affected by stroke than younger patients (Fig.3 and table.2). This result agreed with (H. P. Adams Jr. et al 2007), who postulated that the risk of stroke rises significantly with age. After the age of 55 years, occurrence of stroke is more than doubles with each passing decade. Each year, about 1 percent of people between ages 66 and 75 have a stroke and 5 to 8 percent of people in that age group who have had a TIA go on to stroke. Although the risk associated advancing age cannot be changed, it is an important factor in assessing stroke risk and planning preventive therapies. In this study, data indicated that both obesity and weight gain in males and females were important risk factors for ischemic and total stroke but not hemorrhagic stroke (Fig.4). The relationship between obesity and total stroke depends on the distribution of stroke subtypes in the population. This result was in agreement with the findings of (P. D. Schellinger 2010), on his study which included 403 ischemic strokes patients and 269 hemorrhagic strokes patients whose weights were  $\geq 27$  kg/m<sup>2</sup> and who had significantly increased risk of ischemic stroke, with relative risks (RRs) of 1.75 (95% confidence interval [CI], 1.17-2.59) for BMI of 27 to 28.9 kg/m<sup>2</sup>; 1.90 (95% CI, 1.28-2.82) for BMI of 29 to 31.9 kg/m<sup>2</sup>; and 2.37 (95% CI, 1.60-3.50) for BMI of 32 kg/m<sup>2</sup> or more (P for trend<.001), as compared with those with a BMI of less than 21 kg/m<sup>2</sup>. The study showed that types of stroke the percentage of ischemic stroke 66.6% is more than hemorrhagic stroke 30.8%(Fig.2). One of the most interesting observations obtained from this study is to identify the common site of stroke, the result showed that the percentage of stroke in Periventricular was 63.3% from total number of study sample(Fig.5). The data obtained from this study revealed that the smoker patients were more affected than non-smoker patients (Table.3), and this result agree with (Lancaster T, Stead L (2005), who reported that smoking facilitates atherosclerosis and appears to be a dependent risk factor for strokes that result from a clot. It also seems to be a risk for stroke that results from cerebral hemorrhage. Men in the community studied for cardiovascular

diseases who smoked more than 40 cigarettes per day has twice stroke risk of men who smoked fewer than 10. In a large Harvard Medical School study of women, the number of cigarettes smoked was found to be directly related to stroke risk. Women smoking more than 25 cigarettes a day had a 2.7 times greater risk of stroke from a clot or embolus and a 9.8 significantly reduce stroke risk by stopping smoking. Five years after they stop, smokers have a stroke risk equal to that of non-smokers (National Institute for Health and Clinical Excellence 2011).

### Conclusion:-

Complex set of pathophysiologic events occurs in cerebral ischemia MRI provides excellent information's on almost all the elements taking part in this setting, from cerebral tissue itself to blood vessels and blood flow dynamics, and helps us to get a grasp of this dynamic process. The development of tissue and clinical-based prediction models relying on MRI not only provide the clinician with prognostic data, but also help in optimizing patient selection of stroke therapies. The automated lesion- outlining and volume calculation software currently present in some workstations is a major step forward in individualization of stroke care. However, despite advantages, MRI by itself cannot supply all the information needed to make accurate predictions, and ideal prognostic models should consist of a combination of clinical and imaging data. MRI allows accurate diagnosis of the infarct lesion, detection of cerebral arterial occlusion or significant stenosis with evaluation of actual collateral flow and may also display certain reversible ischemic changes. However, the main objective for MRI still remains improvement of non-invasive rapid and accurate identification of brain tissue at risk for infarction, which may be salvaged by safe and effective reperfusion therapy MRI is better for detection of acute ischemia, and can detect acute and chronic hemorrhage; therefore, it should be the diagnostic method of choice for patients with suspected acute stroke. The greater overall sensitivity of MRI for acute stroke in this study is attributable to its effectiveness for detection of acute ischemic stroke.

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