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Original Research Article

The Diagnostic value of CT Scan Techniques in Evaluation of Intracranial Fluid Collection in Patients with Acute Brain injures

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Abstract

The study objective is to evaluate intracranial fluid collection in acute brain injuries patients. This a cross sectional study performed using electronic data base system to determine the outcomes of the study from patients whom following acute brain injury and being examined by CT scan techniques. Inclusion and exclusion criteria were retrieved and findings were reported according to analytic descriptive methodology. 120 patients were diagnosed having intracranial fluid collection and being evaluated by CT scan techniques. Sixty six patients (55%) affected by trauma etiology followed by strokes (26.0) detection. The age group between (21- 30) had the big distribution 55.0%, and regarding gender distribution, the study found that sixty eight male patients were affected more than women (70%). Most patients presented with variable neurological signs and most of them complained from headage (33.3%) whereas significant correlation was shown between degree of the severity and those with severe symptoms while the moderate degree were most commonly affected. Most patients affected with subgelial hemorrhage (22.5%). The study successfully approved that CT scan techniques has highly sensitivity in detecting patients whom had intracranial accumulation fluid due to acute brain injury.

Keyword: Diagnostic value, Acute Brain injuries, Intracranial Fluid collection

INTRODUCTION

Intracranial fluid collection in acute brain injury refers to collection of intra and extra axial fluid within the skull including any bleeding or excess fluid (brain edema) within the intracranial spaces. It occurs when there are external force to the brain and can be classified based on severity, mechanism (closed or penetrating head injury), or other features such as occurring in a specific location or over a widespread area. Injury to the brain (also it known as intracranial injury) defined as a disruption that can be caused by traumatic factors such as a bump, blow, or jolt to the head, or caused by non-traumatic causes such as strokes and vascular aneurisms rupture. The buildup of blood within the skull and accumulation of excess fluid within the brain parenchyma (Cerebral edema), can lead also to hydrocephalus and brain herniation, which often occur together particularly after generalized injury. It is a leading cause of mortality and morbidity in the world's population, everyone is at risk for it, especially children and older adults. (Centers for Disease Control and Prevention, 2018).

The estimation of traumatic brain injures ranges from (64- 74) million individuals worldwide each year and the most common causes include violence, transportation accidents, and sports. The road traffic accidents alone was estimated 56% with greatest in Africa and Southeast Asia (Michael C, 2018). In Kingdom of Saudi Arabia's

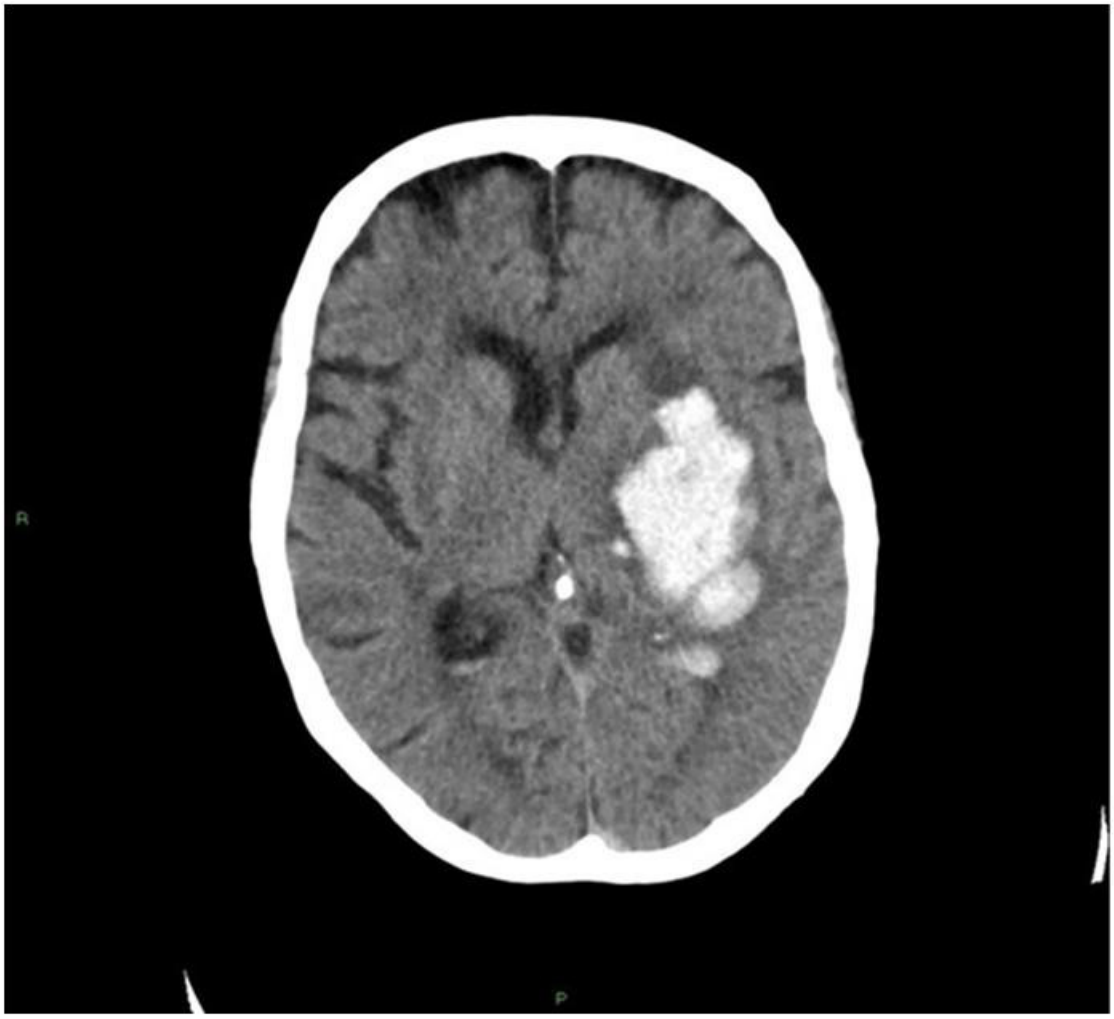


Figure 1. Axial CT Scan in patient with Acute Basal Ganglia hemorrhage

(KSA), traumatic brain injury is becoming the most common and devastating problem, this may be due to exponential growth in population and the increased vehicle use. It was reported that the road traffic accident is one of the biggest challenges facing the health care nowadays in Saudi Arabia. These accidents have resulted in severe brain injuries for thousands of people across the country and according to a recent news article, there is one traffic accident every minute occurring in the Kingdom and more than 1200 traffic accidents a day and over 7,000 people are killed every year (Farah A. Mansuri et al., 2015).

Multi-detector CT remains the preferred first line imaging study for moderate and severe traumatic brain injury, that is because it can quickly identify patients who require urgent neurosurgical intervention, particularly in the emergency departments. The imaging of head injuries including the detection of the extra axial fluid collection by Computed Tomography (CT Scan) examinations, has become key diagnostic tool in the assessment of patients with cerebrovascular disease or acute brain injury. Intracranial pathology can be subdivided according to anatomic location and the most basic distinction being whether it localizes to the brain parenchyma (intra axial) or outside the brain tissue (extra axial). Spaces such as epidural, subdural, subarachnoid spaces and ventricles (Figure 1 and Figure 2). These are potential sites for post-traumatic complication which most often being brain hemorrhage (Gentry LR,1994). Acute Brain injuries can be differentiated into primary and secondary mechanisms, where the primary injury is typically defined as the direct mechanical damage caused by trauma, usually apparent acutely and include contusion, fractures and hemorrhage .This type of injury is best detected with conventional CT and MR structural imaging techniques. And the secondary injury mechanisms are related to varied disorders such as oxidative stress, vascular abnormalities, metabolic dysfunction and inflammation of the cerebrum. However these processes are mediated at the cellular level which

Figure 2. Axial CT scan image in patient with Acute Intraventricular hemorrhage

is currently below the resolution of conventional imaging (Hawryluk GWJ, 2015). Neuroimaging also plays a critical role in the evaluation of patients with suspected acute stroke and in distinguish between hemorrhagic and ischemic stroke where the early detection provides diagnostic information needed for choosing the most appropriate therapy (Hussein W, 2015).

More concern has recently been appeared about head trauma wide world ,particularly in Kingdom of Saudi Arabia (Najran city) were the epidemiology data concerning acute traumatic brain injury for patients in area of study were not known , for this reason , the recent study was conducted to evaluate the diagnostic values of CT techniques to assessment the intracranial fluid collection in patients with acute brain injury .

MATERIALS AND METHODS

The goal and importance of study

The goal of this research is to evaluate acute brain injuries in Najran city, Kingdom of Saudi Arabia and to also improve the way of practicing radiological imaging

and to find out new aspects and correlations concerning advance CT scan techniques.

THE OBJECTIVES OF THE STUDY

General objective

The present study aimed to evaluate intracranial fluid collection in patients with acute brain injures using CT scan techniques in an attempt to analyze and find out the prevalence results obtained during the period January to April 2019 in Najran city – Saudi Arabia and also to establish best medical practices for area community.

Specific Objectives

- Study and evaluate the various features associated with radiological computed tomography examinations of head injuries.

- Correlate the CT features with clinical operative findings and find prevalence estimates of Brain injures incidence in Najran, Saudi Arabia.

- Expanding of knowledge concerning head injury to reduce causes and effect on populations.

- Increase awareness and better understanding of Brain injures complications in order to improve the way of diagnoses and treatment.

Population /Inclusion

The database registry was limited to hospitalized patients following injury and being examined by CT scan techniques in period from January to April 2019. The initial search of population identified a total of 224 patients were underwent Computed tomography examinations and after excluding the normal conditions, a total of 120Participants were including in the study.

Type, Place and Duration of the Study

The study is a prospective descriptive quantity which was conducted in Najran province, Kingdom of Saudi Arabia. The demographic data was obtained from patients reports in the database system for all patients whom underwent head CT scan techniques in period from January to April 2019. Requests for CT examinations were indicated by neurologist or by resident's physicians and the reports were diagnosed and signed by radiologists.

Statistical Analysis

Descriptive programmer analysis of statistical package for the social sciences (SPSS version 25) was used to determine the frequency distribution and find out correlations for the obtained demographic variables in tables and figures and describe categorical variables for the outcomes.

Ethical Considerations

The official permission and all confidential requirements have been met prior to conduct this study. For financial consideration, the authors declare no conflict of interest.

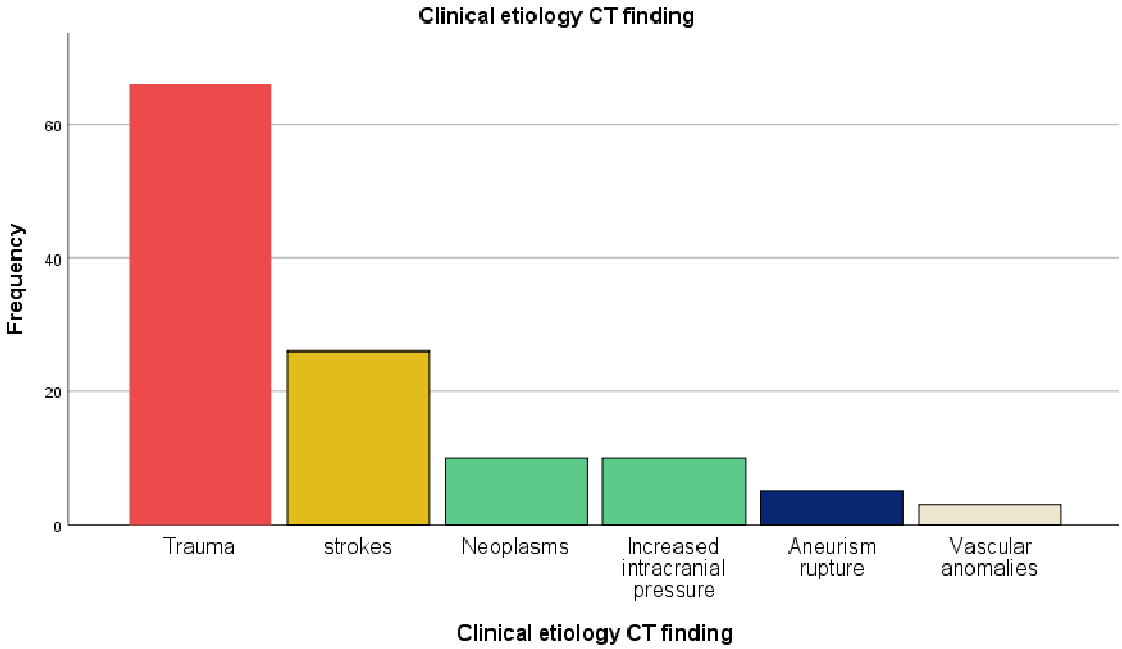
RESULTS

This study aimed to evaluate the intracranial fluid collection including hemorrhages and edema in brain injury patients. Population of study including 120 patients diagnosed with intracranial hemorrhage, their ages between (1- 100 years). Those patients were being examined using advanced Multi-detector CT Scan techniques in the period from January to April 2019. The outcomes had being detecting from patients reports which was diagnosed by specialized radiologists and consulted neurologist. The demographic data including, clinical etiology, distribution of age groups, distribution of gender, distribution of symptoms, distribution of the degree of severity and distribution of types of ICH. All these results were represented in tables and graphs as shown in following pages.

- First result regarding clinical etiology, reveal 120 incident of intracranial fluid collection including traumatic and non-traumatic causes. Trauma etiology had the biggest distribution with 55.0 percent. The non -traumatic incident were caused by bleeding due to aneurism ruptures (4.2 percent) and Strokes (21.7 percent) .Other etiology finding included brain neoplasms and increased intracranial pressure (8.3percent) in addition to any vascular abnormalities (2.5 percent). The distributions were shown in Table 1 and Graph 1 as follows.
- The result concerning age group distribution showed that the group between (21- 30) had the big percentage distribution 55.0 % as shown in Table 2 and Graph 2.
- Results regarding gender distribution showed that male is more affecting than women with 70.0 percent as shown in Table 3 and Graph 3.
- The obtained results for brain injures achieved different sign and symptoms, the big distribution detected

Table 1. Present clinical etiology

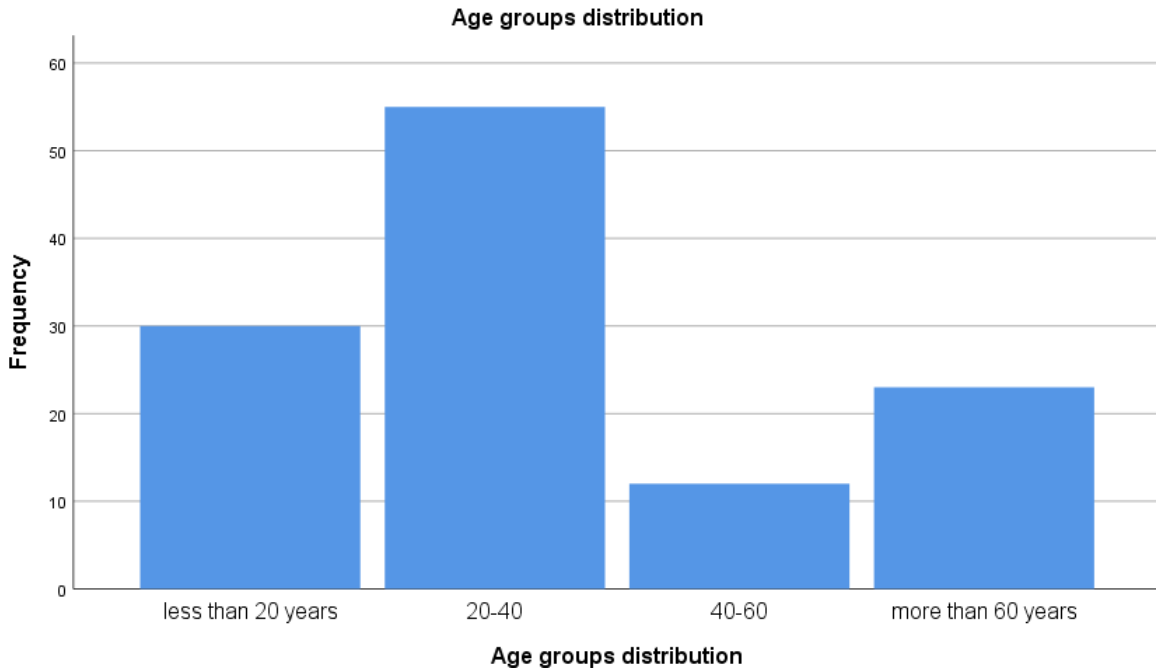
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Trauma	66	55.0	55.0	55.0
	strokes	26	21.7	21.7	76.7
	Neoplasms	10	8.3	8.3	85.0
	Increased intracranial pressure	10	8.3	8.3	93.3
	Aneurism rupture	5	4.2	4.2	97.5
	Vascular anomalies	3	2.5	2.5	100.0
	Total	120	100.0	100.0	



Graph 1. Present clinical etiology

Table 2. Shows distribution of age groups

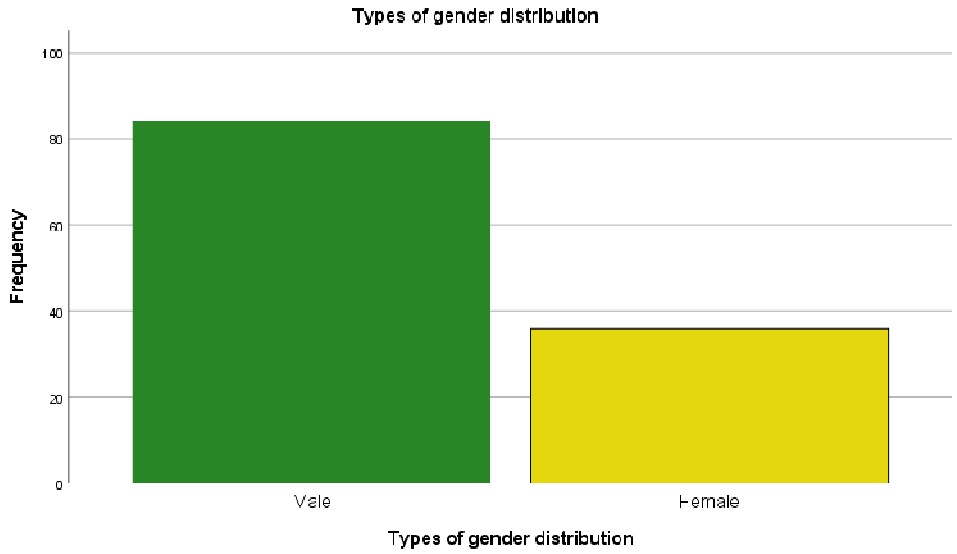
Statistics	Age groups distribution				
	Valid				
	< 20 years	20-40	40-60	> 60 years	Total[a]
Frequency	30	55	12	23	120[a]
Percent	25.0	45.8	10.0	19.2	100.0[a]
Valid Percent	25.0	45.8	10.0	19.2	100.0[a]
Cumulative Percent	25.0	70.8	80.8	100.0	



Graph 2. Shows distribution of age groups

Table 3. Shows gender distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	84	70.0	70.0	70.0
	Female	36	30.0	30.0	100.0
	Total	120	100.0	100.0	



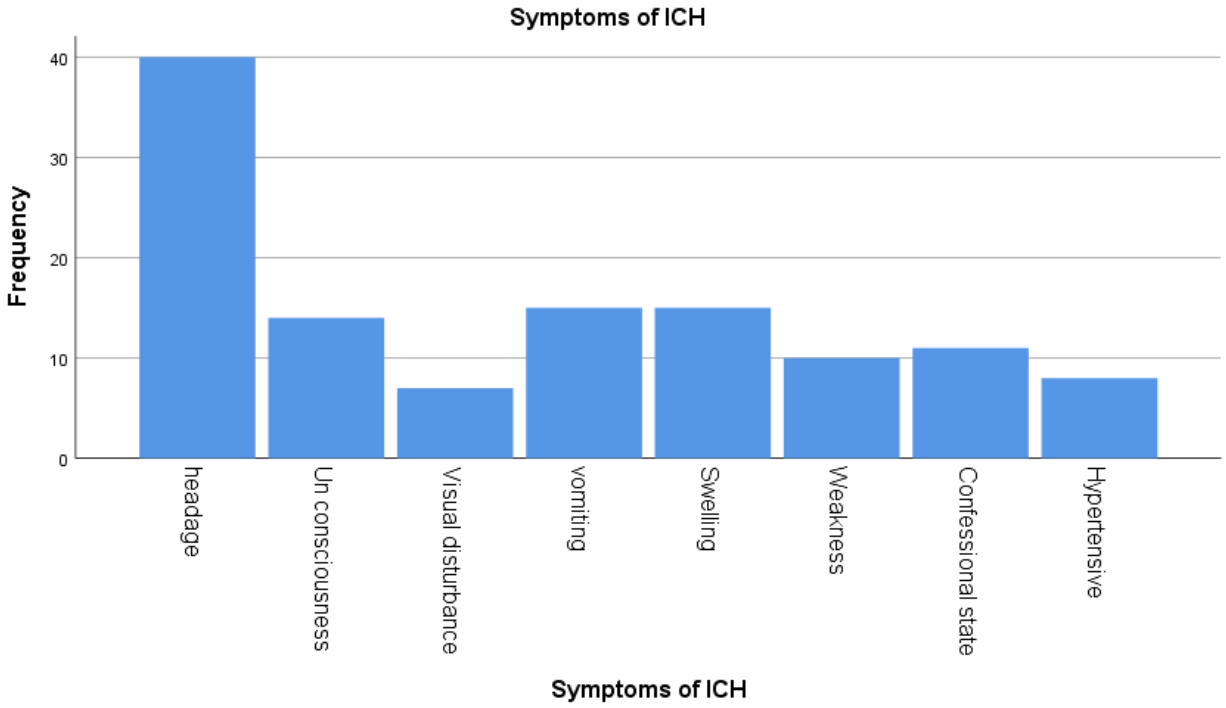
Graph 3. Shows gender distribution

for headage symptoms with 33.3 percent, the other results achieved present in Table 4 and Graph 4.

- The degree of severity for intracranial hemorrhage achieved that most of the cases are moderate than mild and severe condition as represented in Table 5 and Graph 5.

Table 4. Shows different Signs &Symptoms distribution

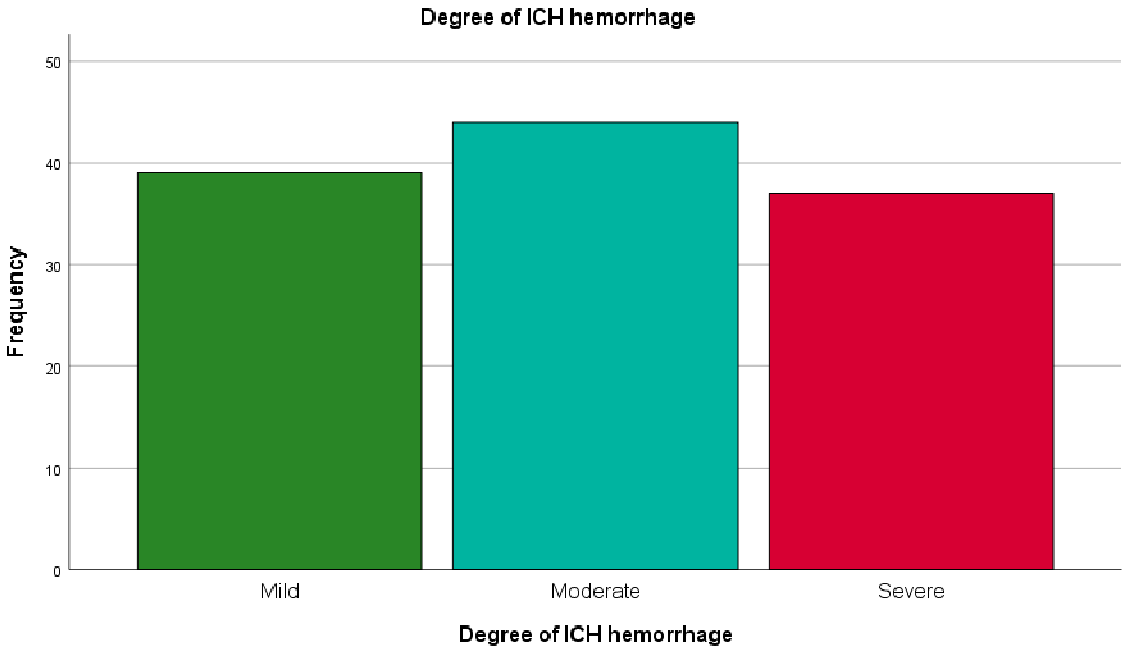
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Headage	40	33.3	33.3	33.3
	Un consciousness	14	11.7	11.7	45.0
	Visual disturbance	7	5.8	5.8	50.8
	vomiting	15	12.5	12.5	63.3
	Swelling	15	12.5	12.5	75.8
	Weakness	10	8.3	8.3	84.2
	Confessional state	11	9.2	9.2	93.3
	Hypertensive	8	6.7	6.7	100.0
	Total	120	100.0	100.0	



Graph 4. shows Signs &Symptoms distribution

Table 5. Shows the degree of I.C.H hemorrhage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Mild	39	32.5	32.5	32.5
	Moderate	44	36.7	36.7	69.2
	Severe	37	30.8	30.8	100.0
	Total	120	100.0	100.0	



Graph 5. Shows the degree of I.C.H hemorrhage

Obtained results from classification of intracranial fluid collection in brain injuries achieved 15.0 percent for Intra parenchymal hemorrhage (IPH), 8.3 percent for Epidural hematomas (EDH), 17.5 percent for Sub Dural hematomas (SDH), 16.7 percent for Sub Arachnoid hemorrhage (SAH), 9.2 percent for Intra Ventricular Hemorrhage (IVH), 10.8 for Basal Ganglia Hemorrhage (BGH) and 22.5 as the biggest detection for Subgelial hemorrhage (SGH) . All these classifications and percentages distribution were shown in table 7

DISCUSSION

Intracranial fluid collection in acute brain injury refers to collection of intra and extra axial fluid within the skull including any bleeding or excess fluid (brain edema) within the intracranial parenchymal spaces and surrounding meningeal spaces. The clinical etiology belong to various causes such as intracranial hematomas from head injury which causes blood to accumulate within the brain or between the brain and the skull, this accumulation can lead to increases in intracranial pressure and can cause potentially deadly brain herniation. Also it occurs due to blood vessel or aneurism rupture within the skull or caused by spontaneous non traumatic caused such as strokes or brain neoplasms. The CT finding in current study demonstrated different clinical etiologies which have been present in (table and graph 1). The biggest distribution achieved for trauma etiology with 55 percent and mean value 1.93 followed by strokes with 21.7 percent. These results matching with reports found in literature (Appelros P et al., 2009) which detected near similar ranges. Acute brain injuries can pose challenges for all persons, of regardless of age, sex, geography, military status, or other distinguishing characteristics. Although the risk factors health effects, and long-term implications of brain injury vary for each person, some persons "pediatric" as example, require special considerations, were some studies suggest that even children with mild injuries are at risk for disability .Concerning age groups distributions , the recent study detected age group between 21 to 30 years old as the biggest distribution of intracranial fluid collection (table and graph 2) with 45.8 percent and mean value 2.23 .And for gender distribution, the research found that male was more affected than female with (70%) percentage and mean value 1.30 (table and graph 3), these results agree with previous researches (Appelros P, 2009; Palled ER, 2014). The potential causes of traumatic brain injuries are various such as falls , violence and road traffic accidents and in addition to the damage caused at the moment of injury also, it can result in physical, cognitive, social, emotional, and behavioral symptoms, and outcome can range from complete recovery to permanent disability or death.

Regarding sign and symptoms of ICH, most patient were found complaining from headage symptom with (33.3%) percentage (table 4, graph 4), these results also agree with many previous studies found in literature (Apurva Vohra, 2015; Nishijima DK et al., 2013). Injury to the Brain is a significant cause of death and disability, the severity and site of injury affect the outcome, were injury of several cubic centimeters of brain parenchyma may be clinically silent, however severe brain damage

Table 6. Showed the correlation between ICH symptoms and the degree of severity

		Symptoms of ICH	Degree of ICH hemorrhage
Symptoms of ICH	Pearson Correlation	1	.920**
	Sig. (2-tailed)		.000
	N	120	120
Degree of ICH hemorrhage	Pearson Correlation	.920**	1
	Sig. (2-tailed)	.000	
	N	120	120

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7. Classification of I.C.H hemorrhage type

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Intra parenchymal hemorrhage (IPH)	18	15.0	15.0	15.0
	Epidural hematomas (EDH)	10	8.3	8.3	23.3
	Sub Dural hematomas (SDH)	21	17.5	17.5	40.8
	Sub Arachnoid hemorrhage (SAH)	20	16.7	16.7	57.5
	Intra Ventricular Hemorrhage (IVH)	11	9.2	9.2	66.7
	Sub Glial hemorrhage (SGH)	27	22.5	22.5	89.2
	Basal Ganglia Hemorrhage (BGH)	13	10.8	10.8	100.0
	Total	120	100.0	100.0	

can occur in the absence of external signs of head injury and conversely, severe lacerations and even skull fractures do not necessarily indicate damage to the underlying brain. Results achieved for degree of severity in the current study detected that most of the traumatic cases were moderate to mild (36.7%) detection for moderate , with mean value 1.98 (Table 5, Graph 5) , this result agree with previous reports (Martini SR ,2012, Brasure, M,2012). There was significant correlation (.920**) between the symptoms of ICH and the degree of severity which was shown in (Table 6). Radiological imaging especially CT scan techniques can determine the presence and extent of fluid collection due to the injury and guide surgical planning procedures. Currently the advantages of cost and convenience for CT scan have limited the use of MRI in management of acute brain injuries, additionally investigators are using MRI to better understand the mechanism of secondary brain injury in trauma.

(Bruce Lee and Andrew Newberg, 2012; Zasler N.D et al., 2013). However radiological imaging plays a critical role in the evaluation of traumatic causes , non-contrast CT scan (NCCT) have been accepted as standard image technique for evaluating of intracranial hemorrhage, it's accurate in detecting intracranial fluid and in differentiate between traumatic hemorrhages according to its site, where the study achieved Subgelial hemorrhage (SGH) type as big distribution with percentage of (22.5%) and 4.08 mean value (Table 7). Accuracy with early CT scanning detection of acute brain injuries were reported in many previous studies found in literature. (Akanji AO, 2015; Wintermark M, 2013).

CONCLUSION

The current study used the advanced Multi detector computed tomography to evaluate the accumulation of intracranial fluid in acute brain injuries patients. And hence the diagnostic value of the study approved that, radiological CT scan techniques is sensitive and highly accurate in evaluation head injury in general including accumulation of intracranial hemorrhage and brain edema . Moreover the widespread availability and the short scanning time make it the standard technique of choice for evaluation the accumulation of intracranial fluids within the brain.

Competing interest

The author declare that there is no conflict of interest.

Declarations

The author declares that he has no competing interest.

Financial Disclosure

There are no financial supports.

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