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Original Article

Evaluation of Acute Intracerebral hemorrhage using Computed-Tomography and Magnetic Resonance imaging from Tertiary Care Hospital Peshawar

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ABSTRACT

Background: Acute intracerebral hemorrhage (ICH) is a severe form of stroke characterized by bleeding within the brain parenchyma, posing high risks of mortality and disability. Accurate and rapid diagnosis is crucial for effective management. This study aimed to evaluate the detection and diagnostic accuracy of computed tomography (CT) and magnetic resonance imaging (MRI) in acute ICH.

Objective: This study aimed to evaluate the detection of acute intracerebral hemorrhage and assess the diagnostic accuracy of computed tomography and magnetic resonance imaging.

Methods: A descriptive cross-sectional study was conducted from February 2023 to June 2023 at Rehman Medical Institute and Kuwait Teaching Hospital in Peshawar, Khyber Pakhtunkhwa. The sample size was 110 patients, and data were analyzed using the Statistical Package for the Social Sciences (SPSS).

Results: Out of 110 patients, 38 (34.5%) were aged 49-66. All patients (100%) had subarachnoid or other types of hemorrhage confirmed on scans. Hypertension was present in 41 (37.3%) patients, while 69 (62.7%) were not hypertensive. Loss of consciousness was observed in 26 (23.6%) patients, whereas 84 (76.4%) did not experience it. Subdural/epidural hematomas were found in 28 (25.5%) patients, and 82 (74.5%) had no such hematomas.

Conclusion: The study concluded that the capabilities of detection and diagnostic accuracy of the computed tomography scan in acute intracerebral hemorrhage are superior to magnetic resonance imaging due to higher sensitivity and faster image acquisition time.

Keywords: Acute intracerebral hemorrhage, Computed Tomography, Diagnostic accuracy, Magnetic Resonance Imaging, Stroke evaluation

INTRODUCTION

Intracerebral hemorrhage refers to any type of intra-parenchymal bleeding within the brain's cranial cavity and meningeal spaces. It is the most destructive form of stroke, characterized by high mortality and severe disability among survivors. Intracerebral hemorrhage can be further categorized into intracranial hemorrhage (ICH) and subarachnoid hemorrhage (SAH), both of which have significant morbidity and mortality (1). Acute ICH is particularly dangerous and difficult to treat, often resulting in serious disability for survivors. Some patients survive up to one year, and a third survive up to five years. The relative impact of intraventricular hemorrhage (IVH) and ICH location on functional outcomes is uncertain, which may influence therapeutic decisions favoring one hematoma location over another (2).

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Non-contrast and contrast-enhanced CT scans are invaluable tools for identifying acute ICH due to their rapid execution and excellent sensitivity. CT is considered the gold standard diagnostic tool for ICH in emergency situations, providing critical information such as ICH location, volume, degree of edema, intraventricular extension, hydrocephalus, brainstem compression, and midline shift secondary to hematoma mass effect. Additionally, CT is widely available and non-invasive, making it ideal for detecting vascular abnormalities and secondary causes of ICH. MRI, with sensitivity equal to that of non-contrast CT (NCCT), is particularly useful for detecting underlying secondary causes of ICH, such as hemorrhagic transformation of ischemic stroke or neoplastic lesions (3).

Primary ICH typically arises from progressive small vessel disease, most commonly microvascular angiopathy or hypertensive arteriopathy. Secondary ICH can result from trauma, vascular malformation, arteriovenous malformation (AVM), tumor, or other conditions like small vessel ischemia, hematoma, brain atrophy, infarct, and vasogenic edema leading to ischemic and hemorrhagic strokes (4). In the United States, ICH has a reported mortality rate of over 20,000 Americans per year, accounting for two-thirds of hemorrhagic strokes and 10%-20% of all strokes. While CT is preferred for diagnosing acute ICH due to its high sensitivity and availability, MRI is a powerful diagnostic tool for chronic hemorrhages due to its high specificity and sensitivity (5).

The most common types of ICH include subdural hematoma, epidural hematoma, subarachnoid hemorrhage (SAH), and hemorrhagic contusions. CT scans are predominantly used for traumatic ICH due to their outstanding sensitivity (6). While MRI has higher sensitivity than CT for detecting acute intracerebral hemorrhage, CT is better suited for identifying structural abnormalities in the brain. MRI excels in characterizing ICH from acute to chronic stages and reliably estimating the age of hemorrhagic lesions. However, MRI's limitations include lower availability, increased complexity, and longer scan times compared to other modalities (7).

Limited data is available from Pakistan regarding the evaluation of acute ICH using imaging modalities. A previous study by Akhtar et al. (2022) demonstrated that 7.9% of patients suffered from hemorrhage and stroke detected by CT scan (8). This study focused on the traumatic aspect of the brain due to time and resource constraints, excluding the evaluation of neoplastic aspects. The objective of this study was to evaluate the detection of acute intracerebral hemorrhage using computed tomography and magnetic resonance imaging.

MATERIAL AND METHODS

The study was a descriptive cross-sectional design conducted in two hospitals in District Peshawar, Khyber Pakhtunkhwa: Rehman Medical Institute (RMI) and Kuwait Teaching Hospital, from February to June 2023. A sample size of 110 patients was determined using the previously published criteria (n = Z^2 P (1- P) / d^2) (9). The sampling technique employed was convenience sampling. The study included conscious patients aged 12-80 of all genders with various types of hemorrhage. Patients younger than 12 years or older than 80 years were excluded.

Two imaging modalities, computed tomography (CT) and magnetic resonance imaging (MRI), were utilized. Data were obtained from hospital databases through convenience sampling, with informed consent obtained from all participants. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 2019 software.

The research focused on testing the following hypotheses: H0: The detection capability of the computed tomography scan in acute intracerebral hemorrhage is not better than magnetic resonance imaging. H1: The detection capability of the computed tomography scan in acute intracerebral hemorrhage is better than magnetic resonance imaging. H0: The diagnostic accuracy of the computed tomography scan in acute intracerebral hemorrhage is not better than magnetic resonance imaging. H1: The diagnostic accuracy of the computed tomography scan in acute intracerebral hemorrhage is better than magnetic resonance imaging.

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RESULTS

Out of a total of 110 patients, 60 were males having percentage of 54.5% and the remaining females having with percentage of 45.5%. Most of the patients were in the age groups of 49-66 years with percentage of 34.5%. Majority of the patients were married and belonged from urban area (Table 1).

Table 1: Shows the patient demographic details of the patients

Variables	Categories	Frequency	Percentage
Age	12-30	24	21.8%
	31-48	26	23.6%
	49-66	38	34.5%
	67-84	22	20.0%
Weight	31-45	7	6.4%
	46-60	10	9.1%
	61-75	63	57.3%
	Above 75	30	27.3%
Gender	Male	60	54.5%
	Female	50	45.5%
Marital status	Single	15	13.6%
	Married	95	86.4%
Residence	Rural	44	40%
	Urban	66	60%

The weight of patients was distributed in different categories in which weight from 31-45 are 7 patients having 6.4%, the weight from 46-60 patients having 9.1%, the weight from 61-75 are 63 patients having 57.3%, the weight above 75 are 30 patients having 27.3%. Out of all 110 patients there are 41 (37.3%) patients have headache before performing CT/MRI scan and the remaining 69 (62.7%) patients have no headache before performing CT/MRI scan. The responses of the patients to asking mentioned questions are shown in Table 2.

Table 2: The table shows the responses of the patients to asking mentioned questions in data form

S. No	Questions	Response	Frequency	Percentage
	Do you have any headache?	Yes	41	37.3%
		No	69	62.7%
	Do you have history of falling from anywhere?	Yes	11	10%
		No	99	90%
	Do you have history of any trauma or accident?	Yes	19	17.3%
		No	91	82.7%
	Do you have any type of Hydrocephalus?	Yes	13	11.8%
		No	97	88.2%
	Do you have history of fits/seizers/epilepsy?	Yes	7	6.4%
		No	103	93.6%
	Do you have any intracerebral hemorrhage (subarachnoid or others)?	Yes	110	100%
		No	0	0%
	Do you have any edema?	Yes	12	10.9%
		No	98	89.1%
	Do you have any type of infarct (ischemic/hemorrhagic)?	Yes	26	23.6%
		No	84	76.4%
		Yes	17	15.5%

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	Do you have any type of small vessels ischemia (chronic/acute)?	No	93	84.5%
	Do you have any hypertension (high blood pressure)?	Yes	41	37.3%
		No	69	62.7%
	Do you have Brain/cerebral atrophy (the loss of nerve cells)?	Yes	19	17.3%
		No	91	82.7%
	Do you have any type of stroke (Ischemic/Hemorrhagic)?	Yes	14	12.7%
		No	96	87.3%
	Do you have any loss of consciousness?	Yes	26	23.6%
		No	84	76.4%
	Do you have any type of hematoma (subdural/epidural)?	Yes	28	25.5%
		No	82	74.5%

Our findings suggested that the detection capability of CT scan was better than MRI in case of acute intracerebral brain hemorrhage (Figure A, B,C), as well as the diagnostic accuracy of CT was more efficient than MRI. Figure (1, D) represents the MRI brain image; the marked sign showed the interventricular hemorrhage of the brain. Figure (1, E) represents the CT scan image of brain demonstrating the subarachnoid hemorrhage. Our finding demonstrated that we are rejecting both the null hypothesis and accepting the alternate hypothesis.

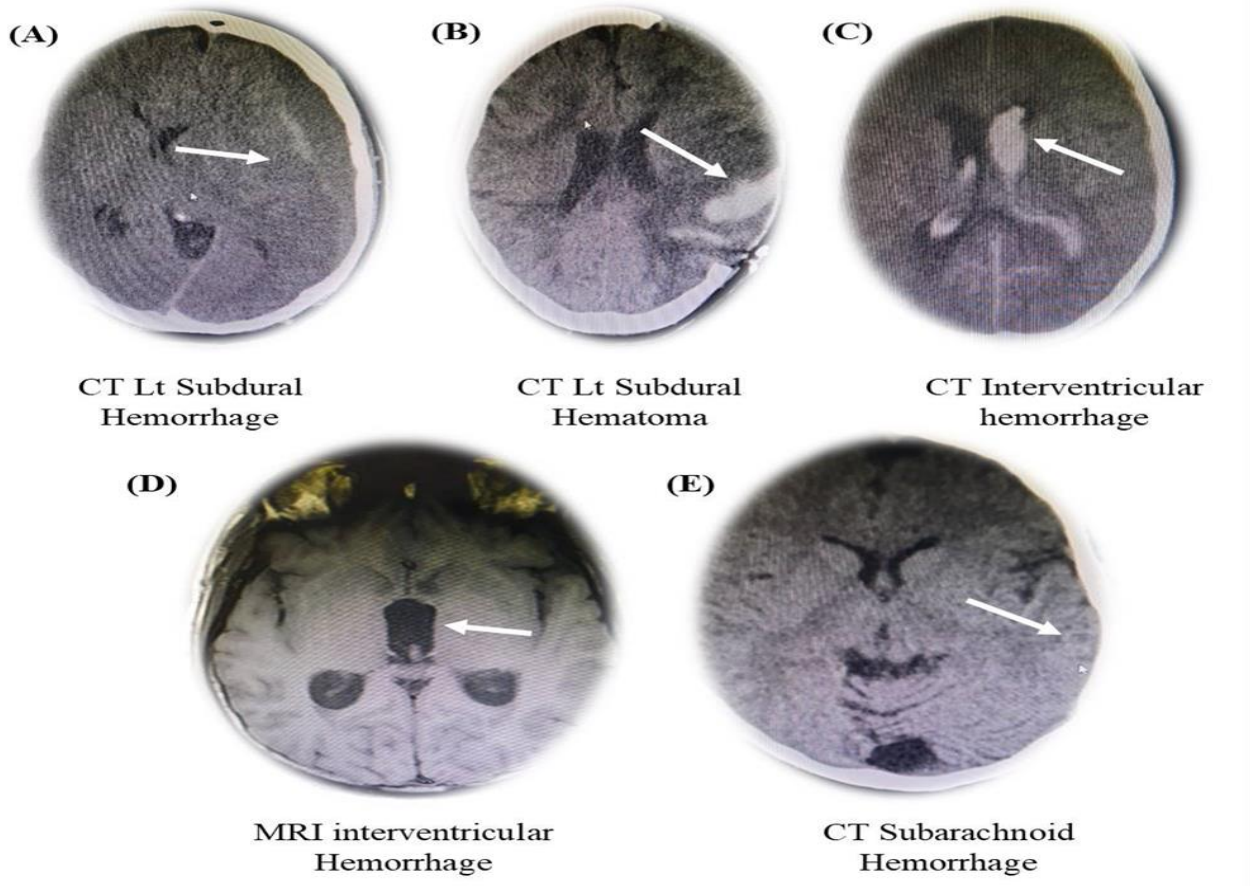

Figure 1: Represents the CT scan and MRI images of brain in case of acute intracerebral hemorrhage, **Figure (1, A)** shows the subdural hemorrhage, **Figure (1, B)** subdural hematoma, **Figure (1, C)** Interventricular hemorrhage, **Figure (1, D)** shows the brain image demonstrates the interventricular hemorrhage using MRI, while **Figure (1, E)** the subarachnoid hemorrhage using CT scan

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DISCUSSION

This study, conducted at Rehman Medical Institute and Kuwait Teaching Hospital in Peshawar, aimed to evaluate acute intracerebral hemorrhage (ICH) using non-contrast computed tomography (CT) and non-contrast magnetic resonance imaging (MRI). Of the 80 patients, 67% underwent non-contrast CT, and 33% underwent non-contrast MRI. Non-contrast CT, with its excellent sensitivity, is considered the gold standard for diagnosing ICH in emergency situations. Most of the patients were married (95%) and from urban areas (66%), with the remaining 44% from rural areas.

In this study, the majority of patients were in the age group of 49-66 years. In contrast, another report from Al-Zahra Hospital in Tehran observed that most patients were over 65 years old, with increased risks of ventricular bleeding and subarachnoid hemorrhage (10). Imaging evaluations revealed that 42% of patients had hemorrhage in the putamen, 71.4% had lobar hemorrhage with associated brain edema, and 54.6% had lobar hemorrhage. Haller et al. noted that hypertension is the strongest factor for cerebral microbleeds and ICH in India (11).

The findings of this study align with previous reports from New York, USA, where acute ICH was more common in male patients (58.2%) with an average age of 60.8 years (12). A study from Tehran, Iran, at Sari Imam Khomeini Hospital complex, found that CT is a more sensitive and cost-effective diagnostic modality compared to MRI, with CT sensitivity decreasing from 93.1% to 83.8% depending on the onset time of symptoms (13).

A report from New Delhi, India, demonstrated that non-contrast CT is an effective screening tool for predicting ICH in emergency situations and intensive care units, outperforming Near Infra-Red Spectroscopy (NIRS) which is unreliable for sub-acute to chronic hemorrhage and bilateral lesions (14). In Japan, CT is predominantly used for post-trauma ICH evaluation and provides essential information about brain structure, similar to the findings of this study (15). Kidwell et al. reported that MRI is more accurate than CT for chronic ICH, but the current investigation focused on acute ICH (16).

ICH accounts for 10-20% of all strokes and is associated with severe outcomes, including a 30-day mortality rate of up to 40% (17). In this study, 12.7% of individuals experienced stroke, closely resembling previous reports. ICH was mostly observed in the 49-66 age group, consistent with other studies that identify old age as a significant risk factor for ICH (18). Other risk factors studied included male sex and hypertension, both significantly observed in ICH patients (19). Hematoma expansion, another significant risk factor, was observed in 30% of cases, a finding closely mirrored in this study (20).

The study's strengths include the use of standardized diagnostic criteria and the inclusion of both urban and rural populations. However, limitations include a small sample size and the exclusion of patients below 12 and above 80 years, which may affect the generalizability of the results. Additionally, the study was constrained by time and resource limitations, resulting in a limited patient pool and focus on the traumatic aspect of the brain only.

Overall, this study underscores the importance of CT as a rapid and sensitive diagnostic tool for acute ICH, while acknowledging the complementary role of MRI in specific cases. Future research should aim to include larger, more diverse populations and explore the neoplastic aspects of brain hemorrhage to provide a more comprehensive understanding of ICH diagnosis and management.

CONCLUSION

The study concluded that non-contrast CT is a highly sensitive and effective diagnostic tool for acute intracerebral hemorrhage, particularly in emergency settings, while MRI serves as a valuable complement in specific cases. The findings highlighted the prevalence of ICH among middle-aged to older adults, with hypertension identified as a significant risk factor. Despite the small sample size and focus on traumatic brain injury, the results align with global research emphasizing the critical role of imaging in ICH management. Future research should expand to larger, more diverse populations and explore neoplastic aspects, enhancing diagnostic accuracy and treatment strategies. This study underscores the need for accessible and reliable imaging modalities in acute care to improve patient outcomes.

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