# THE SPECTRUM OF RADIOLOGICAL FINDINGS IN PATIENTS PRESENTING WITH DIFFERENT CLINICAL INDICATIONS FOR CRANIAL COMPUTED TOMOGRAPHIC SCAN

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## ABSTRACT

***Objectives:*** To identify the main reasons for seeking computed tomography (CT) scan evaluation and primary brain and skull pathologies seen on CT scan and to determine the percentage of negative and positive CT scans for a particular referring reason and correlate the commonest reason for seeking CT scan evaluation with age and gender.

***Study Design:*** A cross-sectional study.

***Place and Duration of Study:*** Department of Radiology, Sheikh Khalifa Bin Zaid Al Nahyan Hospital Muzaffarabad, Azad Jammu and Kashmir, from Jan to Sep 2016.

***Material and Methods:*** Through consecutive sampling, we included 137 patients referred for radiological evaluation of skull and brain through CT scan. The study was performed by a senior CT scan technologist using CT scan machine Brilliance CT 16 slice – DS, taking 0.5 mm slices in all patients and reviewed by a consultant radiologist. The sample was divided into two age-groups i.e. age ≤36 years and age >36 years. The data were analysed using statistical program Statistical Package for Social Sciences version 20.0.

***Results:*** Out of 137 individuals, (mean age: 34 ± 23 years), 86 (62.8%) were male and 51 (37.2) were female. The majority (61.3%, n=84) of the individuals were referred for complaint of head trauma. The head trauma was significantly more common in age group of ≤36 years ($p$<0.001) and males were more involved in head trauma than females (male-to-female ratio of 2:1, odds ratio: 1.53, confidence interval: 0.76-3.11). On CT scan evaluation, 19.7% (n=27) had a normal study while 80.3% (n=110) had at least one abnormal finding. Fracture of the skull bones (with or without other abnormalities) was the commonest abnormality found in 46.4% (n=51) patients. Higher percentage of positive CT scan was found in patients with all sorts of presenting complaints.

***Conclusion:*** The majority were referred for cranial CT scan evaluation for the complaints of head trauma. Fracture of the skull bones was the commonest finding. Head trauma was significantly more common in age-group of ≤36 years and males were more commonly involved than females. Higher percentage of positive CT scan was found in patients with all sorts of presenting complaints.

**Keywords:** Brain pathologies, Computed tomography scan, Skull pathologies.



## INTRODUCTION

Computed Tomography (CT) scan is a radiological modality that makes use of computer-processed combinations of many X-ray images taken from different angles to produce cross-sectional (tomographic) images (often called slices) of specific areas of a scanned object, allowing the user to see inside of the object without cutting. Digital geometry processing is used to generate a three-dimensional image of inside of the object from a large series of two-dimensional radiographic images taken around a single axis of rotation. The CT Scan is the investigation of choice in many clinical problems to identify the primary pathology and guide the management process.

In the modern era, CT scan is the modality of choice in initial assessment of many neurological emergencies, as it is widely available, faster, and highly accurate in detection of skull fractures and acute intracranial haemorrhage[1]. CT scan is also the primary modality to detect ischemic or

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*Received: 23 Jun 2017; revised received: 20 Oct 2017; accepted: 27 Nov 2017*

haemorrhagic nature of a stroke[2]. In cases of migraines, headaches, and loss of consciousness, CT scan is helpful in identifying the underlying pathology as it can detect brain tumours, abscess, hydrocephalus, sinus blockage, cerebrovascular accidents, vascular malformation, and haemorrhages, etc[3].

CT scan is the first-line imaging modality for the investigation of acute neurological emergencies because it is fast and readily and widely available. Image findings, in combination with Glasgow Coma Scale can be used to classify the severity of the neurological issues and guide the treatment in the right direction. In fact, we have observed a positive CT scan, identifying abnormalities related to the expected pathology in 80.3% of the referred cases. In the literature, the incidence of abnormal CT scan findings has been quite variable and has ranged from 37% to 100%[1,4-7]. The chances of getting an abnormality on CT scan was found to be directly related to the severity of clinical symptoms[8].

The studies regarding the pattern of pathologies seen on CT scan are lacking in Azad Jammu and Kashmir. This study was aimed at identifying the main reasons for seeking CT scan evaluation and brain and skull pathologies seen on CT scan films in patients referred for such evaluation. Association of traumatic vs non-traumatic etiologies with age and gender and percentage of negative and positive CT scans for a particular referring reason were secondary goals.

## MATERIAL AND METHODS

It was a cross-sectional study carried out at Sheikh Khalid Bin Zaid Al-Nahyan Hospital (SKBZH), Muzaffarabad. After approval from the hospital ethical review committee of SKBZH, we sampled 145 patients who were referred from various departments of SKBZH for radiological evaluation of skull and brain using CT scan through consecutive sampling from January to September 2016. The patients with already diagnosed status epilepticus, carcinoid tumours, and other neoplastic lesions of the brain, and history of a psychiatric disorder were not included in the study. The study was performed by a senior CT scan technologist. All studies were performed using CT scan machine Brilliance CT 16 slice – DS (Koninklijke Philips Electronics, Naamloze vennootschap, The Netherlands). In all

**Table-I: The demographic and clinical characteristics of the sample.**

| Characteristics | n (%) | Characteristics | n (%) |
|---|---|---|---|
| **Gender** | | **CT Scan Evaluation** | |
| Male | 86 (62.8) | Normal | 27 (19.7) |
| Female | 51 (37.2) | Abnormality | 110 (80.3) |
| **Primary reason for referral** | | **Abnormality seen on CT scan** | |
| Head trauma | 84 (61.3) | Fracture of the skull bones | 51 (46.4) |
| Generalized or localized weakness | 25 (18.2) | Extradural hematoma | 17 (15.4) |
| Loss of consciousness | 17 (12.4) | Cerebral infarct | 16 (14.5) |
| Headache | 5 (3.6) | Intracerebral hemorrhage | 15 (13.6) |
| Epilepsy | 3 (2.2) | Subdural hematoma | 14 (12.7) |
| Speech abnormality | 3 (2.2) | Brain contusions | 12 (10.9) |
| | | Scalp hematoma | 9 (8.2) |
| | | Age related cerebral atrophy | 8 (7.3) |
| | | Subarachnoid hemorrhage | 8 (7.3) |
| | | Hemosinus | 8 (7.3) |
| | | Hydrocephalus | 6 (5.4) |
| | | Deep white tissue ischemic changes | 6 (5.4) |
| | | Sinusitis | 4 (3.6) |
| | | Dural sinus thrombosis | 3 (2.7) |
| | | Diffuse brain swelling | 2 (1.8) |

patients, 0.5 mm slices were taken. All reports were studied and reported by a consultant radiologist.

All the data were analysed using statistical program Statistical Package for Social Sciences (SPSS) version 20.0 (IBM Corp., Armonk, NY, USA). For the analysis of association of traumatic vs non-traumatic etiologies with age, the sample was divided into two groups i.e. age ≤36 years and age >36 years. Means and standard deviations were calculated for age. Frequencies and percentages were calculated for gender, the reasons for the referral, age-groups, and radiological finding on CT scan. The odds ratio was calculated for gender association with traumatic vs non-traumatic etiologies, while Chi-square test was applied for the association of age-group with traumatic vs non-traumatic etiologies. A *p*-value less than 0.05 was considered significant.

## RESULTS

Out of a total of 137 individuals finally included, 86 (62.8%) were male and 51 (37.2) were female. The mean age of the sample was 34 ± 23 years with a range of 2-85 years. Fifty-eight individuals were ≤36 years of age, while forty-five individuals were >36 years of age (56.3% and 43.7% respectively after eliminating thirty-four missed entries). The majority (61.3%, n=84) of the individuals were referred for the radiological evaluation by CT scan for the complaints of head trauma (table-I). The head trauma was significantly more common in the age-group of ≤36 years, while non-traumatic complaints were more common in the age-group of >36 years ($p$<0.001) (table-II). The males were more commonly involved in head trauma than females (Male-to-female ratio of 2:1, Odds ratio: 1.53, Confidence interval: 0.76-3.11) (fig-1).

On CT scan evaluation, 19.7% (n=27) had a normal study while 80.3% (n=110) had at least one abnormal finding. Fracture of the skull bones (with or without other abnormalities) was found in 46.4% (n=51) patients. Sixty-seven (79.8%) individuals with a history of head trauma showed an abnormal pathology on CT scan related to trauma. The common abnormalities other than the fracture were extradural hematoma (n=17), cerebral infarct (n=16), intracerebral haemorrhage (n=15), and subdural hematoma (n=14) (table-I). The correlation between clinical questions and CT scan results is shown in table-III.

**Table-II: Association of traumatic vs non-traumatic etiology and age-groups.**

| Age group | Traumatic vs non-traumatic etiology | |
|---|---|---|
| | Traumatic etiology | Non-traumatic etiology |
| | n (%) | n (%) |
| Age ≤36 years | 49 (74.2) | 9 (24.3) |
| Age >36 years | 17 (25.8) | 28 (75.7) |

Thirty-four missing entries excluded; $p$<0.001

**Table-III: Correlation between clinical questions and computed tomography results.**

| Clinical questions | Total n (%) | Negative CT Scan n (%) | Positive CT Scan n (%) |
|---|---|---|---|
| Head trauma | 84 (61.3) | 17 (20.2) | 67 (79.8) |
| Generalized or localized weakness | 25 (18.2) | 1(4) | 24 (96%) |
| Loss of consciousness | 17 (12.4) | 6 (35.3) | 11 (64.7) |
| Headache | 5 (3.6) | 2 (40) | 3 (60) |
| Epilepsy | 3 (2.2) | 1 (33.3) | 2 (66.7) |
| Speech abnormality | 3 (2.2) | 0 | 3 (100) |

## DISCUSSION

We observed that the majority of individuals were referred for the radiological evaluation by CT scan for the complaints of head trauma. The cases of head trauma are increasing worldwide due to increased incidence of motor vehicle accidents (MVA) and acts of violence. Head trauma and the related traumatic brain injury is

more common in persons younger than 35 years and the male-to-female ratio is nearly 2:1[9]. We found a similar trend as head trauma was significantly more common in the age-groups of ≤36 years and male-to-female ratio was exactly 2:1. The apparent reason for male gender predominance appears to be greater participation of males in the outdoor activities. The social and cultural values in many countries entail male population to be more involved in work, sports, and other outdoor activities as compared to the females. Therefore, the exposure to MVA, acts of violence, and environmental calamities is greater among males than females.

CT is the imaging modality of choice for detecting fractures and depending on the type and location of fractures, quick surgical intervention can be done to prevent cerebrospinal fluid leak, infection, thrombosis, infarct or haemorrhage[1]. The literature shows an incidence of 3.1% to 80% of skull fractures seen radio-logically in cases of acute head trauma[1,10-18]. We found that 60.7% of individuals with a history of head trauma showed a fracture. While including pathologies related to fracture, this percentage increased to 79.8% and thus facilitated prompt appropriate treatment.

The other common abnormalities seen on CT scan were extradural hematoma (15.4%), cerebral infarct (14.5%), intracerebral haemorrhage (13.6%), subdural hematoma (12.7%), and brain contusions (10.9%). Tomar *et al*, in an Indian study, found the incidence of extradural hematoma, intracerebral haemorrhage, brain contusion, and subdural hematoma to be 12%, 26%, 22%, and 18% respectively in a sample of 100 patients of head trauma who underwent cranial CT scan[1]. Imtiaz, in another Indian study found an incidence of 4%, 15%, 43%, and 21% respectively for the above-mentioned CT scan findings in a sample of 100 individuals[17]. Zimmerman and colleagues, in an American study, found incidence of the abnormalities in the same order as 4.9%, 6.3%, 21.3%, and 12.6% respectively in 286 patients of head trauma[16]. Hidayat, in an Iraqi study, observed incidence of 16%, 46%, 44%, and 38% respectively for the same findings in the above-mentioned order[19]. Lobato *et al*, in a Spanish study, observed incidence of 13.7%, 31.4%, and 20.2% for extradural hematoma, brain contusions, and subdural hematoma in 277 cases of head injury[20].

For other complaints of generalized or localized weakness, loss of consciousness, headache, epilepsy, and speech abnormality, we also found a higher percentage of positive CT scans, which verifies the importance of CT scan evaluation in such abnormalities. The medical literature endorses the usage of CT scan in evaluation, depending upon the clinically observed necessity, of patients with headaches, loss of consciousness, and suspected cerebrovascular accident[21-23]. However, the literature advises against routine use of CT scan for all patients with new onset nonfebrile seizures[24]. We suggest that all patients with suspected acute neurological emergency must be evaluated by CT scan examination. Advantages with CT scan evaluation include rapid diagnosis and real-time observation of etiologies that might be lethal to the patient. CT scan decreases the rate of mismanagement, hence better care of the patients can be warranted in time.

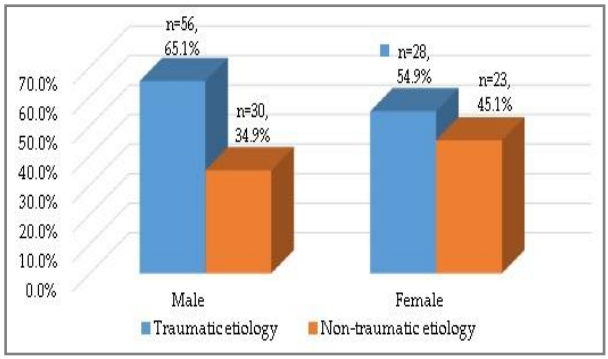


**Figure: Distribution of traumatic etiology among the two genders.**

## CONCLUSION

The majority of individuals were referred for the radiological evaluation by CT scan for the complaint of head trauma. Fracture of the skull bones was the commonest abnormality seen on CT scan evaluation. Head trauma was signi-

ficantly more common in age groups of ≤36 years and males were more commonly involved than females. Higher percentage of positive CT scan was found in patients with all types of presenting complaints. CT scan is a reliable, highly accurate, and sensitive modality in evaluation of patients with acute neurological emergencies. It may clearly outline those patients who require surgery or other form of intervention, so it can provide rapid, effective diagnostic information to guide appropriate clinical management.

## CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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