Original Article

CT Scan of Head with repeated Episodes of Headache

Computed Tomography Head Scan to Evaluate Patient with Chief Complaint of Headache: Is It Necessary and Cost-Effective?

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ABSTRACT

Objective: To determine the cost-effectiveness of computed tomography head scan in patients with chief complaints of headache.

Study Design: Prospective cross-sectional study

Place and Duration of Study: This study was conducted at the department of Radiology, PNS Shifa Hospital, Karachi from February, 2018 to December, 2018.

Materials and Methods: Total 401 patients with chief complaint of headache were included. CTHS were carried out and reports were evaluated. A pre structured questionnaire was filled by principal investigator to record the findings. Statistical analysis was done using SPSS. Frequency and percentages were reported for qualitative variables. Mean and standard deviation were reported for quantitative variable. Bivariate analysis was done using fisher exact test. Level of significance was set at 0.05.

Results: The studied population contained 63.8% male and 36.2% female patients. Mean was found to be 37.39±17.30 years. Among 401 patients included in the studied population, 323 patients (84% of males and 74.5% of the females) were found to have normal CTHS results and while 76 patients (16% of males and 25.5% of the females) were found to have abnormal CTHS results.

Conclusion: CTHS is not a cost-effective method of diagnosing the cause of headache. If the patients have no associated symptoms and sign of intracranial pathology, CTHS is seldom helpful in the diagnosis of the cause of headache. It should be advised only after the detailed study of clinical history and neurological examination.

Key Words: Computerized Tomography, cost-effectiveness, headache, intracranial pathology, neuro-imaging, neuro-physician and patients

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INTRODUCTION

Among the pain complaints recorded worldwide, headaches are the most commonly reported. Headaches are generally categorized into primary and secondary types Primary headaches include migraine, headache due to tension and due to clustering.[1] Primary headache does not routinely require neuro-imaging as neuroimaging cannot identify or figure out the underlying disease process.

A study by International Headache Society reported migraine and tension-type headaches as common headache disorders which are reported to prevail in about 50% of the North-American, Asian, European and Australian population.[2]

Tension-type headaches that prevail more, influence the quality of life and require frequent physicians' consultation. It affects more than 95% of the global population at least once in life, and 33% of the population faces chronic headaches at least once.[3, 4]

Chronic headache is characterized by pain in head area sustaining for more than 15 days in a month, and for a period of more than 3 months.[5, 6] It is also one of chief complaint reported by the patients visiting OPD and a major complain recorded by the patients visiting emergency departments.[7-9] Out of these patients, about 10% of the patients with recurring headaches have secondary causes.[10]

Secondary headaches are always associated with underlying diseases like extra cranial benign condition such as sinusitis or mastoiditis and intracranial pathologies such as subarachnoid hemorrhage or brain tumors. The relation of headache with normal CTHS results is not adequately researched. The rationale of this study is to determine the frequency of normal CTHS results in patients with a chief complaint of a

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headache as several cases, with complaint of head usually recommended for CTHS. But mostly are normal, which increase the cost of diagnosis and treatment and increase burden on radiologists due to referral system. So we conducted to determine the extent of normal CTHS in local population.

MATERIALS AND METHODS

This prospective cross-sectional study was performed at the department of radiology, PNS Shifa Hospital, Karachi, Pakistan from February to December 2018. A number of patients referred for CTHS to the radiology department in the aforementioned hospital were included in this study. Patients with a history of neurosurgery such as VP shunt, aneurysm clips installation or patients diagnosed to have a brain tumor and patients who were already admitted in the hospital; were excluded. Ethical approval was obtained by the Institutional review board of PNS Shifa hospital and informed verbal consent was taken by the participants prior to the induction in the study. The CTHS of all the patients were carried out on 160-slice Siemens CT scanners; where contiguous slices (10mm steps) were recorded starting from foramen magnum to the vertex and reconstructed in the bone window for evaluation.

Statistical analysis was carried out on SPSS version 20. Frequencies and percentages were calculated for qualitative variables while arithmetic means and standard deviations were calculated for quantitative variables. Bivariate analysis using fisher exact test. Level required for significance was considered to be at 0.05 or 5%.

RESULTS

Out of 401 patients, 63.8% were male and 36.2% were female. Mean age and age range of the patients included in the study was found to be 37.39±17.30 years. 28.7% (93) patients reported the persistence of headache for a duration of 1 month, 51.6% (168) reported the pain duration between 1 month to 1 year and 19.7% (62) reported the duration of pain to be greater than 1 year. This CTHS of this group was found to be normal. Among 401 patients included in the studied population, 323 patients (84% of males and 74.5% of the females) were found to have normal CTHS results and while 80.5% (i.e. 323 patients out of which 16% were males and 25.5% were females) were found to have normal CTHS results, while rest 19.5% had abnormal results. Detailed characteristics of the population are presented in Table-1.

19.5% patients with abnormal findings comprised 9.7% patients with cerebral atrophy, 4.0% with chronic infarct, 1.0% with basal ganglia calcification, 1.2% with sinusitis, 0.2% with intracranial infection, 0.7% with neoplasm, 0.2% with hydrocephalus, and 2.2% had other complaints. The distribution of all and abnormal CTHS is summarized in Table-2 and Figure-1 respectively.

High significance was observed between age and CTHS results. Age stratified normal and positive CT findings are presented in Table-3.

Results found the association of gender with CTHS results analysis to be insignificant while the duration of the headache with CTHS results was found to be significant. The detailed results and figures are shown in Table-4.

Table No.1: Characteristics of the study population

	n(%)
Age(years)	37.39±17.30°
Duration Group	
<1 month (days)	115(28.7), 8.16±7.53°
1 month to 1 year (months)	207(51.6), 3.21±2.11°
>1 year(years)	79(19.7), 2.81±2.37°
Gender	
Male	256(63.8)
Female	145(36.2)
CT Findings	
Normal	323(80.5)
Abnormal	78(19.5)
°Mean±SD	

Table No.1 Distribution of CTHS findings

	N (%)
Normal	323 (80.5)
Cerebral Atrophy	39 (9.7)
Basal Ganglia Calcification	4 (1)
Sinusitis	5 (1.2)
Intracranial Infection	1 (0.2)
Chronic Infarct	16 (4)
Neoplasm	3 (0.7)
Hydrocephalus	1 (0.2)
Misc	9 (2.2)

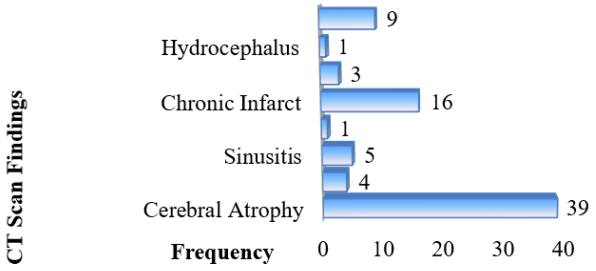

Figure No.1: Distribution of Abnormal CTHS finding

Table No.3: Distribution and association of CTHS results with age

n(%)											P-Value
Age	**No.**	**Normal**	**Cerebral Atrophy**	**Basal Ganglia Calcification**	**Sinusitis**	**Intracranial Infection**	**Chronic Infarct**	**Neoplasm**	**Hydro-cephalus**	**Misc**	
0-9	19	17 (89.5)	0 (0)	0 (0)	0 (0)	1 (5.3)	0 (0)	0 (0)	1 (5.3)	0 (0)	0.000
10-19	44	41 (93.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (6.8)	
20-29	68	66 (97.1)	1 (1.5)	1 (1.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	
30-39	96	86 (89.6)	1 (1)	2 (2.1)	3 (3.1)	0 (0)	1 (1)	0 (0)	0 (0)	3 (3.1)	
40-49	76	64 (84.2)	3 (3.9)	1 (1.3)	1 (1.3)	0 (0)	4 (5.3)	1 (1.3)	0 (0)	2 (2.6)	
50-59	48	32 (66.7)	8 (16.7)	0 (0)	0 (0)	0 (0)	5 (10.4)	2 (4.2)	0 (0)	1 (2.1)	
60-69	31	13 (41.9)	13 (41.9)	0 (0)	0 (0)	0 (0)	5 (16.1)	0 (0)	0 (0)	0 (0)	
70-79	15	4 (26.7)	9 (60)	0 (0)	1 (6.7)	0 (0)	1 (6.7)	0 (0)	0 (0)	0 (0)	

Correlational significant was assessed by applying the Fisher Exact Test and P≤0.05, considered as insignificant.

Table No.4: Distribution and association of CTHS results with gender and duration of the headache

N (%)											P-Value
	No.	**Normal**	**Cerebral Atrophy**	**Basal Ganglia Calcifi-cation**	**Sinusitis**	**Intra-cranial Infection**	**Chronic Infarct**	**Neoplasm**	**Hydro-cephalus**	**Misc**	
Gender											
Male	256	215 (84)	19 (7.4)	1 (0.4)	3 (1.2)	1 (0.4)	7 (2.7)	2 (0.8)	1 (0.4)	7 (2.7)	0.093**
Female	145	108 (74.5)	20 (13.8)	3 (2.1)	2 (1.4)	0 (0)	9 (6.2)	1 (0.7)	0 (0)	2 (1.4)	
Duration											
<1 Month	115	93 (80.9)	12 (10.4)	1 (0.9)	1 (0.9)	2 (1.7)	1 (0.9)	1 (0.9)	1 (0.9)	3 (2.6)	0.595**
1-12 month	207	168 (81.2)	18 (8.7)	1 (0.5)	3 (1.4)	0 (0)	9 (4.3)	2 (1)	0 (0)	6 (2.9)	
>12 month	79	62 (78.5)	9 (11.4)	2 (2.5)	1 (1.3)	0 (0)	5 (6.3)	0 (0)	0 (0)	0 (0)	

DISCUSSION

Headache is the common neurological symptom faced by more than 95% per cent of the population in their lives.[11] The present study highlights the fact that the CT scan was unable to find to the cause of headache for more than 80% of the patients. This study was conducted to determine the frequency that CTHS is successful in finding causes of headache and to assess the cost-effectiveness of the CTHS performed on the prescription of physicians for headache causes evaluation.

Epidemiological studies have been performed in various countries related to primary headache.[10] Stovner et al have reported the existence of regional linkage with the prevalence of primary headache.[1] Other studies have shown that tension-type headache (TTH) is more prevalent in Europe than in Asia and North America. Similarly, migraine prevalence in Asia is lower than in North America and Europe.

Among the helpful neurosurgical diagnosis, techniques are neoplasms imaging and computed tomography head scan (CTHS). The former is proved to be helpful in early diagnosis and prompt neuro-surgical treatment. The later helps in identification of life-threatening causes such vascular disorders, infections or substance abuse. Like any other method, both of these methods have their limitation. CTHS is not sensitive to the ophthalmoplegic migraine as it remains uninformative about it.[12] Another superior method of radio imaging is magnetic radio imaging (MRI) which gives more detailed results than computer tomography (CT) scans. CT scans are recommended more by the physicians because it is considered economical. However, CT scan is found not to be an ineffective technique as it reports the results of a patient with chronic headache as normal even for the cases marked as "red flag".[13-15]

A detailed clinical history and thorough physical and neurological examination help in deciding which patient with headache requires a CT or MRI scan of the brain to evaluate the underlying cause. Clinician often advises CT-scan or MRI of the brain in the absence of red flags in order to relieve the patients' anxiety. CTHS is easily available in most of the hospitals, therefore is fast and economic, but besides being ineffective in many cases, it poses a high risk of radioactive damage. MRI is more detailed and sensitive but is costly and has claustrophobic effects.[11]

Another researcher Mitchell conducted a significant study on patients who were referred for CTHS with or without physical and neurological symptoms. He discovered that the patients who were diagnosed with abnormal CTHS results actually were marked for neurological examination and most of them were marked for 'red flag'.[16] Another study by Dumas et al., resulted in the establishment of the fact that CTHS is inaccurate for headache cause assessment.[17] He observed that less than 1% CTHS results in help in the diagnosis of the cause of headache while up to 4.5% shows abnormality, no details are observed in rest of more than 95% cases where CTHS result appears to be normal.

Researches performed by Frishberg[18] and Thomas[19] support our study. Both of these studies showed that CTHS results are less likely to find the cause of headache when the headache is accompanied by routine symptoms. Simpson found that the results of CTHS are mostly found to be normal. He found that only 1.4% of the results found to be abnormal actually helps in the identification of the cause of headache while rest all represent the abnormalities that occur incidentally and are not actually linked with the headache diagnosis.[6] He summarised his study that there is less incidence of the detection of pathology in patients with chronic headaches. He also provided complete reassurance to the patient that there is no structural cause for their headaches without red flags and explained the cost-effective benefits to the patients while reducing the workload on radiology department.[6]

Another important study was conducted by Lateef et al to determine the importance of red flags in the acute care of young children with headache. His results showed normal neurological examination and non-worrying history in young children presenting with headache. He also found that CTHS seldom helps in diagnosis or contribution to the treatment of disease.[20, 21]

Perpic et al performed another research on children with chronic headache.[22] 71.3% of the child patients were found to have normal neuro-imaging while 28% of children had incidental findings like the asymmetry of ventricles, enlarged cisterna magna, enlarged adenoids, fluid in the mastoids, etc while only 0.7 per cent had a clear indication of the problem.[22] On contrary, 6.68% children showed positive findings when research by Gupta et al. A even higher percentage was reported by Simpson et al.[6] Our study in comparison shows 0.2% of positive CT findings among children. It is recommended to take extra care in performing CTHS of children to avoid excessive radiation exposure.

CONCLUSION

It is concluded in the study that CTHS results are normal for the majority of the patients with headache. Every patient is not a candidate of CTHS as it is not helpful in the diagnosis of the cause of headache especially when the headache is not accompanied by clear signs and symptoms of intracranial pathology. If a detailed clinical history and dedicated neurological examination performed prior to recommending for CTHS or MRI, the examination would become more cost-effective.

Recommendations: CTHS is found to have inaccuracy and limited cost-effectiveness for the diagnosis of headache cause however, it can be used to attain psychological benefits of false-negative results to the patients. It is required general practitioner and neuro-physician to sensibly evaluate the patients with detailed history, thorough neurological and focused physical examination. CTHS should be recommended by physicians only for patients with red flag signs. In the absence of this, the only function of CTHS appears to provide reassurance to the patients at the cost of unnecessary exposure to radiations and increased socioeconomic loss for the patient and increased workload for the radiology department.

Author's Contribution:

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