

# Utility of CT Scan Head in Non-Trauma Patients; How Appropriate We Are?

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## ABSTRACT

There has been a significant increase in the overall use of CT scans of head in patients over last few decades and this is particularly happening in the emergency departments. This increase in CT scans have variable effects on patients like cost of therapy, radiations, manpower dislocation from other needed areas of the hospital. To know Utility and appropriateness of these CT scans is very important. This is the first study which looks into utility of CT head in non-trauma patients, whether it was appropriate or inappropriate. Although there are clinical guidelines for performing CT head in non-trauma patients but the same are not utilized to the best. The reasons for it are different from easy availability to medico legal repercussions.

**Key words:** Appropriate, CT head, non-trauma, emergency department (ED)

## INTRODUCTION

Computed tomography (CT) has revolutionized radiology and medicine as a whole. <sup>(1)</sup> Computed tomography (CT) scan has improved the quality of health care and made it safer by providing less invasive methods for diagnosis and treatment. With better technology and imaging quality, CT scans have become a vital part of the diagnostic process <sup>(2,3)</sup> Many centers have CT scanners available in the emergency departments and this easy access leads to shorter transfer time, hence quicker diagnosis and better patient outcome. <sup>(4)</sup> But increasing number of scans lead to

increasing cost of healthcare, exposure to radiation and adds to the cost ineffective therapies. The use of computerized tomography (CT) scans has sky rocketed in the last few decades; increasing approximately 21 fold and is not yet tapering. <sup>(2,5-7)</sup> This increase is happening at a high rate in the emergency department as compared to anywhere else. Recent studies have shown that the most significant growth in utilization of imaging procedures is due to imaging performed by non-radiologists. Overall, imaging utilization by non-radiologists has grown twice as fast as imaging by radiologists. Radiologists perform imaging examinations ordered by patients' physicians or other providers based on the clinical needs of the patient. Does availability of scanners lead to inappropriate use? Appropriate use of medical imaging remains a cornerstone of high quality medical care. This article aims to look into the utility of CT scan of the head and their appropriate use upon the patients; So that guide lines can be framed for appropriate utilization of CT scans in the emergency working areas.

## MATERIAL AND METHODS

This study was conducted in the department of emergency medicine of SKIMS Soura Srinagar over a period of two years (2016-2018). Patients between the age of 18 and above who were subjected to non-contrast CT scans of the head by the resident staff on duty for any of the clinical

indication were included. 3628 CT scans were ordered, performed and utilized as supportive investigation in confirming the clinical diagnosis by the resident staff in medical emergency. The CT scans of head prescribed and performed in the emergency medicine were interpreted and reported by the senior resident radiology and the consultant physician emergency medicine. There were 37 scans done upon patients from private sector and were prescribed by doctors from outside this hospital were also included in. The indication for CT scan based on appropriateness, patients under lying clinical diagnosis and scan positivity were analyzed. We did not analyze the CT finding details in positive scans. A daily 24 hr. retrospective audit was conducted upon the requests as advised by the resident staff whether doing a CT scan was indicated and was appropriate or not. The patients were over 18 years of age and were admitted for various medical illnesses. These patients were evaluated for short period of time in the emergency medicine. Patients with malignancy with or without metastasis, surgical problems and trauma were not included in the study. These CT scans were performed upon patients with any of these indications:

1. Stroke
2. Neurological deficit
3. Headache
4. seizure
5. altered mental status
6. diplopia and vision changes
7. vertigo, dizziness and syncope.

CT scans of head performed in the prescribed period for the different mentioned clinical problems, and their utility was classified on the basis of appropriate and inappropriate. The criteria utilized for the CT head scan for different indication were as under.

**A: Stroke:**

1. Single focal neurological deficit, acute onset, stable or incompletely resolving
2. Single focal neurological deficit, acute onset, completely resolving
3. Single focal neurological deficit, acute onset, progressive
4. Single focal neurological deficit, sub-acute onset, progressive or fluctuating

5. Clinically suspected sub arachnoid hemorrhage (SAH), not yet confirmed

6. Clinically suspected parenchymal hemorrhage (hematoma), not yet confirmed

Non contrast CT (NCCT) head is the first line imaging test with acute ischemic or hemorrhagic stroke; the goal being to

- A. Exclude hemorrhage in patients for early thrombolysis.

- B. Exclude mimics of stroke; like infection, inflammation and neoplasm.

- C. To detect and quantify infarcted brain tissue

**B: Headache:**

1. Patients with acute and severe headache

2. Headache with new abnormal finding on neurological examination

3. HIV patients with new type of headache

4. Patients above 50 years with new onset headache, with or without abnormal neurological examination

5. Worsening headache with Valsalva maneuver

6. Headache that awakens the patient from sleep

7. Occipital location of pain and headache associated with nausea /syncope

The main goal of urgent CT head in headache is to identify treatable pathology like: stroke, extradural/subdural hematoma, subarachnoid hemorrhage, AV malformation, tumor, venous sinus thrombosis, hydrocephalus and infections

**C: Seizure**

Although MRI is the recommended test by different scientific societies; CT head is the test of choice in case of patients with acute cerebral symptomatology; who have seizure and need urgent treatment. Indications for Urgent CT brain in a patient with seizure are different in case of first seizure and a fresh seizure in a known epileptic patient, the same are as under

A, In patients with First seizure:

Focal start seizure, new focal deficit, age more than 40 years, persistent alteration in mental state,

Intracranial lesion which needs urgent treatment, fever, cranial trauma, persistent

headache, history of cancer, patient on anticoagulation and immunosuppression

**B, In Epileptic patient:**

Change in seizure duration and pattern, increase in seizure frequency, prolonged postictal status

**D: Vertigo, dizziness and syncope**

There is evidence that history and clinical examination can help to differentiate central from peripheral vertigo. Many clinicians utilize neuroimaging initially to exclude the central cause. CT Head has a low yield indications are Equivocal or uncertain clinical findings, age more than 60 years, history of recent head trauma, focal neurological deficit

**E: Diplopia and vision changes**

The first step in diplopia is to determine whether it is monocular or binocular. Monocular is related to eye pathology. Binocular must put one alert as it may be a symptom of stroke, aneurysm, neoplasm, myasthenia gravis, infection, trauma, giant cell arteritis, Guillain Barre. With all these pathologies we may order a CT head. But in many situations costly investigations may not catch a serious problem for example myasthenia and giant cell arteritis are not apparent on CT and an aimed correct scan of orbit can diagnose diplopia secondary to thyroid eye disease and orbital tumor. An important fact is to take into account the useless expense that occurs when performing imaging tests in a case of monocular diplopia in these situations Pinhole test will assure that it is not a neurological problem

**F: Altered mental status**

There are many causes for altered mental status like structural, metabolic and systemic and CT head for altered mental status is the highest in the emergency departments. For delirious patients however there is little evidence based guidance to when a CT head is appropriate. Their routine use is not recommended as its diagnostic yield may be low. Structural intracranial pathology involves indication of emergency brain CT in altered mental status and coma. Usually medical history and examination are enough to lead us into systemic/metabolic or structural origin.

**RESULTS**

A total of 3286 CT scans head were performed. (Table: 1) There were 56% males and 44% females in the study. The mean age of patients was 37.6 years. As per the indications utilized 75% (2464) scans were found appropriate while 25% (822) were inappropriate. Highest inappropriate scan request were found for diplopia and vision changes in 58.3%; because in majority CT of the orbit and sinus was not requested as should have been requested instead of CT head. This was followed by non-stroke neurological deficit in 37.5%, vertigo, dizziness and syncope in 30% while, in altered mental status 30% of requests were inappropriate. Patients with Headache, seizure and stroke had inappropriate requests in 20%, 20% and 13% respectively. Off the 3286 scans 1883(57.3%) had positive findings and 1403(42.69%) had no findings or negative scans. (Table: 2) We did not analyze the nature of positive CT scan findings.

**Table: 01 Distribution of appropriate and inappropriate CT scan Head**

Indication	No of scans N=3286	Appropriate N=2464 (%)	Inappropriate N=822 (%)
Stroke	1543	1334(86.4%)	209 (13.6%)
Altered mental status	1230	738 (60%)	492 (30%)
Seizure	220	176 (80%)	44(20%)
Neurological deficit(non stroke)	112	70 (62.5%)	42 (37.5%)
Headache	81	65 (80%)	16 (20%)
Vertigo, dizziness, syncope	76	51 (67.1%)	25(32.8%)
Diplopia and vision changes	24	10 (41.7%)	14(58.3%)
Total	3286	2464 (75%)	822 (25%)

(p>0.05)

**Table: 02 Distribution of positive and negative CT Scan Head**

Indication for CT Head	No of Scans	Positive scan (%)	Negative scan (%)
Stroke	1543	1402(90.86%)	141 (9.14%)
Altered mental status	1230	368 (30%)	862 (70%)
Seizure	220	49 (22.2%)	171 (77.8%)
Neurodeficit (non stroke)	112	27 (24.1%)	85 (75.9%)
Headache	81	15 (18.5%)	66 (81.5%)
Vertigo, dizziness, syncope	76	23(30%)	43 (70%)
Diplopia and vision changes	24	08 (33.3%)	16 (66.7%)
Total	3286	1883 (57.31%)	1403 (42.69%)

## DISCUSSION

Computerized tomography (CT) has revolutionized radiology and Medicine. (1) Since its inception in 1972 the use of CT has increased exponentially. It is an accepted fact that CT scanning has been skyrocketing all over in medical practice by both surgeons and physicians especially in emergency departments. It is difficult to ascertain how much of this increase is due to the convenience of having a scanner available and how much of it is necessary. (2,4) The majority (80%) of annual increase in CT use in the emergency department(ED) can be explained by increased frequency of CT scanning, while 20% are attributed to increased number of patients in the ED. (7) Inappropriate utility of CT scan also increases the financial burden of health care (3,7) especially in societies where healthcare is free or subsidized. Appropriate use of medical imaging study remains a cornerstone of high quality medical care. We were unable to find the utility of CT scan head for medical patients in literature, and ours is possibly the first study to look into the utility of CT scan head for its appropriate utility. We observed inappropriate use of CT head in 25% of patients (table 1). Factors that promote the increased use of CT in the ED include its: availability, efficiency, image resolution, noninvasive nature and the higher ED patient throughout, patient's expectations and providers fear of medico legal repercussions. (7-11) Because of this growth in utilization of CT, policy makers are increasingly concerned about the increase in both costs and exposure that occurs during CT acquisition. (12) These studies also suggest almost all non-trauma patients with abnormal head CT findings have abnormal

findings on neurological examination, and that the majority of patients who had abnormal findings would be over 65 years of age. (13-15) Utilizing the guidelines for CT head requests could potentially translate into substantial decrease in the utility of CT scans. While many CT head scans in the ED are requested for patients with no trauma, few studies have examined the utility of CT head for positive scans in this studied population (patients with delirium, dizziness, vertigo, syncope and others); where in appropriate guidelines are not utilized. (13, 14, 15) In our study 42.69% scans were positive and 66.29% had no findings, others have observed positive scans in 15% and 33.7% scans. (13,16) Studies have shown that a routine CT examination for a chronic headache in the absence of focal neurological sign or any abnormal symptom is less likely to have a positive scan. (17,18) More selective use of CT in the ED has the potential to substantially reduce health care costs and there is a need for valid and reliable clinical decision guidelines to support physicians' decision to order CT head upon these patients. Accordingly the objective of this study was to look into utility of CT head and appropriateness of the requests submitted by the doctors in patients with no history of trauma. Even a small reduction in the number of requests from the ED by using appropriate indication will decrease the load of CT. It is paramount that physicians remember that while CT scanning is an excellent diagnostic tool, it must not replace clinical examination of the patient. There are many obvious benefits of these CT scans, but these must be balanced against the possible harm, especially in light of their increasing utilization. It is well documented that CT scans have significant

radiation exposure, which can lead to adverse effects especially malignancy in later life. This leads diversion of resources and man power away from the much needed areas. This is not only from the scans themselves but also from the investigations following incidental finding or radiation related disease. Incidental finding on CT scan, while often benign can cause unnecessary worry. (19) CT head is one of the most common scans prescribed by physicians in ED for various indications such as weakness, aphasia, headache, syncope, dizziness and trauma. However, the number of CT scans ordered by the physicians varies from one hospital to another and from one physician to another because of lack of implementation of standardized protocols. Some physicians rely more on their clinical history and examination findings while others on evidence of presence or absence of pathology in the form of a positive or negative CT scan. However many physicians have begun ordering otherwise unnecessary scans to avoid malpractice litigation. The benefits from these scans are unlikely to justify the unnecessary radiation and Potential benefits should outweigh risks for each imaging procedure that is performed. In addition to following appropriate imaging utilization standards, radiologists and medical physicists should work together to improve the safety of imaging examinations by minimizing dose without sacrificing diagnostic quality or therapeutic effectiveness. Working with radiology equipment manufacturers, radiologic scientists are directly involved in the development of technologies and protocols to ensure patient safety in medical imaging scenarios.

## CONCLUSION

Misuse of CT head is common especially in an emergency setting. Emergency physicians should be encouraged to obtain a detailed history and perform a thorough physical examination with reference to internationally

standardized guidelines, while ordering CT scan. Organizing clinician awareness, education and training, establishment of guidelines in wards and regular audit of the CT requests will prove a fruit full exercise to increase the appropriate use of CT scans and make it a cost effective therapy and save from the unnecessary radiations. To explore opportunities to improve patient safety through appropriate utilization, quality assurance and dose optimization; future studies focusing on the appropriate utility of CT scans would be particularly useful in changing current practice.

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