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CT FINDINGS FOR PATIENTS PRESENTING TO THE EMERGENCY DEPARTMENT WITH ALTERED MENTAL STATUS

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ABSTRACT

Background: Altered mental status (AMS) is a common emergency department (ED) presentation with diverse etiologies. Noncontrast computed tomography (NCCT) of the head is frequently requested to exclude acute intracranial pathology, yet its diagnostic yield remains variable.

Objective: To evaluate the radiological findings on NCCT head examinations in nontraumatic ED patients presenting with AMS, and to assess whether additional clinical information influenced diagnostic yield.

Methods: We retrospectively reviewed consecutive NCCT head examinations requested from the ED for AMS. Patients with trauma or known intracranial pathology were excluded. Demographic data, request descriptors, and imaging findings were extracted from electronic records. Findings were classified as acute abnormalities, incidental/chronic, or normal. Statistical comparisons were performed using chi-square and T test, with $p<0.05$ considered significant.

Results: Of 500 CT head examinations reviewed, 121 (24.2%) met inclusion criteria. The mean patient age was 69.6 years (range 19–95), with 55 females and 65 males. Twenty-six patients (21.0%) had acute abnormal findings: 23 (88.5%) acute infarcts and 3 (11.5%) intracranial hemorrhages. Ninety-five patients (78.5%) had normal or incidental findings, including 11 (9.2%) with chronic microvascular disease or remote infarcts. There was no statistically significant difference in age or gender between patients with normal and abnormal scans. Additional clinical information was present in 35 requests (28.9%), but was not significantly associated with abnormal findings ($p=0.292$).

Conclusion: In this single-center cohort, NCCT head yielded acute abnormalities in only one-fifth of nontraumatic AMS patients, with ischemic infarction being the most common finding. Clinical descriptors in imaging requests did not significantly predict abnormal scans. While NCCT remains essential for excluding life-threatening pathology, the relatively low yield underscores the need for improved clinical decision tools to guide imaging in AMS.

Keywords: Altered Mental Status, Emergency Department, Head CT, Diagnostic Yield, Ischemic Stroke, Intracranial Hemorrhage

1. INTRODUCTION

Altered mental status (AMS) is a frequent and diagnostically challenging presentation in the emergency department (ED). It accounts for approximately 4% to 10% of chief presenting complaints in the ED [1]. AMS encompasses a wide spectrum of clinical states, ranging from mild confusion and disorientation to stupor and coma, and may result from metabolic, infectious, toxic, psychiatric, or neurological etiologies [2]. Due to its nonspecific nature, AMS often requires a broad diagnostic evaluation, with neuroimaging serving as a cornerstone of the initial workup [3].

Noncontrast computed tomography (NCCT) of the head is widely used in this context because of its speed, accessibility, and ability to detect time-sensitive intracranial conditions such as hemorrhage, infarction, and mass effect [3]. Over the past two decades, CT utilization in EDs has increased substantially, with head CT examinations accounting for 16–50%, and in some institutions up to 90%, of total CT volume [4,5]. This growth reflects both the greater availability of CT scanners and heightened awareness of time-critical neurological conditions, particularly stroke. Furthermore, in patients with AMS where history may be unreliable and neurological examination limited, imaging is often performed liberally to prevent missed diagnoses and reduce medicolegal risk [2,3].

Despite its widespread use, the overall diagnostic yield of CT in nontraumatic AMS remains relatively low, at approximately 13% [6]. Most scans are either normal or reveal only incidental chronic findings [7]. Ischemic infarcts and intracranial hemorrhages constitute the most common acute abnormalities, although NCCT has limited sensitivity for early or subtle ischemic changes [7,8].

The absence of robust clinical predictors of positive imaging further complicates efforts to refine imaging criteria. Some studies suggest that the presence of focal

neurological deficits, a history of malignancy, or rapid symptom onset may increase diagnostic yield, whereas nonspecific descriptors such as “confusion” are associated with a low probability of positive findings [8].

The challenge, therefore, lies in balancing the need for early identification of serious intracranial pathology against the risks of overutilization, radiation exposure, increased cost, and the detection of incidental findings of uncertain significance. As CT demand continues to rise, institution-specific data are essential for understanding local imaging yield and guiding evidence-based clinical decision-making.

The purpose of this study was to retrospectively evaluate head CT findings in patients presenting with AMS to our emergency department, excluding those with trauma or pre-existing intracranial pathology. We aimed to characterize the frequency and nature of acute abnormalities, document incidental findings, and determine whether additional clinical descriptors provided in imaging requests correlated with diagnostic yield. In doing so, we sought to contribute evidence to support a more targeted and efficient use of CT imaging in this common yet diagnostically challenging presentation.

2. METHODS

2.1 Study Design and Setting

We conducted a retrospective observational study at a tertiary care hospital with a 24-hour emergency department (ED). The study included consecutive patients who underwent head CT examinations in the ED for the indication of altered mental status (AMS) between March 10 2024 till April 30 2024.

2.2 Ethical Approval

The study was reviewed and approved by the institutional ethics review board. Due to its retrospective design and the use of anonymized data, the requirement for informed patient consent was waived. All procedures were conducted in accordance with the principles of the Declaration of Helsinki and local institutional policies on patient confidentiality.

2.3 Patient Selection

Patients were identified through a systematic search of the institutional picture archiving and communication system (PACS). The search included all head CT

examinations requested from the ED during the study period with clinical indications containing one or more of the following descriptors: decreased level of consciousness, reduced Glasgow Coma Scale (GCS) score, confusion, or altered mental status.

2.3.1 Inclusion criteria were

1. Patients aged ≥18 years.
2. Presentation to the ED with AMS as a primary or contributory complaint.
3. Undergoing noncontrast CT head within the ED encounter.

2.3.2 Exclusion criteria were

1. History of head trauma preceding presentation.
2. Known pre-existing intracranial pathology (e.g., brain tumor, previously diagnosed vascular malformation).
3. Postoperative patients with prior neurosurgical intervention.
4. Inadequate image quality (e.g., motion artifacts) precluding interpretation.

2.4 Data Collection

Demographic and clinical data were extracted from electronic health records (EHR) and radiology request forms. This included:

1. Age, sex, and clinical presentation.
2. Specific descriptors in imaging requests (e.g., fever, headache, blurred vision, vomiting, focal neurological deficit, slurred speech).
3. Radiology reports of CT head examinations.
4. All CT head examinations were performed using standard noncontrast protocols with axial sections reconstructed at 5 mm slice thickness.

2.5 Imaging Interpretation

2.5.1 Radiological findings were categorized as follows

1. Normal examination – no acute or chronic intracranial pathology identified.
2. Acute abnormal findings – acute findings such as ischemic infarcts, intracranial hemorrhage (intraparenchymal, subarachnoid, or intraventricular), hydrocephalus, or mass effect.

3. Incidental or chronic findings – unrelated chronic microvascular disease, cerebral atrophy, remote infarcts, or other incidental findings not contributing to AMS.

Reports were generated by board-certified radiologists at the time of clinical care. For study purposes, findings were reviewed retrospectively and categorized into the above groups. The reports were reviewed by a single reviewer.

2.6 Statistical Analysis

Continuous variables, such as age, were summarized as means, while categorical variables, such as sex and imaging findings, were presented as frequencies and percentages. Independent-sample t-tests were used to compare mean ages between groups with normal and abnormal CT findings. Chi-square tests were employed to examine associations between categorical variables (e.g., sex, presence of additional clinical descriptors, and acute abnormal findings). Statistical significance was defined as a p-value < 0.05.

As this was a retrospective observational study, no formal sample size or power calculation was performed. The analysis included all consecutive eligible patients who underwent CT head examinations for altered mental status during the study period.

3. RESULTS

A total of 500 nontraumatic cases from the emergency department were reviewed. Among these, 121 patients (24.2%) met the inclusion criteria. Patient ages ranged from 19 to 95 years, with a mean age of 69.6 years. The mean age of patients with abnormal CT findings was 67.8 years, compared with 62.5 years among those with normal examinations. The cohort included 55 females and 65 males, with no statistically significant difference in age or sex between patients with abnormal and normal CT findings. (table 1)

Of the 121 patients, 27 (22%) demonstrated acute abnormalities. The remaining 94 (77.7%) had either normal examinations or incidental chronic findings. Among the acute abnormalities, 24 patients (88.9%) had acute infarcts, and 3 patients (11.1%) had acute intracranial hemorrhage. Incidental findings, such as chronic microvascular ischemic changes or remote infarcts, were identified in 9 patients (7.4%).

Review of the CT requests revealed that 35 cases (28.9%) included additional relevant clinical information, such as fever, headache, blurred vision, focal weakness, slurred speech, or vomiting. However, there was no statistically significant association between the presence of additional clinical details and the likelihood of acute abnormalities on CT (p = 0.292). (Table 1)

Table 1. summary of results

	Normal CT N=94 (77.7%)	**Abnormal CT N=27 (22.3%)**	**P value**
Age (mean)	62.5	67.8	0.09068
Gender			
Male (N=65)	N=52(55%)	N=14 (51.9%)	0.75
Female (N=55)	N=42(44.7%)	N=13 (48.2%)	
Additional clinical information	25	10	0.29
Present N=35 (28.9%)	69	17	
Absent N=86 (40.6%)			

4. DISCUSSION

Altered mental status (AMS) is among the most common and diagnostically challenging presentations in the emergency department (ED). It encompasses a wide spectrum of etiologies, ranging from metabolic disturbances and intoxication to primary intracranial pathology (2). The diagnostic role of neuroimaging, particularly noncontrast computed tomography (NCCT) of the head, is well established in cases of acute trauma and suspected stroke; however, its utility in the broader population of nontraumatic AMS presentations remains less certain. In this retrospective review of 121 consecutive patients with nontraumatic AMS, only 22.3% demonstrated acute abnormal CT findings, while nearly 77.7% had normal examinations or incidental chronic changes. These results underscore the relatively modest diagnostic yield of NCCT in this context and reinforce ongoing discussions regarding imaging appropriateness in patients with AMS.

4.1 Comparison with Prior Studies

Our finding of a 22% positive yield is slightly higher than that reported in previous studies (6, 7), where diagnostic yields in nontraumatic AMS populations have ranged from 6.4% to 13%.

Our data also highlight the predominance of ischemic stroke among abnormal CT findings. Of the acute abnormalities, 88.9% were infarcts, whereas only 11.1% represented intracranial hemorrhages. This distribution aligns with the known epidemiology of cerebrovascular disease both locally and globally, where ischemic events outnumber hemorrhagic strokes by approximately 4:1 (9, 10). However, other institutions have reported differing patterns, with acute intracranial hemorrhage being the most common positive CT finding in similar patient populations (7, 8). These results underscore the essential role of NCCT as a rapid, first-line modality for excluding hemorrhage and identifying early ischemic changes, both of which are critical in guiding acute management.

4.2 Clinical Predictors and Request Quality

An interesting observation in our study was the lack of association between additional clinical descriptors in imaging requests (e.g., fever, focal neurological signs, headache) and the likelihood of detecting acute abnormalities. Although 28.9% of CT requests included such information, no statistically significant predictive relationship was identified. This finding contrasts with several earlier reports. For instance, Shin et al. (8) demonstrated that the presence of focal neurological deficits significantly increased the probability of abnormal CT findings, whereas vague descriptors such as “confusion” were associated with a low diagnostic yield. Similarly, Seo et al. (11) emphasized that clinical reassessment and detailed phenotyping can substantially improve diagnostic yield. The discrepancy may reflect differences in documentation quality, interobserver variability in interpreting request notes, or the relatively small sample size of our cohort. Nevertheless, our results underscore an important point: reliance solely on referral wording may be insufficient for stratifying imaging risk in AMS, reinforcing the need for structured clinical–imaging decision tools.

4.3 Age and Demographic Trends

Although patients with acute abnormalities were, on average, slightly older than those with normal CT findings (67.8 vs. 62.5 years), this difference was not statistically significant. Similarly, gender distribution did not differ significantly between groups, consistent with previous reports (7, 8). These findings suggest

that while demographic factors may provide contextual information regarding risk, they cannot reliably guide imaging decisions in isolation.

The relatively low diagnostic yield observed in our study has important implications for clinical practice. On one hand, the low positivity rate underscores the potential for resource overutilization, unnecessary patient exposure to ionizing radiation, and increased downstream costs from incidental findings. On the other hand, CT remains indispensable for the prompt detection of life-threatening but potentially reversible intracranial conditions, including ischemic stroke, hemorrhage, and hydrocephalus. The consequences of missed or delayed diagnoses in AMS can be catastrophic, which understandably drives clinicians toward liberal use of imaging.

A balanced approach is therefore essential. The key challenge lies in identifying clinical, laboratory, and contextual predictors that can refine pretest probability without compromising patient safety. Awareness of the limited diagnostic yield of head CT in nontraumatic AMS, coupled with thorough evaluation for non–central nervous system causes, may promote more judicious and efficient use of neuroimaging in this population.

4.4 Limitations of Noncontrast CT

It is important to acknowledge the inherent limitations of NCCT in evaluating AMS. While highly sensitive for acute hemorrhage, mass effect, and established infarcts, its sensitivity for early ischemic changes, posterior fossa lesions, and small cortical abnormalities remains limited. In our cohort, the true incidence of ischemic stroke may have been underestimated, as subtle or hyperacute infarcts can be radiographically occult on initial NCCT. Advanced imaging techniques such as CT angiography and CT perfusion can improve sensitivity in suspected stroke; however, their role in the broader, undifferentiated AMS population remains debated due to cost, contrast risk, and limited availability.

Our study has several limitations. The retrospective, single-center design may restrict generalizability, and selection bias cannot be excluded. Documentation of clinical descriptors in imaging requests was variable, and lack of detail does not necessarily imply absence of pertinent findings. Additionally, we did not assess downstream outcomes, management changes, or cost-effectiveness. Finally, given the limited sensitivity of NCCT for early ischemia, our findings likely underestimate the true prevalence of intracranial pathology.

Future research should focus on developing and validating evidence-based decision support tools that integrate demographic, clinical, and laboratory

parameters to better stratify imaging risk in AMS. Prospective multicenter studies are particularly needed to enhance external validity. Furthermore, incorporation of artificial intelligence applications for triaging CT requests and detecting subtle abnormalities holds promise for improving both diagnostic yield and workflow efficiency. Importantly, outcome-based research examining how CT findings influence clinical management and patient prognosis would provide a more comprehensive measure of utility than yield alone.

5. CONCLUSION

In summary, our study demonstrates that noncontrast CT (NCCT) of the head in nontraumatic AMS patients reveals acute abnormalities in approximately one out of five cases, with ischemic stroke being the most common finding. Neither demographic variables nor additional clinical descriptors in imaging requests were significantly predictive of abnormal results. Although CT remains indispensable in the emergency evaluation of AMS for promptly identifying life-threatening but treatable conditions, its relatively low diagnostic yield underscores the need for more refined, evidence-based decision-making. Future integration of clinical prediction tools, advanced imaging modalities, and artificial intelligence–assisted approaches may help achieve a more optimal balance between diagnostic timeliness, patient safety, and resource stewardship in this complex and frequent presentation.

6. FUNDING

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7. DISCLOSURE OF CONFLICT OF INTERESTS

The authors declare no conflict of interest.

8. ACKNOWLEDGMENT

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9. DECLARATION OF GENERATIVE AI

During the preparation of this work the authors used GPT-4 (OpenAI, San Francisco, USA) to improve the readability of some of the sections, assure homogeneity of the passages and reduce redundancies in writing. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.a acquisition.

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