



Evaluation of Clinical Indications and Radiological Findings in Brain Computed Tomography Examinations Requested from the Emergency Department: Experience from a Tertiary Private Hospital

Acil Servisten İstenen Beyin Bilgisayarlı Tomografi Tetkiklerinde Klinik Nedenlerin ve Radyolojik Sonuçların Değerlendirilmesi: Üçüncü Basamak Özel Hastane Deneyimi

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ABSTRACT

Aim

This study aimed to evaluate the clinical indications and radiological outcomes of brain computed tomography (CT) examinations performed in the emergency department of a tertiary private hospital, with emphasis on emergent pathologies and incidental findings.

Materials and methods

A total of 1,319 patients who presented to the emergency department and underwent brain CT between January 1, 2024, and August 1, 2025, were included in this retrospective study. After excluding 110 cases with insufficient clinical information, analyses were conducted on 1,209 patients. Clinical indications were categorized into eight groups, and radiological findings were classified into six diagnostic categories. Radiological outcomes were analyzed both overall and within each clinical indication group.

Results

The mean age of the cohort was 48.2±19.7 years; 44.2% were male. A total of 1,889 clinical indications were analyzed. The most common indications were headache (28.6%), nausea-vomiting (21.5%), and trauma (19.7%). Overall, 80.9% of brain CT scans were normal. Acute pathologies were most frequently detected in trauma and cerebrovascular disease groups. Mass lesions were notable in patients presenting with seizures (20%) and in 5.5–8.7% of those with syncope, nausea-vomiting, or dizziness. The most common acute abnormalities were infarction (3.5%), hemorrhage (2.8%), and skull fracture (2.7%).

Discussion and Conclusion

Most brain CT examinations performed in the emergency department resulted in normal findings; however, trauma and cerebrovascular disease were more strongly associated with acute abnormalities. The presence of mass lesions in specific clinical presentations highlights the need for careful symptom-based imaging strategies. Multicenter studies with larger patient cohorts are warranted to optimize evidence-based imaging use in emergency settings.

Key words: Brain CT, emergency department, radiology, clinical indications

ÖZ

Amaç

Bu çalışmanın amacı, üçüncü basamak özel bir hastanenin acil servisinden istenen beyin bilgisayarlı tomografi (BT) tetkiklerinin klinik istem nedenlerini ve radyolojik sonuçlarını değerlendirmek; acil patoloji saptanma oranlarını ve raslantısal bulguların sıklığını belirlemektir.

Gereç ve Yöntemler

Retrospektif olarak planlanan çalışmaya 01.01.2024–01.08.2025 tarihleri arasında acil servise başvurarak beyin BT çekilen 1.319 hasta dahil edildi. Klinik bilgi eksikliği bulunan 110 olgu çalışma dışı bırakılarak analizler 1.209 hasta üzerinden yapıldı. Klinik istem nedenleri sekiz gruba ayrıldı; radyolojik sonuçlar altı kategoride değerlendirildi. Klinik istem nedenleri özelinde ve tüm hasta grubunda radyolojik sonuçların analizi yapıldı.

Bulgular

Çalışma grubunun yaş ortalaması 48,2±19,7 yıl olup %44,2'si erkekti. Toplam 1.889 klinik istem değerlendirildi; en sık istem nedeni baş ağrısı (%28,6), bulantı-kusma (%21,5) ve travmaydı (%19,7). Tüm beyin BT'lerin %80,9'u normal bulundu. Travma ve serebrovasküler hastalık gruplarında akut patoloji oranı en yüksekti. Kitle lezyonları özellikle nöbet (%20) ve senkop/bulantı-kusma/baş dönmesi (%5,5–8,7) gruplarında dikkat çekiciydi. En sık akut bulgular enfarkt (%3,5), kanama (%2,8) ve kırık (%2,7) olarak saptandı.

Tartışma ve Sonuç

Acil serviste istenen beyin BT'lerin büyük kısmı normal sonuçlanmaktadır. Ancak travma ve serebrovasküler hastalık gibi belirli klinik tablolar akut patoloji ile daha yakından ilişkilidir. Bazı semptom gruplarında saptanan kitle lezyonları klinik değerlendirmenin önemini göstermektedir. Daha geniş, çok merkezli çalışmalar acil serviste görüntüleme kullanımının daha etkin planlanmasına katkı sağlayabilir.

Anahtar Kelimeler: Beyin BT, acil servis, radyoloji, klinik istem

Introduction

The number of emergency department visits and imaging examinations has been increasing annually. In addition to the overall rise in imaging volume, the number of imaging studies per patient has also shown a steady increase (1,2). Although radiologic imaging obtained in the emergency department often yields a low rate of acute pathology detection, it remains the most powerful tool available to healthcare professionals against the risk of potential critical missed diagnoses (3-5). Among all computed tomography (CT) examinations performed, brain CTs constitute by far the largest proportion (6). The high number of imaging studies not only increases the workload but also contributes to greater radiation exposure. In this context, evaluating the detection rates of emergent and critical pathologies on brain CT scans performed in emergency departments holds significant clinical importance.

In our study, we aimed to investigate the clinical indications and radiological findings of brain CT examinations requested from the emergency department of a tertiary private hospital. Through this analysis, we sought to identify the reasons for imaging requests, the rate of emergent pathologies, and the frequency of incidental findings.

Methods

In this retrospective study, patients who presented to the emergency department of a tertiary private hospital and underwent brain CT examinations between January 1, 2024, and August 1, 2025, were evaluated. The radiology reports of all examinations, along with the clinical indications and medical data of the corresponding patients, were reviewed through the hospital information management system. This study was approved by the Izmir Tinaztepe University Non-Interventional Clinical Research Ethics Committee on September 25, 2025, under the approval number MUKCE2025/100. All procedures performed in this study were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Patients aged 18 years and older were included in the study. In addition to brain CT reports, findings from magnetic resonance image (MRI), diffusion-weighted MRI, and CT angiography were also utilized in cases with diagnoses such as infarction or mass. Cases with insufficient preliminary diagnosis or clinical information in the hospital information system were excluded from the study.

The clinical indications obtained from the hospital information management system were categorized into eight main groups based on the most common reasons for emergency department visits (Table 1).

Table 1. Classification of clinical indications for brain CT examinations.

Number	Clinical Indication
0	Trauma
1	Headache
2	Dizziness
3	Syncope
4	Cerebrovascular Disease
5	Seizure
6	Nausea–vomiting
7	Other

Brain CT reports were categorized into six diagnostic groups based on radiological findings (Table 2). Mucosal thickening, soft tissue edema, skin lesions, and pathologies involving extracranial structures and other similar findings were classified under the “Other” category.

The data obtained from the study were analyzed using IBM SPSS Statistics software (version 26.0; IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as the mean $\pm$ standard deviation (SD) for continuous variables and as frequencies and percentages (%) for categorical variables.

Table 2. Classification of radiological findings on brain CT.

Number	Radiological Finding
0	Normal
1	Hemorrhage
2	Infarction
3	Mass
4	Fracture
5	Other

Results

A total of 1,319 patients who presented to the emergency department and underwent brain CT

between January 1, 2024, and August 1, 2025, were included in the study. One hundred ten patients with insufficient clinical information in

their CT requests were excluded, and analyses were conducted on the remaining 1,209 patients. The mean age of the included patients was 48.2 ± 19.7 years, comprising 534 males (44.2%) and 675 females (55.8%).

A total of 1,889 clinical indications corresponding to 1,209 patients were evaluated. The number of indications exceeded the total number of patients because some patients presented with multiple concurrent complaints. The most common indication was headache,

accounting for 541 requests (28.6%), which ranked first among all reasons for imaging. This was followed by nausea and vomiting (407, 21.5%), trauma (372, 19.7%), and dizziness (237, 12.5%), which together accounted for more than half of all clinical indications. When examined by patient, 44.7% presented with headache, 33.7% with nausea and vomiting, and 30.4% with trauma. Detailed distribution of all categories is shown in Table 3.

Table 3. Distribution of clinical indications for brain CT examinations.

Clinical Indication	Number of Requests	% by Total Requests	% by Total Patients
Headache	541	28.6	44.7
Nausea–Vomiting	407	21.5	33.7
Trauma	372	19.7	30.4
Dizziness	237	12.5	19.6
Cerebrovascular Disease	121	6.4	10.0
Other	99	5.2	8.2
Syncope	92	4.9	7.6
Seizure	20	1.1	1.7
Total	1889	100.0	155.9

Across all clinical indication groups, a normal brain CT was the most common result. The highest proportion of normal brain CT results was observed in patients presenting with headache (89.5%), whereas trauma patients demonstrated the lowest percentage of normal findings (69.6%). Skull fractures (8.1%) and intracranial hemorrhage (6.2%) were predominantly

associated with trauma. Cerebrovascular disease cases showed the highest rate of acute infarction (9.9%). Mass lesions were notably identified in headache and nausea–vomiting groups (each 5–6%). In the syncope group, mass lesions and other abnormalities were equally detected (both 8.7%) (Table 4).

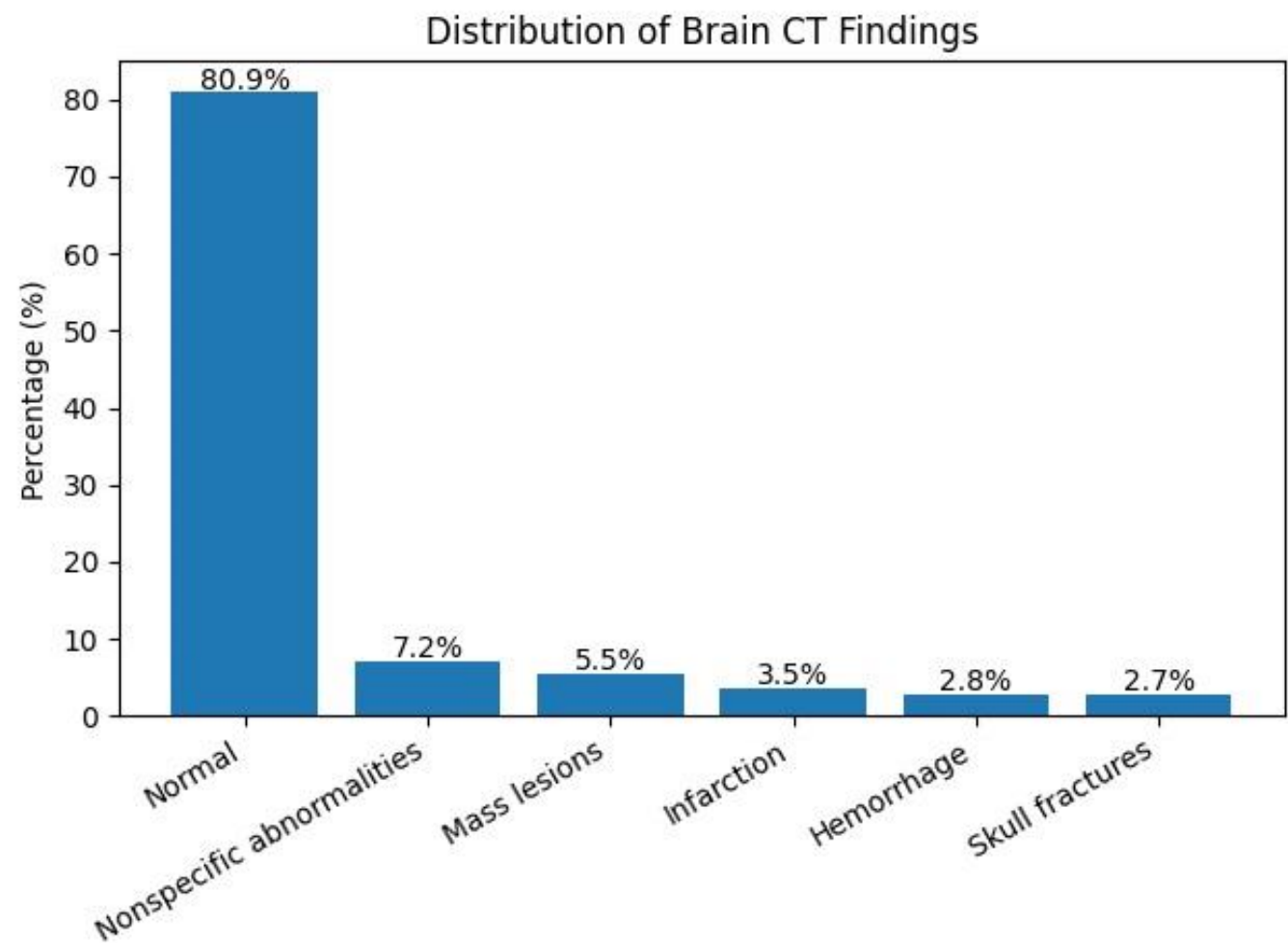
Table 4. The three most common CT findings in each clinical indication group.

Clinical Indication (n)	Most Finding	Common Second Finding	Most Common Third Finding
Headache (n=541)	Normal: 484 (89.5%)	Mass lesion: 24 (4.4%)	Other: 23 (4.3%)
Nausea–Vomiting (n=407)	Normal: 350 (86.0%)	Mass lesion: 24 (5.9%)	Other: 21 (5.2%)
Trauma (n=372)	Normal: 259 (69.6%)	Other: 55 (14.8%)	Fracture: 30 (8.1%)
Dizziness (n=237)	Normal: 208 (87.8%)	Mass lesion: 13 (5.5%)	Infarction: 9 (3.8%)
Cerebrovascular Disease (n=121)	Normal: 94 (77.7%)	Infarction: 12 (9.9%)	Mass lesion: 7 (5.8%)
Other (n=99)	Normal: 78 (78.8%)	Infarction: 13 (13.1%)	Mass lesion: 5 (5.1%)
Syncope (n=92)	Normal: 71 (77.2%)	Mass lesion: 8 (8.7%)	Other: 8 (8.7%)
Seizure (n=20)	Normal: 14 (70.0%)	Mass lesion: 4 (20.0%)	Other: 4 (20.0%)

Overall, brain CT scans demonstrated normal results in 978 patients (80.9%). Pathological findings were detected in approximately one out of every five cases (231 patients, 19.1%), with other nonspecific abnormalities in 87 patients (7.2%) and mass lesions in 66 patients (5.5%)

being the most common. Acute intracranial injuries were relatively infrequent in the overall cohort, including infarction in 42 patients (3.5%), hemorrhage in 34 patients (2.8%), and skull fractures in 33 patients (2.7%) (Figure 1).

Figure 1. A pie chart illustrating the distribution of all radiological findings in the overall patient population.



Discussion

In recent years, the use of imaging in emergency departments has continued to rise and medicolegal pressures have played a major role in this increase. Since brain CT accounts for a significant portion of all imaging studies, understanding the distribution of clinical indications and radiological findings is important. Although there are studies on this topic in the literature, no research has evaluated the experience of an emergency department in a tertiary private hospital. In this context, the

findings of our study may contribute to the existing literature by presenting the experience of a tertiary private hospital emergency department. In the study by Seidel et al., which analyzed CT examinations requested from the emergency department, brain CT accounted for 46% of all imaging studies. The most common indications for brain CT were neurological symptoms, trauma, and headache, respectively. Neurological findings accounted for 73% of the indications for imaging(5). In the study by Baris et al., which evaluated findings from a tertiary university

hospital, the most common clinical preliminary diagnoses were trauma, cerebrovascular disease, and impaired general condition (7). In the study conducted by Lunde et al., the most common indications were also reported to be trauma and ischemic stroke (8). In our study, the most common indications were headache, nausea and vomiting, and trauma. Headache accounted for 44.7% of all imaging indications in our patient population. Our findings regarding clinical indications differ markedly from those reported in the literature. Notably, cerebrovascular disease and trauma, which are among the leading indications in other studies, appear much less prominent in our cohort. These discrepancies may be related to differences in the patient populations presenting to state hospitals versus those presenting to private institutions. Additionally, patients presenting with complaints such as headache may be directed to outpatient clinics in state hospitals, whereas in tertiary private hospitals like ours, imaging may be performed in the emergency department to avoid missing rare but potentially significant pathologies.

Knowing the proportion of normal radiological results in brain CT examinations requested from the emergency department is important for the effective management of diagnostic and treatment processes. In the study by Barış et al., the most frequent radiological finding across all examinations was reported as normal, with a rate of 74% (7). In the same study, normal results were observed in up to 95% of cases with

preliminary diagnoses such as syncope, headache, and dizziness. Similarly, in the study conducted by Siedel et al., the rate of normal findings was reported as 79% (5). In the same study, brain CT demonstrated the highest rate of normal findings compared with imaging of other body regions. In our study, 80.9% of all brain CT examinations resulted as normal. When evaluated by clinical indication, the highest proportion of normal findings was observed in patients presenting with headache and nausea–vomiting, whereas the lowest rate of normal results was found in trauma patients.

In the study by Wang et al., which investigated factors associated with abnormal findings on CT in non-traumatic patients, focal neurological deficit, altered mental status, history of malignancy, nausea and vomiting, and derangement in coagulation parameters were identified as independent clinical predictors (9). Similarly, Simwatachela et al. reported that focal neurological deficits and loss of consciousness were associated with abnormal brain CT findings (10). In the study by Mitsunaga et al., acute abnormal findings were identified in 7.1% of patients presenting to the emergency department with dizziness and 6.4% of those presenting with syncope. The same study also found that focal neurological deficits and acute trauma were significantly associated with abnormal brain CT findings (3). Lawhn-Heath et al. demonstrated that among patients presenting with vertigo or dizziness, the rate of emergent pathology detected on CT was 1.6% (11). In our study, acute

pathologies were most frequently identified in patients with trauma and cerebrovascular disease as the primary clinical indication. Additionally, mass lesions represented a noteworthy finding, occurring in 20% of patients presenting with seizures and in 5.5–8.7% of those presenting with syncope, nausea–vomiting, or dizziness. Although the majority of radiological results were normal, determining which clinical presentations are more likely to predict significant or acute radiological abnormalities remains crucial. In this regard, studies involving larger patient populations and incorporating detailed clinical histories may help clarify the relationship between specific presenting symptoms and radiological outcomes. Such evidence could guide more targeted and efficient use of imaging in emergency settings.

This study has several limitations. The retrospective design, which relied on previously recorded clinical and radiological data, represents one of the major constraints, as it heavily depends on the accuracy and completeness of system-based documentation. Although the study provides valuable insights into the patient population of a single tertiary private hospital emergency department, its single-center nature limits the generalizability of the findings to other healthcare settings. Brain CT results were evaluated solely based on radiology reports, and the original imaging data were not re-analyzed, which may have restricted the ability to identify subtle findings or reassess borderline cases. Although additional imaging modalities such as

MRI and CT angiography were reviewed when available, not all patients underwent further imaging, potentially leading to an underestimation of subtle or evolving pathologies that may not be detectable on CT alone.

Conclusion

In this study, we evaluated the clinical indications and radiological outcomes of brain CT examinations performed in the emergency department of a tertiary private hospital. The majority of scans yielded normal results, particularly in patients presenting with headache and nausea–vomiting, whereas trauma and cerebrovascular disease were associated with higher rates of acute pathological findings. The detection of mass lesions in a subset of patients presenting with seizures, syncope, and dizziness highlights the importance of careful clinical assessment when determining the need for imaging. Although most CT examinations did not reveal emergent pathology, identifying clinical presentations that are more likely to predict significant abnormalities remains essential for optimizing imaging strategies. Future multicenter studies with larger cohorts and detailed clinical correlations are needed to refine imaging guidelines and support more effective, evidence based use of brain CT in emergency settings.

Ethical Approval: This study was approved by the Tinaztepe University Non-Interventional Clinical Research Ethics Committee on September 25, 2025, under the approval number MUKCE2025/100. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent: All individuals included in the study were informed and signed voluntary consent forms.

References

1. Drescher FS, Sirovich BE. Use of Computed Tomography in Emergency Departments in the United States. *JAMA Intern Med.* 2016;176(2):273.
2. Larson DB, Johnson LW, Schnell BM, Salisbury SR, Forman HP. National Trends in CT Use in the Emergency Department: 1995–2007. *Radiology.* 2011;258(1):164–73.
3. Mitsunaga MM, Yoon HC. JOURNAL CLUB: Head CT Scans in the Emergency Department for Syncope and Dizziness. *American Journal of Roentgenology.* 2015;204(1):24–8.
4. Nesselroth D, Klang E, Soffer S, Druskin E, Barash Y, Hoffmann C, et al. Yield of head CT for acute findings in patients presenting to the emergency department. *Clin Imaging.* 2021;73:1–5.
5. Seidel J, Bissell MB, Vatturi S, Hartery A. Retrospective Analysis of Emergency Computed Tomography Imaging Utilization at an Academic Centre: An Analysis of Clinical Indications and Outcomes. *Canadian Association of Radiologists Journal.* 2019;70(1):13–22.
6. Maxwell S, Ha NT, Bulsara MK, Doust J, McRobbie D, O’Leary P, et al. Increasing use of CT requested by emergency department physicians in tertiary hospitals in Western Australia 2003–2015: an analysis of linked administrative data. *BMJ Open.* 2021;11(3):e043315.
7. Baris MM, Canturk A, Karabay N. Retrospective analysis of head computed tomography investigations ordered by emergency department: comparison of clinical pre-diagnosis and radiologic results. *Dokuz Eylül Üniversitesi Tıp Fakültesi Dergisi.* 2020;34(2):103-10.
8. Lund AM, Larsen JJ, Schmidt TA. Brain Computed Tomography Overutilization in an Emergency Department Setting. *Emergency Care and Medicine.* 2025;2(3):44.
9. Wang X, You JJ. Head CT for Nontrauma Patients in the Emergency Department: Clinical Predictors of Abnormal Findings. *Radiology.* 2013;266(3):783–90.
10. Simwatachela E, Ozoh JO, Mabuza LH, Kalinda C. Clinical Predictors of Abnormal Head Computed Tomography Findings in Non-trauma Patients Presenting to a South African Emergency Department. *Frontiers in Radiology.* 2021;25;1.
11. Lawhn-Heath C, Buckle C, Christoforidis G, Straus C. Utility of head CT in the evaluation of vertigo/dizziness in the emergency department. *Emerg Radiol.* 2013;20(1):45–9.