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Diagnostic Yield and Prognostic Value of Emergency Neuroimaging in Older Adults: Role of the Glasgow Coma Scale

Yaşlı Hastalarda Acil Nörogörüntülemenin Tanısal Getirisi ve Prognostik Değeri: Glasgow Koma Skalasının Rolü

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ABSTRACT

Aim: Emergency neuroimaging is increasingly used in older adults with neurological symptoms; however, evidence on diagnostic yield and outcomes in this population remains limited. This study evaluated the diagnostic performance of computed tomography (CT) and magnetic resonance imaging (MRI) in older adult emergency patients and assessed the prognostic significance of Glasgow Coma scale (GCS) combined with imaging findings.

Materials and Methods: This retrospective study included 743 patients aged ≥65 years who presented to a tertiary emergency department between January and March 2025 with non-traumatic neurological symptoms requiring brain imaging. Demographics, symptoms, GCS scores, imaging findings, hospital disposition, and mortality were analyzed. Logistic regression identified predictors of abnormal imaging and clinical outcomes.

Results: The cohort (mean age 77.1±7.7 years; 52.8% male) had abnormal CT findings in 20.7% of patients and MRI abnormalities in 36.1%. Cerebrovascular accidents were most common (CT: 12.0%, MRI: 26.7%). Abnormal GCS (<15) was associated with abnormal imaging (CT: 28.5% vs. 17.8%; MRI: 46.7% vs. 33.1%). Mortality was 1.3%, exclusively in patients with abnormal GCS. Among those with altered consciousness, mortality varied by imaging: CT abnormal (8.8%), MRI abnormal (14.0%), CT normal (3.5%), MRI normal (2.0%). Abnormal imaging was associated with substantially higher hospitalization rates (CT: 79.9% vs. 20.9%; MRI: 87.3% vs. 24.5%) and increased odds of mortality [CT: odds ratio (OR)=3.9, 95% confidence interval (CI): 1.1-13.8; MRI: OR= 11.0, 95% CI: 1.3-92.4].

Conclusion: MRI demonstrated higher diagnostic yield than CT in older adults with neurological emergencies. A normal GCS was a strong negative predictor of short-term mortality. Combining GCS with neuroimaging findings enables effective risk stratification and supports clinical decision-making in emergency care. In patients with altered consciousness (GCS <15), neuroimaging provided additive prognostic value, with mortality risk increasing stepwise from normal to abnormal imaging findings, highest in those with abnormal MRI.

Keywords: Emergency department, older adults, neuroimaging, Glasgow Coma scale, mortality

ÖZ

Amaç: Nörolojik semptomlarla başvuran yaşlı hastalarda acil nörogörüntüleme giderek daha sık kullanılmaktadır; ancak bu popülasyonda tanısal verim ve klinik sonuçlara ilişkin kanıtlar sınırlıdır. Bu çalışmada, yaşlı acil servis hastalarında bilgisayarlı tomografi (BT) ve manyetik rezonans görüntülemenin (MRG) tanısal performansı değerlendirilmiş, ayrıca görüntüleme bulguları ile birlikte Glasgow Koma skalası (GKS) skorunun prognostik önemi araştırılmıştır.

Gereç ve Yöntem: Bu retrospektif çalışmaya, Ocak-Mart 2025 tarihleri arasında üçüncü basamak bir acil servise travma dışı nörolojik semptomlarla başvuran ve beyin görüntülemesi yapılan, 65 yaş ve üzerindeki 743 hasta dahil edildi. Demografik özellikler, başvuru semptomları, GKS skorları, görüntüleme bulguları, hastaneye yatış durumu ve mortalite verileri analiz edildi. Anormal görüntüleme bulgularını ve klinik sonuçları öngören faktörler lojistik regresyon analizi ile değerlendirildi.

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Bulgular: Çalışma grubunun ortalama yaşı 77,1±7,7 yıl olup hastaların %52,8'i erkekti. BT'de hastaların %20,7'sinde, MRG'de ise %36,1'inde anormal bulgu saptandı. En sık görülen patoloji serebrovasküler olaydı (BT: %12,0; MRG: %26,7). Anormal GKS (<15), anormal görüntüleme bulguları ile ilişkiliydi (BT: %28,5'e karşı %17,8; MRG: %46,7'ye karşı %33,1). Mortalitenin %1,3 olduğu ve yalnızca GKS'si anormal olan hastalarda görüldüğü belirlendi. Bilinç değişikliği bulunan hastalarda mortalite oranları görüntüleme bulgularına göre farklılık gösterdi: BT anormal %8,8, MRG anormal %14,0, BT normal %3,5 ve MRG normal %2,0. Anormal görüntüleme bulguları, belirgin derecede daha yüksek hastaneye yatış oranları (BT: %79,9'a karşı %20,9; MRG: %87,3'e karşı %24,5) ve artmış mortalite olasılığı ile ilişkili bulundu [BT: olasılık oranı (OR)=3,9, %95 güven aralığı (GA): 1,1-13,8; MRG: OR=11,0, %95 GA: 1,3-92,4].

Sonuç: MRG, nörolojik acillerle başvuran yaşlı hastalarda BT'ye göre daha yüksek tanısal verim sağlamıştır. Normal GKS, kısa dönem mortalite açısından güçlü bir negatif öngörücü olarak bulunmuştur. GKS'nin nörogörüntüleme bulguları ile birlikte değerlendirilmesi, etkili risk sınıflandırması yapılmasına olanak sağlamakta ve acil serviste klinik karar verme sürecini desteklemektedir. Bilinç değişikliği olan (GKS <15) hastalarda nörogörüntüleme ek prognostik değer sağlamış; mortalite riski normal görüntülemeden anormal görüntülemeye doğru kademeli olarak artmış ve en yüksek risk anormal MRG bulgusu olan hastalarda gözlenmiştir.

Anahtar Kelimeler: Acil servis, yaşlı erişkinler, nörogörüntüleme, Glasgow Koma skalası, mortalite

INTRODUCTION

Emergency neuroimaging represents a critical component of acute care for older adults' patients presenting with neurological symptoms or altered mental status. Non-traumatic brain emergencies are the leading cause of morbidity and mortality in this population, driven by widespread age-related physiological changes and increased comorbidities[1]. The growing older adult population, combined with the higher incidence of emergent neurological conditions, necessitates rapid and reliable neuroimaging for accurate diagnosis and appropriate treatment decisions in this vulnerable age group[2].

Computed tomography (CT) remains the most utilized first-line neuroimaging modality in emergency departments due to its widespread availability, rapid acquisition, and cost-effectiveness[3]. The number of emergency department visits and neuroimaging examinations has increased significantly, with neuroimaging utilization in emergency departments growing considerably between 2007 and 2017[4]. CT is the most commonly used imaging modality for the assessment of patients with suspected stroke, owing to its widespread availability, rapid acquisition, and lower cost compared with magnetic resonance imaging (MRI)[5]. However, the diagnostic limitations of CT in detecting acute ischemic changes and subtle parenchymal abnormalities have led to increased utilization of MRI in emergency settings.

MRI is widely considered superior to CT for detecting acute stroke. However, this assumption has not been conclusively validated across the entire spectrum of patients in whom acute stroke is suspected[6]. Recent comparative studies have demonstrated significant differences in diagnostic yield between these modalities. MRI identified acute ischemic stroke in 164 of 356 individuals [46%; 95% confidence interval (CI: 41-51%], whereas CT detected it in only 35 of 356 patients (10%; 95% CI, 7-14%). When compared with the final clinical diagnosis, the sensitivity of MRI for detecting any acute stroke was 83% (181/217; 95% CI, 78-88%), while CT demonstrated a sensitivity of just 26% (56/217; 95% CI, 20-32%)[6].

The decision to perform neuroimaging in older adults patients requires careful consideration of clinical factors, as indiscriminate use of imaging studies can lead to increased costs and unnecessary radiation exposure[7]. When the etiology is uncertain and intracranial pathology cannot be safely excluded, neuroimaging should be performed during the first assessment of acute changes in mental status. Imaging is especially recommended for patients with trauma, anticoagulation therapy, hypertension or hypertensive emergencies, headache, gastrointestinal symptoms such as nausea or vomiting, suspected infection, new seizures, neurological deficits, a cancer history, older age, or pre-existing intracranial conditions[8].

The needs of older adults in acute care are unique, but little is known about the potential benefits of imaging in frail populations[9]. Older adults aren't typically included in clinical studies that examine the utility and efficacy of medical imaging procedures, and it's difficult to generalize study results to older groups[9]. According to a systematic review, CT scans revealed abnormal results in 15.6% of elderly emergency patients presenting with confusion or altered mental status, with focal neurological deficits showing a strong association with acute intracranial pathology[10]. This knowledge gap underscores the importance of studying diagnostic yields and clinical outcomes specifically in older adults.

Glasgow coma scale (GCS) serves as a fundamental neurological assessment tool that has demonstrated strong prognostic value across various clinical contexts[11]. A relationship between assessments of the GCS and outcome was shown clearly, demonstrating the existence of a continuous, progressive association between increasing mortality after a head injury and decreases in GCS score from 15 to 3[11]. The prognostic utility of GCS extends beyond traumatic brain injury to various neurological emergencies in older patients.

Recent studies utilizing machine learning approaches have demonstrated that key predictive factors for mortality include metabolic syndrome, NEWS2 score, GCS, surgical status, bowel movement status, potassium level, and aspartate transaminase level[12]. This evidence supports the integration of GCS with neuroimaging findings for comprehensive risk stratification in elderly patients.

The present study aims to evaluate the diagnostic yield of brain imaging modalities (CT and MRI) in older adults (≥65 years) presenting to the emergency department with non-traumatic neurological symptoms, and to assess the prognostic significance of neuroimaging findings in relation to GCS scores and short-term clinical outcomes.

MATERIALS AND METHODS

This retrospective, observational study was conducted at a tertiary care hospital emergency department. The study protocol was approved by the institutional ethics committee, and patient consent was waived due to the retrospective nature of the study. This study was approved by the Sivas Cumhuriyet University Non-Interventional Clinical Research Ethics Committee (approval no: 2025-06/18, date: 12.06.2025). All procedures were conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

All patients aged 65 years and older who presented to the emergency department between January 1, 2025, and March 1, 2025, and required brain imaging were included in the study. All patients underwent non-contrast head CT as the initial imaging modality. Subsequent MRI was performed only in patients for whom additional imaging was deemed clinically necessary based on CT findings and/or persistent clinical suspicion, in accordance with routine emergency department practice. Inclusion criteria were age ≥65 years, emergency department presentation during the study period, and brain imaging (CT and/or MRI) performed during the emergency department visit. Exclusion criteria included age <65 years, history of trauma, and brain imaging with technical inadequacy or severe motion artifacts preventing proper evaluation. The patient selection process and imaging pathway are summarized in Figure 1.

Non-contrast brain CT was performed using a GE Revolution Evo scanner (GE Healthcare, USA) standard axial acquisition parameters with thin-section reconstruction, according to institutional emergency imaging protocols. MRI examinations were performed using a 1.5-T system (Siemens Magnetom Aera, Siemens Healthineers, Erlangen, Germany) and included mandatory sequences for acute neurological assessment: axial T1-weighted, T2-weighted, fluid-attenuated inversion recovery, diffusion-weighted imaging with corresponding apparent diffusion coefficient maps, and susceptibility-weighted imaging, when available. MRI was used to assess acute ischemia, intracranial hemorrhage, mass lesions, and other parenchymal abnormalities.

Patient data were retrospectively collected from the hospital information management system. Demographics including age, gender, and preliminary diagnoses recorded at emergency department presentation were extracted. Brain CT images were reviewed through the picture archiving and communication system. Acute pathologies (e.g., ischemic stroke, hemorrhage) and incidental findings (e.g., masses, aneurysms, calcifications) were separately documented. For patients who underwent MRI, imaging findings and reported diagnoses were similarly evaluated and recorded. Clinical outcomes and emergency department dispositions were categorized as discharged home, death, admission to neurology or neurosurgery services, or admission to other services for non-neurological diagnoses. The term “general disorder” was used to describe non-specific clinical presentations commonly observed in elderly emergency patients, including generalized weakness, malaise, functional decline, or nonspecific clinical deterioration.

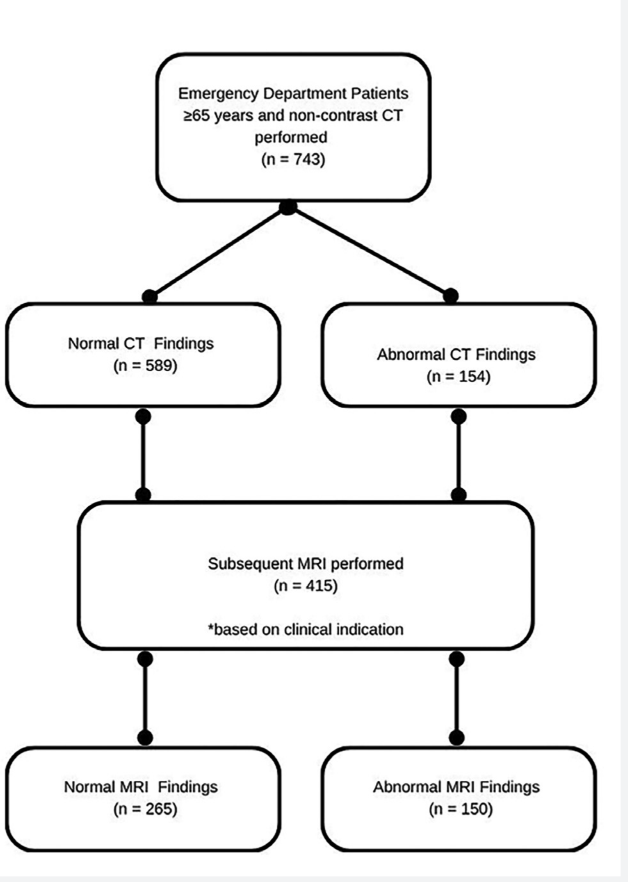

Figure 1. Patient flow diagram of emergency neuroimaging pathway in older adults

CT: Computed tomography, MRI: Magnetic resonance imaging

The GCS score was recorded at the time of initial emergency department admission, prior to neuroimaging. Patients were categorized as having normal consciousness (GCS=15) or altered consciousness (GCS<15), with further subcategorization into mild (GCS)[13-14], moderate (GCS)[9-12], and severe (GCS)[3-8] impairment.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 23.0. Descriptive statistics included mean ± standard deviation, median, minimum and maximum values for continuous variables, and frequencies with percentages for categorical variables. The chi-square test or Fisher's exact test (when appropriate) was used to evaluate associations between categorical variables. Normality of continuous variables was assessed using the Kolmogorov-Smirnov or Shapiro-Wilk tests. Independent sample t-tests were used for normally distributed data, while Mann-Whitney U tests were applied for non-parametric comparisons between two groups. For multiple group comparisons, one-way ANOVA was used for parametric data and Kruskal-Wallis test for non-parametric data. Logistic regression analysis was performed to evaluate the relationship between imaging findings and clinical outcomes (hospitalization, mortality). Variables found to be significant in univariate analysis were included in the multivariate model to assess their independent effects on hospital admission or mortality. A p-value<0.05 was considered statistically significant for all analyses.

RESULTS

A total of 743 older adult patients with a mean age of 77.1±7.7 years were included in this study, with 52.8% being male and 47.2% female (Table 1). The majority of patients (72.7%) presented with normal GCS scores of 15, while 26.9% had abnormal scores below 15 (GCS was not recorded in 3 patients, 0.4%)[15]. The most common presenting symptoms were general disorder (22.3%), dizziness (11.4%), and headache (9.4%).

Neuroimaging findings revealed significant differences between CT and MRI diagnostic capabilities (Table 2). CT imaging demonstrated abnormal findings in 20.7% of patients (154/743). MRI, which was performed in a clinically selected subset of patients following initial CT evaluation (n=415), demonstrated a substantially higher diagnostic yield of 36.1% (150/415, p<0.001). Cerebrovascular accident was the most frequently identified pathology, detected in 12.0% of CT scans and 26.7% of MRI examinations. Mass lesions were identified in 2.8% of CT and 4.3% of MRI studies, while intraparenchymal hemorrhage was found in 2.6% of CT and 1.9% of MRI cases.

Analysis of factors associated with abnormal brain imaging revealed that age and gender were not significantly associated with abnormal findings on either CT or MRI (Table 3). However, GCS status emerged as a strong predictor of abnormal neuroimaging results. Patients with abnormal GCS (<15) demonstrated significantly higher rates of abnormal CT findings (28.5% vs. 17.8%, p<0.001) and abnormal MRI findings (46.7% vs. 33.1%, p=0.017) compared to patients with normal GCS scores.

Overall mortality was low at 1.3% (10 of 743 patients), but

Table 1. Baseline characteristics and clinical presentation

Characteristic	Total (n=743)
Age (years)	
Mean ± SD	77.1±7.7
Median (IQR)	76
Age groups, n (%)	
65-74 years	293 (39.4%)
75-84 years	318 (42.8%)
≥85 years	132 (17.7%)
Gender, n (%)	
Male	392 (52.8%)
Female	351 (47.2%)
Glasgow Coma scale, n (%)	
Normal (15)	540 (72.7%)
Mild (13-14)	62 (8.3%)
Moderate (9-12)	96 (12.9%)
Severe (3-8)	42 (5.7%)
Most common symptoms, n (%)	
General disorder	166 (22.3%)
Dizziness	85 (11.4%)
Headache	70 (9.4%)
Speech disorder	66 (8.9%)
Fatigue	57 (7.7%)
Confusion	55 (7.4%)

SD: Standard deviation, IQR: Interquartile range

Table 2. Imaging findings and diagnostic yield

Findings	CT (n=743)	MRI (n=415)
Normal, n (%)	589 (79.3%)	265 (63.9%)
Abnormal, n (%)	154 (20.7%)	150 (36.1%)
Specific pathologies, n (%)		
Cerebrovascular accident	89 (12.0%)	111 (26.7%)
Mass lesion	21 (2.8%)	18 (4.3%)
Intraparenchymal hemorrhage	19 (2.6%)	8 (1.9%)
Subdural/epidural hemorrhage	16 (2.2%)	7 (1.7%)
Meningioma	9 (1.2%)	6 (1.4%)
Diagnostic Yield (%)	20.7	36.1*

*p<0.001 vs. CT (chi-square test), MRI: Magnetic resonance imaging, CT: Computed tomography

Table 3. Association between patient characteristics and CT/MRI abnormalities

Variable	CT abnormal n (%)	CT normal n (%)	CT p-value	CT adjusted OR (95% CI)	MRI abnormal n (%)	MRI normal n (%)	MRI p-value	MRI adjusted OR (95% CI)
Age groups								
65-74 years	63 (21.5%)	230 (78.5%)	0.912	1.00	59 (35.1%)	109 (64.9%)	0.892	1.00
75-84 years	65 (20.4%)	253 (79.6%)		0.90 (0.61-1.34)	66 (36.3%)	116 (63.7%)		1.07 (0.68-1.66)
≥85 years	26 (19.8%)	106 (80.3%)		0.78 (0.46-1.33)	25 (38.5%)	40 (61.5%)		1.06 (0.58-1.94)
Gender								
Male	83 (21.2%)	309 (78.8%)	0.751	1.00	78 (36.8%)	134 (63.2%)	0.779	1.00
Female	71 (20.2%)	280 (79.8%)		1.05 (0.73-1.50)	72 (35.5%)	131 (64.5%)		1.06 (0.70-1.59)
Glasgow Coma scale								
Normal (GCS=15)	96 (17.8%)	444 (82.2%)	<0.001*	1.00	106 (33.1%)	214 (66.9%)	0.017*	1.00
Abnormal (GCS<15)	57 (28.5%)	143 (71.5%)		1.91 (1.30-2.80)*	43 (46.7%)	49 (53.3%)		1.77 (1.10-2.86)*
Detailed GCS categories								
Normal (GCS=15)	96 (17.8%)	444 (82.2%)	0.009*	1.00	106 (33.1%)	214 (66.9%)	0.048*	1.00
Mild (GCS 13-14)	15 (24.2%)	47 (75.8%)		1.48 (0.79-2.75)	14 (37.8%)	23 (62.2%)		1.23 (0.61-2.49)
Moderate (GCS 9-12)	31 (32.3%)	65 (67.7%)		2.21 (1.36-3.57)*	26 (54.2%)	22 (45.8%)		2.39 (1.29-4.41)*
Severe (GCS 3-8)	11 (26.2%)	31 (73.8%)		1.64 (0.80-3.38)	3 (42.9%)	4 (57.1%)		1.51 (0.33-6.89)
Presenting symptoms								
General disorder	24 (14.5%)	142 (85.5%)	<0.001*	0.47 (0.29-0.76)*	20 (35.1%)	37 (64.9%)	<0.001*	1.00
Headache	13 (18.6%)	57 (81.4%)		0.63 (0.33-1.20)	9 (29%)	22 (71%)		0.76 (0.31-1.87)
Dizziness	5 (5.9%)	80 (94.1%)		0.17 (0.07-0.44)*	4 (8%)	46 (92%)		0.16 (0.05-0.49)*
Other symptoms	112 (26.5%)	310 (73.5%)		1.00	117 (42.2%)	160 (57.8%)		1.35 (0.75-2.43)

*p<0.05, statistically significant

CT: Computed tomography, MRI: Magnetic resonance imaging, GCS: Glasgow Coma scale, OR: Odds ratio, CI: Confidence interval, adjusted OR calculated using multivariable logistic regression including age group, gender, and GCS

demonstrated a critical pattern based on GCS status (Figure 1). All observed mortality occurred exclusively in patients presenting with an abnormal GCS score (<15), whereas no fatalities were recorded among those with a normal GCS (15) regardless of imaging findings. Among patients with abnormal GCS, mortality risk varied by imaging results: 3.5% for normal CT, 8.8% for abnormal CT, (p=0.152), 2.0% for normal MRI, and 14.0% for abnormal MRI (p=0.048). The highest mortality risk was observed in patients with both abnormal GCS and abnormal MRI findings (14.0%). Accordingly, a normal GCS demonstrated a 100% negative predictive value for in-hospital mortality (0/540 deaths). Mortality rates stratified by GCS status and neuroimaging findings are illustrated in Figure 2.

Clinical outcomes analysis demonstrated that patients with abnormal neuroimaging had dramatically different hospital dispositions (Table 4, Figure 3). Among patients with abnormal CT findings, 79.9% required hospitalization compared to only 20.9% of patients with normal CT (p<0.001). Similarly, 87.3% of patients with abnormal MRI findings required hospitalization versus 24.5% with normal MRI (p<0.001). As illustrated in Figure 3, discharge rates were correspondingly lower in patients with abnormal

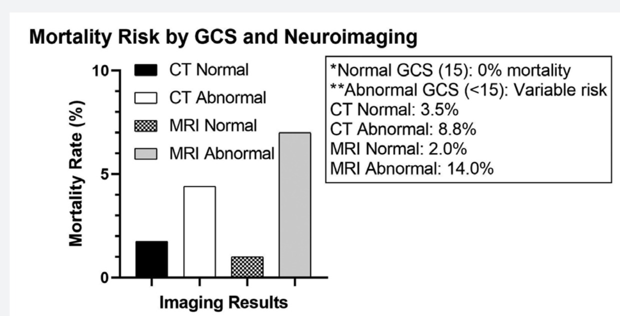

Figure 2. Mortality rates stratified by Glasgow Coma scale (GCS) status and neuroimaging results in geriatric patients (n=743). Patients with normal GCS (15) demonstrated 0% mortality regardless of CT or MRI findings. In contrast, patients with abnormal GCS (<15) showed variable mortality risk depending on imaging results: CT normal (3.5%), MRI normal (2.0%), CT abnormal (8.8%), and MRI abnormal (14.0%). The highest mortality risk was observed in patients with both abnormal GCS and abnormal MRI findings. Black bars represent normal GCS patients; patterned/gray bars represent abnormal GCS patients. Statistical significance was achieved for GCS groups (p<0.001).

MRI: Magnetic resonance imaging, CT: Computed tomography

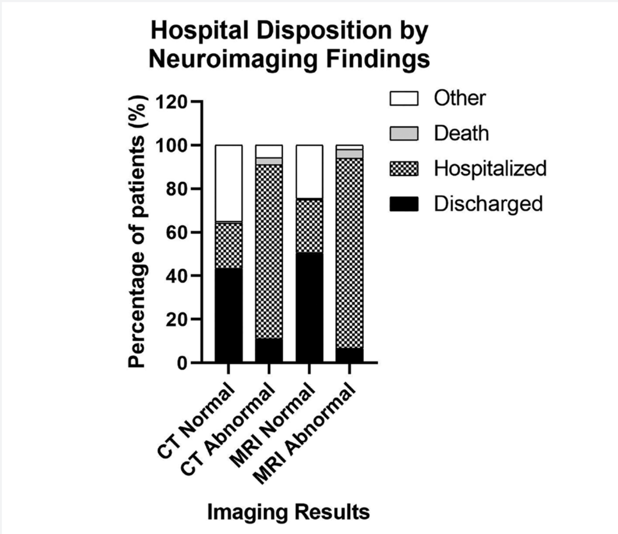

Figure 3. Distribution of hospital disposition outcomes stratified by neuroimaging results in geriatric patients (n=743). Stacked bar chart demonstrates the percentage distribution of patient outcomes: discharged (bottom, white), hospitalized (middle, gray), death (black), and other dispositions (top, striped). Patients with abnormal neuroimaging showed dramatically higher hospitalization rates compared to normal imaging: CT abnormal (79.9% vs. 20.9% for CT normal, p<0.001) and MRI abnormal (87.3% vs. 24.5% for MRI normal, p<0.001). Conversely, discharge rates were significantly lower in abnormal imaging groups: CT abnormal (11.0% vs. 43.3%) and MRI abnormal (6.7% vs. 50.6%). Mortality rates, while low overall, were consistently higher in abnormal imaging groups. Each bar represents 100% of patients in that imaging category.

MRI: Magnetic resonance imaging, CT: Computed tomography

imaging: 11.0% for abnormal CT versus 43.3% for normal CT, and 6.7% for abnormal MRI versus 50.6% for normal MRI.

Abnormal neuroimaging was associated with significantly elevated overall mortality rates. Patients with abnormal CT findings had higher odds of mortality [odds ratio (OR)=3.9,

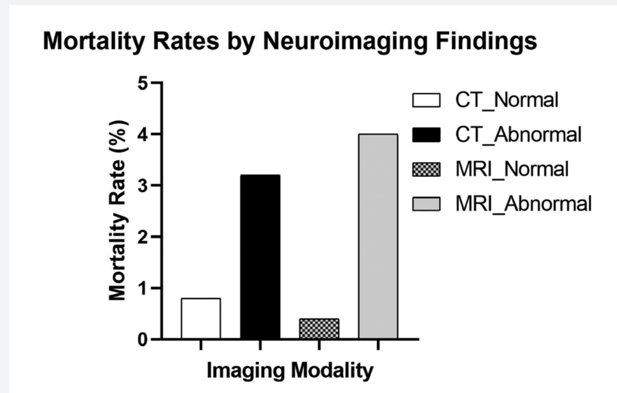

Figure 4. Comparison of mortality rates across different neuroimaging categories in geriatric patients (n=743). Bar chart displays mortality percentages for each imaging group: CT normal (0.8%), CT abnormal (3.2%), MRI normal (0.4%), and MRI abnormal (4.0%). Abnormal neuroimaging findings were associated with significantly higher mortality rates compared to normal findings: 3,9-fold increase for CT (p=0.021) and 11-fold increase for MRI (p=0.006). MRI abnormal patients demonstrated the highest mortality risk at 4.0%, while MRI normal patients had the lowest risk at 0.4%. These findings highlight the prognostic value of neuroimaging in geriatric patients and support risk stratification for clinical decision-making.

MRI: Magnetic resonance imaging, CT: Computed tomography

Table 4. Clinical outcomes and mortality analysis by imaging modality

Outcome	CT imaging (n=743)			p-value	MRI imaging (n=415)			p-value*
	Total n (%)	Normal n (%)	Abnormal n (%)		Total n (%)	Normal n (%)	Abnormal n (%)	
Hospital disposition								
Discharged	272 (36.6%)	255 (43.3%)	**17 (11.0%)**	**<0.001**	144 (34.7%)	134 (50.6%)	**10 (6.7%)**	**<0.001**
Hospitalized	246 (33.1%)	123 (20.9%)	**123 (79.9%)**	**<0.001**	196 (47.2%)	65 (24.5%)	**131 (87.3%)**	**<0.001**
Death	10 (1.3%)	5 (0.8%)	**5 (3.2%)**	**0.021**	7 (1.7%)	1 (0.4%)	**6 (4.0%)**	**0.006**
Other	215 (28.9%)	206 (35.0%)	9 (5.8%)	**<0.001**	68 (16.4%)	65 (24.5%)	3 (2.0%)	**<0.001**
Mortality by GCS status								
Normal GCS (15)	**540 (72.7%)**	**444 (75.4%)**	**96 (62.3%)**	---	**320 (77.1%)**	**214 (80.8%)**	**106 (70.7%)**	---
Death in normal GCS	0/540 (0.0%)	0/444 (0.0%)	0/96 (0.0%)	**<0.001**	0/320 (0.0%)	0/214 (0.0%)	0/106 (0.0%)	**<0.001**
Abnormal GCS (<15)	**200 (26.9%)**	**143 (24.3%)**	**57 (37.0%)**	---	**92 (22.2%)**	**49(18.5%)**	**43 (28.7%)**	---
Death in abnormal GCS	10/200 (5%)	5/143 (3.5%)	**5/57 (8.8%)**	**0.152**	7/92 (7.6%)	1/49 (2.0%)	**6/43 (14.0%)**	**0.048**
Overall mortality								
Total deaths	10 (1.3%)	5 (0.8%)	**5 (3.2%)**	**0.021**	7 (1.7%)	1 (0.4%)	**6 (4.0%)**	**0.006**

CT: Computed tomography, MRI: Magnetic resonance imaging, GCS: Glasgow Coma scale

95% CI: 1.1-13.8, p=0.021], while abnormal MRI findings were associated with markedly higher odds of mortality (OR=11.0, 95% CI: 1.3-92.4, *p=0.006). A comparative overview of mortality rates across different neuroimaging categories is presented in Figure 4.

DISCUSSION

This study provides comprehensive evidence regarding the diagnostic utility and prognostic significance of neuroimaging in older adults presenting to the emergency department with non-traumatic neurological symptoms. Our findings demonstrate substantial differences between CT and MRI diagnostic capabilities, with important implications for clinical decision-making and patient outcomes in this vulnerable population.

Previous studies have consistently reported that MRI has superior diagnostic sensitivity compared to CT in older patients with acute neurological presentations. For example, Kabra et al.[13]. found that MRI identified clinically significant findings in 37% of cases, whereas CT detected abnormalities in only 16%[14]. Similarly, Machner et al.[15] highlighted MRI's ability to detect small ischemic lesions and microbleeds that are often missed on CT scans in older populations.

Our findings are in agreement with these studies. The superior diagnostic yield of MRI compared to CT (36.1% vs. 20.7%, p<0.001) observed in our study reinforces the enhanced sensitivity of MRI for detecting acute neurological pathology. MRI is superior to CT in identifying acute ischemia and can detect both acute and chronic hemorrhage; therefore, it should be the preferred modality for accurate diagnosis in patients with suspected acute stroke[5,6]. Our findings extend this evidence to encompass a broader spectrum of non-traumatic neurological presentations in older adults, suggesting that MRI's superior tissue contrast resolution and sensitivity to subtle parenchymal changes provide significant clinical advantages. Despite its superior diagnostic sensitivity, the routine use of MRI in the emergency setting—particularly among older adults—may be limited by several practical factors. Prolonged acquisition times, increased susceptibility to motion artifacts, reduced patient cooperation, and clinical instability such as respiratory distress can restrict the feasibility of MRI in acutely ill elderly patients. These limitations underscore the continued importance of CT as a rapid and widely available first-line imaging modality in emergency care, while MRI may be reserved for selected patients in whom clinical stability and logistical conditions allow. It should be emphasized that the primary focus of this study was not to compare identical pathologies detected by CT and MRI, but to evaluate their overall diagnostic yield and prognostic contribution within real-world emergency department practice. While MRI provides superior tissue characterization and prognostic stratification in clinically stable patients, the limited feasibility of MRI in unstable older adults underscores the continued role of CT as the primary first-line imaging modality in emergency settings.

The identification of cerebrovascular accidents as the most common pathology (12.0% on CT, 26.7% on MRI) reflects both the high prevalence of stroke in older populations and the superior sensitivity of MRI for detecting acute ischemic changes. This finding has important implications for treatment decisions, particularly regarding thrombolytic therapy and secondary stroke prevention measures, where early and accurate diagnosis is crucial for optimal outcomes. These results align with Masood et al.[16], who reported cerebrovascular accident detection rates of 11.8% with CT and 25.9% with MRI in older patients. Early ischemic changes on non-contrast CT may be subtle or indirect, particularly in elderly patients, which limits CT sensitivity in the hyperacute phase. This limitation reflects inherent modality characteristics rather than under-evaluation and underscores the complementary role of MRI in the detection of acute cerebral ischemia.

Our study demonstrates that GCS status serves as a powerful predictor of both abnormal neuroimaging findings and clinical outcomes. Navi et al.[17] observed that older patients with GCS <15 had a 2.5-fold increased likelihood of positive findings on CT or MRI. Furthermore, Felfela et al.[18] conducted a meta-analysis showing a strong association between declining GCS scores and mortality in older populations. Importantly, GCS was assessed at the time of emergency department presentation, prior to neuroimaging, and was analyzed as a clinical predictor of imaging findings and outcomes; the reverse relationship was not evaluated.

These findings are consistent with our results, where abnormal GCS (<15) was associated with increased rates of abnormal imaging findings (28.5% vs. 17.8% for CT, 46.7% vs. 33.1% for MRI) and higher mortality. This supports the integration of neurological assessment with imaging decisions. Although it is one of the most powerful clinical prognostic features, neither the GCS score nor any single feature alone should be used to predict an individual patient's outcome, as the prognostic implications of the score are influenced by several factors[11,14]. In elderly patients, the assessment of GCS may also be influenced by pre-existing dementia, sensory impairment, or baseline cognitive dysfunction, which should be considered when interpreting GCS scores despite their strong prognostic value.

The finding that all mortality occurred exclusively in patients with abnormal GCS scores provides crucial insight for clinical practice. This observation suggests that normal consciousness level (GCS=15) may serve as a powerful negative predictor for short-term mortality, regardless of neuroimaging findings. Among patients with altered consciousness, the combination of abnormal GCS and abnormal neuroimaging, particularly MRI, identified the highest-risk group with 14.0% mortality. This finding is consistent with recent evidence showing that decreasing GCS is strongly associated with higher incidence of mortality over time[14,19].

The dramatic differences in hospital disposition patterns based on neuroimaging results have significant implications for healthcare resource allocation and capacity planning. The finding that 87.3% of patients with abnormal MRI findings required hospitalization versus 24.5% with normal MRI represents a substantial impact on hospital resources and patient flow. In the chaotic environment of the emergency departments; complex, frail older adults with complex conditions are sometimes subjected to prolonged lengths of stay, excessive tests and iatrogenic complications[20]. These findings support the development of evidence-based imaging protocols that can optimize resource utilization while ensuring appropriate care for high-risk patients.

The low discharge rates in patients with abnormal imaging findings (11.0% for CT: 6.7% for MRI) demonstrate the clinical significance of positive findings and support the value of advanced neuroimaging in emergency decision-making. This aligns with systematic evidence that appropriate imaging improves diagnostic accuracy and guides management decisions effectively[21].

The increased odds of mortality associated with abnormal CT (OR=3.9) and MRI findings (OR=11.0) highlight the prognostic value of neuroimaging beyond its diagnostic role. Our study extends this concept to non-traumatic neurological presentations, showing that the combination of consciousness level and imaging findings provides powerful prognostic information. The variation in mortality risk among patients with abnormal GCS (ranging from 2.0% in MRI normal to 14.0% in MRI abnormal) demonstrates the additive prognostic value of advanced neuroimaging. This stratification capability has important implications for family counseling, treatment intensity decisions, and goals-of-care discussions in older adults.

Previous research has shown that older patients had significantly higher GCS scores than younger patients in traumatic brain injury contexts, suggesting that age-related factors may influence neurological presentation patterns[19]. Additionally, because many older adults have mobility difficulties, simply getting them to the radiology department to conduct a scan can be problematic, with image quality frequently being lower and inadequate for diagnosis[9]. These practical considerations highlight the importance of optimizing imaging protocols for older adults and ensuring adequate support for safe and effective scan acquisition.

Our findings support the development of risk stratification algorithms that incorporate both clinical assessment (particularly GCS) and imaging findings to guide decision-making in older adults with neurological presentations. The superior diagnostic yield and prognostic value of MRI suggest that broader access to emergency MRI services could improve outcomes in selected high-risk older patients, particularly those with altered consciousness. Neuroimaging should be performed in patients who did not previously receive imaging and in whom initial therapy has failed. In patients with new-onset delirium, imaging should be considered if there is no other obvious precipitating cause[8]. This evidence-based approach to imaging utilization, combined with our findings regarding the prognostic significance of neuroimaging results, supports the development of more precise clinical pathways for older patients.

Study Limitations

This study has several limitations. First, the retrospective study design may introduce selection bias, limits the ability to establish causality, and resulted in non-standardized documentation of focal neurological examination findings, which were therefore not included in the analysis. Second, the study population consisted of patients who had already been selected for brain imaging in the emergency department, which may have resulted in a higher pretest probability of abnormal findings compared to the general emergency population. Third, critically ill patients who were unable to undergo MRI were not included, which could potentially underestimate the diagnostic yield of MRI in the sickest subgroup Fourth, our analysis did not distinguish between clinically significant and incidental imaging findings, nor did it fully account for morbidity outcomes such as functional impairment, changes in functional independence, or neurological sequelae. Fifth, comorbid conditions, medications, and other confounding factors that might influence neuroimaging findings and outcomes were not fully controlled. Because CT and MRI were not uniformly applied to all patients and MRI was performed selectively based on clinical indication following initial CT evaluation, direct comparison of diagnostic yields between imaging modalities is subject to selection bias. The observed perfect negative predictive value of normal GCS for in-hospital mortality should be interpreted with caution, as it reflects short-term outcomes in a selectively imaged cohort and may not be generalizable to longer follow-up periods or unselected emergency populations. Finally, as this was a single-center study, the generalizability of our findings to other healthcare settings may be limited.

CONCLUSION

In conclusion, neuroimaging provides substantial diagnostic and prognostic value in older adults presenting with non-traumatic neurological symptoms. The integration of GCS assessment and advanced neuroimaging, particularly MRI, enables effective risk stratification and supports critical clinical decisions regarding hospitalization, treatment intensity, intensive monitoring, and prognosis. These findings reinforce the importance of implementing evidence-based clinical pathways that combine clinical and imaging parameters to optimize the management of older adults in emergency settings.

Ethics

Ethics Committee Approval: This study was approved by the Sivas Cumhuriyet University Non-Interventional Clinical Research Ethics Committee (approval no: 2025-06/18, date:12.06.2025). All procedures were conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

Informed Consent: This retrospective, observational study was conducted at a tertiary care hospital emergency department.

Footnotes

Authorship Contributions

Surgical and Medical Practices: N.B., İ.S., Concept: N.B., İ.S., Design: N.B., P.S., İ.S., Data Collection or Processing: N.B., P.S., Analysis or Interpretation: N.B., P.S., İ.S., Literature Search: N.B., P.S., İ.S., Writing: N.B., İ.S.

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