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Original Article

Analysis of the neurology consultations in the emergency department and diagnostic accuracy of emergency physicians for the neurologic emergencies

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Abstract

Aim: The aims of this study are twofold: Firstly, it aims at determining the profile of patients who are requested to consult neurology in the emergency department. Secondly, it aims at evaluating the concordance between the pre-consultation neurologic diagnoses and the post-consultation diagnoses in the emergency department.

Material and Methods: The study presents a retrospective evaluation of the records of the patients who were admitted to the emergency department and requested neurology consultation between July 1st, 2018 and July 1st, 2019. Demographic characteristics, admission types, diagnostic imaging procedures, requested consultations, pre-consultation diagnoses, duration of neurology consultation, post-consultation diagnoses, and outcome of patients in the emergency department are included in the analysis.

Results: Neurology consultation was requested for 347 (0.83%) patients among 41,850 emergency department admissions during the study period. The female/male distribution of consulted patients was 50.7% vs. 49.3%. The ambulatory admission and ambulance arrival rates to the emergency department were 51.9% (n = 180) and 48.1% (n = 167), respectively. Only neurology consultation was requested for 227 patients (65.4%), while the additional consultation/consultations other than neurology consultation were needed for 120 (34.6%) patients. Diagnostic accuracy was 60.8% for the study sample and 71.2% for the patients requiring neurology consultation only. The diagnostic accuracy of ischemic stroke was 84.7%. The hospitalization rate of the study sample was 64% (n = 222). The majority of hospitalized patients were admitted by the neurology department (n = 182).

Conclusion: The high accuracy of the diagnosis of ischemic stroke in this study may result from all neurology consultations in our emergency department being requested by the emergency physician specialists. On the other hand, carefully integrated algorithms and neurological examination training will be useful to improve diagnostic accuracy in other neurological emergencies.

Keywords: Cerebral infarction; consultation; Emergency department; neurology; stroke

INTRODUCTION

At least 10% of emergency admissions have a neurological origin (1). For the last two decades, diagnostic/therapeutic options in emergency departments have become more accessible. Resultantly, the diagnosis/treatment processes in neurologic emergencies have become faster (2). Neurological emergencies in emergency departments usually manifest with very typical and dramatic presentations, but they may also have very subtle symptoms and/or additional non-neurologic conditions. Accordingly, it is sometimes difficult to diagnose these patient groups in the emergency settings (3). Emergency physicians and neurologists should work collaboratively, starting from the consultation process for the acute care of neurologic emergencies. Therefore, the steps such as the content of the consultations, the preliminary diagnostic studies carried out and the effective conclusion of the consultation should be completed by both emergency physicians and neurologists. In some patient groups, the other department physicians may also be required in the patient care team.

Since the first admission point of many neurological diseases is emergency departments, the profile of consulted patients within the neurologic emergency group is essential for developing logistic infrastructures, training curriculum and diagnostic/treatment protocols. The evaluation of acute neurologic care given also has an essential role in identifying and reducing human error or technical problems.

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This study aims at determining the profile of patients who required neurology consultation in the emergency department. The secondary aim is determining the diagnostic accuracy level of emergency physicians in neurological emergencies.

MATERIAL and METHODS

The study was carried out by a retrospective investigation of all neurology consultations requested from the emergency department over one year, as well as the cases that were consulted to the neurology department during their follow-up in the emergency department. The study protocol was approved by the ethics committee of the university and followed the Declaration of Helsinki Ethical Principles (Protocol No: 2017-KAEK-189_2019.08.07_12).

The sample of the study consisted of the patients who admitted to the emergency department and consulted with the neurology department between July 2018 and July 2019. We recorded the demographic characteristics, chronic diseases, medications, neurological examination findings, diagnostic procedures, requested consultation/consultations, pre-consultation and post-consultation diagnoses, the duration of neurology consultation in the emergency department, and the final status of patients (e.g., discharge, hospitalization, etc.). We tried to minimize the errors arising from the diagnostic codes by reviewing the codes and epicrisis together on the hospital automation system. Additionally, we examined the preliminary diagnoses predicted by the emergency physicians before the neurology consultation and the designated diagnoses by the neurologists after the consultation procedures with the help of the consultation notes of the electronic patient files.

Statistical analysis

We employed SPSS® (Statistical Package for Social Sciences, IBM Inc., Chicago, IL, USA) v25.0 to conduct statistical analysis. We used the Kolmogorov Smirnov test for the distribution of normality. We used Student t test to compare the normally distributed data and Mann Whitney U test for the data distributed not normally. In order to calculate the diagnostic accuracy rate, we coded the diagnostic accuracy as positive for each case if the preliminary diagnosis of the emergency physician and the final diagnosis of the neurologist were matched; if not, we coded it as negative. A p value of 0.05 was considered as a cut-off for statistically significance during the analysis.

RESULTS

During the study period, a total of 41850 patients were admitted to the emergency department and 347 (0.83%) of these patients have required consultations with a neurologist. The mean age of the patients was 63.14 ± 18.61 years. The mean age of 176 (50.7%) male subjects was 61.85 ± 18.45, whereas the mean age of 171 (49.3%) female subjects was 64.47 ± 18.72. There was no statistical difference between the mean ages of males and females (p = 0.19). The presence of comorbidity was observed in 73.8% (n = 256) of the patients and the prescripted medication use was present in 56.5% (n = 196). The most common comorbidities were hypertension (47%, n = 163), diabetes mellitus (23.6%, n = 82), ischemic heart disease (20%, n = 71), epilepsy (8.3%, n = 29), ischemic stroke history (7.2%, n = 25), chronic obstructive pulmonary disease (0.6%, n = 21) and dyslipidemia (0.6%, n = 21). The ambulatory admission and ambulance arrival rates to the emergency department were 51.9% (n = 180) and 48.1% (n = 167), respectively. The ratio of the referred patients from another emergency department to our institution for further investigation was 28.9% (n = 100). The ambulance transfer was used for the vast majority of the referred patients to our institution (97%, n = 97) and only 3 (0.9%) patients were referred ambulatory.

The findings during the neurological examinations of the patients who required neurological consultation were recorded. Table 1 presents the pathological neurological examination findings of the patients.

Table 1. The pathological neurological examination findings in patients who required neurology consultation

	n (%)
Motor deficit	144 (41.5)
Speech disorder	76 (21.9)
Facial asymmetry	68 (19.5)
Altered mental status	63 (18.1)
Sensorial system disorder	44 (9.5)
Pathologic reflex	39 (11.2)
Ataxia	28 (8.0)
Nystagmus	22 (6.3)
Seizure	11 (3.1)
Involuntary movement	8 (2.3)
Visual disorder	6 (1.7)

When the performed diagnostic imaging techniques were evaluated, it was found that 265 patients (76.4%) had at least one cranial imaging before neurological consultation. Among 82 patients (23.6%) who did not undergo any pre-consultation imaging, at least one imaging modality was suggested by the consulted neurologist for 46 (56.1%) patients. The median duration of the neurology consultations was 40 (min-max: 10-90) minutes. Stroke was the most common cause of neurology consultations. Table 2 shows the diagnosis of patients before and after the neurology consultation.

Diagnostic accuracy between the preliminary consultation diagnoses of the emergency physicians and the designated diagnoses of the neurologist after the consultation was 60.8% for the whole study sample and 71.2% for the patients requiring only neurology consultation. This rate was 84.7% for the ischemic stroke subgroup.

Table 2. The distribution of diagnoses of the patients before and after the neurology consultation

	The preliminary consultation diagnoses of the emergency physician	The final diagnosis of the neurologist after the consultation
	n (%)	n (%)
Ischemic stroke	229 (65.9)	194 (55.9)
The patients with ambiguous presentation	48 (13.8)	79 (22.8)
Hemorrhagic stroke	37 (10.7)	41 (11.8)
Transient ischemic attack	11 (3.2)	10 (2.9)
Status epilepticus	5 (1.4)	4 (1.2)
Encephalopathy	3 (0.9)	3 (0.9)
Intracranial tumor	3 (0.9)	7 (2.0)
Multiple sclerosis	3 (0.9)	4 (1.2)
Status migrainosus	2 (0.6)	2 (0.6)
Delirium	2 (0.6)	1 (0.3)
Spinal cord disease	1 (0.3)	0 (0)
Guillian-Barre Syndrome	1 (0.3)	1 (0.3)
Optic neuritis	1 (0.3)	1 (0.3)
Motor neuron disease	1 (0.3)	0 (0)
Total	347 (100)	347 (100)

Only neurology consultations were performed in 227 (65.4%) of 347 patients. At least one consultation other than neurology consultation was needed for 120 (34.6%) patients, and the total number of further consultations was 161. The most frequent concomitant consultations were internal medicine (26.7%, n = 43), cardiology (24.8%, n = 40), neurosurgery (16.8%, n = 27), otolaryngology (9.3%, n = 15), infection disease (6.2%, n = 10) and anesthesiology (4.3%, n = 7). Pulmonology, general surgery, ophthalmology, orthopedic, cardiovascular surgery, psychiatry and urology consultations were performed for the minority of the patients (11.8%, n = 19).

More than half of 347 patients who were consulted with neurology were hospitalized (64%, n = 222). While 18% (n = 40) of hospital admissions carried out by the other departments, the majority of them (82%, n = 182) were performed by the neurology department. Among the hospitalized cases, 50 (27.5%) patients were admitted to the intensive care unit, and 132 (72.5%) were admitted to the neurology ward. The hospitalization rate of the patients consulted solely with neurology was 52.4%. Figure 1 represents the final disposition status of the study sample.

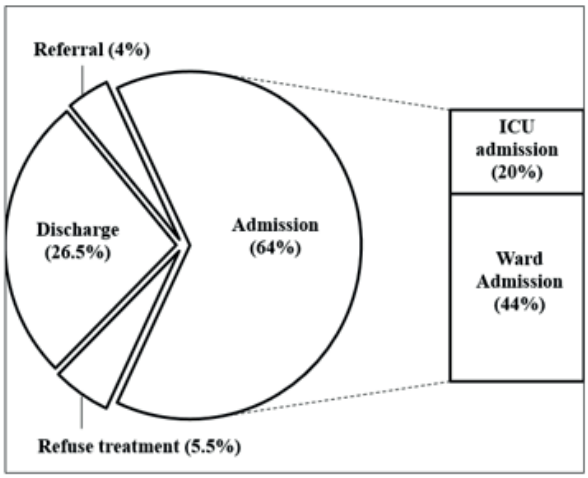

Figure 1. The final disposition status of the emergency department patients with neurology consultation

DISCUSSION

Although neurology is one of the most commonly consulted departments from the emergency department after cardiology, general surgery, and orthopedics, the neurology consultation rate in this study was found to be 0.83% within a one-year study period (4). When the studies in different parts of the world are evaluated, the neurological emergencies seem to constitute 10-59.4% of all emergency visits (1,5-7). However, in most of these studies, this ratio composes of the patients who present to the emergency department with a neurological complaint. In the studies focused on the requested neurology consultations for emergency department patients, the ratio was found to be 4.8-6.9% (8, 9). Their higher rates may be attributed to lower emergency admissions, lower consultation threshold, or included neurologic diagnoses.

There was no significant difference in the gender distribution of the study sample, similar to the existing literature (1,5,8). The mean age of the patients was 61.85, which could either be considered at the end of adulthood as advanced age. Although there is a common belief that the typical neurology patients even the consulted ones from the emergency department are geriatric population, there are also samples in the literature with a mean age of 40s and 50s (1,6,8). This finding suggests that physicians should maintain clinical suspicion of neurological emergencies for all age groups.

The most common symptoms of the emergency patients consulted with neurology in our study were motor deficit, speech disorder, and facial asymmetry. These results were not very similar to the studies in the literature (5,8,10). For example, the altered mental status (AMS), headache and dizziness have been reported as the first three reasons for neurology consultation in one study (8). What makes these results differ from ours is the fact that the majority of the patients in our study were consulted with neurology with a specific condition such as status migrainosus, intracranial tumor, hemorrhagic or ischemic stroke, rather

than a symptom such as a headache or dizziness. Another more recent study by Mapoure et al. has shown a ranking of headache, altered mental status and lumbar pain, respectively for the consultation reason (5). However, similar to many previous studies, they included patients with head and spinal trauma in their sample. Since neurology and neurosurgery serve as separate clinical units rather than a collective team in our country, patients with trauma and neuropathy due to spinal compression were not included in our study.

According to our findings, the primary reasons for the neurology consultation were acute ischemic stroke, the cases with ambiguous presentation (neurological differential diagnosis could not be made) and hemorrhagic stroke. Given the high incidence of stroke in Turkey as well as the increasing rates of the disease in the aging world, the consistency between our findings with the existing literature marks the significance of stroke in neurology consultations (11). Stroke, which has a well-described motto "time=brain cell" is the primary neurology consultation reason in emergency departments even if neurosurgical cases were included in the studies (1,6-8,12). Therefore, these patients must reach to rapid diagnosis and treatment in acute periods.

The categorization of the consultation reasons based on symptoms or diagnoses is not the only factor causing the different findings for the neurology consultations in the literature. The variables such as the world region in which the studies were conducted and the socioeconomic level of the study sample are also effective in obtaining different results for consultation reasons. For example, the main reasons for consultation were stroke, central nervous system (CNS) infections, and myelopathies in the north and south of Nigeria (6,13). Malaria and tetanus-related central nervous system infections, which are endemic to sub-Saharan African countries, are the most often atraumatic neurological causes (5,6). However, in the United Kingdom, CNS infections constitute only 2.5% of neurology admissions (14).

The consultation procedures used by the emergency department are also critical for determining the length of stay and the disposition of the patients in the emergency department (15). The neurology consultation period represents the time beginning when the emergency physician requests consultation via the hospital automation system and ending when the neurology consultant approves the final consultation report on the same system after examining the patient and evaluating test results. Although physicians communicate via domestic or cell phones most of the time, the electronic processes are mandatory. In this study, the median for the duration of neurology consultation was found to be 40 minutes. As one study examining the time lapse to be consulted by a specialist found 2.1 hours, another one calculated the mean time between admission and evaluation by a neurologist as 32 min but it is not very clear if these time intervals cover the whole consultation process or not (5,16). Our shorter consultation period may result from being an academic department of emergency medicine, planning and performing imaging procedures by emergency physicians for most of the patients before the consultation request, the presence of on-call neurology residents in the hospital and the proximity of imaging devices to the emergency department.

Not all cases consulted with neurology had a unique presentation or isolated neurological diagnosis (5,8). One-third of our sample (34.4%) required at least one additional consultation for a more comprehensive and multidisciplinary evaluation. The majority of this subgroup consisted of the patients with oral intake disorder, previous stroke with sequela, and/or multiple comorbidities. This finding is in line with the existing literature which shows that the definitive diagnosis of the patients consulted with neurology is a non-neurological one in 9.7-43.7% of the patients (8,10). Accordingly, neurology departments should act in cooperation with other disciplines both in the differential diagnosis and in the planning of the patient's treatment. Almost half of the additional consultations of our sample were requested from internal medicine and cardiology departments which were reported as the most frequently consulted disciplines for all admissions in emergency departments (8). It can be attributed to that the risk factors of and accompanying pathologies to neurological diseases are mostly cardiac and internal medicine in origin.

The disposition of the consulted patients was evaluated. The rates were 26.5% for discharge, 64% for hospitalization and 4% for referral to another medical center. Current publications suggest that a discharged rate of 50.8-72.2% after the diagnosis and treatment procedures in the emergency department, 19.4-22.3% admission rate by the neurology department, 23.6% admission rate by other departments and 3.3-6.3% referral rate to an external center (8,10). As a general approach, low hospital admission rates may suggest that there are too many unnecessary consultation requests from the emergency department, and vice versa high rates may indicate that patients who need hospitalization are being missed. When we compare our results with the literature, the admission rate of the study is markedly above the average. It may be due to that our institution is a university hospital (Level 3) accepting patients from the lower healthcare levels.

The pre-consultation and post-consultation diagnostic accuracy rates of the emergency physicians were 60.8% for the whole study sample and 71.2% for the patients who were consulted only with neurology. These ratios symbolize a strong agreement in the literature (17). Moeller et al. found 60.4% diagnostic accuracy for consulting physicians and 80% for consulted neurologists in the emergency settings (18). However, we cannot make any interpretations of the missed diagnoses or diagnostic errors in the statistics mentioned above. A recent meta-analysis showed that almost 9% of stroke cases missed at their initial emergency visit (19). The degree of diagnostic

accuracy in the neurologic cases by the emergency physicians has a determinative impact on the effective detection of neurological emergencies, rapid access to the optimal and specific treatment of diagnosed cases, the short and long-term morbidity and mortality. Stroke is an overdiagnosed pathology other than misdiagnosed one both by emergency physicians and neurologists, even in the pediatric population (18,20). Our diagnostic accuracy level between the emergency department and neurology for the ischemic stroke subgroup, which constitutes the majority of neurological emergencies, are considered as "strong accuracy" in the literature (84.7%). One of the most important reasons for this may be the evaluation of benign conditions that can mimic the stroke in favor of stroke rather than misdiagnosing in patients with subtle clinic.

The cases with unmatched diagnoses between the two departments were predominantly the ones without any significant pathological findings on cranial imaging. That may suggest several commonly seen scenarios. One is the suspicion of a transient ischemic attack after the clinical evaluation of the patient. Another one is that emergency physicians may have considered the possibility of missing the pathological findings, or the possibility of early stage pathology. On the other hand, this may be due to that the emergency physicians cannot exclude the presence of central pathology in the symptoms such as vertigo that should be excluded first.

CONCLUSION

The profile of the emergency patients consulted with neurology in the Central Anatolia region of Turkey was presented for the first time. The regular evaluation of the patient profile will guide thought the reorganization and optimization steps of the acute care protocols of the physicians, health care facilities and the logistics infrastructure. Strengthening and reevaluating the diagnostic accuracy is critical for the optimization of acute health care. Further and multi-centered studies are needed to establish more detailed patient profiles and allow comparison of intra-rater and inter-rater diagnostic compatibility.

Competing interests: The authors declare that they have no competing interest.

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Ethical approval: The University School of Medicine Ethics Committee approved the study protocol (protocol number: 2017-KAEK-189_2019.08.07_12).

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