

Characteristics, diagnosis and outcome of patients referred to a specialized neurology emergency clinic: prospective observational study

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BACKGROUND: Organization and management of neurological emergencies differs among hospitals. Some have specialized neurological emergency rooms (ER).

OBJECTIVES: The purpose of this study was to determine the characteristics, diagnosis and outcome of patients referred to a specialized emergency neurology clinic.

DESIGN: Prospective, observational study of consecutive patients presenting between March 2014 and July 2014.

SETTING: Neurologicaler of a training and research neuropsychiatric hospital.

PATIENTS AND METHODS: Patients older than 16 years of age with a neurological complaint were assessed by neurological exam, laboratory and imaging tests including brain computed tomography (CT), brain magnetic resonance imaging (MRI), cerebrospinal fluid analysis, electroencephalography or electro-myography.

MAIN OUTCOME MEASURES: Types of diagnosis.

RESULTS: Of 4500 patients, 2602 (57.8%) were female, and the mean age was 49.2 (23.6) years. The most common symptom was headache, which presented in 30.8% of all patients. The three most common diagnoses after emergency work-up were headache (27.8%), stroke (20.6%) and peripheral vertigo (13%). In the ER, CT was performed on 65.5% of patients and MRI on 66.9%. After emergency work-up, 72.2% patients were discharged home.

CONCLUSIONS: Neurological diseases are common, with headache and cerebrovascular diseases being the most frequent diagnosis in this specialized ER. CT and MRI are most often used to diagnose or exclude neurological diseases. Many patients do not require immediate hospitalization. The two most frequent diagnoses for hospitalization were stroke and demyelinating disease.

LIMITATIONS: Absence of follow up data on patients discharged home.

Neurological disorders are a common reason for admission to the ER.¹ Rapid diagnosis and accurate treatment are crucial for preventing morbidity and mortality and for improving neurological outcomes for acute neurological disorders.² In addition to accurate diagnosis, the time frame for initiating therapy is important in most neurological emergencies, including stroke or infections. The expertise of the managing physician and the setting of the emergency room (ER) may also affect the outcome.

The organization and management of neurological emergencies differs among hospitals with some hospitals having interdisciplinary ERs with consulting neurologists. Others have specialized neurological ERs. In some hospitals, a neurologist is not available and patients are often treated by internal medicine specialists, and are referred to tertiary centers if necessary.

In Turkey, state hospitals have specialized departments and emergency units provide care to a wide spectrum of patients ranging from internal medicine,

neurology to minor and major surgeries. In case of an emergency, patients can be referred to any medical emergency unit preferably close to the residence of the patient. However, the population of Istanbul is approaching 17 million inhabitants, which leads to an increase in the number of patients presenting to outpatient or polyclinics, up to 500-1000/day in a general ER. In this overpopulated emergency setting it may be challenging to accurately diagnose and treat patients. Newly emerging treatment options (e.g. thrombolytic therapy) in neurological emergencies require prompt neurological decisions. The purpose of this study was to determine the characteristics, diagnosis and outcome of patients referred to a specialized neurology ER in a training and research neuropsychiatric hospital and discuss the efficacy of a specialized neurological unit for managing neurological emergency patients.

PATIENTS AND METHODS

In this prospective, observational study, consecutive patients who presented at the neurological ER of Bakirköy Training Hospital, Departments of Neurology, Neurosurgery and Psychiatry were enrolled between March 2014 and July 2014. The inclusion criteria included age over 16 years with a neurological complaint. Patients with previous neurological diseases were included when they presented with acute complications or a recent worsening of symptoms. The study was approved by the local ethics committee of the hospital, informed consent was obtained from the patients. The hospital is a longstanding and well-known hospital specialized for neurology, neurosurgery and psychiatry and a member of five public hospital units in central Istanbul. It serves approximately 5 million inhabitants, but can accept patients from all over the country.

In the neurological ER, two neurology residents and a neurology consultant ascertain incoming patients. Patients either present themselves or are referred by paramedics and emergency physicians from surrounding hospitals. Demographic data, admission time to and duration at ER, the means of transfer to the ER (consultation or referral from other regional hospitals, transport individually or by ambulance), first symptom, concomitant illnesses, final diagnosis, and outcome were all recorded. All patients were assessed by neurological exam and when necessary, laboratory and imaging tests including brain computed tomography (CT), brain magnetic resonance imaging (MRI), cerebrospinal fluid analysis, electroencephalography or electromyography were performed.

The main diagnoses were categorized into the following disease groups: Cerebrovascular disease (CVD),

confirmed based on brain imaging that revealed distinct arterial and venous hemorrhagic and ischemic stroke conditions; epilepsy when the patient presented with a previous history of seizures and was admitted because of convulsive symptoms within the last 6 hours; or if the patient presented with first-ever seizures within the past 24 hours without secondary findings after clinical, neurological and complementary evaluation, excluding a secondary seizure; primary headache when the patient presented with a previous history of primary headache with symptoms worsening within the past 24 hours; or if clinical, neurological and complementary evaluation excluded secondary causes for the symptoms in a patient without a previous headache history. As a primary type of headache, migraine was diagnosed using the criteria for migraine in adults with repeated attacks of headache lasting 4-72 hours which had these features: (1) at least 2 symptoms of either unilateral pain, throbbing pain, aggravation by movement, moderate or severe intensity (2) at least 1 symptom of nausea/vomiting, photophobia and phonophobia³ and tension headache lasting from 30 minutes to seven days including at least two of the following criteria: (1) Pressing/tightening (non-pulsatile) quality, (2) mild or moderate intensity (inhibits, but does not prohibit activity), (3) bilateral location, (4) no aggravation by walking, climbing stairs or similar routine physical activity and both of the following: (1) no nausea or vomiting, (2) photophobia and phonophobia absent, or one but not both are present. Neurological symptoms secondary to clinical conditions (SCC) were considered when the neurological symptoms were related to clinical diseases due to systemic infection or metabolic, cardiac, endocrine or other system disorders. Central nervous system (CNS) infection was suspected when clinical, neurological and complementary diagnosis confirmed a possible acute meningitis, encephalitis or brain abscess.

Referral to other ERs and consultation with other medical sub-specialities was performed whenever necessary. Because of a limited inpatient capacity to hospitalize all patients, some had to be transferred to other regional hospitals after emergency neurological work-up.

The statistical analysis was performed with SPSS 16.0 software (SPSS Inc.). Statistical significance was assessed by the t test for the parametric variables, and the chi-square and Mann-Whitney tests were used for the nonparametric variables. Statistical significance was determined at $P < .05$.

RESULTS

Of 4500 patients enrolled, 2602 (57.8%) were female,

and the mean age was 49.2 (23.6). Twenty-seven percent of the patients had a known neurological disease; 12.5% stroke, 7.5% epilepsy, 3.2% migraine, 1.7% demyelinating disease, 1.4% dementia, 0.8% movement disorders, and 0.2% neuromuscular disease. The rate of comorbid diseases (hypertension, diabetes, hyperlipidemia, congestive heart failure and others) was 23% (Table 1). Ninety percent of patients seen in the ER were admitted by their own facility and 10% by ambulance. Referrals for neurological or suspected neurological acute diseases from regional hospitals accounted for 6.6% and 3.4% of patients required consultation by other clinics (neurosurgery or psychiatry) of our institution.

The most common symptom was headache, which presented in 30.8% of all patients. Other signs were motor signs 24.4%, loss of consciousness 17.1%, cerebellar signs 16.5%, sensory signs 8.6%, and visual signs 2.4%. The three most common diagnoses after emergency work-up were headache (27.8%), stroke (20.6%) and peripheral vertigo (13%). Epilepsy was observed in 8.2% of patients. The rates of the other diagnoses were Bell palsy 2.8%, peripheral nerve injury 2%, psychiatric disorders 4.2%, central nerve system neoplasm 0.6%, and nonneurological conditions (hypertension, drug intoxication, metabolic disorders, systemic infection) 5.7%. Four percent had no pathology and the diagnosis was delayed in 9.7% of the patients, meaning a polyclinic work up was needed after emergency care (Table 2).

Sixteen patients received thrombolytic therapy during the study period. In the ER, CT was performed in 65.5% of the patients, MRI 66.9%, EEG 1%, and EMG 0.8%. Lumbar puncture was performed on 0.2% of the patients. The times of admission were as follows: 37.6% between 13:00-18:00, 30% between 19:00-24:00, 19.8% between 07:00-12:00 and 12.6% of the patients between 24:00-06:00. The duration of stay in the ER was as follows: 75.1% of the patients stayed for 0-4 hours, 19% of the patients for 4-12 hours, 4.7% of the patients for 12-24 hours, 0.9% of the patients for 24-48 hours and 0.4% of the patients stayed longer than 48 hours. Ten percent of patients arrived at the hospital by ambulance and the rate of hospitalization of the patients arriving by ambulance was 40.2%. After emergency work-up, 72.2% patients were discharged home, 6.3% patients were referred to other specialties, 0.1% patients died in the ER and all other patients were hospitalized in the neurological clinic (19.4%); 84.5% were hospitalized in neurological clinics of our institution, 9.1% in our critical care unit, 4% at other hospitals' neurological clinics within the

Table 1. Description of patients.

Characteristic	Frequency (n=4500)
Age (mean and standard deviation)(n=4500)	49.2 (23.6)
<55 y	2734 (60.8)
55-64 y	664 (14.8)
65-74 y	543 (12.1)
75-84 y	453 (10.1)
>85 y	106 (2.4)
Sex (n=4500)	
Female	2602 (57.8)
Mode of transportation	
Self/family	4048 (90)
Ambulance	452 (10)
History (n=2411)	
Systemic condition	1036 (23)
Neurological condition	1226 (27.3)
Stroke	561 (12.5)
Epilepsy	337 (7.5)
Migraine	145 (3.2)
Demyelinating disease	75 (1.7)
Dementia	61 (1.4)
Movement disorders	36 (0.8)
Muscle disease	11 (0.2)
Psychiatric condition	149 (3.3)

Values in parentheses are percent.

region and 2.4% in other hospitals' critical care units within the region.

DISCUSSION

A specialized neurology ER is a center where neurology specialists work 24 hours a day. Our hospital is the only hospital in the nation with a neurology department dedicated specifically to neurologic emergencies such as stroke, epilepsy and dementia. It serves as an outpatient clinic where specialists meet patients 24 hours a day, and patients can be observed for short periods using 8 observation beds. A quick work up can include CT, MRI, MR angiography, echocardiography, and carotid and vertebral artery ultrasonography. Emergency neurology is becoming increasingly important as triaging, identifying, and treating these patients can potentially advance care.

Table 2. Main neurological diagnosis and clinical outcomes for 4500 patients evaluated by the neurology staff in the ER.

Diagnosis	No . of cases		Gender		Mean age (y)(SD)	Discharge		Hospitalization	
	n	%	Female	Male		n	%	n	%
Headache	1253	27.8	855	398	40.4 (15.4)	1240	99	7	0.6
CVD	925	20.6	447	478	65.9 (14.0)	188	20.3	706	76.3
Peripheral vertigo	584	13	368	216	48.5 (17.2)	580	99.3	1	0.2
Epilepsy	371	8.2	155	216	38.6 (19.1)	343	92.5	21	5.7
Psychiatric condition	190	4.2	122	68	47.4 (20.8)	97	51.1	1	0.5
Bell palsy	127	2.8	60	67	44.5 (17.4)	122	96.1	1	0.8
Metabolic/systemic	102	2.3	60	42	66.4 (15.9)	54	53.0	4	3.9
Peripheral nerve injury	88	2.0	48	40	47.7 (17.0)	39	44.3	31	35.2
CNS infection	67	1.5	29	38	50.3 (22.6)	25	37.4	11	16.4
Demyelinating disease	65	14	41	24	37.9 (12.1)	56	86.1	40	61.5
Hypertension	54	1.2	35	19	57.7 (16.2)	42	77.8	3	5.6
SCC	31	0.7	10	21	47.8 (21.0)	19	61.3	1	3.2
CNS neoplasm	27	0.6	16	11	55.4 (13.0)	5	18.5	2	7.4
Delayed diagnosis	437	9.7	247	190	46.2 (18.3)	383	87.7	44	10.1
Healthy person	179	4	109	70	46.0 (19.1)	174	97.2	-	-
Total	4500	-	2602	1898	-	3340	74.2	873	19.4

CVD: cerebrovascular diseases; SCC:secondary to clinical condition; CNS: central nervous system

The most relevant findings of our study are that (i) most of the patients suffered from headache and cerebrovascular diseases; (ii) the most used radiological technique was MRI; (iii) 10% of all patients arrived at the hospital by ambulance and the rate of hospitalization of the patients arriving by ambulance was higher, and (iv) in many patients, hospitalization was not initially needed. The most frequent diagnosis was headache, followed by CVD, peripheral vertigo and epilepsy.

Carroll and Zajicek showed that stroke, headache and seizures were the three most common ER admissions, accounting for 53% of cases.⁴ Another study also demonstrated that 39% of hospital admissions after ER evaluation were related to CVD, headache and epilepsy.⁵ These results were not similar to the data in our study. Headache accounts for roughly 2% of ER visits, of which only a small percentage have serious secondary causes.⁶ However, it is difficult to decide which patients to investigate beyond clinical evaluation. As our ER is a

specialized unit for neurology, headache is the most frequent diagnosis that requires further testing or referrals for consultation. The final diagnosis for these patients was primary headache. Only 27 (2.1%) patients were diagnosed as having brain tumor and 54 (4.3%) patients had headache due to hypertensive crisis. The most commonly diagnosed headache type was migraine and the patients were admitted for analgesic injection.

Dizziness is also a common and vexing diagnostic problem in emergency departments. Physicians working in emergency departments must be able to rapidly identify patients with potentially serious forms of vertigo, which could cause death or disability, and patients with mild conditions that can be effectively treated. These patients account for most of those hospitalized by the specialized neurological ERs. Another important neurologic condition in the ER is epilepsy, which had an admission rate of 8.2% in our study. Epilepsy is a chronic condition that is best treated in the outpatient

clinic setting; however, many patients use the ER as a primary resource for seizure management, despite the existence of specialized epilepsy clinics.

In nearly 6% of patients, the discharge diagnosis was not related to neurological conditions; 4% of patients had no systemic or neurological condition. In unclear situations, both patients and health professionals may tend to exclude a neurological event before referring the patient to another medical department. These health professionals are mostly general practitioners working in urban or pay hospitals whom the patients first meet. Then they transfer the patients to a specialized neurological ER to exclude a neurological disorder.

Imaging techniques play an important role in neurology practice. In our study, 65% of patients were examined by CT, 67% of patients were examined by MRI. The study showed that CT was performed mostly on patients suffering from headache, MRI on patients having cerebellar signs and both CT and MRI for patients with motor signs, consciousness and visual signs. CT is much faster than MRI, making it the study of choice in cases of trauma and other acute neurological emergencies. CT is sufficient to exclude many neurological disorders whereas MRI has a much greater range of available soft tissue contrast, depicts anatomy in greater detail, and is more sensitive and specific for abnormalities within the brain itself. We observed an unusually high rate of CT and MRI use higher than in previous reports.^{7,8} Previous studies showed that the use of neuroimaging has rapidly increased over the past two decades, with utilization rates rising 69% from 1995 to 2004.⁹ The higher use of MRI in our cohort may be due to increased availability of these studies, a sicker patient population, or different practice patterns at our institution, which is an academic, secondary-care medical center and also a primary stroke center. As in our hospital, there are two radiology centers in which MRI can be performed in minutes. This enables us to exclude most of the neurological emergencies, decrease ER length of stay and make decisions to safely discharge patients.

Diffusion-weighted imaging (DWI) can rapidly detect ischemic brain lesions within 30 minutes, which enables us to select stroke patients who are more likely to have a favorable clinical response to thrombolytic therapy. These patients demonstrate substantial improvements in neurological function and have smaller final infarct volumes after successful thrombolysis. During the study period, 16 stroke patients received thrombolytic therapy successfully. Early DWI scans in stroke patients and examination by a neurology spe-

cialist on admission in an ER make stroke patients for ideal candidates for thrombolytic therapy even beyond 3 hours after stroke onset.

In a multicenter study, EEG was performed in the ER in only 3% of patients.¹⁰ Another more recent study found that only in 51 of 3215 patients with a seizure was an EEG ordered as a diagnostic test.¹¹ In our study, EEG was performed in only 1% of patients. The American Epilepsy Society concluded that EEG should be considered as part of the routine neurodiagnostic evaluation of adults presenting with an unprovoked first seizure as a level B recommendation.¹¹ The timing of EEG after the initial event could influence the value of the results. As EEG cannot be performed during weekends or off-duty times in our institution, the rate of EEG is low. Similarly EMG is rarely performed in our ER on neurological patients (rate 0.8%).

In another study, 0.53% of patients admitted to an ER underwent lumbar puncture.¹³ This rate is similar to that in our study. The most frequent indication for a lumbar puncture is to search for an infection of the CNS. A brain imaging (CT/MRI) prior to lumbar puncture seems to be routinely employed, and can be a reason to delay lumbar puncture.

Our data demonstrate that a high proportion of patients do not require immediate hospitalization. After emergency work-up, 72.2% of patients were discharged home. The two most frequent diagnoses for home discharge were peripheral vertigo and Bell palsy. The two most frequent diagnoses for hospitalization were stroke and demyelinating disease, with 93.6% of these patients hospitalized to our neurological clinics and intensive care unit. However, because of a limited inpatient capacity, 6.4% of them had to be transferred to other regional hospitals after emergency neurological work-up. Of all 4500 enrolled patients, the final diagnosis was not a neurological disorder for 9.7%. However, we observed that these patients spent the longest time in ER because many investigations in the ER required more tests and scans to exclude a neurological event. The duration of ER stay depended on the diagnosis: patients with headache, peripheral vertigo and Bell palsy spent less time in the ER, while patients with epilepsy, stroke and nonneurological conditions needed a longer period of observation.

Ten percent of patients arrived at the hospital by ambulance. The diagnosis for these patients were mostly stroke and epilepsy and the rate of hospitalization of the patients arriving by ambulance was 40.2%. A history of illness (epilepsy, stroke etc.) probably contributes to heightened awareness and recognition of symptoms, prompting an earlier pursuit of medical at-

tention and greater need for an ambulance. If patients realize that they are having a stroke or a seizure based on previous experience, they call an ambulance to seek medical treatment sooner. Because of the severity of illness or uncontrolled seizures, they need more hospitalization. In an urban study, in 85 cases where paramedics in an ambulance felt ER transport was necessary, 32% met criteria for ER treatment, including 18% who were admitted including 6% admitted to an intensive care unit.¹⁴ In another study, paramedics recommended alternative transport for 97 patients, 23 of whom needed ambulance transport. Paramedics recommended non-ER care for 71 patients, 32 of whom needed ER care.¹⁵ These two studies concluded that paramedics working in ambulance service cannot reliably predict which patients require ER care. However, our data shows that paramedics working in our ambulance services are aware of neurological findings and make better decisions on transporting patients.

The major limitation of our study was the absence of any follow-up data. The overwhelming majority of

patients were discharged home, but we had no information on the rate of re-presentation with the same complaint or with a complication of a missed diagnosis (e.g. stroke after an initial presentation with TIA). A second limitation on the issue in general is the lack of studies about specialized neurological ERs. As these kinds of emergency departments, especially in our country, are rare, we could not make comparisons with other studies since there are few other studies, which makes our study important.

In conclusion, neurological diseases are common, with headache and cerebrovascular diseases being the most frequent diagnosis in our specialized ER. Imaging techniques, mostly CT and MRI, play an important role in diagnosing and excluding neurological disease. EEG and EMG are rarely needed. A high proportion of admitted patients do not require immediate hospitalization. The two most frequent diagnoses for hospitalization were stroke and demyelinating disease. Patients transported by ambulance to ER should be managed sooner as they are more frequently hospitalized.

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