Rapid referral for headache management from Emergency Department to Headache Centre: four years data

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Abstract

Background

Headache is one of the most common reason for medical consultation to emergency department (ED). Inappropriate use of ED for non-urgent conditions is a problem in terms of crowding emergency facilities, unnecessary testing and treatment, increased medical bills, burden on medical service providers and weaker patient-primary care provider relationships. The aim of this study was to analyzed the different steps of the ED management of patients with headache to detect those deficiencies that can be overcome by a prompt referral to a headache clinic.

Methods

The study is a retrospective analysis of the electronic medical records (EMRs) of patients discharged from an academic ED between 1 January 2015 and 31 December 2018 and referred to the tertiary level headache centre of the same hospital. We analyzed all the aspects related to the permanence in ED and we also assessed if there was a concordance between ED diagnosis and ours.

Results

Among our sample of 244 patients, 76.2% were admitted as green tag, 75% underwent a head computed tomography, 19.3% received neurological consultation, 43% did not receive any pharmacological treatment and 62.7% still had headache at discharge. Length in ED stay was associated with the complaint of the first aura ever ($p = 0.014$) and if patients received consultations ($p < 0.001$). Concordance analysis shown a significant moderate agreement only for the diagnosis of migraine and only between triage and headache centre.

Conclusions

The majority of patients who went to the ED complaining of headache received the same therapy regardless of their diagnosis and in many cases the headache had not yet resolved at the time of discharge. Given the several shortcomings of ED management of headaches, a rapid referral to the headache centre is of primary importance to help the patient obtain a definite diagnosis and adequate treatment.

Introduction

Headache is one of the most common symptoms and an important reason for medical consultation and presentation to emergency departments (EDs). Indeed, of all patients who visit EDs, up to 4.5% report that non-traumatic headache is their main complaint [1]. The third edition of the International Classification of Headache Disorders (ICHD-III) distinguishes secondary forms, in which headache is a symptom, from primary headaches which include migraine (with or without aura), tension-type headache and the group of trigeminal autonomic cephalalgias (TACs) for which cluster headache counts for the majority [2].

Migraine alone is the world's second leading cause of years of life lived with disability [3] and chronic migraine (CM) patients, who have ≥ 15 headache days per month, are more likely to have a higher disability, lower quality of life and greater use of healthcare resources than episodic migraine (EM) patients [4, 5].

In the ED, as in the general population, primary headache disorders are much more common than secondary disorders and it can be challenging for ED doctors to distinguish the few patients with potentially life-threatening headaches among the vast majority with benign headaches [6]. A primary headache is diagnosed in 58-81.2% of patients entering the ED with headache and, as regards the specific diagnosis of primary headache, migraine is the main condition, which represent 17–64% of cases [7–10]. While most headaches have benign etiology and are self-limiting, up to 5% have a serious and life-threatening cause (e.g., subarachnoid hemorrhage) that requires immediate medical attention [11, 12].

Inappropriate use of ED for non-urgent conditions is a problem in terms of crowding emergency facilities, unnecessary testing and treatment, increased medical bills, burden on medical service providers and weaker patient-primary care provider relationships. Studies evaluating this phenomenon found that inability to take time off from school or work during the day, the ease of use of emergency care and the non-necessity for an appointment are indicated as a reason for their consultation by a significant percentage of patients, suggesting that inappropriate use of ED could be a matter of personal convenience [13, 14]. An observational study investigated the factors associated with ED visits for migraine and found that the most common reason for visiting ED was a perceived emergency condition or referral by a physician (33.3%) [15]. The other most commonly cited reasons concerned timely access to care, either because the medical office was closed (20%) or because patients could not get an appointment early enough (11%), or because they didn't have a doctor or nowhere else to go (9%) [16]. Studies conducted in other countries suggest that migraine is under- or misdiagnosed and, consequently, patients are often undertreated or receiving inadequate care when consulting an ED [8, 16, 17].

There is a close collaboration with ED in our hospital and all patients with headache complaints after discharge can be referred to our clinic and visited within 36 hours.

Given the lack of Italian studies on patients presenting with headache to ED, we conducted a study to determine the demographic and clinical characteristics of these patients, to establish the frequency and accuracy of the diagnosis of migraine and to describe the treatment they received and their follow-up in our headache centre.

Methods

The study is a retrospective analysis of the electronic medical records (EMRs) of patients who presented to the academic ED of Azienda Ospedaliera Sant'Andrea, between 1 January 2015 and 31 December 2018 with a chief complaint of headache and who, after discharge, were referred to the Regional Referral

Data collection

The data analyzed included basic demographic information, presentation time, priority assessment and diagnosis of admission by the hospital triage nurse, door-to-doctor time and the length of stay in ED, life parameters, diagnostic investigations, specialist consultations, administration of treatments and discharge diagnosis. We also assessed the time elapsed between discharge from the ED and the first visit to our headache center and whether there was a concordance between the diagnosis of discharge from the emergency room and ours.

For what concern the priority of admission, our ED uses an advanced triage system that involves a color-coding scheme using white, green, yellow and red tags to defining conditions on increasing level of severity:

- white tags - (dismiss) are given to those with minor injuries for whom a doctor's care is not required;
- green tags - (wait) are reserved for the "walking wounded" who will need medical care at some point, after more critical injuries have been treated;
- yellow tags - (observation) for those who require observation (and possible later re-triage). Their condition is stable for the moment and, they are not in immediate danger of death. These victims will still need hospital care and would be treated immediately under normal circumstances;
- red tags - (immediate) are used to label those who cannot survive without immediate treatment but who have a chance of survival.

For the analysis of the vital signs, we defined elevated blood pressure (BP) as follows: systolic BP (SBP) ≥ 140 mm Hg or diastolic BP (DBP) ≥ 90 mm Hg [18].

The diagnosis in our headache centre was made on the base of the beta version or the final version of the ICHD-III depending on the year when the visit was performed [2, 19].

Statistical analyses

Descriptive analysis of the sample characteristics was performed. Categorical data was summarized by numbers and percentages, continuous data by mean and standard deviation. The association between total time in emergency department and follow-up at the headache centre was evaluated by Mann-Whitney tests. The concordance between primary headaches diagnosis was assessed using the Cohen Kappa coefficient (κ). The significance level was set at 0.05 (always corrected if necessary). All analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

Demographics and clinical characteristics of the study population

Demographic and clinical characteristics of patients treated in the emergency department in Table 1. The sample analyzed was composed of 244 patients, 192 (78.7%) women and 52 (21.3%) men, aged between 14 and 89 years and an average of 40.7 years. After the evaluation of the general conditions, the triage nurses coded a patient (0.4%) as a white tag, 186 (76.2%) as a green tag, 56 (23.0%) as a yellow tag and a patient (0.4%) as a red tag. Medical history was negative for any conditions in 157 (64.3%) patients. Among several conditions, the most frequent were hypertension (in 11.1% of patients), psychiatric disorders (in 8.6% of patients) and thyroid diseases (in 7.0% of patients). Patients presented to the ED after a mean of 1.9 days after the onset of the headache for which they required assistance. The appearance of the aura was the primary reason for ED consultation for 40 (16.4) patients and for 16 (40%) of them it was the first aura of their life. The average vital signs values for the entire sample of patients were in the normal range: systolic pressure was 130 mmHg (range: 100–190), diastolic pressure was 77 mmHg (range: 50–111), heart rate was 78 bpm (range: 39–116), temperature was 36.6°C (range: 35.9–38) and oxygen saturation was 98% (range: 94–100).

Table 1
Demographic and clinical characteristics of patients treated in the emergency
department

Demographics	
age (years) (SD)	40.7 (16.3)
sex (female)	192 (78.7)
Medical history	
negative	157 (64.3)
hypertension	27 (11.1)
psychiatric disorders	21 (8.6)
thyroid disorders	17 (7.0)
hematologic disorders	10 (4.1)
dyslipidemia	9 (3.7)
DM type 2	8 (3.3)
cerebrovascular diseases	7 (2.9)
COPD/asthma	4 (1.6)
ischemic heart disease	3 (1.2)
solid tumor	3 (1.2)
Time of ED presentation	
08:00–15:59	147 (60.3)
16:00–23:59	79 (32.4)
00:00–07:59	18 (7.4)
Headache onset	
days before ED visit	1.9 (5.7)
Triage codes	
white	1 (0.4)
green	186 (76.2)
yellow	56 (23.0)

DM: diabetes mellitus; ED: emergency department; SD: standard deviation

Demographics	
red	1 (0.4)
Vital signs	
systolic BP (mmHg)	130 (16.9)
diastolic BP (mmHg)	77 (10.6)
heart rate (bpm)	78 910.60
temperature (°C)	36.6
oxygen saturation (%)	98 (1.4)
Aura	
reason to access ED	40 (16.4)
first aura in their life	16 of 40 (40.0)
ED times in min, mean (SD)	
door-to-doctor time	139 (118.4)
time of care	241 (269.8)
ED length of stay	381 (307.7)
DM: diabetes mellitus; ED: emergency department; SD: standard deviation	

Diagnosis of headache in the emergency department

Table 2 summarized the changes in diagnoses in relation to the clinical evaluation setting. We found eleven different admission diagnoses assessed by triage nurse. The three most common diagnoses were headache (63.6%), migraine without aura (9.0%) and ophthalmic headache (6.6%). ED physicians used less diagnoses (four) and the most frequent was headache (52.5%).

Table 2
Changes in diagnoses in relation to the clinical evaluation setting

DIAGNOSIS	TRIAGE nurse	ED doctor	Headache centre	Concordance TRIAGE - headache centre
	(244 patients)	(244 patients)	(240 patients)	(κ; p - value)
Headache	155 (63.6)	128 (52.5)	–	
Migraine without aura	22 (9.0)	82 (33.6)	140 (57.4)	0.581 ; p < 0.001
Migraine with aura (ophthalmic headache)	16 (6.6)	–	34 (13.9)	0.032 ; p = 0.586
Tension-type headache	–	–	32 (13.1)	–
Chronic migraine	–	–	35 (14.3)	–
Medication overuse headache	–	–	31 (12.7)	–
Cluster headache	2 (0.8)	2 (0.8)	7 (2.9)	-0.013 ; p = 0.001
Other TACs	–	–	1 (0.4)	–
Trigeminal neuralgia	8 (3.3)	–	3 (1.2)	–
Headache attributed to trauma	5 (2.1)	32 (13.1)	8 (3.3)	–
Sinusitis	–	–	2 (0.8)	–
Headache attributed to cranial and/or cervical vascular disorder	16 (6.6)	–	6 (2.5)	–
Headache and arterial hypertension	10 (4.1)	–	5 (2.0)	–
Headache and systemic infection	6 (2.5)	–	1 (0.4)	–
Headache and anxiety disorder	3 (1.2)	–	–	–
Cervicogenic headache	1 (0.4)	–	–	–
TACs: trigeminal autonomic cephalalgias				
Triage nurses used the definition “ophthalmic headache” to indicate the diagnosis of “migraine with aura”.				
The concordance between primary headaches diagnosis was assessed using the Cohen Kappa coefficient (κ). The significance level was set at 0.05.				
There was not agreement between diagnoses made by ED physicians and headache centre.				

Headache investigations received in the emergency department

Most patients performed complementary examinations for diagnosis (Table 3). The most common investigation was head computed tomography (CT) required for 183 (75%) patients. A patient with a known diagnosis of migraine refused to undergo CT. Of the 182 CT scans performed 170 (93.4%) were negative and 13 (7.1%) had findings that were all considered incidental: sphenoid and maxillary sinus mucosal thickening (3), white matter lesions (2), mega cisterna magna (2), sinusitis (1), chronic ischemic leukoencephalopathy (1), < 5 mm engagement of cerebellar tonsils into the foramen magnum (1), subcutaneous sebaceous cyst (1), aneurysm of basilar artery (1) and occipital bone exostoses (1). The second most common investigation was electrocardiogram (ECG) performed in 31 (12.7%) patients with no correlation with vital signs. All ECGs were reported as non-pathological. Finally, 16 (6.6%) patients underwent other investigations besides head CT and ECG: supra-aortic trunk echo-doppler (8), sinus CT scan (3), brain magnetic resonance imaging (MRI) (2), cervical X-rays (2) and electroencephalogram (1).

Table 3
Interventions in the emergency department

Investigations	
head CT	183 (75.0)
ECG	31 (12.7)
other	16 (6.6)
Specialist consultations	
neurologist	47 (19.3)
ophthalmologist	7 (2.9)
otolaryngologist	5 (2.0)
psychiatrist	5 (2.0)
cardiologist	2 (0.8)
neurosurgeon	2 (0.8)
Treatment administered	
none	105 (43.0)
NSAIDs	108 (44.3)
weak opioids	43 (17.6)
antiemetics	31 (12.7)
PPIs	25 (10.2)
paracetamol	20 (8.2)
corticosteroids	16 (6.6)
anxiolitics	12 (4.9)
antibiotics	2 (0.8)
Classes of drugs (in ED)	
one	61 (25.0)
two	45 (18.4)
three	24 (9.8)
four	7 (2.9)

CT: computed tomography; ECG: electrocardiogram; ED: emergency department; NSAIDs: non-steroidal anti-inflammatory drugs; PPIs: proton pump inhibitors

Investigations	
five	2 (0.8)
CT: computed tomography; ECG: electrocardiogram; ED: emergency department; NSAIDs: non-steroidal anti-inflammatory drugs; PPIs: proton pump inhibitors	

Specialist consultations received in the emergency department

Most patients were managed by ED physicians without the need for specialist consultation (Table 3). Of the total population of 244 patients, 47 (19.3%) were visited by a neurologist, 7 (2.9%) by an ophthalmologist, 5 (2.0%) by an otolaryngologist, 5 (2.0%) by a psychiatrist, 2 (0.8%) by a cardiologist and 2 (0.8%) by a neurosurgeon.

Headache treatment received in the emergency department

The pharmacological treatments administered in ED are summarized in Table 3. NSAIDs and weak opioids were the most commonly prescribed pharmacological agents, being administered in 44.3% and 17.6%. of patients, respectively. None of the 244 patients received a triptan. Treatment for associated symptoms included antiemetics and anxiolytics, administered to 12.7% and 4.9% of patients, respectively. Proton pump inhibitors were administered to 10.2% of patients. About 43% of patients did not receive any pharmacological treatment while among those who were treated 25% received monotherapy, and 18.4% and 9.8% received a combination of two or three pharmacological agents, respectively.

Triage and stay information in the emergency department

Stay information in ED of the 244 patients are summarized in Table 4. The median door-to-doctor time was 139 (range: 3-881), the median time of care (since the first contact with the ED to the time of discharge) was 241 minutes (range: 1-1404) and the mean time of permanence (since the arrival in the ED to the time of discharge) was 381 minutes (range: 20-2212). There was no significant correlation between the length of stay in ED and a number of factors (time of arrival in ED, triage coding, compliant of aura, blood pressure, head CT scan, ECG, other investigations and treatments' administration). Conversely, the longer stay length in ED was significantly associated with the complaint of the first aura ever ($p = 0.014$) and if patients received neurological consultation ($p < 0.001$) or other specialist visits ($p = 0.001$).

Table 4
Factors that influence the length of stay in the emergency department

LENGTH OF STAY IN EMERGENCY DEPARTMENT					
TIME OF ARRIVAL	mean	min	max	SD	p-value
08:00–15:59	381	20	2212	327	NS
16:00–23:59	393	37	1540	277	
00:00–07:59	321	72	740	211	
TRIAGE	mean	min	max	SD	p-value
white	320	320	320	.	NS
green	380	20	1540	282	
yellow	387	37	2212	373	
red	202	202	202	.	
AURA	mean	min	max	SD	p-value
NO	368	20	2212	291	NS
SI	446	37	1412	360	
FIRST AURA	mean	min	max	SD	p-value
NO	527	133	1412	376	0.014
SI	325	37	1386	306	
SBP $\geq$ 140 mmHg	mean	min	max	SD	p-value
NO	383	20	2212	304	NS
SI	373	37	1529	306	
DBP $\geq$ 90 mmHg	mean	min	max	SD	p-value
NO	389	20	2212	312	NS
SI	271	92	479	114	
HEAD CT	mean	min	max	SD	p-value
NO	349	20	1540	270	NS
SI	391	37	2212	314	
ECG	mean	min	max	SD	p-value
CT: computed tomography; DBP: diastolic blood pressure; SBP: systolic blood pressure; SD: standard deviation					

LENGTH OF STAY IN EMERGENCY DEPARTMENT						
NO	359	20	1540	260	NS	
SI	531	37	2212	492		
OTHER INVESTIFGATIONS	mean	min	max	SD	p-value	
NO	372	20	2212	294	NS	
SI	510	37	1386	413		
NEUROLOGICAL CONSULTATION	mean	min	max	SD	p-value	
NO	333	20	2212	252	< 0.001	
SI	580	37	1533	408		
OTHER CONSULTATIONS	mean	min	max	SD	p-value	
NO	359	20	2212	279	0.001	
SI	625	115	1533	447		
TREATMENT	mean	min	max	SD	p-value	
NO	385	41	1529	303	NS	
SI	377	20	2212	305		
CT: computed tomography; DBP: diastolic blood pressure; SBP: systolic blood pressure; SD: standard deviation						

Discharge

Discharge information are summarized in Table 5. At the time of discharge from ED the headache had not disappeared in 62.7% of the 244 patients and 43.9% of the patients had been discharged without a prescription. The most commonly prescribed drugs for headache treatments were NSAIDs and paracetamol, administered to 33.2% and 11.1% of patients, respectively, while triptans were prescribed only to 1.6%. Monotherapy was prescribed more frequently than combination therapy with two agents (44.7% vs 10.2%). Only 5.8% of patients were prescribed prophylactic treatment on discharge. The most common post-discharge investigation was brain MRI that was prescribed to 4.1% of patients, while no further investigation was requested in 92.6% of patients.

Table 5
Discharge from the emergency department

Headache at discharge	
no	153 (62.7)
yes	91 (37.3)
Drugs prescription	
none	107 (43.9)
NSAIDs	81 (33.2)
paracetamol	27 (11.1)
week opioids	19 (7.8)
prevention	14 (5.8)
corticosteroids	5 (2.0)
triptans	4 (1.6)
anxiolitics	2 (0.8)
antiemetics	1 (0.4)
antibiotics	1 (0.4)
Classes of drugs (at discharge)	
one	109 (44.7)
two	25 (10.2)
three	3 (1.2)
Post-discharge investigations	
brain MRI + angio-MRI	12 (4.8)
EEG	2 (0.8)
psychiatric visit	2 (0.8)
Holter blood pressure	2 (0.8)
EEG: electroencephalogram; MRI: magnetic resonance imaging; NSAIDs: non-steroidal anti-inflammatory drugs	

Follow-up in the headache centre

Information on follow-up visit in the headache centre are summarized in Table 6. The mean time to follow-up at our headache centre was 8.9 days (range: 1–30) after visiting the ED and 4 (1.6%) patients

did not show up at the appointment. Considering the all sample of 244 patients, 97.5% were new patients and 2.5% were already followed in our headache clinic. All the 240 patients who attended the follow-up appointment at our clinic had their headache diagnosed according to the ICHD [2, 19]. Most patients (66.7%) were already aware of their diagnosis. A primary form of headache was diagnosed in 90% of patients, while a secondary headache was diagnosed in 10%. The three most common primary headache diagnosis were migraine without aura (53.3%), chronic migraine (CM) (14.6%) and migraine without aura (14.2%). The three most common diagnoses of secondary headache were medication overuse headache (MOH) (12.7%), headache attributed to trauma (3.3%) and headache attributed to cranial and/or cervical vascular disorder (2.5%). A double diagnosis was given to 24.6% and a triple diagnosis to 1.2% of the patients. The most frequent combinations of two diagnoses were CM and MOH (11.7%) followed by migraine with aura and migraine without aura (9.6%). The most frequent combination of three diagnoses was CM, MOH and migraine with aura (0.8%) followed by CM, MOH and headache attributed to cranial and/or cervical vascular disorder (0.4%). The average age at the onset of their headache was 25 years (range: 6–89) and 45% had a family history of migraine. Patients were managed according to their headache diagnosis. All patients with a new migraine diagnosis were prescribed specific acute treatment for migraine (e.g., triptans), where not contraindicated. To those patients with a known migraine diagnosis who had already encountered efficacy and/or tolerability problems with the triptan they had already used, another molecule belonging to the class of triptans and/or analgesic combination (e.g., paracetamol plus caffeine or codeine) was prescribed. Both patients with migraine and tension-type headache with > 4 attacks per month received oral prevention treatments according to international guidelines [20]. Regarding CM prevention, 24 (68.6%) of 35 patients with this diagnosis were prescribed quarterly injections of onabotulinumtoxinA [21, 22] and 26 (83.9%) of 31 patients with MOH began an in-patient withdrawal and rehabilitation protocol [23].

Table 6
Follow-up in the headache centre

Age at the onset (years) (SD)	25 (18.1)
New patient to our headache clinic	238 (97.5)
Days since discharge	8.9 (7.2)
Familiarity for headache (yes)	108 (45.0)
Aware of their diagnosis (yes)	160 (66.7)
Headache days per month	12.6 (9.5)
OnabotulinumtoxinA for CM	24 of 35 (68.6)
Rehabilitation for MOH	26 of 31 (83.9)
CM: chronic migraine; MOH: medication overuse headache; SD: standard deviation	

Discussion

We conducted a prospective study of a consecutive sample of 244 patients observed in our tertiary level headache centre after direct referral from our hospital's ED where they presented with a chief complaint of headache. Our aim was to analyze the different steps of the ED management of patients with headache to detect those deficiencies that can be overcome by a prompt referral to a headache clinic.

The first step of this journey is represented by the need to make the correct diagnosis. The evaluation of patients with headache in the ED environment presents significant differences compared to the evaluation of patients with headache in the clinic. The management of headache in an acute environment should focus on the exclusion of serious secondary causes, on the correct diagnosis, on the management of symptoms and possibly on establishing a continuing care plan [24]. The sense of urgency to rule out secondary and often life-threatening causes of headache, also due to time constraints due to the need for efficient patient management, can lead ED physicians to interrupt the diagnosis process on the differential diagnosis between primary and secondary headache. Furthermore, a Canadian study to evaluate the diagnostic accuracy of neurological complaints in ED found that in 35.7% of cases the initial ED diagnosis was not in accordance with the final diagnosis possibly made by a neurologist; among the most common problems diagnosed incorrectly was primary headache [25]. There was a high discrepancy rate between the diagnosis made in our headache centre and that made in ED. This discrepancy can have several reasons. ED physicians may be more interested in ruling out serious causes of headache than in distinguishing different primary headaches or they may simply not be familiar with the ICHD diagnostic criteria. However, despite being aware of the diagnostic criteria, ED physicians may not have mattered because they intended to use the same treatment regardless of the diagnosis of primary headache. In addition, there is a possibility that ED physicians may simply accept the diagnosis of a triage nurse or that they may not change the diagnosis already entered in the system. However, the interesting finding was that ED physicians used only four diagnostic categories while triage nurses used eleven different diagnosis and the analyses of concordance among the three different diagnoses (triage, ED physician and headache centre) shown a significant moderate agreement only for the diagnosis of migraine and only between triage and headache centre.

The second step of the journey is the diagnostic investigations that may be necessary to confirm the diagnostic intuition and establish consistent treatment. Head CT is commonly used to evaluate headache due to its prompt accessibility and diagnostic accuracy, but unnecessary head CT scans lead to a longer duration of ED stay [26], exposure to radiations [27] and increased medical costs [28]. The use of CT for non-traumatic headache in the US emergency departments has doubled in the past 20 years. A recent study showed that up to 31% of patients who had headache underwent imaging [11, 29] and head CTs accounted for almost the 50% all CTs performed in United States ED visits [30]. However, of the CT scans performed in the United States EDs among patients with headache between 1992 and 2001, almost 95% showed no pathology [11]. We found that 75% of the patients who attended our ED with a major complaint of headache underwent CT scan which in 93.4% of the cases was negative while in the other cases it showed results all considered accidental and not potentially lethal (Table 3). However, this large

use of CT in the ED requires serious reflection. In fact, a recent study found that a 9.6% decrease in the use of head CT for patients who come to ED with a chief complaint of headache was not followed by an increase in death or missed diagnoses [31], adding to the convincing evidence that there is a possibility to safely decrease CT scan for ED patients. In contrast, in support of CT use, another study found that patients who underwent a CT scan of the head during an initial ED visit were about half as likely to return to ED within 30 days than those weren't underwent CT [32]. Cranial imaging has been shown to have a positive influence on patients' fear and anxiety levels [33] and, reassuring patients, CT scan prevent return ED visits. However, we can speculate that a rapid referral to a headache unit may have, at least in some patients, a similar reassuring effect but avoiding the impact of CT on the patient and the healthcare system.

The third step is the request for specialist consultations aimed at adding experience to the work of ED physicians. In our ED at least one neurologist is available 24hours a day, 7 days a week, both for first-line evaluation if the pre-hospital evaluation suggests a neurological condition, and for the second-line, according to the judgement of a non-neurologist ED physician at the arrival of the patient. However, less than a fifth (19.3%) of the patients received a neurological consultation (Table 3). This rate was lower than that found in another study conducted in French EDs in which a third of patients received a consultation with a neurologist [8]. The authors speculated that this may have been due to the fact that patients were experiencing an unusually severe attack or because a differential diagnosis was deemed necessary for patients who had reported a first episode of headache. We can assume that the lower rate of consultations in our study may have several reasons and, among these, the doctor's certainty of excluding a secondary headache and the knowledge of the possibility of a rapid referral to our headache clinic. Further consultations were requested for 8.2% of the patients and the three most frequently consulted specialists were ophthalmologists (for the aura), otolaryngologists (for sinusitis) and psychiatrists (for comorbid conditions). However, having received specialist consultations, both neurological and other, was the only factor, together with the complaint of the first aura in life, to be significantly associated with a longer stay in ED (Table 4). It is possible that in front of a patient who reported having previously had other episodes of aura, the ED doctor was reassured on the benignity of the symptom while in the case of the first aura the doctor had a more cautious attitude and preferred to seek advice. this fact could also indicate an inadequate knowledge of the diagnostic criteria of primary headaches in general, and specifically of the clinical spectrum of migraine.

The fourth and fundamental step in the management of headache in ED is pharmacological treatment. Patients presenting with migraine or other headaches have the third highest self-reported pain scores among all patients presenting to ED with a painful condition [34]. Consistently, the American Migraine Prevalence and Prevention (AMPP) study found that unbearable pain was the patients' most common reason for using ED for migraine [35]. Patients attending ED with a headache pattern similar to previous migraine attacks generally do not require, or either want, diagnostic tests, but expect rapid and effective management of their headache and any incorrect diagnosis can lead to a generalized pain treatment rather than of migraine-specific treatment [17]. More than 20 different drugs and drug combinations are used to treat migraine in ED, including migraine-specific drugs (e.g., sumatriptan and dihydroergotamine),

dopamine antagonists (e.g., metoclopramide, chlorpromazine and prochlorperazine), NSAIDs, opioids, corticosteroids, and anti-histamines (e.g., diphenhydramine and promethazine) [36]. In our ED, the most commonly prescribed pharmacological agents were NSAIDs and weak opioids, administered in 44.3% and 17.6% of patients, respectively, followed by paracetamol which was administered to 8.2% of patients (Table 3). Treatment for associated symptoms included antiemetics and anxiolytics, administered to 12.7% and 4.9% of patients, respectively. Another study conducted in Europe showed an opposite use of NSAIDs (42.9%) and non-opioid analgesics (61.2%) and a lower use of antiemetics (8%) and anxiolytics (3%) [8]. In the study mentioned above, approximately 9% of patients did not receive any pharmacological treatment and triptans were not administered as frequently (11.2%) [8]. In our sample, approximately 43% of patients did not receive any drugs and no patients received triptans (or ergotamines). However, the limited use of triptans in ED is not limited to European countries. A survey conducted in a United States ED found an equally high percentage of patients (38%) who received neither drugs nor intravenous fluids [17]. Significant variations exist in managing headache between and within EDs due to lack of strong recommendations, physician comfort and familiarity with specific medications, beliefs about efficacy, concern about short-term side effects and patient request [36–38]. Only recently, the Canadian Headache Society and the American Headache Society provided evidence-based therapeutic recommendations for migraine that require treatment in emergency settings [39, 40].

The fifth and final step in the management headache in ED is represented by discharge. Significant evidence suggests that migraine discharge management is often suboptimal. About 40% of emergency physicians never prescribed triptans at discharge [41], approximately 60% of patients had no documented discharge medications and 2/3 of patients did not receive a physician follow-up recommendation [17]. These malpractices contribute to the high rate of return visits to ED noted among migraine patients [42]. Another study found a high percentage of patients (34.7%) discharged without a prescription and also in this case the most commonly prescribed drugs were analgesics and NSAIDs rather than migraine-specific drugs [8]. Our data, in line with the previous literature, shown that 43.9% of patients were discharged without a prescription while the most commonly prescribed drugs for headache treatments were analgesics NSAIDs (33.2) and paracetamol (11.1%) while triptans were prescribed only to 1.6% (Table 5).

Considering what has been previously discussed about the journey through ED of a patient complaining of headache, a fast track between ED and a headache clinic represents a step forward in managing headache. Headache is the most common disorder among patients presenting to ED with neurological complaints [43] and although in most cases it is discharged as non-urgent complaint, those patients feel they need urgent medical evaluation [44]. In contrast, migraine patients, especially those with a known diagnosis, should have an idea that their headache is not a life-threatening condition and if they get to ED it is more because of access issues and less because of a perceived need for emergent treatment. Inappropriate ED utilization causes overcrowding and consequently an increase in intervention times, which is one of the main reasons for leaving ED to prematurely [45], especially among patients with headache compliant [46]. This suggests that a healthcare system could reduce ED visits among migraine patients by increasing the availability of urgent care or walk-in appointments [47].

Another proof of the importance of rapid referral to a headache centre comes from an analysis of the use of ED by patients with migraine. The AMPP study showed that only a small subset of respondents used ED to treat severe headaches in the previous 12 months: 3% visited the ED once and another 3% visited ED more than once [35]. Interestingly, in a previous study, we showed that among 548 migraine patients who attended our headache clinic and who were in continuous treatment and underwent regular follow-up visits, only 0.9% of them entered the ED during the entire 2-years observation period [48]. This finding is explained by the fact that migraine prevention and prescription of migraine-specific rescue therapies reduce resource use in general, and in particular ED visits [49–51]. In addition to improving the health and quality of life of patients, a preferential between ED and the headache clinic can lead to significant economic savings considering that ED care is considerably more expensive than both hospital outpatient care and office-based outpatient care. In a time characterized by economic difficulties and the availability of new and expensive treatments, such as the monoclonal antibodies targeting the calcitonin gene-related peptide, a virtuous allocation of economic resources becomes mandatory [52].

Limitations

The study has several potential limitations. First of all, there are intrinsic limitations related to the use of data collected mainly for clinical care, such as errors in the registration of some information that could be perceived of secondary importance in the particular setting of ED. However, we believe the variables of primary interest in this analysis, including socio-demographic characteristics, diagnostic procedures, specialist consultations and drugs should not have been subjected to inaccurate recording. Second, the enrollment period was between January 1, 2015 and December 31, 2018 and, for this reason, most patients were diagnosed according to the beta version of the ICHD-III published in 2013 while the definitive version was published in early 2018. Third, the decision of ED physicians to refer or not a patient discharged from the ED for a major complaint of headache to our headache centre is totally personal and independent. As a result, there is a possibility that patients have been primarily referred by some physicians and not others and that it may introduce a selection bias towards a certain type of patient rather than another. Finally, this study was conducted in a single university hospital for tertiary care and our results may not be generalized to other countries or even to other Italian regions or to other EDs that could have different organizational and therapeutic protocols.

Conclusions

The great majority of patients who went to the emergency room complaining of headache received the same therapy regardless of the cause of the headache and for this reason in many cases the headache had not yet resolved at the time of discharge. We showed a high rate of misdiagnosis of primary headaches and a short track between ED and the headache center is of primary importance to help the patient obtain a definite diagnosis and adequate treatment. Reducing the number of emergency visits for primary headaches, and in particular migraine, is the goal and an easy and rapid referral to headache specialists can prevent further recourse to ED. In addition, an implementation of referral from ED to the

headache center of the same hospital, if any, can increase the quality of management of headache patients and, due to shared information on the hospital's EMRs, may avoid the need to repeat diagnostic investigations and reduce time and expenses, thus leading to better allocation of public resources.

Abbreviations

BP: blood pressure; CGRP: calcitonin gene-related peptide; CM: chronic migraine; CT: computed tomography; ECG: electrocardiogram; ED: Emergency department; EEG: electroencephalogram; EM: episodic migraine; EMR: electronic medical records; ICHD: International classification of headache disorders; MOH: medication overuse headache; MRI: magnetic resonance imaging; NSAIDs: non-steroidal anti-inflammatory drugs; TACs: trigeminal autonomic cephalalgias

Declarations

Ethics approval and consent to participate

Study protocol was submitted to the Ethics Committee.

Consent for publication

Not applicable.

Availability of data and material

Dataset available from the corresponding author on reasonable request

Competing interests

A. Negro received travel grants, consulting fees and speaking fees from Allergan, Eli Lilly, Novartis, and TEVA.

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Authors' contributions

AN: study design, data acquisition, data analysis and interpretation, drafting the manuscript.

VS: study design, data acquisition.

PS: statistical analysis.

PM: conception of the study and revising the manuscript critically.

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