

The urgent neurological consultation in the population of the province of Ferrara, Italy

Key words: urgent neurological consultation population

Introduction

Acute neurological disorders are common source of admission to the Emergency Room (ER) and are frequently associated with high mortality and costs [1-3, 4-5]. In the UK, 10% of ER patients have a neurological complaint [1] and neurological disorders account for 10-20% of hospital admissions [6]. A neurological consultation is required in 8-15 % of ER patients [7,8]. Many insidious conditions require an ER urgent neurological consultation (UNC) including headache [9,10], transient loss of consciousness [11] and vertigo [12]. In these conditions a UNC is relevant to decide the need for hospital admission and the treatment in the acute phase [13]. However, as in other countries [14-16], neurologists are often not available in the Italian ERs [3]. **An Italian nationwide survey estimated an average of 2146 annual UNC cases for ER [3].** Few data are available on the frequency of UNC cases in the population [7,8,17]. In the province of Ferrara (Fe-province), Italy, the only place where an outpatient can undergo a UNC is the ER of the university hospital of Ferrara (UHFe) where the only on-call neurologist in the whole area is available 24 h a day 7 days a week (24/7) [18]. As a considerable part of our work as neurologists in the UHFe is the ER on-call activity we were interested in establishing the frequency and the indications of the UNC cases. **The UHFe database provided the mean cost for a hospital day of stay for neurological conditions in 2016 which was 890 euro, a fourfold increase respect to the 204 euro estimated in Italy in 2000 [19].** Therefore, the hospital admissions for the ER UNC cases should be strictly appropriate. We present an analysis of the UNC cases in the Fe-province population in 2016. This could contribute to establish the need for on-call neurologists.

Material and methods

Study area and population. The study area was the Fe-province, in the Emilia-Romagna region of Italy, a 2635 km² well-defined area encompassing 23 municipalities [18,20-21]. The study population was the resident population in 2016, a well-defined homogeneous population [18,20-21] of 354073 inhabitants (169208 men). The study population data are available on the official website of the Emilia-Romagna region Statistical Office (<http://statistica.regione.emilia-romagna.it>). The Fe-province is a suitable area for epidemiologic research in the field of acute neurological disorders as acute neurological cases in this area are routinely referred to the UHFe ER where the only on-call neurologist in the whole area is available 24/7 [18,21]. In the UHFe placed in the municipality of Ferrara, in the middle of the study area, there are two joined neurology units (NU) with a total of 24 beds inclusive of a 6 beds stroke unit and two intensive care units (ICU) which serve the whole

Fe-province. The other three hospitals in the Fe-province lack an on-call neurologist, lack NUs lack ICUs and are served by the UHFe ER for acute neurological disorders [18,21]. The territorial emergency service protocol for acute neurological disorders in the Fe-province recommends stabilizing the patient and taking the patient as soon as possible to the UHFe ER [18,21]. Given this health organization the UNC cases in the study population virtually correspond to the resident outpatients who undergo a UNC in the UHFe ER. We randomly selected one week (seven days from Monday to Sunday) for each month in 2016. So, a 12 weeks (84 days) study period was considered. At the end of each of these 12 weeks we retrospectively extracted all the ER UNC cases for resident outpatients made in the week from the UHFe database where these data are routinely recorded.

Statistics. The UNC cases period prevalence rate was estimated. The 95% confidence interval (95% CI) of the rates was estimated assuming Poisson's distribution [22]. The crude rates were age-adjusted by direct method to the Italian population in 2015 [23]. **The median age of the UNC cases was estimated [24]. The median test was used to compare two medians [24].** The hypothesis that the UNC cases daily number follows the Poisson distribution was tested using the goodness of-fit test [24]. The χ^2 test for trend was used when appropriate [25]. The daytime UNC cases (from 8 a.m. to 20 p.m.) and the nocturnal UNC cases (from 20 p.m. to 8 a.m.) were considered too. The discharge diagnoses of the admitted UNC cases were retrospectively extracted from the UHFe database where these data are routinely recorded. The UNC cases space distribution in the Fe-province was evaluated by considering their residence according to three geographical areas that is a central area corresponding to the municipality of Ferrara which is the nearest area to the UHFe, a peripheral area encompassing the 12 municipalities at the boundaries of the Fe-province which is the most distant area from the UHFe and an intermediate area encompassing the remaining 10 municipalities placed between the central and the peripheral area whose distance from the UHFe is intermediate between the central and the peripheral area.

Results

The outpatients who underwent a UNC in the study period were 666, but 54 non-resident patients were excluded. So, the UNC cases in the study population were 612 (269 men, 343 women) giving a crude period prevalence rate of 173.0 per 100,000 (95% CI 159.3 – 187.3), 159.0 per 100,000 (95% CI 140.2 – 180.3) for men and 185.5 per 100,000 (95% CI 166.8 – 206.3) for women, a non significant gender difference. The age-adjusted period prevalence rate was 126.5 per 100,000 (95% CI 116.6 – 137.1), 115.5 (95% CI 102.0 – 131.0) for men and 136.0 (95% CI 122.0 – 151.0) for women, a non significant gender difference. The age-specific period prevalence rate increased with age in both sexes (table 1).

The daily UNC cases ranged from 0 to 14 with a mean of 7.3 (95% CI 7.1 - 7.5), 3.2 (95% CI 2.7 – 3.7) for men and 4.1 (95% CI 3.6 – 4.5) for women, a non significant gender difference. The daily UNC cases followed the Poisson distribution in the whole sample (goodness-of-fit test: $\lambda = 7.3$, $\chi^2 = 8,082$, 12 degrees of freedom, $p > 0.70$) and in both men (goodness-of-fit test: $\lambda = 3.2$, $\chi^2 = 11,049$, 9 degree of freedom, $p > 0.20$) and women (goodness-of-fit test: $\lambda = 4.1$, $\chi^2 = 9,054$, 9 degree of freedom, $p > 0.40$).

The age of the UNC cases ranged from 7 to 102 years (range 7 – 98 years for men, 8 – 102 years for women) with a median age of 67,5 years, 65.7 years for men and 68.6 years for women ($\chi^2 = 1.25$), a non significant gender difference.

The daytime UNC cases were 451 (197 men, 254 women) with a mean of 5.3 (95% CI 5.1 – 5.5, range 0-12), 2.3 (95% CI 2.0 – 2.7) for men and 3.0 (95% CI 2.6 – 3.3) for women, a non significant gender difference. The daytime UNC cases followed the Poisson distribution (goodness-of-fit test: $\lambda = 5.3$, $\chi^2 = 8,604$, 11 degrees of freedom, $p > 0.60$).

The nocturnal UNC cases were 161 (72 men, 89 women) with a mean of 2.0 (95% CI 1.7 - 2.3, range 0 – 6), 0.9 (95% CI 0.6 – 1.2) for men and 1.1 (95% CI 0.8 – 1.3) for women, a non significant gender difference. The nocturnal UNC cases followed the Poisson distribution (goodness-of-fit test: $\lambda = 2.0$, $\chi^2 = 4.159$, 6 degrees of freedom, $p > 0.60$).

The median age of the daytime cases was 66.5 years (65.0 years for men and 67.7 years for women, $\chi^2 = 0.74$, a non significant gender difference) whereas that of the nocturnal cases was 65.6 years (65.5 years for men and 65.0 years for women, $\chi^2 = 0.05$, a non significant gender difference). The difference in the median age ($\chi^2 = 1.23$) between the daytime and the nocturnal cases was not significant.

The period prevalence rate decreased from the central to the peripheral area (table 2).

The commonest clinical conditions which required UNC's were acute cerebrovascular disorders, headache vertigo and epilepsy **which on the whole accounted for 56% of the UNC cases (table 3). The whole commonest UNC cases increased with age. The UNC cases according to the commonest clinical condition increased with age for acute cerebrovascular disorders vertigo and epilepsy.**

The UNC cases admitted to hospital were 199 giving an admission rate of 32.5 % which increased with age (table 4). **The admission rate of the commonest clinical conditions ranged from 80.1 % for acute cerebrovascular disorders to 8.4 % for headache. The commonest discharge diagnoses were ischemic stroke, epilepsy, transient ischemic attack and intraparenchymal haemorrhage (table 5) which on the whole accounted for 76 % of the discharge diagnoses. All the commonest discharge diagnoses increased with age (table 5). The admission unit was a NU in 51.2 % of the cases, ranging from 66.7% for ischemic stroke to 12.5 % for peripheral vertigo (table 6).**

Discussion

The UNC cases period prevalence rate. The UNC cases in the study period were 2 per 1,000 inhabitants which means 2659 expected UNC cases in one year, a non negligible burden of neurological activity which is greater than the 2146 annual UNC cases for ER previously reported in Italy [3]. This confirms that the Italian neurologists are heavily involved in the ER [4]. **However, as the whole admissions to the UHFe ER in 2016 were 86656, those for acute neurological disorders in the study period accounted for 3.3 % of the UHFe ER admissions which is lower than the 8-15 % reported in other countries [7,8].** The age-specific period prevalence rate increased with age. This could be the consequence of the increase with age of the incidence of stroke [29]. **However, the UNC cases increased with age not only for acute cerebrovascular disorders, but also for epilepsy and vertigo which on the whole accounted for 14.4 % of the UNC cases.**

The UNC cases according to space and time. The UNC cases daily number followed the Poisson distribution, but their space distribution was not homogeneous as the prevalence decreased from the area which is the nearest to the UHFe to the area which is the most distant from the UHFe. This means that the UNC demand in the Fe-province is influenced by the distance between the patient residence and the UHFe suggesting that the UNC could be poorly appropriate. However, a UNC is often sought not only for life-threatening conditions but also for clinical conditions that, while requiring careful evaluation, do not usually have severe prognostic implications such as vertiginous symptoms or syncope [4]. The UNC are thus fraught with responsibility and carry considerable litigation risks [26] as it is shown by the high incidence of ER visits for headache, a notoriously insidious symptom [9,10]. Between 1.2% and 4.5% of the ER adult patients have headache and between 4.3% and 6.4% of them are affected by a secondary headache [27,28]. So, the ER neurologist expertise is important in order to ensure a correct clinical approach and a timely differential diagnosis. In a Spanish study the secondary headaches diagnosed thanks to the ER neurologist were 13.4 % of the evaluations requested [28].

The clinical conditions requiring UNC. The commonest clinical conditions requiring UNC were acute cerebrovascular disorders, headache, vertigo and epilepsy. This is consistent with a previous Italian nationwide survey [3] which moreover showed that acute cerebrovascular disorders accounted for 28 % of the ER UNC, the same finding estimated in the present survey. This suggests that the present findings are reliable. The main difference respect to that nationwide survey was for head trauma which in that survey accounted for 13% of the ER UNC [3]. This difference was due to the availability in the UHFe ER of a 24/7 on-call neurosurgeon who is directly involved in the head trauma management. **Since the UNC cases concerning the commonest clinical conditions on the whole increased with age, the population age is heavily involved in the demand for UNC in the population.**

The UNC cases admitted to hospital. The survey confirmed that only a limited proportion of the UNC cases are admitted to hospital and stroke is the most important acute neurological disorder leading to hospital admission [4]. The present admission rate seems high if an efficiency indicator is considered as a good admission rate should be lower than 25% [3]. This was probably the consequence of the old study population since the inhabitants in the age group ≥ 65 years (elderly people) amounted to 27 % of the study population. As about two-third of strokes occurs in individuals older than 65 years and the incidence of stroke increases with age [28] it is likely that in an elderly population such as the study population stroke accounts for a higher proportion of the UNC cases causing an increase in the admission rate. Stroke was the most common discharge diagnosis which is consistent with previous Italian data [3] confirming that stroke is the most important acute neurological disorder in term both of frequency [7,8] and of the need for prompt intervention [14,30]. **Since the mean hospital stay in 2016 for acute neurological conditions in the UHFe was 7.2 days and 18 discharge diagnoses (9% of the discharge diagnoses) concerned primary headache, peripheral vertigo and cases of epileptic seizure occurred in patients with a definite epileptic syndrome, it is possible to assume lower costs of 115344 euro in the study period by better management of these cases which could mean 501197 euro in one year.**

The discharge diagnoses of the admitted UNC cases. The proportion of strokes (63 %) among the discharge diagnoses estimated in this survey seems high respect to previous Italian data which were lower than 40 % [3]. This was probably the consequence of the elderly study population too [4]. In this survey acute cerebrovascular disease accounted for 28 % of the UNC cases and for 69 % of the discharge diagnoses. A previous survey showed that only 36 % of the Italian hospitals had a 24/7 on-call neurologist [3]. Even among the four hospital in the Fe-province only the UHFe has a 24/7 on-call neurologist. Given the present findings the inadequate number of 24/7 on-call neurologists [3] could constitute a serious problem. In fact, a competent approach to acute neurological disorders is important for early expert treatment [31,32]. This is even more important for ischemic stroke which requires prompt treatment [30]. The second and the third most frequent discharge diagnoses were epilepsy and TIA which is consistent with previous Italian data [3] confirming that the present findings are reliable. This survey showed that 48.7 % of the admitted cases were treated in non-neurological units. Although nearly half of the admitted cases were treated in non-neurological units, 67 % of the ischemic strokes seen by the ER on-call neurologists were admitted to a NU suggesting an improvement in stroke management respect to previous Italian data which were lower than 50 % [3,33]. This was likely due to the advances in neuroimaging and the introduction of new treatments for ischemic stroke [14,15] which led to the implementation of stroke units inside the NUs [30]. However, 33.3 % of the ischemic strokes seen by the ER on-call neurologists were admitted to non-neurological units probably because of the few beds dedicated to stroke in the UHFe. It is to remark that in Italy even if acute cerebrovascular disease overcomes acute myocardial infarction in term of number of discharges the latter receives more attention in term of dedicated beds technologies and funding than does stroke [33]. The present findings suggest that a more efficient health policy is necessary to provide all Italian hospitals with a 24/7 available active neurological consultation and neuroimaging with an appropriate number of beds dedicated to stroke. **Since 60 of the UNC cases admitted to the UHFe (30 % of the admitted cases) came from the primary service areas of the other three hospitals in the Fe-province it is possible to**

assume that an available on call neurologist in those hospitals could assure lower costs for the UHFe of 384480 euro in the study period which could mean 1670657 euro in one year.

The on-call neurologist contribution in the ER. The survey showed that the patients seen by the ER on-call neurologists are more than the hospital admissions for acute neurological disorders which does not correspond to the real burden of activity of the ER on-call neurologists confirming that the demand for UNC's in Italy is high [4]. In fact, with advances in the field of diagnostic imaging and the new treatments availability [34] the neurologist is emerging as an increasingly important figure in the ER [4]. Nevertheless, the real advantage of having an ER on-call neurologist has not yet adequately established. However, indirect evidences suggest that the neurologists provide an important contribution as a high percentage of incorrect diagnoses are recorded in the ERs where no neurologist is on call [7]. In an Irish study neurological referral resulted in a change in diagnosis in 55 % of patients [35]. In a further study the initial diagnosis made by the ER physician agreed with the final diagnosis in 60.4 % of cases whereas it disagreed or was uncertain in 35.7 % [36]. Furthermore, in a Spanish study the ER neurologists were found to halve the hospital admissions for headache [28].

Conclusions. This survey confirmed that acute cerebrovascular disease is the acute neurological condition most frequently requiring attention in the ER [3]. Prompt symptoms recognition, early diagnosis of the site and nature of the injury and rapid therapeutic decision-making, particularly as regards the decision to perform thrombolysis in ischemic stroke will influence the outcome [30]. The present survey carried out in a well-defined homogeneous Italian population [18,20-21] showed that the demand for UNC's is high and it is higher than that expected on the basis of previous Italian data [3]. However, it is to remark that other variables such as the population age and the distance between the patient residence and the ER are involved in the UNC's demand. This suggests that the UNC's could be poorly appropriate. These findings would require the healthcare administrators attention.

Compliance with Ethical Standards

The authors declare that they have no conflict of interest.

For this type of study formal consent is not required.

This article does not contain any studies with human participants or animals performed by any of the authors.

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