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RESEARCH ARTICLE

A FIVE-YEAR OBSERVATIONAL STUDY OF THE PATTERNS OF NEUROLOGICAL DISORDERS AMONG YEMENI PATIENTS BASED ON MAGNETIC RESONANCE IMAGING

Hameed M. Aklan[1]., Handan Ankarali[2]* and Orhan Alimoglu[3,4]

[1]Faculty of Medicine, University of Science and Technology, Sana'a, Yemen
[2]University of Science and Technology Hospital, Sana'a, Yemen
[3,4]Faculty of Medicine, University of Istanbul Medeniyet, Istanbul, Turkey

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ABSTRACT

Background: Neurological disorders are significant threats causing mortality and disability worldwide. In Yemen, there is a paucity of data on the pattern of these disorders. Thus, the present study was conducted on patients with suspected diagnosis of neurological disorders admitted to the University of Science and Technology Hospital to determine the prevalence and trend of neurological diseases.

Methods: A total of 1850 patients with suspected diagnosis of neurological diagnosis were enrolled in this study. Biodata were retrieved from patient records. Patients were examined for neurological disorders using the magnetic resonance imaging.

Results: The most common neurological disorders were infarction (7.9%, 95% CI: 7 – 9%), senile brain atrophy (7.8%, 95% CI: 7 – 9%) and multiple sclerosis (3.3%, 95% CI: 3 – 4%). A significant increase in ischemia (χ^2 = 11, p =0.001), senile brain atrophy (χ^2 = 162, p < 0.001), meningioma (χ^2 = 14, p <0.001), and infarction (χ^2 = 77.6, p < 0.001) with increase in age was noted. However, younger age showed a statistically significant association with arachnoid cysts (χ^2 = 20, p< 0.001) and atrophy (χ^2 = 8, p = 0.038).There were statistically significant differences between males and females regarding some neurological disorders as senile brain atrophy (χ^2 = 21, p < 0.001) and infarctions(χ^2 = 11, p = 0.001) were more common among males while pituitary macroadenomas were more common among females (χ^2 = 5, p = 0.021). In the last three years of the study period, there was a significant increase in the prevalence of multiple sclerosis and a decrease in that of infarction.

Conclusion: In conclusion, infarction, senile brain atrophy and multiple sclerosis are the most frequent neurological disorders among Yemeni patients. This study warrants further multicenter studies to identify the possible predictors of these most frequent neurological disorders in Yemen.

INTRODUCTION

Neurological disorders are significant causes of morbidity and mortality worldwide. The introduction of magnetic resonance imaging (MRI) enhances the accuracy of detecting brain abnormalities even if they are asymptomatic. Most studies proved that MRI is superior to computerized tomography (CT) scan in the detection of acute stroke[1], especially if done within six hours after the onset of acute cerebral ischemia[2]. In addition, MRI has become the primary noninvasive modality for stroke imaging[3]. Neurological disorders include a wide spectrum of diseases, including infarctions, multiple sclerosis (MS), brain tumors and arachnoid cysts. Age is a significant prognosticator in most neurological disorders, and ageing causes changes to the brain size, vasculature and cognition. The brain shrinks as the age progresses, and changes happen at all levels from the molecules to morphology. Incidence of strokes, white matter lesions, dementia and level of memory impairment also rise with age. There are also changes in the levels of neurotransmitters and hormones[4].

Infarctions, like lesions, are frequently detected in symptomatic and asymptomatic older individuals undergoing cerebral MRI. They were detected in almost 30% of patients subjected to cerebral MRI[5]. MS affects two million people worldwide and more than 400,000 in the USA[6]. In 2012, approximately 256,000 new cases of central nervous system (CNS) tumors were discovered, with 189,000 deaths[7]. Brain tumors range between 85-90% of all primary CNS tumors[8]. The most common brain tumor are the glial cell tumors. The anaplastic astrocytoma and glioblastoma account for about 38% of primary brain tumors, but the former represents less than 10%. Meningiomas and other mesenchymal tumors account for about 27% of primary brain tumors[1]. Other less frequent CNS tumors are pituitary gland tumors, schwannomas, CNS lymphomas, ependymomas, oligodendrogliomas, low grade astrocytomas, and

medulloblastomas. On the other hand, schwannomas, meningiomas and ependymomas are the primary spinal tumors, representing about 79% of these types of tumors[9]. Arachnoid cysts originate as developmental anomalies, but some of them are associated with neoplasms, adhesions as a result of infections such as leptomeningitis, or associated with hemorrhage or surgery. They represent about 1% of intracranial masses[10].

No data are available about the patterns of neurological disorders in Yemen. Thus, this study aimed at determining these patterns as diagnosed by MRI among Yemeni patients complaining of neurological disorders, who have been admitted to the University of Science and Technology Hospital (USTH) over a five-year period (from 2007 to 2011).

MATERIALS AND METHODS

Study participants

All patients suspected of having neurological disorders and referred for MRI in the USTH, Sana'a, Yemen, in the period from 2007 to 2011, were enrolled in this study. Biodata and clinical history were obtained from patients' records. Patients' information were kept confidentially and treated anonymously. The study protocol was approved by the Ethical Committee of the Faculty of Medicine and Health Sciences, University of Science and Technology, Yemen.

Magnetic resonance imaging

The MRI was performed using MAGNETUM®Avanto 1.5 Tesla machine (SiemensMedical Solutions, Erlangen, Germany). The protocols used were for head (routine and contrast), tumors, trauma, hemorrhage or cavernoma, MS, cerebrovascular acute strokes, pituitary dysfunction and suprasellar mass.

Statistical analysis

The relationships between categorical variables were tested using Pearson's Chi-square or Chi-square trend test where applicable. The level of significance was defined as *p*-values of <0.05. Data analysis was performed using the Statistical Package for Social Sciences for Windows (SPSS ver.22).

RESULTS

A total of 1850 patients with suspected diagnosis of neurological disorders were enrolled in this study. Of them, 53.5% were males and 46.6% were females.

Table 1 Characteristic of the study subjects (n=1850)

Variable*	N	%
Age (years)		
<20	319	17.3
20-40	688	37.3
41-60	524	28.4
>60	313	17
Gender		
Male	987	53.5
Female	862	46.6
Source of patient		
Inpatient	1189	64.4
Outpatient	656	35.6
Year of examination		
2007	265	14.3
2008	314	17
2009	498	26.9
2010	373	20.2
2011	400	21.6

*Missing data include the age of 6 cases, gender of one case and source of patient of 5 cases

The age of patients ranged from one year to 95 years with a median of 37 years and interquartile range was 25 – 54 years. Most of the patients were inpatients (64.4%) (Table1).

The most common neurological disorder was infarction (7.9%, 95% CI: 7 – 9%) followed by senile brain atrophy (7.8%, 95% CI: 7 – 9%) and MS(3.3%, 95% CI: 3 – 4%) (Table 2).

Table 2 Frequency of neurological disorders among patients admitted to the USTH and subjected to MRI in the period from 2007-2011 (n=1823)*

Disease	Prevalence n (%)	95% CI
Arachnoid cyst	18 (1.0)	(1 – 2%)
Brain atrophy	13 (0.7)	(0 – 1%)
Senile brain atrophy	143 (7.7)	(7 – 9%)
Multiple sclerosis	61 (3.3)	(3 – 4%)
Infarction	146 (7.9)	(7 – 9%)
Hemorrhage	21 (1.1)	(1 – 2%)
Ischemia	21 (1.1)	(1 – 2%)
Pituitary macroadinoma	21 (1.1)	(1 – 2%)
Glioma	53 (2.9)	(2 – 4%)
Meningioma	37 (2.0)	(1 – 3%)
Total	532 (28.8)	(27 – 31%)

*Patients with a single disorder or with a very low frequency were not included.

The study showed a significant increase in ischemia (χ^2 = 11, p = 0.001), senile brain atrophy (χ^2 = 162, p < 0.001), meningioma (χ^2 = 14, p <0.001), and infarction (χ^2 = 77.6, p < 0.001) with increasing in age. In opposite, arachnoid cyst (χ^2 = 20, p < 0.001) and atrophy (χ^2 = 8, p = 0.038) were significantly more prevalent among younger age groups. Patients aged 21 – 60 years old had the highest prevalence of MS compared to other age groups (χ^2 = 22, p < 0.001). Male patients had significantly higher proportion of senile brain atrophy (10.6%) compared to female patients (4.7%) (χ^2 = 21, p < 0.001). Infarction was also more common among male patients (9.9%) compared to female patients (5.8%) (χ^2 = 11, p = 0.001). Pituitary macroadenoma was significantly more apparent among females compared to males (χ^2 = 5, p = 0.021) (Table 3).

Regarding the trend in the occurrence of the studied neurological disorders, there was an increase in the prevalence of multiple sclerosis (χ2 = 38, p <0.001) and a decrease in that of infarction (χ2 = 4, p = 0.042) (Fig. 1).

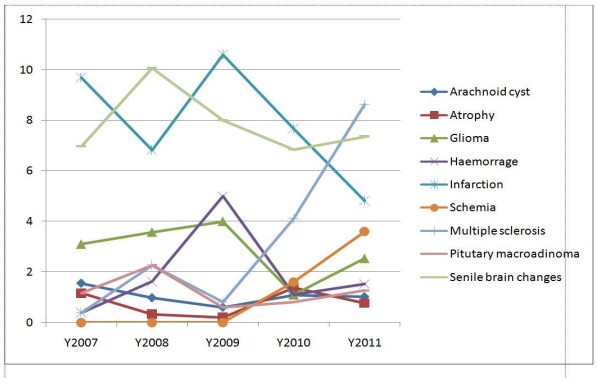

Fig 1 Trend of the major neurological disorders among patients with suspected neurological diagnosis attending the USTH based on MRI

DISCUSSION

The present study revealed that infarction was the most common brain defect, with males being more affected than females.

Table 3 Prevalence of neurological disorders among patients admitted to the USTH as stratified by age and gender n (%)

Variable	N	Arachnoid cyst	Atrophy	Glioma	Hemorrhage	Infarction	Meningioma	Multiple sclerosis	Pituitary macroadinoma	Senile brain atrophy	Ischemia
Age (Years)											
≤20	315	9 (2.9)	6 (1.9)	12 (3.8)	3 (1)	2 (0.6)	0 (0.0)	1 (0.3)	0 (0.0)	7 (2.2)	3 (1.0)
21-40	678	9 (1.3)	4 (0.6)	17 (2.5)	6 (0.9)	29 (4.3)	11 (1.6)	25 (3.7)	13 (1.9)	9 (1.3)	2 (0.3)
41-60	518	0 (0.0)	1 (0.2)	16 (3.1)	7 (1.4)	64 (12.4)	14 (2.7)	30 (5.8)	6 (1.2)	41 (7.9)	5 (1.0)
>60	306	0 (0.0)	2 (0.7)	8 (2.6)	4 (1.3)	51 (16.7)	12 (3.9)	5 (1.6)	2 (0.7)	85 (27.8)	11 (3.6)
χ^2		20	8	1	0.8	77.6	14	22	8	162	11
p value		<0.001	0.038	0.69	0.85	<0.001	0.003	<0.001	0.05	<0.001	0.001
Gender											
Male	975	7 (0.7)	7 (0.7)	23 (2.4)	15 (1.5)	97 (9.9)	14 (1.4)	30 (3.1)	6 (0.6)	103 (10.6)	15 (1.5)
Female	847	11 (1.3)	6 (0.7)	30 (3.5)	6 (0.7)	49 (5.8)	23 (2.7)	31 (3.7)	15 (1.8)	40 (4.7)	6 (0.7)
χ^2		2	0.001	2.2	3	11	4	0.47	5	21	3
p value		0.21	0.98	0.13	0.098	0.001	0.053	0.49	0.021	<0.001	0.098

n= sample size

The high proportion of brain infarction among males compared to females is consistent with previous findings[11] and could be explained by hormonal differences. Previous studies conducted among experimental animals and humans indicated that circulating estrogens and progestins afford greater neuro-protection to females[12]. Senile brain change was the second most common brain defect among study subjects. Although male brains are larger in volume than female brains, especially in the cerebellum, it was found that the proportions of caudate and hippocampus to total cerebral volumes are larger in females than in males[13]. In this study, the rate of senile brain atrophy was significantly higher in males than in females. This finding is in consistent with that reported in a previous study[14]. It is quite acceptable in this study to find an increase in the prevalence of senile brain atrophy and infarctions as the age progresses. It could be due to an increase in the prevalence of atherosclerosis and hypertension as the age progresses among these patients. Vascular diseases increase the risk of occurrence of multiple, small or large cerebral infarcts (multi-infarctions dementia)[15].

In the present study, MS ranked as the third most prevalent neurological disorder. Patients aged 21–60 years old had significantly the highest prevalence of the disease. The age-linked distribution of MS found in this study is in consistent with previous reports, which demonstrated that about 70% of MS patients were between 20-40 years old, 20% of them were above 60 years old and 10% were under the age of 20 [6,16,17]. The present study showed an increasing trend in the proportion of MS over years, which is unexpected in a country where people are exposed to multiple microbial infections and long sunny days[18]. Meningioma showed a significant increase with increasing age, which has been previously reported as well [19]. The higher occurrence of meningioma among female could be attributed to the possibility of using hormone replacement therapy[20]. Arachnoid cysts and brain atrophy had low prevalence rates among study subjects and were significantly more prevalent among younger age groups. The arachnoid cysts are discovered in early ages and they need urgent surgical interventions such as shunt operation or fenestration [21]. The present study showed and increase in the prevalence of MS and dropping in the prevalence of cerebral infarction over the last three years. The lack of studies on the predictors of the two diseases in Yemen make it difficult to explain their trends.

Findings of this study are limited by the fact that it is based on one hospital in Sana'a, the capital of Yemen. However, it should be noted that the USTH is a big referral hospital in the country in addition to its inclusion of five-year observations of patients from all over the country.

In conclusion, this study identified infarctions, senile brain atrophy and MS as the most frequent diseases among Yemeni patients with suspected diagnosis of neurological disorders who were admitted to the USTH in the period from 2007–2011. Age and gender-linked distribution of neurological disorders among Yemeni patients is quite similar to the international pattern. This study warrants further multicenter studies to identify the predictors of the most frequent neurological disorders in Yemen.

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