A Survey about the Temporal Pattern of Stroke Occurrence

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ABSTRACT

Background: Temporal variation of stroke onset is suggested in some studies contained somewhat varieties. It is proposed that some predisposing changes occur in some ascertained times consequently resulted in stroke occurrence in some special times.

Objective: To determine the circadian and circaseptan variation of stroke onset.

Materials and Methods: This cross sectional study was conducted from March 2012 to February 2013 in an academic hospital in the North of Iran. All patients with acute onset of neurological symptoms were enrolled in the study after being diagnosed as a stroke patient. The diagnosis was made by a neurologist using brain imaging. Age, gender, history of diabetes and hypertension, time and date of stroke onset were recorded for all patients. The data were analysed using Chi-square test in SPSS software version19.

Results: A total of eight hundred sixty-nine patients with mean age of 67.5 ± 12.4 years (55.6% women 44.4% men) were admitted during one year study. Eighty-five percent of stroke cases were ischemic in nature and the others were hemorrhagic type. Distribution of cases during a day was not uniform ($p < 0.0001$). The peak of stroke onset occurred in the mornings (7-9 a.m.) followed by a second peak in the evenings (7-9 p.m.). In addition, the distribution of cases during the week was also not uniform ($p < 0.016$).

Conclusion: Stroke occurrence has a diurnal variation probably resulted from circadian physiologic changes. Although there is a circaseptan variation in the times of stroke record, it seemingly isn't related to physiologic changes.

Keywords: Stroke; Circadian; Variation

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Introduction

Stroke is a serious public health issue and is the second leading cause of death worldwide and is a major cause of disability in adults. In the United States, figures indicate a total of 5,800,000 prevalent stroke cases, with 780,000 first-ever or recurrent strokes expected in each year (1,2). Stroke is a global epidemic event and about eighty-five percent of all death due to stroke was occurred in low income and developing countries (3).

With aging of population an increase in incidence of stroke will occur. Until 2030, seventy five percent of world's old people will live in developing countries. In the Middle East the mortality of stroke will increased by twofold until 2030 (4).

Stroke occurrence shows chronobiological variations, such as circannual, circaseptan and also circadian variations. Various patterns have been reported but no conclusions have been achieved on circadian variations yet (5,6,7). Understanding the temporal patterns of stroke incidence and its fatality can offer an opportunity to identify the potentially critical times and to develop preventive strategies (8). Understanding the times in a day or the days of a week in which more strokes occur could help the hospitals to be prepared for sudden increases in the numbers of stroke admissions. Some treatments of stroke such as intravenous tissue plasminogen activator (t-PA) should be used in a narrow time window after stroke onset. Because of existence a few data about the temporal pattern of stroke (9,10,11) we decided to investigate the temporal pattern of stroke occurrence .

Materials and Methods

This cross sectional study was conducted from March 2012 to February 2013 in an academic hospital in the North of Iran. All patients with acute onset of neurological symptoms were enrolled in the study. Brain imaging studies including brain Computed Tomography (CT) and/or Magnetic resonance imaging (MRI) were carried out for all of them and an expert neurologist confirmed the diagnosis of stroke. Patients with other diagnosis based on imaging studies (e.g. brain tumors, subdural

hematoma and etc.); patients with transient symptoms and normal brain MRI were excluded.

Age, gender, history of diabetes and hypertension, time and date of stroke occurrence and the stroke subtype were recorded for all patients. Recalling the exact time of stroke was definitely impossible; so the time of stroke occurrence was recorded by approximation, for example the range of time from 6:31 to 7:30 was recorded as 7.00 o'clock.

The data were analyzed using Chi-square test in SPSS software version 19.

Results

A total of eight hundred sixty-nine stroke patients were admitted to hospital during the study period. The time of stoke onset was not identified by fourteen cases. The mean age of patient was 67.5 ± 12.4 years (range of 22-94 years). Totally 44.4% of patients were men with mean age of 67.32 ± 12.5 years and 55.6% were women who their mean age was 67.71 ± 12.33 years.

A hundred nine patients (12.5%) involved by intra-cerebral hemorrhage (ICH), 739 patients (85%) by ischemic stroke and 21 patients (2.5%) had subarachnoid hemorrhage (SAH) with mean age of 64.2, 68.4 and 51.8 years, respectively.

In taking past medical history, a total of four hundred eighty-four patients (55.7%) reported hypertension and 266 patients (30.6%) stated to have diabetes mellitus.

Regarding the time of stroke onset, more strokes occurred at 7 and 8 a.m. and a second peak occurred at 7 and 8 p.m. (Diagram 1). With dividing the day to eight 3 hours times, the peak of stroke occurrence was during 7 to 9 a.m. ($p < 0.0001$).
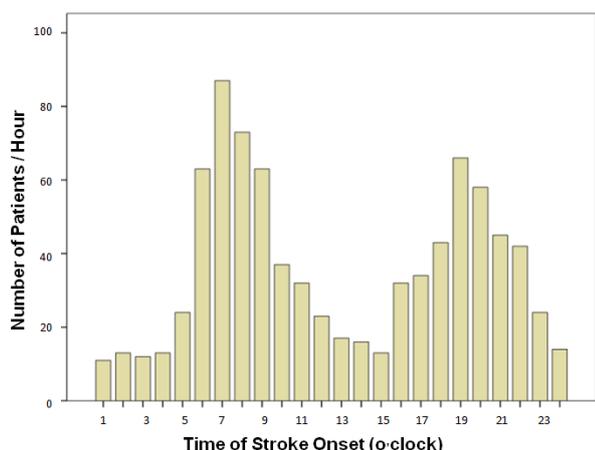
Diagram 1: The frequency of stroke cases in the hours of the days

Distribution of stroke cases in time groups was not different between diabetics and non-diabetics ($p = 0.747$), hypertensive and non-hypertensive ($p = 0.510$) and between men and women ($p = 0.447$). Also the circadian pattern of stroke occurrence was not different between the subtypes of stroke ($p = 0.754$). The largest numbers of ischemic stroke and ICH occurred between 7 and 9 a.m. (195 ischemic stroke and 24 ICH cases) followed by 7 to 8 p.m. (141 ischemic stroke and 23 ICH cases). The largest number of SAH cases occurred during 7 to 9 a.m. followed by 4 to 6 and 7 to 9 p.m. (Table 1).

Table 1: The distribution of stroke subtypes in circadian times

Time of stroke onset (o'clock)	Subtypes of stroke					
	Ischemic N (%)		Intra-cerebral hemorrhage N (%)		Subarachnoid hemorrhage N (%)	
1-3	30	(4.1%)	6	(5.5%)	0	0%
4-6	90	(12.3%)	9	(8.2%)	1	(5.2%)
7-9	195	(26.8%)	24	(22%)	4	(21%)
10-12	78	(10.7%)	13	(11.9%)	1	(5.2%)
13-15	38	(5.2%)	6	(5.5%)	2	(10.5%)
16-18	86	(11.8%)	19	(17.4%)	4	(21%)
19-21	141	(19.4%)	23	(21.1%)	5	(26.3%)
22-24	69	(9.5%)	9	(8.2%)	2	(10.5%)
Total	727	(100%)	109	(100%)	19	(100%)
$p = 0.754$	(Among 826 subjects, the hour of stoke onset was not identified by 14 cases)					

Stroke occurrence had non-uniform distribution among days of week ($p = 0.016$). The largest number of stroke cases occurred in Wednesday (Diagram 2).
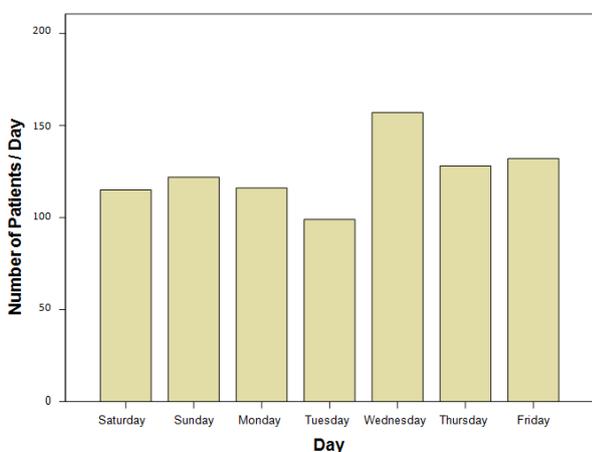
Distribution of stroke cases among the days of the weeks was not different between diabetic and non-diabetic patients ($p=0.717$), between hypertensive and non-hypertensive subjects ($p<0.844$) and between men and women ($p = 0.434$).

There was an insignificant circaseptan difference in the occurrence of the stroke subtypes ($p = 0.395$) (Table 2).

Diagram 2: The frequency of stroke cases in the days of the weeks

Table 2: The distribution of stroke subtypes in the days of the weeks

Day of stroke onset	Subtypes of stroke					
	Ischemic N (%)		Intra-cerebral hemorrhage N (%)		Subarachnoid hemorrhage N (%)	
Saturday	95	(12.9%)	17	(15.6%)	3	(14.3%)
Sunday	100	(13.5%)	20	(18.3%)	2	(9.5%)
Monday	106	(14.3%)	5	(4.6%)	5	(23.8%)
Tuesday	85	(11.5%)	13	(11.9%)	1	(4.8%)
Wednesday	133	(18%)	20	(18.3%)	4	(19%)
Thursday	107	(14.5%)	17	(15.6%)	4	(19%)
Friday	113	(15.3%)	17	(15.6%)	2	(9.5%)
Total	739	(100%)	109	(100%)	21	(100%)
p = 0.395						

Discussion

The present study showed circadian pattern of stroke occurrence. The greater number of cases occurred at 7 and 8 a.m. followed by a second peak occurred at 7 and 8 p.m. The observed circadian pattern was not related to the accompaniment of diabetes mellitus and hypertension and also the stroke subtypes. Similar results found in a study done in Italy which showed that the ischemic stroke reached to its highest point of onset in the morning, which was followed by a second peak in the evening. The circadian variation of the ischemic stroke onset was shown to be independent of clinical variables considered (5). In a study done in Japan by Omama, the highest peak of ischemic stroke incidence was in the morning with a second peak in the evening although the highest peaks of ICH and SAH incidence were in the evening and the lowest points were in the morning (12). Sudden increase in blood pressure in morning may play a role in the circadian pattern of stroke onset (13). Circadian difference in vascular tone with increased tone in the morning may also play a role. Other possible reasons for increased stroke incidence in the morning include hyperactivity of platelets, hypercoagulation, hypofibrinolysis and increased blood viscosity (12,14). Some studies also showed decreased cerebral blood vessels reactivity to hypoxia and hypercapnia and decreased auto-regulation of cerebral blood vessels in the morning which may also play a role in stroke occurrence (15). Of course some of these explanations cannot explain the decreased occurrence rate of ICH and SAH in the morning in abovementioned Japanese study. Searching about the circadian variation in stroke occurrence may be useful in identifying the possible triggers of stroke onset. Preventive pharmacological interventions target for morning increment of the stroke risk factors may be helpful to reduce stroke incidence and more studies in this field should be done (13).

In the present study the most of stroke cases occurred in Wednesday, Friday and Thursday respectively and the least of stroke cases occurred in Tuesday. Other studies showed different results. In a study done in Finland, the maximum stroke incidence among men was in Monday and among women was in Tuesday (16). In another study in Japan maximum ischemic stroke incidence was in Mondays and Tuesdays. In fact; the incidence of stroke was higher in days after weekend (8) but this pattern was not seen in our study and it seems that strokes had achieved its highest rate of being recorded in weekend and before it. More recordings of stroke in Wednesday and weekends in our study could be a result of referring of patients from other suburb areas because of absence

of resident neurologists. The results of our study show the importance of having plans for encountering higher numbers of patients in the weekends.

Conclusion

Our study showed that stroke occurrence has a diurnal variation probably resulted from circadian physiologic changes. Although there is a circaseptan variation in the times of stroke onset, it seems that it isn't related to physiologic changes.

Investigating of this pattern could help in understanding the possible triggers of stroke onset and also having plan for encountering the over-referral times of stroke in emergency wards.

Conflict of Interest

No conflict of interest

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