Chronobiology of Acute Myocardial Infarction

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Abstract

Background: The chronobiology of the Acute Myocardial Infarction (AMI) is an interesting matter for recognition of the biological mechanism that might trigger AMI. The present study was aimed to investigate the circadian, seasonal and circannual variation of the AMI occurrence with solar, lunar, and Christian months.

Patients and Methods: A retrospective study of 1174 cases with diagnosis of AMI was conducted. All the cases were admitted to the coronary care unit of Shahid Beheshti and Yahyanejad Hospitals in Babol, north of Iran, between 1990 to 2000. The day was extracted by the day and months of diagnosis based on the solar, lunar and Christian calender from hospital charts. The Chi-square test was used to test the uniformity of the observed frequencies of AMI onset in the different months based on solar, lunar, Christian and the days of the week.

Results: The result showed that there was a significant trend toward higher rate of MI at the beginning of the week, on Saturday (18.1%) and the least (12.3%) on Fridays. Although, the observed frequency of AMI has tendency to be higher in Ordibehesht of solar month and Shaban in lunar month than other months, the monthly variation was not statistically significant ($P>0.05$). However, there was a significant difference in MI occurrence in Christian months with the highest peak in November ($P<0.05$). Also, we did not find a significant seasonal variation of AMI where 26.2%, 32.1%, 26.8% and 23.9% of MI occurred in spring, summer, fall, and winter respectively ($P>0.05$).

Conclusion: Our result indicated a significant day of week variation in AMI occurrence with higher peak on Saturdays and full moon phase of lunar months.

Key words: acute myocardial infarction, chronobiology, solar month, lunar month, Christian month, days of week.

Introduction.

Cardiovascular diseases, especially, Myocardial Infarction (MI) are the major causes of morbidity and mortality throughout the world.\(^1\) The knowledge of chronobiologic variation of some events and diseases, particularly, myocardial infarction is a subject of interest in the epidemiological studies for the recognition of biological mechanisms that might trigger myocardial infarction. Chronobiological variation was defined as a systematic biological rhythm in alive creatures.\(^2\) Many alive creatures have a chronological mechanism that can change their situation automatically by temporal changing of day, month and seasonal variations.
This mechanism is affected by different factors such as hormonal, neurological, chemical, genetical and immunological changes.2

There is a relationship between changes of biological process and pattern of the rhythm of arterial practices in the cardiovascular events. The biological mechanism causes the indicators of behaviors of cardiovascular system such as pulse rate, hypertension, vasomotor tone and aggregation of platelets are changed during a day.3 The neurologic and hormonal activities are the major factors in initiation of daily changes of cardiovascular function. For example, vasomotor tone is a neurologic and hormonal factor which affects the resistance of arterial system and it is increased when ischemic attack occurs in the morning than other times of the day. Also, the platelet aggregation is a function of a specific daily changes and it is increased in the morning. Thus, the MI occurrence has a specific daily pattern; it has an obvious peak between at 6 to 12:00; the rate of its occurrence is greater about 2 to 3 times than other hours of the day.4 The reason for this high occurrence in the morning are the morning increases in catecolamine concentration, blood pressure, serum cortisol and platelet aggregability.5

In addition to the circadian rhythm, some of behaviours tend to have a seasonal variation. This rhythm is a function of environmental factors such as availability of food and environmental temperatures. It has been shown that some hormones and vitamins, neurological and biochemical factors have a seasonal variation in human being.4 For example, melatonin has a maximum rate in fall and winter and a minimum rate in spring and summer; the platelet activities increases in the spring and winter and decreases in fall for men and in the summer for women. In addition, T3 and T4 hormones has a maximum stimulation effect in the spring and summer. This high stimulation causes overfeeding and over activities in the animal.4

The occurrence of some events such as suicide, cardiac arrhythmias (especially atrial fibrillation) depression, labor, schizophrenic attack and the number of emergency ward admission has been attributed to the sun and lunar rotation in the literature.6,7 Although, the most epidemiologic studies focused on the circadian rhythm of MI occurrence, the seasonal and circannual rhythm is an issue of interesting for investigation. Regarding to the rotation of earth and moon, it has been judged that some events occurred at specific time of these rotation. Particularly, when the moon is full phase, its relation with some events has been considered in the literature.8 Although the circadian rhythm of MI occurrence has been documented by several studies in the literature, the effect of seasonal, circannual and circaseptan rhythm is still controversial. The aim of the present study was to determine the monthly variation of MI occurrence with respect to the solar, lunar, Christian months and the days of week.

Patients and Materials
A retrospective study of 1174 cases with diagnosis of MI was conducted. The consecutive patients with AMI were included in this study, who were admitted to the coronary care unit of two main teaching hospitals of Shahid Beheshti and Yahyanejad in Babol, north of Iran, during 1990 to 2000. A standardized diagnostic criteria was used and all cases were diagnosed under supervision of the radiologist based on criteria of typical chest pain, typical electrocardiogram (ECG) changes an typical increase in CK and LDH cardiac isoenzymes. We reviewed the hospital charts of all patients with diagnosis of AMI. The data included age, gender, type of MI (Q-wave, non-Q-wave) and the date of chest pain onset based on the day, and month of solar, lunar and Christian calendar.

The statistical analysis was performed using the Chi-square test to determine the homogeneity of observed frequency of MI onset over the different time period based on different days of week and monthly variation of solar, lunar and Christian calendar.

Results
The result showed that 62.6% of patients were male; the mean (±SD) age of patients was 58.5 (±8.8) years and 47.7% cases were Q-wave MI and 52.3% non-Q-wave MI. Fig 1 shows that there is a significant trend toward higher admission rates at the beginning of the week on Saturdays (P<0.05). Most of the cases (18.1%) were admitted on Saturday (the first working day in Iran) and the least cases (12.3%) on Friday (weekend).

Regarding to seasonal variation, 26.2%, 23.1%, 26.8% of MI were occurred in the spring, summer,
fall, and winter respectively and the difference in seasonal variation was not achieved to statistically significant figure (P>0.05). We did not find different variation of MI occurrence in the three decades of each month in solar and lunar rotation (roughly 33% of MI for each decade), but with respect to Christian calendar months, the frequency of MI was significantly increased to 37.2% in the third decade. Regarding to solar months variation, the results showed that the most cases (10.3%) were admitted in Ordbehesht as a first peak of MI and the second peak was in Aban (9.5%); the least frequency (7.1%) was in Esfand (Fig 2).

Based on the lunar month, the relative frequency tended to be greater in Shaban (10.3%) and the least (6.8%) was in Rabi Al-Awwal (Fig 3).
However, we did not observe a statistical significant monthly variation with respect to the solar and lunar months (P>0.05). Regarding to Christian Calender, the highest rate (9.9%) was in November and the least (6.1%) in February (Fig.4), and the difference in variation was significant (P<0.05).

In addition, the daily average of MI occurrence was significantly greater in the three days of lunar month with full moon phases than other days (P<0.05). We also did not find a significant difference of monthly variation of MI between males and females (Fig. 5), and between Q-wave and non-Q-wave MI (Fig. 6).

Discussion
Our results showed that there was a weekly and monthly variation in the MI occurrence with respect to solar and lunar and Christian months. In particular, we found a significant increasing trend of MI occurrence on Saturday and the two days of the full moon-days (14th, 15th and 16th) in lunar months.

In comparison with other studies, Shiva and et al (2009) in Brazil, Genechi-Roscone and et al (1994) in Italy, Willich and et al (1994) in Germany, Vander-Palen and et al (1995) in New Zealand had reported the more occurrence of MI on Monday. Also in studies of Spielberge and et al (1995) in Germany and Chiang and et al (1999) in Taiwan, the least occurrence of MI were found on Saturday. Our results are inherently consistent with those reported in the literature since the stated weekly working day is on Saturday in Muslim population of Iran that is similar to Monday in Christian calender and also Friday in Muslim population is the same as Sunday in Christian calender as a weekend.

We think that people have more opportunity for resting and more flexibility for daily activities and less constrained and less working pressure on Fridays (or Sunday in Christian calender). Thus, the rate of stress and spiritual pressure will be decreased essentially on Fridays. On the other hand, on the first working day, people are exposed to more physical activities and more stress and they should plan their time to a specific schedule. Thus, in our study, the changing from the situation of low stress to high stress can explain the high incidence of MI on Saturdays and the fewer number of cases on Friday.
compared to other days of the week is suggestive of this point that freedom from stress or workload on Friday might have an important impact on low incidence of MI in Iranian population.

Regarding monthly variation of MI based on solar month, we found that the occurrence of MI tended to be greater in Ordibehesht (10.3%) and the least occurrence of MI was seen in Esfand (7.1%). Also the observed frequency of MI tend to decrease in Shahrivar, and then again, it suddenly increases after summer holidays in Mehr an Aban as a second peak of MI; however, the difference was not achieved statistically significant. Since in Iranian population, Norouz national holiday lasts for the first two weeks of Farvardin, thus the increasing number of MI in the Ordibehesht as second month of the year, which can induce more physical stress in the occurrence of the first peak of MI in Ordibehesht. Again, in our findings, the increasing physical and mental activities can explain the second peak of MI in Mehr an Aban after summer holidays. In particular, changing from situations without stress (holidays) to high stress due to working pressures can induce more number of MI. In the literature, also the increasing of MI was reported after national Christian holidays and after summer. Spilberg and et al (1996) observed the increasing number of MI in March and September which are also consistent with those we found in our study.

Regarding to the lunar rotation, we observed frequency of MI tend to be greater in Shaban and the least was observed in Rabi-Al-Awwal. This increasing number of MI in Shaban might be due to the changing of nutritional regimens. Many of marriages and religious celebrations in Shaban may be a reason for avoiding from usual nutritional regimens. This also might be a reason to explain the increasing number of MI in Ziajja as a second peak of MI occurrence in the lunar months. The rate of MI decreased in Ramazan; it is probably due to fasting of Muslims in this month.

In terms of Christians monthly variation of MI, we found that the number of MI was significantly increased in November (9.9%) and the least was seen in February (6.1%) and March (6.1%) which are concurrent with Esfand and Farvardin respect to the solar months. In comparison to other studies Spielberg and et al (1996) found that the most and the least occurrence of MI was in March and June respectively. Also Meal and et al (2000) in England reported that the most MI was occurred in January. The result of both studies are not consistent with those we found. These differences might be due to cultural differences and the lack of using Christian calendar in Iran. In addition, the change of climate, particularly, changing to cold weather might explain this variation. Thus, the increasing number of MI in November which is concurrent with Aban and Azar might be due to suddenly changing of warm weather to the cold weather. In relation to seasonal variation of MI, we found that the most cases (26.8%) was in fall and the least (23%) in summer, however the difference in pattern of seasonal variation of MI was not statistically significant. In other studies, Ku, et al (1998) in Taiwan and Chiang and et al (1999) did not find any seasonal relation to occurrence of MI which are also consistent with those we observed. In contrast, in the other studies, in Europe and North America, more cases of MI were reported in the winter. These results might be due to the cold winter in the European countries and North America. The difference in seasonal variation of MI in different countries may be due to the difference of variation of temperature. Since the north of Iran has a moderate climate without a large difference in temperature between the seasons, this can explain the uniformity of distribution of MI in different seasons in our studies.

In our study, the rate of observed frequency of MI occurrence was significantly greater during the full moon days of lunar months in comparison to other days. In contrast, Sha and et al (1989) in China, reported that the rate of MI occurrence obviously decreased around the full moon days and the sharp peak of incidence of MI and hemorrhagic character were observed at the beginning and the end of the lunar months which are not compatible with what we found in this study. This difference might be due to differences in cultural beliefs regarding accident with the phase of moon in different population. However, the effects of full moon on the occurrence of some accidents has been suggested in the literature. For example in a study regarding to labour and lunar rotation, around the full moon, the more
deliveries were observed.\textsuperscript{2} In addition, it has been reported that the occurrence of atrial fibrillation attack was decreased obviously during the three days with full phase moon.\textsuperscript{19} In another study, the increasing consumption of food and decreasing consumption of alcohol had been reported during full moon days.\textsuperscript{20} While Wilkinson and et al (1997) did not find increasing rate of depression and anxiety during the full phase moon.\textsuperscript{18} However, people in some cultures, might believe the effects of days of full moon on the unpleasant accidents. Then, they might limit their physical activities in these days.

In conclusions, our results indicated a significant chronologic pattern of MI occurrence with higher peak on Saturdays and three days of full moon phase in the north of Iran. Thus, it is necessary to provide enough equipments and care in hospitals and coronary care units in these days and to transmit load of working from the beginning of the week to middle in order to decrease MI occurrence. Regarding to lunar and solar monthly variation, further investigations with larger number sample sizes could help to detect some of the underlying triggering mechanism of myocardial infarction, to improve prevention of the disease.

Acknowledgements

We would like to thanks Dr. Jabbari and Dr. Fozoni for collection of our data from medical charts.

References

