

厚生労働科学研究費補助金（循環器疾患・糖尿病等生活習慣病対策総合研究事業）
大規模災害における循環器病診療の体制と手法の確立に関する多施設共同研究
分担研究報告書

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研究要旨： **Background:** Previous studies have reported a relationship between large earthquakes and acute coronary events, but have yielded conflicting results. The aim of this study is to clarify the influence of the 2011 Northeast Japan earthquake and tsunami the risk of acute myocardial infarction (AMI) including sudden cardiac death on the basis of data from a population based analysis. **Methods:** The study subject was residents in the northeast of Iwate prefecture, Japan. Cases corresponding to the definition of AMI according to the criteria of the World Health Organization MONICA project were registered from four weeks before to eight weeks after the disaster and in the corresponding periods in 2009 and 2010. **Results:** The relative risk of AMI was 2.03 (95% confidential interval 1.55 to 2.66) for the four week period after the disaster compared to the corresponding periods in the preceding years. The number of events peaked within the first week after the earthquake, decreased to levels seen in the preceding years, and then increased again following high magnitude aftershocks. **Conclusion:** This population based study suggests that the increase in AMI events after a major earthquake varies depending on the seismic scale of the initial shock and each aftershock.

A. Purpose

Previous studies have reported a relationship between large earthquakes and acute coronary events, but have yielded conflicting results. On March 11, 2011, a massive magnitude 9.0 earthquake occurred off Japan's Pacific coast and hit the northeast of the country. We have studied the incidence of acute myocardial infarction (AMI) according to the criteria of the World Health Organization (WHO) MONICA project in the community of Iwate prefecture. The aim of this study is to clarify the influence of the 2011 northeast Japan earthquake on the risk of AMI events including sudden cardiac death (SCD) on the basis of data from this population based analysis.

B. Methods

Study population

The study subject was residents in seventeen municipalities located in the east of Iwate prefecture from February 2009 to May 2011. The study region included twelve general public hospitals. Study teams including cardiologists and trained research nurses retrospectively checked medical charts and obtained information regarding the occurrence of AMI and SCD including age at onset, sex, and date of onset. Furthermore, to capture community cases of SCD, we checked death certificates in government offices within the target district. Cases registered in the study were aged ≥ 20 years and occurring between February 11, 2011 (four weeks before the disaster) and May 5, 2011 (eight weeks after

the disaster), and in the corresponding periods in 2009 and 2010 as a reference.

Disease definitions

AMI was defined according to the criteria of the WHO MONICA Project. According to the WHO criteria for sudden death, SCD was defined as sudden unexpected death. Cases were registered if they met type 1 definition of the MONICA diagnostic AMI criteria.

Approval was obtained from the ethics review board of each participating hospital and Iwate Medical University before commencement of the study.

Statistical analysis

Numbers and characteristics of cases with AMI occurring during the twelve-week period from four weeks before to eight weeks after the day of the earthquake were compared to those during the corresponding periods in the previous two years. For comparison of event incidence before and after the disaster, the relative risk (RR) of AMI incidence and its 95% confidential interval (CI) were calculated from a 2-by-2 table. Furthermore, numbers of AMI cases over these four week periods were analyzed according to sex, age group (< 70 years at onset and ≥ 70 years), and presence of tsunami-induced flooding in more than 10 % of the built-up area. The SI scale of the Japan Meteorological Agency was used. Spearman correlation coefficients were used to examine the association between the scales of weekly maximum SI and weekly incidence of AMI during the twelve-week period. In this analysis, SI scales were substituted with maximum SI measurements taken in each municipality. P values of < 0.05 were considered to be statistically significant.

C. Results

During the four weeks after the disaster (March 11 to April 7, 2011), 96 patients developed AMI corresponding to the MONICA diagnostic criteria. The crude number of AMI cases per 100,000 people has increased after the disaster, and it approximately doubled during the first to fourth weeks after the disaster compared to the corresponding periods in the previous two years. Age, sex, the proportion of diagnostic type of AMI criteria (corresponding to either definite AMI, possible coronary death or unclassifiable SCD) and residential areas of AMI cases did not differ in any period between each year before and after the disaster. The RR for the incidence of AMI during the first four weeks after the disaster was significantly higher compared to the corresponding periods in the previous two years ($p < 0.001$).

We have examined weekly maximum SI and relative risks for weekly incidence of AMI during the twelve weeks before and after the disaster and compared to the corresponding periods in the pre-disaster years. The incidence peaked during the first week after the disaster (RR 2.77, 95% CI 1.73 to 4.43) and then decreased to the levels seen in the preceding years during the second week. The incidence then increased over the following two weeks (RR 1.84, 95% CI 1.05 to 3.24 in the third week; RR 2.00, 95% CI 1.13 to 3.55 in the fourth week). From the fifth week after the disaster, AMI incidence did not differ significantly from the corresponding periods in the previous two years. These trends in weekly incidence of AMI were closely related to the weekly maximum seismic intensity of each earthquake as strong intensity aftershocks

occurred repeatedly during the four weeks after the main shock and then decreased markedly.

We have examined the number of AMI cases over two-day period during the two weeks before and after March 11, 2011 plus the corresponding periods in 2009 and 2010. The number of AMI cases peaked over the first two-day period after the disaster. Compared to the corresponding periods in 2009 and 2010, the increase in events was significant for the first (RR 3.89, 95% CI 1.45 to 10.7) and following two-day periods (RR 5.76, 95% CI 1.70 to 21.4) after the disaster. There was no significant difference in the incidence for any of the two-day period before March 11 between the disaster and pre-disaster years.

D. Discussion

Several reports have investigated the effect of earthquakes on cardiac events, yet the results of those reports have not necessarily been consistent. Three community based studies found increase in cardiac mortality on the basis of death certificate reviews; those related to the 1981 earthquake in Athens, Greece, the 1994 Northridge earthquake in the Los Angeles area, and the 1995 Hanshin-Awaji earthquake in Japan. Hospital based studies have shown less consistent results, with an increase in AMI admissions after the Northridge earthquake, but no increase was observed after the 1989 Loma Prieta earthquake in the San Francisco. These disparate results may be due to the variety of end points analyzed in association with earthquakes of different magnitudes along with differences in case identification methodology. Generally, hospital based registration of AMI incidences cannot capture

out-of-hospital coronary deaths, while the registration of cardiac mortality based on death certificate review cannot necessarily capture every incidence of AMI events. This suggests that previous studies may have had a limited ability to identify earthquake related AMI events.

In contrast to the present study, a population based study after the Newcastle earthquake in Australia found no significant increase in AMI according to the MONICA diagnostic criteria. This discrepancy may have arisen due to the difference in degrees of magnitude of the two disasters, with the Japanese event measuring magnitude 9.0 and the Newcastle earthquake measuring magnitude 5.6. Furthermore, the Newcastle study was conducted among the population aged < 70 years old, while the present study found a higher incidence of earthquake related AMI events in individuals aged 70 years and older.

The relationship found in this analysis between weekly seismic activity and cardiac events (Fig. 1) that occurred in the same week will be relatively novel. This suggests a rapid causal effect in seismic activity, the associated stress and cardiac events. The aftershocks, most of which caused little environmental damage, could apparently also cause significant psychological distress. In addition, residents have experienced physical distress due to environmental situations such as housing damages and a lack of heating. The psychological or physical stressors lead to activation of the sympathetic nervous system and have cardiovascular effects through hemodynamic alterations acting on vulnerable atherosclerotic plaque or hemostatic alterations such as activation of procoagulant

factors. It can be hypothesized that the increased incidence of AMI seen after the earthquake was caused by earthquake induced direct stress rather than by indirect stress induced by environmental damages. However, since the present study did not evaluate different degrees of stress among residents with and without tsunami damages, we cannot provide an explanation for the influence of the tsunami on AMI risk.

The present findings of a correlation between the risk of AMI and the scale of aftershocks suggest that, in large scale earthquakes, it is necessary to recognize the event risk in conjunction with aftershocks as well as the main shock. In this regard, several approaches can be considered for risk prevention. First, medical supports should be maintained after a major earthquake or ensure that such supports are restored as quickly as possible. Lifeline damages and traffic cutoff after disasters would hinder intervention for AMI cases that require an urgent transportation by an ambulance. Second, a preventive approach can be instituted at a public health level with provision of defibrillators and rapid cardiac resuscitation capability to reduce incidences of cardiac death. 20

Study limitations

The present study had several limitations. First, there might have been problems and insecurities in diagnosing AMI events, especially after a major disaster with a strained health care system. In fact, it was impossible to review the medical records of three hospitals located in the survey areas that were flooded by the tsunami. Approximately 6,000 persons, corresponding to 5 % of the study area population, were found dead due to

drowning or missing after the tsunami following the initial earthquake, and those persons may have included the cases of AMI. These could lead to an underestimation of tsunami related AMI risk. Secondly, we have previously reported that the incidence of sudden unexpected death was doubled immediately after the disaster. This observation may be similar to the present study. However, in the previous study, only 16% of sudden unexpected death fulfilled the definition of MONICA-AMI. Third, for analysis of a correlation between SI and overall weekly incidence of AMI, the scale selected for analysis was from the municipality where the maximum SI was recorded. Therefore, these scales may not have reflected the actual SI in each municipality. Finally, although the ascertainment of the case was done according to the standard criteria (MONICA), event classification was not done blinded as the nature of the retrospective study. This could be a limitation for classification of suspected AMI events.

E. Conclusion

This population based study suggests that the increase in AMI events after a major earthquake varies depending on the seismic scale of the initial shock and each aftershock.

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G . 知的財産権の出願・登録状況

- 1 . 特許取得
特になし
- 2 . 実用新案登録
特になし
- 3 . その他
特になし