



# Now is the time to consider reducing the total ischemic time

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The global prevalence of ischemic heart diseases, such as angina pectoris and myocardial infarction, ranks them among the leading causes of mortality [1]. This is also true for South Korea, where cardiovascular diseases have consistently been a major cause of death for nearly a decade. An analysis of the trends of the causes of death in Korea from 2009 to 2019 revealed that malignant neoplasms were the most prevalent, followed by cardiovascular diseases [2]. Notably, when considered as an individual organ disorder, deaths attributable to heart disease were the highest, with a steadily increasing proportion. As such diseases are often preventable, cardiologists and physicians have emphasized appropriate preventative strategies. To comprehensively analyze the causes of cardiovascular diseases and ultimately alleviate their burden, large-scale registry studies of acute myocardial infarction (AMI) have been initiated, such as the Korean Acute Myocardial Infarction Registry-National Institutes of Health (KAMIR-NIH) study [3]. In this context, I would like to provide an opinion on the topic of pre-hospital delay, which absolutely needs to be improved in the future in the treatment of acute myocardial infarction in Koreans, along with a literature review focusing on KAMIR-NIH data.

KAMIR-NIH is a prospective, multicenter, web-based observational cohort study that aims to develop prognostic and monitoring indicators for Korean patients with AMI. It began in November 2011, is partially funded by the Korea Disease Control and Prevention Agency, involves 15 domestic centers, and has enrolled more than 80,000 patients to date. The results, published in more than 400 papers, have significantly contributed to knowledge on the current status of AMI in Korea.

An analysis of the trends in KAMIR-NIH data over the past decade reveals valuable information. Examining the prevalence of AMI during this period, ST-elevation myocardial infarction (STEMI) decreased from 64.3% in 2005 to 48.4% in 2018, while non-ST-elevation myocardial infarction (NSTEMI) increased from 35.7 to 51.6% over the same period [4]. This can be attributed to global trends, in which the widespread use of sensitive assays such as highly sensitive troponin has led to the early detection of myocardial infarction in patients previously considered to have unstable angina, resulting in a decrease in the STEMI/NSTEMI ratio [5]. The average age of AMI patients in Korea has increased gradually from 63.2 years in 2005 to 65.0 years in 2018 [6]. From a cardiovascular risk factor perspective, the prevalences of hypertension, diabetes, and dyslipidemia have increased from 47.9, 28.4, and 11.0% in 2005 to 75.4, 41.8, and 23.0% in 2018. Conversely, smoking has decreased from 43.7 to 36.1% over the same period, although it remains high compared to European registry studies [6,7]. This underscores the ongoing challenge of effectively managing modifiable cardiovascular risk factors in Korea.

Invasive strategies for the treatment of AMI are crucial for improving clinical outcomes, such as mortality. As of 2018, primary percutaneous coronary intervention (PCI) has been performed in 99.1% of STEMI patients in Korea, a significantly higher rate compared to Western countries [4,6]. The proportion of STEMI cases with multivessel disease has remained consistently around 50% over the past decade. For these patients, the implementation of a complete revascularization (CR) strategy is essential [8]. Studies in Korea have also highlighted the benefits of CR [9,10].

Over the last decade, in-hospital mortality due to AMI has gradually decreased from 4.8% in 2005 to 3.8% in 2018 [4]. However, while NSTEMI had an in-hospital mortality of

2.4% in 2018, STEMI remains at 5.3%. The 1-year rate of major adverse cardiac events for AMI in Korea decreased from 20.4% in 2005 to 12.3% in 2018, with STEMI and NSTEMI showing reductions from 20.5 and 20.1% to 13.4 and 11.4%, respectively. In terms of 1-year mortality, both STEMI and NSTEMI have shown a declining trend, with STEMI decreasing from 11.9 to 7.9% and NSTEMI from 10.6 to 6.1%. These rates, while lower than in Western studies, may be influenced by the higher rates of PCI and primary PCI in Korea, as mentioned earlier.

Regarding symptom onset-to-balloon time (SBT) and door-to-balloon time (DBT), the SBT gradually decreased from 257 minutes in 2005 to 189 min in 2018, while DBT decreased from 72 minutes in 2008 but has leveled off at 60 minutes since 2012. Recent European guidelines underscore the significance of total ischemic time, encompassing the duration from symptom onset to revascularization [8]. Total ischemic time has three key components: patient delay, emergency medical service (EMS) delay, and system delay. Patient delay is the interval from symptom onset until the patient seeks emergency care or contacts the EMS, defining the period until the first medical contact. EMS delay refers to the time from EMS contact to arrival at the emergency room, and system delay is the time taken to receive reperfusion therapy, such as thrombolytic therapy or coronary intervention, after reaching the emergency room.

In Korea, the factors contributing to patient delay, the most substantial component of the total ischemic time, include age (taking longer in elderly patients), NSTEMI (those with it), family indifference, being a diabetic without chest pain, and having atypical symptoms such as abdominal pain [11]. Public awareness campaigns and educational initiatives are imperative to enhance patient understanding of AMI symptoms and treatment.

Although EMS and emergency call centers are efficient in Korea, challenges persist with EMS delays due to a shortage of emergency room medical personnel and hospital beds. Collaborative efforts between the government and medical community are essential to formulate strategies to ensure high-quality medical teams and hospitals. Furthermore, the introduction of innovative medical software, for example, to perform electrocardiograms in ambulances and transmit the results to the emergency room in advance for swift AMI diagnosis, could mitigate EMS delays.

While the reduction of DBT to 60 minutes reflects meaningful progress in system delay, driven by commendable ef-

forts of healthcare professionals, it raises questions about the current emphasis on total ischemic time. In recent times, there has been a decline in the count of interventional cardiologists, a phenomenon attributed to the inclination of young doctors to shy away from challenging responsibilities. This trend is not unique to Korea but echoes globally. Given the context of Korea's heavy reliance on primary PCI in AMI treatment, it becomes crucial to institute diverse countermeasures for mitigating system delays. One such measure is to promote thrombolytic therapies as an alternative to primary PCI, aiming to prevent inevitable system delays. Additionally, medical personnel must remain vigilant, always considering the possibility of nonspecific symptoms of AMI.

## REFERENCES

1. GBD 2017 Causes of Death Collaborators. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018;392:1736-1788.
2. Vital Statistics Division, Statistics Korea, Noh H, Seo J, et al. Statistical analysis of the cause of death in Korea in 2019. *J Korean Med Assoc* 2022;65:748-757.
3. Kim JH, Chae SC, Oh DJ, et al.; Korea Acute Myocardial Infarction-National Institutes of Health Registry Investigators. Multicenter cohort study of acute myocardial infarction in Korea - interim analysis of the Korea Acute Myocardial Infarction Registry-National Institutes of Health Registry. *Circ J* 2016;80:1427-1436.
4. Kim Y, Ahn Y, Cho MC, Kim CJ, Kim YJ, Jeong MH. Current status of acute myocardial infarction in Korea. *Korean J Intern Med* 2019;34:1-10.
5. Rogers WJ, Frederick PD, Stoehr E, et al. Trends in presenting characteristics and hospital mortality among patients with ST elevation and non-ST elevation myocardial infarction in the National Registry of Myocardial Infarction from 1990 to 2006. *Am Heart J* 2008;156:1026-1034.
6. Belle L, Cayla G, Cottin Y, et al.; FAST-MI 2015 investigators. French Registry on Acute ST-elevation and non-ST-elevation Myocardial Infarction 2015 (FAST-MI 2015). Design and baseline data. *Arch Cardiovasc Dis* 2017;110:366-378.
7. Chung SC, Gedeberg R, Nicholas O, et al. Acute myocardial infarction: a comparison of short-term survival in national outcome registries in Sweden and the UK. *Lancet* 2014;383:

1305-1312.

8. Byrne RA, Rossello X, Coughlan JJ, et al.; ESC Scientific Document Group. 2023 ESC Guidelines for the management of acute coronary syndromes. *Eur Heart J* 2023;44:3720-3826.
9. Park DW, Clare RM, Schulte PJ, et al. Extent, location, and clinical significance of non-infarct-related coronary artery disease among patients with ST-elevation myocardial infarction. *JAMA* 2014;312:2019-2027.
10. Kim I, Kim MC, Jeong HC, et al. Optimal timing of percutaneous coronary intervention for nonculprit vessel in patients with ST-segment elevation myocardial infarction and multivessel disease. *Korean Circ J* 2017;47:36-43.
11. Lee SR, Jeong MH, Ahn YK, et al.; Korea Acute Myocardial Infarction Registry Investigators. Clinical safety of drug-eluting stents in the Korea acute myocardial infarction registry. *Circ J* 2008;72:392-398.

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**Received** : December 11, 2023

**Accepted** : December 18, 2023

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**Conflicts of interest**

The author discloses no conflicts.

**Funding**

None