Perspective with Antiplatelet and Risk of Major Adverse Cardiac and Cerebrovascular Events in Acute Coronary Syndrome Patients after Percutaneous Coronary Intervention in Indonesia: A Retrospective Cohort Study

Erna Kristin1, Lucia Kris Dinarti2, Alfi Yasmina3, Woro Rukmi Pratiwi1, Rizaldy Taslim Pinzon1, Sudi Indra Jaya1, Sudi Indra Jaya

1Department of Pharmacology and Therapy, Faculty of Medicine Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia; 2Department of Cardiology and Vascular Medicine, Faculty of Medicine Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia; 3Department of Pharmacology, Faculty of Medicine, Universitas Lambung Mangkurat, Indonesia

Abstract

BACKGROUND: Acute coronary syndrome (ACS) is a life-threatening condition that carries high risk of recurrent cardiovascular events and death. Persistence with treatment is known to reduce morbidity and mortality in patients with ACS.

AIM: This study focuses on ACS patients undergoing their first percutaneous coronary intervention (PCI) to investigate the association between persistence with antiplatelet therapy and clinical outcomes.

MATERIALS AND METHODS: A retrospective cohort study with 2 years of follow-up was conducted with 367 patients recruited. Patients were deemed as having persistence with antiplatelet therapy (WHO ATC code: B0A1C), if the gap between prescriptions was ≤30 days. The clinical outcomes were defined as a composite of major adverse cardiac event (MACE), major adverse cardiovascular and cerebrovascular events (MACCE), myocardial infarction, recurrent PCI, stroke, all-cause death, cardiovascular death, and hospitalization.

RESULTS: Cumulative persistence with antiplatelet showed that 72.3% of all ACS patients were still taking antiplatelet 1 year after PCI. Persistence to treatment with antiplatelet therapy can be used as a predictor of MACE and MACCE, because it was associated with recurrent PCI (RR 3.09, 95% CI = 1.18–8.05). History of cardiovascular disease in non-persistence patients was associated with increased risk of MACE (RR 4.90 95% CI = 1.37–17.48) and MACCE (RR 3.67 95% CI = 1.12–11.98) events.

CONCLUSION: After PCI, not all ACS patients continued taking their drug exactly as prescribed. Our study indicates that among ACS patients who underwent their first PCI, non-persistence with antiplatelet therapy might lead to worse clinical outcomes. This data will help promote secondary prevention among ACS patients after PCI.

Introduction

Acute coronary syndrome (ACS) is a life-threatening condition that carries a high risk of recurrent cardiovascular events and death [1]. This condition may worsen in the presence of comorbidities such as diabetes mellitus, hypertension, dyslipidemia, obesity, hematological diseases, and poor lifestyle. A long-term pharmacological approach is essential for secondary prevention. It is therefore vital to ensure the patient’s therapy persistence in this long-term therapy management. The treatment persistence is known to reduce disease morbidity and mortality substantially [2], [3], [4]. This study focuses on the persistence of antiplatelet therapy on ACS patients undergoing their first PCI to investigate the association between persistence with antiplatelet therapy and clinical outcomes. This data will be helpful for policymakers in reviewing ACS management and improve secondary prevention.

Materials and Methods

A retrospective cohort study was conducted to assess the association between persistence with antiplatelet and clinical outcomes in ACS patients undergoing PCI. We used existing medical record data from five hospitals: Dr. Sardjito Hospital, Dr. Moewardi Hospital, Hardjolukito Hospital, Dr. Karyadi Hospital, and Panti Rapih Hospital. Data were collected from
January 2019 to February 2020. The patients’ follow-up was based on data available from the medical records.

The subjects of this study were ACS patients who underwent their first PCI. Inclusion criteria for the study were as follows: (1) 18 years of age or older and (2) patients having PCI procedure for the first time. The exclusion criteria were as follows: (1) incomplete or unavailable medical record data; (2) patients with pregnancy; (3) patients diagnosed with chronic kidney disease; and (4) patients diagnosed with cancer. Patients were defined as having persistence with antiplatelet (WHO ATC code: B0A1C), if the gap between prescriptions was ≤ 30 days. Clinical outcomes were defined as a composite of major adverse cardiac event (MACE), major adverse cardiovascular and cerebrovascular events (MACCE), myocardial infarction, recurrent PCI, stroke, all-cause death, cardiovascular death, and hospitalization. MACE consists of all-cause death, myocardial infarction, and recurrent PCI. MACCE is defined as a composite of recurrent PCI, myocardial infarction, stroke, or all-cause death.

Baseline characteristics of ACS patients undergoing PCI were analyzed descriptively. Categorical data are presented in frequency and proportion, while continuous data are expressed as mean and standard deviation (SD). Persistence to treatment with antiplatelet is presented with the Kaplan–Meier method and stratified by the history of cardiovascular diseases followed by a log-rank test to see if any differences exist.

Association between persistence to treatment with clinical outcomes (MACE, MACCE, myocardial infarction, recurrent PCI, stroke, all-cause death, cardiovascular death, and hospitalization) was analyzed by logistic regression adjusted for age and gender. Subgroup analysis was conducted to evaluate the relationship between treatment persistence and clinical outcomes based on baseline characteristics. The association between non-persistence with antiplatelet and clinical outcomes was reported in the form of relative risk (RR) with 95% confidence interval (CI) and \( p < 0.05 \) set as a significant result. Statistical analysis was performed with Microsoft Excel and SPSS Statistics 23 Version. This research protocol had received ethical approval from the Medical and Health Research Ethics Committee (MHREC) of the Faculty of Medicine, Public Health and Nursing of Universitas Gadjah Mada. This was an observational study using secondary data from medical records so the informed consent was waived.

**Results**

**Baseline characteristics**

ACS patients who underwent PCI that met the inclusion and exclusion criteria in the study were 367 people. Table 1 shows that most of the patients were male (85.0%), with a mean age of 58.8 ± 9.7 years. Most of the patients had an education level of high school or below (62.4%). As many as, 24.0−36.5% of patients had comorbidities (diabetes mellitus, hypertension, and cardiovascular diseases). At baseline, the patients’ mean systolic blood pressure was 131.1 ± 23.5 mmHg and the mean diastolic blood pressure was 80.9 ± 15.1 mmHg. This measurement conforms to the prehypertension category. The majority of the patients (78.5%) were admitted to the hospital through the emergency unit. Most patients showed persistence to treatment with antiplatelet (74.7%).

| Characteristics                  | Total (n = 367), n (%) | Antiplatelet (n = 274), n (%) | NP (n = 93), n (%) |
|----------------------------------|-----------------------|------------------------------|-------------------|
| **Gender**                       |                       |                              |                   |
| Male                             | 312 (85.0)            | 230 (83.9)                   | 82 (88.2)         |
| Female                           | 55 (15.0)             | 44 (16.1)                    | 11 (11.8)         |
| **Age (years), mean ± SD**       | 58.3 ± 9.7            | 59.1 ± 9.9                   | 58.1 ± 9.1        |
| **Education level**              |                       |                              |                   |
| High school or below             | 229 (62.4)            | 170 (62.0)                   | 59 (63.5)         |
| Higher than high school          | 108 (29.2)            | 63 (23.0)                    | 19 (20.4)         |
| No data                          | 56 (15.3)             | 41 (15.0)                    | 15 (16.1)         |
| **Comorbidities**                |                       |                              |                   |
| Diabetes mellitus                | 88 (24.0)             | 60 (21.9)                    | 28 (30.1)         |
| Hypertension                     | 134 (36.5)            | 102 (37.2)                   | 32 (34.4)         |
| Cardiovascular diseases          | 106 (28.9)            | 80 (29.2)                    | 26 (28.0)         |
| Cerebrovascular diseases         | 5 (1.4)               | 4 (1.5)                      | 1 (1.1)           |
| Respiratory diseases             | 16 (4.4)              | 8 (2.9)                      | 8 (8.6)           |
| Gastrointestinal diseases        | 21 (5.7)              | 14 (5.1)                     | 7 (7.5)           |
| **Blood pressure, mean ± SD**    |                       |                              |                   |
| Systolic (mmHg)                  | 131.1 ± 23.5          | 130.8 ± 22.9                 | 132.0 ± 25.4      |
| Diastolic (mmHg)                 | 80.9 ± 15.1           | 80.7 ± 15.1                  | 81.4 ± 15.3       |
| Hospital admission               |                       |                              |                   |
| Emergency unit                   | 288 (78.5)            | 221 (80.7)                   | 67 (72.0)         |
| Outpatient clinic                | 78 (21.3)             | 52 (19.0)                    | 26 (28.0)         |
| No data                          | 1 (0.3)               | 1 (0.4)                      | 0                 |

Table 1: The baseline characteristics of acute coronary syndrome patients undergoing percutaneous coronary intervention

![Persistence with antiplatelet during follow-up for all patients](image)

**Persistence with antiplatelet**

The median follow-up duration for antiplatelet therapy was 8.3 (IQR: 2.2−17.2) months. The Kaplan–Meier curve (Figure 1) shows a rapid (27.7%) decline in cumulative persistence of antiplatelet use in the 1st year before declining gradually until the 4th year. The...
shows that several characteristics tend to increase the adjusted relative risk (RR) value for MACE, as shown in Table 2. Two factors that significantly increase the adjusted RR for MACE are education level of high school or above (RR 4.26, 95% CI = 1.12–11.98), and diastolic blood pressure of ≥ 80 mmHg (RR 2.60, 95% CI = 1.12–6.06).

Table 2: Association between non-persistence with antiplatelet and clinical outcomes

| Clinical outcomes       | Event | Crude RR (95% CI) | Adjusted RR (95% CI)* |
|-------------------------|-------|-------------------|-----------------------|
| MACE                    | 23/274| 1.77 (0.86–3.66)  | 1.72 (0.83–3.57)      |
| MACCE                   | 27/274| 1.99 (0.97–3.71)  | 1.87 (0.96–3.66)      |
| Myocardial infarction   | 14/274| 0.83 (0.27–2.60)  | 0.89 (0.25–2.55)      |
| Recurrent PCI           | 9/274 | 3.15 (1.21–8.21)  | 3.09 (1.18–8.05)      |
| Stroke                  | 7/274 | 3.17 (1.32–7.05)  | 3.11 (0.33–5.29)      |
| Death                   | 1/274 | 0/93 Not analyzed | Not analyzed          |
| Hospitalization         | 52/274| 1.40 (0.80–2.45)  | 1.39 (0.79–2.45)      |

*Adjusted to age and gender. Relative risk marked with bold indicate statistically significant differences in NP group compared to P group. CI: Confidence interval. NP: Non-persistence, P: Persistence, RR: Relative risk, BP: Blood pressure.

Discussion

The results of this retrospective cohort study showed that persistence to treatment with antiplatelet decreased with time. Non-persistence use of antiplatelet therapy was significantly associated with an increased risk of recurrent PCI.

Cumulative persistence of antiplatelet use decreased rapidly to 72.3% in the 1st year, before gradually declined until the 4th year. Compared with other countries, persistence to treatment with antiplatelet in this study is almost comparable to that of antiplatelet persistence in Catalonia (Spain), which decreased to

CI = 1.01–18.01), history of cardiovascular diseases (RR 3.67, 95% CI = 1.12–11.98), and diastolic blood pressure of ≥ 80 mmHg (RR 2.60, 95% CI = 1.12–6.06).

Table 3: The adjusted relative risk of non-persistence with antiplatelet and major adverse cardiac events

| Characteristics          | Event | Crude RR (95% CI) | Adjusted RR (95% CI)* |
|--------------------------|-------|-------------------|-----------------------|
| Education level          |       |                   |                       |
| High school or below     | 16/170| 2.46 (1.09–5.65)  | 2.44 (1.07–5.55)      |
| Higher than high school  | 6/219 | 1.12 (0.21–6.05)  | 1.13 (0.21–6.24)      |
| Hospital admission       |       |                   |                       |
| Emergency unit           | 10/221| 1.24 (0.50–3.09)  | 1.22 (0.49–3.06)      |
| Outpatient clinic        | 4/52  | 3.60 (0.92–14.15) | 4.26 (1.01–18.01)     |
| History of hypertension  |       |                   |                       |
| Yes                      | 7/102 | 1.97 (0.86–5.81)  | 2.63 (0.83–8.31)      |
| No                       | 10/172| 1.36 (0.52–3.50)  | 1.28 (0.49–3.33)      |
| History of diabetes mellitus |   |                   |                       |
| Yes                      | 5/80  | 2.71 (1.88–5.39)  | 4.90 (1.37–17.48)     |
| No                       | 16/194| 0.96 (0.36–2.53)  | 0.97 (0.37–2.58)      |
| Systolic BP (mmHg)       |       |                   |                       |
| ≥130                     | 11/102| 1.97 (0.68–5.74)  | 1.93 (0.66–5.70)      |
| No                       | 16/172| 1.59 (0.59–4.27)  | 1.57 (0.58–4.25)      |
| Diastolic BP (mmHg)      |       |                   |                       |
| ≥80                      | 13/160| 2.08 (0.84–5.16)  | 1.95 (0.75–4.88)      |
| No                       | 10/113| 1.33 (0.39–4.53)  | 1.22 (0.35–4.24)      |

*Adjusted to age and gender. Relative risk marked with bold indicate statistically significant differences in NP group compared to P group. CI: Confidence interval. NP: Non-persistence, P: Persistence, RR: Relative risk, BP: Blood pressure.

Table 4: The adjusted relative risk of non-persistence with antiplatelet and MACCE

| Characteristics          | Event | Crude RR (95% CI) | Adjusted RR (95% CI)* |
|--------------------------|-------|-------------------|-----------------------|
| Education level          |       |                   |                       |
| High school or below     | 16/170| 2.46 (1.09–5.65)  | 2.44 (1.07–5.55)      |
| Higher than high school  | 6/219 | 1.12 (0.21–6.05)  | 1.13 (0.21–6.24)      |
| Hospital admission       |       |                   |                       |
| Emergency unit           | 10/221| 1.24 (0.50–3.09)  | 1.22 (0.49–3.06)      |
| Outpatient clinic        | 4/52  | 3.60 (0.92–14.15) | 4.26 (1.01–18.01)     |
| History of hypertension  |       |                   |                       |
| Yes                      | 7/102 | 1.97 (0.86–5.81)  | 2.63 (0.83–8.31)      |
| No                       | 10/172| 1.36 (0.52–3.50)  | 1.28 (0.49–3.33)      |
| History of diabetes mellitus |   |                   |                       |
| Yes                      | 5/80  | 2.71 (1.88–5.39)  | 4.90 (1.37–17.48)     |
| No                       | 16/194| 0.96 (0.36–2.53)  | 0.97 (0.37–2.58)      |
| Systolic BP (mmHg)       |       |                   |                       |
| ≥130                     | 11/102| 1.97 (0.68–5.74)  | 1.93 (0.66–5.70)      |
| No                       | 16/172| 1.59 (0.59–4.27)  | 1.57 (0.58–4.25)      |
| Diastolic BP (mmHg)      |       |                   |                       |
| ≥80                      | 13/160| 2.08 (0.84–5.16)  | 1.95 (0.75–4.88)      |
| No                       | 10/113| 1.33 (0.39–4.53)  | 1.22 (0.35–4.24)      |

*Adjusted to age and gender. Relative risk marked with bold indicate statistically significant differences in NP group compared to P group. CI: Confidence interval. NP: Non-persistence, P: Persistence, RR: Relative risk, BP: Blood pressure.
73% at 1 year after PCI [5]. A study in Finland also showed a similar trend, with ~75% of ACS patients still taking antiplatelet drugs at 1 year after the diagnosis was made [6]. On the other hand, a study in Belgium with 295 ACS patients found that treatment persistence with oral antiplatelet after an ACS at 360 days from hospital discharge was 73% [7]. Persistence with antiplatelet drug use in the Netherlands tends to be higher, that is, 84.0% at 1 year after myocardial infarction [8]. Another study in French reported 50.9% persistence with dual antiplatelet therapy during a 12-month period after hospitalization in patients admitted with myocardial infarction and PCI [9]. Another report from Vietnam National Heart Institute also showed similar results on persistence with antiplatelet therapy at 46.29% after 12 months of hospital discharge in patients with myocardial infarction and PCI [10]. Meanwhile, in China, persistence with antiplatelet therapy was found to be lower. Nearly 85% of patients had discontinued antiplatelet by the end of the study, with a time-to-discontinuation of 117.4 ± 119.7 days [11].

However, a subgroup analysis done in this study showed that the cumulative persistence of antiplatelet therapy did not significantly affect the history of cardiovascular diseases. The results of this study are different from the previous studies, in which older age, female gender, history of hypertension, history of hyperlipidemia, history of atrial fibrillation, and history of ACS event were associated with increased risk of non-persistence with antiplatelet therapy [5], [6]. Even though the history of cardiovascular diseases did not significantly affect antiplatelet persistence in this study, it still needs to be considered in the management of ACS patients undergoing PCI. A study in Poland had found that previous diagnosis of coronary artery disease, previous myocardial infarction, prior PCI, or coronary artery bypass graft was associated with the decrease in persistence to treatment [12]. Another study with clopidogrel, an antiplatelet drug, reported that non-persistence was significantly associated with prior use of clopidogrel, prior all-cause hospitalization, PCI without stenting, chronic pulmonary disease, younger age, and diabetes [13].

This study indicated that non-persistence with antiplatelet was associated with the incidence of recurrent PCI. The results of this study were consistent with the results of a study on a population of PCI patients in the United States from the PARIS Registry, which showed that discontinuation of dual antiplatelet therapy (DAPT) for > 30 days after PCI was associated with increased MACE (RR 1.61, 95% CI = 1.20-2.17) [14]. Another insight highlighted from PARIS Registry was that in patients with DAPT disruption due to non-compliance, higher MACE rates [hazard ratio (HR):1.73, 95% CI = 1.17–2.54] were found [15]. A study in China also added that non-persistence with guideline-recommended medications was associated with a 2-fold higher odds of MACEs [16]. Studies in the PARIS Registry also showed that in the context of time after PCI, they saw that the risk of adverse cardiac events was highest in the first 6 months after intervention [17].

The previous studies have also shown several characteristics that are significantly associated with recurrent cardiovascular events in STEMI or coronary artery disease patients undergoing PCI, such as the history of previous cardiovascular diseases, history of diabetes mellitus, and history of hypertension, older age, smoking, stent length, and hyperlipidemia[18], [19], [20], [21], [22]. These results were similar to those found in this study that a history of cardiovascular diseases increased the adjusted RR for MACE and MACCE events.

The present study does have some limitations. One major limitation is due to the medical record data used in this study. There were possibilities of coding errors and incomplete information about patients' characteristics that might be relevant for the study, and thus might limit the generalizability of the results.

Conclusion

After PCI, not all ACS patients continued taking their drug exactly as prescribed. This study showed that only 72.3% of ACS patients continued taking antiplatelet 1 year after PCI. Patients who were non-persistent with antiplatelet therapy had a relative risk of recurrent PCI 3.09 times higher than those who were persistent with antiplatelet therapy. Persistence with antiplatelet can be a predictor of clinical outcomes in ACS patients undergoing their first PCI. Although there were some limitations, this study provides real-world evidence that assists in discovering the association between persistence with antiplatelet therapy and clinical outcomes, which may promote secondary prevention for ACS patients after PCI.

Acknowledgement

This study was funded by PT Pfizer Indonesia. The funders had no role in study design, data collection, analysis, interpretation of data, decision to publish, or preparation of the manuscript. The authors thank the director and staff of Dr. Sardjito Hospital, Dr. Moewardi Hospital, Hardjolukito Hospital, Dr. Karyadi Hospital, and Panti Rapih Hospital, whose support and collaboration made this study possible.
References

1. Devon HA. Typical and atypical symptoms of acute coronary syndrome: Time to retire the terms? J Am Heart Assoc. 2020;9(7):e015539. https://doi.org/10.1161/jaha.119.015539 PMid:32208828

2. Anderson JL. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: A report of the American college of cardiology foundation/American heart association task force on practice guidelines. Circulation. 2013;127(4):362-425. https://doi.org/10.1001/jama.2012.147810 PMid:23247304

3. Amsterdam EA, Wenger NK, Brindis RG, Casey DE, Ganiats TG, Holmes DR, et al. 2014 AHA/ACC Guideline for the management of patients with non-ST-elevation acute coronary syndromes: Executive summary: A report of the American college of cardiology/American heart association task force on practice guidelines. Circulation. 2014;130(25):2354-94. https://doi.org/10.1161/circ.0000000000000133 PMid:25249586

4. Perhimpunan Dokter Spesialis Kardiovaskular Indonesia (PERKI). Pedoman Tata Laksana Sindrom Koroner Akut 2018. Indonesia: Perhimpunan Dokter Spesialis Kardiovaskular Indonesia; 2018. p. 76. https://doi.org/10.30701/jic. v353.431

5. Ribera A, Ferreira-Gonzalez I, Marsal JR, Oristrell G, Faixedas MT, Rosas A, et al. Persistence with dual antiplatelet therapy after percutaneous coronary intervention for ST-segment elevation acute coronary syndrome: A population-based cohort study in Catalonia (Spain). BMJ Open. 2019;9(7):e028114. https://doi.org/10.1136/bmjopen-2018-028114 PMid:31340064

6. Prami T, Khanfir H, Deleskog A, Hasvold P, Kytö V, Reissell E, et al. Clinical factors associated with initiation of and persistence with ADP receptor-inhibiting oral antiplatelet treatment after acute coronary syndrome: A nationwide cohort study from Finland. BMJ Open. 2016;6(11):e012604. https://doi.org/10.1136/bmjopen-2016-012604 PMid:27881527

7. Claeyss MJ, Beauloye C, Pourbaix S, Sinnaeve PR. Real world insights on the initiation and treatment duration of oral antiplatelets in acute coronary syndromes: A retrospective cohort study. Eur Heart J Cardiovasc Pharmacother. 2017;3(4):189-97. https://doi.org/10.1007/s41060-017-0043-2 PMid:28122793

8. Yasmina A, de Boer A, Denev VH, Souverein PC, Klungel OH. Patterns of antiplatelet drug use after a first myocardial infarction during a 10-year period. Br J Clin Pharmacol. 2017;83(3):632-41. https://doi.org/10.1111/bcp.13139 PMid:27662521

9. Latry P, Martin-Latry K, Lafitte M, Peter C, Couffhinal T. Dual antiplatelet therapy after myocardial infarction and percutaneous coronary intervention: Analysis of patient adherence using a French health insurance reimbursement database. Eurointervention. 2012;7(12):1413-9. https://doi.org/10.4244/eijv72ia221 PMid:22522552

10. Luu X, He X, Wu J, Luo D. Initiation and persistence with antiplatelet agents among the patients with acute coronary syndromes: A retrospective, observational database study in China. Patient Prefer Adherence. 2019;13:2159-69. https://doi.org/10.2147/paa.s228065 PMid:31908423

11. Liu X, He X, Wu J, Luo D. Initiation and persistence with antiplatelet agents among the patients with acute coronary syndromes: A retrospective, observational database study in China. Patient Prefer Adherence. 2019;13:2159-69. https://doi.org/10.2147/paa.s228065 PMid:31908423

12. PietrzynowskiI, MichalskiP, KosobuckaA, KasprzakM, FabiszakT, StolarekW, et al. Medication adherence and its determinants in patients after myocardial infarction. Sci Rep. 2020;10(1):12028. https://doi.org/10.1038/s41598-020-68915-1 PMid:32694522

13. Zhu B, Zhao Z, McCollam P, Anderson J, Bae JP, Fu H, et al. Factors associated with clopidogrel use, adherence, and persistence in patients with acute coronary syndromes undergoing percutaneous coronary intervention. Curr Med Res Opin. 2011;27(3):633-41. https://doi.org/10.1186/s00079-2010-55167-7 PMid:21241206

14. Vogel B, Chandrasekhar J, Baber U, Mastoris I, Sartori S, Aquino M, et al. Geographical variations in patterns of DAPT cessation and two-year PCI outcomes: Insights from the PARIS registry. Thromb Haemost. 2019;119(10):1704-11. https://doi.org/10.1055/s-0039-1693463 PMid:31365942

15. Moalem K, Baber U, Chandrasekhar J, Claessen BE, Sartori S, Aquino M, et al. Incidence, predictors, and outcomes of DAPT disruption due to non-compliance vs. bleeding after PCI: Insights from the PARIS registry. Clin Res Cardiol. 2019;108(6):643-50. https://doi.org/10.1077/a00392-018-1392-2 PMid:30607496

16. Hou Y, Yue Y, Zhao M, Jiang S. Prevalence and association of medication nonadherence with major adverse cardiovascular events in patients with myocardial infarction. Medicine (Baltimore). 2019;98(44):e17826. https://doi.org/10.1097/md.00000000000017826 PMid:31689870

17. Mehran R, Baber U, Steg PG, Antl C, Weiss G, Wintenbichler B, et al. Cessation of dual antiplatelet treatment and cardiac events after percutaneous coronary intervention (PARIS): 2 year results from a prospective observational study. Lancet. 2013;382(9906):1714-22. https://doi.org/10.1016/s0140-6736(13)61720-1 PMid:24004642

18. Farhadian M, Karsidani SD, Mozayanimonfared A, Mahjub H. Risk factors associated with major adverse cardiac and cerebrovascular events following percutaneous coronary intervention:A 10-year follow-up comparing random survival forest and Cox proportional-hazards model. BMC Cardiovasc Disord. 2021;21(1):38. https://doi.org/10.1186/s12872-020-01834-1

19. Huynh T, Montigny M, Iftikhar U, Gagnon R, Eisenberg M, Lauzon C, et al. Recurrent cardiovascular events in survivors of myocardial infarction with ST-segment elevation (from the AMI-QUEBEC study). Am J Cardiol. 2018;121(8):897-902. https://doi.org/10.1016/j.amjcard.2017.12.037 PMid:29452691

20. Tsai IT, Wang CP, Lu YC, Hung WC, Wu CC, Lu LF, et al. The burden of major adverse cardiac events in patients with coronary artery disease. BMC Cardiovasc Disord. 2017;17(1):1. https://doi.org/10.1186/s12872-016-0436-7 PMid:28052754

21. Park KH, Ahn Y, Jeong MH, Chae SC, Hur SH, Kim YJ, et al. Different impact of diabetes mellitus on in-hospital and 1-year mortality in patients with acute myocardial infarction who underwent successful percutaneous coronary intervention: Results from the Korean acute myocardial infarction registry. Korean J Intern Med. 2012;27(2):180-8. https://doi.org/10.3904/kjim.2012.27.2.180 PMid:22707890

22. Ali WM, Zubaid M, El-Menyar A, Al Mahmeed W, Al-Lwati J, Singh R, et al. The prevalence and outcome of hypertension in patients with acute coronary syndrome in six Middle-Eastern countries. Blood Press. 2011;20(1):20-6. https://doi.org/10.3109/08037051.2010.518673 PMid:20843191