consistent with those of the current analysis. From these clinical trials, the recommendation of routine TA in the current guideline should be reconsidered. However, the clinical efficacy of TA cannot be totally denied and further investigation evaluating the clinical benefit of selective TA should be performed. In some selective cases, TA could facilitate the primary PCI procedure by more clearly delineating the true lesion length for appropriate stenting. In addition, one of the most important findings in the TOTAL trial is an increased rate of stroke. The safety concern about stroke associated with TA should also be investigated in future studies.

**Limitations**

Our study has several limitations. First, this is not a randomized control trial but an observational study. The indication of TA was at the discretion of the operator or of the hospital, so that outcomes might be affected by the effect of the operator's skill or of the hospital's practice level. In addition, baseline patient characteristics differed significantly between the TA and non-TA groups. Despite the appropriate statistical adjustment for potential confounders, unmeasured confounding factors might have influenced the results of the current study. Second, the current study did not evaluate detailed angiographic findings such as thrombus burden or myocardial blush grade. Third, as Glycoprotein (GP) IIa/IIIb inhibitors are not currently available in Japan, much caution is required in generalizing these results to patients outside Japan.

**Conclusions**

Adjunctive TA during primary PCI was not associated with better five-year mortality in

STEMI patients with primary PCI.

**Acknowledgements**

We appreciate the support and collaboration of the co-investigators participating in the CREDO-Kyoto AMI registry. We are indebted to the outstanding effort of the clinical research coordinators for data collection.

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**Disclosures**

None of the authors have conflict of interest to disclose regarding this manuscript.

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**Figure titles and legends**

**Figure 1:** Study flow chart

CREDO-Kyoto AMI registry=Coronary Revascularization Demonstrating Outcome Study in Kyoto Acute Myocardial Infarction registry; AMI=acute myocardial infarction; CABG=coronary artery bypass grafting; NSTEMI=non-ST-segment elevation myocardial infarction; PCI=percutaneous coronary intervention; STEMI=ST-segment elevation myocardial infarction; TA=thrombus aspiration

**Figure 2:** Crude and Adjusted Kaplan-Meier curves for cumulative incidence of all-cause death

TA=thrombus aspiration

**Figure 3:** Subgroup analyses and forest plots of hazard ratio for all-cause death

LAD=left anterior descending; PCI=percutaneous coronary intervention; TA=thrombus aspiration; TIMI=Thrombolysis In Myocardial Infarction

## Tables

### Table 1: Baseline patient characteristics-TA group versus non-TA group

| Variables | TA group N=2239 | non-TA group N=1297 | p value |
|---|---|---|---|
| **Clinical characteristics** | | | |
| Age | 66.6±12 | 68.9±12.1 | <0.001 |
| *†>75years | 640(28.6%) | 451(34.8%) | <0.001 |
| *Male gender | 1700(75.9%) | 933(71.9%) | 0.009 |
| Body mass index | 23.8±3.5 | 23.3±3.4 | <0.001 |
| *†<25.0kg/m2 | 1557(69.5%) | 977(75.3%) | <0.001 |
| *†Hypertension | 1749(78.1%) | 1011(77.9%) | 0.91 |
| Diabetes mellitus | 659(29.4%) | 459(35.4%) | <0.001 |
| *†on insulin therapy | 83(3.7%) | 72(5.6%) | 0.01 |
| *Current smoking | 953(42.6%) | 492(37.9%) | 0.007 |
| *†Previous heart failure | 686(30.6%) | 422(32.5%) | 0.24 |
| *†Multivessel disease | 1054(47.1%) | 738(56.9%) | <0.001 |
| *†Mitral regurgitation3-4/4 | 55(2.5%) | 43(3.3%) | 0.14 |
| *Previous myocardial infarction | 196(8.8%) | 129(9.9%) | 0.24 |
| *†Previous stroke | 175(7.8%) | 136(10.5%) | 0.008 |
| *Peripheral vascular disease | 65(2.9%) | 42(3.2%) | 0.58 |
| Previous PCI or CABG | 215(9.6%) | 121(9.3%) | 0.79 |
| *†eGFR<30, without hemodialysis | 79(3.5%) | 62(4.8%) | 0.07 |
| *†Hemodialysis | 19(0.9%) | 29(2.2%) | <0.001 |
| *†Atrial fibrillation | 224(10.0%) | 114(8.8%) | 0.23 |
| *Anemia(hemoglobin<11.0g/dl) | 185(8.3%) | 136(10.5%) | 0.03 |
| *†Thrombocytopenia(Platelet < 100*109/L) | 42(1.9%) | 28(2.2%) | 0.56 |
| *COPD | 69(3.1%) | 41(3.2%) | 0.90 |
| *†Liver cirrhosis | 52(2.3%) | 32(2.5%) | 0.79 |
| *†Malignancy | 173(7.7%) | 118(9.1%) | 0.16 |
| **Presentation** | | | |
| Killip class<=2 | 1873(83.7%) | 1053(81.2%) | 0.06 |
| *†Killip class4 | 324(14.5%) | 206(15.9%) | 0.26 |
| *Initial TIMI flow grade=0 | 1620(72.4%) | 664(51.2%) | <0.001 |
| Total ischemic time(median hours) | 2.0(1.0-3.9) | 2.3(1.1-4.4) | 0.004 |
| IABP use | 369(16.5%) | 218(16.8%) | 0.80 |
| PCPS use | 62(2.8%) | 39(3.0%) | 0.68 |

| | | | |
|---|---|---|---|
| **Lesion and procedural characteristics** | | | |
| Infarcted area | | | <0.001 |
| Anterior wall | 961(42.9%) | 701(54.0%) | |
| Inferior wall | 1066(47.6%) | 397(30.6%) | |
| Lateral wall | 36(1.6%) | 73(5.6%) | |
| Unprotected LMCA | 79(3.5%) | 84(6.5%) | <0.001 |
| Chronic total occlusion | 207(9.3%) | 171(13.2%) | <0.001 |
| Target lesion | | | |
| *†Unprotected LMCA | 62(2.8%) | 60(4.6%) | 0.004 |
| *Proximal LAD | 1146(51.2%) | 767(59.1%) | <0.001 |
| LAD | 1184(52.9%) | 825(63.6%) | <0.001 |
| LCX | 394(17.6%) | 278(21.4%) | <0.001 |
| RCA | 1188(53.1%) | 522(40.2%) | <0.001 |
| *†Bifurcated lesion | 533(23.8%) | 383(29.5%) | <0.001 |
| *Chronic total occlusion | 61(2.7%) | 50(3.9%) | 0.07 |
| *Side-branch stenting | 58(2.6%) | 52(4.0%) | 0.02 |
| Implanted stents | | | |
| mean ±SD | 1.6±1.0 | 1.8±1.2 | <0.001 |
| median(IQR) | 1(1-2) | 1(1-2) | |
| Total stent length | | | |
| mean ±SD | 34.0±23.1 | 36.8±27.7 | 0.48 |
| median(IQR) | 24(18-42) | 27(18-44) | |
| * >28mm | 839(40.4%) | 517(44.6%) | 0.02 |
| Minimal stent diameter | | | |
| mean ±SD | 3.1±0.5 | 2.9±0.4 | <0.001 |
| median(IQR) | 3.0(3.0-3.5) | 3.0(2.5-3.0) | |
| *< 3.0mm | 513(24.7%) | 476(41.1%) | <0.001 |
| Distal Protection | 249(11.1%) | 26(2.0%) | <0.001 |
| **Medication at discharge** | | | |
| Aspirin | 2210(98.7%) | 1272(98.1%) | 0.15 |
| Thienopyridine | 2157(96.3%) | 1204(92.8%) | <0.001 |
| *Cilostazole | 823(36.8%) | 448(34.5%) | 0.19 |
| *†Statin | 1220(54.5%) | 671(51.7%) | 0.11 |
| *†ACE-I/ARB | 1654(73.9%) | 898(69.2%) | 0.003 |
| *†β blocker | 946(42.3%) | 517(39.9%) | 0.16 |
| *Calcium channel blocker | 397(17.7%) | 307(23.7%) | <0.001 |
| *†Nitrate | 622(27.8%) | 402(31.0%) | 0.04 |
| *†Nicorandil | 595(26.6%) | 406(31.3%) | 0.003 |

| | | | |
|---|---|---|---|
| *Warfarin | 264(11.8%) | 123(9.5%) | 0.03 |
| *PPI | 786(35.1%) | 406(31.3%) | 0.02 |
| *H2 blocker | 760(33.9%) | 429(33.1%) | 0.60 |

Categorical variables are expressed as number (%) unless otherwise indicated. Continuous variables are shown as mean±SD or median (interquartile range).

* Potential independent variables selected for multivariable analysis.

† Potential independent variables selected for multivariable analysis in the specific subgroups.

PCI=percutaneous coronary intervention; CABG=coronary artery bypass grafting; eGFR=estimated glomerular filtration rate; COPD=chronic obstructive pulmonary disease; TIMI=Thrombolysis in Myocardial Infarction; IABP=intra-aortic balloon pumping; PCPS=percutaneous cardiopulmonary support; LMCA=left main coronary artery; LAD=left anterior descending; LCX=left circumflex; RCA=right coronary artery; SD=standard deviation; IQR=interquartile range; ACE-I/ARB=angiotensin converting enzyme inhibitor/angiotensin receptor blocker; PPI=proton pomp inhibitor

**Table 2: Crude and Adjusted 5-year clinical outcomes-TA group versus non-TA group**

| | TA group No. of events (Cumulative incidence) N=2239 | Non-TA group No. of events (Cumulative incidence) N=1297 | Crude HR (95%CI) | p value | Adjusted HR (95%CI) | p value |
|---|---|---|---|---|---|---|
| All-cause death | 393(18.5%) | 297(23.9%) | 0.74 (0.67-0.86) | <0.001 | 0.90 (0.76-1.06) | 0.21 |
| Cardiac death | 239(11.1%) | 180(14.5%) | 0.78 (0.65-0.95) | 0.01 | 0.99 (0.79-1.24) | 0.91 |
| Non-cardiac death | 154(8.3%) | 117(11.0%) | 0.68 (0.54-0.85) | <0.001 | 0.78 (0.62-1.03) | 0.08 |
| Myocardial infarction | 115(5.9%) | 78(7.1%) | 0.83 (0.63-1.09) | 0.18 | 0.88 (0.65-1.20) | 0.42 |
| Stent thrombosis | 55(2.6%) | 33(2.9%) | 0.91 (0.60-1.40) | 0.68 | 0.92 (0.59-1.45) | 0.71 |
| Stroke | 108(5.5%) | 77(7.0%) | 0.74 (0.56-0.98) | 0.03 | 0.79 (0.58-1.10) | 0.16 |
| TLR | 436(21.6%) | 294(25.8%) | 0.82 (0.71-0.95) | 0.01 | 0.90 (0.76-1.07) | 0.23 |

Cumulative incidence was estimated by the Kaplan-Meier method.

TA=thrombus aspiration; HR=hazard ratio; CI=confidence interval; TLR=target lesion revascularization

**Figure 1**

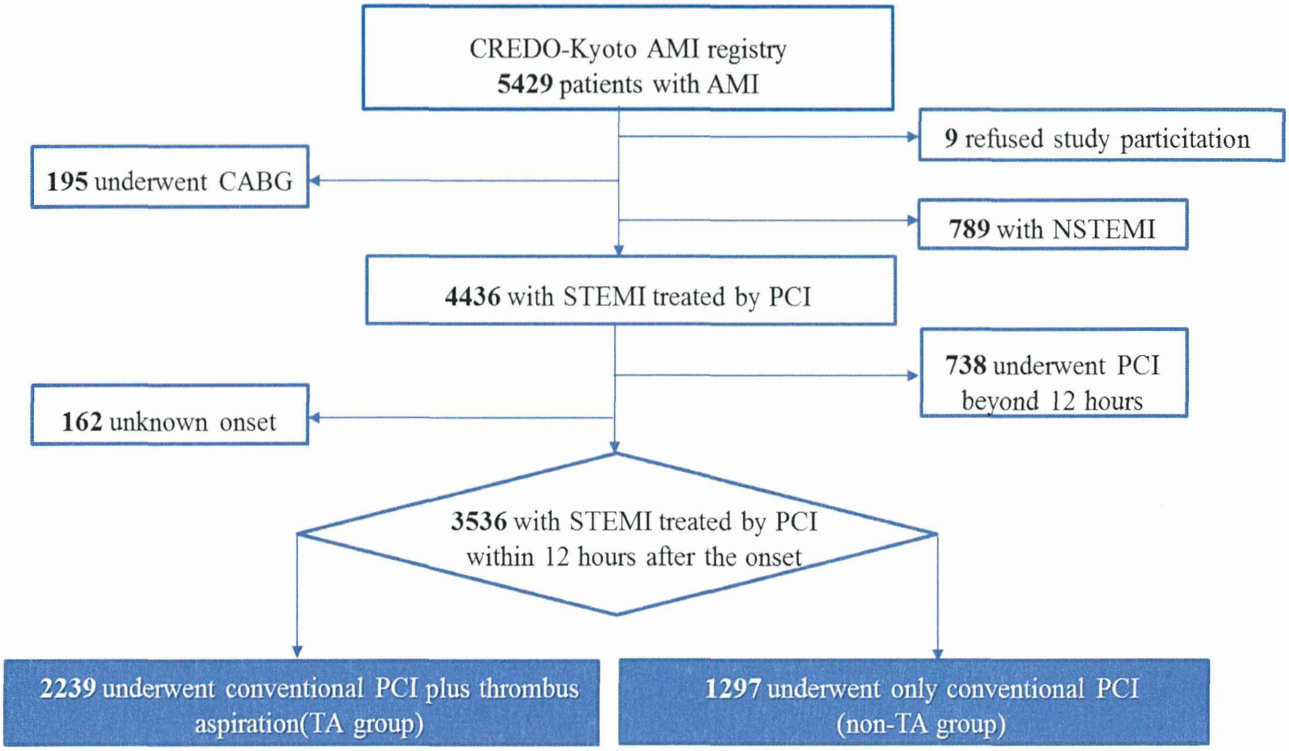
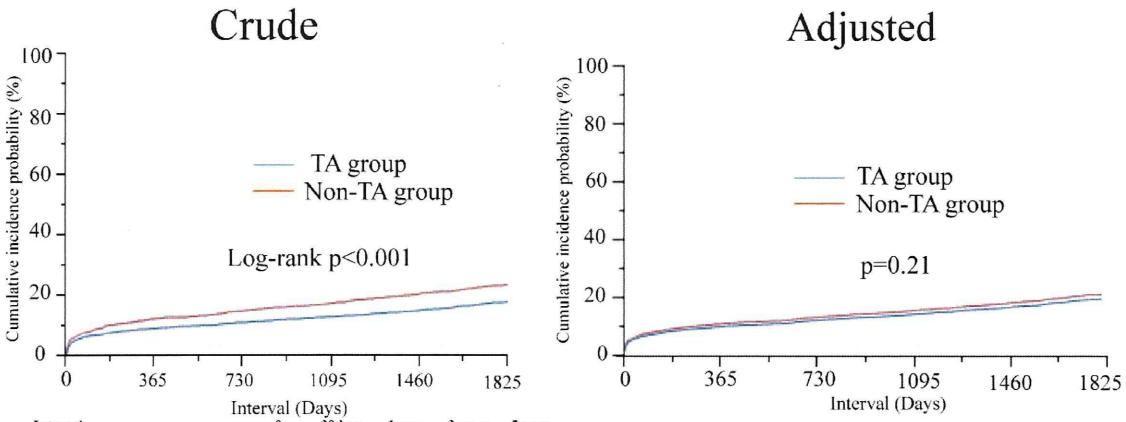

CREDO-Kyoto AMI registry
5429 patients with AMI
9 refused study particitation
195 underwent CABG
789 with NSTEMI
4436 with STEMI treated by PCI
738 underwent PCI beyond 12 hours
162 unknown onset
3536 with STEMI treated by PCI within 12 hours after the onset
2239 underwent conventional PCI plus thrombus aspiration(TA group)
1297 underwent only conventional PCI (non-TA group)

**Figure 2**





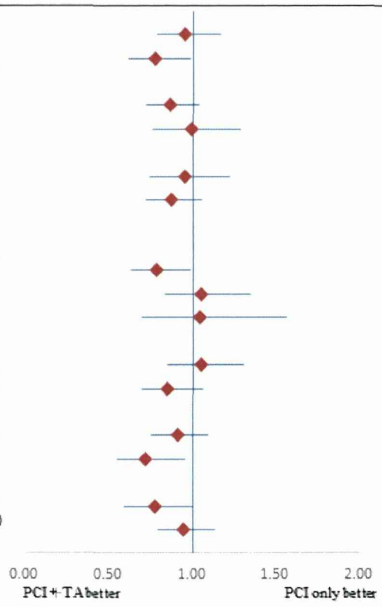


| Interval | 0 | 30days | 1year | 3years | 5years |
|---|---|---|---|---|---|
| **Thrombus aspiration** | | | | | |
| No of patients with at least one event | 0 | 122 | 213 | 295 | 393 |
| No of patients at risk | 2239 | 2106 | 1992 | 1851 | 1175 |
| Cumulative incidence probability | | 5.5% | 9.6% | 13.3% | 18.5% |
| **Non-thrombus aspiration** | | | | | |
| No of patients with at least one event | 0 | 85 | 164 | 228 | 297 |
| No of patients at risk | 1297 | 1210 | 1114 | 1019 | 636 |
| Cumulative incidence probability | | 6.6% | 12.7% | 17.8% | 23.9% |

| Interval | 1year | 3years | 5years |
|---|---|---|---|
| **Thrombus aspiration** | | | |
| Cumulative incidence probability | 10.0% | 14.3% | 19.7% |
| **Non-thrombus aspiration** | | | |
| Cumulative incidence probability | 10.9% | 15.5% | 21.3% |

## Figure 3

| Variables | TA group No. of events /No. of patients (Cumulative Incidence) N=2239 | Non-TA group No. of events /No. of patients (Cumulative Incidence) N=1297 | Adjusted Hazard Ratio (95%CI) | p value | Interaction p value |
|---|---|---|---|---|---|
| Age | | | | | |
| >=75 years old | 250/640(39.1%) | 193/451(42.8%) | 0.95(0.78-1.16) | 0.60 | 0.11 |
| <75 years old | 176/1599(11.0%) | 131/846(15.5%) | 0.77(0.61-0.98) | 0.03 | |
| Male | 280/1700(16.5%) | 216/933(23.1%) | 0.86(0.72-1.03) | 0.10 | 0.08 |
| Female | 146/539(27.1%) | 108/364(29.7%) | 0.99(0.76-1.28) | 0.92 | |
| Diabete mellitus(+) | 139/659(21.1%) | 127/459(27.7%) | 0.95(0.74-1.22) | 0.69 | 0.90 |
| Diabete mellitus(−) | 287/1580(18.2%) | 197/838(23.5%) | 0.87(0.72-1.05) | 0.14 | |
| Total ischemic time | | | | | |
| <=2hours | 178/1132(16.5%) | 139/601(23.7%) | 0.78(0.63-0.98) | 0.03 | 0.24 |
| 2-6 hours | 158/821(20.4%) | 110/501(23.2%) | 1.05(0.83-1.34) | 0.67 | |
| 6-12hours | 57/286(20.6%) | 48/195(26.1%) | 1.04(0.69-1.56) | 0.87 | |
| Culprit lesion | | | | | |
| LAD culprit | 200/958(20.9%) | 185/694(26.7%) | 1.05(0.85-1.30) | 0.64 | 0.99 |
| Non-LAD culprit | 226/1281(17.6%) | 139/603(23.1%) | 0.85(0.69-1.06) | 0.16 | |
| Initial TIMI grade 0 | 340/1620(21.0%) | 179/664(27.0%) | 0.91(0.75-1.09) | 0.30 | 0.13 |
| Initial TIMI grade 1-3 | 86/619(13.9%) | 145/633(22.9%) | 0.72(0.55-0.95) | 0.02 | |
| Killip class4(cardiogenic shock) | 142/324(43.8%) | 111/206(53.9%) | 0.77(0.59-0.99) | 0.045 | 0.55 |
| Killip class1-3 | 284/1915(14.8%) | 213/1091(19.5%) | 0.94(079-1.13) | 0.53 | |



## Supplemental Appendix A: List of Participating Centers and Investigators for the CREDO-Kyoto AMI Registry

Kyoto University Hospital: Takeshi Kimura, Ryuzo Sakata, Akira Marui

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# Comparison of Long-Term Mortality After Acute Myocardial Infarction Treated by Percutaneous Coronary Intervention in Patients Living Alone Versus Not Living Alone at the Time of Hospitalization

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**Living alone was reported to be associated with increased risk of cardiovascular disease. There are, however, limited data on the relation between living alone and all-cause mortality in patients with acute myocardial infarction (AMI) undergoing percutaneous coronary intervention (PCI). The Coronary REvascularization Demonstrating Outcome Study in Kyoto (CREDO-Kyoto) AMI registry was a cohort study of patients with AMI enrolled in 26 hospitals in Japan from 2005 through 2007. For the current analysis, we included those patients who underwent PCI within 24 hours of symptom onset, and we assessed their living status to determine if living alone would be an independent prognostic risk factor. Among 4,109 patients eligible for the current analysis of 5,429 patients enrolled in the CREDO-Kyoto AMI registry, 515 patients (12.5%) were living alone at the time of hospital admission. The cumulative 5-year incidence of all-cause death was 18.3% in the living alone group and 20.1% in the not living alone group (log-rank p = 0.77). After adjusting for potential confounders, risk of the living alone group relative to the not living alone group for all-cause death was not significantly different (adjusted hazard ratio 0.82, 95% confidence interval 0.65 to 1.02, p = 0.08). In a subgroup analysis stratified by age, the adjusted risk for all-cause death was also not different between the living alone group and the not living alone group both in the older population (aged ≥75 years) and the younger population (aged <75 years). In conclusion, living alone was not associated with higher long-term mortality in patients with AMI who underwent PCI.**  **(Am J Cardiol 2014;114:522–527)**

Living alone was reported to be associated with increased risk of cardiovascular disease[1–4] and poorer clinical outcomes after acute myocardial infarction (AMI).[5–10] However, the proportion of patients who had undergone percutaneous coronary intervention (PCI) was small in these studies. Indeed, some of the recent studies reported no significant association between living alone and mortality after AMI.[11,12] Therefore, the association between living alone and long-term mortality in patients with AMI undergoing PCI in the current real-world clinical practice is controversial. Additionally, living alone in older patients is an important welfare issue in rapidly aging societies. However, little is known about the influence of living alone in older patients on clinical outcomes after AMI. The aim of this study was to determine whether living alone is an independent prognostic risk factor for long-term mortality in patients with AMI who underwent PCI within 24 hours of symptom onset in the real-world clinical practice.

## Methods

The Coronary REvascularization Demonstrating Outcome Study in Kyoto AMI registry is a physician-initiated non–company-sponsored multicenter registry that enrolled consecutive patients with AMI who underwent coronary revascularization within 7 days of the onset of symptoms from January 2005 to December 2007 at 26 tertiary hospitals in Japan (Supplementary Appendix A). The relevant review boards or ethics committees at all 26 participating hospitals approved the study protocol. Obtaining written informed consent from the patients was waived because of the retrospective nature of the study; however, we excluded those patients who refused participation in the study when contacted at follow-up. This strategy is concordant with the

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See page 526 for disclosure information.

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