Multicentre Cohort Study of the Impact of Percutaneous Coronary Intervention on Patients With Concurrent Cancer and Ischaemic Heart Disease

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Research Article

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Abstract

Background: The incidence of concurrent cancer and ischaemic heart disease (IHD) is increasing; however, the long-term patient prognoses remain unclear.

Methods: Five-year all-cause mortality data pertaining to patients in the Osaka Cancer Registry, who were diagnosed with colorectal, lung, prostate, and gastric cancers between 2010 and 2015, were retrieved and analysed together with linked patient administrative data. Patient characteristics (cancer type, stage, and treatment; coronary risk factors; medications; and time from cancer diagnosis to index admission for percutaneous coronary intervention (PCI) or IHD diagnosis), were adjusted for propensity score matching. Three groups were identified: patients who underwent PCI within 3 years of cancer diagnosis (n=564, PCI+ group), patients diagnosed with IHD within 3 years of cancer diagnosis who did not undergo PCI (n=3058, PCI-/IHD+ group), and patients without IHD (n=27,392, PCI-/IHD- group). Kaplan-Meier analysis was used for comparisons.

Results: After propensity score matching, the PCI+ group had better prognosis (n=489 in both groups, hazard ratio 0.64, 95% confidence interval 0.51–0.81, P<0.001) than the PCI-/IHD+ group. PCI+ patients (n=282) had significantly higher mortality than those without IHD (n=280 in each group, hazard ratio 2.88, 95% confidence interval 1.90–4.38, P<0.001).

Conclusions: PCI might improve the long-term prognosis in cancer patients with IHD. However, these patients could have significantly worse long-term prognosis than cancer patients without IHD.

Background

Continued advances in cancer treatment have led to dramatic increases in the number of survivors [1]. As a result, the incidence of those suffering from concomitant coronary artery diseases (CAD) and cancer is also increasing. Some studies have reported that cancer itself, as well as cancer therapy, increases the risk of cardiovascular events [2-4]. However, cancer patients have historically been excluded from most CAD intervention trials. With the recent introduction of the field of onco-cardiology, patients suffering both diseases simultaneously are attracting significant attention from oncologists and cardiologists [5,6]. Several studies have shown that cancer patients undergoing percutaneous coronary intervention (PCI) exhibit higher all-cause mortality, bleeding, and other adverse cardiovascular events when compared with patients who have no history of cancer [7-13]. This raises the question of whether PCI can improve long-term prognosis in patients with cancer and comorbid ischaemic heart disease (IHD).

Including cancer patients in studies is challenging, given the wide heterogeneity in cancer type, stage, and treatment. Recently, Potts et al. compared the short-term outcomes of PCI in prostate, breast, colorectal, and lung cancer patients with those of patients with a history of cancer and those with no cancer [10]. They found that patients with metastatic disease had worse prognoses. They also noted that the rate of each adverse event varied by cancer type. However, data on the long-term prognosis of cancer patients undergoing PCI has not been reported in the literature. Thus, this report presents a comparison of all-cause mortality between cancer patients with IHD who underwent PCI and cancer patients with IHD who did not undergo PCI. Furthermore, this study aimed to determine how the long-term prognosis of cancer patients with IHD who underwent PCI differed from those who did not undergo PCI, as well as those without concurrent cancer and IHD.

Methods

The study was approved by the local ethics committee of Osaka International Cancer Institute (Approval number: 1707105108) and the study protocol was in accordance with the principles set out in the 1964 Declaration of Helsinki. The requirement for informed consent was waived due to the retrospective nature of the study.

Data sources

This was a multicentre retrospective cohort study using the Osaka Cancer Registry (OCR) and administrative data [14-18]. The OCR is a population-based cancer registry that compiles information on cancer diagnoses and outcomes in patients residing in Osaka Prefecture, Japan. OCR data include age, sex, history of smoking, type of cancer, date of cancer diagnosis, date of the last follow-up, date of any cause of death, cancer stage (i.e., localised, regional to lymph nodes, regional by direct extension, and metastatic) according to SEER (surveillance, epidemiology, and end results) [19]). OCR also includes treatment information (i.e., curative surgery/endoscopic treatment, chemotherapy, hormonal therapy, and radiation therapy). Cancer types are defined according to the International Classification of Diseases for Oncology, Third Edition (ICD-O-3). Furthermore, administrative data from Japan's Diagnosis Procedure Combination Per-diem Payment System (DPC) were collected from 36 designated cancer care hospitals in Osaka Prefecture. The DPC data include medication and history of PCI. In addition, upon hospital admission, patient data on activities of daily living (ADL, Barthel Index score), smoking habits, and International Classification of Diseases, Tenth Revision (ICD-10) diagnoses are recorded. OCR data are linked to administrative data at the patient level, using each hospital’s patient identification number.

Study population

Study investigators identified gastric (ICD-O-3 topographical codes: C16.x), colorectal (C18.x-C20.x), prostate (C61.x), and lung (C34.x) cancer patients who were diagnosed between 2010 and 2015. This decision was based on data that patients with these cancers underwent PCI most frequently (See Supplementary Figure 1, Additional File 1). Exclusion criteria included a number of items: having undergone coronary artery bypass grafting (CABG),...
Furthermore, coronary risk factors such as smoking, hypertension, dyslipidaemia, and diabetes mellitus were more prevalent in the PCI+ group. than the PCI-/IHD+ group (33% vs. 15%). In terms of medication, PCI+ group patients were more likely to receive b-blockers, statins, and ACE inhibitors. characteristics of the 2 groups are described in Table 1. The PCI+ group had a lower prevalence of metastatic cancer, but a higher prevalence of ACS. In the primary analysis, the PCI+ (n=564; mean age 72 years) and PCI-/IHD+ (n=3,058; mean age 74 years) groups were compared. Baseline Long-term prognosis of cancer patients according to PCI

Results

In the primary analysis, the PCI+ (n=564; mean age 72 years) and PCI-/IHD+ (n=3,058; mean age 74 years) groups were compared. Baseline characteristics of the 2 groups are described in Table 1. The PCI+ group had a lower prevalence of metastatic cancer, but a higher prevalence of ACS than the PCI-/IHD+ group (33% vs. 15%). In terms of medication, PCI+ group patients were more likely to receive b-blockers, statins, and ACE inhibitors. Furthermore, coronary risk factors such as smoking, hypertension, dyslipidaemia, and diabetes mellitus were more prevalent in the PCI+ group.
To assess the effects of PCI, we compared the PCI+ and PCI-/IHD+ groups after propensity score matching. Adjusted variables were well-balanced after matching (standard deviations <0.1). The PCI+ group (n=489) had significantly better prognoses than the PCI-/IHD+ group (n=489) (log-rank test, P=0.001; Figure 2). The Cox regression analysis with IPTW also found better prognoses in the PCI+ group (n=564) than in the PCI-/IHD+ group (n=3058) (hazard ratio [HR] 0.75, 95% confidence interval [CI] 0.59–0.96, P=0.002). Multivariable analysis showed that PCI was a significant independent predictor of all-cause mortality (HR 0.59, 95% CI 0.46–0.74, P=0.001; See Supplementary Table 3, Additional File 1). We also compared those who had undergone PCI or were diagnosed with IHD within 1.5 years (See Supplementary Table 4, Additional File 1). These results also showed a better prognosis in the PCI+ group (log-rank test, P=0.011; See Supplementary Figure 2, Additional File 1). Cox regression analysis with IPTW revealed better prognoses in the PCI+ group (n=394) than in the PCI-/IHD+ group (n=2621) (HR 0.75, 95% CI 0.57–0.97, P=0.030).

The effects of PCI on the long-term prognosis of each cancer type were also assessed (See Supplementary Tables 5 to 8, Additional File 1). After propensity score matching, PCI+ group patients with colorectal cancer had a significantly better prognosis (log-rank test, P=0.043), while those with gastric cancer showed a trend toward improvement (log-rank test, P=0.093) despite the relatively small number of patients (n=157 and n=106, respectively) (Figure 3). Some variables had standard deviations >0.1 in this propensity score-matched sample.

**Long-term prognosis of patients with IHD undergoing PCI and those without IHD**

Differences in all-cause mortality between patients who had undergone PCI (PCI+ group, n=282) and those who had had no documented IHD (PCI-/IHD- group, n=27,392) (Table 2) were assessed. All-cause mortality between the PCI+ (n=0 at cancer diagnosis) and PCI-/IHD- groups (n=560 at cancer diagnosis) were compared after adjusting for immortal time bias. Kaplan-Meier analysis of the propensity score-matched groups showed significantly higher all-cause mortality in the PCI+ group (log-rank test, P=0.001) (Figure 4). Multivariable analysis showed that PCI was an independent predictor of mortality (See Supplementary Table 9, Additional File 1). Even after excluding ACS patients (See Supplementary Table 10, Additional File 1), the PCI+ group still showed higher mortality rates (log-rank test, P=0.042) (See Supplementary Figure 4, Additional File 1).

**Discussion**

**Impact of PCI on the survival of cancer patients with IHD**

Our primary analysis suggests that PCI may lead to better long-term prognosis in patients with certain cancers and IHD. Our results were verified using multiple tests such as IPTW and multivariable Cox proportional analysis. Additionally, similar results were observed after reducing the time interval from cancer diagnosis to index PCI or IHD from 3 years to 1.5 years.

Cancer patients reportedly have a higher risk of cardiovascular events after PCI than non-cancer patients. Landes et al. [8] reported that cancer patients had higher rates of a composite of death, myocardial infarction, target lesion revascularisation (TLR), and CABG. Nakatsuma et al. [9] reported that the 5-year incidence of cardiac death was higher in cancer patients and that rates of definite or probable stent thrombosis also tended to be higher. A meta-analysis found that 1-year cardiovascular mortality after PCI was higher in cancer patients [11]. Taken together, these findings suggest that cancer can lead to the progression of atherosclerosis and increased cardiovascular mortality. In fact, Tabata et al. reported that not only do cancer patients have higher 1-year TLR rates, but those with elevated high-sensitivity C-reactive protein levels also have higher overall cardiovascular event rates (cardiovascular death, non-fatal MI, unstable angina pectoris, TLR, non-TLR, and hospitalisation for heart failure decompensation) [13]. They speculated that increased inflammation in cancer patients might lead to the progression of coronary artery atherosclerosis. This may mean that cancer patients with IHD have a very high risk of cardiovascular events, which could explain why PCI and regular cardiology follow-up of our cancer patients reduced all-cause mortality.

We could not determine why our PCI-/IHD+ group patients did not undergo PCI. In real-world clinical settings, cardiologists and oncologists usually decide to proceed with PCI after considering cancer prognosis, ADL, and bleeding risk with antiplatelet therapy. Our initial PCI-/IHD+ group actually had higher rates of metastatic cancer. However, despite adjusting for several variables, we cannot completely exclude the presence of confounding factors that exist due to the very nature of retrospective database studies.

We assessed the impact of PCI on each cancer type. However, despite a propensity score matching, the results were underpowered. Colorectal and gastric cancer patients in the PCI+ group had significantly lower mortality and trends toward lower mortality, respectively, compared to PCI-/IHD+ patients. This was consistent with the overall analysis. In contrast, no difference in mortality was observed between lung and prostate cancer patients in both groups. Since metastasis is more common in lung cancer patients, the advantage of PCI may be nullified by increased cancer lethality. In prostate cancer patients, a higher prevalence of a Barthel Index of 40–59, treatment with oral anticoagulants, and chemo/radiation/hormonal therapy, which were not sufficiently balanced after propensity score matching, might have affected the results. Furthermore, since prostate cancer has low lethality, there may be fewer reasons to forego PCI. Therefore, one possible explanation is that PCI-/IHD- group patients with prostate cancer might have had a relatively low-risk IHD that did not require PCI. One of the major concerns with PCI is post-procedural bleeding. It has been shown that gastrointestinal cancer patients have higher rates of gastrointestinal bleeding after PCI [24,25]. Our results suggest that the advantages of PCI might outweigh bleeding risk.

**Impact of IHD and PCI on the survival of cancer patients**
Secondary analysis showed that cancer patients undergoing PCI had higher mortality compared to those who had no history of IHD. As shown in Figure 4, the difference between the two groups increased over the first few months. Roule et al. reported that cancer patients undergoing PCI for ACS have higher rates of all-cause (relative risk [RR] 2.62, 95% CI 1.2–5.73) and cardiac deaths (RR 2.44, 95% CI 1.73–3.4,) compared to non-cancer patients [12]. Although their study population differed from ours, the results of the two investigations are consistent. In order to exclude the potential impact of ACS prevalence on the short-term prognosis, we analysed the mortality only in patients undergoing PCI for stable IHD as a sensitivity analysis. Similar to other results, long-term mortality was worse in the subgroup of patients who underwent PCI for stable IHD. This result may also be related to the elevated inflammatory state mentioned earlier [8,9,11,13]. The PCI+ group patients could have had a higher risk of cardiovascular events, including cardiac death, compared to the PCI-/IHD- group patients.

Limitations

Our study had several limitations. First, since this was a retrospective registry-based cohort study, we could not adjust for all confounders. Second, we could not identify a history of coronary artery diseases or any related treatment that occurred before the beginning of administrative data collection in 2010. Third, cause of death data (e.g., cardiovascular or cancer-related) and PCI procedural variables (i.e., type of stent used) were not available. In addition, we did not have ischaemic parameters and disease extent data for IHD patients. Fourth, despite the use of a large cancer registry, the number of patients we identified who had undergone PCI was relatively small. Fifth, a substantial number of cancer patients were not hospitalised after being definitively diagnosed with cancer; therefore, our secondary analysis lacked ADL data (Barthel Index score). Sixth, the use of antiplatelet therapy was not assessed. Because antiplatelet treatment was contraindicated for most of the patients in the PCI-/IHD+ group, antiplatelet therapy rates were not appropriate covariates for propensity score matching. Thus, it should be counted as a factor “not prevalent in PCI patients” in this study. To address these limitations, more studies are needed.

List Of Abbreviations

ACE: angiotensin-converting enzyme;
ACS: acute coronary syndrome;
ADL: activities of daily living;
ARB, angiotensin II receptor blocker;
CABG: coronary artery bypass grafting;
CAD: coronary artery diseases;
Cl: confidence interval;
DPC: Diagnosis Procedure Combination Per-diem Payment System;
HR; hazard ratio;
ICD-10: International Classification of Diseases, Tenth Revision;
ICD-O-3: International Classification of Diseases for Oncology, Third Edition;
IHD: ischaemic heart disease;
IPTW: inverse probability of treatment weighting;
IQR, interquartile range;
NA, not available;
OCR: Osaka Cancer Registry;
OMI: old myocardial infarction;
PCI: percutaneous coronary intervention;
RR: relative risk;
TLR: target lesion revascularisation

Declarations
Ethics approval and consent to participate

The study was approved by the local ethics committee of Osaka International Cancer Institute (Approval number: 1707105108) and was conducted in accordance with the Declaration of Helsinki. The requirement for informed consent was waived due to the retrospective nature of the study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author upon reasonable request.

Competing interests:

There are no conflicts of interest to declare.

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Authors' contributions

T.N., T.M., T.Otsuka, T.K., M.F. wrote the main manuscript text and S.O., Y.F., T.F., R.K., T.Y., W.S., T.Oka., T.T., I.M. prepared database, figures and tables. All authors reviewed the manuscript.

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Tables

**Table 1** Baseline characteristics of the PCI+ and PCI-/IHD- groups for the primary analysis
| Age, mean ± standard deviation | Entire cohort | Propensity score-matched sample |
|--------------------------------|---------------|---------------------------------|
| (n=3622) | (n=564) | (n=3058) | SD* | (n=489) | (n=489) | SD* |
| 74 ± 7.8 | 74 ± 7.1 | 0.209 | 73 ± 7.1 | 73 ± 7.7 | 0.015 |
| Sex | 0.231 | 0.035 |
| Female | 785 (22) | 705 (23) | 0.050 | 74 (15) | 68 (14) |
| Male | 2837 (78) | 2353 (77) | 0.050 | 415 (85) | 421 (86) |
| Cancer type | | | | | |
| Colorectal cancer | 1165 (32) | 970 (32) | 0.061 | 174 (36) | 170 (35) |
| Lung cancer | 910 (25) | 795 (26) | 0.133 | 103 (21) | 104 (21) |
| Prostate cancer | 505 (14) | 381 (12) | 0.254 | 97 (20) | 98 (20) |
| Gastric cancer | 1042 (29) | 912 (30) | 0.154 | 115 (23) | 117 (24) |
| Cancer stage | | | | | |
| In situ | 252 (7) | 204 (7) | 0.070 | 45 (9) | 41 (8) |
| Localized | 1836 (51) | 1539 (50) | 0.047 | 253 (52) | 249 (51) |
| Regional to lymph nodes involved | 471 (13) | 403 (13) | 0.034 | 61 (12) | 66 (14) |
| Regional by direct extension | 399 (11) | 321 (11) | 0.102 | 66 (14) | 75 (15) |
| Distant site(s)/node(s) involved | 579 (16) | 526 (17) | 0.231 | 48 (10) | 41 (8) |
| Unknown | 85 (2) | 65 (2) | 0.086 | 16 (3) | 17 (4) |
| Barthel Index score | | | | | |
| 60-100 | 3206 (89) | 2717 (89) | 0.066 | 428 (87) | 427 (87) |
| 40-59 | 153 (4) | 132 (4) | 0.030 | 19 (4) | 15 (3) |
| 0-39 | 263 (7) | 209 (7) | 0.100 | 42 (9) | 47 (10) |
| Overweight | 968 (27) | 804 (27) | 0.069 | 144 (29) | 148 (30) |
| Current or past smoking | 1986 (55) | 1685 (54) | 0.090 | 283 (58) | 277 (57) |
| Dyslipidemia | 1052 (29) | 729 (24) | 0.740 | 259 (53) | 252 (52) |
| Hypertension | 1851 (51) | 1467 (48) | 0.417 | 320 (65) | 319 (65) |
| Diabetes mellitus | 1179 (33) | 918 (30) | 0.319 | 217 (44) | 219 (45) |
| Chronic kidney disease | 252 (7) | 205 (7) | 0.068 | 44 (9) | 49 (10) |
| Congestive heart failure | 635 (18) | 467 (15) | 0.343 | 133 (27) | 148 (30) |
| Atrial fibrillation | 309 (9) | 246 (8) | 0.091 | 52 (11) | 47 (10) |
| b-blocker | 2773 (77) | 619 (20) | 0.476 | 185 (38) | 187 (38) |
| Statin | 2499 (69) | 817 (27) | 0.610 | 255 (52) | 259 (53) |
| ACE inhibitor | 296 (8) | 206 (7) | 0.303 | 68 (14) | 71 (14) |
| ARB | 1472 (41) | 959 (31) | 0.118 | 182 (37) | 191 (39) |
| Oral anti-coagulants | 447 (12) | 379 (12) | 0.002 | 63 (13) | 64 (13) |
| Acute coronary syndrome | 650 (18) | 465 (15) | 0.416 | 134 (27) | 129 (26) |
| Days from cancer diagnosis to PCI/IHD admission, median (IQR) | 78 (31-384) | 65 (27-325) | 0.555 | 250 (85-588) | 279 (48-599) |
| Chemo/radiation/hormonal therapy | 1242 (34) | 1074 (35) | 0.119 | 143 (29) | 156 (32) |
| Surgery or endoscopic resection | 2300 (64) | 1931 (63) | 0.058 | 323 (66) | 322 (66) |
Data are presented as n (%) unless otherwise indicated.

ACE, angiotensin-converting enzyme; ARB, angiotensin II receptor blocker; IHD, ischaemic heart disease; IQR, interquartile range; PCI, percutaneous coronary intervention; SD, standard deviation; PCI+, cancer patients undergoing PCI; PCI-/IHD-, cancer patients without IHD and not undergoing PCI

**Table 2** Baseline characteristics of the PCI+ and PCI-/IHD- groups
|                                | Entire cohort | Propensity score-matched sample |
|--------------------------------|---------------|---------------------------------|
|                                | (n=27676)     | (n=280)                         | (n=27392) |
| Age, mean ± standard deviance  | 70 ± 10.2     | 73 ± 6.9                        | 70 ± 10.2 |
|                                | 0.822         | 73 ± 7.0                       | 73 ± 8.4 |
|                                | 0.027         |                                 |          |
| Sex                            | 0.444         | 0.077                           |          |
| Female                         | 8563 (31)     | 37 (13)                         | 8526 (31)|
| Male                           | 19111 (69)    | 245 (87)                        | 18866 (69)|
| Cancer type                    |               |                                 |          |
| Colorectal cancer              | 9807 (35)     | 95 (34)                         | 9712 (35)|
| Lung cancer                    | 5997 (22)     | 68 (24)                         | 5929 (22)|
| Prostate cancer                | 4317 (16)     | 55 (20)                         | 4262 (16)|
| Gastric cancer                 | 7553 (27)     | 64 (22)                         | 7489 (27)|
| Cancer stage                   |               |                                 |          |
| In situ                        | 2569 (9)      | 21 (7)                          | 2548 (9) |
| Localized                      | 12738 (46)    | 148 (52)                        | 12590 (46)|
| Regional to lymph nodes involved| 2924 (11)    | 39 (14)                         | 2885 (11)|
| Regional by direct extension   | 2818 (10)     | 36 (13)                         | 2782 (10)|
| Distant site(s)/node(s) involved| 5852 (21)   | 31 (11)                         | 5821 (21)|
| Unknown                        | 773 (3)       | 7 (3)                           | 766 (3)  |
| Barthel Index score            |               |                                 |          |
| 60-100                         | 25701 (93)    | 267 (95)                        | 25434 (93)|
| 40-59                          | 694 (2)       | 3 (1)                           | 691 (2)  |
| 0-39                           | 1279 (5)      | 12 (4)                          | 1267 (5) |
| Overweight                     | 6116 (22)     | 85 (30)                         | 6031 (22)|
| Current or past smoking        | 14138 (51)    | 168 (60)                        | 13970 (51)|
| Dyslipidemia                   | 562 (2)       | 16 (6)                          | 546 (2)  |
| Hypertension                   | 1393 (5)      | 29 (10)                         | 1364 (5) |
| Diabetes mellitus              | 1137 (4)      | 34 (12)                         | 1103 (4) |
| Chronic kidney disease         | 220 (1)       | 13 (5)                          | 207 (1)  |
| Congestive heart failure       | 250 (1)       | 11 (4)                          | 239 (1)  |
| Atrial fibrillation            | 308 (1)       | 0 (0)                           | 308 (1)  |
| b-blocker                      | 562 (2)       | 31 (11)                         | 532 (2)  |
| Statin                         | 1251 (5)      | 46 (16)                         | 1205 (4) |
| ACE inhibitor                  | 301 (1)       | 9 (3)                           | 292 (1)  |
| ARB                            | 1755 (6)      | 49 (17)                         | 1707 (6) |
| Oral anti-coagulants           | 247 (1)       | 8 (3)                           | 239 (1)  |
| Acute coronary syndrome        | -             | 81 (29)                         | -        |
| Days from cancer diagnosis to PCI/IHD admission, median (IQR) | - | 243 (92-543) | - | 242 (90-547) |
| Chemo/radiation/hormonal therapy | 10220 (37) | 97 (34)                        | 10123 (37)|

Table entries are rounded to 0.01.
Surgery or endoscopic resection | 16624 (60) | 189 (67) | 16435 (60) | 0.216 | 188 (67) | 194 (69) | 0.046

Data are presented as n (%) unless otherwise indicated.

ACE, angiotensin-converting enzyme; ARB, angiotensin II receptor blocker; IHD, ischaemic heart disease; IQR, interquartile range; NA, not available; PCI, percutaneous coronary intervention; SD, standard deviation, NA, not available; PCI+, cancer patients undergoing PCI; PCI-/IHD, cancer patients without IHD and not undergoing PCI

### Additional Files

**File format:** DOC (Microsoft Word)

**Title of data:** Supplementary Figures and Tables.

**Description of data:**

- **Supplemental Figure 1** Total number of patients with PCI in the Osaka Cancer Registry
- **Supplemental Table 1** Definitions of diagnoses and corresponding ICD-10 codes
- **Supplemental Table 2** Medications considered in the analysis
- **Supplemental Table 3** Multivariable analysis of mortality with propensity score matching for the primary analysis
- **Supplemental Figure 2** Kaplan-Meier analysis of all-cause mortality for the PCI+ group and the PCI-/IHD+ group
- **Supplemental Table 4** Baseline characteristics for sensitivity analysis of the primary analysis, as shown in Supplemental Figure 1
- **Supplemental Table 5** Baseline characteristics for colorectal cancer as a subgroup analysis in the primary analysis
- **Supplemental Table 6** Baseline characteristics for lung cancer as a subgroup analysis in the primary analysis
- **Supplemental Table 7** Baseline characteristics for prostate cancer as a subgroup analysis in the primary analysis
- **Supplemental Table 8** Baseline characteristics for gastric cancer as a subgroup analysis in the primary analysis
- **Supplemental Table 9** Multivariable analysis of mortality with propensity score matching and immortal time bias adjustment (secondary analysis)
- **Supplemental Figure 4** Kaplan-Meier analysis of all-cause mortality for PCI+ group without acute coronary syndrome and PCI-/IHD- group
- **Supplemental Table 10** Baseline characteristics for the PCI+ group without acute coronary syndrome and PCI-/IHD- group