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Procedural Success and Complications Following Percutaneous Coronary Interventions among Asians and Pacific Islanders

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Summary

Background: Although Asians and Pacific Islanders (PI) make up the fastest growing ethnic group in the United States, little is known about the clinical characteristics, procedural success, and procedure-related complications of those who undergo percutaneous coronary interventions (PCI).

Hypothesis: This study investigated PCI procedural success and procedural complications among PI and Asian patients in comparison with Caucasians.

Methods: We examined clinical characteristics, procedural success (post-PCI lesion < 50%) and procedure-related complications (hemorrhage, renal failure, myocardial infarction, stroke, bypass surgery, death) for all patients undergoing PCI at our hospital from January 1999 to June 2003.

Results: Overall, 2,598 PCIs were performed—1,058 (39%) in Caucasians, 1,163 (43%) in Asians, and 377 (14%) in PIs. The mean age of PIs (59 ± 11 years) was significantly lower than that of Caucasians (65 ± 12 years) and Asians (66 ± 12 years). The mean body mass index (26 ± 5) of Asians was significantly lower, while that of PIs (31 ± 7) was significantly higher than that of Caucasians (28 ± 6). More Asians (33.3%) and PIs (40.5%) had diabetes mellitus than did Caucasians (19.9%). More Asians (71.6%) and PIs (76.1%) had hypertension than did Caucasians (61.9%). Renal failure was more prevalent in Asians and PIs (6.0 and 7.4%, respectively) than in Caucasians (3.8%). Other than a higher prevalence of disease involving the left anterior descending vessel in Asians (56.4%) compared with Caucasians (50.4%), angiographic features across the three races were similar. There was no significant difference in procedural success (~ 94%) or procedure-related complications among Caucasians (6.4%), Asians (7.1%), and PIs (4.3%).

Conclusion: Although PIs and Asians have a substantially higher burden of comorbidities than Caucasians, race does not appear to influence PCI procedural success or procedure-related complications.

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Introduction

In 2001, over 570,000 percutaneous coronary interventions (PCIs) were performed—nearly double the number performed in 1991.[1] With improvements in technology and adjunctive medical therapy, PCI is a safe and effective treatment for symptomatic coronary artery disease, with an overall procedural success rate > 95%.[2]

Since 1993, guidelines issued by the National Institutes of Health (NIH) have mandated proportionate representation of patients by race and ethnic group in clinical research funded by the NIH.[3] However, there continues to be scant information on Asians and Pacific Islanders (PI), even though this population is one of the fastest growing racial groups in the United States[4] and, as in other populations, cardiovascular disease is its leading cause of death.[1] Although Asians are generally perceived to be healthier than Caucasians and other minority groups, both Asians and PIs carry a heavy burden of heart disease. For example, Native Hawaiians have the highest cardiac disease death rate and the second highest rate of obesity in the country.[4, 5] Similarly, Asians and PIs have one of the highest rates of diabetes in the United States.[6, 7] However, little is known about the clinical characteristics, procedural success, and procedure-related complications of Asians and PIs who undergo PCI.

Methods

The study was approved by the hospital's Institutional Review Committee. The study population included all patients who underwent PCI at our institution from January 1, 1999, through June 30, 2002. The Queen's Medical Center is a 500-

bed, university-affiliated, tertiary-care hospital in Honolulu, Hawaii, and is the largest single hospital in Hawaii. All PCI procedures (balloon angioplasty, stent placement, rotablator, directional coronary atherectomy) during the study period were performed by 1 of 20 board-certified cardiologists using standard techniques. For each patient who underwent PCI, a trained nurse specialist performed a detailed medical record review and obtained information on patient demographics, medical history, clinical presentation, procedure information, and in-hospital events, including hemorrhage, myocardial infarction (MI), renal failure, and death.

Procedural success was defined as post-PCI residual stenosis < 50%. Procedure-related complications included MI, defined as electrocardiographic (ECG) changes (ST-segment elevations, new Q waves in ≥ 2 contiguous ECG leads, or new left bundle-branch block pattern) and/or biochemical evidence of myocardial necrosis (creatine kinase [CK]MB > 3× upper limit of normal or total CK > 3× upper limit of normal if CKMB was not available); renal failure, defined as an increase in serum creatinine to > 2.0 mg/dl or ≥ 50% increase over an abnormal baseline, or requiring dialysis; hemorrhage, defined as blood loss at the arterial or venous access site or due to perforation of a traversed artery or vein requiring transfusion and/or prolongation of hospital stay, and/or causing a drop in hemoglobin > 3.0 g/dl; cerebrovascular accident or stroke, defined as a loss of neurological function caused by an ischemic event with residual symptoms > 24 h after onset; death, defined as all-cause mortality during hospitalization.

We compared Caucasians with Asians and PIs and examined two outcomes, procedural success and procedure-related complications. Patient race was based on self-identification and, to simplify analysis, was divided into four categories: Caucasian, Asian, PI, and Others. Asians included patients of Japanese, Chinese, Korean, Filipino, Thai, Vietnamese, South Asian, and other Southeast Asian descent; PIs included patients of Hawaiian, Micronesian, Polynesian, Tongan, Samoan, or Marshallese descent.

We used descriptive statistics to compare demographic and clinical variables. Because of the small number (n = 106 or 4% of the study population) and heterogeneity of the "Other" category, this group was excluded from our analyses. Fisher's exact and analysis of variance (ANOVA) tests were used to identify significant differences in baseline characteristics, presentation, and PCI details between Caucasians, Asians, and PIs. When a significant difference was indicated, Fisher's exact test and the Student's *t*-test were used to perform two-group comparisons between Asians and Caucasians, and PIs and Caucasians. Continuous variables were presented as mean ± standard deviation. P-values < 0.05 were considered statistically significant. For PCI procedures performed January 1, 2001 through June 30, 2002, information on the use of adjunctive antiplatelet (e.g., glycoprotein IIb/IIIa inhibitor, heparin, aspirin, clopidogrel) and intravenous thrombolytic therapy for acute MI was obtained. Because these agents may be associated with differences in procedure outcomes, subgroup analyses evaluating the impact of these agents on procedure-related complications were performed. Repeat hospitalizations were counted as separate observations and, therefore, an individual patient could be represented in the sample more than once.

Results

Demographics and Medical History

Between January 1999 and June 2003, 2,598 PCI procedures were performed by 20 cardiologists on 2,228 patients. Overall, 39% (n = 1058) of procedures were performed on Caucasians, 43% (n = 1163) on Asians, and 14% (n = 377) on PIs. Of the Asian population, 54% were Japanese, 20% Filipino, and 11% Chinese.

Compared with Caucasians (65 ± 12 years), Asians were significantly older (66 ± 12 years, p < 0.01) and PIs were significantly younger (59 ± 11 years, p < 0.001). There was no significant difference in the percentage of women undergoing PCI among Caucasians (29%), Asians (27%), and PIs (31%).

A comparison of medical history among racial groups is shown in Table I. Compared with Caucasians (28 ± 6), body mass index (BMI) was significantly lower for Asians (26 ± 5, p < 0.001) and significantly higher for PIs (31 ± 7, p < 0.001). Over 80% of PIs were overweight or obese (BMI ≥ 25), compared with 70% of Caucasians and 52% of Asians. Compared with Caucasians (59%), Asians were significantly less likely (50%, p < 0.001) and PIs were significantly more likely (66%, p = 0.02) to have a history of tobacco use. Similarly, compared with Caucasians, Asians and PIs were significantly more likely to have a history of hypertension (62 vs. 72 vs. 76%), diabetes (19.9 vs. 33.3 vs. 40.5%), and renal failure (3.8 vs. 6.0 vs. 7.4%).

TABLE I Medical history by race

	Caucasian (n = 1,058)	Asian (n = 1,163)	Pacific Islander (n = 377)
BMI (mean ± SD)	28 ± 6	26 ± 5 [c]	31 ± 7 [c]
Overweight (BMI 25–29.9) (%)	39	35 [a]	34
Obese (BMI ≥ 30) (%)	31	18 [c]	48 [c]
Prior tabacco use (%)	59	50 [c]	66 [a]
Hypertension (%)	62	72 [c]	76 [c]
Diabetes mellitus (%)	20	33 [c]	41 [c]
Renal failure (%)	3.8	6.0 [a]	7.4 [b]
Coronary bypass surgery (%)	18	20	11 [b]
Stroke (%)	9.1	11	12
Myocardial infarction (%)	27	26	32
Heart failure (%)	9.8	9.4	11
Prior percutaneous coronary intervention (%)	30	32	31

[a] p < 0.05 (when compared with Caucasians).
[b] p < 0.01 (when compared with Caucasians).
[c] p < 0.001 (when compared with Caucasians).
Abbreviations: BMI = body mass index, SD = standard deviation.

TABLE II Clinical presentation by race

	Caucasian (n = 1,058)	Asian (n = 1,163)	Pacific Islander (n = 377)
Myocardial infarction within 7 days (%)	35	29 [b]	29 [a]
Acute coronary syndrome (%)	54	52	52
Canadian Cardiovascular Class 3 or 4 (%)	51	50	48
Left vventricular ejection fraction ≤ 40% (%)	12	15	16
3-vessel disease or left main stenosis ≥ 50% (%)	12	13	11
Left main stenosis ≥ 50% (%)	4.9	5.5	4.5
LAD stenosis ≥ 75% (%)	50	56 [b]	53
RCA stenosis ≥ 75% (%)	49	48	47
LCx stenosis ≥ 75% (%)	33	36	30

[a] $p < 0.05$ (when compared with Caucasians).
[b] $p < 0.01$ (when compared with Caucasians).
Abbreviations: LAD = left anterior descending coronary artery, LCx = left circumflex coronary artery, RCA = right coronary artery.

Clinical Presentation

A comparison of clinical presentation is shown in Table II. Compared with Caucasians (35%), Asians (29%, p = 0.01) and PIs (29%, p = 0.03) were significantly less likely to have had an MI in the 7 days preceding PCI. However, similar proportions of patients presented with an acute coronary syndrome and with Canadian Cardiovascular Class 3 or 4 symptoms. The percentage of patients with left ventricular ejection fraction < 40% was also similar among the three groups. Other than the presence of less left anterior descending artery disease among Caucasians (50%) than Asians (56%, p = 0.01), there were no other significant differences in the extent of angiographic disease.

Percutaneous Coronary Intervention Details, Procedural Success, and All Complications by Race

There was no significant difference in the proportion of Caucasian, Asian, and PI patients who received a stent (79, 78, and 79%, respectively, p = 0.8) or underwent balloon angioplasty alone (14, 14, and 13%, respectively, p = 0.8). Compared with Caucasians (52%), urgent or emergent PCI was performed significantly less frequently among Asians (46%, p = 0.008), with a trend for a lower rate among PIs (46%, p = 0.07). Percutaneous coronary intervention was attempted in > 1 lesion in 32% of Caucasians, 37% of Asians, and 32% of PIs (p = 0.14).

Percutaneous coronary intervention was performed to treat restenosis in 13% of Caucasians, 15% of Asians, and 14% of PIs (p = 0.45). Table III displays PCI-related outcomes, including procedural success and complication rates. On univariate analysis, the procedural success rate was 94% for both Caucasians and PIs, and 95% for Asians, without significant differences among the three groups. Similarly, although there was a trend favoring PIs, there was no significant difference in procedure-related complications among the three groups (Caucasians 6%, Asians 7%, and PIs 4%, p = 0.13), nor were there significant differences in death rates and non-death procedure-related complications. Our results were unchanged when procedural success and complication rates were stratified by the type of PCI device (e.g., stent, balloon).

Subgroup Analysis

Information on the use of antiplatelet agents (i.e., glycoprotein IIb/IIIa inhibitor, heparin, clopidogrel, aspirin) and thrombolytic therapy was available for patients who underwent PCI between January 1, 2001, and June 30, 2002. Of the 536 Caucasians, 603 Asians, and 187 PIs in this subset of patients, the use of glycoprotein IIb/IIIa inhibitors (96, 93, and 91%, respectively, p = 0.06), aspirin (78, 76, and 81%, respectively, p = 0.2), clopidogrel (67, 67, and 69%, respectively, p = 0.6), and thrombolytic therapy (10, 8, and 10%, respectively, p = 0.3) were similar among the three groups. Compared with Caucasians (100%), PIs received heparin significantly less often (98%, p < 0.01), whereas its use among Asians was similar (93%, p = 0.8). There was no significant difference between Caucasians, Asians, and PIs in the rates of in-hospital mortality (1.7 vs. 2.7 vs. 0.5%, respectively, p = 0.2), hemorrhage (2.4 vs. 1.8 vs. 2.7%, respectively, p = 0.7), and procedure-related complications (7.1 vs. 9.0 vs. 5.4%, respectively, p = 0.3).

TABLE III Percutaneous coronary intervention outcomes

	Caucasian (n = 1,058)	Asian (n = 1,163)	Pacific Islander (n = 377)
Procedural success (%)	94	95	94
In-hospital mortality (%)	1.5	2.2	0.8
Non-death complications (%)	4.9	5.0	3.5
All complications (%)	6.4	7.1	4.3

Complications: in-hospital death, myocardial infarction, stroke, renal failure, coronary artery bypass surgery, hemorrhage.

Discussion

In this study, Asians and PIs undergoing PCI had substantially more comorbidities than Caucasians, including significantly higher rates of hypertension, diabetes, and renal failure. In particular, PIs had approximately twice the rate of diabetes and renal failure than did Caucasians, and nearly 50% were obese. Nonetheless, we found no difference in procedural success or procedure-related complications.

To our knowledge, this is the largest study of PCI outcomes among Asians and the first specifically to examine PIs. Prior studies examining minority populations have traditionally compared African Americans[8–13] and Hispanics[2, 10] with Caucasians and, like in our current study, found similar rates of procedural success and procedure-related complications despite a greater burden of comorbidities. For example, African Americans have rates of diabetes and hypertension as high as 41 and 87%, respectively,[2, 8, 9, 12, 13] which is similar to the rates among Asians and PIs in our study. In a recent analysis using data from the National Heart, Lung, and Blood Institute Dynamic Registry, Slater *et al.* examined the clinical characteristics and outcomes of 4,618 patients who underwent PCI, including 3,669 (79.4%) Caucasians, 446 (9.7%) African Americans, 301 (6.5%) Hispanics, and 201 (4.4%) Asians.[2] Similar to our study, Asians had a lower BMI (26.0 vs. 28.6 kg/m^2, $p \leq 0.001$) and were more likely to have diabetes (34.0 vs. 24.9%, $p \leq 0.01$) and hypertension (68.7 vs. 58.5%, $p \leq 0.01$) than were Caucasians. Nonetheless, the rate of procedural success (96%) and procedure-related complications, including bypass surgery, MI, or death, was similar for Asians and Caucasians (odds ratio 0.92, 95% confidence interval 0.48–1.77).[2]

Similar to studies of African Americans undergoing PCI,[2, 8–10] PIs in our study were significantly younger than Caucasians, which may reflect an earlier age of onset of symptomatic coronary artery disease. In contrast to other studies,[2, 14, 15] Asians were significantly older than Caucasians in our study. Although the reasons for this are unclear, the "Asian" race category includes a broad range of ethnicities that may differ between studies. For example, "Asians" may include a large number of subjects of Indian, Pakistani, or Bangladeshi descent if the study is from the United Kingdom,[14] or subjects of Chinese or South Asian descent if the study is from California[15] or based on a national PCI registry.[2] In our study, over 50% of Asians were Japanese, who are felt to be at lower risk of developing cardiovascular disease than are other Asians.[1]

Limitations

There are several limitations to our study. First, our study included patients treated at a single institution and our results may not be generalizable to other populations. However, to our knowledge, this is the largest study of Asians and PIs, and the proportion of these racial groups in our study is similar to their proportion in the state of Hawaii (42% Asian and 9% PI).[16] Moreover, the clinical characteristics, procedural success rate (~ 96%), and in-hospital mortality (1.5%) of Asians included in the Dynamic Registry study[2] is similar to the rates among Asians in our study. Second, the outcomes of our study, PCI success and complications, were limited to in-hospital events, and long-term follow-up is not available. Although data on long-term outcomes are slightly mixed,[2, 8, 9, 11–13] data from the Dynamic Registry study reported no significant difference in 1- or 2-year event-free survival among Asians compared with Caucasians.[2] Third, although we separated Asians and PIs into two distinct groups, we were unable to study ethnic subgroups (e.g., Chinese, Japanese, Marshallese, Filipino) because of the limited sample size.

Conclusion

Despite a substantially greater burden of comorbidities among Asians and PIs, we found that race does not appear to influence PCI procedural success or procedure-related complications. Further studies will need to address long-term outcomes and differences among Asian and PI subpopulations.

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