A Quality Study of CABG Surgery in Asian Americans in California

What have we learnt?

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Hotel Kabuki

CABG surgery
Coronary Artery Bypass Graft surgery

CAD - #1 cause of death in the U.S.
Coronary Artery Disease

BACKGROUND
Why study isolated CABG surgery?
High impact surgery
- High volume
- High cost

Quality indicator
OSHPD
Office of Statewide Health Planning and Development

Study Aim
Health or healthcare disparities in Asian Americans with isolated CABG surgery

Two main research questions
With all other potential confounding predictor variables controlled:
- Clinical characteristics
- Operative mortality
Three comparisons

- Race
- Gender
- Hospital surgery volume

Key research questions

1. What were the patient characteristics by race and gender?
2. What were the unadjusted mortality by race, gender and hospital volume?
3. What were the adjusted mortality by race, gender and hospital volume?

Statistical Methods

(SPSS Statistics gradpack v. 17, Stata v. 9.1, and SAS v. 8.2)

- GEE methods (bivariate and multivariate)
- Descriptive statistics using frequencies and chi squares
- Unweighted t-test
- Multilevel logistic regressions

Findings and Discussion
**Descriptive Results**
122 Hospitals in California
(Total: 57,316 patients)

<table>
<thead>
<tr>
<th></th>
<th>Asians</th>
<th>Caucasians</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>5,332 (9.3% of total)</td>
<td>43,132 (75.3% of total)</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td>1,469 (27.5% of Asians)</td>
<td>10,894 (25.3% of Caucasians)</td>
</tr>
</tbody>
</table>

**Mean age**
- Asians: 66.3
- Caucasians: 67.6

**BMI > 40.0**
- Asians: 1.2%
- Caucasians: 1.8%

**BMI < 18.5**
- Asians: 3.6%
- Caucasians: 0.8%

**Emerg. status**
- Asians: 4.7%
- Caucasians: 5.9%

**Hypertension**
- Asian: 85.1%
- Caucasian: 78.3%

**Chronic lung dz**
- Asian: 14.0%
- Caucasian: 18.5%

**Mean creat.**
- Asian: 1.35
- Caucasian: 1.16

**Estimate/ OR**
- Hypertension: 1.6*
- Chronic lung dz: 0.7*
- Mean creat.: 0.2*

* Statistically significant, p<.05

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**Descriptive Results**
122 Hospitals in California

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<th>Asian</th>
<th>Caucasian</th>
<th>Estimate/ OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>66.3</td>
<td>67.6</td>
<td>-1.3*</td>
</tr>
<tr>
<td>BMI &gt; 40.0</td>
<td>1.2%</td>
<td>3.6%</td>
<td>0.3*</td>
</tr>
<tr>
<td>BMI &lt; 18.5</td>
<td>1.8%</td>
<td>0.8%</td>
<td>2.2*</td>
</tr>
<tr>
<td>Emerg. status</td>
<td>4.7%</td>
<td>5.9%</td>
<td>0.8*</td>
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* Statistically significant, p<.05

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### Hypertension
- Asian: 85.1%
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**Estimate/ OR**
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* Statistically significant, p<.05

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**CVA**
- Asian: 8.9%
- Caucasian: 7.6%

**Diabetes**
- Asian: 49.7%
- Caucasian: 36.0%

**Dialysis**
- Asian: 4.7%
- Caucasian: 2.0%

**OR**
- CVA: 1.2*
- Diabetes: 1.6*
- Dialysis: 2.2*

* Statistically significant, p<.05
Descriptive Results
122 Hospitals in California

<table>
<thead>
<tr>
<th></th>
<th>Asian</th>
<th>Caucasian</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart failure</td>
<td>18.9%</td>
<td>16.9%</td>
<td>1.1*</td>
</tr>
<tr>
<td>Class 4 angina</td>
<td>23.2%</td>
<td>28.0%</td>
<td>.82*</td>
</tr>
<tr>
<td>≥3 dz vessel</td>
<td>4.7%</td>
<td>2.0%</td>
<td>1.2*</td>
</tr>
</tbody>
</table>

* Statistically significant, p<.05

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<tr>
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<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior PTCA</td>
<td>14.0%</td>
<td>20.1%</td>
<td>0.7*</td>
</tr>
<tr>
<td>Previous CABG w CPB</td>
<td>2.4%</td>
<td>5.1%</td>
<td>0.5*</td>
</tr>
<tr>
<td>Previous CABG w/o CPB</td>
<td>0.4%</td>
<td>1.0%</td>
<td>0.5*</td>
</tr>
</tbody>
</table>

* Statistically significant, p<.05

Descriptive Results

<table>
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<tr>
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<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left main &gt;50%</td>
<td>24.7%</td>
<td>26.6%</td>
<td>.87*</td>
</tr>
<tr>
<td>IMA use</td>
<td>88.7%</td>
<td>88.5%</td>
<td>1.02</td>
</tr>
<tr>
<td>Unadjusted mortality</td>
<td>3.1%</td>
<td>3.0%</td>
<td>1.02</td>
</tr>
</tbody>
</table>

* Statistically significant, p<.05

Highlights in Gender Comparisons

- **Age** – OR >3*
- **Mean BMI** AM – 25.98*
  AF – 25.50*
- **BMI** Very low BMI (<18.5) – OR >3*
  Very high BMI (>40) – OR >1.2*
- **Hypertension** – OR >2*
- **Stroke** - OR 1.0, AF:CF-1.0, AM:CM-1.3*
Highlights in Gender Comparisons: AF vs. AM

- Diabetes – OR \( \leq 1.7^* \)
- Dialysis – OR \( \leq 1.8^* \) (2.7 CF)
- Peripheral vascular dz – OR \( > 1.3^* \)
- Immunosuppressive therapy – OR \( > 1.7^* \)
- Chronic lung dz – OR \( < 0.8^* \)

* Statistically significant, \( p < 0.05 \)

Highlights in Gender Comparisons: AF vs. AM

- Heart failure – OR \( > 1.4^* \)
- Ejection fraction < 30% – OR \( < 0.7^* \)
- Angina – OR \( > 1.1^* \)
- \( \geq 3 \) vessel disease – OR \( < 0.8^* \)
- Mitral insufficiency – OR \( > 1.2^* \)

* Statistically significant, \( p < 0.05 \)

Highlights in Gender Comparisons: AF vs. AM

- HX of PTCA – AM:AM \( < 0.78^* \), AF:CF \( = 0.6^* \), AM:CM \( = 0.7^* \)
- Prior CABG w CPB
  - AM:AM \( = 0.5^* \), AF:CF \( = 0.5^* \), AM:CM \( = 0.5^* \)
  - Previous CABG w/o CPB
  - AM:CF \( = 0.3^* \), AF:CF \( = 0.3^* \), AM:CM \( = 0.6^* \)
- Use of internal mammary artery – OR \( = 0.7^* \)

* Statistically significant, \( p < 0.05 \)

Risk Adjustment

- Requires a stipulated, unique set of patient, physician, and perioperative prediction factors and characteristics – the CCORP variables
- Assessed at two levels: Individual patient level and the clustering effect at the hospital level
- GEE (generalized estimating equations) used
Results- Comparisons between high and low volume hospitals

Varied from 5 - 2,499 surgery cases per hospital

Deciding a volume cut-point

Operative mortality
Race and Gender

Race (A:C)
Unadjusted mortality
OR ~1.02 (p=.788)

Gender (AF:AM)
Unadjusted mortality
OR ~1.4 (p=.057)

Adjusted mortality
OR ~1.2 (p=.452)

Results- Comparisons between high and low volume hospitals

Cut-point: 300 surgeries in 3 years

- 56 low-volume hospitals (9,614 patients)
- 66 high-volume hospitals (38,850 patients)

GEE model for operative mortality by hospital volume

56 low-volume hospitals ≤ 300 surgeries in 3 yrs
66 high-volume hospitals >300 surgeries in 3 yrs

Low-volume group
Risk-adjusted OR-1.22 (p=.05)
Hospital Volume Results
Access to hospital groups

High volume hospitals
73% Asians vs. 81% Caucasians

Low volume hospitals
27% Asians vs. 19% Caucasians

(p < .01)

Results
Access to hospitals

Estimated average of Asians in each hospital group
• High volume hospitals – Asians ~10%
• Low volume hospitals – Asians ~17%

(p = .026)

Conclusion
Healthcare disparities exist in those who underwent isolated CABG surgery in California, 2003-2005:

- between Asians and Caucasians
- between Asian males and females

Summary of Salient Findings

Gender:
• Marginal difference in the unadjusted mortality.
• Asian females 40% more likely to die than Asian males.
### Summary of Salient Findings

- Suspect Asians had a later presentation for CABG surgery compared to Caucasians. Asians have:
  - Younger mean age for males
  - More multivessel disease
  - A higher likelihood of hypertension, diabetes, renal disease, and heart failure between races
- A higher likelihood of these chronic illnesses in Asian females than Asian males
- Less class IV angina
- Relatively normal mean BMI ~25
- Less use of IMA in Asian females

### Study Limitations

- “Asians” as a racial category
- Lack of data alignment in the CCORP dataset with the 17 CABG quality indicators chosen by the National Quality Forum
- Operative mortality as the only outcome variable
- Different approaches to doing the CABG surgery
- Data accuracy
- Important missing data – the other CAD patients without surgery

### Summary of Salient Findings

Between high and low volume hospitals:

- Hospital referral pattern: Less Asians had CABG surgery in the high-volume hospitals
- Higher operative mortality in the low-volume hospitals for both Asians and Caucasians

### Theoretical Implications

- Most data – structural patient characteristics aspects
- Need more data - process and outcomes
Clinical Implications
- Later presentation for CABG surgery compared to Caucasians
- Less complaints of angina
- Relatively normal BMI ~25
- Hospital referral pattern

Policy Implications
- Racial designation of Asian sub-categories
- Public awareness of heart disease in Asians, especially Asian women
- Language ordinances
- Funding for clinical research
- A review board at the national level
- A national center of clinical resources for Asians

Educational and Study Support Disclosures
- Graduate Dean’s Health Science Fellowship
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- Graduate Student Research Award

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OSHPD Staff

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- Other OSHPD staff

THANK YOU!

多謝！
ありがとう
감사합니다
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Background information about OSHPD

- Facilities Development (hospitals, nursing homes)
- Cal-Mortgage Loan Insurance
- Healthcare Workforce Development
- Healthcare Information Division (HID)
- Administrative Services
- Health Professions Education Foundation
- Rural Health Policy Council

Why study Asians

- Few clinical data exist for Asian Americans
- Surge in immigration from Asian countries - triple by 2050
- Urbanization and looming obesity epidemic
- Language barriers — Limited healthcare resources
- Availability of mandatory CABG surgery data in California — one of the largest and the best clinical datasets for Asian Americans

Review of literature

- Many studies from clinical datasets – few on minorities
- Of the minority studies – mostly on African Americans and Hispanics
- Pubmed search: ‘CABG’ + ‘Asian Americans’ → 7 studies

OSHPD Healthcare Information Division (HID)

Professional Providers

Quality

Coronary Artery Bypass Graft Reports
Asian American CABG surgery outcomes studies

On access to services
- Taira, Seto and Marcel (2001): ‘Examining disparities among Asian subgroups in Hawaii’
- Rothenberg et al. (2004): ‘Examining access to high quality surgeons’

Asian American CABG surgery outcomes studies

On mortality outcomes
- Nallamothu et al. (2001): Coronary artery bypass grafting in Native Americans: A higher risk of death compared to other ethnic groups

Asian American CABG surgery outcomes studies

Comparing preoperative risks and mortality
- Verderber, Castelfranco, Nishioka, & Johnson (1999): Cardiovascular risk factors and cardiac surgery outcomes in a multiethnic sample of men and women
- Yeo, Li, and Amsterdam (2007): Clinical characteristics and 30-day mortality among Caucasians, Hispanics, Asians and African Americans in the 2003 California Coronary Artery Bypass Graft Surgery Outcomes Reporting Program
Theoretical Model
Applying Donabedian’s quality framework in CABG surgery

Structure
- Hospital
- Surgeons
- Cardiac Service Line
- Patients

Process
- Use of IMA grafts
- Use of cardiopulmonary bypass machines
- Use of minimally invasive direct techniques
- Use of blood products
- Cardiac anesthesia

Outcome
- Operative mortality
- Major complications
- Length of stay
- Surgery cost
- Patients’ quality of life issues

Fluidity in the model
**Methodology**

- A secondary analysis using coronary artery bypass graft (CABG) surgery clinical data

**Methodology Subjects**

- **Inclusion criteria**
  - Race - Asian or Caucasian
  - >18 years old
  - Only isolated CABG surgery
  - Surgery done in California
  - Date of surgery between 2003-2005

**Methodology Subjects**

- **Exclusion criteria**
  - Race designated other than Asian or Caucasian
  - <18 years old
  - CABG surgery in combination with valve or other major cardiovascular surgery
  - Surgery not done in California

**3-Steps Auditing conducted by CCORP –**

- Identify hospital outliers using state average
- Identify discrepancies from Vital Statistics and discharge status from PDD data
- On-site auditing
On-site Auditing Conducted for 2003 data

- 15 hospitals selected
- 1/3 of cases reviewed - 958
- All 60 deaths from these 15 hospitals were selected for auditing

On-site Auditing conducted for 2003 data

**Under-reporting** was relatively high:
- status of procedure
- New York Heart Association classification angina type, and
- mitral insufficiency

Methodology

**Data preparation**
- Recode variables from string into numeric, and create categories for contrasts
- Identify data discrepancies – Variables 35 and 35, “0”s in LOS and charges
- Separate data file for Asian and Caucasians
- Obtain predicted values for operative mortality
- Create categories for chosen continuous variables: age, ejection fraction
- Centering data
- Aggregate hospital volumes, create high and low surgical volume categories

Definition of Isolated CABG Surgery

- CABG surgery not including other major cardiac surgeries, such as valve replacement surgery
- A moving target – Revisions made with discussions at the CCORP Clinical Advisory Panel (CAP) Meetings to allow inclusion of more procedures (endarterectomies, left atriotomy, thoracentesis, femoral artery/vein repairs)
**Correlations Between Surgical LOS and Total LOS**

Linear Regression

Length of Stay (LOS recoded) = 2.11 + 0.99 * surglos

R Square = 0.83

Surgical LOS more reliable than total LOS

**Healthcare Information Division**

- Select the type of information you are seeking.
  - Hospitals
  - Professional Providers
  - Submit Data
  - Long-Term Care Facilities
  - State and County
  - Recently Released Data or Reports
  - Primary Care / Specialty Clinics
  - Get Hospital Fair Pricing Policies
  - Home Health & Hospice

**ROC Curve**

Area Under the Curve

Test Result Variable(s): Predicted probability

<table>
<thead>
<tr>
<th>Area</th>
<th>Std. Error</th>
<th>Asymptotic Sig.</th>
<th>Asymptotic 95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>.816</td>
<td>.006</td>
<td>.000</td>
<td>.805 - .827</td>
</tr>
</tbody>
</table>

a. Under the nonparametric assumption
b. Null hypothesis: true area = 0.5

Other models: ROC ranges from 0.75 – 0.85
**Risk-adjusted mortality (RAMR)** = O/E X state mortality rate (3.1%)

**RAMR for Asians**
3.1/3.08 X 3.1% = **3.12%**

**NS**

**RAMR for Caucasians**
3.0/3.04 X 3.1% = **3.06%**

Mean operative mortality for CABG surgery in the whole 2003-2005 CCORP Data **3.1%**

**Female versus males**

GEE model, controlling for 26 other predictor variables in the model.

**OR = 1.57**

**P < .0001**

The worst risk appears to be the emergency–salvage status

**OR – 12.75 times**

↑ operative mortality
The second worst risk appears to be cardiogenic shock

OR – **2.41** times
↑ operative mortality

Severe chronic lung disease (cld) and VT/VF have about the same risks

OR – ~2 times (severe cld)
OR – ~2 times (VT/VF)
↑ operative mortality