Assessment of Coronary Intervention in Japan From the Japanese Coronary Intervention Study (JCIS) Group

—— Comparison Between 1997 and 2000 ——

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**Background**

The first nationwide survey of the situation in Japan (the 1997 SJ) regarding percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) was conducted by the Japanese Coronary Intervention Study (JCIS) group and the results of the second nationwide, continuous survey of Japan in 2000 (the 2000 SJ) are presented here.

**Methods and Results**

A questionnaire was collected from 8,268 facilities (99.93%). In the 2000 SJ, the total number of coronary arteriography (CAG) performed was 543,046 (428 CAGs per 10^5 population). The estimated ratio of CAG to patients with coronary artery disease (CAD) in Japan is approximately 1.4-fold that in the US. Total numbers of PCI and CABG performed were 146,992 and 23,584, and increased to 134% and 130%, respectively, over the 3 years. PCI facilities with an annual number of PCIs performed of more than 100 were 40.2%, and the respective CABG facilities were 8.3%. The ratio of PCI to CABG was 6.23 in the 2000 SJ, and was several times higher than the ratio in Western countries.

**Conclusion**

The situation in Japan regarding the number of CAG, PCI, and CABG procedures performed is very different from that in Western countries. This provides important information for diagnosis, treatment and guidelines for Japanese patients with CAD. (Circ J 2004; 68: 181–185)

**Key Words:** Annual number; Coronary intervention; Japan

Coronary artery disease (CAD) is a serious and common disease that seriously influences the prognosis and quality of life of patients. Coronary intervention for CAD is classified into percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG). The indications of PCI have widened with the development of new devices and techniques, and the outcome of treatment has improved. Thus, PCI is increasingly used throughout the world; although it is an invasive and expensive therapy and still has some serious problems in terms of complications and/or restenosis. The first nationwide survey of PCI and CABG in Japan (the 1997 SJ) was conducted in 1998 by the Japanese Coronary Intervention Study (JCIS) group with the support of 7 Japanese societies of cardiology, including the Japanese Circulation Society, the Japanese Society of Interventional Cardiology, the Japanese College of Cardiology, the Japanese Coronary Association, the Japanese Association for Thoracic Surgery, the Japanese Society for Cardiovascular Surgery, and the Japanese Association for Cerebro-cardiovascular Disease Control. To define whether PCI and CABG have increased since then, we investigated the first continuous survey of Japan in 2000 (the 2000 SJ) in 2002. In addition, the number of coronary arteriography procedures (CAG) performed in Japan was investigated. This is the first such investigation in Japan, and the relationship between CAG and PCI or CABG was analyzed in the present study.

**Methods**

For the 2000 SJ, a questionnaire was dispatched by letter or fax to the departments of internal medicine, cardiology and cardiovascular surgery of 8,274 hospitals throughout Japan. Basic data such as the names and addresses etc of hospitals all over Japan were obtained from the Japanese hospital database of Japan Medical Press Inc (Tokyo, Japan).

We narrowed the questionnaire down to the following 5 questions as the minimum information required, in order to increase the collection rate: (1) number of cases of CAG performed from January 1 to December 31, 2000; (2) the number of cases of PCI performed from January 1 to December 31, 2000; (3) the number of cardiologists; (4) the number of cases of CABG performed from January 1 to December 31, 2000; and (5) the number of cardiovascular surgeons. Note that items (2)–(5) in the 2000 SJ are the same as those in the 1997 SJ, but that item (1) is a new question.

These data were collected in the Second Department of Internal Medicine, Gifu University Graduate School of Medicine, and were analyzed by a host computer at the Japan Clinical Research Assist Center (JCRAC, Tokyo, Japan).

This study was approved by the local ethics committee on human research (Gifu University, Japan).
Results

In the 2000 SJ, we obtained complete answers from 8,268 of 8,274 hospitals (collection rate: 99.93%). The percentage was similar to that of the 1997 SJ (7,993 of 8,253 hospitals: 96.85%).

Number of CAG Performed in Japan

CAG was performed in 1,442 facilities of 8,274 hospitals (17.4%), and the total number performed was 543,046. The mean number of CAG performed per CAG facility was 377 (minimum: 1, maximum: 9,369). Thus, the number of

Table 1 Changes in the Numbers of Coronary Interventions and Facilities During the 3 Years, 1997–2000

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<tbody>
<tr>
<td><strong>PCI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total numbers of coronary interventions</td>
<td>109,788</td>
<td>146,992</td>
<td>18,121</td>
<td>23,584</td>
</tr>
<tr>
<td>Total increase</td>
<td>+37,204 [+33,713]</td>
<td>+5,463 [+4,887]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of increase</td>
<td>+134% [+130%]</td>
<td>+130% [+126%]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of facilities</td>
<td>1,023 [1,056]</td>
<td>1,240 [+121% [+117%]]</td>
<td>486 [501]</td>
<td>581 [+120% [+116%]]</td>
</tr>
<tr>
<td>Mean number per facility</td>
<td>107</td>
<td>119 [+111%]</td>
<td>37</td>
<td>41 [+111%]</td>
</tr>
<tr>
<td>Facilities in which PCI or CABG was performed in both 1997 and 2000</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No. of facilities</td>
<td>967</td>
<td>427</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of coronary interventions</td>
<td>106,967</td>
<td>131,131</td>
<td>16,740</td>
<td>18,728</td>
</tr>
<tr>
<td>Increase in number of coronary interventions</td>
<td>+24,164 [+123%]</td>
<td>+1,988 [+112%]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean number per facility</td>
<td>111</td>
<td>136 [+123%]</td>
<td>39</td>
<td>44 [+113%]</td>
</tr>
<tr>
<td>Contribution ratio to the total increase in number</td>
<td>65.0%</td>
<td>36.4%</td>
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<tr>
<td>Facilities in which PCI or CABG was discontinued during 1997–2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No. of facilities</td>
<td>52</td>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of coronary interventions</td>
<td>1,702</td>
<td>–</td>
<td>1,042</td>
<td>–</td>
</tr>
<tr>
<td>Mean number per facility</td>
<td>33</td>
<td>–</td>
<td>20</td>
<td>–</td>
</tr>
<tr>
<td>Facilities in which PCI or CABG was newly started during 1997–2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of facilities</td>
<td>273</td>
<td>154</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of coronary interventions</td>
<td>13,040</td>
<td>3,475</td>
<td>48</td>
<td>23</td>
</tr>
<tr>
<td>Ratio to the total number in 2000</td>
<td>8.9%</td>
<td>14.7%</td>
<td></td>
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<tr>
<td>Contribution ratio to the total increase in number</td>
<td>35.0%</td>
<td>63.6%</td>
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</table>

[ ] Numbers assuming that the collection rates of 96.85% in 1997 and 99.93% in 2000 are equivalent in both years.

( ) rate of increase in 2000.

PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting.
CAGs performed was 428 patients per 10^5 population in Japan.

The percentage of CAG facilities with an annual number of CAG below 100 was 24.1% (347 facilities), that below 200 was 42.9% (560 facilities), and that over 800 was 11.9% (252 facilities) (Fig 1-A). Only 3.0% of the total CAGs were performed in CAG facilities with an annual number of CAG below 100, 10.1% in those below 200, and 40.0% in those over 800 (Fig 1-B).

**Number of PCI Performed in Japan**

PCI was performed in 1,240 facilities of 8,274 hospitals (15.0%) (1,023 facilities in the 1997 SJ), and the total number of PCI performed was 146,992 in the 2000 SJ (109,788 in the 1997 SJ). PCI increased to 134% (corrected % by questionnaire collection rate of 2000: 130%) over the 3 years (Table 1). The number of facilities in which PCI was newly performed in 2000 was 273, and the total PCI performed in those facilities was 13,040 (8.9% of the total number in 2000). The mean number of PCI performed per PCI facility was 119 in the 2000 SJ (minimum: 1, maximum: 2,967) (107 in the 1997 SJ). Thus, the number of PCIs performed was 116 patients per 10^5 population in the 2000 SJ, and 90 in the 1997 SJ.
The percentage of PCI facilities with an annual number of PCI below 50 was 36.7% (41.6% in the 1997 SJ), that below 100 was 59.8% (64.8% in the 1997 SJ), and that below 200 was 82.0% (84.5% in the 1997 SJ) (Fig 1-C).

Some 7.1% of the total PCI number (8.9% in the 1997 SJ) was performed in PCI facilities with an annual number of PCI below 50, 20.9% in those below 100 (24.0% in the 1997 SJ), 46.9% in those below 200 (49.6% in the 1997 SJ), and 20.7% in those over 400 (21.6% in the 1997 SJ) (Fig 1-D).

Number of CAG Performed in Japan
CABG was performed in 581 facilities of 8,274 hospitals (7.0%) (486 facilities in the 1997 SJ), and the total number of CABG performed was 23,584 (18,121 in the 1997 SJ). CABG increased to 130% (corrected % by questionnaire collection rate of 2000: 126%) over the 3 years (Table 1). The number of facilities in which CABG was newly performed in 2000 was 154, and the total number CABG performed in those facilities was 3,475 (14.7% of the total number in 2000). The mean number of CABG performed per CABG facility was 41 in the 2000 SJ (minimum: 1, maximum: 371) (37 in the 1997 SJ). Thus, the number of CABGs performed was 19 patients per 10^5 population in the 2000 SJ, and 14 in the 1997 SJ.

The percentage of CABG facilities with an annual number of CABG below 50 was 70.9% (76.1% in the 1997 SJ), and that below 100 was 91.7% (95.1% in the 1997 SJ) (Fig 1-E).

Some 37.2% of the total CABG number (44.7% in the 1997 SJ) was performed in CABG facilities with an annual number of CABG below 50, and 71.2% in those below 100 (79.8% in the 1997 SJ) (Fig 1-F).

PCI facilities with cardiac surgery departments in the same hospital accounted for 19.6% of PCI facilities with an annual number of PCI below 50 (28.4% in the 1997 SJ), 40.0% of those between 50 and 100 (42.6% in the 1997 SJ), 63.8% in those between 100 and 200 (70.6% in the 1997 SJ), and 91.5% in those over 200 (89.7% in the 1997 SJ) (Fig 2-A). Therefore, 72.2% of the total PCI number was performed in PCI facilities equipped with a cardiovascular surgery department.

Correlations Between the Annual Numbers of CAG and PCI or CABG
There was a strong significant correlation between the annual numbers of CAG and PCI performed at each facility (r=0.953, p<0.0001) in the 2000 SJ (Fig 2-B). The ratio of CAG to PCI was 3.3, and this rate was almost the same among all institutions. On the other hand, there was no significant correlation between PCI and CABG in the 2000 SJ (Fig 2-C).

Ratio of PCI to CABG
The ratio of the total number of PCI performed to that of CABG performed was 6.23 in the 2000 SJ and was similar to that (6.21) of the 1997 SJ. The number of hospitals with a ratio between 0 and 3 was 175 (30.6%), that between 3 and 5 was 114 (19.9%), that between 5 and 8 was 129 (22.6%), and that over 8 was 155 (27.1%). The percentages were similar to those of the 1997 SJ.

Numbers of Cardiologists and Cardiovascular Surgeons in the 2000 SJ
In the 2000 SJ, the total number of cardiologists was 11,232, and that of cardiovascular surgeons was 2,999, and the ratio was 3.7. The 8,769 cardiologists (78.1%) were working at 1,442 CAG facilities, and 8,190 (72.9%) in 1,240 PCI facilities. The mean number of cardiologists per CAG and PCI facility, excluding University hospitals, was 4.5 and 4.8, respectively. There were significant correlations between the number of cardiologists and the annual numbers of CAG or PCI performed (Fig 3-A, -B).

The 2,719 cardiovascular surgeons (90.7%) were working at 581 CABG facilities. The mean number of cardiovascular surgeons per facility excluding the University hospitals was 3.5. There was a significant correlation between the annual number of CABG performed and the number of cardiovascular surgeons (Fig 3-C).

Discussion
Annual Number of CAG Performed in Japan
CAG was performed in 428 patients per 10^5 population in the 2000 SJ. In the US, CAG was performed in 468 patients per 10^5 population in 2000, which was almost equal to Japan (Table 2). There were 12,900,000 patients with coronary heart disease (4,584 patients per 10^5 population) in the US, but in Japan precise data on the prevalence of coronary heart disease, based on a nationwide survey, are not available. According to the 5th basic investigation of cardiovascular disease in 2000 by the Japanese Ministry of Health, Labour and Welfare, patients with coronary heart disease accounted for 3.2% of 8,369 Japanese (see Internet Web: http://www.mhlw.go.jp/toukei/saikin/hw/kenkow/jyunkan/jyunkan00/). It is estimated that the number of patients with coronary heart disease is 4,060,000 (3,199 patients per 10^5 population); that is, the ratio of CAG to patients with CAD in Japan is estimated to be approximately 1.4-fold that in the US.

The increase in CAG for patients with CAD in Japan may be related to differences in the indications for CAG and the health insurance system: (1) Japanese doctors may have a tendency to choose CAG in order to clarify the presence or absence of a significant stenosis of the coronary arteries or bypass grafts, and to clarify the presence or absence of restenosis at the PCI site after 3–6 months, even

<table>
<thead>
<tr>
<th></th>
<th>Annual number</th>
<th>Number per 10^5 population</th>
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<tbody>
<tr>
<td>CAG</td>
<td>1,318,000</td>
<td>468</td>
</tr>
<tr>
<td>PCI</td>
<td>561,000</td>
<td>199</td>
</tr>
<tr>
<td>CABG</td>
<td>519,000</td>
<td>184</td>
</tr>
</tbody>
</table>

CAG, coronary arteriography; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting.
if the patient is asymptomatic; and (2) the national health insurance system of the Japanese Government bears 70–80% of the costs of CAG for all citizens equally.

Comparison Between 1997 and 2000 of Coronary Interventions

The total number of PCI and CABG performed increased to 130% for PCI and 126% for CABG over the 3 years in Japan, compared with an increase to only 104% for PCI and decrease to 94% for CABG in the US over 2 years (1998–2000). As shown in Table 1, the total numbers of PCI and CABG in the facilities in which PCI or CABG was performed in both 1997 and 2000 increased to 123% and 113%, respectively. The contribution ratios of the increase to the total increase in the number of PCI and CABG were 65.0% and 36.4%, respectively. The number of facilities in which PCI or CABG was newly performed in 2000 was 273 and 154, respectively, and the total PCI and CABGs performed at those facilities were 13,040 and 3,475, respectively. The contribution ratios of the increase in the new facilities to the total increase in the number of PCI and CABG were 35.0% and 63.6%, respectively (Table 1).

Thus, approximately two-thirds of the increase in the total numbers of PCI and CABG during the intervening 3 years has been the increase in the number of PCI performed per facility and the increase in the number of new CABG facilities. We speculate that these increases in Japan may be related to increased application of PCI and CABG because of the development of new techniques and devices, such as stents. However, similar increases in the numbers of PCI and CABG were not seen in the US during the same period. Therefore, the increases cannot be explained purely because of the developments in PCI and CABG techniques. Also, the ratio of increase for the 3 years is too large to explain from the increase in the number of patients with coronary heart disease in Japan. Thus, the increases may be related to other special factors in Japan such as the present Japanese medical economy. Further investigations are required in the future.

The present study demonstrated that the percentage of PCI facilities performing an annual number of PCI less than 50 decreased from 41.6% in the 1997 SJ to 36.7% in the 2000 SI, and that the percentage of CABG facilities performing an annual number of CABG less than 50 decreased from 76.1% in the 1997 SJ to 70.9% in the 2000 SJ. The Japanese Ministry of Health, Labour and Welfare, and the ACC/AHA guidelines in the US, recommend that PCI facilities perform at least 100 (or 200 in the US) procedures annually. Therefore, these decreases may be associated with better, more skilful care of patients with CAD, although this has still to be clarified.

The ratio of PCI to CABG in the 2000 SI, as well as in the 1997 SJ, was several times higher than that of Western countries (Table 2) and although there was a strong significant correlation between the numbers of CAG and PCI performed, there was no significant correlation between the annual numbers of PCI and CABG performed. To analyze these problems, the indications for PCI and CABG in Japan and Western countries should be compared and we intend to do so.

Conclusion

The situation in Japan regarding CAG, PCI and CABG is considerably different from that of Western countries.

Acknowledgments

This survey could not have been carried out without the cooperation and support of the participating cardiologists and cardiac surgeons at all survey institutions. We thank them all for allowing us to obtain this precious data. Furthermore, we thank the Japan Clinical Research Assist Center (JCRAC) for cooperation and support in collecting the data, Ms Natsumi Ishigami for office assistance as secretary of Gifu University, and Dr Daniel Mrozek for assistance with the manuscript.

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References


Appendix 1

Japanese Coronary Intervention Study (JCIS) Investigators

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Data Collection Center: Japan Clinical Research Assist Center (JCRAC, Tokyo); Mr Kenichi Yamamoto, Mr Shiro Maesaki, and Mr Yasuhiro Okawa.