Coronary angioplasty in Australia 1998

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CARDIOVASCULAR DISEASE SERIES
Number 15

Coronary angioplasty in Australia 1998

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June 2001

Australian Institute of Health and Welfare
and
National Heart Foundation of Australia
Canberra

AIHW cat. no. CVD 14

This publication is part of the Australian Institute of Health and Welfare's Cardiovascular Disease Series. A complete list of the Institute's publications is available from the Publications Unit, Australian Institute of Health and Welfare, GPO Box 570, Canberra ACT 2601, or via the Institute's web site (http://www.aihw.gov.au).

ISSN 1323-9236
ISBN 1 74024 110 X

Suggested citation

Davies J & Senes S 2001. Coronary angioplasty in Australia 1998. AIHW Cat. No. CVD 14 (Cardiovascular Disease Series No. 15). Canberra: AIHW and National Heart Foundation of Australia.

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Published by the Australian Institute of Health and Welfare

Printed by CPP Instant Printing

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List of abbreviations

AIHW	Australian Institute of Health and Welfare
AMI	acute myocardial infarction
CABG	coronary artery bypass grafting
CPR	cardiopulmonary resuscitation
Cx	circumflex artery
CK	creatinine kinase
GIT	gastro-intestinal tract
IABP	intra-aortic balloon pump
IMA	internal mammary artery
IMI	inferior myocardial infarction
LAD	left anterior descending artery
LBBB	left bundle branch block
ICD-9	International Classification of Diseases, Ninth Revision, i.e. ICD-10 is Tenth revison
LCx	left circumflex artery
LM	left main artery
LVF	left ventricular function
PTCA	percutaneous transluminal coronary angioplasty
RCA	right coronary artery
SAP	stable angina pectoris
SVG	saphenous vein graft
UAP	unstable angina pectoris
VF	ventricular fibrillation

Preface

This report presents information on coronary angioplasty procedures performed in 1998. It is produced jointly by the Australian Institute of Health and Welfare and the National Heart Foundation of Australia. The National Heart Foundation began compiling data and reporting on coronary angioplasty procedures performed in Australia in 1980.

An advisory committee appointed by the Foundation oversees the angioplasty register and the Institute collects, collates, analyses and reports the data through its National Centre for Monitoring Cardiovascular Disease. The project is financed by the Foundation and the Institute, through funds it receives for the National Centre from the Commonwealth Department of Health and Aged Care.

Under its Act, the *Australian Institute of Health and Welfare Act 1987*, the Institute is able to provide the legislative protection that is required to operate the coronary angioplasty register and protect the data confidentiality interests of the participating units and their patients.

Members of the Cardiac Society of Australia and New Zealand supply data for the coronary angioplasty register and are participating in the development of improved registers for cardiac procedures.

This report is intended primarily for professionals in the field so it uses technical terms widely. However, to make the contents more accessible to other interested readers, a brief explanatory introduction and a glossary have been included.

A report covering procedures performed in 1999 is in preparation and will be issued as soon as the data are made available by all participating interventional cardiology units.

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National Heart Foundation of Australia

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Acknowledgments

The authors gratefully acknowledge comment and advice on the report from Dr Stan Bennett, Dr Paul Magnus, Ms Sushma Mathur and the Coronary Angioplasty Advisory Committee, National Heart Foundation. The members of the Committee are Dr Louis Bernstein (New South Wales), Associate Professor Ian Meredith (Victoria) and Dr Constantine Aroney (Queensland). The assistance of Ms Amanda Nobbs in the publication process is greatly appreciated.

The Australian Institute of Health and Welfare and the Coronary Angioplasty Advisory Committee are very grateful to the staff of interventional cardiology laboratories in Australia, and members of the Cardiac Society of Australia and New Zealand for giving their time to the register and ensuring that it retains its national coverage.

Summary

This report provides details of percutaneous transluminal coronary angioplasty (PTCA) performed in Australia in 1998. It covers patterns and trends in the use of the technique, as well as in its indications, complications and success rates. Comparison in most instances is made with 1996, the most recent year for which detailed data are available.

The main findings of the report are:

- During 1998 there were 18,094 coronary angioplasty procedures performed in Australia, with an average of 393 procedures per interventional cardiology unit.
- Coronary angioplasty procedures in 1998 increased by 14% from 1997.
- The age-standardised national average PTCA rate in 1998 was 908 per million population. This varied across the Australian States and Territories, from 675 per million population in Queensland to 1,108 per million population in Victoria.
- Angioplasty procedures are three times as common in males as they are in females.
- Patients undergoing angioplasty are more likely to be between 60 and 79 years old (57%).
- A total of 108 physicians were operating in 46 interventional cardiology laboratories throughout the country.
- There were 17,873 hospitalisations involving PTCA procedures, with an average length of stay of 3.7 days.
- Nineteen per cent of the procedures were repeats, and in 44% of such cases these repeats occurred within 12 months.
- The main indications for PTCA were stable angina pectoris (43%) and unstable angina pectoris (43%). Acute myocardial infarction (7%) is emerging as another significant indication.
- Twelve per cent of procedures were done on patients with previous coronary artery bypass grafts.
- Thrombolytic therapy was used before angioplasty in 5% of procedures.
- Stents were inserted in 87% of PTCA patients in 1998. This was a marked increase in the use of stents since 1996 when the proportion of PTCA patients receiving stents was 54%.
- Complication rates associated with coronary angioplasty were as follows: need for coronary artery bypass graft 1.0%, myocardial infarction 1.2%, arterial complications 0.8%, death 0.7%.
- Coronary angioplasty achieved an adequate reduction in the lesion in 95% of lesions attempted.
- Ninety-six per cent of patients treated were discharged from hospital with a successful reduction of all lesions and no angina or complications.

Introduction

Heart disease is a major cause of morbidity and mortality in Australia, responsible for 29% of all deaths in 1998. The most common form of heart disease affecting Australians is coronary heart disease. This involves blockages in the heart's own arteries, the coronary arteries, by abnormal deposits known as plaques. There is a range of treatments for coronary heart disease, one of which is percutaneous transluminal coronary angioplasty (PTCA). The use of this minimally invasive technique has grown dramatically over the past 20 years.

PTCA involves inserting a catheter, carrying a balloon near its tip, into a major artery reached via the skin (percutaneously). The catheter is threaded through the circulation back towards the heart and into the coronary arteries to the area of the vessel obstruction. The balloon is then inflated to disrupt the plaque and create a wider passage for blood flow.

PTCA avoids the major trauma of coronary artery bypass graft (CABG) surgery because it does not require opening the patient's chest. However, the technique can only be used to treat certain types of coronary vessel obstruction. Generally, it is used where lesions are suitable or in patients in whom CABG is contraindicated.

While initial PTCA success rates are high, there is a risk of early acute closure of the coronary artery and a high rate of recurrence of the obstruction (restenosis). This has led to the development of other catheter-based techniques, including atherectomy (cutting or grinding through obstructions with mechanical devices), stenting (expanding prosthetic devices within the artery to form a tubular supporting structure) and laser angioplasty (cutting through obstructions with a laser beam). The most successful of these newer techniques is stenting, which reduces acute closure and restenosis, and hence its use is increasing rapidly.

The aim of this report is to provide details of PTCA as performed in Australia in 1998. The report covers patterns and trends in the use of the technique, indications, complications and success rates, and monitors the uptake of stenting and other adjunctive techniques.

This report is also available on the Internet at the Institute's web site at http://www.aihw.gov.au

Methods

This report summarises data on all coronary angioplasty performed in 1998 in Australia, and includes aggregate figures from previous years. Comparison is made with 1996 in most cases, the most recent year for which data are available. Coronary angioplasty units operating in 1998 are listed in Appendix A. The list of units is reviewed each year and new units are invited to join the register and submit their data.

Data collection and reporting

Generally, data collection forms are sent to all units at the beginning of each year for procedures done in the previous calendar year. Units are asked to complete the forms with aggregate results (i.e. not individual patient details) and submit them within eight weeks. Reports are provided by each unit under the condition that results will be presented in aggregate form only, and that results from individual units will not be released unless the head of the unit concerned agrees in writing.

Data were collected for coronary angioplasty only, via a collection form presented here in Appendix B. This form is reviewed and updated by the Coronary Angioplasty Advisory Committee each year to reflect changes in practice. The form used from 1980 to 1985 was updated in 1986 to collect additional data of interest to angioplasty practitioners and the wider medical community. In 1989 questions were added about the use of stents, lasers and atherectomy in angioplasty procedures. Questions on the use of thrombolytics were incorporated more recently. Details on the use of angioplasty to treat acute myocardial infarction were introduced in 1995. The 1998 form sought detail on subsequent procedures and complications for non-primary or non-rescue PTCA and on primary or rescue PTCA. This provides the distinction between complications for higher and lower risk patients.

Units' responses are reviewed, data are checked for consistency and any discrepancies are referred to the relevant unit. The data are then entered into a dedicated database at the Australian Institute of Health and Welfare (AIHW). Results are analysed and the annual report is compiled and reviewed by members of the Advisory Committee before its publication.

Coverage

The register is believed to have almost full coverage of coronary angioplasty procedures done in Australia from 1980 to the end of 1998. However, for 1997, details are too incomplete to allow analysis, so that only totals (obtained from the National Hospital Morbidity Database) are included in this report for that year. In 1998, five of the 46 hospitals performing procedures did not provide their data.

State	Number of units not participating in the register in 1998
Victoria	3
South Australia	1
Tasmania	1

To give a complete national picture of angioplasty performed in 1998 that allows for non-response, the data from the register have been complemented with information from the National Hospital Morbidity Database held by the AIHW. This database contains demographic, diagnostic, procedural and duration of stay information on episodes of care for patients admitted to hospital. The collection is based on data on hospitalisations compiled by State and Territory health authorities and supplied to the AIHW. A record is included for each separation, not for each patient, so patients who were hospitalised more than once in the year have more than one record in the database.

The difference between the total number of procedures recorded in the Coronary Angioplasty Register and the total from the National Hospital Morbidity Database is not directly attributable to the five non-participating units as there is some degree of underreporting by the 41 units in the Register.

Data held in the National Hospital Morbidity Database were found to correspond well with those reported directly to the register by participating units.

From 1 July 1998, the new International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification (ICD-10-AM) was adopted by New South Wales, Victoria, the Australian Capital Territory and the Northern Territory. The remaining States continued to code using the existing ICD-9-CM codes. The two-stage implementation of ICD-10-AM made it necessary to map data forward to ICD-10-AM for those States using ICD-9-CM while data from 1 July to 31 December 1998 are based on ICD-10-AM.

The total number of PTCA and stenting procedures nationally and for each State/Territory were obtained from the National Hospital Morbidity Database. In addition, the database supplied information on the age and sex of patients undergoing PTCA and stenting, the number of hospital separations and length of stay for PTCA.

Records for separations with procedure codes for PTCA or stenting (see Table 1 below) as principal or additional procedure and with separation dates between 1 January and 31 December 1998 were included, and likewise for the 1997 calendar year.

Table 1: International Classification of Diseases codes used in this report

Procedure	ICD-9-CM	ICD-10-AM	
Percutaneous transluminal coronary angioplasty	36.01 36.02 36.05	Block 670 codes:	35304-00 35305-00
Stenting	36.06 36.07	Block 671 codes:	35310-00 to 35310-10

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification.

ICD-10-AM = International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification.

The coding standards state that only the code for the stent is required in operations where the placement of the stent is done in conjunction with an angioplasty. The exception to this rule is if, during the operation, an angioplasty is performed on a different vessel to that being stented. In this case both the angioplasty and the stent are coded separately (Australian Coding Standards, Volume 4, ICD-9-CM, Second Edition, 1998). Therefore, to count all PTCA procedures, episodes with a code for stenting but no code for PTCA were included in the analysis, as the stent code assumes that an angioplasty has also been performed, but the angioplasty is not recorded. Other assumptions made were:

1. Codes 36.01, 36.02 and 36.05 (ICD-10-AM block 670 codes 35304-00, 35305-00) are mutually exclusive. Thus, if any combination of these codes was reported for one record, more than one procedure was performed.
2. Codes 36.06 and 36.07 (ICD-10-AM block 671 codes 35310-00 to 35310-10) are mutually exclusive. Thus, if any combination of these codes was reported for one record, more than one procedure was performed.
3. If a record contains codes for PTCA (ICD-9-CM 36.01 or 36.02 or 36.05, ICD-10-AM block 670 codes 35304-00, 35305-00) and for stents (ICD-9-CM 36.06 or 36.07, ICD-10-AM block 671 codes 35310-00 to 35310-10), according to the coding standards the PTCA and stent procedures were performed on different vessels in the same operation, so they were counted as one procedure. Assumptions 1 and 2 still apply in this case.

Definitions

In the treatment of acute myocardial infarction (AMI), a 'primary procedure' is when angioplasty is used for AMI as soon as possible, with or without thrombolysis as a preprocedure. A 'rescue procedure' is when angioplasty is used for AMI for failed thrombolysis.

Complication rates are given as percentages of those having the procedure. Complications refer to those occurring during the same hospital admission.

A 'primary success' is defined as a procedure that achieves an absolute reduction of the initial degree of luminal diameter stenosis of at least 20% at the time of the procedure, and a residual diameter stenosis of less than 50%.

An 'early clinical success' is defined as a patient who has an adequate reduction of all lesions (primary success), and no angina or complications before discharge.

Procedure rates are calculated as the number per million people in the Australian population. The rates have been calculated to include the Australian Capital Territory with New South Wales, and the Northern Territory with South Australia, as those States are where the vast majority of Australian Capital Territory and Northern Territory residents are treated. A unit began operation in the Australian Capital Territory during 1998 but since it was not operational for the full calendar year, it is combined with New South Wales in this report. Standardised rates, which take account of differences in the age structure of the populations, have been included to provide a valid comparison of procedure rates between States.

Number of units and procedures

There were 18,094 angioplasty procedures[1] performed in Australia in 1998, by 108 physicians in 46 cardiology units. This was a 14% increase in procedures over 1997, re-affirming the continuing growth of angioplasty among the range of cardiological interventions. The average number of angioplasty procedures in 1998 was 393 per unit, compared with 330 per unit in 1996. To the end of 1998 a total of 108,785 angioplasty procedures had been performed in Australia (Table 2). A list of all interventional cardiology laboratories is given in Appendix A.

Table 2: Number of procedures and units, 1980–98

			Procedures/unit	
Year	Number of procedures	Number of units	Average number	Range
1980	11	2	6	5–6
1981	45	6	8	3–18
1982	151	9	17	1–38
1983	348	10	35	4–80
1984	737	10	74	8–230
1985	1,244	13	96	13–396
1986	1,840	15	123	7–403
1987	2,383	16	149	17–491
1988	3,153	19	166	51–506
1989	4,219	20	211	46–654
1990	4,904	20	245	61–660
1991	5,726	20	286	11–656
1992	6,748	27	250	14–703
1993	8,334	30	278	10–1,004
1994	9,732	38	256	2–897
1995	11,348	39	291	12–1,016
1996	13,854 (a)	42	330	37–1,100
1997	15,914 (a)	43	370	n.a.
1998	18,094 (a)	46	393	6–897

n.a. not available.

(a) The number of procedures for all interventional cardiology units in Australia, based on data from the National Hospital Morbidity Database.

Sources: AIHW/NHF Coronary Angioplasty Register and AIHW National Hospital Morbidity Database.

1 The number of procedures for all interventional cardiology units in Australia, based on data from the National Hospital Morbidity Database.

Angioplasty by age and sex

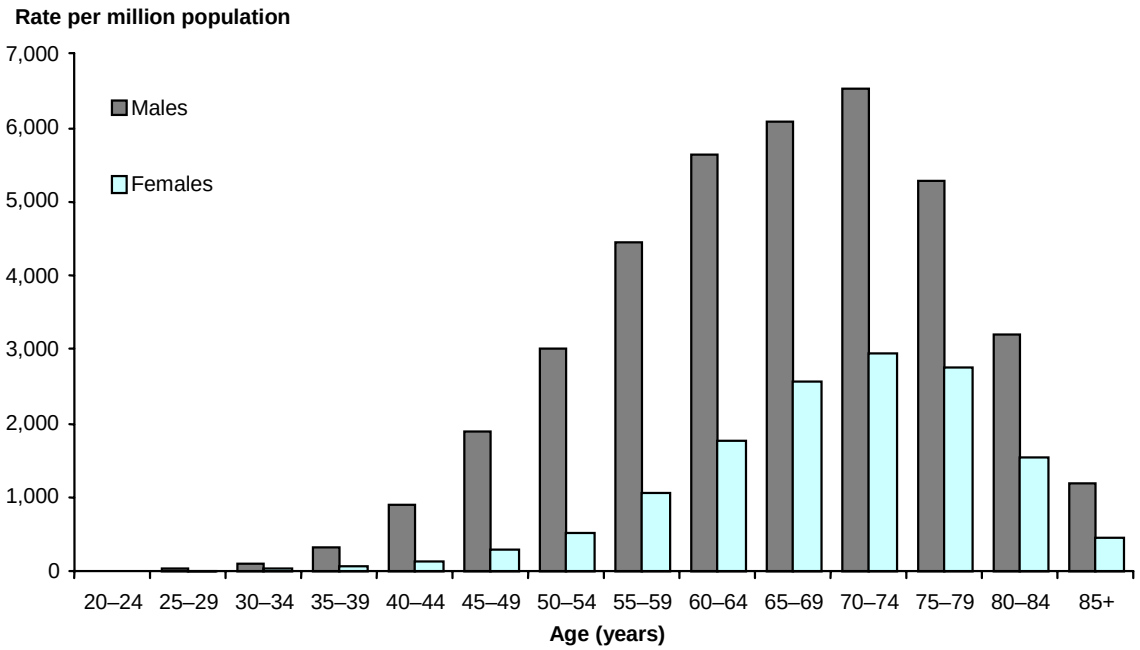
Angioplasty is done more frequently in males than females, with a ratio of about 3:1. The difference in procedure rates between men and women is most marked in the age range 35–54, but it is evident across all adult ages (Table 3 and Figure 1). Age-specific procedure rates peak at ages 70–74 among both males and females.

Table 3: Coronary angioplasty procedures by age and sex, 1998

	Males			Females			
Age (years)	Number	Per cent	Age-specific rate per million	Number	Per cent	Age-specific rate per million	Ratio male:female
20–24	1	0	1.4	0	0	0	. .
25–29	15	0.1	20.3	7	0.1	9.5	2.1
30–34	63	0.5	89.6	17	0.4	24.0	3.7
35–39	248	1.8	332.6	38	0.8	50.7	6.5
40–44	627	4.7	898.0	84	1.8	119.6	7.5
45–49	1,233	9.2	1,882.8	183	3.9	281.7	6.7
50–54	1,776	13.2	3,004.0	291	6.2	510.3	6.1
55–59	1,992	14.8	4,465.4	452	9.7	1,048.3	4.4
60–64	2,080	15.5	5,637.8	647	13.9	1,748.1	3.2
65–69	2,029	15.1	6,069.7	894	19.1	2,563.8	2.3
70–74	1,864	13.9	6,517.0	969	20.7	2,937.2	1.9
75–79	1,061	7.9	5,291.2	742	15.9	2,769.5	1.4
80–84	353	2.6	3,206.8	277	5.9	1,538.9	1.3
85+	81	0.6	1,186.0	70	1.5	448.7	1.2
20+	**13,423**	**100.0**	**1,440.3**	**4,671**	**100.0**	**496.4**	**2.9**

. . not applicable.

Source: AIHW analysis of data from the National Hospital Morbidity Database.



Source: AIHW analysis of data from the National Hospital Morbidity Database.

Figure 1: Coronary angioplasty procedure rates by age and sex, 1998

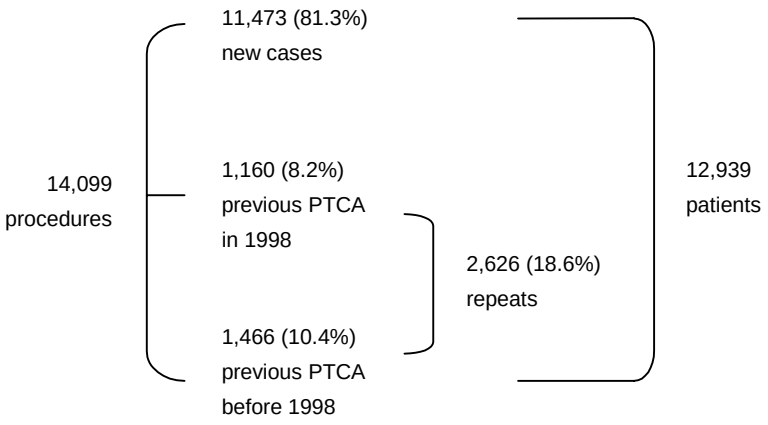
Hospital separations

In 1998 there were 17,873 separations involving coronary angioplasty procedures. The average length of stay in hospital was 3.7 days, with a median length of stay of 2.0 days. Of these hospitalisations, 34.8% (6,215) were overnight separations and 6.9% (1,238) were same-day separations.

Repeat procedures

The Coronary Angioplasty Register provided details on most of the repeat procedures in 1998.

For the 14,099 procedures where information was available, 18.6% of the procedures were repeats, and of these, the patient had undergone previous angioplasty in 1998 in 44.1% of cases, and before 1998 in 55.8% of cases (Figure 2).



Source: AIHW/NHF National Coronary Angioplasty Register.

Figure 2: First and repeat procedures, 1998

Repeat procedures done in 1998

For the 847 repeat procedures done in 1998 where information was available, 8.3% were done less than 24 hours after the first procedure, 50.4% were between 24 hours and less than three months, 23.1% were between three months and less than six months, 9.3% were between six months and less than 12 months, and for 7.7% the interval between procedures was not specified.

The reason for repeat procedures was provided for 427 procedures: 91.8% of repeats were to the same lesion, and 8.2% were for a previous failure.

Of the repeat procedures done to the same lesion (392 procedures), 28.8% were to an unstented lesion, 45.9% were to a stented lesion and 21.7% were not specified.

Repeat procedures done prior to 1998

Not all units could provide information on the interval between repeat procedures done before 1998. For the 1,076 procedures where information was available, 0.6% of repeat procedures were done less than 24 hours after the first procedure, 3.3% were between 24 hours and less than three months, 9.7% were between three months and less than six months, 18.9% were between six months and less than 12 months, 63.8% were 12 months or more apart, and for 3.7% the interval was not specified.

The reason for repeat procedures was provided in 362 procedures: 97.5% of repeats done more than 12 months apart were to the same lesion, and 2.5% were for a previous failure.

Of the repeat procedures done to the same lesion (353 procedures), 50.3% were to an unstented lesion, 41.9% were to a stented lesion and 6.5% were not specified.

Trends in procedure type

The overwhelming majority of procedures are done on single coronary vessels only (Table 4). In 1998, single-vessel angioplasty comprised 89.9% of the 18,094 procedures. Figure 3 illustrates trends in the number of single- and multi-vessel procedures since 1980.

Table 4: Trends in procedure type, 1980 to 1996 and 1998[a]

Year	1 vessel	2 vessels	>2 vessels	Total
1980	10	1	0	11
1981	45	0	0	45
1982	148	3	0	151
1983	336	11	1	348
1984	678	47	12	737
1985	1,127	102	15	1,244
1986	1,651	183	6	1,840
1987	2,163	193	27	2,383
1988	2,865	271	17	3,153
1989	3,753	429	37	4,219
1990	4,420	454	30	4,904
1991	5,243	464	19	5,726
1992	6,162	527	59	6,748
1993	7,577	711	46	8,334
1994	8,961	732	39	9,732
1995[b]	10,320	941	87	11,348
1996[c]	12,444	1,288	122	13,854
1998[d]	16,262	1,694	138	18,094

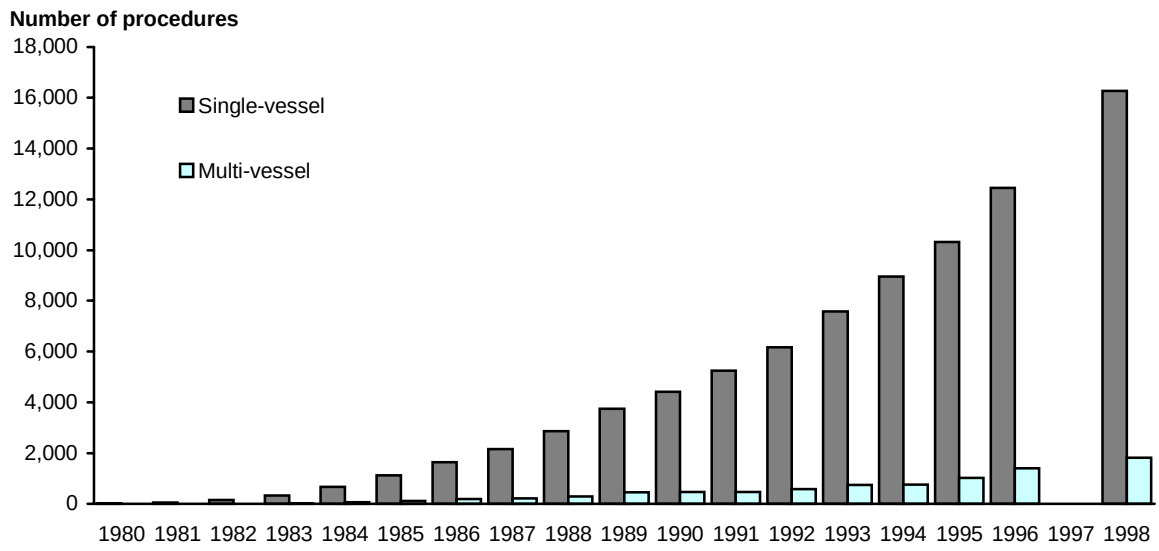
(a) Data for 1997 are unavailable.

(b) Details of vessels were estimated for 155 procedures performed in 1995.

(c) Details of vessels were estimated for 4,098 procedures performed in 1996.

(d) Details of vessels were estimated for 4,853 procedures performed in 1998.

Sources: AIHW/NHF National Coronary Angioplasty Register and National Hospital Morbidity Database.



Notes

1. Details of vessels were estimated for 155 procedures performed in 1995.
2. Details of vessels were estimated for 4,098 procedures performed in 1996.
3. Details for 1997 are unavailable.
4. Details of vessels were estimated for 4,853 procedures performed in 1998

Source: AIHW/NHF National Coronary Angioplasty Register and National Hospital Morbidity Database.

Figure 3: Number of procedures, 1980 to 1996 and 1998

State comparison of PTCA rates

The (age-standardised) national average rate for PTCA procedures is 908 per million population in 1998. There is variation in rates across States, ranging from 675 per million population in Queensland to 1,108 per million population in Victoria (Table 5 and Figure 4). Differences in age-adjusted procedure rates may reflect underlying differences in the prevalence of the conditions being treated or differences in clinical practice between States.

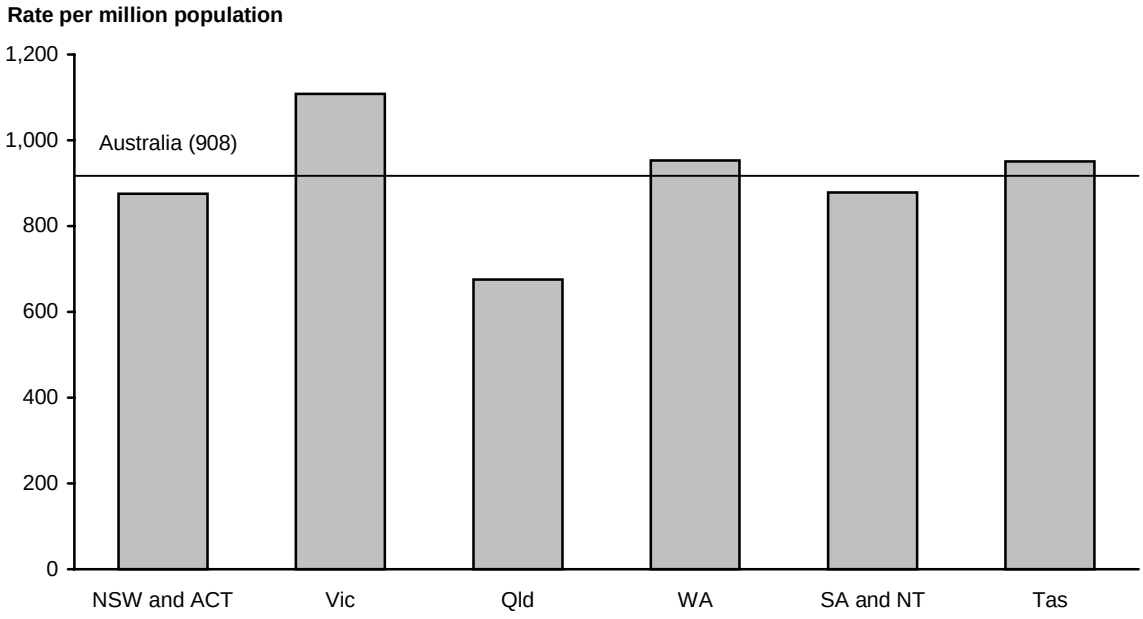
Table 5: Coronary angioplasty by State, 1998

Measure	NSW and ACT	Vic	Qld	WA	SA and NT	Tas	Australia
			Rate per million population				
Crude rate	947	1,204	691	933	957	1,064	966
Standardised rate[(a)]	875	1,108	675	953	878	951	908

(a) Age-standardised to the Australian population as at 30 June 1991.

Note: Rates have been calculated to include the Australian Capital Territory population with New South Wales and the Northern Territory population with South Australia since those are the States where the vast majority of Australian Capital Territory and Northern Territory residents are treated.

Source: AIHW analysis of data from National Hospital Morbidity Database.



Note: Age-standardised to the Australian population as at 30 June 1991.
Source: AIHW analysis of data from National Hospital Morbidity Database.

Figure 4: Coronary angioplasty rate by State, 1998

Indications for angioplasty

Not all units could supply this information, but of the 13,183 procedures for which data were available, the indication in 5,666 (43.0%) was stable angina pectoris (SAP) and in 5,689 (43.2%) was unstable angina pectoris (UAP). Angioplasty was performed for prognostic reasons in 2.9% of cases and for acute myocardial infarction (AMI) in 6.8% of cases (Table 6). Between 1996 and 1998, angioplasty for AMI has declined from 7.7% to 6.8%.

Angioplasty can be used as either a primary or a rescue method for AMI. In this context, a primary procedure is when angioplasty is used for AMI as soon as possible with or without thrombolysis preprocedure. A rescue procedure is when angioplasty is used for AMI for failed thrombolysis.

Where PTCA was used because of AMI, it was used as a primary procedure in 66.8% of the cases, as a rescue procedure in 21.3% of cases, and no details were given in 11.9% of AMI cases.

The interval from AMI to primary or rescue PTCA is also presented in Table 6. For the cases where the information was available, most primary PTCA procedures were done within 4 hours of AMI, whereas rescue PTCA procedures were performed predominantly after 4 hours from AMI being diagnosed.

Table 6: Indications for angioplasty, 1998

Indication	Interval AMI to PTCA	Number of procedures	Per cent
SAP		5,666	43.0
UAP		5,689	43.2
AMI primary	0–<2 hrs	132	1.0
	2–<4 hrs	94	0.7
	4–<6 hrs	67	0.5
	6–<8 hrs	30	0.2
	Not specified	278	2.1
AMI primary subtotal		*601*	*4.6*
AMI rescue	0–<2 hrs	16	0.1
	2–<4 hrs	22	0.2
	4–<24 hrs	67	0.5
	After 24 hours	71	0.5
	Not specified	16	0.1
AMI rescue subtotal		*192*	*1.5*
AMI primary/rescue not specified		107	0.8
Subtotal AMI		*900*	*6.8*
Prognostic		388	2.9
Other indication		83	0.6
Not specified		457	3.5
Total		**13,183**	**100.0**

AMI = acute myocardial infarction; SAP = stable angina pectoris; UAP = unstable angina pectoris.

Source: AIHW/NHF National Coronary Angioplasty Register.

Previous coronary artery bypass grafts

Not all units could answer the question about the number of angioplasty patients with existing coronary artery bypass grafts (CABG). For the 11,792 procedures where information was available, 1,469 (12.5%) were on patients with CABGs.

Approach for procedure

Not all the units could provide information on the approach for procedure. For the 12,876 procedures for which information was available in 1998, in nearly all the procedures (99.2%), the approach to the coronary arteries was made through the femoral artery, the remainder using the brachial (0.4%) and radial (0.4%) approaches. This was similar to previous years.

Angioplasty after thrombolytic therapy

Not all units could supply information on the number of patients who underwent angioplasty after having received thrombolytic therapy for AMI. Of the 10,175 procedures where information was available, 534 (5.2%) involved the use of angioplasty after thrombolytic therapy. This proportion was slightly lower than in 1996.

In 34.3% of such procedures thrombolytic therapy was given less than 24 hours before PTCA, in 13.3% it was given between 24 and 48 hours before PTCA, in 41.6% it was given more than 48 hours before PTCA, and in 10.9% of procedures the time was not known.

Stents, atherectomy, laser and other adjunctive techniques

Not all units could provide information on the use of adjunctive techniques on angioplasty patients. For the 10,527 patients where information was available, 9,188 (87.3%) had stents inserted whereas atherectomies were performed on 365 patients: two directional (0.0%), 358 rotoblator (3.4%) and five extraction (0.0%). There were no procedures in 1998 that involved the use of laser. Abciximab (ReoPro) was used in 1,505 (14.3%) patients in 1998. Intra-aortic balloon pumps (IABP), ticlopidine, urokinase, calcium channel blockers, and cutting balloons were used in other procedures (Table 7).

Since 1993 there has been a sharp increase in stenting as an adjunct to coronary angioplasty (Figure 5).

Table 7: Stents, atherectomy, laser and other adjunctive techniques, 1996 and 1998

		1996		1998	
		Number of patients	Per cent of patients	Number of patients	Per cent of patients
Stents		5,414	54.2	9,188	87.3
Atherectomy	Directional	6	0.1	2	0.0
	Rotoblator	147	1.5	358	3.4
	Extraction	n.c.	. .	5	0.0
Laser		0	0	0	0
Abciximab (ReoPro)		436	4.4	1,505	14.3
Other	Accolysis	n.c.	. .	4	0.0
	Brachytherapy	n.c.	. .	45	0.4
	IABP	n.c.	. .	39	0.4
	IVUS	n.c.	. .	84	0.8
	Perclose	n.c.	. .	4	0.0
	Thrombectomy	n.c.	. .	15	0.1
	Urokinase	n.c.	. .	6	0.1
	Not specified	82	0.8	90	0.9

. . not applicable.

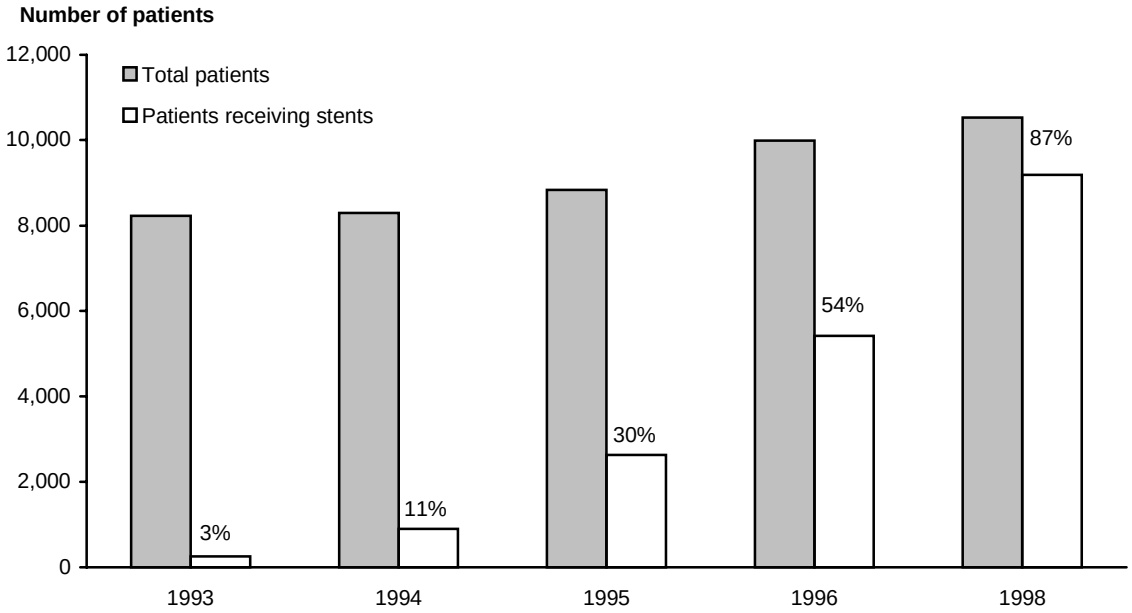
n.c. Information not collected by the National Coronary Angioplasty Register before 1998.

IVUS = intra-vascular ultrasound.

IABP = intra-aortic balloon pump.

Note: Excludes units where details of procedures were unavailable.

Source: AIHW/NHF National Coronary Angioplasty Register.



Note: Excludes patients where details of procedures were unavailable. Data for 1997 not available.
Source: AIHW/NHF National Coronary Angioplasty Register.

Figure 5: Coronary stenting trends 1993–96 and 1998

Stenting by age and sex

Stents were inserted in 14,838 (82%) coronary angioplasty procedures (cf. Table 3) during 1998. This was an increase of 14% from 1997. Stenting rates are highest in males aged 60–74 and females aged 65–79 (Table 8). Reflecting PTCA patterns, there is a marked difference in stenting rates between the sexes, with males having almost three times the rate of females.

Table 8: Coronary stenting procedures by age and sex, 1998

	Males			Females			
Age (years)	Number of procedures	Per cent	Age-specific rate per million	Number of procedures	Per cent	Age-specific rate per million	Ratio male:female
20–24	1	0.0	1.4	0	0	0.0	. .
25–29	11	0.1	14.9	6	0.2	8.2	1.8
30–34	51	0.5	72.5	16	0.4	22.6	3.2
35–39	201	1.8	269.6	35	0.9	46.7	5.8
40–44	534	4.8	764.8	65	1.7	92.5	8.3
45–49	1,014	9.2	1,548.4	143	3.8	220.2	7.0
50–54	1,453	13.2	2,457.7	235	6.2	412.1	6.0
55–59	1,645	14.9	3,687.6	374	9.9	867.4	4.3
60–64	1,735	15.7	4,702.7	525	13.8	1,418.4	3.3
65–69	1,678	15.2	5,019.7	728	19.2	2,087.7	2.4
70–74	1,510	13.7	5,279.3	796	21.0	2,412.8	2.2
75–79	853	7.7	4,253.9	590	15.5	2,202.1	1.9
80–84	289	2.6	2,625.4	226	6.0	1,255.6	2.1
85+	67	0.6	981.0	57	1.5	365.4	2.7
20+	**11,042**	**100.0**	**1,184.8**	**3,796**	**100.0**	**403.4**	**2.9**

. . not applicable.

Source: AIHW analysis of data from the National Hospital Morbidity Database.

State comparison of stenting rates

The age-standardised national average rate for coronary stenting procedures is 745 per million population in 1998. There is variation in rates across States, ranging from 595 per million population in Queensland to 941 per million population in Victoria (Table 9 and Figure 6).

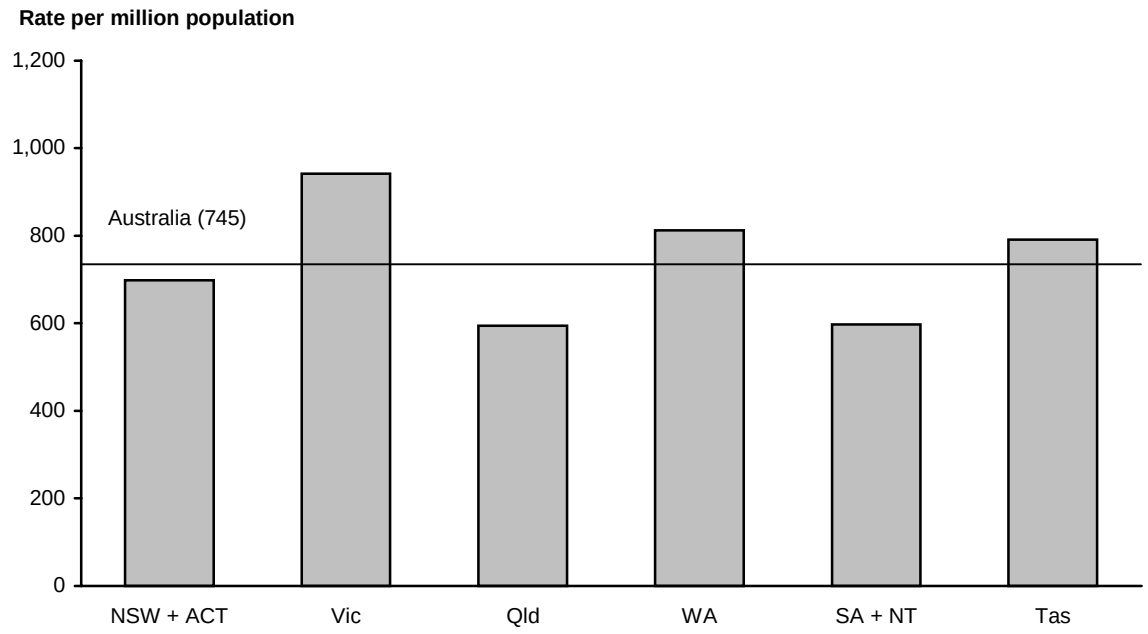
Table 9: Coronary stenting by State, 1998

	NSW and ACT	Vic	Qld	WA	SA and NT	Tas	Australia
			Rate per million population				
Crude rate	755	1,023	608	796	651	886	792
Standardised rate[(a)]	698	941	595	812	597	791	745

(a) Age-standardised to the Australian population as at 30 June 1991.

Note: Rates have been calculated to include the Australian Capital Territory population with New South Wales and the Northern Territory population with South Australia since those are the States where the vast majority of Australian Capital Territory and Northern Territory residents are treated.

Source: AIHW analysis of data from the National Hospital Morbidity Database.



Note: Age-standardised to the Australian population as at 30 June 1991.
Source: AIHW analysis of the National Hospital Morbidity Database.

Figure 6: Coronary stenting rate by State, 1998

Complications

Primary and non-primary PTCA

Data collection forms were revised in 1998 to reflect the more recent use of angioplasty for primary or rescue AMI. As this was a substantial change to the data collection form, not all participating units were able to report this level of detail in 1998. However, with the cooperation of units, a more in-depth analysis will be possible for procedures performed in future years. Information on whether patients were undergoing primary or rescue PTCA and suffered complications was provided for 8,636 patients in 1998.

There were 110 patients undergoing primary or rescue PTCA who had complications. Of these, 54 had CABG (0.6%), 18 had arterial complications (0.3%) and 38 died (0.4%).

There were 248 patients undergoing non-primary or non-rescue PTCA who had complications. Of these, 49 had CABG (0.6%), 118 had AMI (1.3%), 69 had arterial complications (0.9%) and 22 died (0.3%).

Table 10: Complications for primary and non-primary PTCA[(a)], 1998

	Primary/rescue PTCA		Non-primary/non-rescue PTCA	
Complication	**Number**	**Per cent**	**Number**	**Per cent**
CABG	54	0.6	49	0.6
AMI	. .	. .	109	1.3
Arterial complication	18	0.3	69	0.9
Death	38	0.4	21	0.3

. . not applicable.

AMI = acute myocardial infarction; CABG = coronary artery bypass grafting.

(a) Based on details from 8,636 patients.

Source: AIHW/NHF National Coronary Angioplasty Register.

Coronary artery bypass grafts

Table 11 and Figure 7 show the number of patients requiring CABG after angioplasty during the same hospital admission, either as an emergency CABG for complications of angioplasty, or as CABG for a failed but uncomplicated procedure.

Not all units could provide information on the number of angioplasty patients that required CABG during the same hospital admission. Of the 14,133 procedures where information was available, 135 (1.0%) angioplasty patients required CABG during the same hospital admission. Of these, 77 (57.0%) had the surgery within 24 hours of angioplasty, and were emergency operations for complications of the procedure. The remaining 58 patients had CABG later during their admission. Since 1990 the rate of CABG post-angioplasty has fluctuated around 2% but in 1998 it reached 1%. This is probably due to the increased use of stents and Abciximab.

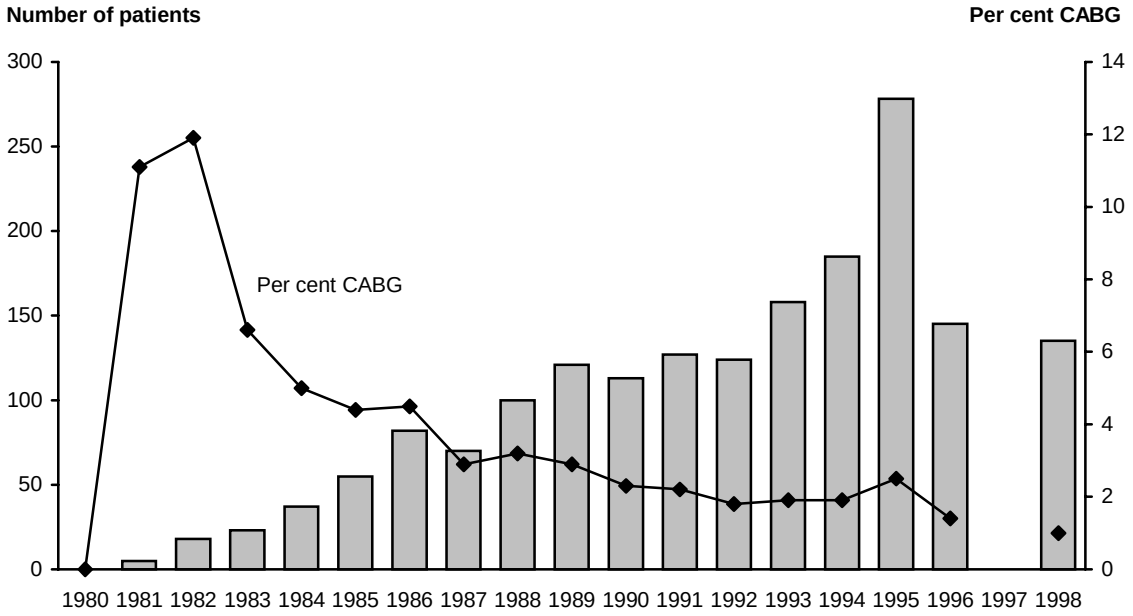
Table 11: Coronary artery bypass grafting for angioplasty failure or complications, 1980 to 1996 and 1998[(a)]

		CABG within 24 hours		CABG after 24 hours		CABG total	
Year	Total number of angioplasty procedures	Number of patients	Per cent	Number of patients	Per cent	Number of patients	Per cent
1980	11	0	0	0	0	0	0
1981	45	3	6.7	2	4.4	5	11.1
1982	151	16	10.6	2	1.3	18	11.9
1983	348	16	4.6	7	2.0	23	6.6
1984	737	29	3.9	8	1.1	37	5.0
1985	1,244	45	3.6	10	0.8	55	4.4
1986	1,840	69	3.8	13	0.7	82	4.5
1987	2,383	52	2.2	18	0.8	70	2.9
1988	3,153	70	2.2	33	1.0	100	3.2
1989	4,219	86	2.0	35	0.8	121	2.9
1990	4,904	77	1.5	36	0.7	113	2.3
1991	5,726	92	1.6	35	0.6	127	2.2
1992	6,748	90	1.3	34	0.5	124	1.8
1993	8,334[(b)]	118	1.6	24	0.3	158	1.9
1994	9,732	137	1.4	35	0.3	185	1.9
1995	11,130[(b)]	222	2.0	56	0.5	278	2.5
1996	10,706[(b)]	118	1.1	27	0.3	145	1.4
1998	14,133[(b)]	77	0.5	58	0.4	135	1.0

(a) Data for 1997 not available.

(b) Excluding procedures performed by the units that could not supply information about this complication.

Source: AIHW/NHF National Coronary Angioplasty Register.



Note: Data for 1997 not available.

Source: AIHW/NHF National Coronary Angioplasty Register.

Figure 7: Coronary artery bypass grafting for angioplasty failure or complications, 1981–96 and 1998

Associated myocardial infarction

Not all units could supply the number of patients who suffered AMI after angioplasty but during the same hospital admission. For the 12,933 procedures where information was available, there were 161 such cases. This is equivalent to a rate of 1.2% for those units' 14,133 procedures over the year. The rate has been around 1–2% since 1984 (Table 12 and Figure 8).

Table 12: Angioplasty and associated myocardial infarction[(a)], 1980 to 1996 and 1998[(b)]

Year	Procedures	Number of AMI	AMI rate (per cent)
1980	11	0	0
1981	45	2	4.4
1982	151	13	8.6
1983	348	13	3.7
1984	737	15	2.0
1985	1,244	20	1.6
1986	1,840	32	1.7
1987	2,383	36	1.5
1988	3,153	62	2.0
1989	4,219	57	1.3
1990	4,089 [(c)]	85	2.1
1991	4,826 [(c)]	70	1.5
1992	5,603 [(c)]	74	1.3
1993	7,041 [(c)]	80	1.1
1994	8,231 [(c)]	112	1.4
1995	10,050 [(c)]	155	1.5
1996	10,706 [(c)]	152	1.4
1998	12,933	161	1.2

(a) Acute myocardial infarction (AMI) is defined in this report as the appearance of new Q waves or T wave changes with enzymes twice the upper limit of normal.

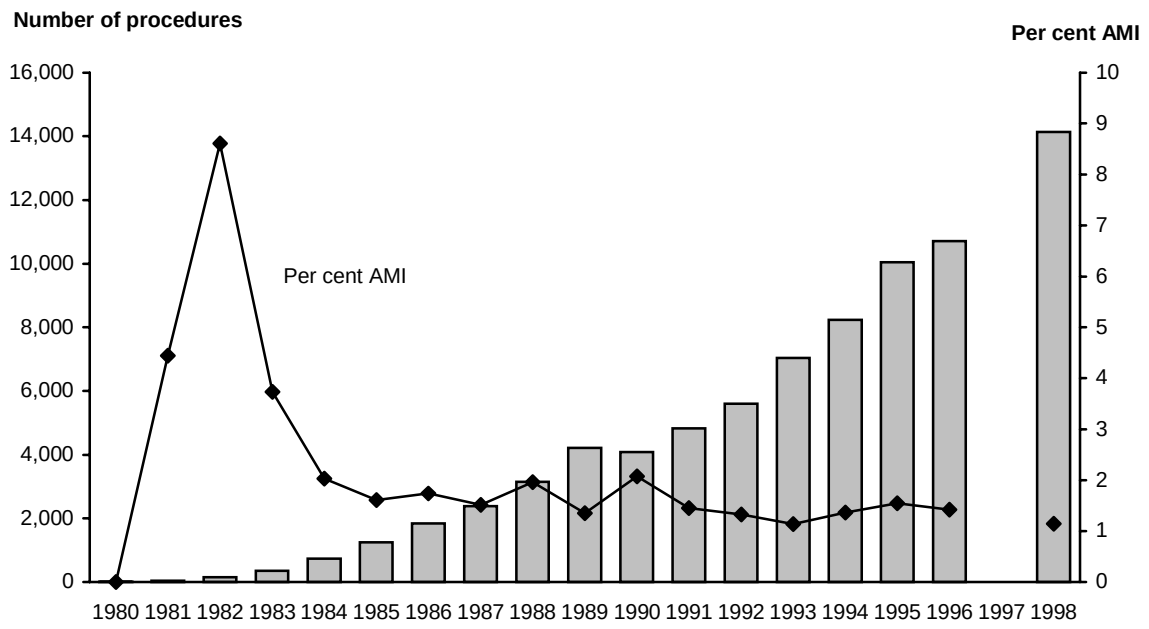
(b) Data for 1997 not available.

(c) Excluding procedures performed by the units that could not supply information about this complication.

Source: AIHW/NHF National Coronary Angioplasty Register.

Arterial complications prolonging hospital stay

Not all units could supply information on the number of arterial complications that prolonged hospital stay after angioplasty procedures. Among 14,133 procedures where information was available, there were 119 (0.8%) such complications.



Note: Data for 1997 not available.

Source: AIHW/NHF National Coronary Angioplasty Register.

Figure 8: Acute myocardial infarction associated with angioplasty, 1980–96 and 1998

Mortality

Not all units could supply information on deaths in 1998. Among 14,133 procedures for which this information was available, there were 87 deaths during the same admission in which angioplasty was performed. Details of the cause of death indicate that many of the cases were extremely high risk pre-procedure with either cardiogenic shock, poor left ventricular function or life-threatening ventricular arrhythmias. The increasing use of angioplasty to try to rescue these patients will continue to have an adverse impact on mortality rates associated with angioplasty.

At least 35 deaths occurred within 24 hours of the procedure, seven of which followed emergency CABG for complications of angioplasty. Twenty-three more deaths occurred after 24 hours but in the same hospital admission giving a total rate of 0.6% for the year (Table 13 and Figure 9).

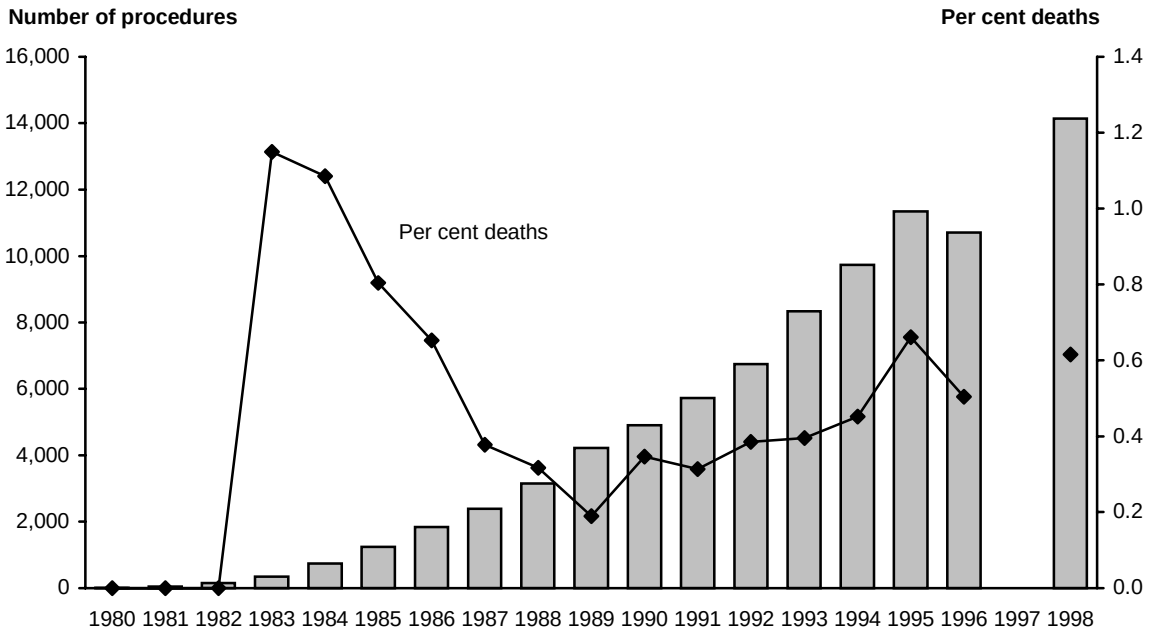
Table 13: Mortality associated with angioplasty, 1980 to 1996 and 1998[a]

Year	Number of procedures	Number of deaths	Per cent of deaths
1980	11	0	0
1981	45	0	0
1982	151	0	0
1983	348	4	1.1
1984	737	8	1.1
1985	1,244	10	0.8
1986	1,840	12	0.7
1987	2,383	9	0.4
1988	3,153	10	0.3
1989	4,219	8	0.2
1990	4,904	17	0.4
1991	5,726	18	0.3
1992	6,748	26	0.4
1993	8,334	33	0.4
1994	9,732	44	0.5
1995	11,348	75	0.7
1996	10,706 [b]	54	0.5
1998	14,133 [b]	87	0.6

(a) Data for 1997 not available.

(b) Excluding procedures performed by units that could not supply information about deaths.

Source: AIHW/NHF National Coronary Angioplasty Register.



Note: Data for 1997 not available.

Source: AIHW/NHF National Coronary Angioplasty Register.

Figure 9: Mortality associated with angioplasty, 1980–96 and 1998

Cause of death

The cause of death of most of the 87 patients who died in 1998 is listed below as supplied by each unit. Patients' ages are shown in five-year age range for confidentiality reasons.

1. Patient with unstable angina pectoris. Occlusion of left circumflex whilst stenting, CHB, intra-aortic balloon pump, haemodynamically unstable, one hour to bypass. Unable to wean the patient off cardiopulmonary bypass pump.
2. Patient with recent myocardial infarction. Less than two hours cardiogenic shock, ventricular fibrillation, cardiac arrest, 57 minutes to bypass. Unable to wean the patient off cardiopulmonary bypass pump.
3. Patient with unstable angina pectoris. Unsuccessful PTCA to right coronary artery, patient died <24 hours later, unknown cause.
4. Patient with stable angina pectoris. Successful PTCA to left anterior descending artery, loss of diagonal. The patient died seven hours later, cause cardiac.
5. Patient presented with myocardial infarction and cardiogenic shock. Successful PTCA/stent to left main artery, also had aortic dissection, multiple arrhythmias. Unable to resuscitate the patient.
6. Patient presented with myocardial infarction. Successful primary PTCA to proximal right coronary artery.
7. 80–84 year old male patient. Acute myocardial infarction with shock. Successful vein graft PTCA. Died in hospital two weeks after procedure.

8. 70–74 year old female patient. Acute myocardial infarction. Successful primary PTCA with no subsequent ischaemic or haemodynamic instability. Patient died >24 hrs from anoxic brain damage.
9. 70–74 year old female diabetic patient. Successful primary PTCA to left anterior descending artery. Persistent ST elevation. Died 24 hours later of cardiac rupture, confirmed at post-mortem.
10. 70–74 year old female diabetic patient. Medical history: previous CABG. Cardiogenic shock with left main coronary artery occlusion. Failed PTCA.
11. 70–74 year old female patient. Significant comorbidities of chronic lung disease, diabetes. PTCA and ReoPro for occluded circumflex artery in context of acute myocardial infarction. PTCA successful. Died next day of heart failure/acute renal failure.
12. 75–79 year old female patient. Medical history: recent myocardial infarction, previous CABG, chronic renal failure. Four lesion PTCA/stent, progressive hypotension. Multisystem organ failure, death day five with reinfarction.
13. 55–59 year old male diabetic patient. Stent restenosis (dominant circumflex artery), haemodynamic collapse/pulmonary oedema on passage of guide wire, unable to be resuscitated.
14. 75–79 year old female patient. Acute myocardial infarction with thrombolysis (twice), stent to right coronary artery, bleeding day four with hypokalaemic shock and ischaemic colitis, reinfarction day eight. Death day ten.
15. 80–84 year old female patient. Angina at rest, ventricular tachycardia, severe CAL, stent to left main artery, death day ten from respiratory failure, septicaemia.
16. 65–69 year old male patient. Medical history: previous CABG. Acute myocardial infarction with shock (BP 80 mmHg), ventricular tachycardia, 3° AV block. Unsuccessful PTCA to saphenous vein graft to left anterior descending artery (no reflow), persistent shock.
17. 70–74 year old male patient. Chronic renal failure, acute myocardial infarction, ventricular tachycardia, BP 120 mmHg. Stent to left main artery, left anterior descending artery, no reflow, persistent shock.
18. 80–84 year old male patient. Acute myocardial infarction with shock (BP 70 mmHg). Unsuccessful PTCA to occluded right coronary artery, severe left main disease, persistent shock.
19. 80–84 year old female patient. Medical history: previous CABG. Acute myocardial infarction, BP 45 mmHg. PTCA to saphenous vein graft to right coronary artery, death.
20. Patient deemed unsuitable for third CABG operation. Patient died following high risk graft PTCA.
21. Patient had acute myocardial infarction two months before, complicated by pulmonary embolus, retroperitoneal haematoma. Readmitted with ongoing ischaemia, hypotension. Successful PTCA but patient had progressive hypotension and tachycardia and died 12 hours later.
22. Female patient had medically refractory cardiogenic shock. Patient died despite achieving patency of hyperdominant infarct related artery (late presentation).
23. 70–74 year old patient. Myasthenia gravis and triple vessel disease. PTCA indication: unstable angina. CABG indication: subintimal dissection of right coronary artery extending to distal PDA. Time interval after PTCA to CABG: one hour. Outcome: cardiac arrest, day five post CABG. The patient did not survive despite resuscitation attempt.

24. Patient had respiratory arrest prior to PTCA, intubated, intensive care unit, did not recover.
25. 50–54 year old male patient. Medical history: severe cardiovascular disease, CABG, PTCA and stenting of saphenous vein graft to the left anterior descending which was the only remaining graft. Patient presented with acute myocardial infarction and cardiogenic shock. PTCA and stenting, and ReoPro to regain patency of the occluded saphenous vein graft to the left anterior descending artery. Patient had poor ongoing left ventricular function, requiring intubation for ongoing pulmonary oedema and was transferred for urgent cardiac transplantation. The patient died prior to transplantation.
26. 75–79 year old female patient. Presented with an acute inferior myocardial infarction within two hours and had a stent of her right coronary artery. Two hours later had ventricular fibrillation. Was cardioverted, had no note of further ST elevation. The following day the patient had ongoing elevation of enzymes suggesting a silent occlusion of a right coronary artery and deteriorated over a four-day period and died.
27. 85–89 year old patient. Within 24 hours of PTCA had restenosed left main artery. Developed hypotension and did not respond to resuscitation.
28. 50–54 year old female patient. Presented three days after acute myocardial infarction with thrombolytics. Evidence of large anterior infarction. Patient died one day following PTCA with decreased cardiac function.
29. 45–49 year old male patient. Presented for PTCA seven days after large anterior infarct with thrombolytics. Developed acute shortness of breath. Massive pulmonary emboli. Non-responsive to resuscitation efforts.
30. 50–54 year old male patient. Presented within two hours of acute myocardial infarction. Runs of ventricular tachycardia and ventricular fibrillation on arrival to laboratory. Intubated and ventilated during procedure. Died five days after PTCA.
31. 55–59 year old male patient. Presented within eight hours of acute myocardial infarction, in cardiogenic shock. Intra-aortic balloon pump inserted and patient transferred for a heart transplant after successful PTCA. Died during that admission.
32. 55–59 year old male patient. Presented within two hours of acute myocardial infarction in cardiogenic shock. Intubated and ventilated during procedure. Developed EMD and could not be resuscitated.
33. 65–69 year old male patient. Presented within six hours of acute myocardial infarction in cardiogenic shock. Intubated and ventilated during procedure. Developed EMD and could not be resuscitated.
34. 70–74 year old male patient. Presented with chest pain for 12–18 hours, in cardiogenic shock. Patient developed ‘no reflow’, hypotension and EMD.
35. 75–79 year old female patient. Presented within six hours of acute myocardial infarction. Successful PTCA. Developed large haemateriosis. Died a few days after PTCA following gastrointestinal tract complications.
36. Patient with cardiogenic shock after myocardial infarction receiving rescue PTCA. Procedure carried out with intra-aortic balloon pump and ventilatory support. Died in intensive care unit.
37. Patient with cardiogenic shock after myocardial infarction receiving acute PTCA. Procedure carried out with intra-aortic balloon pump and ventilatory support. Died in intensive care unit.

38. Patient with cardiogenic shock after myocardial infarction receiving acute PTCA. Procedure carried out with intra-aortic balloon pump and ventilatory support. Died in intensive care unit.
39. Patient with cardiogenic shock after myocardial infarction receiving acute PTCA. Procedure carried out with intra-aortic balloon pump and ventilatory support. Died in intensive care unit.
40. Patient with cardiogenic shock after myocardial infarction receiving acute PTCA. Procedure carried out with intra-aortic balloon pump and ventilatory support. Died in intensive care unit.
41. 65–69 year old male patient. Intubated, after cardiac arrest with acute inferior myocardial infarction and shock. CT scan of chest normal. Successful stent to ostial right coronary artery lesion. Died 24 hours later. At autopsy had an undiagnosed dissection of the aorta.
42. 65–69 year old male patient. Diagnostic angiogram showed ulcerated 90% left main lesion, following which patient developed hypotension with ST elevation in the recovery room. Successful stent to left main artery and intra-aortic balloon pump. Sent for urgent CABG. Unable to wean from bypass.
43. 75–79 year old male patient. Recent inferior myocardial infarction, reinfarction and complete heart block. Stent to right coronary artery but died of cardiogenic shock.
44. 75–79 year old female patient. Two days post anterior myocardial infarction in cardiogenic shock. Stent to occluded left anterior descending artery. Died from left ventricular failure in intensive care unit on day two after procedure.
45. 55–59 year old male patient. Cardiogenic shock three days after CABG. Died during stenting of native vessels.
46. 75–79 year old male patient. Medical history: CABG. Awaiting redo CABG for triple-vessel disease. Acute inferior myocardial infarction after angiogram. Stent to occluded vein graft to right coronary artery. No reflow. Died of cardiogenic shock.
47. 65–69 year old male patient. Medical history: inferior myocardial infarction. Presented with acute anterior myocardial infarction in cardiogenic shock. Stent to proximal left anterior descending artery. Died in intensive care unit on day five from left ventricular failure.
48. 70–74 year old female patient. Presented with acute inferior myocardial infarction. PTCA to right coronary artery but unable to open left ventricle branch. Acute mitral regurgitation with shock due to papillary muscle rupture at day five. Died immediately after mitral valve replacement.
49. 80–84 year old female patient. Medical history: CABG, severe angina. PTCA stent of vein graft ostium to left anterior descending artery. After procedure developed pulmonary embolism. Recurrent angina, PTCA of stent restenosis but heart failure progressed to death.
50. 65–69 year old male patient. Successful PTCA for cardiogenic shock. Died four days later from pump failure despite intra-aortic balloon pump.
51. 65–69 year old female patient. Presented with cardiogenic shock and ventricular fibrillation, cardiac arrest in the setting of acute myocardial infarction. Successful PTCA. Died 48 hours later from pump and renal failure.
52. 55–59 year old male patient. Medical history: CABG. Presented with cardiogenic shock. Successful PTCA to protected left main stem. Ventricular fibrillation, cardiac arrest 20 hours after PTCA from which patient could not be resuscitated.

53. 70–74 year old female patient. One minute after angiographic pictures and prior to PTCA became hypotensive. Re-injection demonstrated pooling of contrast fluid in left main and proximal left anterior descending arteries, suggesting coronary dissection. Despite extensive resuscitation procedures including PTCA, stenting, cardioversion, cardiac massage, and adrenalin, patient died in the catheter laboratory.
54. 75–79 year old male patient. Attempted patent foramen ovale closure and resection of a left lower lobe carcinoma. Successful primary PTCA for post-operative acute myocardial infarction, however he developed significant metabolic acidosis and died in intensive care unit 18 hours after procedure.
55. 40–44 year old male patient. Slowly developed cardiogenic shock and died of heart failure in coronary care unit 24 hours after successful PTCA.
56. 60–64 year old female patient. Medical history: ischaemic heart disease, hypertension, chronic renal failure, on renal transplant waiting list, hyperparathyroidism. Presented to emergency department within one hour of onset of chest pain. ECG changes consistent with large anterior myocardial infarction. Angiographic findings: left main artery equivalent obstruction with significant thrombus burden evident. PTCA and thrombectomy to left anterior descending and circumflex arteries, ReoPro and intra-aortic balloon pump support (augmented BP ≤70). Subsequent asystolic arrest followed by ventricular fibrillation and ventricular tachycardia. Despite resuscitation measures, died eight hours after pain onset.
57. 75–79 year old male patient. No relevant medical history. Presented to emergency department following collapse with acute anterior myocardial infarction complicated by cardiogenic shock. Intubated and transferred to catheter laboratory with cardiopulmonary resuscitation. Angiographic findings: total obstruction ostial left anterior descending artery, total obstruction mid circumflex artery. No reflow following PTCA to left anterior descending artery. No spontaneous BP or rhythm. Patient died two hours after collapse.
58. 75–79 year old female patient. Medical history: previous cerebrovascular accident. Presented to emergency department in pulmonary oedema and peripherally shut down within one hour of onset of chest pain. Transferred to catheter laboratory on CPAP and dopamine infusion. Angiographic findings: total obstruction left anterior descending artery, severe obstruction of circumflex artery. Left anterior descending artery not wired (tortuous ++ , calcification ++). Death three hours after pain onset.
59. 60–64 year old female patient. Medical history: hypertensive. Presented to emergency department following collapse and diagnosed as acute anterior myocardial infarction. Immediate transfer to catheter laboratory on CPAP but no palpable pulse. Angiographic findings: total left main artery obstruction with thrombus, patent right coronary artery. Aortic pressure 40 mmHg systolic. No access for insertion of intra-aortic balloon pump. Antegrade flow established following PTCA to left main, left anterior descending and circumflex arteries. Subsequent ventricular fibrillation/ asystole. No spontaneous cardiac contraction. Died two hours after collapse.
60. 80–84 year old male patient. Medical history: anterior myocardial infarction, unstable angina pectoris, congestive cardiac failure, hypertension, cerebrovascular accident, epilepsy. Admitted electively for percutaneous insertion of stent graft to AAA. Collapse two days after procedure. Systolic BP ≤70mmHg, inferior myocardial infarction. Angiographic findings: total obstruction left anterior descending artery, chronic total obstruction right coronary artery. Right coronary artery opened but no reflow despite

IC GTN. Verapamil, adenosine and intra-aortic balloon pump support. Died seven hours after collapse.

61. 80–84 year old male patient. Medical history: ischaemic heart disease, CABG, PTCA to native vessels and grafts, hypercholesterolaemia, hypertension. Presented with acute myocardial infarction complicated by cardiogenic shock following five hours of chest pain. Systolic BP ≤ 70 mmHg despite intra-aortic balloon pump support and dobutamine infusion. Angiographic findings: total occlusion both grafts. Both opened and stented, ReoPro infusion. No reflow. Progressive EMD. Death eleven hours after pain onset.

Success rates in various vessel types

Definition of success

For the Coronary Angioplasty Register, a 'primary success' is defined as a procedure that achieves an absolute reduction of the initial degree of luminal diameter stenosis of at least 20% at the time of the procedure, and a residual diameter stenosis of less than 50%.

Success rates

Not all units gave information on success rates. Of those that did, 11,502 procedures were performed and 14,036 lesions were attempted in 1998, corresponding to an average of 1.2 lesions attempted per procedure. Of the total attempts, 13,341 (95.0%) were primary successes. Eighty-five per cent of procedures were on partial occlusions, and 14.5% were on total occlusions. Figures 10 and 11 and Table 14 show the number of lesions and success rates for individual vessel types. Attempts on partial occlusions are clearly much more successful than those on total occlusions.

Thirty-nine per cent of the lesions attempted were in the LAD or its diagonals. The RCA accounted for a further 33.0% of the lesions, and the LCx including marginals and intermediate, accounted for 21.8%. This distribution is similar to that of 1996. Success rates were similar for all types of vessels, at around 95.0%.

Trends in success rates for partial and total occlusions are presented in Table 15. Overall success rates have remained consistent from 1996–98.

There were 853 angioplasty procedures performed on bypass graft vessels: 722 on SVG (681 successful), and 34 on IMA (32 successful). There were 92 procedures on LM 86 of which were successful. There were seven procedures on other bypass graft vessels, all of which were successful.

The proportion of patients defined as early clinical successes was 95.6%; that is, they had a successful reduction of all lesions, and no angina or complications pre-discharge.

Table 14: Types of vessels and success rates, 1998

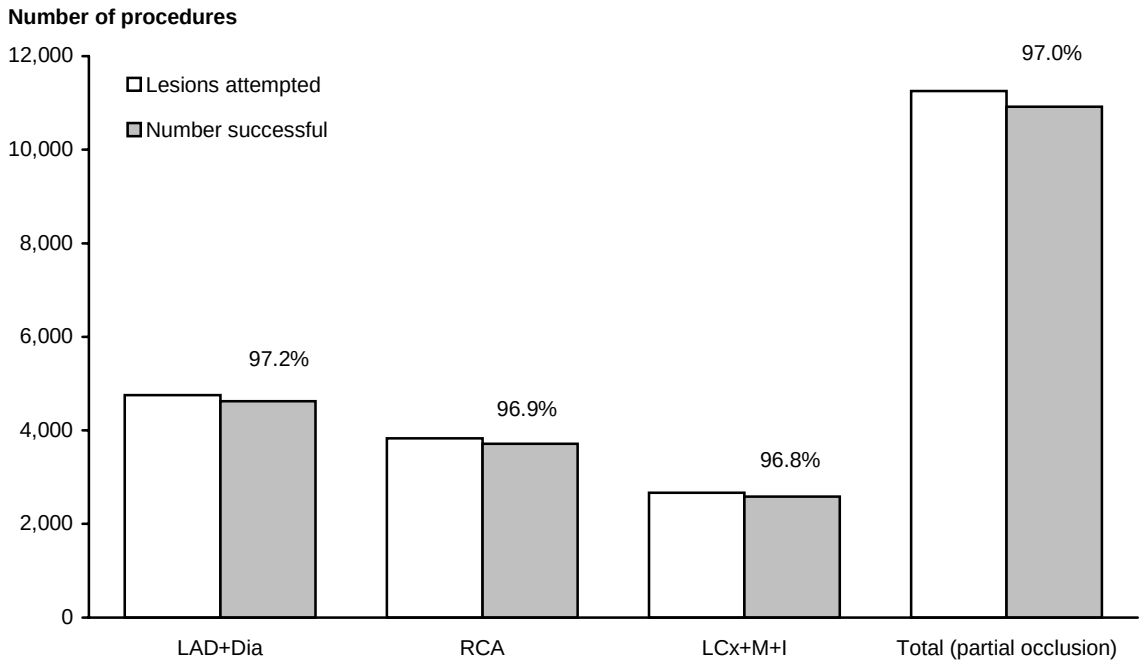
	Partial occlusion		Total occlusion		Overall	
Lesions	**Number attempted**	**Per cent successful**	**Number attempted**	**Per cent successful**	**Number attempted**	**Per cent successful**
LAD	4,108	98.1	694	87.6	4,802	96.6
Diagonals	645	91.8	54	81.5	699	91.0
RCA	3,833	96.9	795	87.6	4,628	94.4
LCx	1,946	97.1	305	82.3	2,251	95.0
Marginals and intermediate	719	96.0	84	96.0	803	94.4
Subtotal	*11,251*	*97.0*	*1932*	*84.0*	*13,183*	*95.1*
SVG	626	96.2	96	82.3	722	94.3
IMA	32	96.9	2	50.0	34	94.1
LM	87	95.4	5	60.0	92	93.5
Other	5	80.0	0	0	5	80.0
Total	**12,001**	**97.0**	**2,035**	**83.8**	**14,036**	**95.0**

Source: AIHW/NHF National Coronary Angioplasty Register.

Table 15: Success rates (per cent), 1996 and 1998

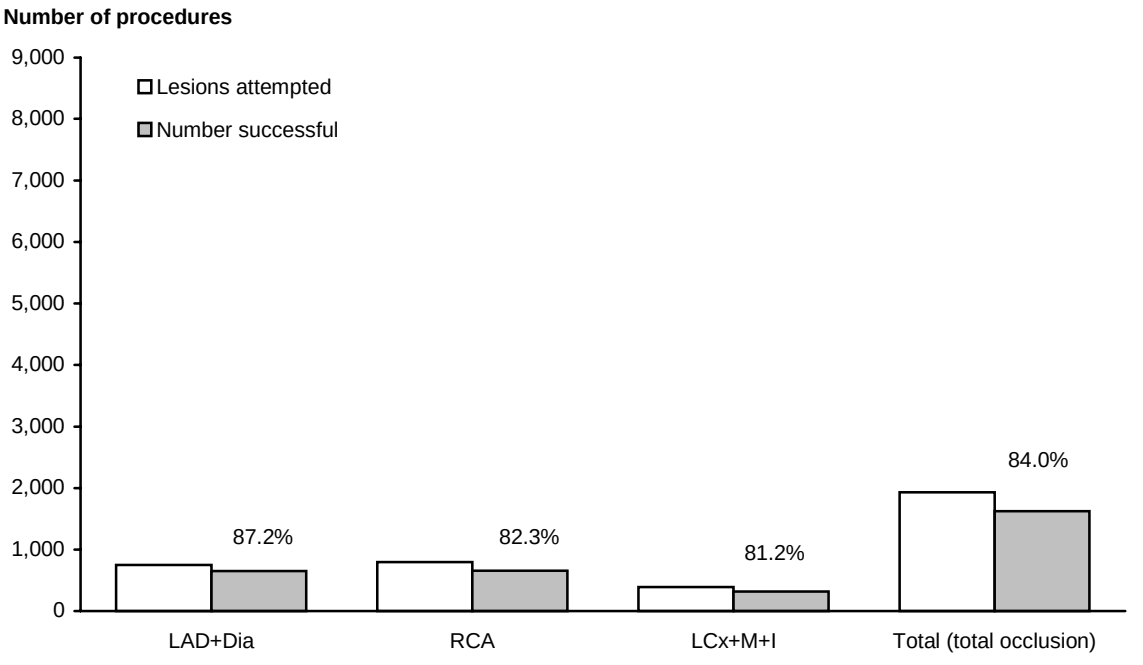
	Partial occlusion		Total occlusion		Overall	
Lesions	**1996**	**1998**	**1996**	**1998**	**1996**	**1998**
LAD and diagonals	95.6	97.2	81.9	87.2	93.7	95.9
RCA	95.9	96.9	74.8	82.3	92.3	94.4
LCx and marginals and intermediate	95.9	96.8	80.0	81.2	93.7	94.8
Total	*95.8*	*97.0*	*78.6*	*84.0*	*93.2*	*95.1*
Total (including SVG, IMA & LM)	**95.7**	**97.0**	**78.7**	**83.3**	**93.2**	**95.0**

Source: AIHW/NHF National Coronary Angioplasty Register.



Source: AIHW/NHF National Coronary Angioplasty Register.

Figure 10: Number of lesions and success rates for partial occlusions, 1998



Source: AIHW/NHF National Coronary Angioplasty Register.

Figure 11: Number of lesions and success rates for total occlusions, 1998

Glossary

Abciximab (ReoPro): drug that stops platelets sticking together to block the coronary arteries. It is given to patients at higher risk of developing complications of undergoing PTCA or atherectomy.

Acute myocardial infarction (AMI): an acute episode of myocardial ischaemia (see below) of sufficient severity and duration to cause permanent damage to some heart muscle. The ischaemia is caused by occlusion of one or more coronary arteries.

Angina pectoris: a clinical syndrome marked by deep, unlocalised discomfort or pain in the chest or arm which is associated with physical exertion or emotional stress, and is relieved promptly by rest or sublingual nitroglycerine. Patients with unstable angina have episodes of discomfort which are more severe and prolonged, and which may occur at rest irrespective of exertion or stress. In most, but not all angina, these symptoms reflect myocardial ischaemia resulting from significant underlying coronary artery disease.

Atherectomy: a dilatation technique, where mechanical devices attached to the insertion catheter cut or grind out obstructions in arteries.

Cardiogenic shock: a condition caused by inadequate cardiac output which fails to maintain blood supply to the tissues.

Coronary artery bypass grafting (CABG): vein or artery grafted surgically to permit blood to travel from the aorta to a branch of the coronary artery at a point past an obstruction.

Coronary stenosis: narrowing or constriction of a coronary artery.

Hypotension: decrease of systolic and diastolic blood pressure below normal.

Intra-aortic balloon pump (IABP): a balloon attached to a catheter inserted through the femoral artery into the descending thoracic aorta to produce alternating inflation and deflation during diastole and systole, respectively.

Intra-coronary stenting: use of a prosthetic metal device to provide a supporting structure and maintain an enlarged coronary lumen at the site of an obstructive atherosclerotic plaque.

Laser angioplasty: use of a laser beam to cut through obstructions in the coronary arteries.

Left bundle branch block (LBBB): an ECG change marked by an intraventricular conduction delay affecting the left ventricular wall and septum. Acute occurrences most commonly result from myocardial ischaemia.

Left ventricular function: the function of the main pumping chamber of the heart that receives blood from the left atrium and pumps it out into the general circulation through the aortic valve.

Myocardial ischaemia: a condition in which oxygen and nutrient delivery to and waste removal from the heart muscle fall below normal levels, and oxygen demand exceeds supply. The metabolism of heart muscle cells is impaired, leading to various degrees of systolic and diastolic dysfunction.

Myocardium: the muscular wall of the heart located between the inner endocardial layer and the outer epicardial layer.

Percutaneous transluminal coronary angioplasty (PTCA): a method of treating localised coronary artery narrowing, using a special catheter with a balloon that can be inflated to dilate the narrowed vessel.

Revascularisation: restoration or improvement of normal blood flow to the myocardium by bypassing or removing obstructions in coronary arteries, as occurs when CABG or PTCA is performed.

Saphenous vein: a blood vessel from the leg, which is the most commonly used conduit for coronary artery bypass grafting.

Separation: refers to the episode of care in hospital. It also means the process by which an admitted patient completes an episode of care by being discharged, dying, transferring to another hospital or changing type of care.

Stenosis: narrowing or blockage.

Stent: see intra-coronary stenting.

Thrombolytic therapy: treatment with a drug that can break up blood clots and restore blood flow to the myocardium.

Unstable angina: angina is termed unstable when chest pain occurs at rest, there is new onset of pain with exertion, or pain is more frequent, longer in duration or lower in threshold.

Ventricular fibrillation: rapid, uncoordinated beating of the heart which is unable to expel its contents.

Appendix A: Units operating in 1998

Table A1: List of units operating in 1998

State	Unit
New South Wales	Charles Wentworth Private Hospital
	The Hills Private Hospital
	John Hunter Hospital
	Lake Macquarie Private Hospital
	NSW Private Hospital
	Prince Henry Hospital (Eastern Heart Clinic)
	Royal North Shore Hospital
	Royal Prince Alfred Hospital
	The St George Hospital
	The St George Private Hospital
	St Vincent's Hospital Sydney
	Strathfield Private Hospital
	Sydney Adventist Hospital
	Westmead Hospital
Victoria	The Alfred Hospital
	Austin Repatriation Medical Centre
	Box Hill Hospital
	Cabrini Hospital
	Epworth Hospital
	Knox Private Hospital
	Melbourne Private Hospital
	Monash Medical Centre
	The Royal Melbourne Hospital
	St Vincent's Hospital Melbourne
	St Vincent's & Mercy Private Hospital
	Warringal Private Hospital
Queensland	Greenslopes Private Hospital
	The John Flynn Hospital
	Mater Misericordiae Private Hospital
	The Prince Charles Hospital
	Princess Alexandra Hospital
	Royal Brisbane Hospital
	St Andrew's War Memorial Hospital
	Townsville General Hospital
	The Wesley Hospital

(continued)

State	Unit
Western Australia	Fremantle Hospital
	Mount Hospital
	Royal Perth Hospital
	Sir Charles Gairdner Hospital
South Australia	Ashford Community Hospital
	Flinders Medical Centre
	Royal Adelaide Hospital
	The Queen Elizabeth Hospital
	Wakefield Hospital
Tasmania	Calvary Hospital
	Royal Hobart Hospital

Appendix B: Data collection form

Calendar year in which information collected: 1998

Hospital/Unit _____

Date form completed_____

Form completed by _____

Names of doctors doing procedures (not assistants)_____

_____

No. of patients

1. No. of patients having first PTCA in 1998 _____

2.

   (a) No. of patients having repeat PTCA in 1998 who had a previous PTCA in 1998 _____

   (b) Interval between procedures:

   less than 24 hours _____

   24 hours to less than 3 months _____

   3 to less than 6 months _____

   6 to less than 12 months _____

   (c) No. where repeat PTCA was to the same unstented lesion _____

   (d) No. where repeat PTCA was to the same stented lesion _____

   (e) No. where repeat PTCA was for previous failure _____

3.

   (a) No. of patients having repeat PTCA in 1998 whose previous PTCA was before 1998 _____

   (b) Interval between procedures:

   less than 24 hours _____

   24 hours to less than 3 months _____

   3 to less than 6 months _____

   6 to less than 12 months _____

   12 months or greater _____

   (c) No. where repeat PTCA was to the same unstented lesion _____

   (d) No. where repeat PTCA was to the same stented lesion _____

   (e) No. where repeat PTCA was for previous failure _____

4. (a) Total number of patients having PTCA _____
(sum of 1 and 3(a) above)

(b) Total number of PTCA procedures in 1998 _____
(sum of 1, 2(a) and 3(a) above)

5. No. of single vessel PTCA procedures _____

6. No. of two vessel PTCA procedures _____

7. No. of three vessel PTCA procedures _____

8. No. of four or more vessel PTCA procedures _____

Note: A vessel is defined as a single arterial trunk
e.g. LAD + LADD = 1 vessel; LCX + marginal or intermediate = 1 vessel;
LM = 1 vessel; LAD + SVG or IMA = 2 vessels; SVG = 1 vessel; IMA = 1 vessel

No. of procedures

9. Approach during procedures:

Femoral _____

Brachial _____

Radial _____

10. No. of procedures for patients with previous CABG _____

11. Indication for PTCA:

Stable angina pectoris _____

Unstable angina pectoris _____

Prognostic (asymptomatic) _____

Acute myocardial infarction:

(a) *primary* (b) *rescue*

(please show number of patients in cardiogenic shock in brackets)

time since AMI:	time since AMI:
0–<2 hours	0–<2 hours .....
2–<4 hours	2–<4 hours .....
4–<6 hours	4–<24 hours .....
6–<8 hours	after 24 hours .....

Other indication (please specify details) _____

12. Total no. of procedures where thrombolytic therapy was given before PTCA:

<24 hours _____

24–48 hours _____

>48 hours but during same admission _____

13. Lesions

		No. of lesions	No. of primary angiographic successes*
LAD	Partial occlusion		
	Total occlusion		
Diagonals	Partial occlusion		
	Total occlusion		
RCA including posterior descendens	Partial occlusion		
	Total occlusion		
LCX	Partial occlusion		
	Total occlusion		
Marginals including intermediate	Partial occlusion		
	Total occlusion		
Saphenous vein grafts	Partial occlusion		
	Total occlusion		
Internal mammary grafts	Partial occlusion		
	Total occlusion		
Left main	Partial occlusion		
	Total occlusion		
Other (please list)			

***Note:** **Primary angiographic success is success at time of procedure characterised by absolute reduction of initial degree of luminal diameter stenosis by at least 20% plus a residual diameter stenosis of less than 50%.**

14. Average no. of lesions attempted per procedure
[total lesions/total procedures (from 4b)] _____

15. Number of patients defined as early clinical successes
(successful reduction of all lesions, and no angina
or complications pre-discharge) _____

16. No. of patients where procedure included insertion of a
stent/s _____

17. No. of patients where procedure included use of laser _____

18. No. of patients where procedure included use of:

(a) Directional atherectomy _____

(b) Rotoblator atherectomy _____

(c) Extraction atherectomy _____

(d) Reopro _____

(e) Other viz _____

19. Subsequent procedures and complications for *non-primary or non-rescue PTCA:*

(With particular reference to haemodynamic status at onset)

(a) Subsequent CABG during same admission

CABG within 24 hours for failed

PTCA or for complications of PTCA No. survived____No. died**____

CABG after 24 hours for failed

PTCA or for complications of PTCA No. survived____No. died**____

(b) Acute myocardial infarction during same admission* **Number**

<24 hours after PTCA _____

>= 24 hours after PTCA _____

Total _____

Survived _____

Died** _____

(c) Other deaths (excluding (a) and (b))

~ within 24 hours of PTCA** _____

~ after 24 hours following PTCA,

during same admission** _____

(d) Arterial complications prolonging hospital stay _____

*** AMI = new Q waves or T wave changes with enzymes twice upper limit of normal**

**** Please provide brief details including time interval after PTCA, indications, procedures and circumstances**

_____

_____

_____

_____

_____

20. Subsequent procedures and complications for *primary* or *rescue* PTCA:

(With particular reference to haemodynamic status at onset)

(a) Subsequent CABG during same admission

CABG within 24 hours for failed

PTCA or for complications of PTCA No. survived____No. died**____

CABG after 24 hours for failed

PTCA or for complications of PTCA No. survived____No. died**____

(b) Acute myocardial infarction during same admission* **Number**

<24 hours after PTCA _____

>= 24 hours after PTCA _____

Total _____

Survived _____

Died** _____

(c) Other deaths (excluding (a) and (b))

~ within 24 hours of PTCA** _____

~ after 24 hours following PTCA,

during same admission** _____

(d) Arterial complications prolonging hospital stay _____

*** AMI = new Q waves or T wave changes with enzymes twice upper limit of normal**

**** Please provide brief details including time interval after PTCA, indications, procedures and circumstances**

_____

_____

_____

_____

_____

Related publications

Australian Institute of Health and Welfare (AIHW) 2000. Australia's health 2000: the seventh biennial health report of the Australian Institute of Health and Welfare. AIHW Cat. No. AUS 19. Canberra: AIHW.

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Waters A-M, Armstrong T & Senes-Ferrari S 1998. Medical care of cardiovascular disease in Australia. Cardiovascular Disease Series No. 7. AIHW Cat. No. CVD 4. Canberra: AIHW.

AIHW web site

Information relating to cardiovascular disease, its treatment and risk factors can be found on the Cardiovascular Health Portal and the National Cardiovascular Disease Database, both located on the Institute's web site http://www.aihw.gov.au