7 REVASCULARIZATION BASED ON PATIENT CHARACTERISTICS

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YOUNG PATIENTS (AGE < 40 YEARS)

A. BACKGROUND. Although coronary artery disease typically occurs with advancing age, 5% of patients are less than 40 years old. Compared to older patients, young patients typically have more cardiac risk factors and less extensive disease. Coronary artery bypass grafting (CABG) can be performed with high success and low mortality (0-2%). However, since young patients may require reoperation due to vein graft failure, catheter-based intervention may offer an alternative to CABG.

B. BALLOON ANGIOPLASTY. Patients as young as 15 years old have been treated by PTCA;[1] larger series indicate that PTCA can be performed with success rates of 86-96% and major complication rates < 5% (Table 7.1).

C. FOLLOW-UP. Among successfully treated patients followed over 3-5 years, repeat PTCA was required in 30%, survival was 87-100%, and more than 80% were asymptomatic and employed.[3,5]

Table 7.1. PTCA in Young Patients: Acute Outcome

Series	Age	N	Success (%)	Complications (%) D / Q-MI / CABG	Other
Ellis[106] (1998)	< 40	86	90	0 / 3.5 / 2.3	5-yr survival (95%); 10-yr survival (91%); 5-yr EFS (89%); 10-yr EFS (68%)
Mehan[2] (1994)	≤ 40 > 40	89 1916	90 86	0 / 0 / 0 5 / 1 / 1	5-yr survival (100%). Follow-up at 30 mos: CABG (5%); re-PTCA (34%)
Buffett[3] (1994)	< 40	140	86	5.7 / 6.4 / 0	10-yr survival (96%); return to work (93%); restenosis (28%)
Kofflard[4] (1994)	<35	57	92	3.4 / 1.7 / 1.7	5-yr survival (87%). Follow-up at 4 yrs: MI (14%); CABG (11%); re-PTCA (32%)
Stone[5] (1989)	≤ 35	71	96	0 / 1 / 0	3-yr survival (98%)

Abbreviations: D = in-hospital death; MI = in-hospital Q-wave myocardial infarction; CABG = emergency coronary artery bypass grafting; EFS = event-free survival

D. CONCLUSIONS. Balloon angioplasty has a high success rate, low complication rate, and excellent long-term survival, and may be preferred over surgical revascularization for young patients with coronary disease. The need for repeat PTCA (for restenosis or new disease) is similar to other PTCA patients.

ELDERLY PATIENTS (AGE 65-75 YEARS)

A. BACKGROUND. In 1990, the United States Census estimated that 25% of the 31 million people over age 65 had symptomatic coronary artery disease. By 2020, this number is expected to increase by 65%. From 1987 to 1990, the rates of PTCA and CABG among the elderly increased by 55% and 18%, respectively.

B. PERCUTANEOUS REVASCULARIZATION. Compared to younger patients, elderly patients undergoing coronary revascularization are more often female, and are more likely to have diffuse disease, calcified lesions, unstable angina, prior MI, comorbid conditions, and low ejection fractions. Nevertheless, elective CABG (Table 7.2), PTCA (Tables 7.2, 7.3) and other devices (Table 7.4) can be performed with success rates > 90% and major complication rates of 3-13%. Although the elderly are at increased risk for death after acute closure, the risk of acute closure and the need for emergency CABG have been dramatically reduced by stents. However, there is still a 2-3-fold higher risk of peripheral vascular complications (pseudoaneurysm, AV fistula, large hematoma) and blood transfusions, and there is a strong correlation between advancing age and in-hospital mortality and late death.[188,189]

C. ACUTE MI. In general, advanced age is a risk factor for adverse outcome following acute MI. Primary PTCA is associated with better 30-day survival than either conservative therapy without reperfusion or intravenous thrombolytic therapy,[184] although outcomes following primary PTCA and lytic therapy are similar at 1-year.[184,185] A prospective multicenter randomized trial (PAMI-Elderly) is in progress, which is comparing intravenous thrombolytic therapy to primary percutaneous intervention (PTCA, stents) in elderly patients with acute MI.

D. FOLLOW-UP. More than 75% of successfully revascularized elderly patients have symptomatic improvement. Survival rates at 1 year and 3 years are 95% and 90%, respectively, with late MI in 5%, CABG in 15%, and PTCA in 20%—similar to other PTCA patients.

Table 7.2. Effect of Age on Coronary Revascularization

Series	Modality	Age	N	Complications (%)[++] D / Q-MI / CABG	Other Results
Kobayashi[208] (2001)	Stent	< 70	476	0.2 / 0.5 / 0.2	No difference in 30-day CABG (~ 0.1%), mortality (~1.5%), or MACE (~1.5%). Vascular complications were highest in patients ≥ 80 years (1.0% vs. 1.6% vs. 4.3%, p = 0.05)
		70-79	251	0.4 / 0.4 / 0	
		≥80	94	0 / 0 / 0	
Batchelor[214] (2000)	PCI	≥ 80	7472	3.8 / 1.9 / 4.4	Patients ≥ 80 years had lower procedural success (84% vs. 89%) and more stroke (0.58% vs. 0.23%), renal failure (3.2% vs. 1.0%), and vascular complications (6.7% vs. 3.3%). Procedural success and complications improved during the 4 year study period
		< 80	102,236	1.1 / 1.3 / 4.5	
ARTS[192‡] (2000)	CABG	< 54	139	-	1-yr MACE (%): 5.4
	Stent	< 54	162	-	23.5
	CABG	> 68	156	-	15.4
	Stent	> 68	145	-	24.1
Lucas[205] (2000)	CABG	≥ 75	4993	-	Overall 1-yr survival (90%); 4-yr survival (78%). CABG with 25% reduction in death vs. PTCA
	PTCA	≥ 75	(total)	-	
Wennberg[188] (1999)	PTCA	< 60	5217	-	Angiographic success was independent of age, but in-hospital death was strongly associated with advancing age
		60-69	3752	-	
		70-79	2696	-	
		≥ 80	507	-	
Pliam[187] (1999)	CABG	> 80*	202	12.9 / 1.0 / -	Strongest predictors of in-hospital death were emergency CABG (OR 10.5) and need for IABP (OR 8.6)
		> 80**	202	5.4 / 0 / -	
					5-yr outcomes (%): Survival / TLR
Mullany[90] (1997)	CABG	< 65	1120	1.1 / - / -	91.5 / 10
	PTCA	< 65		0.7 / - / -	89.5 / 56
	CABG	≥ 65		1.7 / - / -	85.7 / 5
	PTCA	≥ 65	709	1.7 / - / -	81.4 / 53
Thompson[87] (1996)	PTCA	> 65[+]	982	3.3 / 3.9 / 5.5	No difference in survival
		> 65[++]	768	1.4 / 2.2 / 0.7	
Hannan[6] (1994)	CABG	40-49	2448	1.1 / - / -	Older cohorts include more females, emergency surgery, unstable angina, previous CABG, heart failure, renal failure, EF < 20%, previous stroke, peripheral vascular disease
		50-59	6118	1.7 / - / -	
		60-64	5352	2.2 / - / -	
		65-69	6268	2.8 / - / -	
		70-74	5563	3.4 / - / -	
		75-79	3561	5.3 / - / -	
		≥ 80	1372	8.3 / - / -	
O'Keefe[7] (1994)	CABG	> 70	195	9 / 6 / 5	5-yr survival (%): 65
	PTCA	> 70	195	2 / 1 / 0	63

Abbreviations: ARTS = Arterial Revascularization Therapy Study; CABG = emergency coronary artery bypass grafting; D = in-hospital death; EF = ejection fraction; MI = in-hospital Q-wave myocardial infarction; OR = odds ratio; TLR = target lesion revascularization; - = not reported

\+ Elderly patients undergoing PTCA between 1980-1989; ++ Elderly patients undergoing PTCA between 1990-1992

* 1986-1993

** 1994-1996

‡ Randomized trial of multivessel stenting vs. CABG

++ In-hospital complications

Table 7.3. PTCA for Patients Over Age 65: Acute Outcome

Series	Age	N	Success (%)	Complications (%) D / Q-MI / CABG	Comments
Veledar[229] (2002)	70-79 80+	38,621 10,323	- -	2 / - / - 3.9 / - / -	National Cardiovascular Network database
BARI[90] (1997)	65-80	709*	-	1.7 / - / -	5-yr survival (81.4%); 5-yr TLR (53%)
Laster[88] (1996)	> 80	55	96	16 / - / 0	Primary PTCA for acute MI
Jollis[12†] (1995)	65-69 > 80	- 20,006	- -	1.8 / - / - 7 / - / -	1-yr survival (94.8% vs. 83%); 3-yr survival (89.6% vs. 70.4%)
Lindsay[10] (1994)	55-64 65-74 ≥ 75	914 996 474	93 92 94	0.5 / 0.3 / 3.7 1.1 / 0.5 / 2.2 2.1 / 1.3 / 3.6	Vascular repair (1% vs. 1.9% vs. 3.6%); non-balloon devices used in 35%
Burstein[11] (1994)	< 50 50-69 ≥ 70	172 938 622	- - -	0.7 / - / 4.7 1.3 / - / 3.5 3.6 / - / 2.1	
Thompson[13] (1994)					
1980-89	> 65	982	88	3.3 / 3.9 / -	Death/MI at 6 months (10.3% vs. 9.9%)
1990-92	> 65	768	94	1.4 / 2.2 / -	
Little[14] (1993)	< 80 > 80	500 118	88 89	0.2 / 1.4 / 2.6 2.1 / 0.8 / 0.8	Octogenarians: 1-yr survival (76%); 3-yr survival (61%)
Foreman[15] (1992)	60-69 70-79 ≥ 80	570 270 67	88 88 84	2 / 6 / 5 2 / 5 / 4 6 / 5 / 2	3-yr survival (96% vs. 80% vs. 72%)
Thompson[17] (1991)					EFS (%): 1-yr / 3-yr / 5-yr
	65-69	326	82	1.2 / 2.7 / 10.7	74 / 60 / 51
	70-74	233	82	2.2 / 4.3 / 9	72 / 55 / 48
	≥ 75	193	93	6.2 / 6.7 / 3	58 / 36 / 24

Abbreviations: BARI = Bypass Angioplasty Revascularization Investigation; CABG = emergency coronary artery bypass grafting; D = in-hospital death; EFS = event-free survival (no death, MI, CABG, PTCA, angina); MI = in-hospital Q-wave myocardial infarction; TLR = target lesion revascularization; - = not reported

* PTCA + CABG

† From the Medicare Provider Analysis and Review (MEDPAR) file

Table 7.4. Results of Interventional Devices in the Elderly

Series	Modality	Age	N	Success* (%)	Complications (%)† D / Q-MI / CABG	Comments
Hernandez[230] (2002)	Stent	> 75	95	-	0.8	Compared to PTCA, stents resulted in less in-hospital MACE (0.8% vs. 7.3%, p = 0.01) and less repeat PCI at 2 years (9% vs. 24%, p = 0.007)
Kobayashi[208] (2001)	Stent	< 70 70-79 ≥ 80	476 251 94	-	0.2 / 0.5 / 0.2 0.4 / 0.4 / 0 0 / 0 / 0	No difference in 30-day CABG (~0.1%), mortality (~ 0.5%), or MACE (~1.5%). Vascular complications higher in patients ≥ 80 years (1.0% vs. 1.6% vs. 4.3%, p = 0.05)
Trabattoni[221] (2001)	Stent	> 75 51-75 31-50	130 200 150	91 95 96	3.8 / - / 0.7 1.0 / - / 0 0 / - / 0	No difference in late MACE or restenosis between groups
Baklanov[222] (2001)	Stent	> 80	197	93	2 / - / -	Stroke (2%). High-risk patient cohort: acute MI or unstable angina (65%); prior MI (66%); 3-vessel disease (48%)
Alexander[191] (2000)	Various	≥ 75	34,878	-	3.1 / 0.9 / -	Composite results from 6 large registries. Stroke (0.4%); results of PCI improved over time.
Ang[215] (2000)	Various	> 70 > 80	524 65	99 96	1.1 / 0.6 / 1.3 1.5 / 0 / 0	No difference in short-term risk of stroke or need for repeat PCI
Alfonso[186] (1999)	Stent	≥ 65 < 65	378 601	93 95	4.7 / 4.2 / 0 1.3 / 3.4 / 0.3	More in-hospital death and MACE (6.8% vs. 3.4%) in the elderly.
Bage[107] (1998)	Stent	> 70	87	-	4.6 / 0 / 0	EFS at 8.6 months (84%)
DeGregorio[108] (1998)	Stent	> 75 < 75	137 2551	-	2.2 / 2.9 / 3.7 0.1 / 1.7 / 1.4	1-yr survival (91%); 1-yr EFS (54%); elderly with lower EF, more multivessel disease, and more unstable angina
Chauhan[137] (1998)	Stent	< 80 ≥ 80	5624 265	99 99	0.2 / 0.8 / - 0.8 / 1.1 / -	TLR (12.6% vs. 11.7%). More vascular and bleeding complications in the very elderly
Gaxiola[154] (1998)	Stent	< 75 ≥ 75	280 282	97 94	0.7 / 0.7 / 0.7 3.7 / 2.4 / 1.2	EFS at 6 months (81% vs. 77%)
Nasser[92] (1997)	Stent	< 65 65-74 > 75	252 258 35	97 97 97	1.0 / 0.5 / 4.0 0 / 6.5 / 4.3 0 / 0 / 0	EFS at 9 months (90% vs. 89% vs. 90%)
Fishman[19] (1995)	DCA + Stent	< 70 ≥ 70	388 116	96 91	0.8 3.5	
Movsowitz[20] (1994)	DCA	< 65 66-75 ≥ 75	222 101 50	96 88 95	5.7 10.9 9.5	Transfusion required in 17% of patients ≥ 75 years. Trend toward more groin complications in the elderly

Abbreviations: CABG = emergency coronary artery bypass grafting; D = in-hospital death; DCA = directional coronary atherectomy; EF = ejection fraction; EFS = event-free survival (without death, MI, CABG, re-PTCA); MACE = major adverse cardiac events; MI = in-hospital Q-wave myocardial infarction; PCI = percutaneous coronary intervention; PSS = Palmaz Schatz stent; ROTA = Rotablator; - = not reported

* Device + adjunctive PTCA as needed

† In-hospital complications

Table 7.5. Important Considerations for Elderly Patients Undergoing Coronary Intervention

Patient Group	Measure
All patients	Ensure euvolemia Check neurologic and peripheral vascular status Consider sedation with antihistamines rather than benzodiazepines Remove sheaths as soon as possible Promote early ambulation Remove bladder catheter early Prescribe support stockings if prolonged bedrest Simplify medical regimen and educate patient prior to discharge
EF < 40% or culprit supplies large myocardial territory	Consider angiography to evaluate peripheral vessels for IABP Consider Rotablator for calcified lesions Perform culprit vessel angioplasty and/or stent; stage remaining stenoses
Suboptimal result	Prepare for stent implantation
Acute coronary syndrome	Perform culprit vessel angioplasty and/or stent; stage remaining stenoses Consider platelet IIb/IIIa inhibitors

Abbreviations: IABP = intra-aortic balloon pump; EF = ejection fraction

E. APPROACH. Patients between the ages of 65-75 with symptomatic coronary artery disease should not be denied percutaneous or surgical revascularization because of age alone or concerns about excessive complications, even during acute MI.[183] Although CABG and PTCA achieve similar long-term survival rates, PTCA is associated with less in-hospital morbidity and mortality, but greater need for repeat revascularization. Patients with anatomic features unsuitable for percutaneous intervention and those with severe 3-vessel disease with LV dysfunction may have a survival advantage after CABG. Although stents have decreased the incidence of in-hospital ischemic complications, elderly patients are at higher risk for medical and vascular complications. It is important to pay special attention to volume status, contrast load, renal function, bleeding and peripheral vascular complications to minimize morbidity and mortality (Table 7.5).

VERY ELDERLY PATIENTS (AGE > 80 YEARS)

A. BYPASS SURGERY. In-hospital mortality is 5-10% in octogenarians undergoing CABG, and another 5% develop perioperative MI or stroke (Table 7.2). The marked decline in perioperative morbidity and mortality in the late 1990's has been attributed to better patient selection, maintenance of higher perfusion pressures, and improvements in pre- and post-operative patient care.[187] In addition to advanced age, risk factors for operative mortality include female gender, unstable angina, diabetes mellitus, smoking, poor ejection fraction, and severe angina. Five-year survival ranges from 60-85%; 30% of late deaths are due to noncardiac causes. At 1-year follow-up, up to 90% of patients are in functional Class 1 or 2.

Table 7.6. PTCA for Patients Over Age 80: Acute Outcome

Series	N	Success (%)	Complications (%) D / Q-MI / CABG
Veledar[229] (2002)	10,323**	-	3.9 / - / -
Kobayashi[208] (2001)	94 (stent)	-	0 / 0 / 0
Batchelor[214] (2000)	7472 (various devices)	84	3.8 / 1.9 / 4.4
Ang[215] (2000)	65 (various devices)	96	1.5 / 0 / 0
Thompson[197] (2000)	2968	94	3.5 / - / -
Jollis[12] (1995)	20,006*	-	7 / - / -
Weyrens[23] (1994)	26	65	23 / 4 / -
Little[14] (1993)	118	89	2 / 1 / 1
Foreman[15] (1992)	67	84	6 / 5 / 2
Santana[24] (1992)	53+	83	15 / 4 / -
Bedotto[25] (1991)	111	91	6 / 3 / 0
Jackman[26] (1991)	31	90	6 / 6 / 10
Myler[27] (1991)	74	80	1 / 0 / 4
Jeroudi[28] (1990)	54	91	4 / 4 / 0
Rizo-Patron[29] (1990)	53	83	2 / 5 / 7
Rich[30] (1988)	22	86	0 / 14 / 0
Kern[31] (1988)	21	67	19 / 0 / 14

Abbreviations: CABG = emergency coronary artery bypass grafting; D = in-hospital death; Q-MI = in-hospital Q-wave myocardial infarction (some studies did not distinguish between Q-wave and non-Q-wave MI); - = not reported

* From the Medicare Provider Analysis and Review (MEDPAR) file

**From the National Cardiovascular Network database

+ All patients had unstable angina

B. PERCUTANEOUS REVASCULARIZATION. Procedural success were achieved in 65-94% of patients > 80 years old (Table 7.6),[32,188] although success rates $\geq$85% are expected in contemporary practice. Compared to younger patients, octogenarians have more acute complications, in-hospital mortality, and late cardiac death. Nevertheless, 87% of patients in one study were subjectively improved after PTCA, 33% were more physically active, and 55% required less medication.[28] Three-year survival rates of 80-91% have been reported,[27,28] and > 90% of long-term survivors indicated a high level of satisfaction with their quality of life and health status.[14] In anatomically suitable lesions, stent implantation may enhance the early and late outcome after intervention. Octogenarians with acute MI benefit from primary PTCA or stenting with procedural success in 98%, 30-day mortality in 16%, and 1-year event-free survival of 77%.[182]

C. CONCLUSIONS. When medical therapy fails to control anginal symptoms in octogenarians, PTCA, stenting, and other techniques can be performed with high success rates, but acute ischemic complications occur more often than in younger patients. Short-term follow-up reveals relief of angina, but frequent late cardiac events from serious comorbid medical problems. To minimize morbidity and mortality during percutaneous intervention, it is important to pay special attention to volume status, contrast load, renal function, bleeding, and peripheral vascular complications (Table 7.5).

FEMALE PATIENTS

A. BACKGROUND. Many studies suggest differences in the prevalence, manifestations, diagnosis, and prognosis of coronary artery disease between men and women.[33-35,109,151,167,168] Compared to men, women with non-Q-wave MI had more risk factors for atherosclerosis, partially explaining higher 1-year mortality in women.[165]

B. PERCUTANEOUS REVASCULARIZATION. Several studies suggest that females have a higher in-hospital mortality than males (Tables 7.7, 7.8). However, females were older, and had a higher prevalence of diabetes mellitus, hypertension, unstable angina, and prior MI. After accounting for these differences, gender probably has little or no independent effect on outcome,[147,161] even in the setting of primary PTCA or stenting for acute MI.[166] Females are at increased risk for major ischemic and peripheral vascular complications, possibly due to greater comorbidity and lower body surface area. Although women had more bleeding and vascular complications after abciximab than men, major bleeding in women was similar with and without abciximab.[170]

C. CABG. One-year occlusion rates of SVG and LIMA grafts are similar for men and women.[169]

D. FOLLOW-UP. Compared to males, females had similar survival and *better* event-free survival (freedom from death, MI, repeat PTCA, or CABG).[38,39] Mayo Clinic investigators found no difference in 5-year infarct-free survival, although females required less late CABG.[44]

E. CONCLUSIONS. In-hospital mortality is higher for women undergoing PTCA, but is largely related to older age, advanced angina class, small body habitus, and comorbid conditions. Long-term results are similar to men. PTCA and other devices should not be withheld in women who are considered good candidates for intervention because of concerns of lower success rates and more complications.[109]

AFRICAN-AMERICANS

A. BACKGROUND. African-Americans have more risk factors for coronary artery disease and higher cardiac mortality than the general population.[55] Most studies suggest that CABG is equally effective among black and white patients in reducing symptoms and improving survival,[56] although 15-year survival was lower in African-Americans in the Coronary Artery Surgery Study (CASS).[89] Although several studies suggest racial disparities in referral of patients for cardiac catheterization, percutaneous intervention, and CABG,[110-112] survival rates are similar between African-Americans and Caucasians with similar disease severity.[112] Some differences in referral may be due to greater reluctance among African-Americans to undergo invasive procedures.[110,113]

B. PERCUTANEOUS REVASCULARIZATION (Table 7.9). Despite greater comorbidity among African-Americans, results from the 1985-1986 NHLBI PTCA Registry indicate that PTCA outcome is independent of race.[57] However, other reports describing laser, atherectomy, and stents suggest higher procedure-related death among African-Americans,[58,195] which be due to a higher prevalence of comorbid conditions.[58]

C. FOLLOW-UP. One-year survival and event-free survival following percutaneous intervention were lower among African-Americans in one report[195] but not in another;[58] 5-year outcomes were similar[57] (Table 7.9). More than 80% of patients have improved anginal status and repeat PTCA is required in 20-25%, similar to the general population.

D. CONCLUSIONS. Despite more comorbidity, African-Americans have excellent results after percutaneous revascularization. Aggressive management of risk factors for atherosclerosis is mandatory (Chapter 41).

Table 7.7. Effect of Gender on PTCA Outcome

Series	Gender	N	Success (%)	Complications (Male vs. Female) (%)** D / Q-MI / CABG
				In-hospital mortality by age group < 50 / 50-59 / 60-69 / 70-79 / 80+
Veledar[229+]	Male	101,160	-	0.4 / 0.6 / 0.8 / 1.8 / 3.5
(2002)	Female	49,669	-	0.8 / 0.8 / 1.2 / 2.5 / 4.2
Vakili[199]	Male	727[++]	-	2.3 / - / -
(2000)	Female	317[++]	-	7.9 / - / -
				MACE: In-hospital / 1 mo / 6 mo (%)
Adamian[123]	Male	2113	98	0.9 / 1.3 / 4.7
(1999)	Female	247	95	3.6 / 4.8 / 9.8
Jacobs[156]	Female (1985-6)	545	79	2.6 / 4.6 / 4.6
(1997)	Female (1993-4)	274	89	1.5 / 1.8 / 1.8
Jacobs[104]	Male	656	-	In-hospital mortality (1.2% vs. 0.8%);
(1996)	Female	248	-	5-yr mortality (14.4% vs. 14.1%)
Stone[36]	Male	145[++]	90	2.1 / 2.8 / -
(1995)	Female	50[++]	80	4.0 / 2.0 / -
Malenka[37]	Male	11,493	94	Death (0.7% vs. 1.6%); MI or CABG
(1995)	Female	5472	95	(4.5% vs. 5.0%)
Weintraub[38]	Male	7940	90	0.1 / 0.8 / 2
(1994)	Female	2845	91	0.7 / 1 / 2
Arnold[39]	Male	3726	93	0.3 / 0.4 / 4.5
(1994)	Female	1274	94	1.1 / 0.4 / 5
Cavero[40]	Male	340[†]	-	Females had higher in-hospital death but
(1994)	Female	340[†]	-	similar total and event-free survival
Peterson[8*]	Male	129,675	-	30-day mortality (3.0% vs. 3.8%);
(1994)	Female	96,240	-	1-yr mortality (7.8% vs. 8.2%)
Kelsey[148]	Male	1590	89	0.3 / 4.3 / 3.3
(1993)	Female	546	88	2.6 / 4.6 / 4.8
Bell[42]	Male	1508	90	3.1 / 0.6 / 2.1
(1993)	Female	593	87	5.4 / 0.7 / 2.9

Abbreviations: D = in-hospital death; MI = in-hospital Q-wave myocardial infarction; CABG = emergency coronary artery bypass grafting; MACE = major adverse cardiac events (death, MI, repeat revascularization); - = not reported

+ From the National Cardiovascular Network database
† Multivessel PTCA or CABG
* From the Medicare Provider Analysis and Review (MEDPAR) file
++ Primary PTCA for acute MI
** In-hospital complications unless otherwise stated

Table 7.8. Effect of Gender on Stent, Atherectomy, and Laser Outcomes

Series	Modality	Gender	N	Results
Jensen[235] (2002)	Various	Male Female	6064 2113	In-hospital outcomes were similar for males and females. Age > 70 was associated with higher in-hospital mortality and MI than age < 70 (p < 0.0001)
Dangas[209] (2001)	Various	Male Female	347*/4583 180*/1805	Compared to African American males, African American females had higher in-hospital mortality (4.1% vs. 1.0%, p = 0.006), Q-MI (1.9% vs. 0.2%, p = 0.037), and MACE (8.6% vs. 2.4%, p = 0.001). No difference in hospital outcome for Caucasion males vs. females. Female gender was an independent predictor of 1-yr mortality
Watanabe[223] (2001)	Stent/PTCA	Male Female	64,016 54,532	Females had 2-fold higher in-hospital mortality and more in-hospital CABG
Thompson[224] (2001)	Stent/PTCA CABG	Male Female Male Female	24,111 12,141 14,397 6338	After adjusting for baseline differences, females had higher in-hospital mortality after CABG (but not after stent/PTCA)
Sousa[225] (2001)	Stent	Male Female	16,905 6848	Females had higher in-hospital mortality (1.8% vs. 0.9%, p < 0.0001), even after adjusting for baseline differences
EPISTENT[190] (2000)	Stent/PTCA	Male Female	2399 (total)	30-day death, MI, or urgent revascularization (male vs. female): stent-placebo (10.5% vs. 11.7%); stent-abciximab (4.2% vs. 8.7%); PTCA-abciximab (7.6% vs. 5.1%). Females ≥ 65 years with lower 30-day composite endpoint in PTCA/abciximab vs. stent/abciximab groups (2.2% vs. 14.4%)
Ang[198] (2000)	Various	Male Female	1861 723	No differences in procedural success, death, MI, or stroke. Females required more rePTCA (2.5% vs. 1.2%) and emergency CABG (2.9% vs. 1.4%)
Weintraub[136] (1998)	Stent	Male Female	1046 410	Females had higher in-hospital mortality (1.0% vs. 0.7%), 6-month mortality (4.3% vs. 2.9%), and restenosis (27% vs. 22%)
Lansky[93] (1997)	Various	Male Female	1983 1076	Females had lower acute angiographic success (82% vs. 87%), more in-hospital CABG (3% vs. 1.6%), similar 1-yr death (~5.5%) and CABG (~11%), and less repeat PTCA (21% vs. 24%)
Mehran[91] (1997)	Stent	Male Female	836 364	Females had higher in-hospital Q-MI (1.3% vs. 0.4%) and vascular complications (9.4% vs. 3.9%), but similar clinical events at 6 months
Nasser[92] (1997)	Stent	Male Female	396 149	No difference in in-hospital events or clinical follow-up at 9 months
Hermiller[86] (1996)	Bailout stent	Male Female	606 270	Females had similar ischemic complications but more vascular complications (13% vs. 5%)

Table 7.8. Effect of Gender on Stent, Atherectomy, and Laser Outcomes

Series	Modality	Gender	N	Results
STRESS[45] (1995)	PSS	Male Female	170 35	Females had similar EFS (83% vs. 80%), restenosis (36% vs. 30%), and TLR (14%) at 8 months. Females were older, had smaller vessels, and developed more peripheral vascular complications (14% vs. 5%)
Fishman[19] (1995)	Stent or DCA	Male Female	413 91	Females had lower procedural success (89% vs. 96%), similar major complications (~1%), and > peripheral vascular complications (25% vs. 9%)
Baumbach[46] (1994)	ELCA	Male Female	1156 365	Females had 2.5-fold increase in severe dissection and 2.4-fold increase in perforation
Combs[47] (1994)	PTCA + DCA	Male Female	982 406	Females had more acute closure (5.2% vs 2.7%). Emergency CABG and procedural success rates were equivalent
Ellis[49] (1994)	ROTA	Male Female	243 82	Females had a 2.4-fold increase in procedural failure and a 3-fold increase in ischemic complications
Casale[51] (1993)	ROTA	Male Female	1951 785	Females had lower success (93% vs. 95%) and more ischemic complication (12.5% vs 7.4%). Females were older, and had more diabetes, unstable angina, and calcified lesions
Movsowitz[54] (1994)	DCA	Male Female	281 137	Females had lower procedural success (68% vs. 80%), primarily due to inability to engage the ostium (with the guiding catheter) and the inability to cross the lesion with the device due to smaller vessel size

Abbreviations: CABG = coronary artery bypass grafting; DCA = directional coronary atherectomy; EFS = event-free survival (without death, MI, CABG, re-PTCA); GRS = Gianturco-Roubin stent; MI = myocardial infarction; PSS = Palmaz Schatz stent; ROTA = Rotablator; TLR = target lesion revascularization
* African-Americans

DIABETICS

A. BACKGROUND. Patients with insulin-dependent diabetes mellitus (Type I) are prone to micro- and macrovascular complications, whereas those with non-insulin dependent diabetes (Type II) are more prone to macrovascular complications.[162] The most important manifestation of macrovascular disease is coronary artery disease due to accelerated atherosclerosis, which causes nearly 50% of deaths in these patients. Compared to nondiabetics, patients with diabetes mellitus have a 2-3-fold higher rate of coronary artery disease, and are at increased risk for myocardial infarction, congestive heart failure, and death.[149,172,174] Experimental studies suggest enhanced platelet, coagulation, and vasoconstrictor activity, more endothelial dysfunction, and reduced fibrinolytic capacity in diabetics, predisposing to a hypercoagulable state and more ischemic events (Table 7.10).[153,159,172,175]

Table 7.9. Results of Coronary Intervention in African-Americans

Series	Modality	Group	N	Success (%)	Complications (%)+ D / Q-MI / CABG	Other (Black vs. White)
Dangas[209] (2001)	Various	Black female Black male White female White male	180 347 1805 4583	- - - -	4.1 / 1.9 / - 1.0 / 0.2 / - 1.2 / 0.4 / - 0.9 / 0.7 / -	Female gender was a predictor of higher 1-yr mortality
Dangas[195] (2000)	Various	Black White	555 5738	- -	2.3 / 0.9 / 2.9 0.9 / 0.7 / 1.4	1-yr outcomes: death (11% vs. 6%); MACE (29% vs. 26%)
Wong[127] (1999)	PTCA	Black White	1137 20,464	- -	0.9 / 0.4 / 0.6 0.9 / 0.3 / 1.5	
Scott[57] (1994)	PTCA	Black White	76 1939	76* 79*	0 / 7 / 4 1 / 5 / 4	5-yr outcomes: death (11% vs. 10%); MI (13% vs. 14%); CABG (20% vs. 19%); re-PTCA (25% vs. 28%); asymptomatic (66% vs. 81%)
Chuang[58] (1994)	Various	Black White	169 1955	92 91	4.1 / 1.2 / 2.4 0.6 / 0.9 / 3.4	1-yr outcomes: death (1.5% vs. 1.6%); MI (0.8% vs. 1.4%); CABG (9% vs. 8%); re-PTCA (21% vs. 18%)
Scott[59] (1993)	PTCA	Black male Black female	337 160	88 91	0.6 / 2.1 / 4.8 1.9 / 0.4 / 4.4	No difference in survival (~ 79%) or EFS (~ 35%) at 8 years

Abbreviations: D = in-hospital death; MI = in-hospital Q-wave myocardial infarction (some studies did not distinguish between Q-wave and non-Q-wave MI); CABG = emergency coronary artery bypass grafting; EFS = event-free survival
* Clinical success: Final diameter stenosis < 50% without death, MI, or emergency CABG
+ In-hospital

B. BYPASS SURGERY. Compared to nondiabetics, patients with diabetes have more in-hospital death and stroke, shorter long-term survival, and more late MI, redo CABG, and PTCA (Table 7.11).[60,61] Approximately 20-25% of diabetics die within 5 years of CABG. Even after correction for differences in baseline characteristics (unstable angina, lower EF, multivessel disease, other comorbidity), diabetes mellitus remains a strong independent predictor of adverse outcome.

Table 7.10. Factors Associated with Diabetes Mellitus That Facilitate Coronary Arteriosclerosis and Adverse Outcomes[172]

Clinical Factors
Advanced age
Female gender
Obesity
Hypertension
Hyperlipidemia
Prior MI
Prior CABG
Biological Factors
Endothelial dysfunction
Reduction in coronary flow reserve
Increased platelet activity
Increased secretion of thromboxane-A_2
Increased platelet activation
Higher levels of fibrinogen and factor VII
Less antithrombin III activity
High levels of plasminogen activation inhibitor
Angiographic Factors
Small vessels, diffuse disease
Frequent multivessel and left main disease
More left ventricular dysfunction
Poor coronary collateral development
More thrombus formation

C. BALLOON ANGIOPLASTY

1. **Procedural Results (Table 7.11).** Approximately 20% of patients undergoing coronary intervention have diabetes mellitus. Most PTCA series indicate similar success rates (~ 90%) among diabetics and nondiabetics,[62-64,143] despite more unstable angina, prior MI, prior CABG, peripheral vascular disease, coronary calcification, and lower ejection fractions in diabetics.[65] Abciximab (with or without stents) improves in-hospital, 30-day, and 6-month outcomes (death, MI, revascularization), especially for insulin-dependent diabetics.[142,160]

2. **Follow-up.** Compared to nondiabetics, diabetics have shorter long-term survival, more ischemic cardiac events, and more target lesion revascularization after PTCA.[60,62,63,65,116] Potential factors include more diffuse disease, smaller vessels,[126] and more intimal hyperplasia after vessel injury.[176] Importantly, diabetics appear to have a greater propensity for plaque rupture and thrombosis, owing to increased blood viscosity, more platelet aggregation, production of procoagulant factors, decreased synthesis of prostacyclin, and impaired fibrinolysis. The impact of diabetes mellitus on restenosis was controversial, but most reports indicate higher restenosis rates.[66-71] In the Bypass

Angioplasty Revascularization Investigation (BARI) trial, diabetics treated with PTCA had higher 5-year mortality than those treated with CABG (35% vs. 19%, p = 0.0024),[60] with a relative risk of late death of 3.1.[117,118] The survival advantage with CABG was limited to diabetics who received internal mammary bypass grafts,[118] and was most pronounced in diabetics with prior MI and LV dysfunction.[171] At 7 years, the survival advantage for CABG continued to increase (mortality: 44.3% for PTCA vs. 25.6% for CABG, $p < 0.001$).[207] In contrast, two studies, including the nonrandomized BARI registry,[164] reported no difference in 5-year survival for diabetic patients treated by CABG vs. PTCA.[116] Differences in late mortality between studies may be partially explained by differences in case selection, glycemic control, proteinuria, and the prevalence of insulin-dependent diabetes (which seems to be associated with a worse prognosis than non-insulin dependent diabetes).[115,130,132,164] In some studies[128,145] but not in others, elevation of hemoglobin A_{1c} levels and suboptimal glycemic control were associated with a worse late outcome.[144,162] Diabetics with proteinuria had worse 2-year survival after percutaneous intervention compared to nondiabetics and diabetics without proteinuria.[163,173] The combination of diabetes and renal insufficiency identified an extremely high-risk group for 1-year death or MI (25.9%), compared to diabetics without renal insufficiency (7.8%) and nondiabetics with normal renal function (4.2%).[203] Finally, diabetics have a higher incidence of incomplete revascularization with PTCA, which is an important confounding variable when interpreting survival studies.[155]

3. **Acute MI.** In the GUSTO-IIb angioplasty substudy, primary PTCA for acute MI was equally successful in diabetics and nondiabetics, despite worse baseline clinical and angiographic characteristics in diabetics. In diabetics, primary PTCA was more effective than intravenous thrombolytic therapy.[180] In STENT-PAMI, primary PTCA or stenting for acute MI were equally effective in diabetics.[200]

D. NON-BALLOON DEVICES. In CAVEAT-I, compared to non-diabetics undergoing directional atherectomy, diabetics had more angiographic restenosis (60% vs. 47%) and more frequent bypass surgery (12.8% vs. 8.5%).[95] Results from STRESS I-II trials suggest that stenting may be preferred over PTCA in diabetics (Table 7.12).[98] Most studies reported higher restenosis rates after stenting and other devices in diabetics vs. nondiabetics,[96,97,99,130,131,138,141,158] although other reports found no difference.[105,125,139,140,152] Importantly, results from RAVEL indicated 0% restenosis among 19 diabetics treated with the sirolimus-eluting BX Velocity stent.[237] Serial IVUS studies suggest more late intimal hyperplasia after all percutaneous interventions in diabetics compared to nondiabetics.[150] The BARI-II trial will randomize 2600 Type-2 diabetics with stable coronary artery disease to elective percutaneous intervention or aggressive medical therapy, and to tight glycemic control ($HgbA_{1c} < 7.5$) with insulin or insulin-sensitizing drugs.

E. CONCLUSIONS. Compared to nondiabetics, diabetics undergoing PTCA have similar angiographic success but a trend toward higher in-hospital complications; long-term survival after percutaneous or surgical revascularization is reduced. Late vessel occlusion after PTCA is a common manifestation of restenosis, and may partially explain deterioration in LV function and higher mortality rates.[124] Given

the high mortality rates following revascularization, aggressive risk factor modification is recommended to retard progressive disease at non-PTCA sites. Since a 1% increment in hemoglobin A_{1c} levels is associated with a 10% increase in risk of ischemic heart disease, glycemic control, antihypertensive therapy, and lipid-lowering treatment is crucial, especially in patients with Type-2 diabetes.[162] Other important risk-reduction measures, including the use of ACE inhibitors, aspirin, smoking cessation, diet, weight control, and exercise are detailed in Chapter 41.

CHRONIC DIALYSIS PATIENTS

A. BACKGROUND. Coronary artery disease is responsible for more than 40% of deaths among patients with end-stage renal disease. CABG is feasible for patients on dialysis, but operative mortality is increased.[72-73]

B. BALLOON ANGIOPLASTY. As shown in Table 7.13, residual stenosis < 50% can be achieved in 90% of cases, but major ischemic complications (particularly non-Q-wave MI) are increased, especially in those > 65 years of age.[74,161] Even mild renal insufficiency prior to percutaneous revascularization increases the risk of cardiac mortality in the years following successful intervention.[216] Despite platelet and coagulation abnormalities in patients with chromic renal insufficiency, abciximab does not appear to increase the risk of major bleeding complications.[217]

C. STENTS. Acute angiographic results and procedural success rates after stenting are similar for dialysis and non-dialysis patients. However, in-hospital ischemic complications and 1-year rates of death and MI are higher in dialysis patients.[161,196,202]

D. FOLLOW-UP. Compared to the general PTCA population, dialysis patients have a higher incidence of restenosis (50-70% vs. 20-40%) and recurrent cardiac events at 1 year (50-80% vs. 20-35%). Although perioperative mortality is higher after CABG compared to PTCA, 1- and 2-year survival is better after CABG.[134]

E. CONCLUSIONS. Percutaneous revascularization of chromic dialysis patients is associated with high rates of ischemic and vascular complications and restenosis. In the largest report to date, patients on hemodialysis undergoing PTCA or CABG had 2-3 fold higher mortality at 1 and 12 months compared to the general PTCA population.[74] Despite stenting, patients with renal insufficiency (on or off dialysis) have more ischemic complications and higher mortality than patients with normal renal function.[133,146]

Table 7.11. Results of PTCA in Patients with Diabetes Mellitus

Series	Group	N	Success (%)	Complications (%)[++] D / Q-MI / CABG	Comments
DESTINI[210] (2001)	PTCA Diabetic*	70	-	0 / 2.9[+] / 0	Diabetics had lower EFS at 1 year (71% vs. 84%)
	PTCA Nondiabetic*	296	-	0/ 3.0[+] / 0.7	
Sedlis[226] (2001)	PCI Diabetic	454	-	-	Randomized trial of diabetics at high-risk for CABG (refractory unstable angina and prior CABG, MI < 7 days, LVEF < 35%, or IABP to stabilize). 3-yr survival similar (79% vs. 80%)
	CABG Diabetic	overall	-	-	
BARI[60,207] (2000)	PTCA Diabetic	174	-	0.6 / - / -	PTCA group had more death (44% vs. 26%), MI (9.2% vs. 5.7%), and repeat revascularization (70% vs. 11%) at 7 years
	CABG Diabetic	183	-	1.2 / - / -	
Wong[201] (2000)	PTCA Diabetic	4372	-	1.4 / 0.3 / 1.3	Diabetics had more dialysis (0.55% vs. 0.05%) and longer hospital stay (6.4 days vs. 5.5 days)
	PTCA Nondiabetic	18,366	-	0.8 / 0.3 / 1.5	
Gowda[114] (1998)	PTCA Diabetic	77	96	-	Diabetics had similar survival (92% vs. 94%) but lower EFS (55% vs. 67%) at 1 year
	PTCA Nondiabetic	299	97	-	
Weintraub[115] (1998)	PTCA Diabetic	834	-	0.4 / - / -	Survival was similar for PTCA vs. CABG at 5 years (78% vs. 76%) and 10 years (45% vs. 48%). Survival was worse for insulin-dependent diabetics after PTCA
	CABG Diabetic	1805	-	5.0 / - / -	
Van Belle[105] (1997)	PTCA Diabetic	57	-	-	Diabetics had more restenosis (63% vs. 36%), late loss (0.79 mm vs. 0.41 mm), and late vessel occlusion (14% vs. 3%)
	PTCA Nondiabetic	243	-	-	
Weintraub[61] (1995)	CABG Diabetic	2372	-	4.2 / - / -	Diabetics had more stroke (3.1% vs. 1.5%), higher mortality at 5 years (26% vs. 13%) and 10 years (50% vs. 28%), and more late MI and revascularization
	CABG Nondiabetic	10,291	-	1.8 / - / -	
Stein[62] (1995)	PTCA Diabetic	1133	87	0.4 / 0.6 / 2.3	5-yr outcomes: death (17% vs. 7%); MI (19% vs. 11%); CABG (23% vs. 14%); PTCA (43% vs. 32%); EFS (36% vs. 53%)
	PTCA Nondiabetic	9300	89	0.3 / 0.9 / 2.1	
Faxon[63] (1995)	PTCA Diabetic	280	85	3.2 / - / -	8-yr outcomes: death (31% vs. 15%); MI (30% vs. 18%); CABG (34% vs. 26%). Diabetics had a 75% increased risk of death after controlling for baseline differences
	PTCA Nondiabetic	1833	87	0.5 / - / -	

Abbreviations: CABG = emergency coronary artery bypass grafting; D = in-hospital death; EFS = event-free survival (without death, MI, CABG, or re-PTCA); IABP = intra-aortic balloon pump; MI = in-hospital Q-wave myocardial infarction; PCI = percutaneous coronary intervention; TLR = target lesion revascularization; - = not reported

Acronyms: BARI = Bypass Angioplasty Revascularization Investigation; DESTINI = Doppler Endpoint Stenting International Investigation Coronary Flow Reserve

* Doppler-guided optimal PTCA

\+ Q-wave plus non-Q-wave MI

++ In-hospital

Table 7.12. Results of Stenting in Patients with Diabetes Mellitus

Series	Group	N	Results
RAVEL[237] (2002)	Sirolimus Stent Diabetic Standard Stent Diabetic	19 25	Sirolimus-eluting stent with less late loss (0.07 mm vs. 0.82 mm, p < 0.001) and less restenosis (0% vs. 47%, p = 0.002) at 6 months
Wilson[232] (2002)	Stent Diabetic Stent Nondiabetic	851 851	Stents in ~ 80%. Procedural success 97% in both groups. Diabetics had higher mortality at 2.4 years (14.2% vs. 6.8%, p = 0.002)
Kawaguchi[233] (2002)	Stent Diabetic Cutting Balloon Diabetic	35 51	Reference vessel diameter < 2.6 mm. Stent group had higher acute success (97.1% vs. 80.7%, p = 0.02) and similar restenosis (41% vs. 32%) and MACE (38% vs. 32%) at 6 months
Abizaid[212] (2001)	Stent Diabetic Stent Nondiabetic	195 560	Elective multivessel stenting. Similar procedural success and in-hospital MACE. Diabetics had more TLR (17.7% vs. 9.1%, p = 0.004) and MACE (34.8% vs. 19.2%, p < 0.001) at 1 year
DESTINI[210] (2001)	Stent Diabetic Stent Nondiabetic	65 302	In-hospital results (diabetic vs. nondiabetic): no deaths; MI (4.6% vs. 2.3%); CABG (0% vs. 1%). 1-yr follow-up: EFS (72% vs. 79%); CABG (9.4% vs. 1.7%); rePTCA (17% vs. 17%)
CADILLAC[211] (2001)	Stent Diabetic PTCA Diabetic	184 162	Stenting vs. PTCA with and without abciximab for acute MI. Stent group had less ischemic TVR at 6 months (7.1% vs. 17.3%, p = 0.0003) vs. PTCA, but similar death, reinfarction, disabling stroke, and MACE. 6-month MACE was increased in diabetics vs. nondiabetics (17.1% vs. 12.3%, p < 0.02)
Kugelmass[227] (2001)	Stent Diabetic (male) Stent Diabetic (female)	409 314	Procedural success higher in females (92.6% vs. 87.5%, p = 0.026); no difference in in-hospital death or emergency CABG
Villareal[193] (2000)	Stent Diabetic CABG Diabetic	468 762	CABG group had more in-hospital death (5.5% vs. 0.4%) and MI (5% vs. 1.5%), but less TLR (0.4% vs. 3.2%). 2-yr survival for NIDDM better with stents
Dangas[194] (2000)	Stent Nondiabetic Stent NIDDM Stent IDDM	584 121 89	Multivessel stenting. Significant difference in 1-yr MACE (nondiabetic 24.8% vs. NIDDM 37.9% vs. IDDM 48.6%, p < 0.001) and 1-yr TVR (10.7% vs. 17.9% vs. 25.7%, p = 0.01). No difference in angiographic success or in-hospital MACE
STENT-PAMI[200] (2000)	Stent Diabetic PTCA Diabetic Stent Nondiabetic PTCA Nondiabetic	72 63 377 381	Randomized trial for acute MI. Death, recurrent MI, stroke, or ischemic TVR at 1 year: nondiabetics (stent 17% vs. PTCA 25%, p = 0.005); diabetics (stent 20% vs. PTCA 30%, p = 0.21)

Table 7.12. Results of Stenting in Patients with Diabetes Mellitus

Series	Group	N	Results
Ahmed (2000)	Stent Diabetic (SVG) Stent Nondiabetic (SVG)	290 608	Diabetics had higher in-hospital mortality (2.2% vs. 0.3%, p = 0.003), 1-yr TLR (16.6% vs. 12.3%, p = 0.03), and lower 1-yr EFS (68% vs. 79%, p = 0.0003). No difference in early or late outcomes between IDDM vs. NIDDM
Pereira[204] (2000)	Stent Diabetic CABG Diabetic	44 46	Randomized trial. Similar MACE at 1 year (22.7% vs. 19.5%)
Schofer[178] (2000)	Stent Nondiabetic Stent IDDM Stent NIDDM	1439 48 177	Nondiabetics with less late loss, lower loss index, and less TLR than diabetics; no difference between IDDM and NIDDM
Gaxiola[179] (2000)	Stent Diabetic Stent Nondiabetic	118 430	In-hospital outcomes: death (0.8% vs. 0.5%); MI (0.8% vs. 0.5%); CABG (1.7% vs. 0.5). Diabetics with more late TLR (26% vs 13%) and CABG (12% vs. 3%). Multiple stents and diabetes were independent predictors of TLR
Silva[181] (1999)	Stent Diabetic Stent Nondiabetic	28 76	Primary stenting for acute MI. MACE at 1 and 6 months were higher in diabetics than nondiabetics; EFS at 6 months was worse in diabetics (54% vs. 88%)
Joseph[177] (1999)	Stent Nondiabetic Stent IDDM Stent NIDDM	1910 58 214	In-hospital outcomes (nondiabetics vs. IDDM vs. NIDDM): death (0.8% vs. 0% vs. 0.5%); MI (1.4% vs. 0% vs. 0.5%); CABG (0.1% vs. 0% vs. 0%). Greater 1-yr survival in NIDDM vs. IDDM (97% vs. 90.7%), but similar TLR (10.5% vs. 8.2%)
Gencbay[132] (1999)	Stent Nondiabetic Stent NIDDM	96 96	Similar angiographic restenosis at 6 months (18% vs. 17%)
Alonso[131] (1999)	Stent Nondiabetic Stent Diabetic	849 134	MACE at 28 months was higher in diabetics (54% vs. 33%)
Bhaskaran[129] (1999)	Stent Diabetic PTCA Diabetic	188 570	Stent group had higher acute success (99.5% vs. 96%), higher 1-yr EFS (91% vs. 78%) and less TLR (8% vs. 16.3%)
Lansky[130] (1999)	Stent Nondiabetic Stent NIDDM Stent IDDM	386 76 102	Similar in-hospital outcomes. 1-yr TLR was highest in IDDM (27%) compared to NIDDM (10.4%) and non-diabetics (13.4%)
Carrozza[141] (1998)	Stent Diabetic Stent Nondiabetic	- -	Diabetics had more late loss, late loss index, angiographic restenosis (31% vs. 24%), and TLR (15% vs. 10%)
STRESS[98] (1997)	Stent Diabetic PTCA Diabetic	47 45	Stent group had higher acute success (100% vs. 82%), less restenosis (24% vs. 60%), and less TLR (13% vs. 31%)

Abbreviations: EFS = event-free survival; IDDM = insulin-dependent diabetes mellitus; MACE = major adverse cardiac events; MI = myocardial infarction; NIDDM = non-insulin-dependent diabetes mellitus; TLR = target lesion revascularization

Table 7.13. Revascularization of Chronic Dialysis Patients

Series	Modality	Group	N	Success (%)	Complications (%) D / Q-MI / CABG	
Rinder[228] (2001)	Stent	Dialysis	27	-	MACE at 9 months (29.6% vs. 20.9%)	
	Stent	No Dialysis	989	-		
					Early MACE	Late (20 mos)
Sharma[196] (2000)	ROTA/Stent	Dialysis	157	96	1.8	12.1 / - / TVR 28
	ROTA/Stent	No dialysis	803	-	-	2.8 / - / -
					Early	MACE (6 mos)
Beygui[202] (2000)	PTCA++	Dialysis	119	91	2.5 / 3.9 / -	52
	PTCA++	No dialysis	1328	91	1 / 1.5 / -	37
					Early	Late
LeFeuvre[161] (2000)	Stent	Dialysis	27	96	7 / 0 / 0	15 / 0 / 35*
	PTCA	No Dialysis	250	97	1.6 / 0.4 / 0.8	1.6 / 2 / 27*
	Stent	Dialysis	60	85	0 / 0 / 0	12 / 0 / 36*
	PTCA	No Dialysis	864	90	1.6 / 0.8 / 0.2	4 / 4 / 41*
					Early	Late
Gruberg[133] (1999)	Stent	Dialysis	53	-	4.9 / 1.6 / 1.6	34 / 0 / 16*
	Stent	CRF	340	-	3.2 / 0.5 / 0.8	14 / 0.3 / 9*
	Stent	Normal	4018	-	0.8 / 0.5 / 1.2	4.1 / 0.4 / 14*
					In-hospital MACE	Late MACE/death
Dambrin[206] (1999)	Stent	Dialysis	21	96	12	32 / 19
	Stent	No dialysis	211	97	3	23.5 / 2
Simsir[119] (1998)	PTCA	Dialysis	19	-	In-hospital mortality (5.3% vs. 4.5%)	
	CABG	Dialysis	22	-		
Chang[100] (1997)	PTCA	Dialysis	105	94	Mortality in-hospital (8.7% vs. 14.5%) and at 22 months (53% vs. 49%)	
	CABG	Dialysis	84	-		
Gradaus[101] (1997)	PTCA	Dialysis	20	-	Restenosis (60% vs. 49%)	
	PTCA	No dialysis	20	-		
Koyanogi[120] (1996)	PTCA	Dialysis	20	76	EFS at 5 years (18% vs. 70%)	
	CABG	Dialysis	23	-		
Ahmed[74] (1995)	CABG	Dialysis	168	-	Mortality at 30 days (8.9% vs. 5.4% vs. 2.8%) and at 1 year (32% vs. 32% vs. 8%)	
	PTCA	Dialysis	202	-		
	PTCA	No dialysis	58,837	-		

Abbreviations: D = death; MI = Q-wave myocardial infarction; CABG = coronary artery bypass grafting; TLR = target lesion revascularization; TVR = target vessel revascularization; CRF = chronic renal failure; ROTA = Rotablator; MACE = death/MI/PTCA/CABG; - = not reported

* Target lesion revascularization

++ Provisional stenting

CARDIAC TRANSPLANT PATIENTS

A. BACKGROUND. Coronary artery disease affects 20-40% of allografts 1-5 years after transplantation, and is the leading cause of death among patients who survive more than one year. Angiographic findings of allograft arteriopathy range from focal stenoses to diffuse involvement of the entire epicardial coronary circulation. Because allograft hearts are denervated, angina pectoris is distinctly uncommon; clinical presentations typically include myocardial infarction, heart failure, or sudden death. Medical therapy consists of risk-factor modification, immunosuppressive and antiplatelet agents, diet, and exercise. Diltiazem[75] and lipid-lowering agents may retard the progression of coronary disease and are uniformly recommended, even in the absence of hyperlipidemia. Limitations of bypass surgery include early problems with wound healing and infection, and late disease progression. Re-transplantation is feasible but is associated with significant postoperative mortality and a 50% recurrence rate.

B. PERCUTANEOUS REVASCULARIZATION (Table 7.14). PTCA, atherectomy, and stents have been applied to small numbers of patients. Combined data show success in 95% and in-hospital mortality in 5%. Results are slightly better with stents.

C. FOLLOW-UP. In a multicenter report,[76] 39% of PTCA patients died or required retransplantation at 19 months, and actuarial survival at 5-years was only 30%. Restenosis rates ranged from 33-55%.

D. CONCLUSIONS. PTCA and stenting can be performed with acceptable success and complication rates in cardiac transplant patients with focal or tubular stenoses, although repeat intervention may be required. Data on restenosis are incomplete.

SILENT ISCHEMIA

A. BACKGROUND. The presence of silent ischemia increases the risk of adverse cardiac events.[45] Findings from the Asymptomatic Cardiac Ischemia Pilot (ACIP) trial suggest that compared to medical therapy alone, revascularization may improve the extent and frequency of exercise-induced ischemia,[80] anginal status, and 1-year survival.[81,82]

B. PTCA. Following successful PTCA, objective evidence of ischemia was alleviated in 53-93% of patients at 3-6 months;[83,84] 3-year total and infarct-free survival was 98% and 96%, respectively.[83]

C. CONCLUSIONS. Elective PTCA on patients with silent ischemia is safe and effective. The ACIP and other ongoing randomized trials will determine whether suppression of silent ischemia by PTCA or bypass surgery improves long-term outcome.

Table 7.14. Coronary Intervention in Cardiac Transplant Patients

Series	Modality	N	Success (%)	Complications (%) D / Q-MI / CABG	Other
Casey[234] (2002)	Stent/PTCA	27	96	- / 0 / 0	1 MI at 13 months and 2 CABG procedures at 5 and 12 months. No difference in restenosis between stent and PTCA groups (41% vs. 53%)
Takano[235] (2002)	Various	35	93	-	Restenosis (44%)
Patel[121] (1997)	PTCA	10	100	-	-
	ROTA	6	100		
	CABG	5	60		
	TMR	1	100		
	CABG/TMR	1	100		
Jain[103] (1997)	Stent	10	100	0	-
Heublein[122] (1997)	Stent	27	100	0 / 0 / -	Restenosis (25%)
Wong[220] (1997)	Stent	12	100	-	Subacute thrombosis (8.3%)
					Allograft survival†
Halle[76] (1995)	PTCA	66	94	8 / - / -	61% at 19 months
	DCA	11	82	18 / - / -	82% at 8 months
	CABG	12	-	33 / - / -	58% at 9 months

Abbreviations: ROTA = Rotablator; TMR = transmyocardial laser revascularization; D = in-hospital death; MI = in-hospital Q-wave myocardial infarction; CABG = emergency coronary artery bypass grafting; - = not reported
† Freedom from death or re-transplantation

* * * * *

REFERENCES

1. Kahn JW, Hartzler GO. Saphenous vein graft angioplasty in a teenager. Am J Cardiol 1990;65:25-260.
2. Mehan V, Urban P, et al. Coronary angioplasty in the young: procedural results and late outcome. J Invas Cardiol 1994;6:202-208.
3. Buffet P, Colasante B, et al. Long-term follow-up after coronary angioplasty in patients younger than 40 years of age. Am Heart J 1994;127:509-513.
4. Kofflard M, van Dombur R, van den Brand M, de Jaegere P. 5-year follow-up of coronary angioplasty in patients aged 35 years or younger. Circulation 1994;88(Part II):I-218.
5. Stone GW, Ligon RW, Rutherford BD, et al. Short-term outcome and long-term follow-up following coronary angioplasty in the young patient: an 8-year experience. Am Heart J 1989;118:873-877.
6. Hannan E, and Burke J. Effect of age on mortality in coronary artery bypass surgery in New York, 1991-1992. Am Heart J 1994;128:1184-91.
7. O'Keefe J, Sutton M, et al. Coronary angioplasty versus bypass surgery in patients >70 years old matched for ventricular function. J Am Coll Cardiol 1994;24:425-430.
8. Peterson ED, Gollis JG, Bebchuk JD, DeLong ER, et al. Chances in mortality after myocardial revascularization in the elderly. The national Medicare experience. Ann Intern Med. 1994;121:919-927.
9. Mick MJ, Simpfendorfer C, et al. Early and late results of coronary angioplasty and bypass in octogenarians. Am J Cardiol 1991;68:1316-1320.
10. Lindsay J, Reddy V, et al. Morbidity and mortality rates in elderly patients undergoing percutaneous coronary transluminal angioplasty. Am Heart J 1994;128:697-702.
11. Burstein S, Sun GW, Hammer JS, Mann JD, et al. Adjusted influence of age and gender on PTCA outcomes and hospital resource consumption. J Am Coll Cardiol 1994;March Special Issue:223A.
12. Jollis JG, Peterson ED, Bebchuk JD, DeLong ER, et al. Coronary angioplasty in 20,006 patients over age 80 in the United States. J Am Coll Cardiol 1995; February Special Issue:47A.
13. Thompson RC, Holmes DR, Grill DR, Bailey KR. Changing outcome of angioplasty in elderly. J Am Coll Cardiol 1996;27:8-14.
14. Little T, Milner M, Lee K, Contantine J, Pichard AD, Lindsay JJ. Late outcome and quality of life following percutaneous transluminal coronary angioplasty in octogenarians. Cathet Cardiovasc Diagn 1993;29:261-266.
15. Foreman DE, Berman AD, McCabe CH, et al. PTCA in the elderly: the "young-old" versus the "old-old". J Am Geriatr Soc 1992;40:19-22.
16. ten Berg J, Bal E, et al. Initial and long-term results of percutaneous transluminal coronary angioplasty in patients 75 years of age and older. Cathet Cardiovasc Diagn 1992;26:165-170.
17. Thompson RC, Holmes DR, Gersh B, Mock MB. Percutaneous transluminal coronary angioplasty in the elderly: early and long-term results. J Am Coll Cardiol 1991;17:1245-1250.
18. Yokoi H, Kimur T, Sawada Y, Nosaka H, et al. Efficacy and safety of Palmaz-Schatz stent in elderly ($\geq$ 75 years old) patients: early and follow-up results. J Am Coll Cardiol 1995; February Special Issue:47A.
19. Fishman RF, Kuntz RE, Carrozza JP, et al. Acute and long-term results of coronary atherectomy in women and the elderly. Circulation (in-press).
20. Movsowitz H, Manginas A, et al. Directional coronary atherectomy can be successfully performed in the elderly. Am J Cardiol 1994;31:261-263.
21. Elliot JM, MacIsaac AI, Lefkovits J, Horrigan MCG, Franco I, Whitlow PL. New coronary devices in the elderly: comparison with angioplasty. Circulation 1994;90:4:I-333.
22. Henson, K. D., J. J. Popma, et al. Comparison of results of rotational coronary atherectomy in three age groups (<70,70 to 79 and >80 years). Am J Cardiol 1993;71:862-864.
23. Weyrens F, Goldberg I, et al. Percutaneous transluminal coronary angioplasty in patients aged >90 years. Am J Cardiol 1994;74:397-398.
24. Santana J, Haft J, LaMarche N, Goldstein J. Coronary angioplasty in patients eighty years of age or older. Am Heart J 1992;124:13-18.
25. Bedotto JB, Rutherford BD, McConahay DR, et al. Results of multivessel percutaneous transluminal coronary angioplasty in persons aged 65 years and older. Am J Cardiol 1991;67:1051-1055.
26. Jackman JD, Navetta FI, Smith JE, et al. Percutaneous transluminal coronary angioplasty in octogenarians as an effective therapy for angina pectoris. Am J Cardiol 1991;116-119.
27. Myler RK, Webb JG, Nguyen KPV, et al. Coronary angioplasty in octogenarians: comparison to coronary bypass surgery. Cathet Cardiovasc Diagn 1991;23:3-9.
28. Jeroudi OM, Kleiman NS, Minor ST,et al. Percutaneous transluminal coronary angioplasty in octogenarians. Ann Intern Med 1990;113:423-428.
29. Rizo-Patron C, Hamad N, Paulus R, et al. Percutaneous transluminal coronary angioplasty in octogenarians with unstable coronary syndromes. Am J Cardiol 1990;66:857-858
30. Rich JJ, Crispino CM, Saporito JJ, et al. Percutaneous transluminal coronary angioplasty in octogenarians. Am J Cardiol 1988;61:457-458.
31. Kern MJ, Deligonoul U, Galan K, et al. Percutaneous transluminal coronary angioplasty in octogenarians. Am J Cardiol 1988;61:457-458.
32. Weyrens EJ, Goldenberg I, Fishman MJ, et al. Percutaneous transluminal coronary angioplasty in patients aged > 90 years. Am J Cardiol 1994;74:397-398.
33. Lerner DJ, Kannel WB. Patterns of coronary heart disease morbidity and mortality in the sexes: a 26-year follow-up of the Framingham population. Am Heart J 1986;111:383-390.
34. Harper R, Kennedy G, DeSanctis R, et al. The incidence and pattern of angina prior to acute myocardial infarction: a study of 577 cases. Am Heart J 1979;97:178-183.
35. Weiner DA, Ryan TJ, McCabe CH, et al. Exercise stress testing: correlations among history of angina, ST-segment

response and prevalence of coronary-artery disease in the Coronary Artery Surgery Study (CASS). N Engl J Med 1979;301:230-235.

36. Stone G, Grines C, Browne K, et al. Comparison of in-hospital outcome in men versus women treated by either thrombolytic therapy or primary coronary angioplasty for acute myocardial infarction. Am J Cardiol 1995;75:987-992.
37. Malenka DJ, O'Connor GAT, Robb J, Kellett M Jr., et al. Is female gender a risk factor for adverse outcomes following PTCA? Circulation 1995;92:I-437.
38. Weintraub WS, Wenger NK, Kosinski AS, et al. Percutaneous transluminal coronary angioplasty in women compared with men. J Am Coll Cardiol 1994;24:81-90.
39. Arnold A, Mick M, et al. Gender differences for coronary angioplasty. Am J Cardiol 1994;74:18-21.
40. Cavero PG, O'Keefe JH, McCallister B, Cochran V, et al. Effect of gender on early and longterm outcome after multiple vessel revascularization with coronary bypass surgery or balloon angioplasty. J Am Coll Cardiol 1994;February Special Issue:351A.
41. Kelsey S, James M, Holubkov AL, Holubkov R. Results of percutaneous transluminal coronary angioplasty in women. 1985-1986 National Heart, Lung, and Blood Institute's Coronary Angioplasty Registry. Circulation 1993;87:720-727.
42. Bell MR, Holmes DR, Berger PB, et al. The changing in-hospital mortality in women undergoing percutaneous transluminal coronary angioplasty. JAMA 1993;269:2091-2095.
43. Kahn JK, Rutherford BD, McConahay DR, et al. Comparison of procedural results and risks of coronary in men and women for conditions other than acute myocardial infarction. Am J Cardiol 1992;69:1241-1242.
44. Bell M, Grill D, Garratt K, Berger P, Gersh B, Holmes D. Long-term outcome of women compared with men after successful coronary angioplasty. Circulation 1995;91:2876-2881.
45. Erne P, Evequoz D, Zuber M, Yoon S, Burckhardt D. Swiss interventional study on silent ischemia II (SWISSI II): Study design and preliminary results. Circulation 1995;92:I-80.
46. Baumbach A, Bittl J, Fleck E, et al. Acute complications of excimer laser coronary angioplasty: A detailed analysis of multicenter results. J Am Coll Cardiol 1994;23:1305-1313.
47. Combs WG, Rothenberg MD, Burke JA, et al. Gender does not influence the morbidity and mortality associated with diagnostic and interventional cardiac catheterization procedures. J Am Coll Cardiol 1994;February Special Issue:401A.
48. Dean LS, Voorhees WD, Sutor C, Roubin GS. Female gender: A risk factor for complications following intracoronary stenting? A Cook Multicenter Registry Report. Circulation 1994;90:4:I-620.
49. Ellis, S., J. Popma, et al. Relation of clinical presentation, stenosis morphology, and operator technique to the procedural results of rotational atherectomy-facilitated angioplasty. Circulation 1994;89:882-892.
50. Bowling BA, May M, Lichtenberg A, et al. Clinical and angiographic outcome of new interventional devices in men and women. Circulation 1994;88:I-448.
51. Casale PN, Marco J, Warth D, Buchbinder M. Women have a lower success rate and higher complication rate with percutaneous rotational atherectomy. Circulation 1994;88:I-448.
52. Henson KD, Popma JJ, Satler LF, Kent KM, et al. Late clinical outcome after new device angioplasty in women. J Am Coll Cardiol 1993;21:2:233A.
53. Mehta S, Margolis JR, Bejarano J, et al. Acute and long-term results with new devices do not demonstrate significant gender differences: Results from the NACI Registry. Circulation 1994;88:I-448.
54. Movsowitz H, Emmi R, Manginas A, et al. Does female gender affect the success rate and outcome of directional coronary atherectomy? Circulation 1994;88:I-448.
55. Sempos C, Cooper R, Kovear MD, McMullen M. Divergence of the recent trends in coronary mortality for the four major race-sex groups in the United States. Am J Public Health 1988;78:1422-1427.
56. Maynard C, Fisher LD, Passamani ER. Survival of black persons compared with white persons in the Coronary Artery Surgery Study (CASS). Am J Cardiol 1987;60:513-518.
57. Scott, N, Kelsey S, et al. Percutaneous transluminal coronary angioplasty in African-American patients (The National Heart, Lung, and Blood Institute 1985-1986 Ppercutaneous Transluminal Coronary Angioplasty Registry). Am J Cardiol 1994;73:1141-1146.
58. Chuang YC, Merritt AJ, Popma JJ, Bucher TA, et al. Do racial differences affect outcome after new device angioplasty? J Am Coll Cardiol 1994;February Special Issue:301A.
59. Scott NA, Capers Q, Weintraub WS, Liberman HA, et al. In hospital and long term outcome of PTCA in African-American women and men. Circulation 1994;88:I-448.
60. The BARI Investigators. Comparison of coronary bypass surgery with angioplasty in patients with multivessel disease. N Engl J Med 1996;335:217.
61. Uthoff K, Schuerholz T, Mugge A, Schaefers JH, et al. Coronary revascularization in renal patients—coronary angioplasty (PTCA) or coronary artery bypass grafting (CABG)? Circulation 1995;92:I-643.
62. Stein B, Weintraub W, et al. Influence of diabetes mellitus on early and late outcome after percutaneous transluminal coronary angioplasty. Circulation 1995;91:979-989.
63. Faxon DP, Kip KE, Currier JW, Yeh W, et al. Diabetics have a significantly poorer eight-year outcome after angioplasty. Circulation 1995;92:I-76.
64. Tan K, Sulke N, et al. Clinical and lesion morphologic determinants of coronary angioplasty success and complications: Current experience. J Am Coll Cardiol 1995;25:855-65.
65. Bailey WL, Westerhausen DR, Rutherford BD, McConahay DR, et al. Characteristics and long-term outcomes of diabetic patients presenting for coronary angioplasty. J Am Coll Cardiol 1993;21:2:273A.
66. Carrozza J, Kuntz R, et al. Angiographic and clinical outcome of intracoronary stenting: Immediate and long-term results from a large single-center experience. J Am Coll Cardiol 1992;20:328-337.
67. Rensing BJ, Hermans WR, Strauss BH, Serruys PW. Regional differences in elastic recoil after percutaneous

transluminal coronary angioplasty: A quantitative angiographic study. J Am Coll Cardiol 1991;17:34B.

68. Weintraub WS, Kosinski AS, Brown CL, King SB III. Can restenosis after coronary angioplasty be predicted from clinical variables? J Am Coll Cardiol 1993;21:6-14.
69. Levin GN, Leya F, Keeler G, Berdan LG, Jacobs AK. The impact of diabetes mellitus on restenosis following directional coronary atherectomy and PTCA: A report from CAVEAT-1. Circulation 1994;90:4:I-652.
70. Faxon DP. Effect of high dose angiotensin-converting enzyme inhibition on restenosis: Final results of the MARCATOR study, a multicenter, double-blind, placebo-controlled trial of cilazapril. J Am Coll Cardiol 1995;2:362-9.
71. Bourassa MG, Lesperance J, Eastwood C, et al. Clinical, physiologic, anatomic and procedural factors predictive of restenosis after percutaneous transluminal coronary angioplasty. J Am Coll Cardiol 1991;18:368-76.
72. Kahn JK, Rutherford BD, McConahay DR, et al. Short and longterm outcome of percutaneous transluminal coronary angioplasty in chronic dialysis patients. Am Heart J 1990;119:484-489.
73. Reusser LM, Osborn LA, White HJ, et al. Increased morbidity after coronary angioplasty in patients on chronic hemodialysis. Am J Cardiol 1994;73:965-6.
74. Ahmed WH, Pashos CL, Ayanian JZ, Bittle JA. 30-day and one-year mortality in hemodialysis patients undergoing coronary revascularization: results from a national cohort. Circulation 1995;92:I-75.
75. Schroeder J, Gao SZ, et al. A preliminary study of diltiazem in the prevention of coronary artery disease in heart-transplant recipients. N Engl J Med 1993;328:164-170.
76. Halle A, DiSciascio G, et al. Coronary angioplasty, atherectomy and bypass surgery in cardiac transplant recipients. J Am Coll Cardiol 1995;26:120-8.
77. Swan JW, Norell M, Yacoub M, et al. Coronary angioplasty in cardiac transplant recipients. Eur Heart J 1993;14:65-70.
78. Sandhu JS, Uretsky BF, Reddy S, et al. Potential limitations of percutaneous transluminal coronary angioplasty in heart transplant recipients. Am J Cardiol 1992;69:1234-1237.
79. Mullins PA, Shapiro LM, Aravot DA, et al. Experience of percutaneous transluminal coronary angioplasty in orthotopic transplant recipients. Eur Heart J 1991;12:1205-1207.
80. Chaitman B, Stone P, Knatterud G, et al. Asymptomatic cardiac ischemia pilot (ACIP) study: impact of anti-ischemia therapy on 12-week rest electrocardiogram and exercise test outcomes. J Am Coll Cardiol 1995;26:585-593.
81. Rogers W, Bourassa M, Andrews T, et al. Asymptomatic cardiac ischemia pilot (ACIP) study: outcome at 1-year for patients with asymptomatic cardiac ischemia randomized to medical therapy or revascularization. J Am Coll Cardiol 1995;26:594-605.
82. Bourassa M, Pepine C, Forman S, et al. Asymptomatic cardiac ischemia pilot (ACIP) study: effects of coronary angioplasty and coronary bypass graft surgery on recurrent angina and ischemia. J Am Coll Cardiol 1995;26:606-614.
83. Knatterud GL, Bourassa MG, Pepine CJ, et al. Effects of treatment strategies to suppress ischemia in patients with coronary artery disease: 12-week results of the Asymptomatic Cardiac Ischemia Pilot (ACIP) study. J Am Coll Cardiol 1994;24:11-20.
84. Stone GW, Spaude D, Ligon RW, et al. Usefulness of PTCA in alleviating silent myocardial ischemia in patients with absent or minimal painful myocardial ischemia. Am J Cardiol 1989;64:560-564.
85. Lefevre T, Morice MC, Labrunie B, et al. Coronary stenting in elderly patients. Results from the stent without coumadin French Registry. J Am Coll Cardiol 1996;27:252A.
86. Hermiller J, Fry E, Berkompas D, et al. Effect of gender on acute outcome following intracoronary bailout stenting. J Invas Cardiol 1996;8.
87. Thompson RC, Holmes DR, Grill DE, Mock MB, Bailey KR. Changing outcome of angioplasty in the elderly. J Am Coll Cardiol 1996;27:8-14.
88. Laster SB, Rutherford BD, Giorgi LV, et al. Results of direct PTCA in octogenarians. Am J Cardiol 1996;77:10-13.
89. Taylor HA, Mickel MC, et al. Long-term survival of African Americans in the Coronary Artery Surgery Study (CASS). J Am Coll Cardiol 1997;29:2:358-64.
90. Mullany CJ, Brooks M, et al. Outcome of patients $\geq$ 65 years undergoing coronary revasculariation: A report from Bypass Angioplasty Revascularization Investigation (BARI). J Am Coll Cardiol 1997;29(Suppl. A):73A.
91. Mehran R, Bucher TA, et al. Coronary stenting in women: Early in-hospital and long-term clinical outcomes. J Am Coll Cardiol 1997;29(Suppl. A):454A.
92. Nasser TK, Fry ETA, et al. Coronary stenting in women: Clinical outcomes are equivalent to men. J Am Coll Cardiol 1997;29(Suppl. A):71A.
93. Lansky AJ, Kennard E, et al. Does gender affect outcome in the new approaches to coronary intervention (NACI) registry. J Am Coll Cardiol 1997;29(Suppl. A):459A.
94. Hasdai D, Bell M, et al. Outcome $\geq$ 10 years after successful percutaneous transluminal coronary angioplasty. Am J Cardiol 1997;79:1005-1011.
95. Levine GN, Jacobs AK, et al. Impact of diabetes mellitus on percutaneous revascularization (CAVEAT-I). Am J Cardiol 1997;79:748-755.
96. Abizaid A, Kornowski R, Mintz GS, et al. The influence of diabetes mellitus on acute and late clinical outcomes following coronary stent implantation. J Am Coll Cardiol 1998;32:584-9.
97. Elezi S, Schuhlen H, et al. Stent placement in diabetic versus non-diabetic patients. Six-month angiographic follow-up. J Am Coll Cardiol 1997;29(Suppl. A):188A.
98. Savage MP, Fischman DL, et al. Coronary intervention in the diabetic patient: Improved outcome following stent implantation versus balloon angioplasty. J Am Coll Cardiol 1997;29(Suppl. A):188A.
99. Yokoi H, Nosaka H, et al. Coronary stenting in the diabetic patients: Early and follow-up results. J Am Coll Cardiol 1997;29(Suppl. A):455A.
100. Chang GL, Ghazzal ZMB, et al. Coronary revascularization in patients on chronic dialysis. J Am Coll Cardiol 1997;29(Suppl. A):180A.
101. Gradaus F, Schoebel FC, et al. High rate of restenosis following coronary angioplasty in patients with chronic renal failure. J Am Coll Cardiol 1997;29(Suppl. A):418A.

102. Nasser TK, Fry ETA, et al. In-hospital and interim clinical outcomes of coronary stents in the elderly. J Am Coll Cardiol 1997;29(Suppl. A):71A.
103. Jain SP, Zhang S, et al. Is coronary stenting a better option in palliative treatment of cardiac allograft vasculopathy? J Am Coll Cardiol 1997;29(Suppl. A):28A.
104. Jacobs AK, Kelsey SF, et al. Improved outcome for women undergoing coronary revascularization: A report from the bypass angioplasty revascularization investigation (BARI). Circulation 1996;94:I-205.
105. Van Belle E, Bauters C, Hubert E, et al. Restenosis rates in diabetic patients. A comparison of coronary stenting with balloon angioplasty in native coronary vessels. Circulation 1997;96:1454-60.
106. Ellis CJ, French JK, White HD, Ormiston JA, Whitlock RML, Webster MWI. Results of percutaneous coronary angioplasty in patients < 40 years of age. Am J Cardiol 1998;82:135-139.
107. Bage MD, Bauman WB, Gupta R, Berkovitz KE, Ormond AP Jr., Grigera F, Josephson RA. Coronary stenting in the elderly: Longitudinal results in a wide spectrum of patients treated with a new and more practical approach. Cathet Cardiovasc Diagn. 1998;44:397-404.
108. De Gregorio J, Kobayashi Y, Albiero R, Reimers B, Di Mario C, Finci L, Colombo A. Coronary artery stenting in the elderly: Short-term outcome and long-term angiographic and clinical follow-up. J Am Coll Cardiol 1998;32:577-583.
109. Hussain JMA, Estrada AQ, Kogan A, Dadkhah S, Foschi AA. Trends in success rate after percutaneous transluminal coronary angioplasty in men and women with coronary artery disease. Am Heart J 1997;134:19-27.
110. Whittle J, Conigliaro J, Good CB, Joswiak M. Do patient preferences contribute to racial differences in cardiovascular procedure use? J Gen intern Med 1997;12:267-273.
111. Gillum RF, Gillum BS, Francis CK. Coronary revascularization and cardiac catheterization in the United States: Trends in racial differences.
112. Ferguson JA, Tierney WM, Westmoreland GR, Mamlin LA, Segar DS, Eckert GJ, Zhou ZH, Martin DK, Weinberger M. Examination of racial differences in management of cardiovascular disease. J Am Coll Cardiol 1997;30:1707-1713.
113. Sedlis SP, Fisher VJ, Tice D, Esposito R, Madmon L, Sterinberg EH. Racial differences in performance of invasive cardiac procedures in a department of Veterans Affairs Medical Center. J Clin Epidemiol 1997;50:899-901.
114. Gowda MS, Vack JL, Hallas D. One-year outcomes of diabetic versus nondiabetic patients with non-Q-wave acute myocardial infarction treated with percutaneous transluminal coronary angioplasty. Am J Cardiol 1998;81:1067-1071.
115. Weintraub WS, Stein B, Kosinski A, et al. Outcome of coronary bypass surgery versus coronary angioplasty diabetic patients with multivessel coronary artery disease. J Am Coll Cardiol 1998;31:10-19.
116. Barsness GW, Peterson ED, Ohman EM, Nelson CL, DeLong ER, Reves JG, Smith PK, Anderson D, Jones RH, Mark DB, Califf RM. Relationship between diabetes mellitus and long-term survival after coronary bypass and angioplasty. Circulation 1997;96:2551-2556.
117. Chaitman BR, Rosen AD, Williams DO, Bourassa MG, Aguirre FV, Pitt B, Rautaharju PM, Rogers WJ, Sharaf B, Attubato M, Hardison RM, Srivatsa S, Kouchoukos NT, Stocke K, Sopko G, Detre K, Frye R. Myocardial infarction and cardiac mortality in the Bypass Angioplasty Revascularization Investigation (BARI) randomized trial. Circulation 1997;96:2162-2170.
118. The BARI Investigators. Influence in diabetes in 5-year mortality and morbidity in a randomized trial comparing CABG and PTCA in patients with multivessel disease. The Bypass Angioplasty Revascularization Investigation (BARI). Circulation 1997;96:1761-1769.
119. Simsir, et al. A comparison of coronary artery bypass grafting and percutaneous transluminal coronary angioplasty in patients on hemodialysis. Cardiovasc Surg 1998;6:500-505.
120. Koyanagi T, Nishida H, Kitamura M, Endo M, Koyanagi H, Kawaguchi M, Magosaki N, Sumiyoshi T, Hosoda S. Comparison of clinical outcomes of coronary artery bypass grafting and percutaneous transluminal coronary angioplasty in renal dialysis patients. Ann Thorac Surg 1996;61:1793-6.
121. Patel VS, et al. Revascularization procedures in patients with transplant coronary artery disease. Eur J Cardiothorac Surg 1997;11:895-901.
122. Heublein B, Pethig K, MaaB C, Wahlers T, Haverich A. Coronary artery stenting in cardiac allograft vascular disease. Am Heart J 1997;134:930-938.
123. Adamain M, De Gregorio J, Kobayashi N, Corvaja N, Di Francesco L, Albiero R, Moussa I, Vaghetti M, Di Mario C, Moses J, Colombo A. Coronary interventions: Is being a woman a risk factor? J Am Coll Cardiol 1999;33[suppl A]:25A.
124. Van Belle E, Abolmaali K, Bauters C, Mc Fadden EP, Lablanche JM, Bertrand ME. Restenosis, late vessel occlusion and left ventricular function 6 months after balloon angioplasty in diabetics patients. J Am Coll Cardiol 1999;33[suppl A]:25A.
125. Mattos L, Sousa JE, Stone G, Morice MC, Boura J, O'Neill W, Cox D, Garcia E, Madonna O, Grines C. Primary stentings versus PTCA in diabetic patients with acute myocardial infarction: Six months results of the stent PAMI trial. J Am Coll Cardiol 1999;33[suppl A]:33A.
126. De Gregorio J, Kobayashi N, Adamian M, Corvaja N, Moussa I, Reimers B, Linci L, DiFrancesco L, Albiero R, Di Mario C, Moses J, Colombo A. A comparison of diabetics with restenosis to diabetics without restenosis. J Am Coll Cardiol 1999;33[suppl A]:82A.
127. Wong SC, Papadakos S, Rosenberg C, O'Brien RJ, Gustafson G. Are there clinical and procedural outcome differences between African and White American undergoing percutaneous coronary interventions? J Am Coll Cardiol 1999;33[suppl A]:82A.
128. Al-Rashdan IR, Rankin JM, Elliott TG, Wong CW, Carere RG, Hilton JD, Henderon MA, Hayden RI, Spinelli JJ, Buller CE. Glycemic control and major adverse cardiac events after PTCA in patients with diabetes mellitus. J Am Coll 1999;33[suppl A]:97A.
129. Bhaskaran A, Siegel R, Barker B, Underwood P, Breisblatt W, Nuttall A, Swanson D, Vermillion J, Santos P. Stenting during coronary intervention improves procedural and long-

term clinical outcomes in diabetics. J Am Coll Cardiol 1999;33[suppl A]:97A.

130. Lansky AJ, Mehran R, Popma JJ, Hanzel G, Kent HM, Stone GW, Breedy F, Tepordei G, Burwell N, Pichard A, Satler LF, Leon MB. Insulin treatment of diabetic women predicts a worse outcome after intracoronary stenting. Clinical results of 564 consecutive patients. J Am Coll Cardiol 1999;33[suppl A]:97A.
131. Alonso JJ, Fernandez-Aviles F, Duran JM, Ramos B, Serrado A, Garcimartin I, de la Fuente L, Munoz JC, Garci-Moran E. Influence of diabetes mellitus on the initial and long-term outcome of patients treated with coronary stenting. J Am Coll Cardiol 1999;33[suppl A]:98A.
132. Gencbay M, Degertekin M, Dinar I, Turan, F. Coronary stent implantation in patients with non-insulin dependent diabetes mellitus. J Am Coll Cardiol 1999;33[suppl A]:98A.
133. Gruberg L, Mehran R, Lansky A, Pichard AD, Peterson M, Walters CT, Murphy M, Laird JR, Satler LF, Kent KM, Stone GW, Leon MB. Stents do not improve acute and long-term clinical outcomes in patients with chronic renal failure and coronary disease. J Am Coll Cardiol 1999;33[suppl A]:28A.
134. Gradaus F, Iven K, Schoebel FC, Leschke M, Heering P, Grabensee B, Strauer BE. Comparison of coronary bypass surgery versus coronary angioplasty in patients with chronic renal failure. J Am Coll Cardiol 1999;33[suppl A]:97A.
135. Bartorelli AL, Montorsi P, Fabbiochi F, Trabattoni D, Galli S, Granchini L, Lavarra F, Ravagnani P, Cozzi S, Loaldi A. Does coronary stenting eliminate gender difference in percutaneous revascularization outcome? Circulation 1998:98[suppl I]:I-77.
136. Weintraub WS, Thompson TD, Ghazzal ZMB, Douglas JS, Morris DC, King SB. Does gender influence the outcome of coronary stenting? Circulation 1998:98[suppl I]:I-77.
137. Chauhan MS, Schmidt JM, Cutlip D. Outcome of stenting in the aged. Circulation 1998:98[suppl I]:I-78.
138. Schofe J, Rau T, Schloter M, Mathey DG. Angiographic outcome after stenting of coronary lesions in diabetic versus non-diabetic patients: A matched comparison. Circulation 1998:98[suppl I]:I-78.
139. Marso SP, Ellis SG, Bhatt DL, Sapp SK. The stenting in diabetics debate: Insight from the large GUSTO IIb exexperience with extended follow-up. Circulation 1998:98[suppl I]:I-78.
140. Rankin JM, Bullre CE, Al-Rashdan IR, Henderon MA, Hilton CD, Hayden RI, Carere RG, Spinelli JJ. Coronary angiolasty in diabetics: have outcomes improved in the stent era? Circulation 1998:98[suppl I]:I-79.
141. Carrozza JP, Neimann D, Kuntz RE, Cutlip D. Diabetes mellitus is associated with adverse 6-month angiographic and clinical outcome following coronary stenting. Circulation 1998:98[suppl I]:I-79.
142. Bhatt DL, Marso SP, Lincoff MA, et al. Abciximab Reduces Mortality in Diabetics Following Percutaneous Coronary Intervention. J Am Coll Cardiol 2000:35;931-928.
143. Moraes DL, Leopold JA, Cupples A, Moxey C, Ryan TJ, Jacobs AK. Diabetes does not influence outcome of percutaneous coronary intervention. Circulation 1998:98[suppl I]:I-147.
144. Holmes DR, Rihal CS, Garratt KN, Terzic A, Grill D. Relationship between diabetic glycemic control and outcome after percutaneous coronary intervention. Circulation 1998:98[suppl I]:I-148.
145. Bruno J, Feldrappe A, Niederst PN. Influence of current- and long-term metabolic state of PTCA-outcome in diabetics. Circulation 1998:98[suppl I]:I-148.
146. Rubenstein M, Harrell L, Bazari H, Palacios IF. Are patients with renal failure good candidates for percutaneous coronary revascularization in the new device era? Circulation 1998:98[suppl I]:I-148.
147. Bell MR, Grill DE, Garratt KN, Berger PB, Gersh BJ, Holmes DR Jr. Long-term outcome of women compared with men after successful coronary angioplasty. Circulation 1995;91:2876-2881.
148. Kelsey SF, James M, Holubkov AL, Holubkov R, Cowley MJ, Detre KM. Results of percutaneous transluminal coronary angioplasty in women. 1985-1986 National Heart, Lung, and Blood Institute's Coronary Angioplasty Registry. Circulation 1993;87:720-727.
149. Pajunen P, Nieminen MS, Taskinen MR, Syvanne M. Quantitative comparison of angiographic characteritics of coronary artery disease in patients with noninsulin-dependent diabetes mellitus compared with matched nondiabetic control subjects. Am J Cardiol 1997;80:550-556.
150. Kornowski R, Mintz GS, Kent KM, Pichard AD, Satler LF, Bucher TA, Hong MK, Popma JJ, Leon MB. Increased restenosis in diabetes mellitus after coronary interventions is due to exaggerated intimal hyperplasia. A serial intravascular ultrasound study. Circulation 1997;95:1366-1369.
151. Fetters JK, Peterson ED, Shaw LJ, Newby K, Califf RM. Sex-specific differences in coronary artery diseases risk factors, evaluation, and treatment: Have they been adequately evaluated? Am Heart J131(4):796-813.
152. Van Belle E, Bauters C, Hubert E, Bodart JC, Abolmaali K, Meurice T, McFadden EP, Lablanche, JM, Bertrand ME. Restenosis rates in diabetic patients. A comparison of coronary stenting and balloon angioplasty in native coronary vessels. Circulation 1997;96:1454-1460.
153. Silva JA, White CJ. Diabetes mellitus as a risk factor for development of vulnerable (unstable) coronary plaque: A review of possible mechanisms. J Interven Cardiol 1998;11:19-36.
154. Gaxiola E, Vlietstra RE, Browne KF, Brenner AS, Ebersole DG, Roman L, Weekes TT, Kerensky RA. Is the outcome of coronary stenting worse in elderly patients? J Interven Cardiol 1998;11:37-40.
155. Gum PA, O'Keefe JH, Borkon AM, Spertus JA, Bateman TM, McGraw JP, Sherwant K, Vacek J, McCallister BD. Bypass surgery versus coronary angioplasty for revascularization of treated diabetic patients. Circulation 1997;96:[suppl II]:II-7-II10.
156. Jacobs AK, Kelsey SF, Yeh W, et al. Documentation of decline in morbidity in women undergoing coronary angioplasty (A report from the 1993-1994 NHLBI Percutaneous Transluminal Coronary Angioplasty Registry). Am J Cardiol 1997;80:979-984.
157. Lau KW, Ding ZP, Johan A, Lim YL. Midterm angiographic outcome of single-vessel intracoronary stent placement in diabetic versus nondiabetic patients: A matched comparative

study. Am Heart J 1998;136:150-155.
158. Aoki I, Shimoyama K, Oaki N, et al. Platelet-dependent thrombin generation in patients with diabetes mellitus: Effects of glycemic control on coagulability in diabetes. J Am Coll Cardiol 1996;27:560-566.
159. Kleiman NS, Lincoff M, Kereiakes DJ, et al. Diabetes mellitus, glycoprotein IIb/IIIa blockade, and heparin. Evidence for a complex interaction in a multicenter trial. Circulation 1998;97:1912-1920.
160. Marso SP, Lincoff AM, Ellis SG, et al. Optimizing the percutaneous interventional outcomes for patients with diabetes mellitus: Results of the EPISTENT (Evaluation of Platelet IIb/IIIa Inhibitor for Stenting Trial) diabetic substudy. Circulation 1999;100:2427-2484
161. LeFeuvre C, Dambrin G, Helft G, et al. Comparison of clinical outcome following coronary stenting or balloon angioplasty in dialysis versus non-dialysis patients. Am J Cardiol 2000;85:1365-1368.
162. Laakso M. Benefits of strict glucose and blood pressure control in Type 2 Diabetes: Lessons from the UK Prospective Diabetes Study. Circulation 1999;99:461-462.
163. Marso SP, Ellis SG, Tuzcu EM, et al. The importance of proteinuria as a determinant of mortality following percutaneous coronary revascularization in diabetics. J Am Coll Cardiol 1999;33:1269-77).
164. Detre KM, Guo P, Holubkov R, et al. Coronary revascularization in diabetic patients: A comparison of the randomized and observational components of the Bypass Angioplasty Revascularization Investigation (BARI). Circulation 1999;99:633-640.
165. Gowda SM, Vacek JL, Hallas D. Gender-related risk factors and outcomes for non-Q wave myocardial infarction patients receiving in-hospital PTCA. J Invas Cardiol 1999;11:121-126.
166. Azar RR, Waters DD, McKay RG, et al. Short- and medium-term outcome differences in women and men after primary percutaneous transluminal mechanical revascularization for acute myocardial infarction. Am J Cardiol 2000;85:675-679.
167. Vaccarino V, Parsons L, Every NR, et al. Sex based differences in early mortality after myocardial infarction. N Engl J Med 1999;341:217-25.
168. Gan SC, Beaver SK, Houck PM, et al. Treatment of acute myocardial infarction and 30-day mortality among women and men. N Engl J Med 2000;343:8-15.
169. Tan E, van der Meer J, Jan de Kam P. et al. Worse clinical outcome but similar graft patency in women versus men one year after coronary artery bypass graft surgery owing to an excess of risk factors in women. J Am Coll Cardiol 1999;34:1760-8.
170. Cho L, Topol EJ, Balog C. et al. Clinical benefit of glycoprotein IIb/IIIa blockade with abciximab is independent of gender: Pooled analysis from EPIC, EPILOG, and EPISTENT trials. J Am Coll Cardiol 2000;36:381-6.
171. Detre KM, Lombardero MS, Brooks MM, et al. The effect of previous coronary artery bypass surgery on the prognosis of patients with diabetes who have acute myocardial infarction. N Engl J Med 2000;342:989-97.
172. Hammoud T, Tanguay J, Bourassa MG. Management of coronary artery disease therapeutic options in patients with diabetes. J Am Coll Cardiol 2000;36:355-65.
173. Marso SP, Ellis SG, Gurm HS, et al. Proteinuria is a key determinant of death in patients with diabetes after isolated coronary artery bypass grafting. Am Heart J 2000;139:939-44.
174. Devereux RB, Roman MJ, Paranicas M, et al. Impact of diabetes on cardiac structure and function: The strong heart study. Circulation 2000;101:2271-2276.
175. Mak K, Topol EJ. Emerging concepts in the management of acute myocardial infarction in patients with diabetes mellitus. J Am Coll Cardiol 2000;35:563-8.
176. Moreno PR, Fallon JT, Murcia AM, et al. Tissue characteristics of restenosis after percutaneous transluminal coronary angioplasty in diabetic patients. J Am Coll Cardiol 1999;34:1045-9.
177. Joseph T, Fajadet J, Jordan C. et al. Coronary stenting in diabetics: Immediate and mid-term clinical outcome. Cathet Cardiovasc Intervent 1999;47:279-284.
178. Schofer J, Schluter M, Rau, et al. Influence of treatment modality on angiographic outcome after coronary stenting in diabetic patients: A controlled study. J Am Coll Cardiol 2000;35:1554-9.
179. Gaxiola E, Vlietstra RE, Brenner AS, et al. Diabetes and multiple stents independently double the risk of short-term revascularization. J Interven Cardiol 2000;13:87-91.
180. Hasdai D, Granger CB, Srivatsa SS, et al. Diabetes mellitus and outcome after primary coronary angioplasty for acute myocardial infarction: Lessons from the GUSTO-IIb angioplasty substudy. J Am Coll Cardiol 2000;35:1502-12.
181. Silva JA, Ramee SR, White CJ, et al. Primary stenting in acute myocardial infarction: Influence of diabetes mellitus in angiographic results and clinical outcome. Am Heart J 1999;138:446-55.
182. Antoniucci D, Valenti R, Santoro GM, et al. Systematic primary angioplasty in octogenarian and older patients. Am Heart J 1999;138:670-4.
183. Baradat K, Wilkinson P, Deaner A, et al. How should age affect management of acute myocardial infarction? A prospective cohort study. Lancet 1999;353:955-59.
184. Berger AK, Radford MJ, Wang Y, Krumholz HM. Thrombolytic therapy in older patients. J Am Coll Cardiol 2000;36:366-74.
185. Holmes DR, White HD, Pieper KS, et al. Effect of age on outcome with primary angioplasty versus thrombolysis. J Am Coll Cardiol 1999;33:412-9.
186. Alfonso F, Azcona L, Perez-Vizcayna MJ, et al. Initial results and long-term clinical and angiographic implications of coronary stenting in elderly patients. J Am Coll Cardiol 1999;149:1483-87.
187. Pliam MB, Zapolanski A, Ryan CJ, et al. Recent improvement in results of coronary bypass surgery in octogenarians. J Invas Cardiol 1999;11:281-289.
188. Wennberg DE, Malenka DJ, Sengupta A, et al. Percutaneous transluminal angioplasty in the elderly: Epidemiology, clinical risk factors, and in-hospital outcomes. Am Heart J 1999;137:639-45.
189. Gravina Taddei CF, Weintraub WS, Douglas JS, et al. Influence of age on outcome after percutaneous transluminal coronary angioplasty. Am J Cardiol 1999;84:245-251.

190. Foody JM, Balog C, Cho L, et al. Older women benefit from balloon PTCA rather than stenting when combined with IIb/IIIa anti-platelet therapy: A gender specific treatment interaction from EPISTENT. J Am Coll Cardiol 35:12A.
191. Alexander KP, Malenka DJ, Hannan EL, et al. Outcomes of PCI in the aged: Results from 6 large registries. Circulation 2000;102:II-642.
192. Lindeboom WK, Disco CM, Unger F, et al. Comparison of effectiveness and cost effectiveness of CABG versus percutaneous intervention in patients with multivessel disease by age. Circulation 2000;102:II549.
193. Villareal RP, Lee V, Elayda M, Wilson JM. Survival after coronary artery bypass surgery or coronary stenting in patients with diabetes mellitus. Circulation 2000;102:II549.
194. Dangas G, Kobayashi Y, D'Agate D, et al. Long term results after multivessel stenting in diabetic patients. Circulation 2000;102:II-194.
195. Dangas G, Feldman D, D'Agate D, et al. Impact of race on clinical outcome after percutaneous coronary interventions: Results in 6945 patients. Circulation 2000;102II-479.
196. Sharma SK, Cheema AM, Andrews P, et al. Current status of percutaneous coronary intervention (PCI) in patients with chronic renal failure on hemodialysis. Circulation 2000;102:II-480.
197. Thompson TD, Veledar E, Zhang Z, et al. PTCA outcomes among very elderly patients during the stent era: Contemporary results from the national cardiovascular network (NCN). Circulation 2000;102:II-480.
198. Ang PCH, Harper RW, Meredith IT, et al. Angioplasty in women: A re-look into their clinical success and complications. J Am Coll Cardiol 2000;33:71A.
199. Vakili BA, Brown DL. Influence of gender on in-hospital outcomes of patients undergoing primary percutaneous transluminal coronary angioplasty for acute myocardial infarction; New York State experience. J Am Coll Cardiol 2000;35:72A.
200. Mattos L, Grines C, Sousa JE, et al. One year follow-up after primary coronary interventions for acute myocardial infarction in diabetic patients: STENT-PAMI trial results. J Am Coll Cardiol 2000;35:72A.
201. Wong SC, Papadakos S, Rosenberg C, et al. The impact on diabetes mellitus on in-hospital clinical outcomes post-angioplasty. J Am Coll Cardiol 2000;35:72A.
202. Beygui F, Metzger JP, Le Feuvre C, et al. Coronary angioplasty with provisional stenting in dialysis patients: In-hospital and 6 month outcomes. J Am Coll Cardiol 2000;35:202A.
203. Mehran R, Dangas G, Gruberg L, et al. The detrimental impact of chronic renal insufficiency and diabetes mellitus on late prognosis after percutaneous coronary interventions. J Am Coll Cardiol 2000;35:203A.
204. Pereira CF, Bernardi V, Martinez J, et al. Diabetic patients with multivessel disease treated with percutaneous coronary revascularization had similar outcome than those treated with surgery: One year follow up results from two Argentine randomized studies (ERACI-ERACI II). J Am Coll Cardiol 2000;35:3A.
205. Lucas FL, Mc Grath PD, Malenka DJ, et al. Long term survival following CABG and PTCA in the elderly: A study of 4993 patients in northern New England. J Am Coll Cardiol 2000;35:219A.
206. Dambrin G, LeFeuvre C, Metzger J-P, et al. Comparison of coronary stenting in hemodialysis and non-hemodialysis patients. J Am Coll Cardiol 1999;33:92A.
207. The BARI Investigators. Seven-year outcome in the Bypass Angioplasty Revascularization Investigation (BARI) by treatment and diabetic status. J Am Coll Cardiol 2000;35:1122-9.
208. Kobayashi Y, Dangas G, Mehran R, et al. Stenting elderly patients in the new millennium: Results in the year 2000. J Am Coll Cardiol 2001;1189(27):52A.
209. Dangas G, Mehran, Lansky AJ, et al. Gender and racial differences in clinical outcomes after percutaneous coronary interventions. J Am Coll Cardiol 2001;37(2):15A.
210. Moussa I, Colombo A, DiMario C, et al. Long-term outcome of patients with versus without diabetes mellitus in the DESTINI trial. J Am Coll Cardiol 2001;37(2):65A.
211. Stuckey, Grines CL, Tcheng, et al. Does stenting and glycoprotein IIb/IIa receptor blockade improve the prognosis of diabetics undergoing primary angioplasty in acute myocardial infarction: The CADILLAC trial. J Am Coll Cardiol 2001;838(2):342A.
212. Abizaid A, Dangas G, Mehran R, et al. One-year results after multivessel stenting in diabetic vs. non-diabetic patients. J Am Coll Cardiol 2001;860(4):68A.
213. Whang W, Bigger T. Diabetes and outcomes of coronary artery bypass graft surgery in patients with severe left ventricular dysfunction: Results from the CABG patch trial database. J Am Coll Cardiol 2000;36:1166-72.
214. Batchelor W, Anstrom K, Muhlbaier H, et al. Contemporary outcome trends in the elderly undergoing percutaneous coronary interventions: Results in 7,472 octogenarians. J Am Coll Cardiol 2000;36:723-30.
215. Ang P, Omar Farouque HM, Harper R,et al. Percutaneous coronary intervention in the elderly: A comparison of procedural and clinical outcomes between the eighth and ninth decades. J Invas Cardiol 2000;12:488-494.
216. Best P, Lennon R, Ting H, et al. Even mild renal insufficiency is associated with increased mortality after percutaneous coronary interventions. J Am Coll Cardiol 2001;37(2):76A.
217. Best P, Lennon R, Ting H, et al. The safety of abciximab before percutaneous coronary revascularization in patients with chronic renal insufficiency. J Am Coll Cardiol 2001;37(2):4A.
218. Moschi G, Antoniucci D, Valkenti R, et al. Primary PTCA in the elderly. Results in patients aged 80 years or above. Circulation 1998;98 (Suppl I): I-153.
219. Shawl FA, Lapetine FL, Kadra WY, et al. Stent supported carotid angioplasty (SSCA) has more favorable outcome in octogenarians compared to non-octogenarians. Circulation 1998;98 (Suppl I): I-304.
220. Wong PMT, Piamsombonn C, Mathur A, et al. Efficacy of coronary stenting in the management of cardiac allograft vasculopathy. Am J Cardiol 1998 Jul 15;82:239-41.
221. Trabattoni D, Montorsi P, Loaldi A, et al. How is the outcome of coronary stenting in the elderly compared to younger patients? J Am Coll Cardiol 2001;37(2):160A.

222. Baklanov D, Marcu CB, Chawarski C, et al. Coronary stenting is safe and effective in high risk octogenarian patient cohort. J Am Coll Cardiol 2001;37(2):161A.
223. Watanabe C, Maynard C, Ritchie JL, et al. Short-term outcomes following coronary artery stenting: Higher mortality and bypass surgery rates in women compared with men. J Am Coll Cardiol 2001;37(2):9A.
224. Thompson T, Mahoney EM, Valedar E, et al. Gender differences among patients undergoing coronary revascularization. Results from the National Cardiovascular Network (NCN). J Am Coll Cardiol 2001;37(2):16A.
225. Sousa A, Mattos L, Costa M, et al. In-hospital outcome after stenting in women compared to men. Results from the Registry of the Brazilian Society of Interventional Cardiology: CENIC. J Am Coll Cardiol 2001;37(2):16A.
226. Seldis S, Morrison DA, Sethi G, et al. Percutaneous coronary intervention versus coronary bypass graft surgery: Outcome of diabetics in the AWESOME randomized trial and registry. J Am Coll Cardiol 2001;37(2):336A.
227. Kugelmass AD, Mehta S, Simon AW, et al. Gender differences in outcomes among diabetic patients undergoing percutaneous coronary interventions. J Am Coll Cardiol 2001;37(2):65A.
228. Rinder M, Tamirisa P, Lasala J, et al. Hemodialysis and major adverse cardiac events after stenting: Results from the TOPPS trial. J Am Coll Cardiol 2001;37(2):68A.
229. Veledar E, Abramson JL, Mahoney EM, et al. Gender differences in mortality after PTCA, according to age. J Am Coll Cardiol 2002;39 (suppl.A):41A.
230. Hernandez PJC, Rubenstein M, Martin F, et al. The impact of stenting in the very elderly. J Am Coll Cardiol 2002;39 (suppl.A):4A.
231. Laskey WK, Selzer F, Johnston JM, et al. Outcomes in diabetic patients undergoing percutaneous coronary intervention: A report from the NHLBI dynamic registry. J Am Coll Cardiol 2002;39 (suppl.A):47A.
232. Stenestrand U, Wallentin L. Early revascularization and 1-year survival in 14-day survivors of acute myocardial infarction: a prospective cohort study. Lancet 2002;359:1805-11.
233. Kawaguchi K, Kondo T, Suzuki T, et al. Comparison with coronary stent and cutting balloon in small coronary vessels in diabetic patients. J Am Coll Cardiol 2002:39 (suppl.A):48A.
234. Casey DM, Starling RC, Tuzcu M, et al. Outcomes of percutaneous intervention in cardiac allograft vasculopathy. J Am Coll Cardiol 2002;39 (suppl.A):189A.
235. Jensen LO, Thayssen P, Kassis E, et al. Are older women, compared to older men, at higher risk during percutaneous coronary intervention? Results from the Danish PTCA registry. J Am Coll Cardiol 2002;39 (suppl.A):57A.
236. Takano Y, Guttman OT, Currier JW, et al. Percutaneous catheter interventions for cardiac transplant patients. J Am Coll Cardiol 2002;39 (suppl.A):188A.
237. Morice MC, Serruys PW, Sousa E, et al. A randomized comparison of a sirolimus-eluting stent with a standard stent for coronary revascularization. N Engl J Med 2002;346:1773-80.