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Use of coronary angioplasty, bypass surgery, and conservative therapy for treatment of coronary artery disease over the past decade

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Aims There is a continuous increase in the number of percutaneous transluminal coronary angioplasty procedures performed per year per population in most industrialised countries. This analysis searches for trends in treatment decisions after diagnostic coronary angiography.

Methods and Result The degree of coronary artery disease and the therapeutic strategy were determined retrospectively in consecutive patients undergoing coronary angiography at a Swiss university hospital during three different time periods in the past 11 years (n = 750 in 1994, n = 500 in 1990, and n = 545 in 1983). The indication for coronary angioplasty rose from 45% in 1983 to 78% in 1990 and 87% in 1994 in patients with one-vessel disease, from 25% to 38% and 71% in patients with two-vessel disease, and from 10% to 24% and 29% in patients with three-vessel disease. In contrast, the use of conservative therapy declined with time, independent of the severity of coronary artery disease. Indications for coronary artery bypass grafting decreased in patients with two-vessel disease, but did not change in patients with three-vessel disease over the 11-year period.

Conclusions The use of coronary angioplasty, bypass surgery, and conservative therapy changed drastically over the past decade, with an increasing use of angioplasty and a decreasing use of conservative therapy in one-vessel and multivessel disease, and of bypass surgery in two-vessel disease. The expansion of coronary angioplasty is mainly related to increased use in patients previously treated conservatively.
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Key Words: Coronary artery bypass grafting, coronary angioplasty, conservative therapy, coronary artery disease.

Introduction

The number of percutaneous transluminal coronary angioplasty (PTCA) procedures performed per year and per population has constantly increased in most industrialised countries[1–4]. On the other hand, the number of coronary artery bypass grafting (CABG) operations has remained fairly stable. What caused the boom in coronary revascularization and the relative shift from CABG to PTCA? This retrospective analysis was undertaken to detect patterns in treatment decisions concerning patients undergoing diagnostic coronary angiography at three different time periods in the past 11 years.

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Patients and methods

The study examined consecutive unselected patients undergoing coronary angiography for suspected or known coronary artery disease in 1983 (n = 545), in 1990 (n = 500), and in 1994 (n = 750). Patients with congenital heart disease, cardiomyopathy, or pure valve disease were excluded.

Left ventriculography was carried out in right and left oblique projections. Left and right coronary artery angiograms were done by a hand injection after nitrate administration in multiple projections using biplane cineangiography. The degree of coronary artery stenosis was assessed visually as diameter reduction, taking into account all projections showing the narrowing.

The patients were divided into two groups: those with normal coronary arteries or non-significant ($\leq$50%) coronary lesion(s), and significant (>50% diameter stenosis) coronary lesion(s). One-vessel disease

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Table 1 Patient characteristics in 1983, 1990 and 1994

	1983	1990	1994	*P* value
Number	545	500	750	
Age (years)	56 ± 9	60 ± 10	60 ± 10	<0·001*
Male, % (n)	85 (465)	81 (406)	79 (590)	<0·01*
Left ventricular ejection fraction (%)	61 ± 14	61 ± 12	60 ± 13	ns
Previous myocardial infarction, % (n)		41 (205)	45 (335)	ns
Previous coronary angiography, % (n)		33 (162)	28 (210)	ns
Previous angioplasty, % (n)		16 (82)	17 (131)	ns
Previous bypass surgery, % (n)		9 (44)	7 (56)	ns

*1983 vs 1990 and 1994.

Table 2 Degree of coronary artery disease involvement in 1983, 1990, and 1994

	1983	1990	1994	*P* value
Number	545	500	750	
One-vessel disease, % (n)	27 (148)	34 (169)	29 (215)	*P*<0·001*
Two-vessel disease, % (n)	23 (126)	19 (97)	25 (188)	*P*<0·01†
Three-vessel disease, % (n)	28 (153)	21 (103)	24 (182)	*P*<0·01†
Normal coronary arteries or non-significant disease, % (n)	22 (118)	26 (70)	22 (58)	*P*<0·01*

*1990 vs 1983, †1994 vs 1990.

was defined as one or several significant lesions exclusively in the left anterior descending, left circumflex, or right coronary artery or their branches. Two-vessel disease comprised significant disease in any two of these three arteries or their branches. Significant disease in all three major coronaries or their branches was considered to be three-vessel disease. The involvement of the left main stem alone was classified as two-vessel disease. Conservative therapy consisted of stepped-care medical therapy designed to eliminate angina or to prevent silent ischaemia.

Statistical analysis

Values are expressed as percentage or mean ± standard deviation. Continuous variables were compared by one-way ANOVA followed by Scheffe's test when required. Discrete variables were compared by the chi-squared test, with two-sided *P* value. Influences of multiple covariates on treatment were analysed with Cox's proportional-hazards regression model.

Results

Clinical and angiographic characteristics

The clinical and angiographic characteristics of the patients undergoing coronary angiography in 1983, 1990, and 1994 are summarized in Tables 1 and 2. The mean age increased from 1983 to 1990, and then stabilized. However, the proportion of patients older than 70 years rose from 12 to 17% ($P<0·05$) between 1990 and 1994. The percentage of males decreased slightly from 1983 to 1990, then remained stable between 1990 and 1994. The mean left ventricular ejection fraction of patients undergoing cardiac catheterization remained constant between 1983 and 1994.

An increase in one-vessel disease (from 27 to 34%, $P<0·001$) and a decrease in multivessel disease (from 51 to 40%, $P<0·01$) was observed between 1983 and 1990. Between 1990 and 1994, the prevalence of one-vessel disease tended to decrease albeit not significantly, and that of two- and three-vessel disease rose significantly between 1990 and 1994 (19 vs 25%, $P<0·01$, 21 vs 24%, $P<0·01$, respectively).

Treatment strategy

Figure 1 illustrates the treatment strategies in patients with one-, two- and three-vessel disease in 1983, 1990, and 1994. The percentages of patients with one-vessel disease referred for PTCA rose from 45% in 1983 to 78% in 1990 ($P<0·001$ vs 1983) to 87% in 1994 ($P<0·05$ vs 1990). Inversely, the percentages of patients handled by conservative therapy exclusively decreased from 49% in 1983 to 22% in 1990 ($P<0·001$ vs 1983) to 11% in 1994 ($P<0·001$ vs 1990).

In patients with two-vessel disease, the percentages of PTCA rose from 25% in 1983 to 38% in 1990 (ns vs 1983) to 71% in 1994 ($P<0·001$ vs 1990 and 1983). Inversely, the percentages of conservative therapy decreased from 47% in 1983 to 41% in 1990 (ns vs 1983)

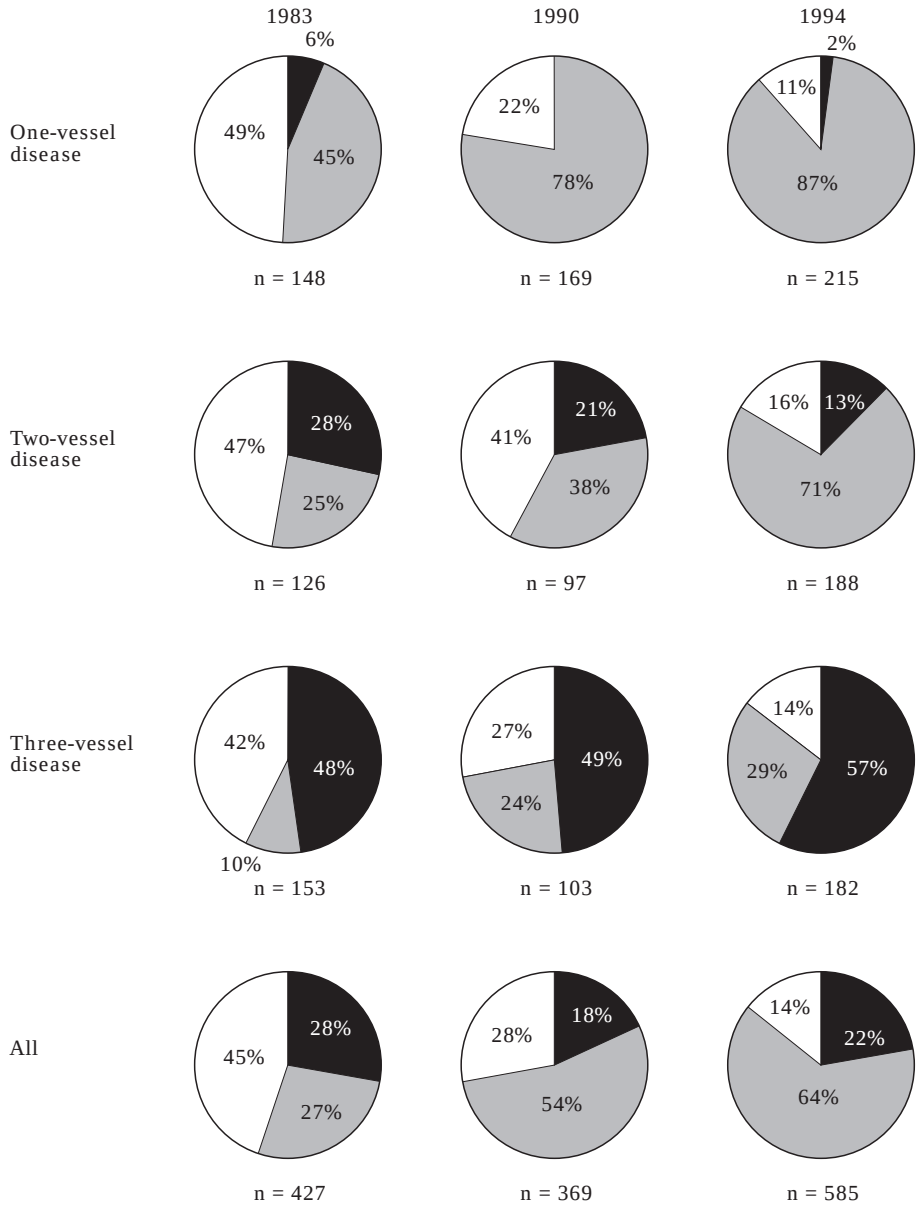

Figure 1 **Treatment advised in 1983, 1990, and 1994 according to degree of coronary artery disease. ■ = coronary artery bypass grafting; ▨ = 30% grey tint percutaneous transluminal coronary angioplasty; □ = medical therapy.**

to 16% in 1994 ($P<0{\cdot}001$ vs 1990 and 1983). The percentage of recommendations for CABG decreased from 28% in 1983 to 21% in 1990 (ns vs 1983) to 13% in 1994 ($P<0{\cdot}001$ vs 1990).

For patients with three-vessel disease, the percentage of recommendations for PTCA increased from 10% in 1983 to 24% in 1990 ($P<0{\cdot}01$ vs 1983) to 29% in 1994 (ns vs 1990, $P<0{\cdot}001$ vs 1983). Indications for conservative therapy decreased from 42% in 1983 to 27% in 1990 ($P<0{\cdot}05$ vs 1983) to 14% in 1994 ($P<0{\cdot}05$ vs 1990). Indications for CABG in patients with three-vessel disease remained stable at 48%, 49%, and 57% in 1983, 1990, and 1994, respectively.

Discussion

This study demonstrates a substantial change in therapeutic strategy in patients undergoing coronary angiography in 1983, 1990, and 1994, in contrast to mostly comparable clinical characteristics of the patients examined at the same time points. There was a gradual replacement of conservative treatment by PTCA in patients not requiring surgery, and the percentage of PTCA procedures per coronary angiogram increased from 27% in 1983 to 64% in 1994. This increase has a precedent as demonstrated in 1991 in the United States according to the reports of the Registry of the Society

for Cardiac Angiography and Interventions[2,5,6] and continued to grow in more recent years in Europe[3,7].

The indications for PTCA rose markedly from 1983 to 1994 in patients with one- and two-vessel disease. In patients with three-vessel disease, this tendency was also clear, but moderate. Conversely, the use of conservative therapy declined drastically with time, independent of the severity of coronary artery disease. Indications for CABG remained negligible in one-vessel disease, decreased in patients with two-vessel disease, but did not change in patients with three-vessel disease over the 11-year period.

Changes in clinical or angiographic factors over the 11-year period that may have influenced the management of patients with coronary artery disease were examined. The severity of the coronary artery disease, as expressed by the number of arteries with significant stenoses, appeared stable between 1983 and 1994. In fact, an increase of milder disease due to earlier diagnosis of coronary artery disease was probably masked by the extension of the indication threshold for coronary artery angiography towards the elderly in recent years, yielding more three-vessel disease. The older the age, the more PTCA is an attractive alternative to CABG, even for true three-vessel disease, because full revascularization is a declining prerequisite and the risk of surgical complications is rising. Therefore, changes in therapy may well have been influenced by a lower incidence of multivessel disease in the majority of patients. The mean age of patients undergoing coronary angiography substantially increased from 1983–1990, and then stabilized between 1990 and 1994, with the exception being an increase in patients older than 70 years. The percentage of old patients ($\geq$70 years) increased from 12% in 1990 to 17% in 1994. This tendency was similar to that of a survey at an American university hospital, where the mean age of catheterized patients increased from 58 ± 9 to 61 ± 11 years, and the percentage of patients older than 65 years increased from 24 to 41% between 1981 and 1988[1]. The indication for PTCA increased significantly in all three groups of patients with one-, two-, and three-vessel disease.

The database is not able to distinguish between true multivessel disease, i.e. disease involving several or all of the main trunks, and multivessel disease concerning mainly secondary vessels. It is, however, plausible that the main increment of PTCA in multivessel disease pertains to the latter, with perhaps the exception of old age. The major increase in PTCA between 1983 and 1994 occurred in patients with one- and two-vessel disease. Such situations were treated conservatively in the past, as illustrated by the decrease in conservative therapy from 45% in 1983 to 28% in 1990, and to only 14% in 1994. Finally, CABG has lost no ground in three-vessel disease.

The indication for coronary angiography is likely to have changed between 1983 and 1994 and influenced the management of coronary artery disease. However, this retrospective analysis does not provide precise and objective data regarding symptoms, clinical parameters, and criteria of functional tests that led to the decision to perform coronary angiography.

Over the period concerned, the results of several trials may have influenced the management of patients with coronary artery disease. In the CASS study, long-term survival was improved by surgical therapy in patients with decreased ejection fraction[8]. Angioplasty was shown to offer earlier and better relief of angina than conservative therapy and was associated with better exercise performance in patients with single vessel disease[9]. In more recent years, several trials have shown comparable outcomes following CABG and PTCA in patients with single-vessel[10] or multivessel[11–13] disease, except for the increased need of repeated procedures and antianginal therapy in the patients treated with PTCA[13].

It could be demonstrated that the use of PTCA, CABG, and conservative therapy changed drastically over the past decade, with an increasing use of PTCA and a decreasing use of conservative therapy in one-vessel and multivessel disease, and of CABG in two-vessel disease. These changes in the practice of coronary revascularization indicate an extension of PTCA towards patients treated conservatively in the past rather than those treated surgically. This testifies to a more active approach to the milder forms of coronary artery disease (no matter whether one, two, or three vessels are involved) which aims more at quality of life than at quantity of life. This sumptuous approach to the treatment of coronary artery disease may be challenged in the future by economic constraints. At present, it continues to be fostered by expansion of well equipped conservative facilities.

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