Does a waiting time for elective coronary angioplasty affect the primary success rate?

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Abstract

Objective—To evaluate the effect of the waiting time for elective percutaneous transluminal coronary angioplasty (PTCA) on the primary success rate.

Setting—University hospital in The Netherlands.

Patients—A cohort of 817 consecutive patients awaiting elective PTCA. Scheduled PTCA was performed in all 817 patients, involving 1237 coronary lesions.

Main outcome measures—The relation between procedural success and the duration of the waiting time was evaluated. Major cardiac events, that is, death and myocardial infarction while awaiting PTCA, were documented. Alterations in lesion characteristics during the waiting time were assessed in unsuccessful procedures.

Results—Elective PTCA was performed within one to six weeks after acceptance in 388 patients (587 lesions; 47.5%), between six and 12 weeks in 203 patients (308 lesions; 25%), and after more than 12 weeks in 226 patients (342 lesions; 27.5%). The procedural success rates in the defined time intervals were 97%, 99%, and 97% in ACC/AHA type A lesions, 93%, 87% and 90% in type B lesions, and 63%, 55% and 38% in type C lesions respectively; 96% of type C lesions were total coronary occlusions. There was a significant decrease in primary success rate in type C lesions after a waiting time beyond 12 weeks. A reasonable explanation for an unsuccessful angioplasty related to alterations in lesion characteristics during the waiting time was documented in only four of 115 procedures.

Conclusions—The primary success in type A and B lesions is unaffected by the duration of a waiting period for elective PTCA. A waiting time of more than 12 weeks is associated with a lower success rate in patients with total coronary occlusions.

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Keywords: angioplasty; waiting time; patient selection; coronary artery disease

In health care systems that operate under limited budgets, financial restrictions may lead to waiting times for resource intensive cardiovascular procedures.^{1,2} There is a tendency to use

waiting times as criteria for evaluating and criticising national health care systems.³⁻⁵ There are limited data available on the consequences of waiting times, and their effects on the quality of medical care.⁶⁻⁸

At our centre, the discrepancy between the number of referred patients and the facilities for performing percutaneous transluminal coronary angioplasty (PTCA) has resulted in waiting times for angioplasty frequently exceeding more than three months in the past years. The purpose of this study was to evaluate the effect of the waiting time for elective PTCA on the primary success rate of the procedure.

Methods

The study group consisted of 817 consecutive patients entered on our waiting list registry after acceptance for elective PTCA between January 1990 and January 1992. During this period we were confronted with increasing waiting times for PTCA. Angioplasty was performed in all 817 patients, involving a total of 1237 coronary lesions. According to the unmodified ACC/AHA criteria,⁹ 405 coronary lesions (32%) were classified as type A, 631 (51%) as type B, and 201 (17%) as type C (figure). This classification was based on the angiogram performed before the procedure. Procedural success was defined as less than 50% residual stenosis without major cardiac events, that is, death, coronary artery bypass grafting operation, acute myocardial infarction, or repeat angioplasty within 24 hours. Myocardial infarction was defined as a creatine kinase MB rise of more than twice the upper limit of normal.

The waiting time was defined as the time period from the day the patient was accepted for angioplasty until the day of the procedure itself. The diagnostic angiogram was performed within one week of acceptance for PTCA in 97.8% of patients. In the remaining 2.2% of the patients, the diagnostic angiogram was performed within six weeks of final acceptance. Patients with unstable angina¹⁰ and patients in whom acceptance for angioplasty was not based on a recent coronary angiogram were excluded.

A lesion was considered totally occluded when there was an interruption of the continuity in the angiographic appearance of a coronary artery without antegrade flow. The duration of an occlusion was determined from angiographic data or estimated from an index clinical event such as a myocardial infarct or a

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Illustrations of lesion types according to the ACC/AHA classification. (A) Angiography of the left coronary artery, left lateral view, showing a proximal concentric lesion of the left anterior descending coronary artery classified as a type A lesion. (B) Angiography of the left coronary artery, left oblique view, showing an eccentric lesion of the left circumflex coronary artery with a sidebranch originating from the lesion, classified as a type B lesion. (C) Angiography of the right coronary artery, left oblique view, showing an eccentric lesion with proximal tortuosity, classified as a type B lesion. (D) Angiography of the right coronary artery, left oblique view, showing a total coronary occlusion with bridging collateral, classified as type C.

marked change in anginal pattern. The selection of patients and their priority on the waiting list was left to the discretion of the attending interventional cardiologists and depended upon varying criteria, such as functional class of angina, progression of symptoms, or the results of non-invasive testing.

OUTCOME MEASURES

The relation was assessed between procedural success and the duration of the waiting time. The waiting time was divided arbitrarily in three time intervals, that is, less than six weeks, six to 12 weeks and more than 12 weeks, as these time periods were considered relevant for patient management.^{11 12} The incidence of death and myocardial infarction on the waiting list was verified at time the patients were scheduled for the actual procedure. The angiograms of 115 unsuccessfully treated lesions were compared with the initial angiogram in order to evaluate alterations in lesion characteristics during the waiting time that could have been responsible for failure of the procedure.

STATISTICS

Continuous variables were expressed as mean (SD). A χ^2 test was used to compare dichotomous variables, Student's *t* test for continuous variables; a P value less than 0.05 was considered significant.

Results

The demographic data of the patients are summarised in table 1. The clinical information on the study patients was complete at the time of the actual procedure. All patients accepted for PTCA were actually scheduled for the procedure, and underwent angioplasty. During the waiting time (mean 8.8 weeks, range 1 to 42), there were no deaths and no patients experienced an acute myocardial infarction.

The overall procedural success rate in the 817 patients was 87.9% (718 patients). Procedural complications included mortality in one patient (0.1%), coronary bypass surgery performed in five patients (0.6%), and acute myocardial infarction found in 20 patients

Table 1 Patient characteristics, 817 patients

Mean (SD) age (years)	60.4	(10.1)
Female	229	(28%)
Male	588	(72%)
Risk factors		
Family history	155	(19%)
Hypercholesterolaemia	269	(33%)
Smokers	351	(43%)
Hypertension	277	(34%)
Diabetes	114	(14%)
Previous myocardial infarction	375	(46%)
Previous PTCA	212	(26%)
Previous CABG	65	(8%)

CABG, coronary artery bypass grafting; PTCA, percutaneous transluminal coronary angioplasty.

Table 2 Procedural result in 817 patients, 1237 lesions

PTCA success (all)	718	(87.9%)
Mortality	1	(0.1%)
CABG (within 24 hours)	5	(0.6%)
MI (CK-MB > 2 × upper limit)	20	(2.5%)
Repeat PTCA (within 24 hours)	5	(0.6%)
Unsuccessful, uncomplicated	68	(8.3%)
Success in 1237 lesions:		
Type A	396/405	(98%)
Type B	575/631	(92%)
Type C	111/201	(55%)

CABG, coronary artery bypass grafting; CK-MB, creatine kinase-MB; MI, myocardial infarction; PTCA, percutaneous transluminal coronary angioplasty.

(2.5%). Repeat angioplasty within 24 hours was performed in five patients (0.6%). The remaining 68 procedures (8.3%) were unsuccessful but uncomplicated. In almost all cases failure of the procedure was due to inability to cross the lesion with a guidewire or balloon (table 2). PTCA was performed within one to six weeks after acceptance in 388 patients, involving 587 lesions (47.5%), between six and 12 weeks in 203 patients, involving 308 lesions (25%), and after more than 12 weeks in 226 patients, involving 342 lesions (27.5%). The distribution of ACC/AHA lesion types was not significantly different between these waiting time intervals (one to six, six to 12, and more than 12 weeks, respectively: table 3).

Table 3 Waiting time distribution of lesion types

	Waiting time			All
	1–6 weeks	6–12 weeks	> 12 weeks	
Type A	211 (35%)	103 (33%)	91 (25%)	405 (32%)
Type B	284 (48%)	146 (47%)	201 (58%)	631 (51%)
Type C	92 (17%)	59 (19%)	50 (16%)	201 (17%)

Table 4 Procedural success related to waiting period

Waiting period	Successful/total number of lesions (%)		
	1–6 weeks	6–12 weeks	> 12 weeks
Type A	206/211 (97%)	102/103 (99%)	88/91 (97%)
Type B	266/284 (93%)	128/146 (87%)	181/201 (90%)
Type C	59/92 (63%)*	33/59 (55%)*	19/50 (38%)*

*χ² for trend: P < 0.005.

Table 5 Type C lesions: percentage of total occlusions and estimated duration of occlusion at the time of acceptance for PTCA

Waiting time	Total occlusions (% of C lesions)	Duration of occlusion at acceptance for PTCA	
		Mean	(SD) (weeks)
< 6 weeks	97%	20.1	(15.2)
6–12 weeks	96%	21.4	(12.5)
> 12 weeks	96%	20.8	(14.4)
	NS	NS	

PTCA, percutaneous transluminal coronary angioplasty.

In type A and B lesions, the waiting time did not influence the primary success rate significantly. In type C lesions, a decrease in primary success rate could be shown beyond a waiting time of more than 12 weeks (less than 12 weeks *v* more than 12 weeks: P = 0.005, table 4). Of all type C lesions, 96% were total coronary occlusions. The mean estimated duration of the occlusion at the time of acceptance for PTCA did not differ significantly between patients with a waiting period of less than six weeks, between six and 12 weeks, and more than 12 weeks (table 5).

The angiograms before and after a waiting period of 115 unsuccessful procedures were reviewed and compared. In 90 of these 115 procedures, a total coronary occlusion was present at the time of acceptance and the artery could not be successfully recanalised at the time of angioplasty. In 21 procedures, PTCA was unsuccessful because of miscellaneous factors (such as urgent bypass surgery, major side branch occlusion, or inability to obtain a less than 50% residual stenosis) which could not be attributed to lesion alterations during the waiting time. In four procedures (after 3, 7, 8, and 13 weeks, respectively), a total coronary occlusion with unfavourable features for PTCA was encountered, while these lesions appeared to be easily accessible for angioplasty on the initial angiogram. In these cases, we considered alterations in lesion characteristics during the waiting time to be the most likely cause of the failure of the procedure (inability to cross the lesion).

Discussion

This study shows that the procedural success rate of elective coronary angioplasty is not influenced by the waiting time in type A and B lesions, while there is a significant decrease in procedural success rate in type C lesions beyond a waiting time of more than 12 weeks. This could not be explained by angiographic alterations in lesion characteristics during this period, as it was noted in only four of 115 failures. To our knowledge, no study has so far reported on the effects of waiting times on the procedural result of percutaneous coronary intervention.

The results of the present study indicate that the procedural success in type A and B lesions is unaffected by the waiting time for coronary intervention with a mean duration of 8.8 weeks. This observation suggests that the priority to perform angioplasty should be based on clinical symptoms rather than on the angiographic characteristics of the coronary lesion. This contrasts to the situation in type C lesions. In comparison with type A and B lesions, the procedural result after a waiting time of more than 12 weeks was significantly worse in type C lesions, almost all (96%) being total occlusions.

Many studies have indicated that the duration of the coronary occlusion is a key factor for success of angioplasty,^{13–15} although others could not demonstrate such a relation.¹⁶ After a

waiting period of less than 12 weeks, the procedural results in type C lesions in the present study are in accordance with the results reported in the literature (percentage success ranging from 47% to 73%).¹⁵⁻¹⁷ However, there was a marked decrease in success rate beyond a waiting time of more than 12 weeks. The lower success rate in total coronary occlusions was associated with an additional time awaiting the procedure, since the estimated duration of occlusion at the time of acceptance for PTCA, was similar in the three waiting time categories (table 5). In our view, these patients are to be given priority, irrespective of the clinical symptoms—which are often mild due to marked development of collateral vessels in chronic coronary occlusion.¹⁸ This patient management is particularly important, since it has been shown that successful recanalisation of total occlusions may reduce the need for coronary bypass surgery.¹⁹⁻²¹

Data on the effects of waiting lists on coronary revascularisation procedures are limited. Mortality rates of 2.2% to 0.4% have been reported after mean waiting times of 42 and 17 days, respectively²²⁻²³ in patients on the waiting list for coronary bypass surgery. Recently, Chester *et al*²⁴ stated that adverse events, that is, myocardial infarction, unstable angina, and angiographic total occlusion, were not uncommon while awaiting PTCA. This contrasts with our study, in which there were no deaths or myocardial infarctions on the waiting list. The incidence of angiographic occlusion in our study appears small, although this was only studied as far as it adversely affected the procedural result. Another difference is that the waiting times evaluated in our study were considerably shorter than those described by Chester *et al*. In their study, every procedure performed within three months was considered urgent, while the median waiting time was eight months, ranging from three to 27 months, as compared to 8.8 weeks, ranging from one to 42 weeks, in the present study.

All patients who entered the waiting list during the study period underwent the procedure after a relatively short mean waiting time. The patients awaiting angioplasty were frequently seen by their attending cardiologists and prioritised in case of progression of anginal symptoms. This careful monitoring of the patients is the most probable reason that the cohort of patients was complete in our study. This completeness of follow up differs from the report of Chester *et al*, and is possibly also related to the differences in waiting times. However, even after a median duration of eight months (range, one to 42 months) the number of patients lost during follow up in their study was rather small: one patient had a fatal myocardial infarction and four patients (2%) were lost.

LIMITATIONS OF THE STUDY

The decision to place a patient on the waiting list, or to change priority during the waiting time, was at the discretion of the interventional cardiologist at the time the patient was accepted for angioplasty, and the attending

cardiologist in charge of the patient while the patient was awaiting PTCA. We did not evaluate these clinical decisions. This certainly may have introduced clinical bias, which nevertheless reflects common clinical practice.

In this study, we used the ACC/AHA lesion morphology classification system,⁹ which is subject to criticism for many reasons, especially when used for the estimation of procedural success and risks.¹⁷⁻²⁵ We considered it appropriate for the purpose of our study, since it was the only generally applied classification system by the time our data were collected.

It is difficult to estimate the duration of coronary occlusion on the basis of clinical information. This drawback in the methodology applies to all three patient categories, suggesting that the observed differences in the result of PTCA in the three patient groups are related to differences in waiting time. However, we cannot exclude the possibility that differences between the patient groups were already present at the time of acceptance.

The results of this single centre experience warrant confirmation by other investigators. The present study is an observational study: randomisation of waiting times may yield a more definitive answer regarding the effects of waiting times on procedural success.

The angiographic alterations in lesion morphology were only studied in unsuccessful procedures; thus the study yields no general information on progression of coronary artery disease during waiting times.

CONCLUSION

The primary success rate in type A and B lesions is unaffected by the duration of a waiting period for elective coronary angioplasty; a waiting time of more than 12 weeks is associated with a lower success rate in type C lesions. Alterations in lesion morphology that adversely affect procedural outcome are rare during the waiting time. The results of angioplasty in type C lesions may be improved by prioritisation based on angiography, irrespective of the clinical presentation.

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