Clinical Significance and Predisposing Factors to Symptomatic Bradycardia and Hypotension After Percutaneous Transluminal Coronary Angioplasty

Aviv Mager, MD, Boris Strasberg, MD, Eldad Rechavia, MD, Yochai Birnbaum, MD, Alexander Mazur, MD, Nir Yativ, MD, and Samuel Sclarovsky, MD

Of 180 consecutive patients who underwent uneventful percutaneous transluminal coronary angioplasty (PTCA), 25 (13.9%) had at least 1 episode of symptomatic bradycardia and hypotension during the early postprocedure period. Symptomatic bradycardia and hypotension occurred 1 to 10 hours (mean 4 ± 2) after PTCA. A higher incidence of symptomatic bradycardia and hypotension was found in patients receiving regular treatment with β blockers (26% vs 10% in patients without β blockers in their regimen, p <0.01), diltiazem or verapamil (20% vs 9%, p <0.025), or both a β blocker and diltiazem or verapamil (64% vs 11%, p <0.001). A higher incidence was also associated with angioplasty of the left anterior descending coronary artery compared with angioplasty of the other coronary arteries (22% vs 8%, p <0.01). It is concluded that symptomatic bradycardia and hypotension is a common occurrence after PTCA. The incidence is higher after PTCA to the left anterior descending coronary artery and in patients receiving diltiazem, verapamil, and β-blocking agents; it is particularly high in patients receiving a combination of a β-blocking agent and either diltiazem or verapamil.

(Am J Cardiol 1994;74:1085–1088)

Symptomatic bradycardia and hypotension are well-known complications of diagnostic and therapeutic cardiac catheterization.[1–5] However, the incidence,[1–5] clinical significance,[5,6] pathogenesis,[6–16] predisposing and precipitating factors, and modes of prevention are still matters of controversy. In patients who have had angioplasty, symptomatic bradycardia and hypotension may result in serious, life-threatening arrhythmias and shock, and in abrupt closure of the dilated coronary artery,[5] calling for reassessment of this phenomenon.

This study assesses the incidence and clinical significance of symptomatic bradycardia and hypotension in patients who have had angioplasty, and evaluates some possible factors of this phenomenon.

METHODS

The study population consisted of 180 consecutive patients (145 men [80.6%] and 35 women [19.4%], aged 32 to 79 years [mean 58.6 ± 10.6]), who were admitted to the intermediate coronary care unit in our hospital after uncomplicated elective 1-vessel percutaneous transluminal coronary angioplasty (PTCA). The study included patients who were transferred from the catheterization laboratory for postangioplasty observation in whom (1) angioplasty was not performed for or during evolving myocardial infarction or cardiogenic shock, (2) there was no need for cardiopulmonary resuscitation or an intraaortic balloon pump in the catheterization laboratory, and (3) there were no residual life-threatening complications such as aortic dissection, cardiac tamponade, or immediate reocclusion. All patients arrived at the intermediate coronary care unit hemodynamically stable, without signs of overt heart failure.

Medical protocol: Our preangioplasty protocol included adjustment of the regular drug regimen (i.e., reduction by half of the β-blocker dosage, adjustment of antihypertensive, diuretic, and oral hypoglycemic medications) and administration of glucocorticoids to patients with known hypersensitivity to contrast media. Acetylsalicylic acid was added when it had never been given before and was not contraindicated. Fasting was mandatory 6 hours before angioplasty.

Diazepam 5 mg was given orally before the procedure. For local anesthesia, lidocaine, up to 100 mg, was injected subdermally at the site of the arterial puncture. After insertion of the guiding catheter, an intravenous bolus of 10,000 U of heparin was administered, and continuous isosorbide dinitrate 2 mg/hour and isotonic intravenous fluids 200 ml/hour were begun. Anxiolytics, analgesics, diuretics, parasymptolytics, adrenergics, vasodilators, and fluids were added as indicated. Uro-

From the Coronary Care Unit, Department of Cardiology, Beilinson Medical Center, Petah Tikva; and the Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel. Manuscript received March 29, 1994; revised manuscript received and accepted July 11, 1994.

Address for reprints: Aviv Mager, MD, Coronary Care Unit, Department of Cardiology, Beilinson Medical Center, Petah Tikva, Israel 49100.

TABLE I Medications in Patients With and Without Symptomatic Bradycardia and Hypotension

	Treatment	No Treatment	SBH in Treated Patients	SBH in Nontreated Patients	p Value*
Acetylsalicylic acid	125	55	18 (14%)	7 (13%)	NS
β blockers	47	133	12 (26%)	13 (10%)	<0.01
Diltiazem or verapamil	81	99	16 (20%)	9 (9%)	<0.025
β blockers + diltiazem or verapamil	11	169	7 (64%)	18 (11%)	<0.001
Vasodilators†	39	141	3 (8%)	22 (16%)	NS

*Treated versus nontreated.
†Nifedipine or angiotensin-converting enzyme inhibitors.
SBH = symptomatic bradycardia and hypotension.

TABLE II Occurrence of Symptomatic Bradycardia and Hypotension According to the Dilated Artery

Artery	Number of Patients	SBH	p Value
Left anterior descending coronary artery	77	17 (22%)	<0.01*
Right coronary artery	49	4 (8%)	
Circumflex artery	44	3 (7%)	
Intermediate ramus or diagonal branch of the left anterior descending coronary artery	10	1 (10%)	

*Patients with versus patients without involvement of the left anterior descending coronary artery.
SBH = symptomatic bradycardia and hypotension.

grafin-76™ was the most frequently used contrast medium, in amounts not exceeding 150 ml per procedure.

After completion of angioplasty, patients were followed for 20 minutes in the catheterization laboratory. If their course was uneventful, they were transferred to the intermediate coronary care unit with an 8Fr, 15-cm long sheath in the arterial insertion site. Intravenous administration of nitrates and fluids was continued, and full heparinization at a rate of 1,000 U/hour was begun. Patients were instructed to remain recumbent until the next day, when the sheath was removed. Thereafter, administration of the patient's regular medications was restarted, except for antihypertensive agents, which were given only in cases of proven hypertension.

All patients were monitored using continuous electrocardiographic monitoring, 4-hour interval cuff blood pressure measurements, and close medical observation. Two-minute cuff blood pressure measurements were obtained whenever indicated, particularly when weakness, dizziness, chest pain, or sweating were reported or bradycardia was observed. In patients who developed symptomatic bradycardia and hypotension, blood pressure and heart rate were recorded repeatedly until complete recovery. Standard 12-lead electrocardiography was recorded on admission and during and after episodes of chest pain or symptomatic bradycardia and hypotension.

The last blood pressure and heart rate measurements before symptomatic bradycardia and hypotension were considered baseline values, and the lowest measurements during the episode of symptomatic bradycardia and hypotension were considered peak values for that episode. The heart rate–blood pressure product (product of systolic cuff blood pressure and heart rate) was calculated for baseline and peak values.

Patient complaints during symptomatic bradycardia and hypotension, history of syncope or presyncope, and duration of symptomatic bradycardia and hypotension episodes were recorded.

For the purpose of this study, symptomatic bradycardia and hypotension were defined as the appearance of at least 2 of the 3 following symptoms: (1) weakness or near-fainting; (2) sweating and pallor with warm extremities; and (3) nausea or abdominal discomfort, accompanied by a decrease in systolic blood pressure to <100 mm Hg and heart rate to <60 beats/min. The term "symptomatic bradycardia and hypotension" was preferred since these diagnostic criteria, which are typical of vagal reaction, are clinical criteria. The establishment of an excessive vagal discharge, which required the determination of episodes of symptomatic bradycardia and hypotension as vagally mediated, was beyond the scope of this study.

Therapy for symptomatic bradycardia and hypotension was administered according to the clinical judgment of the attending physician and included application of the Trendelenburg position, rapid intravenous fluid administration, prompt discontinuation of intravenous nitrates, and administration of atropine and antiemetics.

Statistical analysis: Student's *t* test was used to assess differences between mean values, and chi-square test was used to compare proportions. Values are expressed as mean ± SD. A p value <0.05 was considered statistically significant.

RESULTS

Of the 180 patients, 77 (43%) underwent angioplasty of the left anterior descending coronary artery, 49 (27%) of the right coronary artery, 44 (24%) of the left circumflex artery, and 10 (6%) of the intermediate ramus or a diagonal branch. All patients were given continuous heparinization and intravenous isosorbide dinitrate. The regular drug regimen included acetylsalicylic acid in 76% of the patients, β-blocking agents in 25%, and diltiazem or verapamil in 46%.

During follow-up, 25 patients (13.9%) had episodes of symptomatic bradycardia and hypotension. There was no age or sex predisposition. All episodes occurred within 1 to 10 hours (mean 4 ± 2) of admission to the intermediate coronary unit. In all patients except 2, symptoms occurred within the first 5 postprocedure hours.

TABLE III Changes in Heart Rate, Blood Pressure, and Double-Product Index During Episodes of Symptomatic Bradycardia and Hypotension

	Before (baseline)	During Episodes	Mean Change	% Reduction	p Value*
Heart rate (beats/min)	74 ± 12	46 ± 8	−25 ± 12	34	<0.001
Systolic cuff blood pressure (mm Hg)	126 ± 16	76 ± 15	−47 ± 14	37	<0.001
Double product	9,088 ± 2,603	3,711 ± 1,146	−5,325 ± 2,321	59	<0.001

*Presymptomatic bradycardia and hypotension values versus values during symptomatic bradycardia and hypotension.

Two patients had multiple episodes of symptomatic bradycardia and hypotension.

Serious complications were noted in 4 patients. Two lost consciousness for a few seconds, accompanied by convulsions in 1 of them. Two had chest pain and electrocardiographic changes after symptomatic bradycardia and hypotension, which were transient in 1, but evolved into a fatal myocardial infarction in the other.

Triggers and predisposing factors: A possible trigger of symptomatic bradycardia and hypotension was identified in only 8 patients. Three patients had symptomatic bradycardia and hypotension after a change in posture, and 3 after a light meal. One patient had symptomatic bradycardia and hypotension at the sight of blood, and 1 felt pain in the right groin just before the episode. In the remaining 17 patients, no trigger could be identified. None of the patients had anginal pain or ischemic electrocardiographic changes before or during episodes of symptomatic bradycardia and hypotension.

History of syncope or vasovagal reaction was available in 4 of the patients with symptomatic bradycardia and hypotension, induced by sublingual nitroglycerin, transient ischemic attack, early mobilization after coronary angiography, or painful sheath extraction after a previous angioplasty (1 patient each).

Two of the 25 patients with symptomatic bradycardia and hypotension had diabetes mellitus, 1 with known diabetic neuropathy. The difference in incidence of diabetes mellitus between patients who did and did not have symptomatic bradycardia and hypotension was not significant.

Symptomatic bradycardia and hypotension occurred more frequently in patients who received β-blocking agents than in those who did not (12 of 47 vs 13 of 133, respectively, $p < 0.01$) and in patients who received aralkylamine calcium antagonists than in those who did not (16 of 81 vs 9 of 99, respectively, $p < 0.025$). The incidence of symptomatic bradycardia and hypotension was particularly high (64%) in patients receiving both a β blocker and verapamil or diltiazem (7 of 11 vs 18 of 169 who did not receive this combination, $p < 0.001$) (Table I).

Increased occurrence of symptomatic bradycardia and hypotension was observed in patients who underwent angioplasty of the left anterior descending coronary artery (22%) compared with those who underwent angioplasty of other coronary arteries (17 of 77 vs 8 of 103, respectively, $p < 0.01$) (Table II).

Hemodynamic data: During episodes of symptomatic bradycardia and hypotension, significant changes in blood pressure and heart rate were observed (Table III): Mean systolic cuff blood pressure decreased by 37%, from 126 ± 16 mm Hg before to 76 ± 15 mm Hg during symptomatic bradycardia and hypotension ($p < 0.001$), with a mean difference of −47 ± 14 mm Hg. Heart rate decreased by 34%, from 74 ± 12 beats/min before to 46 ± 8 beats/min during symptomatic bradycardia and hypotension ($p < 0.001$), with a mean reduction of 25 ± 12 beats/min. The rate-pressure product decreased by 59%, from 9,088 ± 2,603 before to 3,711 ± 1,146 during symptomatic bradycardia and hypotension ($p < 0.001$), with a mean reduction of 5,325 ± 2,321.

DISCUSSION

To the best of our knowledge, this is the first attempt to prospectively assess the occurrence and clinical significance of symptomatic bradycardia and hypotension in patients after coronary angioplasty.

Our data show an incidence of 13.9% of symptomatic bradycardia and hypotension in the early hours after PTCA. This is significantly higher than previously reported,[1–6,17] but previously published data related mainly to the incidence of bradycardia and hypotension during catheterization, while we focused on post-PTCA complications.

As previously reported,[18,19] vasovagal reaction occurs most frequently in standing or sitting subjects, but there are some published reports of vasovagal reaction and syncope also in the supine position.[20] In our study, all episodes of symptomatic bradycardia and hypotension except 1 occurred in the supine position. Criteria for symptomatic bradycardia and hypotension used here were not as strict as those used by the National Heart, Lung, and Blood Institute PTCA Registry.[2] According to our criteria, patients had to be symptomatic (weakness, sweat, nausea), and symptoms had to be attributable to a vagally mediated reaction. Although the presence of severe bradycardia or severe hypotension was not required for diagnosis of symptomatic bradycardia and hypotension, we noted a 59% reduction in the calculated mean rate-pressure product in the recumbent position, a significant decrease for patients in whom baseline values were obtained at rest.

None of the studies reporting vasovagal reaction as a complication after catheterization[1–5] took the drug regimen into consideration. We noted a significantly higher incidence of symptomatic bradycardia and hypotension in patients receiving β blockers (26% vs 10%, $p < 0.01$), diltiazem or verapamil (20% vs 9%, $p < 0.025$), and particularly in those receiving a combination of these 2 drug types (64% vs 11%, $p < 0.001$). Coronary artery disease, per se, is a predisposing factor for vagal reactions and carotid sinus hypersensitivity.[7,18,21,22] In a

previous study, no connection was found between the coronary artery that was dilated and the risk of vagal reaction,[21] although these investigators concluded that the magnitude of the response was influenced by the severity of the coronary disease. In the present study, angioplasty to the left anterior descending coronary artery was associated with a higher incidence of symptomatic bradycardia and hypotension episodes than angioplasty to the other coronary arteries ($p < 0.01$). This may be explained by the observation made earlier, that patients with contraction abnormalities of the anterolateral left ventricular region had greater cardioinhibitory responses than patients with normal left ventricular angiograms.[21]

In view of our data, we recommend that the combination of β blockers and aralkylamine calcium antagonists should be avoided in patients after PTCA. Our data support the use of adjunctive vagolytic medications after angioplasty, particularly in patients at risk.

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