were normal and the blood pressure was 120/70 mm Hg. The apex beat was dyskinetic and he had an apical 4th heart sound. The ECG showed anterior myocardial infarction. He had a graded exercise test using the Bruce protocol; he ran for eight minutes and reached his target heart rate (180 beats/minute) without chest pain or ST segment change.

Coronary angiography was performed by the Judkins technique. The left ventricular end-diastolic pressure was 22 mm Hg. The left ventriculogram showed akinesis of the anterior wall and apex and hypokinesis of the septum. The left anterior descending coronary artery was obstructed at its origin and a ghost of the distal artery filled from the circumflex and right coronary arteries. The circumflex artery was normal.

The first injection into the right coronary artery showed a normal proximal vessel. The catheter tip slid down the artery and the pressure wave form became damped. The catheter tip was removed and reinserted. The patient complained of chest pain without ECG change and during the subsequent injection, the vessel appeared to have a fresh narrowing. After a second injection, the narrowing became more severe (Fig 1a). The catheter tip was withdrawn, nifedipine (10 mg) was given sublingually, and after four minutes, the pain subsided. There was no change in arterial blood pressure. A further series of right coronary arteriograms in multiple views showed no evidence of narrowing or irregularity of the arterial lumen; the spasm had disappeared (Fig 1b).

**DISCUSSION**

This case presents direct evidence of the abolition of coronary artery spasm and the relief of angina pectoris by sublingual nifedipine.

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**Unanticipated Response to Alpha-Adrenergic Blockade in Pulmonary Hypertension**

To the Editor:

We wish to report an unanticipated response to parenteral alpha-adrenergic blockade with tolazoline hydrochloride in a patient with primary pulmonary hypertension.

**CASE REPORT**

A 22-year-old black woman presented with a six-month history of progressive fatigue and dyspnea on exertion. Physical examination revealed a well developed female in sinus rhythm with clinical evidence of right ventricular hypertrophy and pulmonary hypertension. Diagnostic cardiac catheterization revealed the following pressures (mm Hg): right atrial, a=17, v=20 (mean=17); right ventricle=100/8; pulmonary artery=100/55 (mean 65); pulmonary wedge=10; left atrium=8; left ventricle=150/8. Three days later, in order to ascertain the degree of pulmonary vascular reactivity, the patient's hemodynamic response to tolazoline was ascertained. Tolazoline, 1 mg/kg, was administered into a peripheral IV line over one minute with continuous monitoring of the hemodynamic response. Within two minutes, the patient became profusely flushed and complained of back discomfort and palpitations. Heart rate increased from 100 to 150 beats per minute. After three minutes, pulmonary artery pressure increased from 100/55 to 140/75 mm Hg (mean=95) and cardiac output increased from 3.5 to 5.75 L/min with systemic blood pressure rising from 130/106 to 140/110 mm Hg. Calculated pulmonary vascular resistance fell by 11 percent and systemic vascular resistance fell by 36 percent. The patient's discomfort resolved within ten minutes while hemodynamic parameters returned to baseline within 45 minutes.

Dresdale and colleagues first reported the value of tolazoline hydrochloride infusion in assessing pulmonary vascular activity in patients with pulmonary hypertension. They gave 25 mg "parenterally." Subsequently, Grover and colleagues reported their experience with eight children with elevated pulmonary vascular resistance greater than twice the normal value. They also gave tolazoline, 25 mg "parenterally".
normal resulting from ventricular septal defects. Using a dosage of 1 mg/kg directly administered into the pulmonary artery, they reduced the resistance to normal in each case without adverse effects. It is unlikely, in this case, that the exaggerated response to tolazoline was due to its administration via a peripheral IV line instead of the pulmonary artery. Weiner states that the acute responses to tolazoline are variable but considerable in some patients with pulmonary hypertension, and a paradoxical increase in pulmonary resistance has been reported in a patient with mitral stenosis. In that situation, the obstruction at the mitral valve was probably an important contributing factor. Therapeutic doses of tolazoline may cause cardiac stimulation that is more than just a reflex response to peripheral vasodilatation and may be associated with arrhythmias possibly related to the histamine and acetylcholine-like properties described by Ahlquist in 1947. In addition, the discovery of catecholamine blockers such as phentolamine and phenoxybenzamine has led to the elucidation of the role of pre- and postsynaptic alpha adrenergic receptors. This apparent paradoxical response can possibly also be explained by catecholamine excess with unopposed beta adrenergic stimulation.

This unanticipated response to parenteral tolazoline in primary pulmonary hypertension is probably not paradoxical since explanations for the occurrence can be proposed. Additionally, discrepant responses to parenteral isoproterenol in pulmonary hypertension would also support the fact that unpredictable responses to catecholamine agonists and antagonists in primary pulmonary hypertension may be more common than heretofore recognized.

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REFERENCES

2 Grover RF, Reeves JT, Blount SG Jr. Tolazoline hydrochloride (Frisoline), an effective pulmonary vasodilator. Am Heart J 1961; 61:3-15

Carbon Monoxide and Stress Testing

To the Editor:

In a previous issue of Chest (1981; 79:302-05) Corbalan et al present what appears to be a fine double-blind study demonstrating that nifedipine significantly improves the exercise tolerance of patients with stable angina pectoris. As the number of studies utilizing an exercise-induced anginal end-point seems to be increasing, with major medical and even surgical decisions being predicated upon their data, it is most distressing to me that an obvious aspect of exercise physiology in these patients is being neglected: namely, carbon monoxide levels in the subjects tested. Decreased time to exercise-induced angina in the presence of very mild elevations in blood carbon monoxide has clearly been demonstrated. These levels were induced in double-blind, controlled studies, both by exposure to cigarette smoke, and freeway air. The physiology has been well worked out, and involves decreased myocardial oxygenation superimposed upon a vascular system inadequate to provide augmented perfusion.

In that the half-life of carbon monoxide is approximately three and one-half to four hours, it is not inconceivable that any patient smoking and/or driving through heavy traffic on his way to the test might have a high enough carbon monoxide level to affect his exercise-induced anginal end-point.

Sadly, as in most studies of this nature, not only do we not know the subjects' carbon monoxide levels, we don't even know who smokes!

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REFERENCES

1 Aronow WS, Rokan SN. Carboxyhemoglobin caused by smoking nonnicotine cigarettes, effects in angina pectoris. Circulation 1971; 44:782-8

To the Editor:

We thank Dr. Moorhead for his letter and agree that a number of factors can influence exercise performance in patients with chronic stable angina pectoris and, certainly, carbon monoxide levels is one of them. In our protocol, special efforts were made to keep some of them constant: several tests were performed consecutively to remove apprehension and to take into account the known adaptation to testing; tests were performed at the same hour of the day and with the same interval after a light breakfast, etc. Carbon monoxide levels were not monitored, but we hope Dr. Moorhead would agree that changes of CO levels are highly unlikely to explain the striking improvement in exercise performance that was observed in every patient.