directly from a polyethylene catheter inserted percutaneously in the radial artery. Blood samples were removed at regular intervals for the determination of halothane concentrations and oxygen and carbon dioxide tensions. Environmental, skin and body core temperatures were measured by a YS1 46 Telethermometer.

When the inspired concentration of halothane had been raised to 4% four patients developed cardiac dysrhythmias (Pulsus bigeminus 3, unifocal extrasystoles 1). Within 5 min of the onset of the dysrhythmia practolol (4 mg) was given intravenously and in each instance sinus rhythm was restored (mean recovery time 34·7 s range 31–39 s). In addition to the restoration of normal rhythm the effect of practolol was to reduce blood flow in the forearm (mean reduction, 18·4%) and in the calf (mean reduction 22·7%). In a control group of four patients with sinus rhythm and not given practolol the forearm blood flow increased slightly (mean increase 7·8%) as did the calf blood flow (mean increase 15·8%) over an equivalent period of study. Thus a significant decrease ($P<0·025$) in limb blood flow occurred in those patients given practolol. This was associated with a significant decrease in blood pressure ($P<0·025$). Furthermore in those patients who developed dysrhythmias the mean blood pressures immediately before the onset of the cardiac disturbances were significantly higher than those in the control group ($P<0·0025$) despite the fact that the arterial pCo_2 values were not significantly different.

C. E. H. holds an MRC Fellowship in Clinical Research.

REFERENCES

HOPE, C. E., CARTER, S. J., HORNY, G. T. & WILCOCK, A. H. (1970). On-line digital computing in venous occlusion plethysmography. *Br. J. Anaesth.*, **42**, 562.

WHITNEY, R. J. (1953). The measurement of volume changes in human limbs. *J. Physiol., Lond.*, **121**.

Comparison of the symptomatic, electrocardiographic and haemodynamic effects of acute and long term β-blockade in angina pectoris

B. SHARMA and S. H. TAYLOR*

Cardiovascular Unit, Department of Medicine, University of Leeds

In many patients with anginal pain during exertion, adrenergic β-receptor blockade induced by either intravenous or oral oxprenolol is associated with conspicuous symptomatic relief, reduction of the electrocardiographic S-T segment depression and haemodynamic changes chiefly characterized by a reduction in the exercising heart rate (Sharma, Majid, Galvin & Taylor, 1970). To confirm these preliminary findings and to establish the predictability of the response to the oral preparation from an acute intravenous injection of the drug, serial studies were made in six patients with uncomplicated angina pectoris.

Comparison of the control studies with those after intravenous oxprenolol and with those after oral oxprenolol demonstrated a conspicuous relief of anginal pain at the same level of exertion in more than half the patients after both methods of administration of the drug. Except for one patient, there was a close correlation between the symptomatic relief afforded by intravenous and oral oxprenolol. There was a significant reduction of the electrocardiographic S-T segment depression during exercise both after intravenous ($P<0·05$) and oral oxprenolol ($P<0·05$). There was a significant reduction in the exercising heart rate and cardiac output both after intravenous and oral oxprenolol; there was a reduction in mean systemic arterial pressure

of 8 mmHg and 6 mmHg after intravenous and oral oxprenolol, respectively. There was little change in the left ventricular function curves relating stroke work to end-diastolic pressure either after intravenous or oral oxprenolol. There was a significant reduction in the left ventricular dp/dt (max) during exercise both after intravenous and oral oxprenolol, but this reduction could probably be largely accounted for by the decrease in exercising heart rate.

These results suggest that in most patients with uncomplicated angina pectoris, intravenous and oral oxprenolol will both result in a conspicuous relief of pain during exercise, and the long-term effects of the oral preparation may be predicted with reasonable certainty from the symptomatic effects of the acute intravenous administration of the drug. Oxprenolol results in a significant improvement in the exercise electrocardiogram whether given by intravenous injection or by mouth. The predominant haemodynamic change is a reduction in heart rate. The fact that left ventricular function is little changed by the drug either after its intravenous injection or after 6 months' oral treatment may possibly be explained by the positive benefit to myocardial oxygen consumption accruing from the direct restraint imposed on the tachycardia of exercise by the negative chronotropic effects of the drug outweighing the reduction in myocardial contractility occasioned by its negative inotropic actions due to adrenergic blockade.

REFERENCE

SHARMA, B., MAJID, P. A., GALVIN, M. C. & TAYLOR, S. H. (1970). Circulatory and electrocardiographic effects of oxprenolol in angina pectoris. *Postgrad .med. J.*, suppl. 72.

Potentiation of the cardiovascular effects of some catecholamines by a monoamine oxidase inhibitor

M. F. CUTHBERT* and D. W. VERE
Department of Pharmacology and Therapeutics, London Hospital Medical College, Turner Street, London, E1

The pressor effect of noradrenaline (NA) is not substantially potentiated by treatment with monoamine oxidase inhibitors (MAOI) (Horwitz, Goldberg & Sjoerdsma, 1960; Elis, Laurence, Mattie & Prichard, 1967; Pettinger & Oates 1968) and it has been generally assumed that the effects of MAOI on other catecholamines are insignificant.

Three healthy male subjects aged 27–41 years were studied. Small doses of NA (1·125–36 μg), adrenaline (1·125–36 μg) and isoprenaline (0·5–9 μg) were delivered intravenously at a constant rate over 30 s and dose related effects determined on heart rate and blood pressure by sphygmomanometry. The object was to simulate a possible accidental intravenous administration of catecholamines. Intravenous phenylpropanolamine (0·9–20 mg), was included as a comparison since it is known that the cardiovascular effects of oral phenylpropanolamine are markedly potentiated by a MAOI (Cuthbert, Greenberg & Morley, 1969). The observations were repeated immediately after each subject had received tranylcypromine (30 mg) daily for 8–14 days. The degree of potentiation was estimated from displacement of dose-response curves using a reciprocal transformation (Draper & Smith, 1966; Vere, 1971).

The results (Table 1) show that the pressor effect of intravenous phenylpropanolamine was potentiated approximately 4–5 times (systolic blood pressure) and 3–10