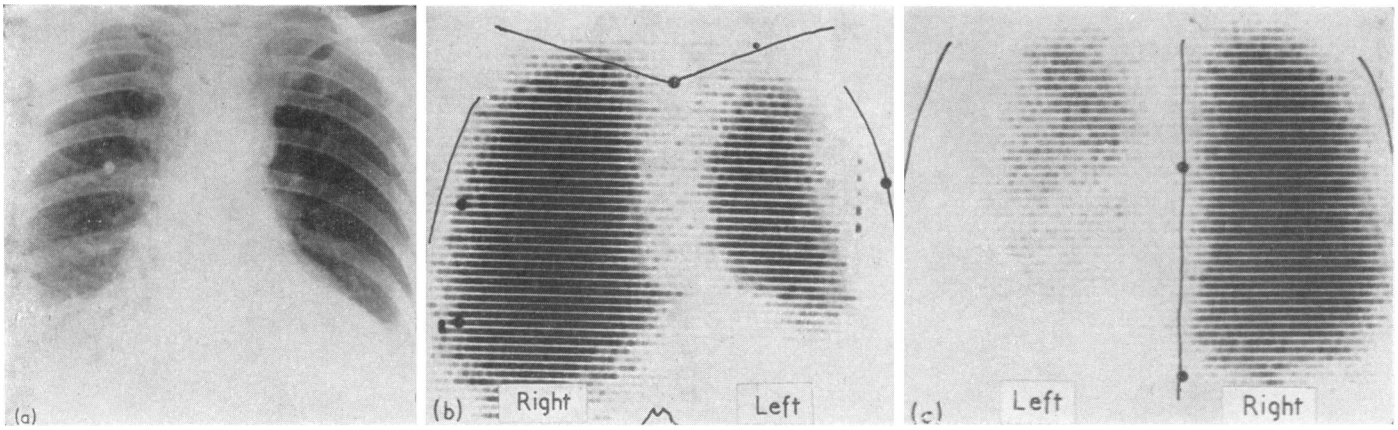
R. H. SECKER-WALKER: SCINTILLATION SCANNING OF LUNGS IN DIAGNOSIS OF PULMONARY EMBOLISM



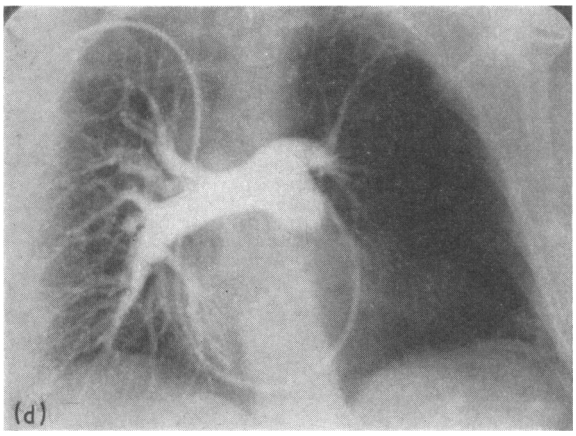


FIG. 6.—Case 5. (*a*) Chest radiograph on admission, 14 January 1967. Oligaemia of most of left lung. (*b* and *c*) Anterior and posterior scans, 17 January. Reduced perfusion of both left upper and left lower lobes. (*d*) Pulmonary angiogram showing small left pulmonary artery and branches, 30 January.

N. CONWAY *ET AL.*: CARDIAC FAILURE AFTER USE OF PROPRANOLOL

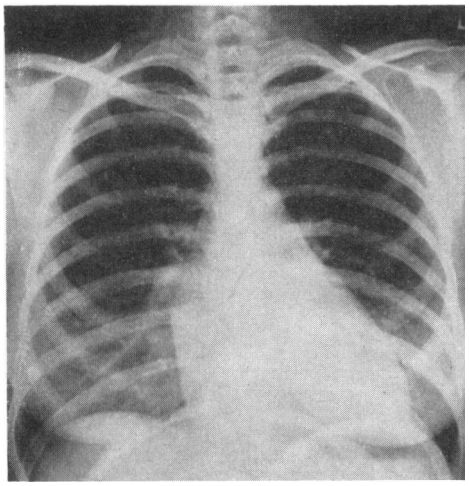


FIG. 1.—Case 2. Chest radiograph on first admission, showing heart size and configuration before propranolol.

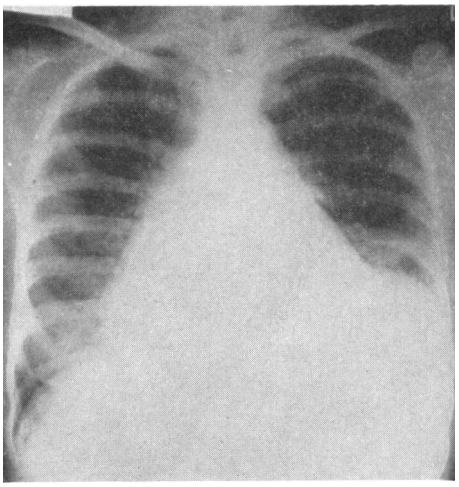


FIG. 2.—Case 2. Chest radiograph showing cardiomegaly and pulmonary venous congestion.

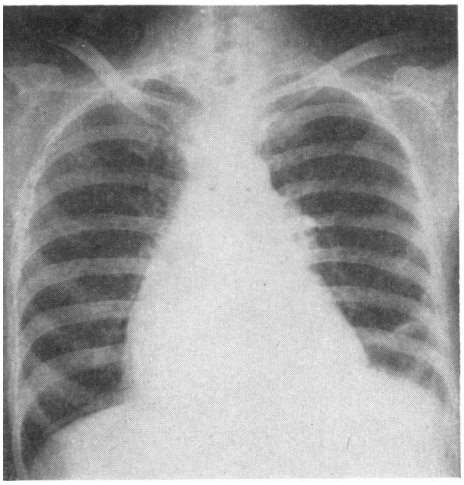


FIG. 3.—Case 2. Chest radiograph 13 days later, after withdrawal of propranolol.

Cardiac Failure in Patients with Valvar Heart Disease after Use of Propranolol to Control Atrial Fibrillation

N. CONWAY,* M.B., M.R.C.P. ; J. SEYMOUR,* M.B., M.R.C.P. ; A. GELSON,† B.A., M.B., B.CHIR.

[WITH SPECIAL PLATE FACING PAGE 207]

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When digitalis fails to control atrial fibrillation propranolol may be useful in slowing the ventricular rate (Besterman and Friedlander, 1965 ; Rowlands *et al.*, 1965). The beta-adrenergic blockade which propranolol causes may induce or aggravate cardiac failure, as cardiac sympathetic nervous stimulation is an important factor supporting myocardial function (Gaffney and Braunwald, 1963). Therefore it is likely that in some patients propranolol may control the heart rate at the expense of myocardial efficiency. This paper reports the cases of four patients with atrial fibrillation and chronic valvar heart disease in whom propranolol was used to control the ventricular rate when digitalis had failed. In each case, though the rate was adequately controlled, heart failure occurred.

Case 1

A 36-year-old man with rheumatic aortic valve disease developed atrial fibrillation, whereupon his exercise tolerance decreased. In September 1966, at another hospital, sinus rhythm was restored by direct current (D.C.) shock and dyspnoea diminished. Propranolol 120 mg. daily was started as an anti-arrhythmic drug. Atrial fibrillation recurred with return of dyspnoea, and D.C. conversion was carried out in December 1966 and again in February and March 1967. After each D.C. conversion sinus rhythm was maintained for progressively shorter periods. Attempts to stop propranolol were followed by uncontrolled ventricular rates, and for this reason it was continued.

After the last D.C. conversion propranolol was increased to 240 mg. daily, and when atrial fibrillation recurred two days later digoxin was started. Exertional dyspnoea increased with orthopnoea and haemoptysis, and in April 1967 he was admitted to hospital but diuretics were not given. His condition deteriorated and 10 days later he was transferred to the Middlesex Hospital for urgent aortic valve replacement.

When seen he was in pulmonary oedema, coughing frothy blood-stained sputum. The respiration rate was 60/min. and there was marked central cyanosis, but the ventricular rate was only 90/min. Jugular venous pressure was 10 cm. and ankle oedema was present. He had the signs of severe aortic and mitral regurgitation. A chest radiograph confirmed extreme pulmonary oedema and considerable cardiomegaly.

Propranolol was stopped and he was treated with intravenous frusemide, morphine, and aminophylline. Oxygen was given and venous tourniquets were applied. He responded slowly in the first 24 hours with a poor diuresis, but over the next three days larger diureses occurred with gradual clearing of pulmonary oedema. The heart rate did not increase. The lung fields were clear 10 days later. Subsequently the aortic valve was replaced by a homograft and the mitral valve repaired.

Case 2

A 44-year-old woman with rheumatic mitral valve disease complained of increasing breathlessness on effort. Atrial fibrillation occurred, causing acute dyspnoea, and she was admitted to hospital. The ventricular rate was controlled with digitalis and, later, cardiac catheterization confirmed significant calcific mitral valve disease with stenosis and regurgitation. The chest radiograph is shown in Fig. 1 (Special Plate). She was given digoxin and bendrofluazide.

While waiting for surgery she was admitted to another hospital as an emergency case, with a rapid heart rate and a severe right hemiplegia of sudden onset. Anticoagulants were started. The heart rate proved difficult to control with digitalis, so propranolol 120 mg. daily was added. Ethacrynic acid was substituted for bendrofluazide. Subsequently, despite restricted activities, she noted progressive breathlessness, orthopnoea, and ankle oedema. On readmission to the Middlesex Hospital she was in frank congestive failure with a heart rate of 85/min. The signs of pulmonary hypertension and tricuspid regurgitation were now present. A chest radiograph showed a considerable increase in heart size with evidence of pulmonary venous hypertension and a left basal opacity (Special Plate, Fig. 2).

Propranolol was withdrawn and the diuretic, given on alternate days, was changed from ethacrynic acid (100 mg.) to frusemide (80 mg.). The dose of digoxin was doubled (to 0.5 mg. daily). The heart rate remained between 80 and 90/min. for several days and then rose to 140/min. Subsequent rate control was achieved only with parenteral digitalis. Signs of failure disappeared slowly and 13 days later the chest radiograph (Special Plate, Fig. 3) showed considerable reduction in heart size with diminution of pulmonary venous congestion.

Case 3

In 1963 a 47-year-old woman with aortic and mitral valve disease developed atrial fibrillation and was digitalized. Over succeeding years her rate was often rapid despite apparently adequate doses of various digitalis preparations. In January 1966 propranolol 30 mg. daily was added by her practitioner and thereafter the ventricular rate was well controlled. However, exertional dyspnoea increased steadily until it occurred on the slightest effort, and when she attended the Middlesex Hospital in October 1967 her chest radiograph showed cardiac enlargement and conspicuous pulmonary venous congestion. The heart rate was 90/min. Propranolol was stopped and admission advised. Within a few days her heart rate rose to 160/min. and she was admitted as an emergency case. The dose of digoxin was increased, with a satisfactory fall in ventricular rate. The diuretic regimen was not altered. Subsequent chest radiographs showed considerable improvement in pulmonary venous congestion and some reduction in heart size.

Case 4

A 55-year-old woman with aortic incompetence and mitral valve disease had had recurrent attacks of atrial fibrillation for several years. D.C. conversion was carried out on three occasions, the last in June 1967. In December atrial fibrillation recurred with a ventricular rate of 160/min. Digoxin failed to control the heart rate, so propranolol 80 mg. daily was added in January 1968. Slowing of the heart rate was achieved. Diuretics were not given. Over the next six weeks she noted progressive breathlessness and

* Senior Registrar, Cardiac Department, Middlesex Hospital, London W.1.
† House-physician, Cardiac Department, Middlesex Hospital, London W.1.

orthopnoea and was transferred to the Middlesex Hospital with a view to cardiac surgery.

On admission the pulse rate was 50/min. The jugular venous pressure was raised. A chest radiograph showed that the cardiothoracic ratio had increased from 56 to 64% over the six-week period during which propranolol had been given. Pulmonary venous congestion had appeared.

Propranolol was withdrawn, digoxin was continued, and diuretics were started. Over the next three days the heart rate rose to 120/min. An increase in the dose of digoxin resulted in satisfactory control of the ventricular rate. One week after admission the chest radiograph showed the cardiothoracic ratio had decreased to 51%; pulmonary venous congestion had cleared.

Discussion

The risk of inducing cardiac failure with propranolol is now well established and most reviews allude to it. At the symposium on beta-adrenergic receptor blockade at Buxton, Stephen (1966) reviewed the published experience in 1,500 patients receiving propranolol orally for various reasons. He noted 13 in whom cardiac failure was recorded as a complication. Three of these cases had rheumatic heart disease. At the same symposium the action of propranolol in slowing rapid atrial fibrillation was underlined (Szekely *et al.*, 1966).

In the four cases reported above the patients had chronic valvar disease with atrial fibrillation and in each case control of the ventricular rate had proved difficult with digitalis. Recourse to propranolol was certainly highly effective in slowing the heart; this was strikingly illustrated by the first patient, whose rate was only 90/min. in the presence of gross left ventricular failure. In each instance the slow pulse appears to have induced a false sense of security, particularly in Cases 2 and 3, where digitalis and diuretics were also being given. In these circumstances deterioration in a patient's condition might well be ascribed to the inevitable progress of heart disease unless the possible adverse action of propranolol on myocardial function were kept in mind. Certainly, each patient had important valvar disease, which imposes a progressive burden on the myocardium, but in view of the sequence of events and the accepted pharmacological action of propranolol it seems likely that this drug precipitated cardiac failure.

Many patients with rapid atrial fibrillation, apparently refractory to digitalis, are underdigitalized. Occasionally they do not take the digitalis prescribed, or they fail to absorb it; sometimes they need unusually large amounts. If these patients are given propranolol the reduction in heart rate masks the need for digitalis. Indeed we have noticed that patients taking propranolol sometimes have such slow heart rates that digitalis is temporarily withheld for fear of overdosage. Digitalis is reputed to protect the heart to some degree from propranolol-induced failure, since its positive inotropic action is not influenced by beta blockade (Levy and Richards, 1965). Patients who are underdigitalized are therefore more vulnerable to this danger. Three patients (Cases 2, 3, and 4) were probably inadequately digitalized judging by the sharp rise in heart rate when propranolol was stopped. In Case 2 this tachycardia occurred despite increased digitalis dosage. Later, rate control was established with digitalis alone.

Even if adequate digitalis is given, propranolol should be employed with particular care if used to control rapid atrial fibrillation in patients with chronic valvar disease. In uncomplicated mitral stenosis, where diastolic filling time is at a premium, the reduction in ventricular rate produced by beta blockade may be helpful (Stock, 1966). With most other severe valve lesions the use of propranolol is more hazardous because of impaired myocardial function. The manufacturers are at pains to point out the risk of inducing heart failure with propranolol, but judging from our experience this hazard needs emphasizing.

Summary

The cases of four patients with important chronic rheumatic valvar disease are described, in whom atrial fibrillation was difficult to control with digitalis. Propranolol was successfully used to slow the ventricular rate, but, though two of the patients were on diuretics, heart failure resulted. Three patients were probably inadequately digitalized. The role of propranolol in causing or accelerating heart failure is discussed, and it is concluded that the use of this drug for controlling atrial fibrillation in the presence of significant valvar disease is hazardous.

We thank Dr. Walter Somerville and Dr. Richard Emanuel for their helpful advice during the preparation of this paper and for permission to report cases under their care. We are grateful to Mr. Donald Ross, who operated on the first patient.

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