acidosis due to tissue hypoperfusion, such as occurs in advanced heart failure.

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Reduction of beta-blocking drugs in hypertensive patients treated with minoxidil

Combining high-dose beta-blocking drugs with minoxidil has proved valuable in severe hypertension.¹ Brunner *et al.*,² however, suggested that beta-blocking drugs may be reduced or even withdrawn in patients taking long-term minoxidil without loss of blood-pressure (BP) control or occurrence of reflex tachycardia. This might also be expected to improve left ventricular function and increase exercise tolerance. We have therefore studied the haemodynamic effects, at rest and during exercise, of reducing beta-blocking drugs in 10 hypertensive patients receiving minoxidil and high-dose beta-blockade.

Patients, methods, and results

We studied seven men and three women (mean age 56±SD 7 years) whose BP had been controlled with minoxidil 5-50 (mean 20) mg daily and either atenolol 200 mg (three patients) or propranolol 320-720 (mean 446) mg daily for at least two years. Measurements were made before and five weeks after reduction (over 10 days) of beta-blocking drugs to propranolol 40 mg twice daily. BP and heart rate (HR) were recorded after five minutes' lying and two minutes' standing. Resting left ventricular function was determined from systolic time intervals and "M"-mode echocardiograms.³ Patients were exercised submaximally on a bicycle ergometer against an increasing work load, the end-point being intolerable dyspnoea or fatigue. BP, HR, and 16-lead precordial electrocardiographic (ECG) maps were recorded before, during, and for 10 minutes after exercise. The ECG maps were then scored according to the area and degree of ST-segment depression.⁴

Haemodynamic values before (1) and after (2) reduction of beta-blockade in hypertensive patients taking minoxidil

Case No	Beta-blockade* (mg)	Min-oxidil (mg)	Blood pressure (mm Hg)				Heart rate (beats min)				Maximum exercise blood pressure (mm Hg)		Maximum exercise heart rate (beats min)		Maximum heart rate and mean blood pressure product		Duration of exercise (min)		PEP LVET+ (")		Echo left ventricular ejection fraction (")		Resting ST-segment depression (mm)								
			Supine		Erect		Supine		Erect		1	2	1	2	1	2	1	2	1	2	1	2	1	2							
			1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2							
1	p480	15	150	92	245	170	168	93	174	124	52	57	62	66	Restarted on high-dose beta-blockade																
2	a200	50	144	95	195	116	150	100	166	118	64	66	74	72																	
3	a200	5	152	98	143	98	133	89	149	102	72	80	74	82	176	100	194	120	115	143	14375	20375	7-0	9-0	36	34	56	58	0	0	
4	p320	30	136	84	148	81	138	84	127	93	68	70	64	67	180	108	190	115	115	130	15180	18200	4-0	4-0	28	24	73	70	0	3	
5	a200	15	141	77	143	98	131	79	146	98	54	64	69	80	190	94	224	118	105	133	13230	20349	6-0	7-0	24	31	57	48	3	4	
6	p720	30	126	86	150	97	124	84	131	91	56	72	60	76	160	100	156	102	110	125	13200	15000	8-6	13-0	16	19	45	44	0	0	
7	p480	10	131	85	125	85	116	76	128	80	65	82	66	85	120	70	160	100	90	95	7830	11400	3-5	3-8	35	41	62	64	0	0	
8	p320	10	150	84	146	84	130	79	132	90	64	74	62	86	190	100	182	105	110	125	14300	16250	2-0	3-0	30	30	42	—	0	0	
9	p480	15	148	88	155	105	146	90	149	103	66	80	74	80	198	100	188	120	95	110	13205	15620	3-0	2-0	27	30	69	63	0	0	
10	p320	20	175	95	150	71	169	84	159	94	76	78	76	82	190	98	210	120	105	110	13440	15000	4-0	3-0	23	30	45	32	5	9	
Mean	p446	20	145	87	145	90	135	83	140	94§	65	75	68	80	176	98	188	112§	106	120	13095	16569	4-8	5-6	27	30	56	54			
SE of mean			6/3		3/4		6/2		5/2		3		2		9/5		9/3		3		6		848		1/167		0/8		1/5		
P†			NS				§<0-002				<0-02		2		<0-002										NS						

*P = Propranolol. a = Atenolol.
†PEP = Pre-ejection period. LVET = Left ventricular ejection time.
‡Significance determined by Mann-Whitney U test. NS = Not significant.

In two patients BP rose sharply within five days after halving the dose of beta-blocking drugs and the original doses were restarted. In the remaining eight patients erect diastolic BP and HR rose significantly both at rest and during exercise (table). Resting left ventricular function, however, was not significantly altered, and neither maximum work capacity nor the duration of submaximal exercise was increased. New ST-segment depression was seen on the ECG maps of three patients at rest and in one further patient during exercise only. In this patient it was associated with angina pectoris. Maximum exercise HR and mean BP product, reflecting myocardial oxygen consumption,⁵ was also significantly increased. (The dose of propranolol had to be increased to 160 mg daily in three other patients within 12 weeks after the initial reduction to maintain BP control.)

Comment

The increases in erect BP and HR, although small, suggest that despite prolonged control of the BP with minoxidil the baroreflex-mediated increase in sympathetic activity continues. The ischaemic changes on the ECG maps and the increased myocardial oxygen consumption are probably mediated by sympathetic overactivity, and relative myocardial ischaemia may account for the lack of improvement in left ventricular function. This in turn would limit exercise tolerance. Reducing the dose of beta-blocking drugs does not appear to confer any benefit to set against some impairment of BP control and the appearance of ischaemic ECG changes. These results do not support the findings of Brunner *et al.*² High-dose beta-blocking drugs should not therefore be routinely reduced in patients receiving long-term minoxidil treatment.

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Corrections

Respiratory influence on heart rate in diabetes mellitus

We regret that an error occurred in the paper by Dr G Sundkvist and others (7 April p 924). In the second sentence below the figure on p 925, "Diabetics with sensory neuropathy . . . were taking significantly more insulin" should be corrected to ". . . significantly less insulin."

Campylobacter enteritis associated with consumption of unpasteurised milk

In the paper by Dr D A Robinson and others (5 May, p 1171) Dr Edgar's initials should be W M and not W J.