Psychological methods in treatment of hypertension: a review¹

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It has been shown in recent years that the blood pressure of most hypertensives can be regulated successfully with drugs (Freis, 1967, 1970). Nevertheless, there are circumstances in which alternative methods of management are attractive. Hypotensive agents frequently produce unpleasant side effects. Bulpitt and Dollery (1973) found that a substantial number of patients complained of sleepiness, weakness of the limbs, or postural hypotension, and it appears that few of the drugs in common use are completely free of such complications (Page *et al.*, 1976). There is also the problem of compliance with treatment. Blackwell (1973) has estimated that over 25 per cent of outpatients do not take prescribed drugs regularly; this is most likely to occur with patients on long-term treatment or taking more than one drug. Both these factors are common in the management of essential hypertension.

Even when patients are under treatment, the regulation of blood pressure is not always satisfactory (Langfeld, 1973). Taguchi and Freis (1974) observed that a considerable proportion of the patients who entered the Veterans Administration study with diastolic pressure levels between 90 and 114 mmHg did not show reductions below 90 mmHg during active treatment. Doubts about the effectiveness of drug therapy for diastolic pressures under 105 mmHg have recently been discussed by Short (1975). Problems with drug therapy may be particularly disturbing in the case of younger hypertensives, since many are faced with the prospect of very long-term medication for an asymptomatic condition.

Recent interest in the psychological regulation of blood pressure has been focused on two methods of voluntary control. The first, known as 'biofeedback', has evolved from research in both man and animals on the instrumental conditioning of

visceral and autonomic functions (Miller, 1969). The patient is provided with information feedback of blood pressure and so is made aware of fluctuations in the level. Regular or continuous monitoring of pressure is required in order to maintain the feedback loop. With such training, the patient may learn to regulate the pressure level and ultimately to reduce it. Exteroceptive feedback of either systolic or diastolic blood pressure can be given, depending on the monitoring techniques available. The second method of control depends on instructing people in relaxation or meditation; compliance with these instructions may lead to deep relaxation of skeletal musculature, together with reduced arousal of the autonomic nervous system. This latter approach will be termed 'instructional' in this review; despite wide variations in the methods by which relaxation and meditation are induced, all such procedures are characterised by programmes of verbal instruction. It has been argued that many techniques such as yoga, hypnosis, transcendental meditation, and zen, may be grouped together since they lead to similar hypometabolic states (Benson *et al.*, 1974a).

There is some difference in the type of voluntary control achieved using biofeedback on the one hand, or instructional methods on the other. Exteroceptive feedback is used to train subjects in the direct control of blood pressure, and this can include both increasing and decreasing the level. Relaxation and meditation produce reductions in autonomic arousal of which blood pressure changes are only one manifestation. In consequence, feedback procedures may lead to specific changes in blood pressure that are relatively independent of other cardiovascular and physiological adjustments, in contrast to the general effects of instructional techniques. It should also be pointed out that while instructional procedures can be simply and economically applied, biofeedback requires instrumentation for continuous or semicontinuous blood pressure monitoring.

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The effects of both biofeedback and instructional techniques in lowering blood pressure are being investigated in patients with essential hypertension. It is inevitable that in a rapidly expanding field of this kind, a review of the current status of treatments cannot be regarded as definitive. Nevertheless, it is hoped that trends emerging from these studies can be identified, and that readers will be able to evaluate the usefulness of the techniques.

Size of effects

The assessment of psychological treatments must take into account the modifications which can be produced with drugs, together with the magnitude of responses that can be considered clinically significant. For example, Freis (1970) reported that patients starting treatment with diastolic blood pressures between 90 and 114 mmHg showed average reductions in systolic and diastolic pressure of 27.2 and 17.4 mmHg, respectively. Greater effects are seen in patients with higher initial pressure. However, Taguchi and Freis (1974) found that a proportion of patients responded only moderately to antihypertensive medication, but nevertheless sustained a reduced rate of morbid events similar to that in patients who showed large pressure reductions. In this group of poor responders the average decrease in diastolic blood pressure was only 7 mmHg. Dorph *et al.* (1970) classified patients into good and poor responders according to the extent to which blood pressure remained above the normal limits for each age group. No difference was found between patients in the two categories in relation to a number of visceral signs of pathology. It can thus be argued that while large changes in blood pressure are desirable, clinically valuable effects may result from comparatively small reductions.

Non-specific factors

Blood pressure is extremely sensitive to external influences. Factors such as clinical attention and an enthusiastic approach to treatment can lead to dramatic blood pressure reductions. Goldring *et al.* (1956) 'treated' hypertensive patients with an impressive electronic gun, having led patients to expect much of the procedure. Decreases in blood pressure of up to 38/27 mmHg were found, though full responses frequently did not occur for several weeks. Similarly with oral placebos, reduction in blood pressure from 222/128 to 176/112 mmHg has been reported, a significant effect being maintained for over 6 months (Grenfell *et al.*, 1964).

On the other hand, the influence of placebos may

have been exaggerated, and confused with other causes of blood pressure fall. The greatest decreases in blood pressure observed by Goldring *et al.* (1956) occurred during the pretreatment stabilisation phase in hospital. Likewise, Moutsos *et al.* (1967) found that many of the effects of drug placebos, including apparent 'dose related' responses, were primarily a function of the duration of hospital stay.

It is probable that any instructional or feedback programme for blood pressure reduction will involve these non-specific factors by generating high expectations for new, vigorously pursued treatments. The resulting reductions cannot be distinguished from the true effects of the treatment unless a control group is given a placebo with equal expectations and the same amount of clinical attention. Thus studies confined to a single group of patients receiving the 'active' treatment do not provide convincing evidence for the value of that procedure. It will be apparent that many of the reports of psychological approaches to the treatment of hypertension fall into this category.

I will not attempt to discuss all the reports of voluntary blood pressure control in hypertensive patients. Several describe laboratory studies which do not include adequate pretreatment assessment or follow-up data. A number are methodologically unsound, first in the use of unsatisfactory blood pressure measurement protocols and secondly in the failure to allow sufficient time for patients to adapt to repeated blood pressure measurements and to the laboratory setting. It is well known that blood pressure recorded in the clinic or laboratory will fall during the course of several sessions, and such a trend can be mistaken for an effect of treatment (Dunne, 1969; Benson *et al.*, 1971; Brady *et al.*, 1974).

Biofeedback methods

It has been found in a number of laboratories that normotensives can raise or lower systolic and diastolic blood pressure using feedback techniques, and there have been some investigations of the mechanisms involved (Brenner, 1974; Steptoe, 1976). Kristt and Engel (1975) have shown that voluntary control can also be acquired by hypertensives. Five patients with long histories of high blood pressure were trained intensively with feedback, and all showed that they were able to raise and lower systolic pressure. This ability was maintained even after several weeks without laboratory training.

Hypertensive patients have been investigated in a number of other studies. Benson *et al.* (1971) studied 7 patients on a number of occasions,

care being taken to allow for complete adaptation to the laboratory and measurement procedures before contingent systolic pressure feedback was introduced. Systolic blood pressure was reduced from a postadaptation average of 164.9 mmHg to 148.4 mmHg at the end of training, the fall in blood pressure varying from 0 to 33.8 mmHg. Diastolic pressures were not recorded, and no follow-up data were reported, so the authors were justifiably cautious in ascribing therapeutic value to the procedure. No control group was included.

Goldman *et al.* (1975) treated 7 unmedicated hypertensives with systolic pressure feedback, and compared them with 4 patients who attended blood pressure measurement sessions alone. By the beginning of the ninth session, blood pressures were reduced from an average of 167.4/108.6 to 161.1/93.9 mmHg, a change which was significant for diastolic pressure only. In contrast, the blood pressure in the control subjects altered from 154.4/98.9 to 157.0/94.5 mmHg. Significant within-session reductions in systolic pressure (average 7.0 mmHg) were also observed in the feedback group. No follow-up data were reported. The diastolic pressure reductions observed in this study are particularly impressive, with falls in pressure ranging from 5 to 35 mmHg. Unfortunately, a number of features in the design make this result difficult to interpret. The blood pressures recorded at the beginning of each session were taken by conventional sphygmomanometry, and the authors do not state that the observer was unaware of whether patients were in control or treatment groups; this practice can lead to bias and error (Wright and Dore, 1970). There were no pre-training sessions to allow for adaptation and it is possible that some of the pressure reductions were a result of this factor. The control group only attended for 3 sessions, but even in this time showed an average reduction in diastolic pressure of 4.3 mmHg. The two groups showed a difference in initial blood pressure and may therefore not be comparable. It is also disturbing that significant reductions were seen in diastolic but not systolic blood pressure, even though the latter was the pressure that patients were learning to control.

A further controlled study has been reported by Richter-Heinrich *et al.* (1975). Thirty untreated mild hypertensives, with an average initial systolic pressure of 144 mmHg, were investigated in a short 4-session experiment. Ten of the patients acted as 'yoked controls'; that is the pressure feedback which they received was derived from another subject and not from themselves, so that the effect of the conditioning procedure *per se* could be discovered. Both between-session and within-session

reductions in blood pressure were observed, and these were consistently greater in the true feedback condition. On the fourth day, the pre-session systolic pressure averaged 123 mmHg in this group. Although this experiment was brief, with no adaptation period or follow-up data, there are a number of features which should be mentioned: (a) The changes in systolic pressure were not dependent on changes in diastolic pressure and heart rate, thus showing the specific nature of feedback training. (b) Patients who were classified as highly anxious on a paper and pencil test showed significantly smaller reductions in blood pressure than the less anxious individuals. (c) The feedback was provided by an automatic recorder which monitored blood pressure once a minute. This is different from the sophisticated systems for semicontinuous measurement that have been used by others, and suggests that simple, widely available equipment may be relatively effective.

This conclusion is supported by Blanchard *et al.* (1975) who gave 4 hypertensive patients relaxation instructions followed by systolic pressure feedback once a minute. Blood pressure decreases were seen in all patients during the experimental sessions. Intermittent feedback was also employed in the studies by Elder and his colleagues (Elder *et al.*, 1973; Elder and Eustis, 1975). Their results are difficult to assess, since blood pressure changes are expressed as percentage changes from the level at the beginning of treatment, and because no time was allowed for habituation or adaptation. In the study which showed positive results, patients were admitted to hospital and put on salt-free diets three days before the experiment (Elder *et al.*, 1973). No clinically significant effects of feedback training were observed by Elder and Eustis (1975) on 30-day follow-up of a mildly hypertensive outpatient group.

The studies discussed above have all used feedback of systolic pressure, and there is little evidence on the efficacy of diastolic pressure information. However, Schwartz and Shapiro (1974) briefly reported a study of 7 hypertensives who were trained with diastolic pressure feedback for 10 sessions. Only one patient responded positively. The modification of patterns of cardiovascular activity was examined by Surwit and Shapiro (1977). Borderline hypertensives were given feedback only when systolic pressure fell and heart rate slowed simultaneously, so that a reduction of general cardiovascular arousal might be generated. Reliable clinical gains were not made, but it is probable that this pattern feedback was inappropriate since patients' heart rates were not increased in the first place.

It can be concluded that clinically useful blood pressure changes with feedback have not been consistently shown. In some cases the blood pressure reductions have been substantial, but they have not been shown to persist. It is possible that efficient and lasting self-control requires rather more sessions than have commonly been employed. For example, the large effects reported by Benson *et al.* (1971) were the result of up to 32 treatment sessions.

Most of the experiments reviewed here were concerned with the demonstration of blood pressure control by hypertensives, and have not included control groups, or follow-up data or other indices of treatment effectiveness. But considerable energy is being devoted to the field, and the roles of biofeedback and the other components of training may be elucidated soon. It is probable that the relaxing laboratory conditions under which training has been carried out are not ideal. Blood pressure falls over time in such settings irrespective of the presence of biofeedback, while attention to a stimulating feedback display may militate against more profound blood pressure changes (Steptoe, 1976). The control of pressor reactions to specific conditions of psychological stress may be more fruitful than attempting to alter the blood pressure level when the patient is at rest.

Instructional methods

The instructional methods that have been studied in relation to hypertension have a number of common features. Nearly all emphasise deep relaxation of the muscles, while attention is frequently directed towards breathing movements (Beary and Benson, 1974). The subject is encouraged to repeat quietly a syllable or short word which prevents his mind from wandering. The mystical properties of this syllable are probably irrelevant to the physiological effects of a technique (Woolfolk, 1975). The rationale for employing instructional techniques in primary hypertension is that they can lead to reductions in autonomic, and particularly sympathetic, discharge. It is hoped that this will continue outside the training setting.

One popular version of the instructional method is transcendental meditation, a yoga technique adapted for Western use. In normotensives, reduction in oxygen consumption and heart rate have been observed, without changes in blood pressure (Wallace *et al.*, 1971). Despite this latter result, the technique has been applied to the treatment of essential hypertension.

Two studies of similar design have been carried

out by Benson and his colleagues (Benson *et al.*, 1974b, c). In both of these studies, volunteers who were about to undergo initiation into transcendental meditation and who knew themselves to be hypertensive, were recruited. It should be pointed out that these volunteers had already chosen to learn meditation before entering the study, and were not persuaded to do so by the investigators. Repeated blood pressure measurements were taken before and after they learned the technique, and were continued for 5 to 6 months. In the first study, 14 people who were taking anti-hypertensive drugs were followed (Benson *et al.*, 1974b). The average premeditation blood pressure was 145.6/91.9 mmHg, and by the end of follow-up blood pressure had fallen by 10.6/4.85 mmHg. The second group of younger subjects were not on treatment, and their average baseline blood pressure was 146.5/94.6 mmHg. Significant reductions in both systolic and diastolic blood pressures were again seen, the mean change being 6.98 and 3.86 mmHg, respectively. Although these results are consistent, their general applicability is open to doubt. The patients were self-referred and atypical in wanting to learn transcendental meditation. High expectations of benefit are likely to be generated when people are being initiated into such a technique. Detailed physical examinations and medical histories are not reported, so that the origin, duration, and variability of the high blood pressure are unknown. In the study of treated hypertensives, no data concerning adherence to prescribed treatment are presented.

A study of transcendental meditation in a well-documented group of hypertensives has been reported by Blackwell *et al.* (1976). After 9 weeks of supervised meditation, 4 of the 7 patients showed significant reductions in blood pressure with no change or some increase in blood pressure in the other 3 patients. At 6 months, only 3 patients maintained these reductions in blood pressure, and some of these effects were contaminated by alterations in drug treatment. The authors concluded that only 2 out of the sample showed sustained decreases, with falls in blood pressure of 13.0/8.2 and 18.0/14.3 mmHg. This report indicates that transcendental meditation has a beneficial effect on the blood pressure of only a minority of people. One of the 'successes' had been diagnosed as hypertensive for only 2 months before treatment, and was not typical of the group studied. Recently, Pollack *et al.* (1977) reported that transcendental meditation had no lasting effects on blood pressure in a group of 20 hypertensives even though many reported subjective feelings of well-being. Systolic blood pressure fell significantly in the first 3 months of

meditation, but by 6 months it did not differ from starting levels.

Conflicting results have emerged from experiments with instructional procedures that, while similar to transcendental meditation, are shorn of its proprietary and mystical overtones. Stone and DeLeo (1976) selected 19 young, well-motivated patients, none of whom was taking antihypertensive drugs. Five were employed as no treatment controls, while the remaining 14 underwent 5 brief relaxation sessions. After 6 months, the blood pressure of controls was unchanged, while there was a significant reduction in the treatment group. The average drop in mean arterial pressure (supine) was 12 mmHg, and 8 of the patients showed decreases of over 14 mmHg. An attempt was made to evaluate peripheral sympathetic activity by monitoring plasma dopamine-beta-hydroxylase (D β H) and plasma renin activity (PRA). The former has been suggested as an index of chronic adrenergic activity, though its use as such has yet to be firmly established (North and Mulrow, 1976). Reductions in both D β H and PRA were observed in the treatment group, and there were significant correlations between the decrease in D β H activity and the blood pressure fall. The fact that the patients in this study had only mildly raised pressure levels to start with (average mean arterial pressure was 110 mmHg) may have contributed to the comparatively large effects. But this is contradicted by the failure of Surwit and Shapiro (1977) to show a fall in blood pressure with a similar technique in a group of borderline hypertensives. This latter study underlines the powerful effect of the circumstances of measurement on blood pressure levels. Average pretreatment blood pressures of 156/92 mmHg were abstracted from medical notes, but in a physician's examination, levels of 170/100 mmHg were recorded. By the time relaxation therapy was introduced after 2 sessions of acclimatisation to the laboratory, average blood pressure had fallen to 137/87 mmHg. It is clear that failure to record adequate baseline measurements could lead to a completely spurious treatment result.

The last group of reports involve more complex techniques. Striking effects of autogenic training were seen in an uncontrolled trial by Klumbies and Eberhardt (Luthe, 1969). Average blood pressure falls of 35/18 mmHg were obtained in 26 patients. This study, which is only briefly described, is unusual in that over 50 patients dropped out of treatment, while of the remainder 17 were under 26 years old. Scanty reporting of baseline and measurement procedures also makes an experiment by Datey *et al.* (1969) on the effects of yoga difficult to interpret.

Further evidence for the value of yoga has emerged from the work of Patel (1973, 1975; Patel and North, 1975). A treatment package has been devised that includes lectures on blood pressure and stress, relaxation and meditation exercises, and exteroceptive feedback of muscle tension or skin resistance. It should be pointed out that biofeedback is here used as an indicator of general relaxation, rather than as a technique for specific blood pressure control. The first study by Patel (1973) will not be discussed in detail, since it has been followed by a randomised controlled trial with 34 patients (Patel and North, 1975). Treatment was carried out for only 12 half-hour sessions, during which control patients were simply asked to relax without specific instructions. Pretreatment blood pressures averaged 168/100 mmHg in the treatment and 169/101 mmHg in the control group, and almost all subjects were taking antihypertensive drugs. At the end of three months' follow-up, systolic and diastolic pressures were reduced by 26.1 and 8.9 mmHg, respectively, in the treatment group, and by 8.9 and 4.2 mmHg in the control group; the difference between the groups was significant. These effects were maintained for a further six months in the treatment group, while control patients changed to the active instructional programme. They likewise responded with blood pressure reductions, coming down to the same level as the first treatment group. This study confirms the earlier results from Patel (1973), even though active treatment time was considerably curtailed. It is apparent that this programme has a substantial effect on the blood pressure of hypertensives. But high therapeutic expectations, generated by the initial meetings and the vigorous treatment, may have contributed to the size of effects in the experimental situation. Patients were encouraged to apply training in their everyday lives, and to practise relaxation and meditation regularly. This extensive active participation by patients seems to pay considerable therapeutic dividends.

Conclusions

The methods reviewed here differ widely in sophistication and duration of treatment. Comparison between them is also hampered by the variation in age, blood pressure, drug treatment, and clinical history of the patients studied. In several cases, large blood pressure reductions have been observed. However, the effects cannot be attributed solely to the biofeedback or instructional methods employed. Comparison has not been made with vigorously pursued 'pseudotherapy' with similar high expectation of benefit. Thus the contribution of non-

specific placebo factors has yet to be evaluated. Nor is the mechanism of blood pressure reduction clear, since few clinical and physiological variables have been recorded apart from the blood pressure itself. Sympathetic pathways are implicated by Stone and DeLeo (1976) and by Richter-Heinrich *et al.* (1975), but more direct evidence is required.

The precise mechanism of therapeutic effects cannot be determined without measurements of variables other than blood pressure. Changes may occur in diet, exercise, smoking, and adherence to drug regimens, and these can lead to blood pressure reductions. Complete alterations in life style have been anecdotally reported by initiates into meditational practices, but few studies have recorded such behavioural data. The contribution of all these factors warrants careful investigation. Yet demonstration of their presence would not be unwelcome. Active participation by patients in a behavioural treatment will inevitably lead to many changes. Thus if adjustments in life style and diet do have effects on blood pressure, they should perhaps be explicitly encouraged in therapy. Biofeedback and instructional methods cannot be used in the same way as drug treatments, where the patient participates passively. These methods of treatment challenge patients to be the principal agents of treatment, and will not be effective without active involvement. Such methods may help to motivate patients to make the necessary adjustments in behaviour; indeed they may be valuable as components of programmes aimed at modification, not only of blood pressure, but also of other factors such as exercise and smoking, that contribute to the risk of cardiovascular disease.

It is probable that psychological treatments will be appropriate for only a proportion of hypertensives, and research into the identification of responsive individuals is required. For these people, methods of the type reviewed here may make a valuable contribution to the long-term management of high blood pressure.

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