

THE EFFECT OF GUIDED IMAGERY IN A HYPNOTIC CONTEXT ON FOREARM BLOOD FLOW

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Abstract

Venous leg ulceration is a painful and debilitating condition. Current treatment comprises local or systemic medical interventions intended to influence the pathological changes associated with ulceration. This study was conducted to determine in a non-ulcerated population, the potential of guided imagery in a hypnotic context to influence blood flow, which is a critical variable in the process of ulcer healing. In a within-subjects design, subjects each underwent one experimental session during which they listened to two kinds of imagery designed respectively to increase and decrease forearm blood flow by suggesting hot or cold sensations. Script order and arm order were counterbalanced. Objective measurement of blood-flow was by a Laser-Doppler flowmeter. Analysis of variance confirmed significant changes in line with the predictions on both objective and subjective measures. Further analysis revealed that the differential changes in blood flow were present only when the left arm was targeted first. The results are discussed in relation to previous literature, particularly in relation to expectancy effects, and implications for treatment of venous leg ulceration are considered.

Key words: hypnosis, guided imagery, blood flow, skin temperature, laterality, expectancy

Introduction

The study reported here is part of a programme of research investigating the use of psychological interventions in the treatment of venous leg ulceration. This is a painful and debilitating condition, which primarily affects those in middle to old age. Incidence is approximately twice as high in females than in males (Dale et al., 1983) and treatment is primarily by medical interventions intended to ameliorate the associated pathological changes (Blair et al., 1988). It is known, however, that psychological factors are important in healing. Stress, for example, can affect the healing of experimental wounds (Kiecolt-Glaser et al., 1995) and there is contradictory evidence as to whether it affects healing of duodenal ulcers (Holtmann et al., 1992; Armstrong et al., 1993). More specifically in the case of leg ulcers the pathological process is associated with disturbed blood flow and consequent tissue breakdown due to inadequate oxygenation. Any psychological intervention that assisted in altering and correcting the blood flow in the affected limbs would be expected to facilitate healing.

Hypnosis and guided imagery have long been regarded as potentially effective techniques in influencing both skin temperature and blood flow (e.g. Grabowska, 1971;

Maslach et al., 1972; Clawson and Swade, 1975; Roberts et al., 1975; Raynaud et al., 1983). More recently Klapow, Patterson and Edwards (1996) have reported a single case study in which foot warming suggestions in hypnosis were used with a patient with Burger's disease to increase peripheral blood flow sufficiently to prevent further necrotizing tissue changes. Similarly Moore and Wiesner (1996) used suggestions of hand-warming in hypnosis, augmented by biofeedback, to create local vasodilation (as measured by objective increases in hand temperature) with a concomitant reduction in pain in patients with upper extremity repetitive strain injury. In earlier work from the same research group Moore and Kaplan (1983) reported acceleration of burn wound healing and pain reduction by hypnotically induced vasodilation in the targeted hand compared with the control hand. It has also been shown that simulated phlebotomy, where the experience of blood donation is created using hypnotic imagery, produces the same forearm blood flow and blood pressure changes in highly hypnotizable subjects as those seen during actual blood donation (Casiglia et al., 1997).

Of particular relevance to the present study is some recent work by Zachariae, Oster and Bjerring (1994), who used UVB radiation to induce inflammation in both forearms in 10 subjects selected for high levels of hypnotic suggestibility. Over a six-hour session these subjects were then given a series of suggestions involving heat imagery intended to increase the inflammatory response in one arm and, simultaneously, suggestions of analgesia in the other arm, which were intended to decrease the response. Objective measurements were made of skin blood flow and erythema (reddening of the skin reflecting tissue blood content, or capillary dilation) in the two arms. The main finding of the study was that there was a significant effect in the expected direction of the hypnotic suggestions for the skin blood flow response to UVB radiation but not for erythema, which seemed to be more affected by general relaxation. The authors concluded that while the blood flow change is under central neurological control, and hence can be directly affected by hypnotic suggestion, erythema reflects local changes related to the release of inflammatory mediators.

As already noted, the interest of the present authors is in developing a psychological intervention to facilitate the healing of leg ulcers. Before attempting to evaluate potentially helpful procedures on client populations, however, it is important to carry out preclinical tests to establish the efficacy of the proposed procedures in affecting relevant variables in a similar non-clinical population. It seems clear from the literature that suggestion and guided imagery, particularly in hypnotic contexts, are able to directly influence skin blood flow in potentially helpful ways, though this may not be the case for tissue blood content. The present study extends the observations in particular of Zachariae et al. (1994) with appropriate procedural changes to match more closely the characteristics and needs of the target leg ulcer patient group. In particular we set out (1) to investigate the effectiveness of guided imagery on peripheral blood flow in subjects not selected for high hypnotizability, (2) using a brief hypnotic technique incorporating guided imagery, (3) where the skin was not inflamed and (4) by comparing a targeted limb with a control limb that was not the focus of imagery. For convenience, and because we felt it would be less intrusive for the participants, we used participants' arms rather than their legs. As general relaxation appeared in the Zachariae et al. study to be associated with increased tissue blood content, relaxation suggestions were included as part of the hypnotic induction procedure.

Method

Design

In a within-subject design, each subject experienced 'cold' and 'hot' imagery scripts sequentially. Each script targeted on arm whilst the non-targeted arm served as the

control. The order of presentation of imagery script (i.e. hot or cold first) and the arm targeted (i.e. left or right arm first) were fully counterbalanced across subjects. Evaluations of subjective temperature for both arms were taken before the two imagery presentations and for the targeted arm in both imagery conditions after both scripts had been delivered. Cutaneous blood flow measurements were made for both the targeted (experimental) arm and the non-targeted (control) arm in a baseline period just before each imagery script was played and during imagery for both imagery conditions.

Subjects

Twenty-nine healthy volunteer, right-handed subjects were recruited via advertisements in out-patients clinics, lecture courses and hospital departments. Exclusion criteria included those suffering from upper-body skin disorders, epilepsy and pregnancy. One subject was excluded because of incomplete data collection and the data from the remaining 28 (21 females) are reported here. Their mean age was 27.9 (sd 13.74) years with a range of 18 – 82 years. The majority (53.57%) were medical students, 17.86% were clerical/administration staff, 17.86% skilled workers, 7.14% professional and one was retired (3.57%). This sample is similar to the prospective patient population in having a preponderance of females and in its upper age range, though the mean age of our volunteers is somewhat lower than would be expected in the clinical group.

Equipment and measurement

Cutaneous blood flow was measured using a Laser Doppler flowmeter, model MBF/3 (Moor Instruments Ltd, Axminster, Devon) as mean, minimum and maximum blood flux via averaging probes attached to the proximal volar region of each forearm. The blood flux measurements are expressed in arbitrary units that reflect blood flow.

The subjective temperature of each forearm was measured using an analogue thermometer consisting of a 140 mm line with the mid-point anchored as 'usual temperature' and 0 mm as 'numbing cold' and 140 mm as 'burning hot'. Subjects had to mark the line according to perceived temperature of each arm.

All subjects were played a tape-recorded hypnotic induction and relaxation script (5 minutes long), which focused on regular breathing and direct suggestions of muscle relaxation, starting with legs and feet, moving on to back and shoulders, arms and hands and then to neck, face and head. They also heard tape-recorded guided imagery scripts matched for length (4.5 minutes) and as far as possible for style of presentation and intensity of imagery content for the 'hot' and 'cold' conditions. The 'hot' script included images of sitting beside a hot fire with the target arm nearest to the heat. The 'cold' script suggested placing the target arm into a bucket of ice-cold water. Both scripts with suggestions that both arms 'return to normal'.

Each imagery session ended with a tape-recorded script, which reinforced returning sensations in both arms to normal and returning to normal levels of alertness.

Procedure

Testing was carried out in a small clinic room within the Dermatology Department. The subject lay on an examination couch and room temperature was maintained between 23.1 and 24.0 degrees centigrade (mean 23.8 degrees).

Subjects were allowed 30 minutes in the test room to adapt to the ambient temperature before any blood flow measurements began and during this time they completed the thermometer analogue for subjectively rated temperature of both arms.

Subjects were then asked to close their eyes and listened to the hypnotic induction and relaxation script followed by the guided imagery scripts. Blood flow measurements (mean, maximum and minimum) were made during (1) a one-minute baseline, (2) the first guided imagery script, (3) a one-minute baseline and (4) the second guided imagery script. Subjects then received the ending script, after which they completed the analogue thermometer of subjective temperature for the targeted arm during the two guided imagery scripts. The order in which the hot and cold scripts were given and whether the left hand or the right hand was tested first were independently counterbalanced across subjects (i.e. there were four cohorts of subjects – left/hot first, right/hot first, right/cold first and left/cold first). The interval between reading each script was one minute, during which time the baseline recording was made.

Results

The raw data were subjected to analyses of variance using SPSS 6 for Windows.

Subjective temperature

Within-subject factors were Time (comparing pre- to post-intervention ratings) and Imagery (hot versus cold). Between subject factors were Arm Order (whether left or right arm targeted first) and Imagery Order (whether hot or cold imagery was presented first). The data are summarized in Table 1. Of the within-subject terms, only the interaction Time versus Imagery was significant ($F_{1,24} = 144.74, p < 0.001$). From Table 1 it can be seen that this represents a marked decrease in the subjective temperature of the cold arm and a modest increase in the hot arm following presentation of the relevant script. As the subjective temperature thermometer had 70 as its 'normal temperature' point, it is evident that before the scripts were presented the subjects perceived their arms as being warmer than normal, presumably as a result of the ambient temperature in the experimental room. There were no significant between-subject effects, suggesting that the order of presentation of the hot and cold scripts and whether left or right arm was targeted first had not influence on the outcome.

Table 1. Subjective arm temperature* before imagery and during imagery (the latter rated retrospectively)

	Subjective temperature (arbitrary units)		
	Before	After	Change (%)
Target 'hot' arm	90.8 (18.6)	103.5 (18.6)	+12.7 (13.9)
Target 'cold' arm	89.4 (21.7)	38.1 (21.8)	-51.3 (57.4)

*Means (and standard deviations)

Cutaneous blood flow

The within-subject factors were Arm (comparing experimental to control arm) and Imagery (hot versus cold). The between subject factors were as before Arm Order and Imagery Order. Analysis was performed on mean, minimum and maximum blood flow measures during the imagery presentation (see Table 2). For each measure of blood flow the flow was greater in the hot arm and less for the cold arm compared with the corresponding control arm. This effect was supported statistically for

the maximum blood flow measure as a significant Imagery \times Arm interaction ($F_{1,24} = 5.88$; $p < 0.05$). To give an indication of how this effect was achieved difference scores were calculated using the maximum blood flow data by subtracting the mean value for the imagery period from the mean value for the immediately preceding baseline period. For the hot condition the difference score for the experimental arm was 3.48 and for the control arm it was -0.31. This indicates that the change which occurred as a result of the hot script was primarily a blood flow increase in the experimental arm with a very small decrease in blood flow in the control arm (this represents an overall differential change in blood flow for the two arms of 3.79). For the cold arm the differential effect on blood flow was achieved somewhat differently with a relatively modest decrease (-2.97) in the cold arm but a very large increase (5.56) in the control arm (an overall differential change of 8.53). The difference measures suggest that the effects for both script conditions were primarily mediated by relative blood flow increases – in the targeted arm in the case of the ‘hot’ script and in the control arm in the case of the ‘cold’ script.

Table 2. Mean, minimum and maximum values of cutaneous blood flow* during hot or cold imagery in the experimental (targeted) and control arm

		Minimum	Mean	Maximum
Hot	Experimental	9.3 (5.8)	14.7 (8.8)	26.5 (17.6)
	Control	8.7 (8.7)	12.7 (10.7)	20.1 (13.8)
Cold	Experimental	8.6 (9.2)	13.1 (10.6)	21.6 (14.5)
	Control	9.5 (5.8)	14.9 (8.9)	25.4 (19.2)

*Group means (and standard deviations)

A further analysis was performed on the maximum blood flow data with the subjects' scores divided according to whether the left or the right arm was targeted first (see Table 3). There was a significant Imagery \times Arm \times Arm Order interaction ($F_{1,24} = 8.04$; $p < 0.01$) with the effect on blood flow being present for both hot and cold scripts in the subjects for whom the left arm was targeted first but no differential effect for either script for the subjects whose right arm was targeted first.

Table 3. Maximum blood flow* shown separately for subjects for whom the left or right arm was targeted first

First arm	Hot		Cold	
	Experimental	Control	Experimental	Control
Left	31.02 (19.22)	16.87 (7.97)	17.99 (7.41)	26.07 (17.24)
Right	22.06 (15.31)	23.35 (17.61)	25.27 (18.85)	24.82 (21.62)

*Group means (and standard deviations)

A similar analysis was performed on the maximum blood flow data with the subjects' scores divided according to whether they received the cold or the hot script first (see Table 4). No significant effects were found, although inspection of the data in

Table 4 indicates that the changes which occurred were more marked for both scripts in the subjects who had the cold script first.

Table 4. Maximum blood flow* shown separately for subjects for whom the hot or cold imagery was presented first

First imagery	Hot		Cold	
	Experimental	Control	Experimental	Control
Hot	29.09 (21.55)	24.69 (17.72)	23.99 (16.76)	26.34 (19.37)
Cold	23.99 (13.00)	15.54 (6.11)	19.27 (12.07)	24.56 (19.71)

*Group means (and standard deviations)

Discussion

The two brief imagery scripts were effective in producing subjective changes in arm temperature in the expected direction in a group of subjects unselected for hypnotic ability. The subjective temperature change, however, was greater for 'cold' imagery. This may be because the subjects perceived their arms as already warmer than usual prior to the imagery suggestions, thereby creating a ceiling effect. An alternative explanation is that the cold script was the more powerful of the two or possibly that reducing perceived temperature in a limb is an inherently easier task. Similarly there was evidence that blood flow changes also occurred in the expected directions in the two arms as a consequence of the imagery suggestions, especially in terms of the maximum blood flow measure. Interestingly in both 'hot' and 'cold' cases this seems to have occurred primarily as a result of blood flow increases rather than relative blood flow decreases compared with baseline measures. In particular the 'hot' imagery produced a blood flow increase in the targeted arm and little if any change in the control arm whereas the 'cold' imagery produced a modest decrease in the blood flow of the targeted arm but a very large blood flow increase in the control arm. As with the subjective temperature change, therefore, it was again the 'cold' condition that produced the larger effect. Further analysis of the maximum blood flow data revealed a significant effect of which arm was targeted first. In fact the differential blood flow effect was there for both imagery conditions only when the subject's left arm was targeted first. This is not the first time that a laterality effect of this sort has been described. Zachariae et al. (1994) reported a significant difference in erythema between arms only when subjects were asked to decrease the response in their non-dominant arm. In contrast to our own finding, however, they found no effect of arm dominance for the blood flow measure. There was also a consistent tendency in the present study for the effects of both scripts to be more marked when the cold imagery was presented first, though this effect was not significant.

Expectancy effects are known to influence the strength of responding to suggestions in hypnotic contexts (e.g. Kirsch, 1985; Wickless and Kirsch, 1989; Montgomery and Kirsch, 1996). That is, if an individual experiences a good response to the first set of suggestions this will facilitate a successful response to any subsequent suggestions. Conversely the experience of little or no response to a first set of suggestions will inhibit the individuals' responses to subsequent suggestions. The present pattern of results in fact lends itself to such an interpretation if it is assumed that suggested changes in blood flow occur more readily, in the present conditions at least, in a

non-dominant arm or if 'cold' imagery is used. On the latter, there is of course evidence within the present study to support the view that both subjective and objective changes are greater in response to 'cold' imagery. Thus targeting the imagery to the left arm first might be expected to produce a strong response that would facilitate a similarly strong response to suggestion when the right arm is subsequently targeted. The reverse effect would be expected if the right arm was targeted first. Similarly presenting 'cold' imagery first would facilitate responding to subsequent 'hot' imagery whereas an initial experience of a weaker response to 'hot' imagery would set up a negative expectancy of responding appropriately to subsequent 'cold' imagery. As laterality and script order effects were not seen for subjective temperature changes these expectancies concerning blood flow responses would have to be viewed as implicit rather than explicit.

In practical terms these results are encouraging evidence that guided imagery may facilitate increases in blood flow in the limbs of leg ulcer patients. In particular when one limb is to be treated these data suggest that the effect of increasing blood flow may be greater if 'cold' imagery is suggested in the contralateral limb. An even more effective strategy in this case might be to present 'hot' and 'cold' scripts simultaneously to the different limbs with the target limb receiving the 'hot' imagery. The present data do not allow any estimate of how effective such a combined approach would be. Where both legs are the focus of clinical attention it may be possible to use cold imagery in the arms to facilitate the blood flow increase in the legs. The results also suggest that where there is a choice of the order in which limbs are to be targeted and imagery is to be used the most effective outcomes are likely to ensue by commencing with the non-dominant limb and 'cold' imagery. Further work is needed to establish whether similar effects to those reported here can be produced using legs as the target limbs and also possibly combining imagery directed to arms and/or legs.

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