

Preoperative Rehearsal of Active Coping Imagery Influences Subjective and Hormonal Responses to Abdominal Surgery

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Existing evidence suggests that preoperative psychological preparation that is designed to reduce anxiety may sensitize cortisol and adrenaline responses to surgery. In a controlled trial of abdominal surgery patients, we therefore tested the effects of a preoperative preparation that used guided imagery, not to reduce anxiety, but to increase patients' feelings of being able to cope with surgical stress; 26 imagery patients were compared with 25 controls who received, instead, background information about the hospital. State-anxiety was similar in each group, but imagery patients experienced less postoperative pain than did the controls, were less distressed by it, felt that they coped with it better, and requested less analgesia. Hormone levels measured in peripheral venous blood did not differ on the afternoon of admission, before preparation. Cortisol levels were, however, lower in imagery patients than in controls immediately before and after surgery. Noradrenaline levels were greater on these occasions in imagery patients than controls. The results are interpreted in relation to two theories. One states that preoperative "worry" reduces surgical stress. The other concerns the influence of active and passive coping on endocrine responses to stress.

Key words: Surgery, preparation, endocrine responses, stress, imagery.

INTRODUCTION

Preoperative psychological procedures can influence recovery from surgery. Effective procedures include instruction in cognitive strategies for managing physical or emotional distress, the provision of emotional support and detailed information about effects of surgery. Reported benefits include reduced medication, shorter postoperative stay and, in some reports, less pain and anxiety (1, 2).

Encouraged by this evidence, preoperative psychological preparation by nurses and anesthetists has become more common. However, it is now known that psychological preparation can have physiological effects and much more information is needed about these before psychological techniques should be used routinely. The need for caution arises from the few studies which have included measurements of endocrine responses to surgery. Although evidence that endocrine responses influence clinical

outcome is not conclusive, anesthetic techniques are widely used to reduce them in the belief that they compromise recovery by, for instance, promoting muscle wasting, immunosuppression and postoperative fatigue (3-8). Many endocrine responses are unaffected by conventional anesthesia and perioperative medication (4-5). However, Wilson (9) reported a postoperative increase in urinary adrenaline excretion in patients who had undergone preoperative relaxation training. Salmon et al. (10), in an uncontrolled study, found greater postoperative cortisol excretion in patients who had been counseled preoperatively by nurses. In a recent controlled trial, Manyande et al. (11) confirmed that subjects receiving brief, audiotape-recorded relaxation training before minor abdominal surgery had increased circulating cortisol and adrenaline levels during surgery in comparison with controls who heard a tape of general information.

In each of these studies, therefore, reassuring psychological preparation was associated with increased cortisol or adrenaline responses—despite reduced subjective indices of distress. This association is consistent with evidence that anxious personality and preoperative anxious state correlated with lower adrenaline and cortisol levels during or after major abdominal surgery (12-14).

One question that arises from these results is whether it is possible to design a form of psychological preparation that improves patients' subjective state while reducing elements of the endocrine stress response. Two separate theoretical arguments sug-

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Transcripts of the tapes are available from P.S.

gest a way of achieving this. The first is based on experimental evidence that cortisol responses to stress in man and animals are reduced if individuals feel able to cope with the challenge or are subject to no demands for additional adaptation (15–20). The second argument is derived from the thesis by Janis (21) that surgical stress (which he conceived of in psychological, not endocrine, terms) can be reduced if patients “work through” impending events, a process that he termed the “work of worry.” These arguments point to forms of preoperative preparation which encourage patients, respectively, to adopt a feeling of being able to cope actively with surgical stress or to “work through” impending stressors in such a way as to reduce their threat. In practice, it is hard to distinguish these two aims and the present study evaluates a form of preparation intended to induce a feeling of being able to cope with impending challenges by directing patients to rehearse successful coping mentally.

The preparatory technique was based on imagery rehearsal, whereby a patient was asked mentally to image different aspects of the procedures and experiences surrounding surgery. Laboratory research has shown that vivid mental imagery of events produces physiological responses similar to those produced by the events themselves, albeit on a smaller scale (22, 23). For example, fearful imagery has been shown to produce cardiovascular and sweat gland responses which increase as the subjects become more actively engaged in the imagery (24). It was predicted that preparation by imagery rehearsal would improve patients’ feelings of being able to cope with postoperative pain and reduce cortisol and, possibly, other endocrine indices of surgical stress. An effect on anxiety could not be predicted: an increase in “worry” or in an attitude of active mental preparation might not allay anxiety, or might even increase it (21). As an attempt to provide external evidence that the intervention had modified coping, a coping checklist was administered (25). This was chosen for its brevity and because, scored on the basis of a principal components analysis (26), it does not rely on a distinction between problem- and emotion-focused coping. Although central in current conceptualizations of coping (17) such a distinction may be less applicable to surgery, where patients have little opportunity for problem-focused coping.

To check that the groups were equivalent on psychological variables known to influence responses to surgery, or which seem likely to influence the response to the imagery procedure, questionnaires were included to measure trait-anxiety, type

A personality, and feelings of control over health care.

METHODS

Subjects

The sample was formed of consecutive admissions for colorectal or anal surgery. Sixty-one patients scheduled for procedures expected to last less than 1 hour, and which would not involve peritoneal incision, were approached. All had been free from steroid medication for at least 6 months and were not receiving psychotropic medication. Three declined to take part; three were excluded because of difficulties in comprehension; one was excluded because of extreme anxiety and three patients were excluded because of procedural difficulties leading to the provision of only one blood sample. Fifty-one remained (30 men, 21 women). Ages ranged from 22 to 76 (mean: 45). The number of previous operations of any kind ranged from 0 to 7 (mean: 2.4). The main diagnoses were anal fistula or abscess, inflammatory bowel disease (ulcerative colitis or Crohn’s disease) and hemorrhoids (see Table 1). The recorded duration of symptoms ranged from 1 to 16 months (mean: 8.5). Premedication was by papaveretum (0.3 mg/kg up to 20 mg) and scopolamine (0.06 mg/kg up to 0.4 mg). Anesthesia was induced by thiopentone (5–7 mg/kg), and spontaneous ventilation maintained by N_2O_2/O_2 and either halothane or isoflurane. Postoperative analgesia, administered up to four times daily, was by paracetamol (1 gm).

Procedure

This was similar to that reported in the previous study (11). Patients were randomly allocated to two groups: Imagery ($N = 26$) and Control ($N = 25$). Patients heard audiotape recordings on the preoperative day and were asked to listen to them subsequently. Venous blood was sampled at recruitment, following at least 30 minutes during which the patient remained supine, and then immediately pre- and postoperatively. Cortisol concentration was measured by radioimmunoassay. After alumina extraction, adrenaline and noradrenaline were measured by high-performance liquid chromatography (HPLC) with electrochemical detection. The questionnaires described previously (11) were completed before first hearing the tape and then on the two postoperative days. Personality questionnaires in addition to those used in the previous study (11) were the Health Opinion Survey (27), the Desire for Control of Health Care Scale (28), and one part of the Multidimensional Health Locus of Control Scale (29; only the scale measuring internal control was used). These were used to ensure that the groups initially had similar attitudes to taking control. In addition to two visual-analog scales measuring intensity of, and distress caused by, pain of an additional scale asked “how well I have coped with my pain” from “not at all” to “completely.” For the imagery group, one further question asked, on the second postoperative day, “how vividly and realistically could you imagine the various situations described” (perfectly vivid and as clear as the real thing, very vividly and realistically, moderately clearly and vividly, vaguely or hardly at all, not at all; scored 5–1).

The audiotape for the control group was that described previously (11), and gave general information about the hospital. For the experimental group, the tape began with brief relaxation

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instructions, as described previously, which were followed by instructions to imagine specific preoperative and postoperative discomforts: hunger and thirst, dry mouth, pain and nausea, weakness. In each case, the suggestion was made that the patient would overcome the discomfort: e.g., . . . pain or feeling sick; you are occupying your mind by the thought that you are in control of the discomfort. . . . you can easily manage for the rest of the day. You feel positive . . . knowing that it is necessary and you can easily cope.' The tape concluded with general suggestions of coping; e.g., "by imagining these things and by seeing yourself coping well you will be much better prepared . . . more able to cope and recover more rapidly. . . ." "your mind is a powerful thing, and its ability to prepare your body. . . is greater than commonly realized." The duration of use of each tape-recorder was measured by a concealed counter.

Statistical analyses were similar to those described previously (11). Briefly, product-moment correlations related transformed ($\log_{10}X+1$) endocrine levels to age, time of blood sampling and personality. Groups were then compared on baseline assessments on each measure by analysis of variance. Subsequent group differences were then examined by one-way analysis of variance (for analgesia intake) or two-way analyses of variance in which time of measurement contrasted induction and recovery values (for endocrine data) or the 2 postoperative days (for questionnaires). In addition, to check whether effects were related to imagery performance, the imagery group was divided according to quality of imaging; patients who imaged "perfectly" or "very vividly" were compared with the rest. These comparisons failed to reach significance and are not reported.

RESULTS

Groups did not differ in the ratio of men/women (relaxation: 15/11; control: 15/10), mean age, the recorded duration of their illness, number of previous operations, time at which operations began and duration of surgery. Neither did they differ in the duration of their postoperative stay or on any measure of personality (Table 1). The groups were similar in state-anxiety, the pain analog scales and Recovery Inventory (measuring subjective bodily state and function) before first listening to the tape. In no blood sample did endocrine levels correlate with the time that it was drawn. Age correlated with only one isolated value: adrenaline in recovery: $r = 0.29, p < .05$.

Evaluation of the Tape

The imagery tape was played for longer than the control (means: 49 vs. 25 minutes; $F(1,49) = 4.46, p < .05$); it was rated as more "helpful" (mean ratings: 2.8 vs. 2.0; $F(1,49) = 50.68, p < .001$), and was more likely to be "used in the future" (2.54 vs. 1.92; $F(1,49) = 6.96, p < .05$). The tapes did not, however, differ on whether they would be "recommended to a friend." Of the imagery group, 11 could

Table 1. Primary diagnoses, type of surgery, and mean scores (+SD) on medical, surgical, and personality measures in each group. All differences between means are nonsignificant ($p > .05$)

	Imagery	Control
Diagnoses		
Anal abscess fistula	12	12
Ulcerative colitis	0	2
Crohn's disease	3	3
Hemorrhoids	3	2
Anal incontinence/bleeding	5	3
Other	3	3
Type of surgery		
Laying open of abscess/fistula	12	11
Sphincter repair	6	5
Hemorrhoidectomy	3	2
Other	5	7
Age (years)	47 ± 13.8	44 ± 15.4
Duration of symptoms (months)	8.6 ± 4.1	8.5 ± 4.8
Previous operations (number)	2.3 ± 1.7	2.6 ± 1.7
Start-time of operation (hr:min)	14:13 ± 2:15	13:23 ± 2:15
Duration of operation (min)	34 ± 16	39 ± 16
Postoperative stay (days)	5.7 ± 3.2	5.0 ± 2.4
Trait Anxiety	51.0 ± 4.9	49.9 ± 3.3
Type A	60.9 ± 14.2	58.9 ± 9.6
Desire for control	29.6 ± 6.3	28.7 ± 6.1
Internal health locus of control	25.4 ± 6.5	23.6 ± 5.1
Krantz Health Opinion Survey		
Information	3.4 ± 2.4	3.1 ± 2.1
Involvement	4.6 ± 2.4	3.9 ± 2.4

imagine "perfectly" or "very" vividly; 4 patients could imagine only "vaguely" and no patient scored "not at all."

Endocrine Responses

Endocrine levels were similar in each group on the preoperative day (Figure 1; $F_s < 1.0$). Differences emerged subsequently. The main effect of group confirmed that cortisol levels were lower in imagery patients than in controls at induction and in recovery ($F(1,48) = 7.53, p < .01$) and that, by contrast, noradrenaline levels were greater and did not decline as in the control group ($F(1,48) = 15.20, p < .001$). There were no effects in interaction with time of measurement (induction vs. recovery). To check whether postoperative group differences in noradrenaline could be accounted for by the nonsignificant difference at baseline, separate analyses of covariance were performed on the induction and recovery values, using the baseline value as covariate. The group difference remained significant (induction: $F(1,46) = 3.91, p = .05$, covariate regression = 0.40; recovery: $F(1,47) = 10.36, p = .001$, covariate regression = 0.18). Postoperative adrenaline levels did not differ between the groups ($F < 1.0$).

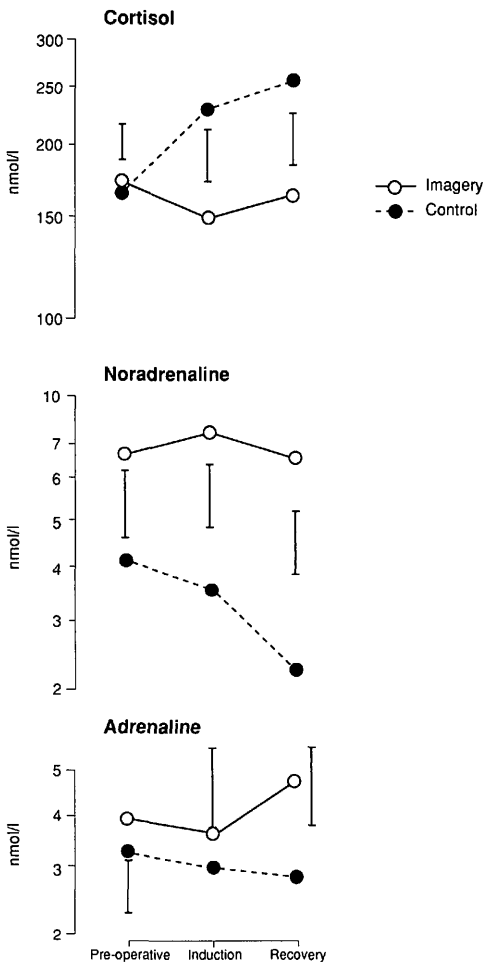


Fig. 1. Group mean endocrine levels. Pooled standard errors of differences of means (SED) are for comparisons between groups in the baseline sample, and for the comparison between groups on each occasion for the combined analysis of the induction and recovery samples. Data are plotted on a log scale [$\log(X+1)$].

Cardiovascular Changes

Heart rate during surgery reached a lower maximum in the imagery group than in controls (68.1 vs. 82.3; $F(1,48) = 18.88$, $p < .001$), but differences in maximum systolic and diastolic blood pressure (108/65 vs. 115/67 mm) did not approach signifi-

cance. Heart rate in the recovery room was also lower in imagery patients (67.5 vs. 75.0; $F(1,46) = 6.76$, $p = .01$). Heart rate and blood pressure measured on the ward did not differ between the groups.

Postoperative Questionnaires and Analgesic Intake

State-anxiety declined after first listening to either tape ($F(1,49) = 12.28$, $p < .001$). This effect did not differ between groups.

State-anxiety scores fell from the first to the second postoperative day ($F(1,49) = 12.40$, $p < .001$), but there was no difference between the groups (group and group \times time: nonsignificant). Similarly, mean Recovery Inventory scores improved (from 27.6–32.0) from the first to the second day postoperatively ($F(1,49) = 34.63$, $p < .001$), but with no difference between the groups (group and group \times time: nonsignificant). The three pain scales showed a single pattern: the groups did not differ preoperatively ($F_s(1, 49) < 1.0$), but imagery patients postoperatively reported less pain-intensity ($F(1,49) = 4.22$, $p < .05$), less pain-distress ($F(1,49) = 8.17$, $p < .01$) and better pain-coping ($F(1,49) = 6.92$, $p < .01$) than controls (Figure 2). No pain scale registered any significant overall change from day 1 to 2 postoperatively and only one interaction of group with time (postoperative days 1 and 2) approached significance (pain-intensity: $F(1,49) = 2.98$, $p < 0.10$). No significant effects were detected on any coping scale.

Mean number of oral analgesic administrations over the two postoperative days was less in imagery patients than in controls (1.0 vs. 2.3; $F(1,49) = 4.64$, $p < .05$).

DISCUSSION

The relaxation and imagery procedure improved the visual-analog ratings of coping with pain, distress caused by pain, and intensity of pain by comparison with controls. The imagery procedure was intended to promote a feeling that patients were actively coping and in control, and its effect on pain might reflect this. Anxiety was not affected, which indicates that the imagery procedure has not simply relaxed or reassured patients. This pattern of results contrasts with the effects of relaxation alone which, as we have reported (11), reduced anxiety without affecting pain. This comparison is, however, tentative because the two interventions have not been evaluated within a single study. Analgesic intake

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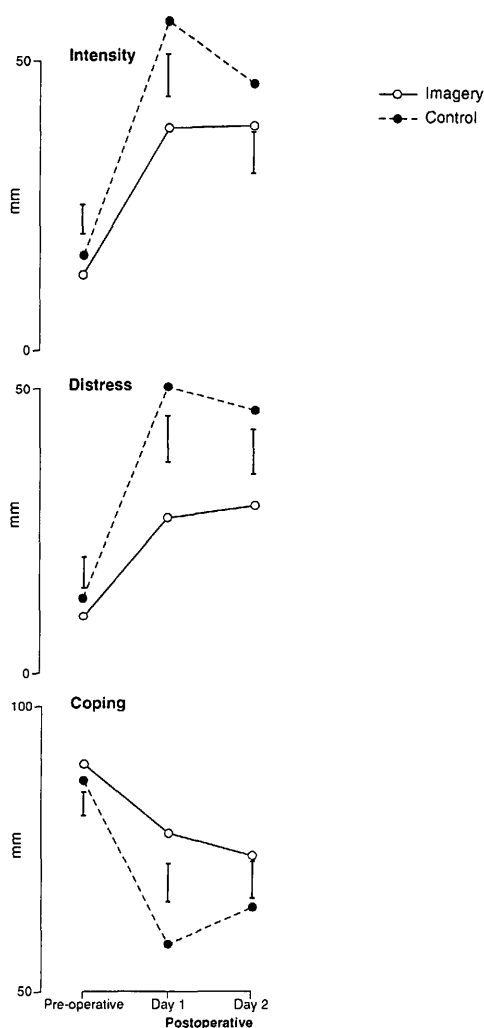


Fig. 2. Group mean visual-analog pain ratings. Bars show SED from relevant analyses of variance for comparisons between groups.

was less in imagery patients, but this is probably not directly related to the increased ability to cope with pain because it was reduced also by relaxation (11). Analgesia provides an ambiguous measure (1) and may reflect variables other than pain, such as patients' willingness to complain to nursing staff.

Imagery patients recorded lower heart rates than

controls during and immediately after surgery. Preparation by relaxation was also followed by a smaller cardiovascular response (11). It is possible that, in the present study, the effect is a physiological result of the relaxation component of the imagery procedure.

The reduction in cortisol levels in imagery patients by comparison with control patients occurred both before induction of anesthesia and postoperatively; unlike in our previous study, the response to surgery was not affected. Nevertheless, the direction of the effect is in line with our prediction, which was drawn from two theories. According to the account of Janis of the "work of worry" (21), preoperative preparation which involves constructive rehearsal of impending stressors should reduce surgical stress. However, Janis' theory could not explain the apparently greater noradrenaline levels. Interpretation of the catecholamine measures is compromised by use of venipuncture to sample blood, rather than an indwelling line which would have avoided confounding values by the stress of venipuncture. This was impractical in the present study. However, a second theoretical framework, encompassing current ideas about the relationship of endocrine changes to the way people cope with stress, can make sense of both hormonal effects (15-17). A large amount of evidence shows that the cortisol response to stress is reduced by the perception that one is able to cope with the stress. As discussed, the imagery script was expressly designed to promote this. By contrast, feelings of active coping have been associated with increased noradrenaline responses, particularly when the coping strategy is perceived as difficult (15, 16).

On this reasoning, the relaxation procedure that we used in the previous study (11), and which increased cortisol responses, might have increased patients' feelings of passivity and inability to cope actively with perioperative stressors. It has been argued that hospital procedures routinely encourage passivity in patients and discourage or denigrate their attempts to exert control (30, 31). Speculatively, it might be that a property of relaxation to increase passivity helps to explain why it is so readily adopted in many clinical settings.

Clearly, comparisons between the effects of different forms of preparation which have been evaluated in different experiments are tentative. A single controlled trial is required to contrast the relaxation and imagery procedures. Even were such a trial to confirm our results, their interpretation in terms of coping must remain speculative until it is possible to demonstrate directly the effects of relaxation and

imagery on patients' manner of coping with surgery. The coping checklist used here failed to detect an effect of imagery or, indeed, of relaxation in the previous study (11). A priority for future work will be to show whether more wide-ranging and better validated measures (e.g., 32) can detect an effect of our procedures on coping and to show whether such changes can explain the effects on endocrine and subjective responses. In addition, the value of imagery as a way of modifying coping requires further evaluation. In the present study, effects of preparation involving imagery could not be related to imagery ability. Larger numbers will be needed to test whether vivid imagery was central to the effects, or whether coping might be influenced without this.

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