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Biofeedback Treatment of Atopic Dermatitis

Controlled Case Studies of Eight Cases[1]

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To investigate the feasibility of a behaviorally oriented intervention program with atopic dermatitis, 12 patients were exposed to a fixed sequence of treatment phases including a no-treatment baseline phase, a phase incorporating nonspecific treatment factors, and a phase involving frontal electromyographic (EMG) feedback and relaxation instructions. Photographic analyses of involved skin areas revealed significant remission of dermatological problems across the entire program, although significant changes could not be attributable to any specific phase. Ratings of itching level decreased within but not across treatment sessions, and variable correlations across subjects were found between frontal EMG and itching level. MMPI results from the dermatitis subjects were within normal limits. Overall, the results provided mixed support for the hypothesis that atopic dermatitis may be amenable to intervention through behaviorally oriented treatment procedures.

Atopic dermatitis (sometimes referred to as neurodermatitis) is an inflammatory disease of the skin affecting thousands of individuals in the United

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States alone (Sulzberger, 1971). The disease is most prevalent in infancy, childhood, and adolescence, although adults with long-term cases are frequently encountered (Sulzberger, 1971). Chronic atopic dermatitis can disfigure and, because of social consequences, can have severely detrimental psychological impact on affected individuals (Roth & Kierland, 1964). The disease most frequently affects the face, neck, upper chest, and the flexures of the arms and legs and is accompanied by a greatly reduced resistance to skin infections. It is commonly associated with the presence of other types of atopy (e.g., urticaria, asthma, gastrointestinal problems) (Frick, 1971).

Multiple causative factors have been postulated for atopic dermatitis (Sulzberger, 1971; Jarrett, 1973; Hill, 1965; Frick, 1974; Bethune & Kidd, 1961). Although the disease probably has primarily an immunological etiology (Sulzberger, 1971; Jarrett, 1973; Hill, 1965; Frick, 1971, 1974; Bethune & Kidd, 1961; Obermayer, 1955; Johansson & Juhlin, 1970; Berg & Johansson, 1969), constitutional factors (Sulzberger, 1971; Frick, 1971, 1974; Ryan, 1972), autonomic imbalance (sympathetic dominance) (Jarrett, 1973; Frick, 1971, 1974; Bethune & Kidd, 1961; Solomon, 1966), the itch–scratch cycle (Sulzberger, 1971; Frick, 1971, 1974; Hill, 1965; Jarrett, 1973; Arthur & Shelly, 1958; Pearlman, 1974), and psychological-emotional factors (Sulzberger, 1971; Bethune & Kidd, 1961; Obermayer, 1955; Pearlman, 1974; Luthe & Schultz, 1969; Miller, 1943; Shapiro, Bierman, & Pierson, 1974) also have been postulated to have etiological or maintenance roles in atopic dermatitis.

Traditional medical treatment has included topical medication and removal of possible irritants from the patient's environment. As suggested above, many investigators have also emphasized the role for psychological stressors and recommend reduction of these stressors as a treatment approach.

As suggested by several investigators (Sulzberger, 1971; Bethune & Kidd, 1961; Obermayer, 1955; Pearlman, 1974; Luthe & Schultz, 1969; Miller, 1943; Shapiro et al., 1974), manifestations of atopic dermatitis in some individuals may be initiated or exacerbated by psychological stress. If atopic dermatitis can be considered a psychophysiologic disorder, it may be amenable to intervention with methods designed to alter an individual's response to stress. Historically, the analysis and treatment of psychophysiologic disorders have been based upon a psychodynamic or medical conceptual system (Alexander, 1950). In the past several years, however, numerous investigations (Stoyva & Budzynski, 1973; Haynes & Gannon 1979) have generated behavioral intervention techniques based upon the supposition that psychophysiologic disorders covary with specific environmental situations and are amenable to modification through application of behavioral intervention precedures.

Instructions in skeletal muscular relaxation have been used as an intervention modality for various psychophysiologic and stress-related dis-

orders such as anxiety neurosis (Jacobson, 1970; Raskin, Johnson, & Rondestvedt, 1973), asthma (Davis, Saunders, Creer, & Chai, 1973; Alexander, 1950), tension headache (Miller, 1943; Shapiro & Schwartz, 1972), insomnia (Haynes, Woodward, Moral, & Alexander, 1974), and hypertension (Luthe, 1963; Moeller & Love, 1973). Training in muscular relaxation is based on the assumption that it reduces a client's physiological response to stress and may, therefore, lead to symptom diminution.

Biofeedback has also been used to successfully treat a wide range of psychophysiologic disorders (Haynes, Griffin, Mooney, & Parise, 1975; Shapiro & Schwartz, 1972; Weiss & Engel, 1971; Budzynski, Stoyva, Adler, & Mullaney, 1973). Like relaxation instructions, electromyographic (EMG) feedback is designed to reduce physiological responses to stress by training an individual to achieve deep levels of muscular relaxation and to exercise control over physiological responses during stressful periods. Although the generality of effects have not been established, both relaxation training and EMG feedback have been found to be effective in decreasing indices of autonomic arousal.

Another important factor in the maintenance of atopic dermatitis seems to be the itch–scratch cycle. Many patients with atopic dermatitis report excessive scratching with consequent eczematoid changes. The scratching response itself seems to be a significant contributor to tissue damage and to maintenance of the clinical manifestations of atopic dermatitis. As indicated by Solomon (1966), prevention or reduction of scratching may facilitate a clearing of the dermatological condition. Because itching may be reduced in a relaxed state, EMG feedback and relaxation instructions may also reduce itching and consequent scratching.

Nonmedical intervention approaches with dermatological disorders have been attempted for a number of years. Most studies have involved the use of hypnosis (Frankel & Mirsch, 1973; Kline, 1959; Twerski & Naar, 1974), although relaxation training methods have also been attempted (Ratliff & Stein, 1968). To date, however, published work on psychological or behavioral intervention with dermatological problems has been confined to uncontrolled single-case studies. The function of this study was to investigate the effectiveness of a treatment package, including frontal EMG feedback and relaxation instruction, for atopic dermatitis.

METHOD

Subjects

Subjects were 12 patients with a clinical diagnosis of atopic dermatitis. All subjects were referred by a local dermatologist and had been refractory to normal pharmacological intervention. Demographic character-

Table I. Demographic Characteristics of Dermatitis Patients

S#	Age	Sex	History (months)
1	47	M	7
2	27	M	300
3	33	M	276
4	27	F	12
5	26	F	300
6	30	F	360
7	20	F	24
8	18	F	216
9	25	F	144
10	23	M	9
11	11	M	24
12	48	M	84

istics of the subjects are presented in Table I. Subjects varied in age from 11 to 48 years and reported histories of atopic dermatitis ranging from 7 to 300 months. Subjects were offered the opportunity to participate in an *experimental* treatment program involving a "psychological" approach to their skin problems. All subjects were fully informed of the procedures and the experimental nature of the program prior to participation.

Experimental Design

When dealing with a small number of subjects, the experimental design employed is a crucial determinant of the degree of confidence that can be placed in the results. Because of the number of available subjects, it was impossible to employ a factorial group design. Because of the potentially irreversible effects of frontal EMG feedback and relaxation instruction, an A-B-A-B replication design was also inappropriate. Multiple baseline design was inapplicable because of the intermittent schedule of referrals. To institute the maximum degree of experimental control possible within the constraints noted above, it was decided to expose each subject to a fixed sequence of intervention procedures. Although the possibility of sequence effects cannot be excluded, it may be possible to infer the contribution made by each of the intervention components. Because reactivity due to assessment, expectancy, placebo, and other nonspecific factors may significantly influence the observed effectiveness of intervention packages (Haynes, 1978), each subject was exposed to three consecutive phases: (1) a no-treatment phase following an initial interview and assessment, (2) a placebo intervention phase, and (3) an active intervention phase involving

frontal EMG feedback and relaxation instructions. It was assumed that with this fixed sequence of treatment components, the contribution of (1) reactive effects due to assessment and contact with experimenters, (2) nonspecific effects such as expectancy, demand, or placebo associated with receiving "treatment," and (3) effects attributable to the experimental manipulations (relaxation instructions/biofeedback) could more easily be evaluated.

The experimenters were also concerned with potential bias from the cyclic and seasonal nature of atopic dermatitis. Some patients naturally demonstrate increased dermatological problems during the winter, others during the summer. To reduce this source of bias, subject referrals and treatment were initiated over a 1-year period, ensuring a random association between treatment phase and season.

Procedure

Initial Interview and Testing. All subjects were given an initial interview and administered the Minnesota Multiphasic Personality Inventory (MMPI). The initial interview and testing lasted approximately 2 hours. During the interview, the subject's dermatological and associated medical history was taken, involved skin areas were specified, and the program was explained.

Baseline Phase. A 2-week no-treatment phase followed the initial interview. During this phase, there was no contact between the therapists and the subjects. The function of this phase was to assess the effects of therapist attention, subject expectancy, reactive effects of the assessment procedures, and effects due to the passage of time.

Placebo Intervention Phase. At the end of the 2-week baseline phase, subjects were brought into a sound-attenuated, temperature-controlled room (3m X 2m) and seated in a reclining chair. Taped instructions were then played that explained that electrodes were to be attached to the forehead. The instructions also suggested that hearing a low tone might be of assistance in relaxing and prove helpful in alleviating the skin problem. An experimenter then reentered the room to scrub the subject's forehead with acetone and to place electrodes over the frontal muscle group and earphones over the subject's ears.

The experimenter left the room and taped instructions were played that instructed the subject to become as relaxed as possible and to wait for further instructions. A 10-minute baseline period followed in which no tone or instruction were provided. After 10 minutes, the subject was informed that a soft low tone would be heard through the earphones and that the subject was to listen to the tone and attempt to become as relaxed as possi-

ble. A steady, low, soft tone was then played through the earphones for 20 minutes. Following the 20-minute tone period, a taped message explained that the session had ended and that the subject should attempt to practice what was being learned in the session and to use these relaxation skills whenever feeling anxious. This phase lasted for four sessions (two sessions/week for 2 weeks).

The function of this phase was to assess the contribution of placebo, demand, or other nonspecific factors inherent in relaxation/biofeedback intervention. It should be noted, however, that sitting in a dark room in a soft chair and listening to a soft, monotonous tone would be expected to be associated with some degree of relaxation. It was felt that inclusion of this phase would facilitate assessment of the proportion of treatment variance accounted for by specific and nonspecific factors.

EMG Feedback/Relaxation Instructions Phase. Following four sessions of placebo intervention, subjects received eight sessions of combined relaxation instructions and frontal EMG feedback.[3] During these sessions, subjects were brought into the experimental room and seated as before. Taped instructions then explained the principles of biofeedback and relaxation training. Subjects were told that they would hear a tone that would vary in pitch with their level of relaxation: as they became more relaxed, the tone would decrease in pitch; as they became more tense, the tone would increase in pitch. They were told that their task was to learn to become as relaxed as possible and that to help them relax, they would also receive taped relaxation instructions. The experimenter then reentered the room, scrubbed the subject's forehead, attached electrodes over the frontal muscles, and placed headphones over the subject's ears. The experimenter left the room and a taped message informed the subject to become as relaxed as possible and to await further instructions. A 10-minute baseline period followed in which no tone or instructions were provided.

Following the 10-minute baseline period, subjects received taped instructions that informed them that they would now hear the feedback tone and relaxation instructions and to become as relaxed as possible. Subjects then heard a tone that varied in pitch with the level of electromyographic activity of the frontal muscles. Decreased EMG levels were associated with a lower tone pitch. The subjects also heard relaxation instruc-

[3]Previously published research and pilot research in this laboratory had suggested individual differences in responses to relaxation instructions or EMG feedback alone. Applications of these two procedures concomitantly was found to increase the number of individuals demonstrating reductions in EMG levels, although the minimal levels of EMG achieved were not reduced. Thus it was assumed that the use of relaxation training and biofeedback together would increase the applicability of the program to a greater number of subjects.

tions concomitant with the feedback tone.[4] The intervention period lasted 20 minutes. At the end of the feedback and relaxation instructions period, subjects were told to practice outside what they were learning in the laboratory and to use their relaxation skills whenever they felt anxious. Sessions occurred twice a week for 4 weeks.

Dependent Measures

Photography. Affected skin areas were photographed at the following points in the intervention program: (1) at the initial interview, (2) at the end of the 2-week baseline phase and prior to beginning the placebo intervention phase, (3) at the end of the placebo phase and prior to the biofeedback/relaxation instructions intervention phase, and (4) at the end of the biofeedback/relaxation instruction intervention phase. Photographic procedures were standardized as much as possible to control for distance, camera angle, lighting, and limb position. Areas to be photographed were selected at the initial interview and were those most severely affected. The same areas were photographed throughout the program.

Photographs were analyzed in two ways. First, two raters, blind to the experimental procedures and the associated program phases, independently ranked all four photographs of each affected area from worst to best. The photographs of each affected area were simultaneously presented side by side but in random order. Two rankers were utilized so that interrater agreement coefficients could be derived.

The photographs were also analyzed through use of a transparent overlay divided into small squares. The grid was superimposed over the slides and the number of squares that contained affected skin area was calculated. Because of slight variations in photographic angle, the percent of affected squares for a particular body area (e.g., from wrist to elbow) was calculated for each slide. Percentiles could then be compared while minimizing variance due to photographic errors. Photographs were analyzed independently by two observers who were unfamiliar with the experimental procedures and program phases.

Frontal EMG Measures. Electrical activity from the frontal muscle groups was integrated (μV/min) across 64-second periods with 20-second intertrial intervals (Biofeedback systems, BIFS-1). EMG measures, therefore, were taken every 84 seconds throughout each session (within each

[4]These instructions have previously been found effective in reducing indices of autonomic arousal (Haynes, Moseley, & McGowan, 1975) and in treating other psychosomatic disorders (Haynes, Griffin, Mooney, & Parise, 1975; Haynes, Sides, & Lockwook, 1977). A transcript of the relaxation instructions is available from the first author upon request.

session, there were 7 integration periods during baseline and 14 integration periods during experimental periods).

Itching Ratings. Three times during each session subjects were requested (via taped message) to estimate the level of their itching on a 10-point scale. Within each session, requests for itching estimates occurred (1) at the beginning of each session, (2) at the end of the 10-minute baseline period, and (3) at the end of the 20-minute intervention period.

Follow-Up. A telephone follow-up was conducted with all subjects 9 months to 1 year after they completed the program. Subjects were asked to report medication intake and number of visits to the dermatologist subsequent to program completion, comment on the generalized effects of the program, evaluate their degree of improvement, and suggest needed improvements in the program.

RESULTS

Attrition

Of the 12 subjects beginning the program, 3 dropped out during the placebo intervention phase and 1 moved to another state during the experimental intervention phase. The subject who left during the experimental intervention phase completed six sessions (four placebo and two intervention) and was included in the analysis of itching and frontal EMG data but not of the photographic data. The 3 subjects who dropped out during the placebo phase were included only in the analysis of itching ratings.

Interobserver Agreement for Photographic Data

Average interobserver agreement between the two grid observers independently analyzing photographs for the percent of affected area was .99 (lowest estimate/highest estimate for each slide). The agreement coefficient (correlations for ranked data) between the two observers who ranked the photographs was .76 (different observers were used for the rankings and grid analysis).

Percent of Affected Area

Because of photographic difficulties, analysis of percent of affected area could be calculated for only 18 sites across five subjects. The mean per-

Table II. Means of Grid Analysis and Rankings of Photographs for Program Phases

Variable	Program		Phase	
	Prebaseline	Postbaseline	Postplacebo	Postintervention
% of measured area affected	21	16	14	12
Averaged rankings by observers[a]	3.1	2.8	2.5	1.5

[a] 1 = best; 4 = worst.

cent of affected area across the four measurement periods as presented in Table II reveals that the percent of affected area steadily decreased across treatment phases but that the rate of decrease is similar between phases. There was a mean reduction of approximately 50% in dermatological involvement across the program. Changes in percent of affected skin area across phases were analyzed by a one-way repeated-measures analysis of variance and Duncan post hoc analyses (Winer, 1962). These statistical procedures revealed that there was a significant change in affected area between initial and post-treatment measures ($F(3/68) = 5.91$, $p < .05$). On the basis of Duncan's post hoc analyses, significant differences were found only between posttreatment and the pre- and postbaseline phases. These findings should be interpreted conservatively because of nonindependence of some of the data points (more than one site was utilized per subject).

Rankings of Photographs

Table II also presents the average rankings of photographs (1 = best, 4 = worst) by the independent observers. Inspection of the average rankings presented in Table II suggests that observers blind to the experimental phases and hypotheses judged photographs to be more improved as phases progressed from baseline through intervention.

The rank data were analyzed by nonparametric statistical procedures (Friedman analysis of variance of ranks), which suggested that there were significant differences in ranks across program phases. (Friedman statistic = 15.35, $df = 3$, $p < .05$). Post hoc Duncan analyses found significant differences only between postintervention and the pre- and postbaseline phases.

Table III. Mean Integrated EMG Levels (μV/min) within Sessions and between Treatment Phases ($N = 8$)

Within-session sampling point	First placebo session	Last placebo session	Last biofeedback/ relaxation session (last two)
First baseline period	8.04	7.63	6.48
Last baseline period	7.36	6.47	5.60
Last treatment period	6.55	5.00	4.39

EMG Levels

Table III summarizes mean integrated EMG levels (μV/min) for eight subjects. The small N and nonindependent qualities of the data render valid statistical analyses difficult but inspection of the table suggest only small within- and between-sessions effects. Of course, the design employed does not allow inferences about the determinants of the EMG reductions.

Itching

To assess the relationship between frontal EMG and itching ratings, a Pearson correlation coefficient was calculated between these two variables for each subject. The results are presented in Table IV. Correlations are not presented for subject 10 because he reported a "0" itching level in every session. Inspection of Table IV reveals that the correlation between itching

Table IV. Correlation between Itching Ratings and Frontal EMG Level

Subject	Correlation
1	.39
3	−.07
4	.35
5	.28
7	.07
8	.29
10	—
11	.07
12	.43

Table V. Average Itching Ratings Across Sessions[a]

Measurement point	Session										
	1	2	3	4	5	6	7	8	9	10	11
Prebaseline	1.0	1.6	2.0	1.8	2.5	1.8	1.9	2.2	2.3	1.4	1.7
Postbaseline	.6	1.3	1.3	1.1	1.9	1.5	1.6	1.5	1.8	1.2	1.0
Post- and feedback relaxation	.8	.5	.6	.6	1.1	.8	1.0	1.3	1.5	.4	.4

[a] 0 = no itching; 10 = maximum itching.

and frontal EMG varied between −.07 and .43. Because of the nonindependence of the data points, confidence levels for the correlation coefficient were not calculated.

Table V presents the average itching ratings measured at the beginning of each session, following the 10-minute baseline period and following EMG feedback and relaxation instructions. As indicated in Table V, there was a consistent decrease in itching ratings during each session but there was no consistent change across sessions.

EMG/Itching Correlations as a Predictor of Program Effectiveness

If relaxation training and biofeedback procedures result in a diminution in itching through a reduction of autonomically mediated arousal, a reduction in scratching and clinical manifestations of atopic dermatitis would be expected. If this hypothesized mediational function is valid, subjects with a higher frontal EMG itching level correlation (Table IV) should demonstrate greater improvement in manifestations of atopic dermatitis. To evaluate this hypothesis, the itching/EMG coefficient for each subject (Tabel IV) was correlated with the subject's mean change in dermatological involvement (taken from the grid analyses). A correlation coefficient of .25 resulted, which indicates that less than 7% of the variance in treatment outcome can be explained by the itching/EMG correlation.

Personality Measures

MMPI profiles of the atopic dermatitis subjects did not reveal any significant deviations from previously published norms. All *t* scores were between 65 and 45 and there was no consistent pattern in maximum scale scores or scale profiles.

Follow-Up

The eight subjects who completed the program were contacted by phone at follow-up (9–12 months after treatment). When asked to report their degree of improvement (very much improved, improved, no change, worse, very much worse), two reported they were very much improved, four reported they were improved, and two reported no change. None reported being worse. When asked if they had contacted a dermatologist or physician about their skin problem since the termination of the intervention program, two reported having consulted dermatologists and six reported no contact. The mean rate of contact with a dermatologist was .4 contacts/year following treatment versus 2.5 contacts/year before treatment. Three were currently taking medication (two were applying topical ointments and one was taking valium). When asked to comment about the program in general, all eight spontaneously mentioned that it helped them relax and better handle a variety of anxiety-associated problems. Two reported that they had stopped practicing the techniques and several offered suggestions for improvement (primarily providing more information about the theory underlying the program). Photographs were not retaken because of difficulties in obtaining a sufficient sample for analysis.

DISCUSSION

Eight subjects with atopic dermatitis were exposed to an intervention package involving three phases: no treatment, placebo treatment, and a treatment combination of frontal EMG feedback and relaxation instructions. Dependent measures included photographic analysis of involved areas, frontal EMG activity, ratings of itching levels by subjects, MMPI profiles, and a follow-up assessment. Overall results from this intervention program for these particular eight patients indicated (1) reductions in affected skin areas between baseline and postintervention, (2) improvement across phases as estimated by experimentally blind judges, and (3) decreases in itching level within but not across treatment sessions. Analysis of psychological factors and mediational aspects of the program indicated (1) MMPI profiles within normal limits, (2) no definite association between frontal EMG and itching level, and (3) low correlation coefficient between EMG/itching coefficients and response to treatment.

Grid-overlay analyses revealed significant decreases in affected skin areas across phases, and judges independently ranked subjects as significantly improved across intervention phases, but a substantial proportion of the improvement may be attributable to nonspecific elements of the treat-

ment program such as assessment reactivity, attention, demand, or placebo. The intervention package (assessment, placebo, biofeedback/relaxation), however, did result in a significant diminution of dermatological problems for these eight cases. In an attempt to maximize the applicability of the behavioral intervention procedures, a combination of relaxation and biofeedback was utilized. Additional research may be useful in partialing out the contribution of eahc of these interventions individually.

It should be noted that these subjects had fairly long histories of dermatological diseases and had been refractory to more traditional medical intervention procedures that also involved nonspecific components. That the program package might be an effective intervention procedure is supported by the follow-up data on self-report measures of both improvement and frequency of visits to dermatologists.

Because of the case study format of the present study, it is impossible to ascribe the observed decreases in EMG level to a general relaxation response accompanying the experimental situation, placebo, or expectancy factors, or the biofeedback/relaxation instructions component. Previous studies, however (Haynes, 1975; Haynes et al., 1977), have noted that a significant proportion of EMG effects can be attributed to factors other than biofeedback or specific relaxation instructions and that EMG changes may not be directly associated with clinical improvement. It is impossible to ascertain, therefore, the degree to which this specific physiological measure of arousal mediated changes in manifestations of atopic dermatitis. Utilization of controlled-group designs with a larger number of subjects would facilitate identification of the mediating factors.

The hypothesis of "psychological" involvement with atopic dermatitis was not supported by results from the MMPI. All scores were within normal limits and there were no consistent patterns of scale scores. If hypotheses about the psychological etiology of atopic dermatitis are valid, higher than normal scores would be expected on scales measuring hypochrondriasis or anxiety. The failure of the MMPI to discriminate subjects with from those without dermatological problems suggests that (1) the instrument was not sufficiently sensitive to pick out differences between these groups or (2) atopic dermatitis is not associated with more generalized behavioral and attitudinal syndromes such as those tapped by the MMPI.

For some subjects, the correlation between itching and frontal EMG activity was relatively high; for others it was low. The lack of systematic across-sessions changes in itching level also suggests that changes in itching (and hypothesized changes in scratching) did not mediate dermatological improvement for these subjects.

This study represents an intiial attempt to assess the effects of behavioral intervention on atopic dermatitis. Methodological difficulties with this

study were unavoidable because of the number and schedule of referrals and were noted previously. Replication of this study using a factorial design in which separate groups of subjects are subjected to separate intervention programs or components is highly desirable. A large sample, probably obtainable from a larger metropolitan area, would also facilitate the assessment of individual differences in etiology of atopic dermatitis and in response to biofeedback/relaxation instructions intervention.

Additional studies might also consider the effectiveness of more specific methods of biofeedback. For example, feedback of skin conductance levels might prove beneficial to subjects whose skin problems are exacerbated by sweat gland activity (e.g., hyperhydrosis). Peripheral temperature feedback might prove beneficial for subjects who demonstrate increases in peripheral skin temperature associated with exacerbation of dermatological problems.

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