Cognitive-behavioural stress management for patients with non-insulin dependent diabetes mellitus

J. L. Henry; P. H. Wilson; D. G. Bruce; D. J. Chisholm; P. J. Rawling

* University of Sydney, ‡ Diabetes Centre, St Vincent's Hospital, Sydney, Australia

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1University of Sydney, & 2Diabetes Centre, St Vincent’s Hospital, Sydney, Australia

Abstract  This study was designed to evaluate the efficacy of a combined cognitive-behavioural stress management programme in improving subjective anxiety and diabetic control in 19 subjects with non-insulin-dependent (NIDDM, Type II) diabetes. Subjects were randomly allocated to either cognitive-behaviour therapy (n = 10) or waiting list (n = 9) conditions. Treatment consisted of six weekly 1.5-hour sessions conducted in two small groups by one therapist. Treatment consisted of both progressive muscular relaxation training and cognitive coping skills training. Measures, obtained at pre-treatment and post-treatment, included self report scales of anxiety, depression and daily stressors, glycosylated haemoglobin and fasting blood glucose. Results indicated that therapy had significant effects in the amelioration of anxiety and stress. Effects of treatment on glycosylated haemoglobin were in the desired direction but statistically less powerful. Overall, the results were encouraging and suggest a useful role for stress management in the maintenance of good diabetic control in NIDDM.

Introduction

It has been suggested that stress may be a destabilizing factor in the course of diabetes, a view which receives some support from the reports of significant associations between the occurrence of stressful life events or anxiety and measures of diabetic control (Carter et al., 1985; Cox et al., 1984; Frenzel et al., 1988; Mazze et al., 1984; Peyrot & McMurry, 1992; Turkat, 1982). Of course, diabetes may itself be viewed as a stressor, especially as the management of the disorder continually intrudes into the routine lives of patients and their families. Fisher et al. (1982) suggested that stress may interfere with an individual’s compliance to his or her treatment or dietary regimen and may thereby undermine metabolic control. Alternatively, poor control might disrupt an individual’s level of general functioning, thus exacerbating the effects of various environmental stressors. The ‘stress hormones’ (e.g. cortisol, glucagon, epinephrine and norepinephrine) have been shown to affect carbohydrate metabolism and blood glucose levels. These hormones have been found to be significantly affected by psychological stress (Surwit & Feinglos, 1988). While the mechanisms through which stress may influence diabetic control remain unresolved, it appears that a reasonable case can be...
made for considering psychological and environmental factors in the management of diabetes (Rubin & Peyrot, 1992; Surwit et al., 1992).

In recent years, several studies of stress reduction techniques as a means of improving diabetic control have been reported (Feinglos et al., 1987; Fowler et al., 1976; Lammers et al., 1984; McCrady et al., 1991; Rose et al., 1983; Rosenbaum, 1983; Surwit & Feinglos, 1983, 1984). In a controlled group outcome study (Surwit & Feinglos, 1983) using a sample of 12 hospitalized non-insulin-dependent diabetics, half of the subjects received an EMG biofeedback/relaxation training programme over a period of 5 days while the other half constituted a control condition. Treatment resulted in improved glucose tolerance and decreased plasma cortisol, but there was no effect on glucose-stimulated insulin secretory activity or insulin sensitivity. Unfortunately, the generalizability of the results is constrained by the fact that the study was conducted in a hospital setting rather than the more typical out-patient setting in which the patient must take primary responsibility for management (e.g. dietary and medication compliance). In addition, the therapy subjects practised relaxation with the assistance of tape-recorded instructions while the post-treatment test was being conducted. Thus, it is possible that the effects may reflect transient changes which could occur during relaxation practice rather than more general effects of relaxation techniques on reactions to stressful events.

Other studies raise some problems in the evaluation of stress control techniques in the management of diabetes. For example, relaxation training and EMG biofeedback have been found not to be effective in a controlled study with Type I diabetes (Feinglos et al., 1987). In another study (Lammers et al., 1984), a significant decrease in blood glucose level was obtained in two of the four Type II diabetic subjects, but this improvement was not accompanied by a decrease in self-reported anxiety and stress. For the remaining two subjects, an improvement was evident in anxiety and stress, but was not accompanied by any improvement in blood glucose levels. McCrady et al. (1991) randomly allocated 18 subjects with IDDM to an experimental or control group. The ten experimental subjects received training in biofeedback-assisted relaxation training over 10 sessions. Results indicated that, when the pre-treatment differences were held constant, average blood glucose level, percentage of patients with blood glucose > 11.2 mM, and percentage of patients with fasting blood glucose at target, were significantly lower in the experimental group than in the control group at post-treatment.

Overall, there are some encouraging findings concerning the usefulness of stress management procedures in diabetic control, although there are methodological problems in many of the studies which prevent firm conclusions from being drawn at this stage. For example, most of the studies lack control conditions; participants have mainly been females; few studies systematically report on blood glucose or glycosylated haemoglobin levels; and there has been little attempt actually to measure stress or anxiety using approaches of known reliability and validity. Most importantly, there have been problems with many of the measures of metabolic control. Such measures include daily insulin dosage, and random blood or urine glucose levels. Unfortunately, these measures are somewhat limited given their susceptibility to fluctuation in response to other variables (e.g. physical activity level and food intake).

Clearly, there is a need for further controlled studies of the contribution of relaxation training and related techniques in the management of diabetes. The aim of the present study was to investigate the efficacy of a cognitive-behavioural stress management programme in reducing stress and improving diabetic control in NIDDM patients. A waiting-list control condition was included in order to control for the passage of time and the effects of assessment. Measures of diabetic control included both fasting blood glucose and glycosylated haemoglobin (HbA1c).
TREATMENT OF DIABETES

Method

Design

The experiment consisted of a $2 \times 2$ (Treatment $\times$ Occasions) design. The two experimental conditions were: (1) cognitive-behaviour therapy and (2) waiting-list control. Assessments took place at pre-treatment and post-treatment.

Subjects

The sample consisted of non-insulin-dependent diabetic patients who were receiving treatment at a specialized diabetic outpatient centre at St Vincent's Hospital, Sydney. Subjects were referred by their physicians when medical examination indicated that stress and anxiety were possible contributing factors in their hyperglycaemia. The physicians carried on their usual practices, and were not provided with specific means of determining such psychological involvement. Selection criteria included: diagnosis of NIDDM with a duration of at least 6 months; not having required insulin therapy in the previous 6 months; not currently requiring insulin therapy; the absence of severe levels of psychopathology or major forms of psychiatric disorder such as schizophrenia, bipolar affective disorder, or addictive disorders; and biochemical evidence of elevated HbA1 (i.e. $>10\%$) obtained within the past month. Thirty-two potential subjects attended an interview with a psychologist, of whom 21 met all screening criteria. Screening of present psychiatric status was conducted at this stage using a semi-structured interview technique guided by definitions of pathology contained in DSM-III. Two subjects discontinued their involvement in the programme for medical reasons unrelated to the conduct of the experiment or the diagnosis of diabetes itself, resulting in a final sample of 19 (Treatment = 4 males and 6 females; Waiting-List = 5 males and 4 females). The mean age of the sample was 59.8 years (range = 47 to 74 years). Sixteen subjects were receiving oral hypoglycaemic medication (8 in the stress management condition and 8 in the control group) and 3 (2 in the stress management condition and 1 in the control group) were being treated by dietary therapy. Medication and dietary regimens were not altered during the period of the study. No subject required insulin during the study. The mean duration of diabetes was 6.4 years (range = 1.5 to 23 years).

Measures

Glycosylated haemoglobin. HbA1 was selected as a measure of diabetic control (Baron et al., 1980; Kynoch & Lehman, 1977) since this index reflects levels of blood sugar over an extended period of time, perhaps up to 3 months prior to the actual measurement, but the result is biased towards the influence of glycaemia in more recent weeks. HbA1 was determined by the microcolumn method (Baron et al., 1980). It is expressed as a percentage indicating the percentage of glycosylated haemoglobin of total haemoglobin. The normal reference range for the method used in this laboratory is 6–9%, hence the decision to employ a selection criterion of 10% in the present study. All blood samples were collected by either nursing or medical staff of the hospital and the assays were performed by the hospital laboratory.

Fasting blood glucose. Subjects were required to fast for approximately 12 hours overnight prior to the testing. The blood glucose assay involved use of the immobilized enzymatic
method, employing glucose oxidase. All blood samples were collected by either nursing or medical staff of the hospital and the assays were performed by the hospital laboratory.

Depression and anxiety. The State scale of the Spielberger State-Trait Anxiety Scale (Spielberger et al., 1970) was included as a measure of subjective anxiety, and the Beck Depression Inventory (BDI; Beck et al., 1961) was selected as the measure of the severity of depressive symptoms. These measures were included in order to provide an assessment of the two principal sets of symptomatology which have been suggested to be common amongst diabetic patients (Muranski et al., 1970; Sanders et al., 1975). Scores on these tests are interpreted as indicating the severity of symptoms rather than as providing a basis for psychiatric diagnosis. Both measures are very widely employed, and have a good deal of psychometric support for their use through normative data and studies of their validity and reliability (Beck et al., 1988; Knight et al., 1983). The BDI is frequently used in studies with non-psychiatric patients (e.g. Oliver & Simmons, 1984).

Hassles scale. This 117-item self-report scale was developed by Kanner et al. (1981) to provide a measure of the occurrence of stressful events. The authors define ‘hassles’ as ‘the irritating, frustrating, distressing demands that to some degree characterize everyday transactions with the environment’ (p. 3). Examples of items include: troublesome neighbours, problems getting along with fellow workers, concerns about job security, overloaded with family responsibilities, unchallenging work, too many things to do, transportation problems, shopping, and traffic. Some alterations were made from the original instructions for the purpose of the present study. Kanner et al. originally required subjects to provide ratings of severity and persistence of any hassles that occurred on two 3-point rating scales. It was considered by the present authors that greater use could be made of data derived from ratings of the degree of stress engendered by the events instead of rating of the ‘severity’ of events since the term ‘severity’ could refer to either the event itself or the reaction to the event, resulting in some ambiguity in interpretation. A second alteration involved having the subjects rate how well they thought that they had coped with each event, since it was also of interest to examine the effects of the stress-management training on self-perceived coping ability. Respondents were asked to indicate which of the events had occurred in the previous month and to make two types of ratings, resulting in three scores: (1) how many events had occurred; (2) how stressful each of the events had been, rated on a 5-point scale from ‘not at all stressful’ to ‘extremely stressful’; and (3) how well the subject thought that they had coped with each event, rated on a 4-point scale from ‘coped very poorly’ to ‘coped extremely well’. Thus, the three scores obtained from this scale represent the: (1) frequency of hassles (raw total); (2) perceived stress level (mean rating for all events that occurred); and (3) perceived coping ability (mean rating for all events that occurred).

Tension ratings and relaxation practice. Subjects in the stress management condition were provided with brief daily monitoring forms on which to record their practice of the relaxation techniques and their pre- and post-practice levels of tension on an 11-point scale.

Assessment sequence

There were two occasions of assessment: pre-treatment and post-treatment. Pre-treatment assessment on all measures, including a fresh HbA1 assay, took place one week prior to the
commencement of the treatment (or waiting-list period). Post-treatment assessment on the self-report measures occurred one week after the conclusion of the treatment/waiting period. Blood samples for the fasting blood glucose and the HbA1c were obtained 3 weeks after the end of the treatment/waiting period in order to allow for the HbA1c measure to reflect the period covered since the conclusion of the programme.

Treatment procedures

Treatment consisted of six weekly 1.5-hour sessions conducted in two groups of 4 and 6 subjects at the Diabetes Centre, St Vincent’s Hospital, Sydney (Australia). One therapist (JLH) conducted the treatment sessions.

Stress management. Each treatment session consisted of both progressive muscular relaxation training and cognitive coping skills training. The relaxation technique consisted of learning to sequentially tense and relax each of the major muscle groups (Bernstein & Borkovec, 1973). Relaxation was presented as a self-control skill, and considerable emphasis was placed on learning to relax quickly in everyday situations, using the cue-word ‘relax’. Differential relaxation was introduced in the fourth session, and involved teaching the subjects to relax muscles which are not in use when engaged in some particular task (e.g. driving a car, walking, sitting on a bus). Subjects were instructed to apply the relaxation technique to situations in which they felt anxious, stressed or noticed muscle tension. Regular home practice was encouraged and subjects were provided with tape-recorded relaxation instructions and monitoring forms on which to record their practice and their pre- and post-relaxation tension levels. Training in cognitive coping skills was designed to instruct subjects in cognitive skills which could be employed to deal with stress and anxiety and involved techniques drawn from a number of sources (Beck et al., 1979; D’Zurilla & Goldfried, 1971; Ellis, 1962; Meichenbaum, 1977; Sobel & Worden, 1982). The procedures involved teaching the subjects to identify and monitor negative self-statements or thoughts about stressful events and to devise and substitute alternative coping-oriented statements in their place. Meichenbaum’s self-instructional training was employed as a means of increasing positive self-talk and fostering positive coping orientations to stress. Cognitive styles involving catastrophizing, absolutistic thinking, overgeneralization and personalization were described and discussed. The techniques of relabelling and reattribution were presented as methods of modifying these negative cognitive styles. Subjects were also instructed in problem-solving skills (D’Zurilla & Goldfried, 1971) using simulated problems for demonstration purposes. Problem-solving involves the identification of specific difficulties such as communication about their diabetes with medical personnel or dealing with interpersonal difficulties. People are assisted to generate alternative solutions and to consider the strengths and weaknesses of each solution. The problems and their desirable solutions were presented in pictorial form and were selected from a problem-solving intervention programme devised for use with cancer patients (Sobel & Worden, 1982). Subjects were encouraged to practise the above coping strategies in between sessions, using set homework assignments, and to select particular strategies according to the nature of the problems which they encountered.

Waiting-list. Subjects who were assigned to the waiting-list condition were informed that, due to limited facilities, their participation in the stress management programme would be delayed for a couple of months. These subjects received treatment immediately following the post-treatment assessment period.
Statistical analysis

A $2 \times 2$ repeated measures analysis of variance was conducted on each dependent variable, using the Bonferroni correction to avoid inflation of the Type 1 error rate due to the large number of dependent variables (Miller, 1966). Correlations were also computed between pre-treatment scores, and between pre-post change scores, on all dependent variables.

Results

A summary of the means and standard deviations for each of the dependent variables at pre-treatment and post-treatment assessments is presented in Table 1.

There were no significant differences between groups at the pre-treatment assessment on the same dependent variables that were used to evaluate the outcome of treatment (all $F$s $< 1.7$, NS), suggesting that the two groups were well equated initially on these measures. There was an overall reduction from pre-treatment to post-treatment (collapsing across groups) on the HbA1 ($F(1,17) = 20.0, p < 0.01$), BDI ($F(1,17) = 15.5, p < 0.01$), and State Anxiety ($F(1,17) = 24.3, p < 0.01$). Treatment $\times$ Time interactions were statistically significant on State Anxiety ($F(1,17) = 16.6, p < 0.01$) and perceived level of stress on the Hassles Scale ($F(1,17) = 18.8, p < 0.01$). Inspection of the mean scores reveals that the treated subjects displayed greater decreases in anxiety and perceived stress than did subjects in the waiting-list control condition. Treatment $\times$ Time interactions failed to reach significance on the other measures. It should be noted, however, that if a more liberal decision-wise error rate had been adopted, where alpha was set at 0.05 for each dependent variable, the Treatment $\times$ Time interactions would have reached significance on the BDI, frequency of hassles, and HbA1 ($F(1,17) = 5.33, 8.35, 5.13$).

Inspection of the HbA1 levels of individual subjects revealed that eight subjects (four from each condition) fell below the selection criterion on this index from the screening to the

<table>
<thead>
<tr>
<th>Measure</th>
<th>Stress management</th>
<th>Waiting-list</th>
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<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Haemoglobin A1 %</td>
<td>M</td>
<td>10.70</td>
</tr>
<tr>
<td></td>
<td>SD</td>
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<tr>
<td>Blood Glucose</td>
<td>M</td>
<td>10.09</td>
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<td></td>
<td>SD</td>
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</tr>
<tr>
<td>State Anxiety</td>
<td>M</td>
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</tr>
<tr>
<td></td>
<td>SD</td>
<td>5.32</td>
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<tr>
<td>Hassles-Frequency</td>
<td>M</td>
<td>39.00</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>20.52</td>
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<td>Perceived Stress</td>
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<tr>
<td></td>
<td>SD</td>
<td>39.02</td>
</tr>
<tr>
<td>Coping Ability</td>
<td>M</td>
<td>71.60</td>
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<tr>
<td></td>
<td>SD</td>
<td>35.80</td>
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<tr>
<td>Beck Depression</td>
<td>M</td>
<td>11.10</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>2.69</td>
</tr>
</tbody>
</table>

For statistical effects:
1 = Main effect for time, Bonferroni corrected, $p < 0.01$;
2 = Treatment $\times$ Time interaction, Bonferroni corrected, $p < 0.01$;
3 = Treatment $\times$ Time interaction, univariate, $p < 0.05$. 

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pre-treatment assessment. For one of these subjects the decrease was marked, but for the others the decrease was either slight or moderate. Nevertheless, a separate analysis was conducted in which subjects were split into those who remained above and those who fell below the HbA1 screening criteria at the pre-treatment assessment (the resulting new independent variable is referred to as Criterion Status). In the reanalysis of the HbA1 data, the Criterion Status × Treatment × Time was not statistically significant (F = 0.50, NS).

Pearson product-moment correlations were computed between all dependent variables at pre-treatment. In general, these correlations were fairly small; however, there were statistically significant correlations between HbA1 and fasting blood glucose (r = 0.64, p < 0.05); HbA1 and BDI (r = 0.54, p < 0.05); State Anxiety and BDI (r = 0.72, p < 0.01); frequency of hassles and fasting blood glucose (r = 0.47, p < 0.05); and between the frequency of hassles and perceived level of stress (r = 0.60, p < 0.01). It is also of interest to note that the correlation between HbA1 and State Anxiety was not statistically significant (r = 0.38).

Correlations were computed on pre-post change scores for all dependent variables. The change-score correlations between either HbA1 or blood glucose levels and the various psychological measures, including tension ratings, were low and non-significant. Correlations amongst change scores on the psychological variables were higher. Significant correlations were obtained between the change scores in State Anxiety and frequency of hassles (r = 0.68, p < 0.05); State Anxiety and coping ability (r = −0.46, p < 0.05); frequency of hassles and coping ability (r = −0.66, p < 0.05), perceived stress and frequency of hassles (r = 0.48, p < 0.05), and perceived stress and BDI (r = 0.61, p < 0.05).

Finally, inspection of daily relaxation practice records indicated a high level of compliance with the practice instructions. A repeated-measures analysis of variance on ratings of tension made in connection with the relaxation practice revealed significant reductions in tension, F(1,9) = 21.04, p < 0.05

Discussion

The results of the Bonferroni-adjusted analysis of variance indicate that a cognitive-behavioural stress management programme for NIDDM patients is associated with reductions in anxiety and perceived level of stress relative to a waiting-list control condition. These findings, together with the reported reductions in tension as rated by subjects who received the stress-management programme, suggest that treatment was effective in meeting the goal of stress reduction. Using the more liberal univariate decision-wise error rate, treatment effects were also observed on the BDI, frequency of hassles, and HbA1.

In the context of the existing literature, the present study has a number of positive features, including a larger sample size, use of a waiting-list control condition, and the measurement of HbA1 levels. However, several methodological and statistical considerations need to be kept in mind when interpreting the results. Although the waiting-list condition controls for the passage of time and the effects of the assessment procedures, there was no control for non-specific treatment factors such as group support, expectation of success, and placebo effects. Thus, the extent to which the specific components of the treatment contributed to the results is not known.

The reduction from screening to pre-treatment in HbA1 scores for some subjects underscores the importance of including a waiting-list control condition in this kind of research. One possible explanation for this finding is that involvement in a research project led some subjects to engage more assiduously in self-management behaviours, such as closer dietary monitoring. A second problem concerns the timing of the post-treatment HbA1
assessment, which was conducted 3 weeks after the conclusion of treatment. Since this index reflects a period of up to 3 months, it is possible that such assessment may have been conducted too early to reflect the full result of the intervention. Nevertheless, the HbA1c is influenced most by glycaemia during recent weeks, so it is likely to have been an appropriate measure at the specified time.

The major statistical consideration in interpreting the results concerns the relatively low power of the analysis. The small sample size, coupled with the use of the Bonferroni correction, meant that very reliable effects would have been needed in order to reach acceptable levels of statistical significance. It could be argued that this approach was overly conservative since several measures employed in the present study served mainly as a manipulation check. That is, the State Anxiety and Hassles Scale subscores were included primarily in order to determine whether treatment had an effect on measures thought to be related to stress. In one sense, they form a set of dependent variables which is separate from the measures of principal interest, i.e. HbA1c and fasting blood glucose. By treating all variables with equal importance, relatively less power was available for the statistical tests associated with each measure. The univariate tests suggest that, in addition to effects on anxiety and perceived level of stress, treatment was also associated with lowered HbA1c, less depression and a reduced frequency of hassles.

Several other aspects of the results deserve some comment. The moderate correlation between HbA1c and fasting blood glucose is consistent with other research (Koenig et al., 1976). Despite this association, the improvement in the HbA1c for the treated group was not replicated on fasting blood glucose. This lack of concordance indicates the importance of including multiple measures of diabetic control in such studies. The failure to find a treatment effect on fasting blood glucose may be due to the fact that this measure can be affected by a number of other variables such as diet and exercise or may indicate that the predominant effect of stress is seen on blood glucose levels during the day and less so after sleeping. The moderate correlations found between HbA1c and both the BDI and the frequency of hassles are consistent with the view that psychological factors may be related to diabetic control, although the direction of causality cannot be determined from the present data. It should also be noted that, contrary to prediction, only a low correlation was obtained between HbA1c and State Anxiety. Taken together, these results suggest that, apart from anxiety, more attention should be given to the assessment and treatment of depression-related symptoms in the psychological management of diabetes. Other researchers have also pointed to a relationship between depressive symptomatology and diabetes (Lustman et al., 1988, 1992; Wing et al., 1990). As mentioned previously, the BDI is a measure of depressive symptoms, rather than a procedure for the diagnosis of a major depressive episode. Thus, the conclusions reached here refer only to variations in non-pathological levels of depressive symptoms such as might be seen in mild-moderate dysphoric states seen in otherwise normal individuals. The failure to find significant correlations between changes in glycosylated haemoglobin or Blood Glucose and changes in psychological variables is difficult to explain. While it appears that the psychological measures showed a high degree of concomitant change across time, these changes were not related to changes in the biological measures. Thus, there is no supportive evidence that the improvement in diabetic control can be attributed to changes in perception of stress or coping ability (at least as measured by the procedures which were used in this study). It is possible that these variables are not sensitive measures of any basic psychological mechanisms involved in therapeutic improvement. While alternative mechanisms can be suggested, such as improvement in dietary management, we would wish to exercise caution in regard to explanations of the effect at this stage. Clearly, a larger-scale study is required,
involving more complex multiple regression analyses and more sophisticated measures of process variables, before any firm conclusions can safely be drawn.

The results of the present study revealed that a cognitive behavioural stress management programme produced a reduction in anxiety and perceived level of stress. There was also a modest improvement in diabetic control. Given the potential importance of such findings, it is suggested that a larger-scale study be conducted, incorporating further methodological refinements such as the inclusion of a non-specific control condition and a lengthy follow-up assessment.

References


