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Personality and Family Profiles of Chronic Insulin-dependent Diabetic Patients Using Portable Insulin Infusion Pump Therapy: A Preliminary Investigation

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Thirty patients were studied before and after introduction of portable insulin infusion pump therapy to determine the psychological and family impact of this new technological intervention. No negative psychological impact or dysfunction appeared to be associated with introduction of the pump. On the contrary, the postpump group reported significantly less depression, significantly less anxiety, and significantly greater family cohesion than the prepump group. Other nonsignificant trends were in a direction indicating improved individual and family psychological status. DIABETES CARE 7: 137–142, MARCH–APRIL 1984.

Self-monitoring of blood glucose (SMBG) and portable insulin infusion pumps (PIIP) have proven effective in improving the metabolic control of insulin-dependent diabetes.[1] Early data also suggest SMBG and/or PIIP efficacy in the reversal of mild chronic diabetic complications[2–4] and reduction of neonatal mortality.[5] However, of concern to physicians and investigators has been the potential negative psychological consequences of PIIP use. For example, a portable pump worn externally may threaten a patient's self-esteem as he becomes increasingly anxious about others' awareness of his disease. Second, the patient might become depressed and/or anxious because of the greater decision-making responsibility inherent in using SMBG and portable pump devices. Third, SMBG and a portable pump both may function as a constant reminder of diabetes to the patient, which could also increase levels of depression and anxiety, as well as threaten self-esteem. Finally, the personal changes required of the patient using PIIP technology could have a negative effect on the family environment by disrupting family function, altering family roles, etc.

In general, there has been little research concerned with the psychological and/or familial impact of PIIP use. Preliminary evidence to date has been either of a clinical nature[6] or has been reported primarily at conferences and in abstract form. From these exploratory efforts it appears that this treatment may have a beneficial effect on patient psychological functioning in terms of improved self-esteem, social adjustment and depression scores, higher energy levels, reduced anxiety about diabetes control, and increased normalization in daily living.[7–9] In one published study, initial bewilderment and resistance were observed in response to the introduction of self-management techniques; however, the final outcome for these patients included better self-reliance, diminished anxiety, better acceptance of illness, and significantly less depression.[10]

There is a large literature supporting the contention that diabetes in the child has a negative influence on marital integration and family function[11] (for an opposite finding, see ref. 12) and that family characteristics are associated with both psychological adjustment and metabolic control in diabetic adolescents.[13–16] However, little attention has been directed to the family of the adult diabetic patient. It is possible that just as family characteristics such as few conflicts, low stress levels, and more cohesion are associated with good control in diabetic adolescents, there may also be family characteristics associated with good control in adulthood. It is also possible that family members' response to introduction of SMBG and PIIP therapy will be related to success or failure of patient adjustment.

By conceptualizing PIIP use as a psychological as well as a medical intervention, studying individuals both before and after pump use should yield data concerning psychological impact. In an effort to address the above questions, adult insulin-dependent diabetic patients were evaluated to determine whether introduction of PIIP technology was associated with any psychological changes, or with any perceived changes in their family dynamics and organization.

TABLE 1
Comparison of pre- and postpump groups according to subject age and duration of diabetes

	Group 1 (N = 6)		Group 2 (N = 24)		
	$\bar{X}$	SD	$\bar{X}$	SD	Two-tail P
Age	32.2	10.6	35.0	10.8	0.56 (NS)
Duration of diabetes	20.8 yr	4.2	14.5 yr	7.7	0.07 (NS)

SUBJECTS

Subjects were drawn from two sources, a university clinic in Orange, California, and a private practice in Long Beach, California. Eleven patients came from the clinic; the remainder were from the private practice. At the time of this study, the subjects represented 84.6% of the total number of patients using PIIP therapy in these two settings. Criteria used in patient selection for pump therapy by the two participating physicians included: (1) prevention of chronic complications, (2) metabolic instability, and (3) no known psychological problems. It was noted that of the 11 clinic patients, 9 initiated the idea of the pump, while the majority of the private patients on the pump were physician initiated. Subjects in the postpump group were recruited at group sessions offered by both physicians to provide information and support to their pump patients. Subjects in the prepump group were recruited on an individual basis by the university-based physician when they approached him about becoming pump candidates. These six individuals met the selection criteria established by the physicians for pump eligibility.

Subjects were divided into two groups, designated as the postpump group and the prepump group. The postpump group, evaluated after pump use was initiated, consisted of 24 insulin-dependent diabetic patients (14 women and 10 men) as previously described.[17] The mean age of this group was 35.0 yr (SD = 10.8); all were of a similar middle-income socioeconomic class, and all were Caucasian. Patients had had diabetes for a mean of 14.5 yr (SD = 7.7) and had used the PIIP for a mean period of 8 mo.

The prepump group consisted of six female insulin-dependent diabetic patients, with a mean age of 32.2 yr (SD = 10.5), and mean duration of diabetes of 10.8 yr (SD = 4.2). These subjects had a similar socioeconomic profile to the postpump group. There were no significant differences on any demographic variables or outcome measures between male and female subjects using the nonparametric Mann-Whitney U test for unequal N's. There were also no significant differences between the prepump and postpump groups in terms of either age or duration of diabetes (Table 1). These findings made it possible for us to compare the two groups in a cross-sectional analysis. The prepump group was also evaluated after 3 mo of PIIP use, thus providing corroborative longitudinal data.

MEASURES

There is some evidence in the literature that depression, anxiety, and poor self-esteem are often psychological "secondary complications" of chronic insulin-dependent diabetes,[18–21] although this relationship may be mediated by the composition of the patient population (many of these studies are done with adolescent subjects), the sex of the subjects, and the level of metabolic control.[22–24] The issue of self-esteem in particular is a murky one, with occasional studies reporting high degrees of positive self-concept in diabetic adolescents.[25,26] Because of the clinical importance of these psychological dimensions and the contradictory empirical findings to date, it was decided to measure subjects on all three dimensions.

The depression measure used in the study is a short, multiple-choice mood-measuring device with well-established reliability and validity that detects the presence of depression and accurately rates its severity.[27] The anxiety measure selected[28] assesses both state and trait anxiety, "state" referring to acute, situational anxiety, and "trait" referring to a more chronic condition and personality trait. The Janis-Field Personality Inventory[29] is a standardized measure of adult self-image, selected for its reliability, extensive validation, and ease of administration.

In addition, because of the importance of health/belief models in influencing compliance, a health locus of control instrument was also administered.[30] The health locus of control measure yielded a score for perceived Internal, Chance, and Powerful-Other attributions about health. Locus of control was considered important because research findings indicate that the Internal scale is positively correlated with positive health status, where Chance is negatively correlated with positive health status.[30] To obtain a general psychological profile of the subjects, an abbreviated version of the Minnesota Multiphasic Personality Inventory was added to the test battery.[31] Finally, in an attempt to assess subjects' perception of their family psychosocial environment, a family environment scale was included.[32,33] The Family Environment Scale represents the patient's perception of his or her family's interpersonal environment and family organizational structure, and yields 10 subscale scores on dimensions of cohesion, expressiveness, conflict, independence, achievement orientation, intellectual/cultural orientation, active/recreational orientation, moral/religious emphasis, organization, and control.

PROCEDURES AND ANALYSIS

For the purpose of this exploratory study, SMBG and PIIP use were assessed simultaneously, as it is well recognized that PIIP treatment should not be performed in the absence of SMBG. Consequently, the impact attributable to SMBG only was not addressed. Thus, the intervention under investigation is conceptualized as consisting of combined SMBG and PIIP use; and in the remainder of this article the term "PIIP" will refer to this combination.

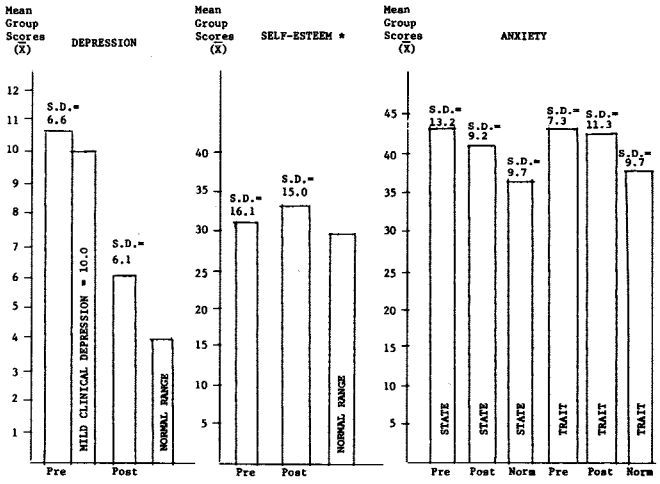

*FIG. 1. Mean prepump, postpump, and normal group scores on measures of depression, self-esteem, and anxiety. Prepump group: N = 6; postpump group: N = 24. *Higher score on this measure equals lower self-esteem.*

Assessment of both pre- and postpump patients by use of the battery of standardized psychological instruments was conducted in a group setting. Patient-and-spouse-structured interviews were also conducted with the pre- and postpump groups. These findings are reported elsewhere.[34] A cross-sectional analysis between the postpump group of 24 and the prepump group of six was then performed. These same six patients were also studied on dimensions of depression and anxiety, using a longitudinal design before and after 3 mo of portable pump use. These patients were not included in the sample of 24 postpump patients.

The cross-sectional data analysis was performed using the rank test for two independent samples (Mann-Whitney U), a nonparametric test. For the longitudinal analysis, data were analyzed using the Wilcoxon Matched Pairs Signed-Rank Test, appropriate in a situation dealing with an extremely small N. All P's reported are two-tailed because of the possibility that respondent scores on all measures could either improve or deteriorate.

RESULTS

Cross-Sectional Pre- and Postpump Group Analyses

Psychological instruments. Mean raw scores on all psychological dimensions indicated that the postpump group, contrary to our initial hypothesis, fell within normal psychological limits, with the possible exception of anxiety. The prepump group was also within normal limits, except in the areas of depression and anxiety.

Depression. Using a nonparametric statistic, the Mann-Whitney U test, the pre- and postpump groups were compared to determine whether any changes in levels of self-reported depression had occurred. The postpump group was less depressed than the prepump group ($Z = -2.19$; two-tailed $P < 0.03$). Since identifiable clinical depression is considered to be a score of 10, the prepump group could be regarded as mildly clinically depressed.

Self-esteem. Introduction of the pump was not associated with significant changes in self-esteem (Figure 1). When compared with normative self-esteem data,[35] both pre- and postpump group mean scores were observed to be near the low end of the normal range.

Anxiety. Introduction of the pump did not appear to be associated with significant changes in anxiety. It is of interest to note that descriptively both pre- and postpump groups showed a trend toward greater anxiety than the normative sample (Figure 1).

Health locus of control. Scores of prepump patients, postpump patients, and normal subjects were virtually identical for internal, chance, and powerful-other attributions (Figure 2).

Minnesota Multiphasic Personality Inventory (MMPI). The prepump group manifested a characteristic "conversion V" or psychosomatic profile. As can be seen in Figure 3, these individuals had elevated scores for hysteria and hypochondriasis, as compared with a normal population. As a group, individuals characterized by a psychosomatic profile tend to somaticize their conflicts and are rather self-centered, dependent, and passive. In contrast, the postpump group exhibited a more normal profile, with minimal elevations in scales of hysteria and psychopathic deviance, suggesting individuals who are somewhat impatient and hypersensitive, but conformist in nature.

Cross-Sectional Family Environment Analysis

Comparing the pre- and postpump groups (Figure 4), five subscales were identified in which the two groups varied. The postpump group described their family environments as significantly more cohesive than did the prepump group ($Z = 1.96$; two-tailed $P = 0.05$). Descriptively, we see that the postpump group was characterized by greater expressiveness, less conflict, more family independence, greater active/recreational orientation, and more moral/religious orientation ($Z = -1.66$; two-tailed $P < 0.09$) than the prepump group. Both pre- and postpump family profiles fell within normal ranges.

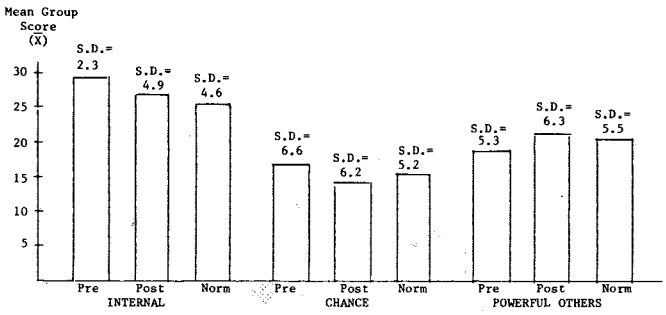

FIG. 2. Mean prepump, postpump, and normal group scores on measure of locus of control. Prepump group: N = 6; postpump group: N = 24.

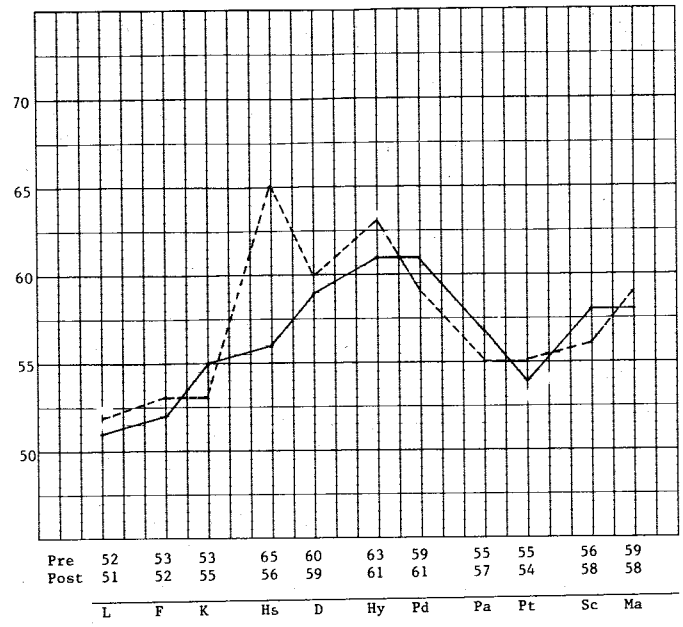

FIG. 3. A comparison of MMPI psychological profiles for pre- and post-PIIP groups. ---- (Pre, N = 6); —— (Post, N = 24). L: "lie" scale, K: defensiveness, Hs: hypochondriasis, Hy: hysteria, Pa: paranoia, Sc: schizophrenia, F: "fake" scale, D: depression, Pd: psychopathic deviancy, Pt: psychasthenia, and Ma: mania. Note: Normal range is defined as falling between the 50th and 70th percentiles.

Descriptively, the postpump group represents a moderately healthy family profile, as evidenced by above-average scores in the areas of cohesion, expressiveness, and independence, and below-average scores in the area of conflict. While the postpump group appeared psychologically healthy, the prepump group resembled a psychosomatic profile[36,37] with fairly high cohesion (although significantly lower than the postpump group), but with lower expressed conflict and independence.

To determine the relationship of family variables to individual psychological and psychosocial health, the two sets of variables were correlated, using the Spearman rank-order coefficient of correlation. The more cohesive a family was perceived to be, the less depressed ($r = -0.37$; $P = 0.05$) and the less anxious (state: $r = -0.55$; $P < 0.01$; trait: $r = -0.53$; $P < 0.01$) the diabetic patient's self-perception, and the greater positive self-esteem the patient reported ($r = -0.38$; $P < 0.05$). Conversely, the greater the perceived level of family conflict, the more likely the diabetic patient was to describe himself as anxious on both state and trait measures ($r = 0.44$; $P < 0.05$; $r = 0.43$; $P < 0.025$).

Longitudinal Analyses

Like the cross-sectional analysis, the longitudinal study (also using the Beck Depression Inventory) showed a significant decrease in depression in the group of six patients before and after 3 mo of pump use ($Z = -1.89$; two-tailed $P < 0.05$). There was a significant decrease in state anxiety ($Z = -2.2$; two-tailed $P = 0.03$), but none in trait anxiety.

DISCUSSION

The small N involved in this study, as well as the self-selection factor involved in recruitment of subjects, precludes quick generalizations. Nevertheless, some tentative conclusions are in order.

The general goal of this study was to determine the psychological and family impact of the introduction of portable insulin infusion pump therapy. Potential negative consequences of the intervention were hypothesized. However, no psychological dysfunction or significant worsening was attributable to the intervention. In fact, patients using portable pumps were significantly less depressed when compared using both longitudinal and cross-sectional designs. They also exhibited significantly less state anxiety when compared pre- and postintroduction of the pump. They perceived their families as significantly more cohesive, and showed trends on dimensions of less conflict, greater independence, greater active/recreational orientation, and greater moral/religious emphasis than the prepump group. While no other statistically significant findings emerged, all other individual psychological measures showed trends or means in a direction reflecting improved psychological status. It is also interesting to note that, replicating past research, this investigation did find evidence that the chronic diabetic patients studied were mildly clinically depressed,[27] had at least a slightly jeopardized sense of self-esteem,[29] and reported levels of state and trait anxiety that resembled a neuropsychiatric population.[28]

In terms of the family environment, the postpump group profile appeared healthier than its prepump group counterpart in the sense of having a better balance of closeness (cohesion) and the encouragement of autonomy (independence). This study also provides preliminary evidence that family factors, such as cohesion and conflict, may be important in influencing the overall psychological adjustment of the adult, as

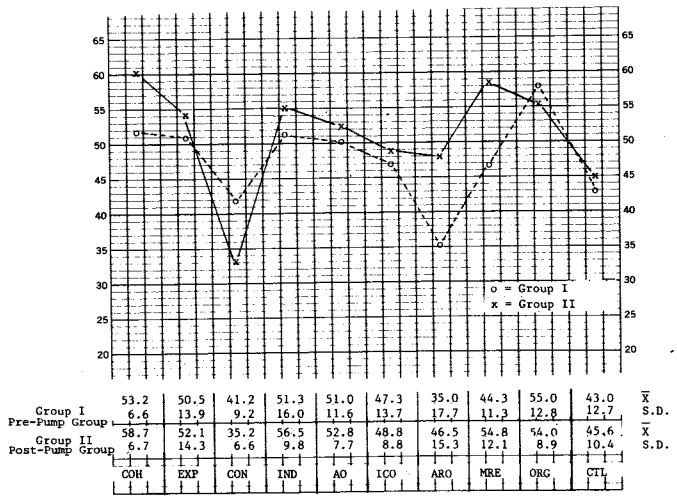

FIG. 4. Comparison of perceived family environment standard scores for pre- and post-PIIP groups. Group I (prepump): N = 6; group II (postpump): N = 24.

well as the adolescent, diabetic patient, and suggests the importance of attention to the family environment when introducing innovative treatment technology.

The findings of this study suggest an alternative hypothesis to the one initially posited: that the PIIP as a psychological intervention may have a positive impact on both patients and families, and that there is increasing evidence that, at the least, it does not show any signs of negative psychosocial impact. These results, combined with preliminary results from other groups, suggest that the PIIP treatment may, in fact, add an important positive dimension to treatment of the psychological ramifications of chronic diabetes. Of course, existing research in this area thus far has only been preliminary. Longitudinal studies with an adequate number of randomly selected subjects are necessary to determine whether the psychological "lift" associated with PIIP use is more than a transient phenomenon.

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