Peptic Ulcer Disease in Youths with Insulin-Dependent Diabetes Mellitus: A Prospective Study

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Tested whether metabolic control, treatment variables, and psychosocial factors are associated with the onset of peptic ulcer disease (PUD) in 14 Ss with IDDM who later developed PUD and a matched group of 14 Ss who did not. Metabolic control was recorded 1 year before PUD diagnosis, at diagnosis, and 6 and 12 months after diagnosis. Treatment variables (adherence, insulin dose, number of injections, number of hospitalizations) and psychosocial factors (coping, stress, family relations) were assessed an average of 20 months prior to PUD diagnosis. A 2 (Group) × 4 (Time) repeated measures ANOVA revealed no between-groups differences on metabolic control. One-way ANOVAs indicated the groups did not differ on treatment variables or psychosocial factors, except that Ss in the PUD group reported more insulin injections.

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Research is needed regarding the correlates of PUD in Ss with well-controlled IDDM of relatively brief duration.

KEY WORDS: children; adolescents; peptic ulcer disease; diabetes; psychosocial.

Children and adolescents with insulin-dependent diabetes mellitus (IDDM) are at risk for future complications involving the major organ systems of the body, including retinopathy and blindness, nephropathy, myocardial infarction, stroke, hypertension, arteriosclerosis, neuropathy, and gangrene and lower extremity amputations (National Diabetes Data Group, 1985; Pirart, 1978). Individuals with IDDM are also at risk for developing gastrointestinal complications related to autonomic neuropathy such as delayed gastric emptying, early bloating, and decreased gastric acid output (Clarke, Ewing, & Campbell, 1979). The decreased gastric acid secretion associated with autonomic neuropathy was thought to create an environment that would account for earlier reports of a lower incidence of peptic ulcer disease (PUD) in people with diabetes (Dotevall, 1961). Because autonomic neuropathy is a complication of IDDM that usually occurs later in the course of the disease (DCCT Research Group, 1988), youths with IDDM who have a relatively short disease duration would not typically have the decreased gastric secretions associated with autonomic neuropathy. Although empirical evidence is lacking, the incidence of PUD is thought to be similar for people with diabetes as compared to the general population (Monson, 1970). The risk of developing peptic ulcer disease for all youths under the age of 16 years is 3.5 per 100,000 children (cf. LaPorte & Cruickshanks, 1985). There is the possibility, however, that PUD is underdiagnosed in youths with IDDM. Because of the intermittent epigastric pain associated with PUD and the epigastric pain accompanying hyperglycemia and ketoacidosis, health care professionals may assume that any gastrointestinal problems reflect poor metabolic control rather than symptoms of PUD.

This study was prompted by an unusually large number of cases of PUD observed in a group of children and adolescents participating in a larger study examining psychosocial variables related to health outcomes in youths with IDDM (Hanson, Henggeler, & Burghen, 1987a, 1987b). Although the association between psychosocial factors and the development of PUD in children and adolescents with IDDM has not been evaluated empirically, it has been suggested that healthy children and adolescents may develop PUD in response to stressful life experiences (Ackerman, Manaker, & Cohen, 1981). Such a hypothesis is consistent with findings that stressful life events are related to problems of health and adjustment among chronically ill youths (Bedell, Giordani, Amour, Tavormina, & Boll, 1977; Brand, Johnson, & Johnson, 1986; Chase & Jackson, 1981; Hanson et al., 1987b). The youths' ability to cope with stressors may also mediate the development of PUD. We have found that the use of ventilation and avoidance coping (e.g., "get an-
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gr, and yell at people," "tell yourself the problem is not important") in youths with IDDM is related to poor adherence to treatment (Hanson et al., 1989). Because this maladaptive coping strategy was predicted by high stress and poor family relations, it also seems important to evaluate the role of these factors in the onset of PUD.

Thus, the purpose of this study was to examine the relationships between metabolic control, IDDM treatment variables (i.e., adherence behaviors, insulin dose, number of daily injections, IDDM-related hospitalizations), psychosocial factors (i.e., stress, coping, family relations), and the onset of PUD in youths with IDDM. Because of the longitudinal nature of our ongoing studies, we were able to examine these questions in a prospective fashion. We assessed whether these psychosocial and treatment variables distinguished between two groups of youths with IDDM: those who later developed PUD and those who did not.

METHOD

Subjects

Within an average of 20 months following initial data collection, 14 youths (7 boys and 7 girls) from a larger sample of 149 youths with IDDM were identified as having developed PUD. The mean age at diagnosis of PUD was 15.5 years, and the onset of gastrointestinal symptomatology preceded the PUD diagnosis by an average of 4 months. The youths in this group were matched with 14 youths (7 boys and 7 girls) with no known history of PUD or other degenerative physiological complications secondary to IDDM. Subjects were matched on the basis of age (PUD M = 14.1 years; non-PUD M = 14.5 years; range = 11–18 years), race (PUD = 36% black and 64% white; non-PUD = 43% black and 57% white), gender, duration of IDDM (PUD M = 5.1 years; non-PUD M = 5.8 years), age at diagnosis (PUD and non-PUD M = 8.9 years), stages of pubertal development (Tanner, 1962; PUD M = 4.1; non-PUD M = 4.5), socioeconomic status (primarily middle class: PUD M = 35.8; non-PUD M = 36.2; Hollingshead, 1975), and relative weight based on the National Center for Health Statistics height and weight growth charts for children and expressed as a percentage of ideal weight, 100 = ideal weight (Hammill et al., 1979; PUD M = 108.9; non-PUD M = 98.9). One-way analyses of variance (ANOVA) and chi-square statistics revealed that the groups did not significantly differ on these variables.

Procedures

Subjects in this study participated in a larger project on the psychosocial factors that relate to health outcomes in youths with IDDM (Hanson...
et al., 1987a, 1987b). A letter specifying the purpose and nature of the investigation was mailed to all youths and their families who were scheduled for a clinic appointment during a 7-month period. Families were called within a week after receiving the letter and asked to participate in a study of how families learn to live with diabetes. The participation response rate was greater than 90%.

Interviews were conducted at the medical center on the day of their regularly scheduled clinical appointment or in the family's home as soon after the clinic visit as possible. All interviews were conducted at a time that would not interfere with the youths' IDDM treatment regimen (i.e., eating and glucose testing requirements). Interviewers were three graduate and two advanced undergraduate students who received extensive training (100-120 hr) regarding the nature of IDDM, interviewing skills, and standardized assessment techniques.

The interviewers obtained informed written consent from the family and assured members of their rights as research participants, including confidentiality and the privilege to discontinue at any time without jeopardizing future treatment. Each youth's blood glucose level was checked at the beginning of the interview to assure that he or she was not hypoglycemic. The questionnaires were administered in a counterbalanced order and were explained to the subjects prior to administration.

**Metabolic Control**

Metabolic control was determined by the youths' hemoglobin A₁c (HbA₁c) levels. HbA₁c is generally considered the best available index of metabolic control over the preceding 6 to 8 weeks (Blanc, Barnett, Gleason, Dunn, & Soeldner, 1981; Koenig et al., 1976). All blood samples were analyzed in the same laboratory using the Bio-Rad HbA₁c Column Assay method. This particular method was used because it is not affected by hyperglycemia at the time of the testing.

**Treatment Variables**

Adherence behaviors were assessed with an interview that was originally developed by Hart and colleagues (Cerkoney & Hart, 1980; Schlenk & Hart, 1984). Our revision of the adherence interview has adequate 3-month stability, $r = .70, p < .001$, and moderate internal consistency (Cronbach's alpha = .62). The adherence measure has significantly related to metabolic
control in previous studies, $r = -.28, p < .001$ (Hanson et al., 1987a). Insulin dose was computed in units per kilogram of body weight according to medical chart records and the youths' reported typical daily insulin dose during the past 2 months. The typical number of daily injections during the 2 months prior to assessment was determined by the youths' self-report and the medical chart records. The number of IDDM-related hospitalizations occurring within 1 year prior to assessment was obtained from youths' medical records.

**Measures of Psychosocial Adjustment**

**Stressful Life Events.** The Adolescent-Family Inventory of Life Events and Changes (A-FILE; McCubbin, Patterson, Bauman, & Harris, 1982) was used to measure the youths' perception of the number of life changes in the past year experienced by any family member. Life changes were assessed across six areas: transitions, sexuality, losses, responsibilities and strains, school strains and substance abuse, and legal conflicts. The scores from each area were summed to provide an overall index of life changes. The A-FILE contains items from the Coddington Life Events Record (Coddington, 1972) and possesses moderately high internal consistency, test-retest reliability, and convergent validity (McCubbin et al., 1982).

**Coping.** The 54-item Adolescent-Coping Orientation for Problem Experiences (A-COPE; Patterson & McCubbin, 1987; Patterson, McCubbin, & Needle, 1983) was used to assess the youths' coping patterns. Second-order factor analysis of the A-COPE (Hanson et al., 1989) reveals two primary dimensions of coping: utilizing personal and interpersonal resources, and ventilation and avoidance coping. Coping responses constituting the first factor involve acquiring emotional support and assistance from family members, participating in social relationships and activities, diverting attention from problems to positive interests, relying on personal skills to manage problems, attending church activities, and maintaining a sense of humor. The second factor, ventilation and avoidance coping, involves behaviors such as getting angry and blaming others for problems, and avoiding problems via minimization and negative activities (e.g., drinking, smoking, drug use).

**Family Functioning.** The Family Adaptability and Cohesion Evaluation Scales-II (FACES-II; Olson, Portner, & Bell, 1982) was used to assess the youths' perceptions of family cohesion and adaptability. This 30-item measure has been shown to discriminate between functional and dysfunctional families (Olson et al., 1982; Rodick, Henggeler, & Hanson, 1986). Internal consistency estimates (alpha) are .87 for family cohesion and .78 for family adaptability (Olson et al., 1982).
RESULTS

Metabolic Control

The means and standard deviations for metabolic control across time for PUD and non-PUD subjects are presented in Table I. A 2 (Group) × 4 (Time: 12 months prior to PUD diagnosis, at PUD diagnosis, 6 months following PUD diagnosis, 12 months following PUD diagnosis) repeated measures ANOVA was conducted on HbA1c. No significant between-groups differences were obtained.

Treatment Variables

The means, standard deviations, and F values for the treatment variables and psychosocial factors are presented in Table II. As indicated, PUD and non-PUD subjects did not differ significantly with regard to adherence to the IDDM treatment regimen, typical daily insulin dose, and number of IDDM-related hospitalizations. However, youths who later developed PUD did report significantly more daily insulin injections than those who did not develop the disease, F(1, 26) = 5.75, p < .03.

Psychosocial Factors

One-way ANOVAs revealed that the PUD group did not differ significantly from the non-PUD group on any measure of psychosocial functioning. As shown in Table II, the groups were comparable with regard to the use of coping strategies, the number of stressful life events, and levels of family cohesion and family adaptability.

Table I. Metabolic Control Across Time

<table>
<thead>
<tr>
<th>Group</th>
<th>Time relative to PUD onset*</th>
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<tbody>
<tr>
<td></td>
<td>1 year prior</td>
<td>At diagnosis</td>
</tr>
<tr>
<td>PUD M</td>
<td>9.58</td>
<td>9.79</td>
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<tr>
<td>PUD SD</td>
<td>2.94</td>
<td>2.83</td>
</tr>
<tr>
<td>Non-PUD M</td>
<td>10.24</td>
<td>9.04</td>
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<tr>
<td>Non-PUD SD</td>
<td>4.35</td>
<td>2.24</td>
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</table>

*The higher the HbA1c, the poorer the level of control.
Table II. Comparisons Between Groups on Treatment Variables and Psychosocial Factors

<table>
<thead>
<tr>
<th></th>
<th>PUD</th>
<th>Non-PUD</th>
<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>F</th>
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<tbody>
<tr>
<td>Treatment variables</td>
<td></td>
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<tr>
<td>Adherence</td>
<td>36.64</td>
<td>4.43</td>
<td>34.29</td>
<td>4.29</td>
<td>2.09</td>
<td></td>
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<tr>
<td>No. of daily insulin injections</td>
<td>2.64</td>
<td>1.08</td>
<td>1.93</td>
<td>0.28</td>
<td>5.75*</td>
<td></td>
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<tr>
<td>Typical insulin dose per kg body weight</td>
<td>1.13</td>
<td>.50</td>
<td>0.99</td>
<td>0.29</td>
<td>0.83</td>
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<tr>
<td>No. of IDDM-related admissions</td>
<td>1.43</td>
<td>2.20</td>
<td>0.43</td>
<td>0.94</td>
<td>1.96</td>
<td></td>
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<tr>
<td>Psychosocial factors</td>
<td></td>
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<tr>
<td>Stress (A-FILE)</td>
<td>4.54</td>
<td>2.50</td>
<td>5.71</td>
<td>4.27</td>
<td>0.75</td>
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<td>Coping strategies (A-COPE)</td>
<td></td>
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<tr>
<td>Utilizing personal and interpersonal resources</td>
<td>125.38</td>
<td>20.32</td>
<td>111.86</td>
<td>19.96</td>
<td>3.04</td>
<td></td>
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<tr>
<td>Ventilation and avoidance</td>
<td>20.92</td>
<td>4.73</td>
<td>23.43</td>
<td>7.20</td>
<td>1.12</td>
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<tr>
<td>Family relations (FACES-II)</td>
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<tr>
<td>Cohesion</td>
<td>62.69</td>
<td>7.81</td>
<td>58.36</td>
<td>12.42</td>
<td>1.16</td>
<td></td>
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<tr>
<td>Adaptability</td>
<td>46.54</td>
<td>5.36</td>
<td>43.78</td>
<td>8.95</td>
<td>0.92</td>
<td></td>
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</table>

*p < .05.

DISCUSSION

Our findings indicate that youths with well-controlled IDDM of relatively brief duration are developing PUD. Although gastrointestinal problems are not uncommon among youths with IDDM, these symptoms may have been regarded as concomitants of the disease process or complications due to poor blood glucose control rather than indicative of PUD. The association between the PUD and IDDM is unclear. The metabolic control of youths in the PUD group did not differ significantly from that of youths in the non-PUD group at 1 year prior to diagnosis or at the time of diagnosis. Moreover, the groups did not differ significantly at 6-month and 1-year follow-up periods.

There was also a lack of significant between-groups differences on treatment variables and psychosocial factors prior to PUD diagnosis. With regard to treatment variables, only one variable differentiated the groups. Youths in the PUD group reported administering more daily insulin injections than their non-PUD counterparts. The decision regarding the number of daily insulin injections was determined by the physicians rather than the youths. It is possible that youths experienced the intensified treatment as stressful and that the stress contributed to the onset of PUD. The youths in the two groups did not differ on a measure of chronic life stress, but perhaps daily stress related to the treatment regimen was higher in the youths who developed PUD because of the more frequent insulin injections. The significance of this finding must be qualified, however. Because we failed to find signifi-
cant differences on any of the other treatment variables or psychosocial variables, it is possible that the finding of increased insulin injections of youths in the PUD group is due to chance. The interpretation of our results is also qualified by the fact that the treatment and psychosocial variables were assessed an average of 16 months prior to the onset of gastrointestinal symptomatology. It is certainly possible that assessing such variables immediately preceding PUD onset or at the time of PUD onset would yield different results.

Nevertheless, the general lack of significant findings suggests that factors other than those addressed in this study may precipitate the onset of PUD in youths with IDDM. One important factor is the number of hypoglycemic episodes the youth experiences, particularly under conditions of an empty stomach (e.g., during the night). Naito et al. (1988) suggested that PUD might develop as a result of repeated episodes of hypoglycemia when the stomach is free of food, based on their findings of a hypersecretion of gastric acid under conditions of hypoglycemia in subjects with insulinomas and PUD. Two additional risk factors might include genotype (e.g., family history of PUD) and the amount and types of foods ingested. The use of alcohol, medications such as aspirin, and cigarette smoking should be considered in subsequent studies. Future researchers might examine these factors as well as other biological variables in order to identify those characteristics that best predict the onset of PUD among youths with IDDM. Although accruing larger sample sizes is difficult because of the low incidence of PUD, replications of these findings are necessary because the relatively small number of subjects in our sample could have contributed to the general lack of significant findings. Given the potentially debilitating nature of PUD, further research is needed.

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