Stress and "Type A" Behavior as Precipitants of Post-Polio Sequelae

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A behavioral profile has begun to emerge from studies of persons who survived acute poliomyelitis and are now experiencing Post-Polio Sequelae (PPS). Persons who had polio have been shown to be employed full time at four times the rate of the general disabled population (1, 21), have more years of formal education on average than the general population (31), and marry at a higher rate than those who are not disabled (4). These data, combined with our own experience with thousands of persons who had polio, indicated that "polio survivors" are competent, hard-driving and time-conscious overachievers who demand perfection in all aspects of their personal, professional and social lives. It appears that those who survived polio exhibit "Type A" behavior and would therefore experience chronic emotional stress.

The notion that individuals who had polio exhibit "Type A" behavior and experience chronic stress was thought to be extremely important for an understanding of the pathophysiology and treatment of PPS. Animal studies have demonstrated that stress accelerates the onset of muscle fatigue (51), augments age-related decreases in the terminal axon branch number (6) and accelerates age-related losses of neurons (7). Therefore, this study was designed to test two hypotheses: 1) persons who had poliomyelitis exhibit "Type A" behavior and symptoms pathognomonic of chronic stress, and 2) "Type A" behavior and stress precipitate or exacerbate PPS.

METHODS

In order to test the above-stated hypotheses, a self-administered survey was designed to record demographic data, quantify "Type A" behavior, document psychophysiological symptoms that are recognized as concomitants of chronic stress and identify the conditions that precipitated or exacerbated PPS.

Quantification of "Type A" behavior. To quantify "Type A" behavior the Young and Barboriak brief "Type A" questionnaire (8) was included as part of the survey. This instrument consists of 10 questions that elicit responses characteristic of "Type A" behaviors and attitudes. It was tested by its authors on a sample of nondisabled males (mostly professional or paraprofessional hospital employees) who were employed full time and who were without cardiovascular disease. They obtained a mean score of 35.6 (±14) for this control sample, and 80% agreement was found between their brief "Type A" score and that obtained using the 65-question Jenkins Activity Survey.

All "Type A" questionnaires, including the Young and Barboriak instrument (81), are designed to quantify the behavior of men who are employed full-time outside of the home. Since the post-polio population includes men and women, some of whom are employed part time in the home, unemployed or receiving social security disability, it was recognized that some of the post-polio respondents would not be able to complete all 10 questions. Therefore, the scoring of the Young and

Barboriak questionnaire (8) was modified in consultation with its authors. It was decided that all questionnaires would be scored by assigning 10 points to each "Type A" response, summing those responses and dividing by the total number of questions answered. This provided a "Type A" percentage on the basis of 10 questions, in persons who were employed full time, and on the basis of 7 questions (eliminating questions 2, 5, and 8) in persons who were not employed full time. The 7-question "Type A" score has been found by the authors of the questionnaire to correlate well with the 10-question score (Young, personal communication).

Documentation of psychophysiological symptoms. To document the occurrence of psychophysiological symptoms that are recognized as concomitants of chronic stress, subjects were asked if they experienced frequent feelings of anxiety, headaches, muscle spasms and "difficulty in failing asleep because my mind is racing." They were also asked if they had been diagnosed as having asthma, hypertension, coronary artery disease, ulcer, or colitis. In addition, subjects were asked if they were experiencing "generalized random myoclonus" (GRM), the slow contraction or rapid twitching that occur randomly in limb and trunk muscles during sleep and especially at sleep onset (9). They were also asked if their sleep was disturbed by GRM.

Psychologic stress and other precipitants of PPS. Subjects were asked whether emotional stress or "upset" precipitated or exacerbated the three most frequently reported and least well understood PPS: muscle weakness, muscle pain and unaccustomed fatigue. They were also asked if these symptoms were precipitated or exacerbated by physical overexertion, exercise or exposure to cold and hot ambient temperatures. Finally, the subjects were asked if PPS interfered with their ability to participate in social activities, complete or perform work and perform self-care activities; they were also asked about their attitudes concerning their new symptoms and the general topic of disability. (Functional and attitudinal data will be presented elsewhere.)

PROCEDURE

Distribution of the Survey. On April 1, 1985, 1,200 surveys were mailed to all self-identified post-polio clinics and support groups in the continental United States. Respondents were instructed to complete the survey after April 15 and to return it by June 30, 1985. A copy of the survey was obtained by a national organization that provides services for persons with disabilities. The organization reproduced the survey and mailed it to their offices across the country for distribution without our knowledge. While this unexpected distribution probably increased the number of persons who obtained the survey, control of the sample was lost and no meaningful response rate can be reported.

Surveys that did not include a completed "Type A" questionnaire or reported a co-existing medical condition that could cause muscle weakness, muscle pain, or fatigue (e.g., arthritis, cancer, CVA, hyperthyroidism) were not included in the analysis.

Data Analysis. Orthogonal analysis of variance and independent groups t-tests were applied to compare parametric variables between groups. The chi-squared statistic was applied to compare the frequency of nonparametric variables between groups. A value of $p < 0.05$ was considered statistically significant.

RESULTS

Demographics, New Symptoms and Level of Functioning. The respondents were remarkably similar to those in other surveys of persons who had polio. The average respondent was a 52-year-old female, who had acute poliomyelitis in 1948 at age 10.5 years. She was experiencing unaccustomed fatigue, muscle weakness (in muscles originally affected by the polio) and muscle pain. She ambulated without orthotics or ambulatory aids prior to developing new symptoms but required some assistive device (brace, cane or crutches) with the onset of PPS. It should be noted that the ability to ambulate distinguishes these respondents from those in other surveys. The percentage of respondents who ambulated unassisted prior to PPS was 1.4 times greater than in other surveys. The percentage who used ambulatory aids or a wheelchair either prior to or following PPS onset was at least 2 times less than in other surveys.

"Type A" Score in Post-Polio Subjects. The mean "Type A" score for all respondents was 53.2 (± 2l.7). This score was significantly higher ($t = 8.10$. $P < .001$) than the 35.6 (±14.0) reported by Young and Barboriak (8) for their nondisabled control sample. The "Type A" score in each post-polio subgroup, whether or not PPS were reported, was significantly higher than the control score of 35.6 ($P < .001$).

"Type A" Score, PPS and Psychophysiological Symptoms. Between 88% and 91% of the respondents reported new decreases in muscle strength, increased muscle pain, or new or increased fatigue. The "Type A" score was significantly higher in respondents reporting muscle pain and fatigue (but not decreased muscle strength) as compared to subjects without these symptoms.

Symptoms pathognomonic of chronic stress were reported by 49% to 58% of the respondents. The "Type A" score was significantly higher in subjects who reported these psychophysiological symptoms than in those who did not.

GRM was reported in 32.8% of the respondents and 29.9% reported both GRM and that their "sleep was disturbed by muscle twitching." It is noteworthy that there was no relationship between GRM or GRM-disturbed sleep and reports of daytime fatigue.

Stress and Other Precipitants of PPS. "Emotional stress" was the second most frequently reported cause of fatigue (61 % of respondents) and the third most frequently reported cause of decreased muscle strength and muscle pain (45% and 51 % of respondents, respectively). The "Type A" score was significantly higher in subjects reporting that their symptoms were exacerbated by emotional stress as compared to those who were unaffected by stress.

Exposure to cold ambient temperatures was the second most frequently reported cause of decreased muscle strength and muscle pain (62% and 60% of respondents, respectively). Exposure to cold or to heat was reported by 39% of the respondents as the third most frequently reported cause of fatigue. As in all other studies, the most frequently reported cause of decreased muscle strength, muscle pain and fatigue was physical overexertion or exercise (reported by 92% to 95% of respondents).

DISCUSSION

The data indicate that both hypotheses should be accepted: 1) persons who had poliomyelitis

demonstrate significantly more "Type A" behavior than do nondisabled controls and evidence psychophysiological symptoms pathognomonic of chronic stress; 2) PPS are initiated or exacerbated by stress. In addition, there is an interrelationship between these 2 hypotheses. "Type A" scores are significantly higher in respondents who report that stress initiates or exacerbates PPS and in those subjects reporting psychophysiological symptoms, new muscle pain, and unaccustomed fatigue.

Genesis of "Type A" Behavior in Persons Who Had Polio. There are a number of hypotheses as to why persons who had poliomyelitis exhibit "Type A" behavior and experience symptoms of chronic stress. It is possible that adults and even children who exhibited "Type A" behavior and were experiencing stress were more susceptible to infection by polioviruses because of stress-induced immunosuppression. It is also possible that to survive the acute poliovirus infection and then thrive despite paralysis in a totally inaccessible world, the special drive of the "Type A" personality was required. It might also be the case that persons with disabilities must learn "Type A" behavior in order to succeed in a "barrier-full" society. For example, physical limitations might require one to become "time-conscious" to perform common tasks that require more time to complete than for persons who are not disabled. Social prejudice might require persons with disabilities to become "hard-driving overachievers" -- personality, professionally, and especially physically -- to be accepted by peers and employers.

This last hypothesis raises the question as to whether orthopedically disabled persons in general, but especially those disabled early in life, exhibit "Type A" behavior, experience chronic stress and may also have late-onset problems. A recently completed study has identified late-onset problems in adults with spina bifida who, although younger than the post-polio population, are similar in educational level and ambulatory ability (Gingher, personal communication). It is interesting to note that muscle weakness, joint pain, and hypertension were reported about half as frequently in the spina bifida sample as in persons who had polio, while fatigue and muscle pain were not reported at all. We are presently conducting a survey of adults with spina bifida to document "Type A" behavior, psychophysiological symptoms and late-onset problems.

Stress and the Pathophysiology of PPS. The mechanism whereby stress induces or exacerbates PPS has not yet been described. Stress in animals has been shown to cause a variety of abnormalities that may contribute significantly to the pathophysiology of PPS. Stress has been shown to accelerate the onset of muscle fatigue and shorten life-span (5). Stress has also been shown to augment age-related decreases in the number of terminal axon branches innervating both hind limb and diaphragm muscles (6). A decrease in the number of functional terminal axon branches may be responsible for the shrinkage of motor unit territories seen in persons who had polio (12,13) and has been implicated as a probable cause of post-polio muscle weakness (13,14).

Corticosterone secretion, a specific hormonal concomitant of stress in animals, has been shown to have deleterious effects directly related to the hypothesized pathophysiology of PPS. Elevated corticosterone levels have been associated with the inhibition of axonal sprouting in aged animals with motor neuron denervation (15). Further, stress-induced hypersecretion of corticosterone has been shown to accelerate age-related losses of hippocampal neurons (16). This effect is thought to result from corticosterone-induced inhibition of neuronal glucose uptake and the impairment of neuronal energy metabolism in these “metabolically vulnerable" neurons (7). It has been suggested

that polio-damaged and extensively sprouted anterior horn cells are also metabolically vulnerable, and that post-polio muscle weakness might occur as these neurons fail to function and even die because they "are just not able to keep pace with the metabolic demands of innervating all of their muscle fibers" (13). Clearly, research needs to be conducted to document the relationship between the physiologic effects of stress and the pathophysiology of PPS.

Clinical Implications.

This survey has documented the deleterious effects of physical overexertion and exposure to extremes in temperature in persons who were less severely affected by the original polio infection than were subjects in other studies (I0,11,17). It has also documented that GRM occurred in nearly two-thirds of this post-polio sample. However, the failure to find a relationship between GRM-induced sleep disturbance and daytime fatigue suggests that GRM may not be a contributor to new and unaccustomed fatigue. This effect on sleep and fatigue of this new sleep disorder needs to be studied in polio survivors.

Most importantly, this survey demonstrated that emotional stress is a precipitant of PPS. Fortunately, it is a precipitant that can be treated. Post-polio clinics and support groups should include stress management as an integral part of both therapeutic and wellness programs. We are presently studying combinations of cognitive and autonomic stress management techniques designed to reduce "Type A" behavior, counter the psychophysiological symptoms of stress, and thereby decrease the symptoms of Post-Polio Sequelae.

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