Relationship between Stress and Learning

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PATIENTS can be motivated to adapt to new conditions imposed by their illness. The adaptation process may be enhanced by careful instruction that assists patients in coping with modifications of lifestyle that are forced upon them. Perhaps just as importantly, a knowledge of health and illness allows patients to participate actively in their own care, including the prevention of and recovery from illness.

Professional nurses have come to realize that the concepts involved in the teaching-learning process are strongly embodied within the theoretical framework of their profession. If this framework is to guide the practice of nursing, the concepts must be identified, tested, validated and implemented in clinical areas. Nurses, furthermore, have an important responsibility in

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developing and evaluating their skills in the area of patient education so that a predictive body of knowledge can be established to insure desired learning outcomes.

Empirical evidence related to the teaching-learning process has not been fully evaluated in terms of the effectiveness of patient-education programs. Nor has it been used to develop patient-education techniques. An investigation was recently undertaken to validate criteria related to the patient's level of preteaching psychophysiological stress that could be used to evaluate and predict effective learning outcomes.

SUMMARY OF BACKGROUND LITERATURE

The crisis of acute myocardial infarction and hospitalization can be a very stressful experience. The stress response is reflected in both physiological and psychological alterations.[1,2] Physiologically, stress has been found to stimulate adrenocortical hormones. Cortisol, a glucocorticoid, has been found to be one of the most sensitive determinants of adrenocorticoid function.[3] Psychologically, anxiety has been used as an index of stress and can be measured by a number of self-reported and observed tests.[4-6] One of the best psychological tests for medically ill patients is the Anxiety-Depression Scale (A-D Scale), which depends less on lengthy questions and more on observation of the patient.[7]

Moderate anxiety is beneficial to learning, whereas high levels of anxiety may be incapacitating.[8-10(p79),11] The nurse must be able to identify the level of anxiety and

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realize its effect on patient readiness to learn.[12(p41)] Teaching that is begun at the wrong time may be totally ineffective. Because high levels of anxiety affect the patient's receptivity and ability to learn, a method for assessing the stress response must be developed so that nursing intervention and patient education can be timely and appppropriate. Formal teaching should be based on the needs of the patient's body, mind and spirit rather than on routine.

If criteria for evaluating the patient's receptivity to the teaching-learning process could be identified, then nursing measures for effecting patient education could be established.

THEORETICAL FRAMEWORK

The concept of adaptation was selected to provide the theoretical framework for this investigation. This concept has relevance for nursing because it can be applied to the physiological, psychological and sociocultural aspects of humans.[13(p43)] Humans may be viewed as biopsychosocial beings who are constantly faced with the unchanging law that change will occur. To cope with this constant change, people use physiological and psychological mechanisms to maintain a state of dynamic equilibrium.[14(p46)]

The capability to change is related to the adaptation strategies used to attain goals

or maintain valued states. The capacity to adapt is dependent on physical and intellectual abilities, as well as sensitivity to external and internal influences that demand change. Adaptation then is dependent on the achievement of goals that, in turn, are influenced by the values involved, the nature of the stressor and the appropriateness of the information available.[14(p58)]

Adaptation, conceptually analyzed, may be viewed as a time-related process for maintaining dynamic equilibrium. It may be seen as a dynamic living process, involving the entire organism, which begins with a stimulus or a stressor. Stressors may be physiological, psychological, social or environmental in nature.

People have been found to react quite differently and unpredictably to the presence of stressors. The ability to adapt depends on the intensity, frequency and duration of the stressor. It is also guided and modified by emotions, perceptions and learning ability. Knowledge obtained as a result of patient teaching may well abet the development of appropriate adaptation strategies.

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From this theoretical framework, the precipitating stressors, the individual's response and the adaptive strategy could be assessed to identify the nursing actions needed to achieve a particular goal. For example, if the goal is effective learning outcomes that would enable the patient to return to an active life within the limitations of his or her disease, then nurses could assess the intensity, frequency and duration of the physiological, psychological, social or environmental stressor and the meaning that the individual patient attaches to them. Additionally, nurses could evaluate the specific etiology and characteristics that permit adaptation or maladaptation to occur. If stress is manifested by high levels of psychophysiological anxiety, the patient may not be capable of attaining the desired goals of energy conservation, integrity or effective function. Instead, the patient may be in a state of maladaptation that actually hinders effective learning. Anxiety can alter the perception of needs and thus can distort thought and problem-solving processes, which, in turn, affect the learning process and products.

If, however, patients are capable of adapting, based on an assessment of specific criteria, then generalizations related to nursing actions could be described and explained on the basis of these events. Once appropriate nursing actions have been identified, then the relationship between these actions and the goal of therapy (effective learning outcomes) could be evaluated. The verification of this relationship could provide an understanding of the effects of nursing actions thereby permitting some degree of prediction and control of patient outcomes. Thus rational nursing actions could be prescribed after the relationship of the variables had been described,

explained and tested on the basis of empirical evaluations.

HYPOTHESES

The following hypotheses were formulated and tested:

1. There is no difference between the level of learning before versus after teaching is done.
2. There is no difference among the mean level of learning for the three levels of the treatment variable (teaching).
3. There is no difference among the mean level of psychological anxiety for the three levels of the treatment variable.
4. There is no difference among the mean level of physiological anxiety for the three levels of the treatment variable.
5. There is no correlation between level of learning and level of psychological anxiety.
6. There is no correlation between level of learning and level of physiological anxiety.
7. There is no correlation between physiological and psychological anxiety.

SETTING AND SAMPLE

The study was conducted in an 800-bed, federally owned hospital in the South. The study sample consisted of 45 patients admitted to the hospital with a diagnosis of acute transmural or subendocardial myocardial infarction as documented by history, serum enzymes, electrocardiogram or positive scintigram. The study ran for five months. All patients included in the study were male.

INDEPENDENT VARIABLE

The independent variable consisted of a cardiac-rehabilitation teaching program existing at three levels. The first level of the treatment variable (A_1) consisted of educating patients during the third, fourth and fifth days after transfer from the coronary care unit (CCU) to the telemetry unit; the second level (A_2) consisted of educating patients on the seventh, eighth and ninth days after transfer; the third level (A_3) consisted of educating patients on the eleventh, twelfth and thirteenth days after transfer.

A cardiac-rehabilitation outline and a written patient-teaching booklet were developed by the investigator and validated by a panel of experts. The program covered the anatomy and physiology of the heart, heart disease and myocardial infarction, risk factors, prevention, medications, diet, resumption of activities after discharge and potential psychological problems.

DEPENDENT VARIABLES

The study consisted of three dependent variables.

1. Measurement of Preteaching Psychological Anxiety by the A-D Scale for Medically Ill Patients

This participant observer scale was developed for use on critically ill patients where physical condition does not warrant lengthy questions. This scale has also been

found to be applicable to all patients with medical illness.

In developing the scale, its authors evaluated the available depression and anxiety scales and textbook descriptions of the symptoms. The items were validated by a panel of experts. The reliability for two examiners, who independently rated patients using the scales, was found to be .73 on the anxiety scale and .92 on the depression scale based on 52 joint interviews. The use of this tool involves a 20-minute interview with the patient based on a specific protocol developed by Sgroi, Holland and Solkoff.[7] The interview is an informal open-ended session conducted at the patient's bedside. Many items on the A-D Scale are answered by observation of the patient. There are four possible answers to each question. The minimum obtainable level for the anxiety score is 15; the maximum score is 60. Normal individuals range in anxiety scores from 15 to 22. Although the entire scale was graded, only the anxiety portion of the instrument was used in the present study.

2. Measurement of Preteaching Physiological Anxiety by 24-Hour Urinary Cortisol Levels

Cortisol (hydrocortisone or Compound F), produced in the zona fasciculata of the adrenal cortex, is the major and most active physiological glucocorticoid in humans. The measurement of urinary unconjugated (free, nonprotein bound) cortisol by competitive protein-binding radioassay represents the best single test to assess adrenocortical function.[3(p709)] The system of competitive protein binding is adaptable to the analysis of large numbers of samples and thus establishes the assay as a valuable, sensitive and reproducible clinical procedure.[15(p347)]

In normal subjects, urinary-free corticoid excretion ranges between 23 and 89 μg per 24 hours, with an average of 48 μg.[15(p346)] Urinary free cortisol levels have a diurnal rhythm with maximum values between 5:00 and 11:00 A.M., falling to about 50% less between 4:00 P.M. and midnight.[16(p128)] Twenty-four hour urine specimens, therefore, were collected using a standardized format. Cortisol levels were determined by the competitive protein binding Schwarz/Mann Radioassay Procedure (Schwarz/Mann, Division of Becton, Dickinson and Company, Orangeburg, New York).

3. Measurement of Level of Understanding of the Cardiac-Rehabilitation Teaching Program by a Written Preteaching and Post-teaching Test

The investigator developed a test based on the behavioral objectives from the cardiac-rehabilitation teaching booklet. The test consisted of 40 true or false questions. There was a total of 40 possible points. A panel of experts, consisting of two nurses and one physician, evaluated the test and offered recommendations concerning its appropriateness, sensitivity and validity. Once validated, it was pilot-tested on 20 nursing service personnel, consisting of nurses and nursing assistants, who were not considered to be "coronary specialists" and who had not participated in formulating the teaching objectives or validating the teaching program.

An item analysis was done to increase

the reliability and validity of the test. Each item was separately evaluated to determine whether it discriminated to the same degree as the overall test. A chi-square goodness of fit test was run. From the results of this analysis, test items were changed appropriately.

METHODOLOGY

The pretest/post-test design was used for this study. Patients were randomly assigned to one of three levels of the independent variable (teaching). Level one (A_1) consisted of 15 patients who received teaching on the third, fourth and fifth days after transfer from the CCU; level two (A_2) consisted of 15 patients who received teaching on the seventh, eighth and ninth days after transfer; and level three (A_3) consisted of 15 patients who received teaching on the eleventh, twelfth and thirteenth days after transfer from the CCU.

Twenty-four hours before teaching was begun, a 24-hour urine for cortisol was collected as a measure of physiological stress. Methods and times of urine collection were standardized.

On the morning of the first day of instruction, each patient was interviewed for 20 minutes. During this interview, the A-D Scale was used to assess the patient's degree of psychological anxiety.

Immediately prior to the commencement of teaching, a pretest was administered to determine the patient's level of understanding of the illness. Each patient received a one-hour instruction session from the investigator on each of the three appointed days. A teaching booklet was used during the sessions to insure standardization of content for each patient. The teaching, however, was flexible to answer individual questions and to meet the needs of each patient. Immediately following the third teaching session, a post-test, identical to the pretest, was administered to measure learning.

All nursing and health team personnel involved in the care of the patients were informed of the purpose and design of the study and were asked to cooperate with the investigator to insure that no additional formal teaching was done during the time of the investigation.

ETHICAL CONSIDERATIONS

Informed written consent was obtained from all patients prior to inclusion in the study. A stronger research design would have been anticipated if a control group could have been built into the study. Because of the potential benefits of cardiac teaching, it would have been unethical to deny the teaching program to any cardiac patient.

DELIMITATIONS

Only patients without previous formal cardiac teaching were included in the study. No attempt was made to select only those patients who had suffered a myocardial infarction for the first time. This decision was based on the suspicion that a subsequent heart attack may have been partially precipitated by a lack of sufficient knowledge about the illness and, therefore, failure to follow the medical regimen after the initial attack.

Patients on steroid medications and patients with a history of untreated renovascular hypertension, Cushing's syndrome, or renal, thyroid, liver or Addison's disease were excluded from the study because of the influence on cortisol levels.[17(p130-160)] Patients who were unable to read or write were excluded because of their inability to comply with the methodological procedure. Patients with a history of myocardial revascularization, patients being prepared for emergency revascularization and patients with severe documented emotional disturbances were not included in the study because of the probable psychological influences which might confound the variables.

ANALYSIS OF DATA

Description of the Sample Population

Forty-five patients met the requirements for inclusion and consented to participate in the study. No significant difference was found in age or level of education among the subjects for the three levels of the independent variable. The mean age of all 45 patients was 54.53 years ± 7.67 S.D.; the mean level of education was 10.09 years ± 3.45 S.D. The proportion of married patients (80%), those working prior to hospitalization (64%) and those with a previous history of myocardial infarction (24%) was found to be equally distributed across the three levels of the independent variable.

Hypotheses

The first hypothesis was tested by determining the gain in score from the preteaching test to the post-teaching test. The grand mean-gain score for all 45 patients was 6.36 ± 3.96 S.D. The *t*-test for dependent and correlated data was applied to the gain scores for all patients and was found to be statistically significant at $p < .05$. The null hypothesis was thus rejected, and it was concluded that the mean level of learning is significantly greater after cardiac-rehabilitation teaching.

The second hypothesis was tested by determining the mean level of learning for each level of the treatment variable. Level A_2 was found to have a higher gain in score (mean = 8.60) compared to level A_1 (mean = 4.33) and level A_3 (mean = 6.13).

A one-way analysis of variance (ANOVA) was applied to the gain scores for the three levels of teaching. Before the ANOVA for the experimental data was computed, however, the following underlying assumptions of the technique were met: (1) the scores were sampled at random, (2) the observations at any level were independent, (3) the samples were drawn from normal populations, and (4) the homogeneity of variance was confirmed.[18(p35)] The F-ratio from the ANOVA summary table was significant $p < .05$, and the null hypothesis was rejected.

As a result, a Newman-Keuls' Multiple Range test was utilized to test all pairwise comparisons as a method of determining which levels were contributing to the overall significance of the F-ratio.[18(p43)] The analysis revealed that the gain in score was significantly different for patients taught three days after transfer versus seven days after transfer. (See Table 1.) It was

TABLE 1

Newman-Keuls' Multiple Range Test for Gain Scores on Knowledge Test

Ranks	Initial Groups	Ranked Means		Mean Difference	Rank Difference	Newman-Keuls' Range Products
3-1	A_2-A_1	8.6000 − 4.3333	=	4.26667	2	3.21612*
3-2	A_2-A_3	8.6000 − 6.1333	=	2.46667	1	2.67387
2-1	A_3-A_1	6.1333 − 4.3333	=	1.80000	1	2.67387

*If the mean difference exceeds the range products, the means are significantly different. Significant results are marked with an asterisk (*).

For rank difference of 1,q (.95,1,42) = 2.86.

For rank difference of 2,q (.95,2,42) = 3.44.

Key: $\overline{X}_{A_1}$ = 4.3333.

$\overline{X}_{A_2}$ = 8.6000.

$\overline{X}_{A_3}$ = 6.1333.

concluded that the gain in score for level of learning of a cardiac-rehabilitation teaching program is significantly greater when begun at least one week after transfer from the CCU.

A one-way ANOVA was used to test the third hypothesis by determining whether the means of the anxiety scores differed. In level A_1 the range of anxiety scores was 17 to 30 with a mean of 22; in level A_2, 16 to 25 with a mean of 18.33; and in level A_3, 15 to 30 with a mean of 22. The ANOVA revealed the F-ratio to be significant at $p < .05$; thus the null hypothesis was rejected.

A Newman-Keuls' Multiple Range test revealed that the psychological anxiety level for acute myocardial infarction patients during the third day after transfer from the CCU was significantly greater than the anxiety level observed one week after transfer, and that the anxiety level during the seventh day after transfer from the CCU was significantly less than the level measured during the 11th day after transfer. There was no significant difference in mean anxiety levels between the third day after transfer and the 11th day. (See Table 2.)

The 24-hour level of urinary cortisol was used as a measure of physiological anxiety to test the fourth hypothesis. The normal urinary cortisol ranges from 23 μg to 89 μg per 24 hours. The urinary cortisol grand mean for all three levels of the treatment variable was 27.90 μg per 24 hours with a range from 3.3 μg to 85.2 μg.

The F-ratio obtained from the ANOVA summary table was not significant at the .05 level of probability. The null hypothesis was substantiated, and it was concluded that the mean level of cortisol was equal across the three levels of the independent variable. It is pertinent to this analysis to note that 19 out of 45 patients (42%) had cortisol levels below the normal range.

A Pearson's product-moment correlation coefficient was computed to test hypothesis 5: that a significant relationship would not obtain between learning, as measured by the gain in score (X), and the level of psychological anxiety (Y). This

TABLE 2
Newman-Keuls' Multiple Range Test for Psychological Anxiety Using the A-D Scale

Ranks	Initial Groups	Ranked Means		Mean Difference	Rank Difference	Newman-Keuls' Range Products
3-1	A_3-A_2	22.0 − 18.33	=	3.66	2	3.49776*
3-2	A_3-A_1	22.0 − 22.0	=	0.00	1	2.90802
2-1	A_1-A_2	22.0 − 18.33	=	3.66	1	2.90802*

*If the mean difference exceeds the range products, the means are significantly different. Significant results are marked with an asterisk (*).

For rank difference of 1,q (.95,1,42) = 2.86.

For rank difference of 2,q (.95,2,42) = 3.44.

Key: $\bar{X}_{A_1} = 22.00$.

$\bar{X}_{A_2} = 18.33$.

$\bar{X}_{A_3} = 22.00$.

correlation coefficient was found to be $r_{xy} = -0.5812$ for all 45 patients. When the correlation coefficient was tested for significance, the computed t was found to exceed the 95th percentile in the Student's t distribution, and hence the null hypothesis was rejected. It was concluded that psychological anxiety and learning are inversely correlated such that patients with a lower level of anxiety have larger learning gain scores.

The results of this analysis demanded further investigation. The ANOVA for learning gain scores of the three levels of teaching revealed a significant F-ratio (hypothesis 2). Furthermore, the ANOVA F-ratio for levels of psychological anxiety was significant (hypothesis 3). The Pearson's product-moment correlation coefficient for learning gain scores and psychological anxiety was also significant (hypothesis 5). The question that remained to be asked was, what would the significance of the learning gain scores for the three levels of teaching be if the effects of the psychological anxiety scores were removed?

As a means of further conceptualizing this problem, it was found that 56% of the patients (25 out of 45) had an anxiety score below 22 with a mean of 17.54. (The anxiety scores for a normal population range from 15 to 22.) These 25 patients had a gain in score of 7.96. In contrast, 44% of the patients (20 out of 45) had A-D scores above 22 with a mean of 24.6. These patients had an average gain score of 3.76.

Clearly, an analysis of covariance (ANCOVA) was needed to evaluate the equality of gain score means after they had been adjusted for psychological anxiety levels. ANCOVA utilizes the two statistical techniques of regression analysis and analysis of variance as a means of applying a statistical control to increase the precision of the experiment. Statistical control is achieved by adjusting the criterion score in terms of a covariable to produce a reduction in the size of the experimental

error and by creating a greater within-cell measure of homogeneity.[18(p304-341),19(p39-50)] As a result, ANCOVA would remove from the gain score (criterion measure = Y) that part which is predictable from the psychological anxiety score (covariable = X).

All the assumptions involved in the analysis of variance were met before applying the ANCOVA. In addition to the usual assumptions, two other requirements must be considered. First, the effectiveness of ANCOVA is related to the degree of linear correlation between the criterion variable and the covariable.[19(p45-51)] If r_{xy} is nonsignificant, then the value of r_{xy} may be attributed to sampling error and there would be no need to apply ANCOVA to the experimental data. As previously shown, $r_{xy} = -0.5812$ and it was concluded that a significant linear correlation did exist between the covariable and the criterion measure.

A second fundamental assumption associated with ANCOVA is homogeneity of within-cell regression. Recent empirical studies, however, have shown that ANCOVA is robust to violations of the assumption of homogeneity of regression, provided the group sizes are equal.[20(p864),21,22] It was concluded that pooling the within-cell regression scores was a tenable procedure since the samples for the three levels of the treatment variable were equal.

An ANCOVA was applied to the gain in scores (criterion measure), which was adjusted by removing the portion of residual variance predictable from the level of psychological anxiety. The F-ratio was nonsignificant, indicating that there was no difference among the treatment means for Y* after adjusting them by the regression on X. (See Table 3). The statistical hypothesis was not rejected, and it was concluded that there were no differences in mean gain scores across the three levels of the teaching after removing the effects of the psychological anxiety scores.

TABLE 3
Analysis of Covariance for Psychological Anxiety and Gain Scores

Source	df	F-Ratio
(X) = psychological anxiety	(2,42)	4.3347*
(Y) = gain scores	(2,42)	5.2491*
(Y*) = adjusted gain scores	(2,41)	2.3578

*Significant at $F_{(.95,2,42)} = 4.0383$.
$F_{(.95,2,41)} = 4.0447$.

The data were subjected to a Pearson's product-moment correlation to test the sixth hypothesis. The correlation coefficient for all levels of the treatment variable between the gain score (X) and the level of urinary cortisol (Y) was found to be $r_{xy} = -0.2601$. The resultant correlation coefficient was subjected to a test of significance, which did not exceed the .05 level of probability. The null hypothesis was not rejected, and it was concluded that there is no correlation between level of urinary cortisol and the gain in score.

As a means of testing the seventh hypothesis, a bivariate correlation coefficient was computed to determine the degree of association between the level of urinary cortisol (X) and the scores obtained from the A-D Scale (Y). The coefficient obtained for all 45 patients was $r_{xy} = -0.0542$. Because of the extremely

low inverse relationship between the two variables, a *t*-test was not attempted. The null hypothesis was not rejected, and the investigator concluded that there was no relationship between levels of urinary cortisol and psychological anxiety.

DISCUSSION

The results of this study have shown that the level of learning for all 45 patients was significant, indicating that the formal cardiac teaching program was beneficial in improving patients' knowledge of their illnesses and related health care issues. Patients suffering from acute myocardial infarction in this study were concerned about their illness and were eager for reassurances, explanations and information regarding their future health. Meeting these body-mind-spirit needs is perhaps one of the most significant outcomes of the investigation.

The level of learning for all 45 patients was significant, indicating that the formal cardiac-teaching program was beneficial in improving the patient's knowledge of his illness and related health care issues.

These findings should have an important impact on hospital administrators and professional nurse educators when considering the need, benefits and results versus the expense, time and effort involved in the development of similar cardiac rehabilitation programs. Both nursing and medicine, furthermore, have an enormously important responsibility for investigating these considerations as a means of establishing a strong knowledge base upon which to justify the implementation and continuation of such programs.

The A-D Scale was found to be a useful tool for making quick and reliable measurements of psychological anxiety in the acute care setting. The level of psychological anxiety was found to be high in both patients who were just transferred out of the CCU and those who were ready for hospital discharge. The results of this analysis support previous investigational findings.[23,24] The time of transfer from the CCU is a stressful period for most patients in that they are abruptly disconnected from the cardiac monitor and the intravenous life line, removed from the shelter of the unit, and deprived of the constant reassurance obtained from one-to-one nursing care.[25,26] It is reasonable to assume that this time period surrounds the transfer process and may continue for several days after the patient has been transferred. Likewise, it can be hypothesized that the time surrounding discharge may also be a stressful period. At this time it becomes apparent that recovery will no longer be managed by health care professionals and that the return home will entail an altered lifestyle.

The lowest mean level of psychological anxiety was found one week after transfer from the CCU. It might be suggested that the patient had successfully adapted to the floor transfer, but had not yet been faced with the reality and concerns of discharge to home.

Patients who were taught during the seventh day after transfer learned consider-

ably more than those taught three days after transfer. It would appear that the "prime time" in which to begin cardiac teaching, when psychological anxiety is low, is approximately one week after the patient's transfer from the CCU. Additionally, when the relationship between psychological anxiety and level of learning was examined, it was found that patients with a lower level of psychological anxiety achieved a higher level of learning.

In view of the significant inverse correlation between level of learning and psychological anxiety, the results of these analyses demanded incorporation and further evaluation in terms of the treatment effect (teaching during time segments) upon the two variables (gain scores and psychological anxiety). The use of ANCOVA was needed as a means of adjusting the gain scores in terms of anxiety levels for levels A_1, A_2 and A_3. The results of the analysis indicated that there were no significant differences in the level of learning for patients taught the third, seventh or eleventh day after transfer from the CCU when the effects of anxiety were removed.

It can be concluded that the time period in which patients are taught is not really an important consideration. The discriminating factor, used in prescribing effective learning outcomes, appeared to be related to the level of preteaching psychological anxiety. Although a significantly low average level of psychological anxiety was identified one week after transfer from the CCU, both high and low anxiety levels were found distributed throughout levels A_1, A_2 and A_3, thereby limiting the clinical usefulness of the statistically significant time segments. The results indicate, therefore, that there is no "prime time" in terms of day of hospitalization in which to begin teaching, but rather that teaching should be initiated based on the individual's needs and level of preteaching anxiety.

It must be emphasized, however, that to say *one* variable (anxiety) is the cause of learning achievement is to express a lack of understanding of the teaching-learning process and the concepts embodied in patient readiness to learn. Future study must be directed toward identifying other related predictive variables that can be used in prescribing effective learning outcomes.

The urinary cortisol values, used as a measure of physiological stress, were found to be equal across the three levels of the treatment variable. The results had several interesting implications which presented some exciting and challenging questions to the investigator. It was initially anticipated that patients with high levels of clinical anxiety would be found to have high levels of urinary cortisol. None of the patients, however, was found to have elevated cortisol values. This unanticipated finding may directly reflect that the stress response, when evaluated two, six and ten days after transfer from the CCU, was not physiologically demonstrated by means of empirical cortisol measurements. It could be alternatively hypothesized that patients observed during these time periods were no longer physiologically stressed and had adapted to the crisis of the acute insult. A more plausible explanation, however, might be that the

stress response was not severe enough to activate the adrenocortical system.

The most surprising and perplexing problem of this investigation was the discovery that 42% of the patients demonstrated abnormally low cortisol levels. It would be expected that patients who were not physiologically stressed would exhibit cortisol values within the normal range. In an attempt to find an answer to this problem, the investigator evaluated various technical, mechanical, procedural, medical, pharmacological, chemical, metabolic and theoretical possibilities. An explanation for the abnormal findings, to date, has not been found.

No correlation was found between level of learning and level of physiological anxiety. Urinary cortisol levels did not appear to be useful in predicting effective learning outcomes. Moreover, it was not surprising that physiological and psychological measurements of stress were not related, since only one of the variables was sensitive to the stress response.

The response to stress, conceptualized within a body-mind-spirit continuum, should be both physiologically and psychologically measurable. Theoretically, these two measures should be related. The psychological response to stress, compared to the physiological response, is a much more abstract concept, making it difficult to measure, quantify and predict. It would seem that if the psychological and physiological parameters were correlated, then important knowledge would be generated regarding the sensitivity, validity and reliability of the psychological tool. It is conceivable that once the relationship between variables has been established, the physiological measurement—which generally requires more time, effort and expense—will not be necessary.

RECOMMENDATIONS

The results of this investigation have led to the following recommendations for nursing practice, nursing research and theory development.

1. A formal cardiac-rehabilitation program should be developed by professional nurses together with the health team in all institutions caring for patients with acute myocardial infarction.
2. Cardiac-rehabilitation teaching should be initiated based on the patient's level of preteaching anxiety, the patient's individual needs and other factors that contribute to readiness to learn.
3. Other variables that influence patient readiness to learn should be identified and evaluated.
4. Future research should explore the possible reasons for the high percentage of abnormally low 24-hour

It is recommended that a formal cardiac-rehabilitation program be developed by professional nurses together with the health team in all institutions caring for patients with acute myocardial infarction.

urinary cortisol values in myocardial infarction patients.

5. The relationship of the scores obtained from the A-D Scale should be correlated with other physiological stress response parameters as a means of increasing the validity and reliability of the tool.
6. Research should be directed toward validating the nursing diagnosis of anxiety related to acute myocardial infarction by identifying the parameters and empirically evaluating the characteristics that differentiate the categories of severe, moderate and mild anxiety.
7. As a means of increasing the degree of generality and the empirical and pragmatic adequacy related to the theoretical claims embodied within the framework of adaptation, research should be collaboratively directed toward the verification of nursing actions that assist patients to achieve appropriate physiological and psychological adaptation strategies needed to attain and maintain a state of dynamic equilibrium.

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