Physical and psychological correlates of severe heart disease in men

CHRISTOPHER BASS AND FAWAZ AKHRAS
From the Academic Department of Psychological Medicine and Department of Cardiology,
King’s College School of Medicine and Dentistry, London

SYNOPSIS  Seventy eight men were assessed one month before coronary artery bypass graft surgery using standardized measures of psychiatric morbidity and personality as well as a measure of emotional expression (the CECS). All patients had at least one coronary vessel occluded by 75% or more of its diameter, and functional capacity was assessed by calculating the exercise treadmill time (in seconds) for each patient.

Most of the variance in exercise treadmill time was accounted for by the following variables: young age, short duration of symptoms, and less severe angina. Only one in five men was designated a psychiatric ‘case’. The only psychological measure significantly associated with atherosclerosis was expression of fear (on the CECS). A measure of Type A behaviour (Bortner score) was related to exercise treadmill time, but not to any of the angiographic or clinical indices of coronary heart disease (CHD).

Like other measures of Type A behaviour, the Bortner scale is psychometrically impure and has doubtful validity. More valid behavioural variables (such as those measured by the CECS) require further investigation. Future studies on the relation between psychological factors and the extent of CHD should take account of not only sex differences but also patients without significant CHD: high rates of psychiatric morbidity in such patients confound the relation between psychological trait measures and atherosclerosis.

INTRODUCTION
Recent studies of the relation between psychological variables and clinical and angiographic indices of coronary heart disease (CHD) have been contradictory. In particular, the evidence supporting an association between Type A behaviour (TAB) and atheroma has become less convincing (Dembroski et al. 1985). There are two possible explanations for this. First, many investigations have been carried out on heterogeneous groups of patients with chest pain which comprise those with and those without CHD. It has been established that up to a third of patients undergoing coronary angiography have normal coronary arteries or mild atherosclerosis (Proudfit et al. 1966; Wielgosz et al. 1984), and that these patients differ from those with established CHD in both their clinical and psychological characteristics (Bass et al. 1983). In particular, they have high rates of psychiatric illness and display neurotic personality traits (Bass & Wade, 1984). Because certain Type A inventories correlate with trait anxiety or neuroticism (Byrne & Rosenman, 1986) it is apparent that any correlation between Type A score and the extent of coronary disease is likely to be confounded in studies which include patients with normal and near-normal coronary arteries. Other apparently anomalous findings such as a negative correlation between Type A score and an abnormal exercise ECG (Scherwitz et al. 1983) could also be explained on this basis. Secondly, previous studies have not taken account of important sex differences. Despite the evidence that women with CHD have higher scores of anxiety and depression than a corresponding group of men (Silver et al. 1980), little attempt is made to consider sex as an independent variable.

In view of the contradictory findings regarding
the relation of psychological variables to the severity of CHD, the present study was designed to examine a more homogeneous population of men with severe coronary artery disease, and to explore the relation of psychological variables to both clinical and angiographic indices of CHD in this sample. Recent reports of an association between hostility and measures of CHD severity (Williams et al. 1980; Barefoot et al. 1983) prompted us to measure emotional control as well as Type A behaviour and other measures of personality and psychiatric morbidity.

METHOD

Consecutive patients, on a waiting-list for elective by-pass graft-surgery at King’s College Hospital and living within 10 miles of the hospital, were interviewed between November 1980 and March 1983. The assessment was carried out one month before surgery, and those patients with a poor command of English were excluded from the study.

Psychiatric morbidity was measured using the clinical interview schedule or CIS (Goldberg et al. 1970). This instrument (administered by C.B.), measures 10 symptoms and 12 signs experienced during the previous week and provides a composite score of psychiatric morbidity. In addition, all patients were asked to complete the Bortner Type A scale (Bortner, 1969). This latter questionnaire measures Type A behaviour and comprises 14 items on each of which the subject indicates on a horizontal line of 1-5 inches where he or she falls on the dimension described. The administration and method of scoring on the Bortner scale has been previously described (Bass & Wade, 1982). All patients completed the Eysenck personality questionnaire (EPQ) (Eysenck & Eysenck, 1975), which measures neuroticism, psychoticism, extraversion and lie scales; and the Courtauild emotional control scale (CECS) which measures a tendency to suppress affects and provides scores on subscales of suppression of anger, fear and unhappiness (Watson & Greer, 1983).

Other relevant medical and biographical data were recorded at this time. In particular, the duration of anginal complaints, anti-hypertensive medication, anginal symptoms (NYHA classification), previous history of myocardial infarction, and details of smoking habits. The latter was calculated both in terms of current smoking habits and total pack years of smoking (20 cigarettes per day for one year is equal to one pack year).

All patients then underwent 12 lead maximal symptom-limited treadmill exercise testing using the Bruce protocol (Bruce, 1971). This provided a measure of functional capacity, which was expressed in total exercise time in seconds on the treadmill. The test was terminated if there was chest pain, a fall of systolic blood pressure of >15 mm Hg, ST-segment depression of >3 mm, dyspnoea or exhaustion. The test was considered to be positive when a net horizontal or down-sloping ST-segment depression of >1 mm persisted for 80 ms beyond the J point in a non-infarcted area.

The coronary artery findings were assessed independently by a consultant radiologist. The three main coronary vessels were examined, namely the left main and left anterior descending, the right, and the left circumflex artery. Occlusion of 50% or more of the luminal diameter was rated as ‘vessel disease’, and patients were assigned to categories of single, double, or triple vessel disease accordingly. In addition, each patient was assigned a composite coronary occlusion score: occlusion in each of the three vessels was rated on a scale from 0 (normal) to 32 (100% reduction of lumen diameter). These scores were summed to provide a composite score (Gensini, 1980).

For data with a normal distribution, correlational analyses were used (Pearson’s product-moment correlation). When the nature and distribution of the data justified the use of non-parametric statistical techniques, the Mann-Whitney U test and Spearman’s rank-order correlations were used. Multiple regression analyses were carried out to determine the contribution of predictor variables to a measure of functional capacity (exercise time on treadmill in seconds). Mean values and standard errors are quoted except where indicated.

RESULTS

Social and demographic data
The mean age of the 78 patients was 55.0 years; SD = 7.6 (range 36–73 years). More than half
(54%) were non-manual workers and the majority (83%) were married. Fifty-nine (76%) of the 78 patients were gainfully employed before surgery, 12 were unemployed, and 7 had retired.

**Coronary risk factors**

Twenty-five (32%) had a family history of premature CHD, defined as a first degree relative with angina or myocardial infarction before the age of 60 years. Thirteen (17%) were in receipt of antihypertensive medication, and the majority (82%) reported smoking cigarettes regularly at some time before surgery. Fourteen (18%) were lifetime non-smokers and 8 (10%) were smoking at the time of the interview.

The 44 patients (56%) with a history of previous myocardial infarction had smoked significantly more cigarettes (measured in pack years) than those without such a history (35.2 ± 3.6 as against 24.6 ± 4.0; \( P = 0.05 \)).

**Cardiovascular status**

Only 3% of patients were free of angina on exertion, with 46% experiencing angina on strenuous or moderate exertion, 48% on mild or trivial exertion and 3% angina at rest. The mean NYHA score was 2.44, SD = 0.8. Adopting lesions of 75% or more of the luminal diameter as the threshold for coronary disease, 3% had single vessel disease, 15% had double vessel disease, and 82% had triple vessel disease. The mean composite coronary occlusion score was 50.2; SD = 19.2 (range 8–96).

**Psychiatric morbidity and psychological scores**

The mean scores on the psychological measures are shown on Table 1. Fourteen (18%) of the 78 men were identified on the CIS as having significant psychiatric morbidity i.e. being 'psychiatric cases'. This rate of psychiatric morbidity is similar to that in men with severe CHD interviewed after coronary angiography (Bass *et al.* 1983), but slightly lower than rates detected on medical in-patient wards (Maguire *et al.* 1974). By comparison with the norms for males aged 50–59 years on the Eysenck Personality

<table>
<thead>
<tr>
<th>Psychological characteristics of the sample (N = 78)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychological measure</td>
</tr>
<tr>
<td>-----------------------</td>
</tr>
<tr>
<td>Psychiatric morbidity score (CIS)</td>
</tr>
<tr>
<td><strong>EPQ</strong></td>
</tr>
<tr>
<td>Neuroticism</td>
</tr>
<tr>
<td>Extraversion</td>
</tr>
<tr>
<td>Psychoticism</td>
</tr>
<tr>
<td>Lie score</td>
</tr>
<tr>
<td><strong>Bortner score</strong></td>
</tr>
<tr>
<td><strong>Suppression of affects</strong></td>
</tr>
<tr>
<td>Total score</td>
</tr>
<tr>
<td>Anger score</td>
</tr>
<tr>
<td>Fear score</td>
</tr>
<tr>
<td>Misery score</td>
</tr>
</tbody>
</table>

* Only 63 men completed this scale

**Table 2. Correlation between psychological scores and clinical and angiographic indices of CHD**

<table>
<thead>
<tr>
<th>Psychological measure</th>
<th>Clinical measures</th>
<th>Angiographic measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Severity of angina (NYHA)</td>
<td>Duration of CHD (months)</td>
</tr>
<tr>
<td>Psychiatric morbidity score</td>
<td>0.03</td>
<td>-0.03</td>
</tr>
<tr>
<td>Bortner score</td>
<td>-0.19*</td>
<td>-0.01</td>
</tr>
<tr>
<td><strong>EPQ</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuroticism</td>
<td>-0.11</td>
<td>-0.06</td>
</tr>
<tr>
<td>Extraversion</td>
<td>-0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Psychoticism</td>
<td>0.05</td>
<td>-0.06</td>
</tr>
<tr>
<td>Lie score</td>
<td>0.16</td>
<td>-0.08</td>
</tr>
<tr>
<td>Suppression of affects (Total)</td>
<td>0.08</td>
<td>-0.16</td>
</tr>
<tr>
<td>Suppression of anger</td>
<td>0.03</td>
<td>-0.13</td>
</tr>
<tr>
<td>Suppression of fear</td>
<td>0.04</td>
<td>-0.15</td>
</tr>
<tr>
<td>Suppression of misery</td>
<td>0.14</td>
<td>-0.14</td>
</tr>
</tbody>
</table>

*\( P < 0.05 \). **\( P < 0.01 \).
Questionnaire, the mean scores revealed the present sample to be less neurotic and extroverted, but with similar scores for psychoticism and Lie score. There are few published accounts of normative data for the Bortner scale in British men, but the mean Bortner score of the present sample was lower than the male executive grade civil servants aged 40-50 cited by Johnston & Shaper (1983), and similar to the sample of 50 British men with CHD aged 40-59 described by Heller (1979). With regard to the CECS scores, the present sample obtained almost identical mean overall and sub-scores to the non-patient sample cited by Watson & Greer (1983).

Relation of sociodemographic factors to Type A and clinical measures of CHD

There was a significant inverse correlation between age and Bortner score \( (r = -0.23; P < 0.05) \). But age was not correlated with any other clinical or angiographic index of CHD except inversely with exercise treadmill time \( (r = -0.41; P < 0.01) \). Duration of anginal symptoms (in months) was not associated with any of the psychological measures, but there was a weak but significant inverse correlation between severity of angina (measured by NYHA score) and Bortner score (Table 2). There was an association between the total Bortner score and social class, with non-manual workers having higher scores \( (179.6 \pm 5.3) \) than manual workers \( (157.4 \pm 5.8; t = 2.8; P < 0.01) \).

Relation of physical variables and psychological scores to measures of functional capacity

Exercise treadmill time was used as a measure of functional capacity, which is influenced by both physical and psychological variables. Of the psychological variables, overall Bortner score, neuroticism and psychoticism showed a positive association with treadmill exercise time and lie score a negative association (Table 2). Multiple stepwise regression was then carried out to determine which of the physical and psychological variables made the greatest contribution to exercise treadmill time before surgery. Table 3 shows that most of the variance was accounted for by the ratings of age, NYHA grade, and duration of symptoms. These three variables together made a significant contribution to the exercise treadmill time \( (F = 12.9; df = 3,74; P < 0.05) \). Only 1% of the variance in treadmill time was accounted for by the variable EPQ psychoticism (Table 3).

Relation of Bortner Type A and CECS scores to angiographic indices of heart disease

There was no significant correlation between Bortner score and either of the two angiographic indices of CHD (Table 2). After adjustment for the effect of age, the correlation between Bortner score and composite occlusion score remained insignificant \( (partial r = -0.05; P = 0.3) \). Turning to the subscales of the CECS, suppression of fear was the only psychological trait measure to show a significant inverse association with the number of diseased vessels \( (r = -0.22; P < 0.05; \) negative correlations with this scale indicate an association with \textit{expression} of affects). Suppression of anger and suppression of misery were also negatively associated with composite occlusion score, but these associations failed to reach statistical significance (Table 2).

In an attempt to determine whether CECS scores were age-related, patients were divided into those above and below the median age of 56

<table>
<thead>
<tr>
<th>Variable</th>
<th>Simple ( r )</th>
<th>Multiple ( r )</th>
<th>Coefficients for the 4 variables†</th>
<th>( F ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (36–73 yrs)</td>
<td>-0.41</td>
<td>0.41</td>
<td>-6.6</td>
<td>( F_{1,76} = 14.9^{**} )</td>
</tr>
<tr>
<td>NYHA grade (0,1,2,3,4)</td>
<td>-0.34</td>
<td>0.54</td>
<td>-5.8</td>
<td>( F_{1,75} = 13.7^{**} )</td>
</tr>
<tr>
<td>Duration of pain (5–216 mths)</td>
<td>-0.37</td>
<td>0.59</td>
<td>-0.7</td>
<td>( F_{1,74} = 5.6^{*} )</td>
</tr>
<tr>
<td>EPQ psychoticism (0–8)</td>
<td>+0.22</td>
<td>0.60</td>
<td>8.9</td>
<td>( F_{1,73} = 2.2 )</td>
</tr>
</tbody>
</table>

\*\( P < 0.05 \). \**\( P < 0.01 \). †Constant = 785.
years. Although there was a trend for younger patients to have lower overall CECS scores (51.5±2.4 as against 54.6±2.3; \( t = 0.9; \) NS) and lower scores of suppression of anger (14.6±0.9 as against 16.6±0.8; \( t = 1.65; \) \( P = 0.1 \)), these differences were not statistically significant.

**Relation of Bortner score to other psychological measures**

Significant positive associations were found between Bortner score and measures of psychiatric morbidity, neuroticism and extraversion (Table 4). There were significant inverse correlations between the Bortner score and all three subscales of the suppression of affects scale (Table 4). This indicates an association between expression of these affects and Bortner score in men.

Of the 14 Bortner items, 8 correlated significantly with neuroticism score and 5 with extraversion (Table 5). The strongest associations were between neuroticism and those Bortner items denoting speed and impatience i.e. ‘always rushed’, ‘impatient’, ‘tries to do too many things at once’, and ‘hard driving’. When a similar analysis was performed for the CECS, the most significant inverse correlations were between suppression of anger and the items ‘impatient’ (\( r = -0.47; \) \( P < 0.01 \)) and ‘expresses feelings’ (\( r = -0.54; \) \( P < 0.01 \)). These latter findings are not surprising and suggest that
patients who suppress anger are more likely to rate themselves as being patient and to bottle up feelings.

Spouse ratings of suppression of affects scale
The spouse of every third patient was asked to complete the spouse version of the CECS i.e. to rate their husband’s behaviour on the three subscales of the questionnaire. Two wives declined and 18 complied, and the correlations with spouse scores were as follows: suppression of anger \( (r = 0.68; P < 0.01) \), suppression of fear \( (r = 0.58; P < 0.01) \), suppression of misery \( (r = 0.74; P < 0.01) \), and total score \( (r = 0.77; P < 0.01) \).

DISCUSSION
It is important to bear in mind the possible effects of case selection when interpreting the results of this study. In related studies of patients undergoing coronary angiography for the investigation of chest pain, individuals with high levels of anxiety and somatic preoccupation had the healthier coronary arteries (Elias et al. 1982; Bass & Wade, 1984). The authors suggested that as many as 30% of patients undergoing angiography were severe and persuasive complainers!

Did the complaint characteristics of the present sample have as important a bearing on the decision to operate as the extent of underlying coronary disease? It is unlikely that this selection factor influenced the findings because the sample were less neurotic and extraverted than age-matched normal controls. For this reason they would be less likely to complain and make use of medical care. Similarly, relatively low mean Type A scores make it unlikely that personality characteristics such as impatience and aggression influenced the decision to operate. Finally, the sample were relatively homogeneous. Although this may lead to less variation in psychological indices within the group, it is important to recall that all were men with severe CHD i.e. at least one coronary vessel occluded by 50% or more, and more than three quarters were in gainful employment. Furthermore, there was a relatively low prevalence of psychiatric morbidity: less than 1 in 5 patients was designated a psychiatric ‘case’ before surgery.

The failure to detect correlation between Type A score and either of the two angiographic indices of CHD is consistent with previous work using the Bortner scale (Bass & Wade, 1982), and with other studies that have used both the JAS (Blumenthal et al. 1978, 1985; Dimsdale et al. 1978) and the structured interview (SI) (Scherwitz et al. 1983; Dembroski et al. 1985) to measure Type A behaviour. Ahnve et al. (1979) used an adjective check list to measure Type A behaviour and found that patients with non-coronary chest pain had higher Type A scores than those who had suffered myocardial infarctions. Population differences are often invoked to explain discrepant findings of this nature, but in the present study the population was relatively homogeneous and the methods used to measure the severity of CHD were very sensitive. Indeed, those studies that have used more rigorous methods of measuring CHD severity have been less likely to detect an association between Type A behaviour and the severity of CHD (Scherwitz et al. 1983; Tennant & Langeluddecke, 1985). Other factors that may contribute to these inconsistent findings are the Type A measure used and the reliability of the angiographic data. In the present study the angiograms were interpreted by a single radiologist, and no attempt was made to assess the accuracy or reliability of this information. The Bortner questionnaire has proven reliability (Johnstone & Shaper, 1983) and correlates highly with the JAS and structured interview (Bass, 1984).

The only psychological measure to correlate with an angiographic index of CHD was suppression of fear, with an inverse correlation indicating an association with inability to control this emotion. These findings are not consistent with those of Dembroski et al. (1985), who found that measures of both ‘potential for hostility’ and ‘anger-in’ (the tendency to withhold expression of anger or irritation against others) were significantly correlated with disease severity. Moreover, the potential for hostility in their patients was associated with disease severity only in those who scored highly on the ‘anger-in’ dimension. Our findings suggest the opposite, that poor control of all three emotions, in particular fear, is associated with measures of atheroma rather than over-control implied by the measure of ‘anger-in’. An alternative explanation for the association
between atheroma and expression of fear is that these men were awaiting surgery and such a psychological reaction would be expected. Although it is possible that the disease could be causing fear rather than the reverse, the high correlation between spouse and patient ratings on the CECS suggests that the questionnaire items reflect trait rather than state measures.

Neither are our findings in accordance with those of Tennant & Langeluddecke (1985), who found a significant association between the number of diseased vessels and suppression of anger as well as total suppression of affects score. Their findings are surprising, and may be explained in part by population characteristics. Their sample contained a subgroup without significant coronary disease and was biased towards older retired males (mean age 61 years). For this reason some of their patients’ replies to questions on the Type A inventories about attitudes to work may have been influenced by their retirement status. Moreover, if psychological factors are important in contributing to CHD risk earlier in life, it is unlikely that these characteristics will be evident in a longer surviving group of patients. Our results suggest that younger patients show less evidence of suppression of emotions, although this failed to reach statistical significance. In addition, Tennant & Langeluddecke did not provide any data about the association between measures of Type A behaviour and the CECS. In our study face validity for the CECS was provided by the significant inverse association with the Bortner scale: patients with high Type A scores were far less likely to report controlling anger (and other emotions). Further indirect support for the absence of a relation between Type A score and the suppression or control of emotion was the strong negative correlation between Bortner score and EPQ Lie score. The latter dimension is a measure of social desirability and conformity, and patients with elevated Bortner scores were less likely to report these characteristics. Tennant & Langeluddecke also failed to confirm the finding of Dembroski et al. (1985) and Williams et al. (1980) of an association between angiographic indices of CHD and measures of hostility. This is surprising in view of the suggestion by Williams et al. (1980), that expressed hostility is more strongly related to atherosclerosis than measures of TAB. The absence of any association between expression of hostility and suppression of anger in Tennant & Langeluddecke’s study also suggests that there is a complex relationship between an individual’s capacity to experience anger and his ability to suppress/express it. This issue is discussed more fully by Spielberger et al. (1985).

Exercise treadmill time was used as a clinical measure of functional capacity before surgery. In the regression analysis the variables with the greatest predictive value were age, severity of anginal symptoms and duration of the illness. The variables Type A score and EPQ psychotism added little extra to the variance in functional capacity. The significant correlation between Type A score and treadmill time is of interest in view of the previous reports that patients with elevated Type A scores tend to deny fatigue and somatic symptoms (Matthews & Bronson, 1979).

The Bortner score was correlated with both overall measures of psychiatric morbidity and with the personality traits neuroticism and extraversion. This is consistent with previous findings in a more heterogeneous population of male patients awaiting coronary angiography (Bass, 1984), and confirms that neurotic manifestations of personality are important components of the Bortner scale. The Bortner items denoting speed, impatience, and ‘rush – hurry’ were most strongly correlated with neuroticism. The significant inverse correlation between the Bortner scale and the Lie scale also suggests that subjects who rate themselves as Type A are less likely to ‘fake good’ or present socially desirable responses.

The correlation between scores on the EPQ lie scale and all three subscales of the CECS also suggests that the questionnaire responses on the CECS may be subject to a ‘faking good’ bias. Patients may be more inclined to fake good i.e. present themselves in the best possible way, when given a questionnaire by a doctor in the hospital environment, as in this study. However, spouse ratings of their husbands’ emotional control on the CECS produced highly significant correlations, which suggests that the patients’ responses to the questionnaire items were an accurate report of behaviour. Further evidence that the CECS measures emotional inhibition and not merely ‘faking good’ reports was recently reported by Pettingale et al. (1984).
In summary, the findings of this study fail to support any evidence of an association between Bortner Type A score and atheroma in a homogeneous sample of men with severe CHD. Only one psychological measure (expression of fear) was correlated with a disease end-point. The significant correlations between Bortner score and other more established personality traits has prompted Eysenck & Fulker (1983) to remark that the concept of Type A behaviour is a chimera, stemming from psychometrically inappropriate analysis of established personality dimensions of extraversion and neuroticism. Although this is an extreme view, it is clear that there is no consensus about what constitutes the behaviour pattern or how it should be measured. Further obfuscation occurred recently when Friedman, the originator of the concept, described it as a ‘medical illness’ (Friedman & Powell, 1984). The findings of this study suggest that the Bortner scale is an instrument of such doubtful validity that conclusions derived from it have very limited usefulness. Type A behaviour is a multifaceted and psychometrically impure construct which comprises an array of personality traits and motor characteristics, some of which are situation-specific. Future studies of the relation between psychological phenomena and clinical or angiographic indices of CHD might more usefully concentrate on more specific and precisely definable characteristics such as the experience and control of certain emotions such as fear, anger and hostility (Williams et al., 1980, 1985). The CECS is an instrument that deserves further study, and use of this inventory in conjunction with other valid measures of psychopathology and sensitive indices of CHD severity may reveal more about the relationship between the mind and the heart than global measures of Type A behaviour, however assessed.

We thank Dr D. Jewitt, Dr G. Jackson and Mr J. Keates for allowing us to study their patients, Dr P. Gishen for interpreting coronary angiograms, Dr J. Upward for performing some of the exercise tests, and Dr M. Watson and Dr S. Greer for helpful comments on the manuscript. Dr Derek Lowe provided statistical advice.

REFERENCES


