Depression after myocardial infarction

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Summary: The Minnesota Multiphasic Personality Inventory was completed by 101 patients 16 to 18 months after a proved myocardial infarction. The data suggested a bimodal distribution of patients. One class of patients had a relatively "normal" personality score apart from a tendency to hypomania. The second class had severe depression, with associated hysteria, hypochondriasis and psychasthenia. The severely depressed patients were older, with a greater tendency to hypertension and angina, and a tendency to smaller gains in aerobic power despite an equal intensity of endurance training.

The distinction between "normal" and "depressed" postinfarction patients seems of some clinical importance, for the two classes of patients require opposite supportive techniques — restraint and encouragement, respectively.

Résumé: La dépression après infarctus du myocarde

L'inventaire de personnalité multiphasique du Minnesota a été rempli par 101 malades, dans un délai variant de 16 à 18 mois après un infarctus du myocarde dûment prouvé. Les renseignements recueillis indiquent une distribution des malades en deux classes. Une classe de malades avaient une personnalité relativement "normale", sauf une tendance à l'hypomanie. Les malades de la seconde classe souffraient d'une dépression sévère, marquée de tendances hystériques, hypochondriaques et de psychasthénie. Les malades gravement déprimés étaient plus âgés et manifestaient une plus nette tendance à l'hypertension et à l'angine de poitrine; on notait également que ces malades ne faisaient que de faibles gains dans leur capacité respiratoire malgré qu'ils aient eu un entraînement de même intensité d'endurance à l'effort.

Cette distinction entre les malades "normaux" et "déprimés" après un infarctus semble présenter une certaine importance au point de vue clinique, car les traitements à appliquer aux deux classes de malades sont nettement opposés — contrainte dans un cas, encouragement dans l'autre.

Myocardial infarction often represents an acute crisis for a previously healthy middle-aged breadwinner. It poses obvious threats to employment, home and social life and sexuality, and the appearance of anxiety reactions, depression and dependency problems might reasonably be anticipated in at least a proportion of those afflicted.[1]

Personality and attitudes probably play an important role in the genesis of the infarction,[2-4] in the critical decision when to summon the physician, and in the response to rehabilitation.[5-8] The Minnesota Multiphasic Personality Inventory (MMPI) and other personality scales are therefore used in cardiac rehabilitation programs.[9,10] However, formal analysis of data has been relatively limited. Some authors have been unable to establish the personality characteristics that are important in the patient with a coronary in either prospective or retrospective studies,[11,12] but others have pointed to data that hold promise for an understanding of the psychogenic component of the pathogenesis of myocardial infarction, and for a rational basis of treatment.[13-15]

In the present study 101 patients completed the MMPI after a proved myocardial infarction. The study yielded a bimodal distribution of data, with implications for rehabilitation.

Patients and methods

Patients

The patients were an unselected series of 101 men attending a postinfarction rehabilitation program at the Toronto Rehabilitation Centre. Each had had a proved myocardial infarction, the evidence being two or three of the following: typical history, typical electrocardiographic (ECG) changes and typical changes in serum enzyme values.

Methods

The MMPI was completed 16 to 18 months after infarction, when the patient had been with the rehabilitation program for 12 to 15 months. Findings were related to the results of clinical examination, a sociologic questionnaire[16] and standard physiological tests[7] including body weight, skinfold thickness, grip strength, predicted aerobic power and depression of the ST segment of the ECG. Data from physiological tests were available soon after the patient's entry into the program and 1 year later; in this way it was possible to assess both the initial status of the patient after infarction and his response to the rehabilitation program.

MMPI

The MMPI is a widely accepted psychologic test.[9] The patient responds to 399 multiple-choice questions under the supervision of a psychologist. The validity of the responses is first assessed from the number of "cannot say" responses, and scores are computed for lies (L scale), inconsistency of response (F scale) and excessive number of symptoms (K scale). Raw scores are then computed for the 10 basic psychologic scales relating to hysteria (Hs), hypochondriasis (Hy), depression (D), psychopathic deviation (Pd), masculinity/femininity (MF), paranoia (Pa), psychasthenia (Pt), schizophrenia (Sc), hypomania (Ma) and social introversion (Si).

Scores on individual scales indicate a personality tendency rather than a pathologic deviation that requires psychologic treatment. An individual whose responses yielded a high Sc score, for example, would not likely be schizophrenic unless certain other conditions were met in the profile. In the present paper particular attention is directed to a combination of high scores on the scales Hs, D and Hy — the "neurotic triad". When all three of these scores are high a psychoneurotic condition is probable.

All 101 patients completed the MMPI booklet under the supervision of one of us (J.A.T.) However, results for five patients failed to meet the validity requirements, so we analysed the data from only 96 individuals. In accordance with usual practice the raw MMPI scores were normalized to an anticipated mean of 50 ± 10; that is, a score of 60 is 1 standard deviation (SD) above the average for a normal population and a score of 70 is 2 SD above the normal.

Results

Average scores on 5 of the 10 basic psychologic scales were well within normal limits. Attention will therefore be focused on the D scale, the neurotic triad (D, Hs and Hy) and the Pt and Ma scales.

Depression scores*

The frequency distribution of D scores for the postinfarction patients is illustrated in Fig. 1. The results were dis-

*Standard scores for the MMPI were derived from populations aged 15 to 55. Our patients were all at the older end of this range.
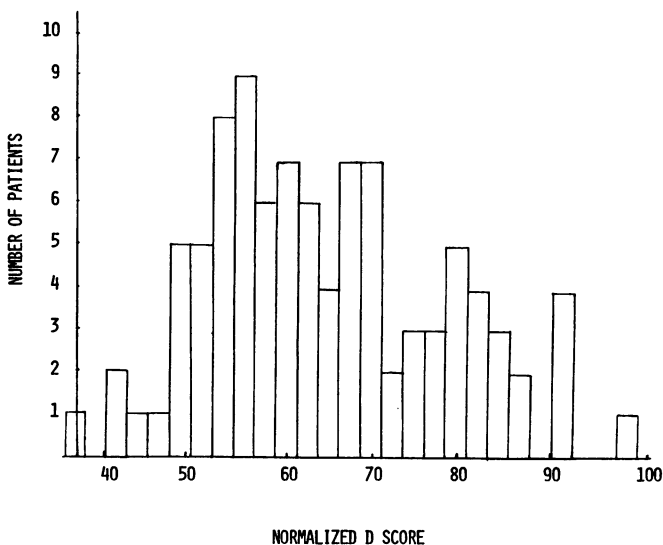

FIG. 1—Distribution of depression (D) scores on Minnesota Multiphasic Personality Inventory completed 16 to 18 months after a myocardial infarction.

tinctly skewed to the right, with a strong suggestion of a bimodal distribution. Thirty-eight patients had D scores of less than 60; although the majority had scores between 50 and 60, none were clinically depressed and we have therefore designated them the "normal" or "nondepressed" group of patients. A further 34 patients had very high D scores (> 70; more than 2 SD above the anticipated value); we have called them the "depressed" group. The final 24 patients formed an "intermediate" group, with D scores of 60 to 70.

The total population is small for a formal test to distinguish the three possibilities of bimodality, trimodality or unimodality with gross skewing. If the distribution were bimodal the intermediate group would comprise an equal number of individuals from the normal and the depressed groups. We tested this possibility by making a random allocation of alternate members of the apparently intermediate group to depressed and normal classes. The mean raw D scores for the two populations then became 18.8 ± 2.6 and 26.8 ± 4.3, with a significant difference of 8.00 ± 0.74 (t_{94} = 10.8, P < 0.001); plainly the existence of two distinct populations is one tenable hypothesis.

A second method of examining the data is a probit plot,† as illustrated in Fig. 2. The graph suggests that the entire postinfarction population may have been somewhat depressed; however, this could be due at least in part to the effect of age on D scores. An unexpectedly large proportion of these patients had very high and clinically important D scores.

†A probit plot is a graphic method of demonstrating normality in the distribution of data. With a normal population the curve of the D scores of the MMPI would be linear, with 2.5% of the population having a score of 30 or less, 50% having a score of 50 or less, and 97.5% having a score of 70 or less.
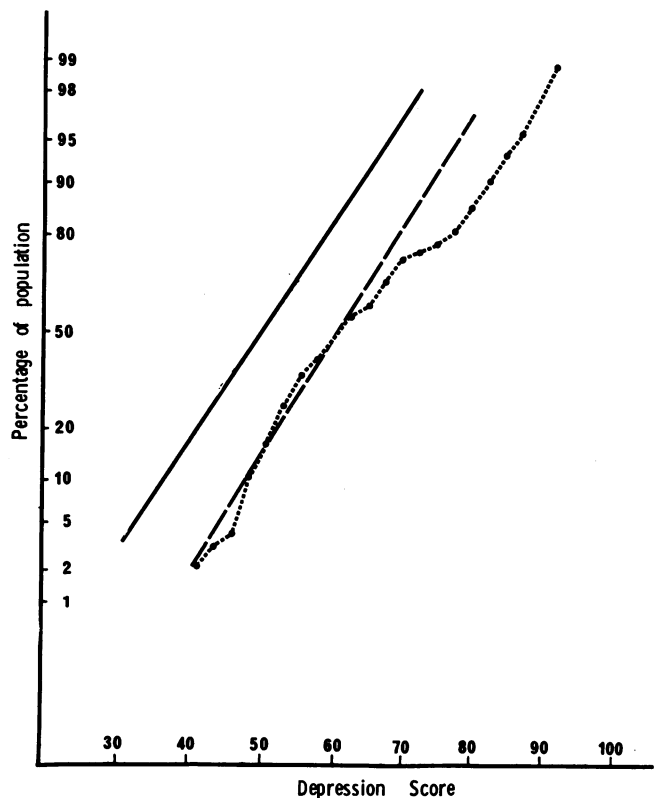

FIG. 2—Probit plot of D scores for healthy population (solid line) and for 96 postinfarction patients (dotted line). Broken line represents estimate for nondepressed postinfarction patients.

Psychologic characteristics of "normal" and "depressed" patients

The psychologic characteristics associated with severe depression (Table I), in terms of MMPI results, include increased scores for depression (D), hysteria (Hs), hypochondriasis (Hy) and psychasthenia (Pt), the first three combining to yield the neurotic triad.

For the normal (nondepressed) postinfarction patients the Hs, Hy and Pt values were normal; their only unusual feature was a somewhat increased hypomania (Ma) score (21.2 ± 3.0 = 60.3) compared with the anticipated normalized value of 50.0 ± 10.0.

Considering the entire Toronto Rehabilitation Centre group, a little over one third showed profound depression.

Clinical features

Clinical and physiological data are reported for 87 of the 96 patients; the other 9 had either had an incomplete initial evaluation or less than a year had elapsed between initial and final tests.

The depressed group was significantly older than the normal group (Table II) but did not differ in the proportion of patients with recurrent attacks. Hypertension and angina were more frequent in the depressed patients, and the difference from the normal patients in the proportion with a systolic blood pressure of more than 150 mm Hg was significant.

The initial period of hospitalization, the duration of rehabilitation, the attained jogging distance and the average speed did not differ between the three groups. The numbers of patients in whom complications developed that led to a temporary halt of exercise training were also similar in the three groups. All except four men returned to full, usual employment; two of the four who were unemployed were in the depressed group.

The main antecedent of myocardial infarction in the middle-aged patients was business rather than social or financial worry, as we previously noted.[16] This is in contrast with the older patients, among whom recent widowhood, as others have noted,[17,18] seems an important etiologic factor. There was a small but statistically insignificant trend for more business and social worries to be reported by the depressed than by the normal patients (respective figures for the year before the infarction: business worries, 74.1 and 60.0%; social worries, 32.2 and 20.0%).

Physiological status

The three groups of patients had a remarkably similar body build (Table III), the excess weight and skinfold thickness in all instances being normal for Toronto men of this age — in contrast with the findings of Lovell and Verghese.[19] Both the workload and oxygen scale predictions of aerobic power‡ suggested a slight and statistically insignificant advantage of initial aerobic power in the normal group. Even if this difference were confirmed on a larger sample it would reflect no more than the age difference between the normal and depressed groups. After the 12-month period of endurance-type training, all groups showed

‡The aerobic power (maximum oxygen intake) can be calculated from the heart rate and the workload or the corresponding oxygen consumption during submaximal work on the bicycle ergometer, using the age-adjusted Astrand-Ryhming nomogram.[28] Maximum oxygen consumption is the internationally accepted index of cardiorespiratory fitness.

Table I—Normalized scores and raw data* from Minnesota Multiphasic Personality Inventory for postinfarction patients in present study and that of Ruskin and colleagues[15]

| | Present study | | | | | | Study of Ruskin and colleagues | |
| | Entire group | | "Depressed" patients | | "Normal" patients | | | |
Psychologic characteristic	Normalized score	Raw data	Normalized score	Raw data	Normalized score	Raw data	Normalized score	Raw data
Depression	63.3	22.6 ± 5.4	79.2	28.3 ± 4.0	53.3	17.6 ± 1.8	70.1	—
Hysteria	54.2	14.7 ± 4.9	66.3	17.9 ± 5.2	52.6	13.1 ± 3.1	63.1	—
Hypochondriasis	55.4	21.9 ± 5.6	64.2	25.2 ± 5.1	50.9	20.2 ± 4.7	63.7	—
Psychasthenia	55.5	26.4 ± 4.7	65.2	29.1 ± 4.5	53.4	23.8 ± 3.7	59.2	—

*Mean values ± SD

Table II—Clinical features* of 87 postinfarction patients

| | Patient group, according to depression score | | | Significance of differences |
Feature	Normal	Intermediate	Depressed	
Age (yr)	45.2 ± 8.0	48.2 ± 8.3	51.4 ± 7.0	t = 3.28 P < 0.001
No. of attacks	1.2 ± 0.4	1.2 ± 0.4	1.2 ± 0.5	NS
Hospital stay (days)	23.2 ± 11.0	27.9 ± 10.9	25.6 ± 11.8	NS
Duration of exercise (mo)	16.4 ± 11.3	16.1 ± 9.9	14.7 ± 8.6	NS
Running per week (km)	15.5 ± 8.5	19.2 ± 20.5	13.6 ± 5.3	NS
Average time for 1 km (min)	8.1 ± 1.8	8.4 ± 2.7	8.7 ± 2.4	NS
Hypertension Systolic (> 150 mm Hg)	5/35	11/21	13/31	t = 2.58 0.02 > P > 0.01
Diastolic (> 100 mm Hg)	3/35	9/21	8/31	NS
Angina	13/35	8/21	16/31	NS
Complications during training	9/35	2/21	7/31	NS
Return to full normal employment	34/35	20/21	29/31	NS

*Mean values ± SD
NS = not significant

a substantial gain in aerobic power (Table IV). There was a statistically insignificant indication (0.2 > P > 0.1) of larger gains in the normal than in the depressed group, although both were undertaking training of equal severity. Body weight, skinfold thickness and grip strength showed little change in any of the three groups.

Discussion

Two cardiac "types"

Considering the entire Toronto Rehabilitation Centre group, adverse scores for depression, hysteria, hypochondriasis and psychasthenia were all less prominent than in the series of Ruskin and colleagues.[15] In particular, half of their patients showed profound depression, compared with a little over one third of our patients.

Because our results suggest a bimodal distribution of depression scores in the postinfarction patient it seems wrong to analyse the characteristics of "the cardiac patient", as Ruskin and colleagues do. Rather, it is clinically desirable — and probably correct scientifically — to distinguish two cardiac "types": those with relatively normal personalities and those who are seriously depressed, with perhaps a

Table III—Initial physiological status* of 87 postinfarction patients

Feature	Patient group, according to depression score		
	Normal	Intermediate	Depressed
Height (cm)	176.0 ± 6.7	172.6 ± 6.5	173.5 ± 7.1
Body weight (kg)	74.9 ± 7.4	74.8 ± 9.2	75.3 ± 7.3
Excess weight (kg)	5.9 ± 5.6	7.2 ± 7.4	7.6 ± 6.0
Skinfold thickness			
(mm)	14.2 ± 3.6	14.8 ± 3.5	14.3 ± 2.7
Grip strength (kg)			
Right hand	49.7 ± 7.9	49.4 ± 8.4	49.8 ± 8.1
Left hand	46.7 ± 8.2	47.0 ± 7.7	46.8 ± 7.4
Aerobic power (ml/kg·min)			
Workload			
prediction	27.1 ± 6.6	29.4 ± 11.5	25.6 ± 6.9
Oxygen			
prediction	24.2 ± 6.8	24.2 ± 11.6	22.1 ± 6.0
ST-segment depression (mV)†			
Mean	0.02 ± 0.14	0.00 ± 0.15	0.00 ± 0.15
Number > 0.1 mV	4/35	6/21	4/31

*Mean values ± SD
†Standard three-stage bicycle ergometer test to target pulse rate, corresponding to 75% of maximum oxygen intake.

Table IV—Improvement of physiological status* of 87 postinfarction patients after 1 year of training

Feature	Patient group, according to depression score		
	Normal	Intermediate	Depressed
Body weight,			
change (kg)	−0.2 ± 3.3	− 0.3 ± 2.6	−1.0 ± 3.6
Skinfold thickness,			
change (mm)	−0.2 ± 2.4	+ 0.6 ± 2.7	−0.2 ± 2.5
Grip strength,			
change (kg)			
Right	−1.8 ± 6.4	− 2.1 ± 6.0	−0.8 ± 6.9
Left	0.4 ± 4.5	− 3.0 ± 5.4	−1.6 ± 5.4
Aerobic power,			
change (ml/kg·min)			
Workload			
prediction	+5.9 ± 6.4	+ 2.8 ± 8.9	+4.7 ± 6.9
Oxygen			
prediction	+6.8 ± 7.4	+ 4.5 ± 9.1	+4.0 ± 7.5
ST-segment depression,			
change (mV)			
At same load	+0.03 ± 0.18	0.00 ± 0.14	+0.03 ± 0.18
At same pulse rate	+0.03 ± 0.20	−0.04 ± 0.16	+0.02 ± 0.18

*Mean values ± SD

quarter of the patients not falling readily into either category.

The nondepressed patient has the characteristics of hypomania: he is a driving, ambitious individual, who takes on too many projects and may have some concealed hostility. He is probably the ambitious, competitive, deadline-fighting "type A" patient of Friedman and Rosenman[3] and, in view of the vigorous exercise and activity-oriented treatment offered by the Toronto Rehabilitation Centre, this type could well be overrepresented in our samples. Certainly, this would be one explanation of why we have seen fewer depressed patients than Ruskin and colleagues.[15]

The severely depressed patient, in contrast, is anxious and preoccupied with his symptoms and, although compliant in the rehabilitation program, is passively dependent and has feelings of inadequacy and hopelessness. The extent of depression revealed by the MMPI was in some instances surprising and if encountered in a normal population would be sufficient to demand psychiatric referral. These patients admitted trying to conceal their low mood, believing this trait was unacceptable to the cardiac peer group.

Etiology of depression

Clinicians have the impression that there is an increased incidence of depression in the months immediately after myocardial infarction,[1,20-22] and one therefore might suggest that the depression is exogenous in type, with the myocardial infarction playing a causal role. However, it is also possible that many postinfarction patients are particularly liable to depression,[13,14] as shown by the neurotic triad of the MMPI, that this type of personality is "coronary prone", and that the infarction serves merely as the critical incident that reveals the underlying personality defect. In support of the latter view, many authors believe that responses to personality questionnaires such as the MMPI are indicative of the basic constitution of the individual rather than his immediate response to exogenous stimuli.

The sociologic questionnaire is not particularly helpful in distinguishing which of these possibilities is correct. Although the depressed group tended to report more problems than the normals in the year before the infarction, this could reflect either a true difference of exogenous pressures[17,18] or a magnification of difficulties secondary to the depression.

The clinical and physiological findings are reminiscent of those from a previous study[7] in which we showed that the physiologically older patient responded poorly to a training program, perhaps partly because of complications such as hypertension and angina and partly because of less motivation. The depressed group also were older, with more hypertension and anginal symptoms, and they tended to show less improvement in aerobic power than the normals. Dobson and colleagues[5] have also noted the link between depression and physical disability. While it could be argued that depression weakened motivation and exaggerated symptoms,[19] leading to inadequate training, this argument is countered in the present study by the equal attainment of walking distance and speed by the two groups. It would seem that the depressed patients were persuaded to try as hard as the normals, yet had a somewhat poorer response.

Possible implications for treatment

We believe that the two types of patients require opposite approaches to therapy by the rehabilitation team: the normal, hypomanic patient needs restraint, whereas the depressed patient needs encouragement. Therefore, careful appraisal of personality and attitudes are important preliminaries to rational therapy.

The normal hypomanic patient is eager to excel in any prescribed exercise and must be cautioned against entering

training in an aggressive and competitive manner. Equally, he must be warned against a precipitate return to a deadline-fighting lifestyle: this would have a detrimental effect on his prognosis and might interact adversely with the exercise program. Some evenings, exercise might be undertaken too hurriedly when appointments closely follow the rehabilitation class; on other occasions, tension might arise when an evening's training is missed because of too many other commitments. Such individuals may use the mechanism of denial to enable them to cope with a heavy load of pressing business commitments in the face of niggling symptoms. In effect they say "This isn't happening to me" or "It is unimportant — a slight touch of indigestion". To a point this is a useful mechanism and accounts for the favourable progress of the group after infarction. However, it can lead to dangerous delay in seeking medical advice when a recurrence is imminent, and fine judgement must therefore be exercised in alerting the patient to his problem.

The Toronto Rehabilitation Centre team were remarkably successful in persuading severely depressed patients to return to full employment. Nevertheless, others have noted that "cardiac neurosis" and depression can be important factors delaying both rehabilitation and return to work,[6,23,24] particularly when the physician has failed to distinguish between the patients who need encouragement and those who need restraint. The depressed patients are the most likely to benefit from the group psychotherapy[25] or hypnosis (or both)[26,27] proposed for the postinfarction patient. In the intimacy of small group sessions, common covert problems are revealed, with beneficial therapeutic effect, hidden feelings of depression forming the main common bond. As the nature of the psychosomatic process becomes better understood by the patient, tension may also be reduced.

Whether the depression is exogenous or endogenous could probably be resolved more satisfactorily by prospective use of the MMPI as a predictor of liability to ischemic heart disease. If indeed a combination of depression, hysteria, hypochondriasis and psychasthenia predisposes to cardiac disorder, then there is the intriguing possibility that premorbid therapeutic intervention might improve the prognosis of this class of patient.

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