PAPERS AND SHORT REPORTS

What contribution has cardiac surgery made to the decline in mortality from coronary heart disease?

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Abstract

The number of deaths from coronary artery disease is declining in New Zealand as in some other Western countries. It has been estimated that in 1981 in the Auckland metropolitan area there were 126 fewer deaths than would have been expected from the data in 1974. The contribution made by cardiac surgery to this decline was assessed from the known numbers of patients who were operated on, from their survival rate, and from the predicted mortality of the surgical cohort had they not undergone operation. Such mortality was predicted from past studies of patients with similar symptoms, exercise data, studies of unstable angina, and the coronary artery surgical study registry. From this method it was estimated that coronary surgery accounted for 26% to 42% of the reduction in coronary deaths. Two previous studies estimated, from calculations based on the European study of patients with modest symptoms, that the contribution of cardiac surgery was much lower. Extrapolating data from one subset of patients to a second subset with quite different characteristics is a conceptual fallacy.

Introduction

The past two decades have seen a decline in mortality from coronary heart disease in some Western countries (World Health Organisation, unpublished). Two recent attempts have been made to assess the factors that might have contributed to this decline. Goldman and Cook estimated that medical management accounted for some 40% of this decline in the United States, including a 4% contribution from cardiac surgery.¹ Beaglehole similarly estimated that medical management accounted for some 40% of the decline in New

Zealand, including a 5% contribution from cardiac surgery.² (He also considered data that estimated the contribution from cardiac surgery as being higher but favoured the 5% assessment.) We accept that assessing the contribution of improved management in hypertension, prehospital resuscitation, coronary care units, and long term medical treatment of ischaemic heart disease is difficult. We believe, however, that both papers mentioned above show a significant conceptual error when considering cardiac surgery.

The modern management of patients with obstructive coronary artery disease is designed to relieve symptoms, identify patients at high risk of premature death or myocardial infarction, and treat patients who have major symptoms, or who are at high risk, with surgery (or, more recently, angioplasty). Though the most common indication for operation is persistent limitation of lifestyle by severe symptoms, management is influenced by the known strong association between such symptoms and increased mortality.^{3,6} To judge whether coronary surgery reduces mortality we must determine three factors: the number of patients undergoing surgery, the survival of the surgical cohort, and their mortality had they not had the operation. The first two factors can be determined accurately, but the third must be estimated. Because of the association between major persistent symptoms and mortality it is clearly inappropriate to make a judgment about the mortality predicted from patients with few symptoms. The European trial,⁷ used in both previous publications to assess the contribution of cardiac surgery to reduced mortality, is therefore unsuitable. The aim of the European study was to evaluate whether coronary artery bypass surgery prolonged life in patients whose symptoms, in the past, had not been considered to be severe enough to warrant surgery. Patients judged to require operation were therefore excluded from this trial. Furthermore, the trial did not seek to compare surgical with medical management but to compare early routine operation with standard medical treatment unless the development of important symptoms was judged to require operation. Indeed, 22% of the "medical" cohort developed important symptoms and underwent surgery. This crossover prohibited an assessment of the prognosis of even relatively asymptomatic patients who were receiving medical treatment alone.

The doctor is constantly reminded of the threatening nature of unremitting angina. Because of this no controlled trial will ever be undertaken to compare the mortality for medical and surgical

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treatment of patients with severe symptoms unrelieved by drugs. We can only estimate the mortality for the surgical cohort from the available published evidence. In patients who have severe left ventricular dysfunction this determines prognosis.^{5,8} Though there is evidence that the prognosis of some patients with impaired left ventricular function is improved by surgery,⁹ the numbers of patients are quite small, and we shall not discuss this group further. In most patients undergoing cardiac surgery prognosis is determined by a combination of symptoms and the extent of coronary disease. The Cleveland Clinic data from patients studied from 1963 to 1965 show that prognosis is related both to symptoms and to the extent of coronary disease but that the prognosis of patients with few symptoms is generally good even when coronary artery disease is extensive.^{3,8} As discussed below, these conclusions are supported by more recent studies and by clinical experience.

TABLE I—Comparison of patients in 1963-5 Cleveland Clinic Series with 1976-7 surgical cohort from Green Lane Hospital

Database	No of patients	Follow up (years)	% Of patients in each symptomatic class*				
			I	II	III	IV	Atypical
Cleveland Clinic ⁸	469	6.0	9	40	30	17	5
Green Lane Hospital ¹⁰	492	6.4	3	17	32	48	

*New York Heart Association classification.

TABLE II—Relation between exercise capacity and annual mortality

Database	No of patients	Follow up (years)	Exercise stage* New York Heart Association class†	% Annual mortality			
				4	3 I	2 II	1 III-IV
Bruce 1977 ¹¹	1221	2					9.6
McNeer 1977 ¹²	876	2.4		2.6	5.4	6.2	23.2
Dagenais 1982 ¹³	107	5			3.0	6.0	12.8
Mean				2.3	5.1	6.2	15.1

*Bruce protocol.¹¹

†Approximate equivalent of exercise stage.

Methods and results

PREDICTED MORTALITY FOR SURGICAL COHORT

Auckland regional study and Cleveland Clinic study

Information about the reduction of mortality for coronary heart disease in New Zealand comes from national statistics. In the Auckland region the evidence is supported by information from two epidemiological studies carried out in 1974 and 1981.² From national statistics Beaglehole calculated that in 1981 there were 126 fewer deaths in the Auckland region (population 829 000) than would have been predicted from the 1974 data. This estimate is of course no more than an approximation, but it can be used as a basis for a discussion of the contribution of various interventions.

Isolated coronary artery bypass grafting was undertaken in few patients in the Auckland region before 1974, in 86 patients in 1974, and in 181 patients in 1981. All surgery was carried out at Green Lane Hospital, and the criteria for patient selection remained consistent during this period. Data on the survival of patients of Green Lane Hospital were obtained in a follow up study of 492 patients (from throughout the country) who underwent surgery during 1976-7.¹⁰ Follow up was complete in 99% of the patients. After the mean follow up period of 77 months 409 patients had survived, giving an annual mortality of 3%. (To allow comparison with other studies annual mortality has been calculated throughout this paper on the assumption that the population declined in an exponential fashion.) Table I shows a comparison of the symptomatic class of these patients and those in the Cleveland Clinic study. More patients in the Green Lane series had severe symptoms, 80% being graded as New York Heart Association class III or IV. Patients with left main stem disease—15% in the Green Lane series and 6% in the Cleveland Clinic series—were included in both studies. The observed mortalities for patients in the Cleveland Clinic study were: New York Heart Association class I 3.6%, class II 4.4%, class III 8.9%, class IV 19.6%, and

atypical chest pain 7.7%. Ignoring for the moment any changes in mortality arising from improvements in medical management in the 13 years separating the two studies we calculated a predicted annual mortality of 13% for the Green Lane patients. This was done by multiplying the percentage mortality for each symptomatic class in the Cleveland Clinic series (above) by the fraction of Green Lane patients in that class (table I) ($3.6 \times 0.03 + 4.4 \times 0.17 + 8.9 \times 0.32 + 19.6 \times 0.48 = 13.11$). It is widely believed, but not proved, that modern medical management has decreased mortality. This figure of 13% would therefore represent an upper limit for the range of predicted mortality for our surgical cohort.

Exercise studies

Some further evidence may be derived from exercise studies carried out in the years 1971-6. Table II shows the results from three studies¹¹⁻¹³ and the approximate relation between New York Heart Association class and the capacity for exercise. In each study the patients had been considered for cardiac surgery, but operation had been decided against and a medical follow up was possible. Generally, patients with severe left ventricular dysfunction were not exercised then, and most of the patients would have been suitable, on technical grounds, for operation. The relation between the capacity for exercise and annual mortality is again striking and similar to that seen for symptomatic class in the Cleveland Clinic study a decade earlier. Taking an average of the figures and making the same calculation as with the Cleveland Clinic data we again predicted the annual mortality for the Green Lane surgical cohort as being 13% ($3.7 \times 0.03 + 6.2 \times 0.17 + 15.1 \times 0.8 = 13.25$).

As expected, however, the relation was not always obvious when there were few patients in classes III or IV, as in the studies of Podrid *et al.*¹⁴ and Burggraf and Parker,¹⁵ and group B of the study by Dagenais *et al.*¹³ Further,

when information from cardiac catheterisation was included in the study the significance of symptomatic class may have been eliminated during stepwise linear discriminant analysis, but this does not reduce the value of exercise tolerance as a non-invasive predictor. In the study of Hammermeister *et al.*, for example, symptoms were not used in the multivariate analysis, but the annual mortality for patients in New York Heart Association class I was 2.0%, class II 3.2%, class III 9.1%, and class IV 15.2%.¹⁶

Studies of unstable angina

It may be anticipated that further information should be available from controlled studies of unstable angina. The results of early studies of patients with pain at rest and progressive angina showed a mortality of about 20% a year with medical management.¹⁷ The results of studies within the last 10 years showed a one year mortality of about 10%,¹⁸ but crossover of patients from the medical group to surgery was substantial. Most patients can be managed medically initially, but the infarction rate is fairly high, and many patients come to operation because of persistent symptoms. For example, the results of the national cooperative study showed a 30 month mortality of only 6%, but 36% of the medical group underwent surgery.¹⁹ Other smaller studies similarly showed a low mortality but a high surgical intervention rate in the year of admission to the trial.^{20,21}

The same trend was evident in the recent trial of nifedipine treatment.²² "Failure" (death, myocardial infarction, or cardiac surgery) of medical treatment occurred in 61% of patients receiving the placebo and 44% of patients receiving nifedipine. Lewis *et al.* showed a one year mortality of 6% after 12 weeks' treatment with aspirin and 10% after treatment with placebo.²³ The incidence of cardiac surgery during this period was not recorded.

A combination of low mortality and low surgical rate was reported only rarely and probably represented unusual selection.^{18,24} The high rate of surgical intervention in these studies prevented any prediction of mortality for medical management alone, and the studies provided no evidence to challenge the concept that persistent, severe angina carries a high mortality.

The Coronary Artery Surgical Study registry

A clue to the lower limit of the predicted mortality of surgical patients was gained from the Coronary Artery Surgical Study.²⁵ The Coronary Artery Surgical Study registry contained details of 14 249 patients with documented disease in one, two, or three vessels and no prior operation. The four year survival of these patients (including those with left main stem disease) was 80%, giving a 5.4% annual mortality.

Table III compares the patients in the Coronary Artery Surgical Study and Green Lane series. Mortality for patients in the Coronary Artery Surgical Study was described in relation to the number of diseased vessels, the annual mortality for patients with disease in one, two, and three vessels being 2.1%, 4.3%, and 9.2%, respectively. After correcting for the difference in the

TABLE III—Comparison of patients in 1975-9 CASS registry²⁵ with 1976-7 surgical cohort from Green Lane Hospital¹⁰

	% Of patients	
	Green Lane Hospital	Coronary Artery Surgical Study
New York Heart Association class:		
I	3	6
II	17	30
III	32	36
IV	48	28
No of vessels affected:		
1	12	29
2	21	32
3	67	40
Ejection fraction:		
>50	70	70
30-50	26	24
<30	4	6

TABLE IV—Contribution of cardiac surgery to calculated salvage of 126 patients in Auckland district in 1981

Database	Predicted annual mortality (%) of 1976-7 Green Lane surgical cohort	Calculated No (%) of patients salvaged by cardiac surgery in 1981
Cleveland Clinic 1963-5	13	52 (41)
Exercise studies 1971-6	13	53 (42)
CASS study 1975-9	7	33 (26)

Calculations of salvage are based on number of patients undergoing coronary artery bypass surgery from 1970, annual mortality of these patients (3%), and mortality predicted for medical treatment alone (see text and appendix).

extent of coronary artery obstructive disease in the Coronary Artery Surgical Study and Green Lane patients the predicted annual mortality for the Green Lane surgical cohort was 7% ($2.1 \times 0.12 + 4.3 \times 0.21 + 9.2 \times 0.67 = 7.32$). This prediction would be wrong if the Coronary Artery Surgical Study group included a substantial proportion of patients with advanced left ventricular disease, but this is unlikely. A subgroup of 51 high risk patients was recognised in the Coronary Artery Surgical Study group.²⁶ They had suffered from an acute myocardial infarction within two months after enrolment, suffered from congestive heart failure, and either had had a previous cardiac arrest or were taking antiarrhythmic drugs. This group had a one year follow up mortality of 30% (15 patients), representing only 2% of the total deaths of the registry patients in the first year.

The mortality for the patients in the Coronary Artery Surgical Study registry represents the deaths of patients who were judged to require catheterisation, remained under clinical observation, and were put forward for operation if this was deemed necessary. For our purposes the follow up was stopped at the point of operation, which was in fact undertaken in 58% of these patients. The figure of 7% annual mortality predicted for Green Lane Hospital patients should therefore represent a baseline figure well below the mortality anticipated for medical treatment alone.

DEATHS PREVENTED BY CARDIAC SURGERY

The number of deaths in 1981 for the Green Lane Hospital surgical cohort was predicted from the annual mortalities derived above—that is, 13% from the Cleveland Clinic data, 13% from exercise studies, and 7% from the Coronary Artery Surgical Study. The calculation was repeated with the observed annual mortality of the surgical cohort, 3%. The difference between these calculations represented the estimate of the number of deaths prevented in 1981 by cardiac surgery carried out during 1972-81. The same calculations were made for the year 1974, the difference between the number of deaths prevented in 1981 and those prevented in 1974 representing the contribution of cardiac surgery to the reduction in mortality between those two years. The reduction in deaths thus calculated from Cleveland Clinic data amounted to 52 patients, from exercise data 53 patients, and from Coronary Artery Surgical Study data 33 patients. Table IV summarises these results. The appendix shows an example of the detail of calculation.

Discussion

Mortality is high for patients with extensive coronary disease and either major symptoms or a strongly positive exercise test. Mortality for a surgical cohort can be predicted only from data from a suitable population. An estimate based on any of the controlled trials of cardiac surgery, not just the European trial, is quite inappropriate. All such trials included patients with modest symptoms, a group that had a low mortality even in the 1960s. Furthermore, all trials had a large crossover from the medical group to the surgical group, so when patients entered the high risk group at a later date the risk was minimised by operating. The trials did not therefore examine survival in medically treated patients but sought to answer the question of whether routine operation was preferable to standard medical management with progression to surgery if symptoms demanded it or if specific unfavourable features were present. Similarly, evidence about survival of patients with unstable angina given medical treatment is confounded by the crossover to surgery of the 30-40% of patients who failed to respond to medical treatment.

In the absence of appropriate trials how much reliance can be placed on the studies mentioned above? Since the 1960s the medical management of symptoms of coronary disease has clearly improved. We lack proof, however, that medical management has lessened the incidence of myocardial infarction or reduced the mortality for patients with severe angina. The annual mortality of our surgical cohort predicted from the data of Webster *et al*⁸ may therefore represent the true position, though we believe—without proof—that the mortality is actually lower than this prediction. The estimate based on the exercise studies would be inflated if the patients observed included many who had severe left ventricular impairment, but this is unlikely because patients with severe left ventricular dysfunction were not usually exercised at that period. Counterbalancing this effect is the fact that patients were observed in academic units with the facilities for cardiac surgery, the doctors in the trials judging whether surgery could be avoided or postponed in this group. It is likely therefore that the mortality predicted for our surgical cohort from these studies is not greatly inflated. Data from the Coronary Artery Surgical Study, setting the lower limit of the prediction, can be accepted with confidence.

Our prediction of the annual mortality for the Green Lane surgical cohort from data from the Cleveland Clinic and the exercise studies was based on symptoms rather than on the extent of coronary artery disease, the objective being to emphasise the role of symptomatic state in survival. In fact the prediction based on the extent of coronary artery disease is quite similar. Calculated annual mortalities for patients in the Cleveland Clinic study with disease in one, two, and three vessels are 4%, 8%, and 15%, respectively, giving a predicted annual mortality for the Green Lane surgical cohort of 12% ($3.7 \times 0.12 + 8.2 \times 0.21 + 15.3 \times 0.67$). Bearing in mind the higher prevalence of left main stem disease in the Green Lane group this would give a very similar prediction to that based on symptomatic state. The 58% crossover to surgery in the Coronary Artery Surgical Study medical cohort really prevents meaningful analysis in terms of symptoms, so the data were analysed in terms of the extent of coronary disease.

In calculating the contribution of cardiac surgery to the total reduction in deaths from coronary heart disease account must be taken of the errors in the original estimate of 126 fewer deaths in 1981 than predicted from 1974 figures. One hundred and twenty six "events" in the age group 35-69 of the population at risk (representing the number of trials) gives 70% confidence limits of about 115 and 138 and 95% confidence limits of 107 and 148.²⁷ Probably more important, however, is the observation that the reduction in the number of deaths has been fairly consistent over several years. No changes in diagnostic patterns were recognised during this period. Similarly, confidence limits can be given for each of the mortalities from which we made theoretical predictions of the survival of our surgical cohort. The most important single factor in determining these confidence limits is the number of events, and the range of error in the second part of the calculation is quite small. It should be appreciated, however, that the final figures given in table IV are mean values, each figure carrying its own 95% confidence limits at about 20% on either side of the value given. The availability of multiple sources of information increases the likelihood of an accurate estimate.

On the basis of these predictions the contribution of cardiac surgery, including the whole practice of medical assessment and treatment with surgery in high risk cases, to the salvage of patients in the Auckland study is 26-42% (table IV). Perhaps we may apply to our surgical cohort the estimate that improvements in medical management would have reduced their mortality by about 35%, the figure previously calculated for the Auckland patients.² This would give a predicted annual mortality for the surgical cohort of about 9% and a predicted reduction of 30% in mortality of the patients in 1981 because of surgery. It so happens that 1974-81 was the period during which coronary bypass surgery was introduced, so the influence of surgery during this period was essentially that of a new treatment. The estimate does, however, emphasise the possible effect of a medical intervention in a high risk cohort. It also emphasises the need for a careful and realistic scrutiny of medical reports when attempting to explain population changes. It does not in any way argue against the importance of preventive measures in the campaign to reduce the mortality from coronary heart disease.

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Appendix

ARITHMETIC CALCULATION OF PREDICTED MORTALITY FOR SURGICAL COHORT FROM CLEVELAND CLINIC DATABASE

The figures shown in the text have been rounded up. The actual figures used in the calculations were: annual mortality of Green Lane surgical cohort=2.838%; and predicted mortality from Cleveland Clinic series data=13.112%, from exercise studies=13.245%, and from the Coronary Artery Surgical Study registry=7.319%.

(a) Calculate the predicted deaths of the surgical cohort in 1981 assuming a 13.112% annual mortality

As a slight simplification we assumed that only half of the patients undergoing surgery during 1981 were at risk of dying during that year but that all patients presenting in other years were at risk of dying during the whole year. Surgery began in 1970 (12 patients in 1970 and eight in 1971), but surgery was assumed to give protection for only 10 years. For surgical groups in each year survival was calculated to 1981 and to 1982, the difference being the mortality for 1981.

An annual mortality of 13.112% corresponds to a one year survival of 0.86888, a two year survival of $0.86888^2=0.75495$, a three year survival of $0.86888^3=0.65596$, and so on. For each yearly group of the surgical cohort the number of patients undergoing an operation was multiplied by the fraction so derived to calculate survival up to the beginning of 1981. The figure for 1981 was then multiplied by 0.86888 to calculate the number of patients surviving to the beginning of 1982. The difference between the 1982 and the 1981 figures represents those patients who would have died in 1981. Table V shows these figures.

TABLE V

Year of cohort	No of patients	Fraction surviving to 1981	No of patients surviving	
			To 1981	To 1982
1981	181/2	1.00000	91	79
1980	150	0.86888	130	113
1979	145	0.75495	110	95
1978	153	0.65596	100	87
1977	155	0.56995	88	77
1976	137	0.49522	68	59
1975	99	0.43029	43	37
1974	86	0.37387	32	28
1973	37	0.32485	12	10
1972	8	0.28225	2	2
Total			676	587

Difference=predicted deaths=89.

(b) Calculate, on the same basis, the predicted deaths of the surgical cohort in the year 1981 assuming a 2.838% annual mortality

Calculated deaths=28.

The reduction, due to surgery during 1972-81, in the number of deaths in 1981 therefore=89-28=61 patients.

(c) Calculate, on the same basis, the predicted deaths of the surgical cohort in 1974 assuming a 13.112% annual mortality

Calculated deaths=12.

(d) Calculate, on the same basis, the predicted deaths of the surgical cohort in the year 1974 assuming a 2.838% annual mortality

Calculated deaths=3.

The reduction, due to surgery during 1970-4, in the number of deaths in 1974 therefore=12-3=9 patients.

The contribution of cardiac surgery to the reduction in the number of deaths in 1981 compared with 1974 therefore=deaths prevented 1981-deaths prevented 1974=61-9=52.

We considered it appropriate to use identical calculations for predicting deaths in 1981 for both the 13.112% and the 2.838% annual mortality estimates. From year to year there is of course minor variation between the predicted and the actual deaths of the surgical cohort. For example, 20 deaths in 1981 would be predicted for the 1976-7 surgical cohort with a 13.112% annual mortality and seven with a 2.838% mortality. There were five actual deaths.

Because the Cleveland Clinic study presented only six year survival figures actuarial calculations could not be applied, and mortalities were calculated on the basis of an exponential decline in population. This should not introduce any significant error when studies have similar follow up periods of intermediate duration. The mortality for patients with angina, however, tends to be higher in the year of presentation than in subsequent years. Predictions from studies with a short period of follow up may therefore exaggerate the predicted longer term mortality.

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Psychiatric morbidity among spouses of patients with stroke

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Abstract

The medium term psychiatric morbidity of spouses of patients with stroke was evaluated one to three years after the event. Compared with a control group the spouses were more likely to be depressed ($p<0.005$) and had more physical symptoms ($p<0.01$). Depression increased with the severity of the stroke in the spouse ($p<0.05$) and with time during the three years. Regular contact with friends and neighbours protected spouses ($p<0.005$). Depressed spouses were more likely to be taking tranquillisers than non-depressed spouses ($p<0.0001$) but no more likely to be taking antidepressants. Social rehabilitation after stroke was less successful when the spouse was depressed.

Proper attention paid to spouses of patients with stroke might improve the prospects of these patients.

Introduction

Stroke is responsible for the disabilities of about 24% of severely handicapped people living in the community.¹ Stroke is also responsible for a large burden on those who care for these sufferers.² Some carers find it difficult to cope, which may have a profound effect on the rehabilitation of patients with stroke. After the first year there is little or no further recovery of physical function, but there are large differences among patients in the level of social rehabilitation that they achieve.³ It has been shown how an overprotective attitude by spouses may adversely affect rehabilitation.⁴ Possibly depression in spouses may also hinder progress in patients with stroke.

This study aimed at discovering the prevalence of depression and other psychiatric illness in the spouses of patients with stroke and seeing how far it correlated with poor progress by the patient. A further aim was to delineate factors which might make spouses more vulnerable to mental illness and so suggest strategies of prevention.

By comparing spouses with controls we also hoped to define the various disadvantages suffered by families of patients with stroke. In this paper we refer to spouses of patients with stroke simply as "spouses" and to patients with stroke as "patients."

Subjects and methods

We tried to identify all married people under 75 living in Stockport who had had a stroke between one and three years previously. Stockport is a largely urban area just outside Greater Manchester. Patients were identified from hospital records and by contact with general practitioners, district nurses, and the community physiotherapy service. In a prospective study in the same area all cases of stroke had been identified as they occurred through contact with general practitioners and hospitals.⁵ That study allowed an estimate of the number of cases that we were likely to find, and on this basis we think that over 95% of patients were eventually identified.

A total of 103 couples in whom both members were still alive were identified and interviewed at home. Two further couples refused interview.

A control group of 51 couples was selected from the age and sex registers of two group practices in Stockport. Neither member of these couples had had a stroke. Patients were selected at random from the practice lists and admitted to the study if they matched members of the index group for age, sex, and social class and were also married. None of the controls refused to be interviewed. There were no significant differences between the groups as regards past medical or psychiatric history or family history of mental illness. Interestingly, the control group had suffered more deaths of close relatives during the previous year ($p<0.05$).

INTERVIEWS

Spouses and controls were interviewed using the psychiatric assessment schedule,⁶ which is a slightly expanded version of the present state examination⁷ and has been used successfully in a previous survey.⁶ The technique permits psychiatric diagnosis both by computerised processing of the present state examination (CATEGO) and also by research diagnostic criteria.⁸ When depression was diagnosed it was assessed by the Hamilton rating scale.⁹ Physical symptoms were scored using the PILL rating scale.¹⁰ Social problems were assessed by means of the social stress and support interview.¹¹ Various specific questions were asked about such things as personal and medical history, help from neighbours and local services, tablets taken, and so on.

The physical state of the patient was assessed by the Barthel index.¹² Clinical assessment was made of speech and memory difficulties. The Frenchay activity index was used to assess the extent of the patient's activities.¹³ Patients were asked to assess themselves on an eight point visual scale on the following items: depression, sexual disability, irritability,

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