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Prognostic Value of a Coronary Artery Jeopardy Score

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The prognostic value of a coronary artery jeopardy score was evaluated in 462 consecutive nonsurgically treated patients with significant coronary artery disease, but without significant left main coronary stenosis. The jeopardy score is a simple method for estimating the amount of myocardium at risk on the basis of the particular location of coronary artery stenoses. In patients with a previous myocardial infarction, higher jeopardy scores were associated with a lower left ventricular ejection fraction. When the jeopardy score and the number of diseased vessels were considered individually, each descriptor effectively stratified prognosis. Five year survival was 97% in patients with a jeopardy score of 2 and 95, 85, 78, 75 and 56%, respectively, for patients with a jeopardy score of 4, 6, 8, 10 and 12. In multivariable analysis when only jeopardy score and number of diseased vessels were considered, the jeopardy score contained all of the prognostic information. Thus, the number of diseased vessels added no prognostic information to the jeopardy score. The left ventricular ejection fraction was more closely related to prognosis than was the jeopardy score. When other anatomic factors were examined, the degree of stenosis of each vessel, particularly the left anterior descending coronary artery, was found to add prognostic information to the jeopardy score.

Thus, the jeopardy score is a simple method for describing the coronary anatomy. It provides more prognostic information than the number of diseased coronary arteries, but it can be improved by including the degree of stenosis of each vessel and giving additional weight to disease of the left anterior descending coronary artery. Other factors, especially left ventricular function and the functional status of the patient, must also be considered when prognostic estimates are made.

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Since the earliest reports of coronary angiography, the extent of coronary artery narrowing has been considered a primary determinant of survival in patients with coronary artery disease. The early "natural history" studies from the Cleveland Clinic (1,2) categorized patients according to whether one, two or all three of the major coronary arteries were involved. Subsequent studies of patient outcome with nonsurgical (3–8) and surgical (9,10) therapy have relied on a similar classification of coronary anatomy. In addition, randomized clinical trials of coronary artery bypass grafting (11–14) have used the number of diseased coronary arteries as the basis for investigating the therapeutic benefit of surgery.

Although the simple division into one, two and three vessel disease has provided a convenient scheme for classifying patients, it may underestimate the potential importance of coronary anatomy as a prognostic factor. Some clinicians have proposed that the total amount of myocardium in "jeopardy" is one of the most important anatomic determinants of survival (15). The amount of myocardium in jeopardy can be defined as the sum of the amount of myocardium distal to each lesion in the coronary artery tree.

A coronary artery "jeopardy score" was developed to estimate the amount of myocardium at risk based on the usual distribution of the coronary arteries (16). The score was found to predict the degree of left ventricular dysfunction resulting from spontaneous or pacing-induced ischemia in patients with coronary artery disease (17) and to provide some insight into patient selection for left ventricular aneurysmectomy (18). It has not been tested previously, how-

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ever, as a predictor of outcome in the general population of patients with coronary artery disease. The purpose of this investigation was to determine: 1) the prognostic value of the jeopardy score, 2) the amount of prognostic information provided by the jeopardy score in addition to that provided by the number of diseased vessels, and 3) the adequacy of the jeopardy score as a descriptor of the prognostic importance of coronary anatomy.

Methods

Study patients. The study group included 462 consecutive patients who met the following criteria: 1) cardiac catheterization between January 1, 1974 and January 1, 1977; 2) significant coronary artery disease (≥75% luminal diameter narrowing of at least one major coronary artery) (19); 3) presence of suspected angina; 4) absence of congenital heart disease, previous cardiac surgery or significant valvular heart disease other than mitral regurgitation secondary to ischemic heart disease; 5) absence of 50% or greater stenosis of the left main coronary artery; and 6) absence of coronary artery bypass grafting as a form of therapy within 6 weeks after catheterization. Patients with left main coronary artery stenosis were excluded because their outcome with surgical and nonsurgical therapy has been described in detail (20–22). Furthermore, nonsurgically treated patients with left main coronary disease may represent a select population, since the standard of practice at our institution during this time was to perform surgery on these patients unless the coronary anatomy was unsuitable or comorbid diseases were present. Surgical patients were excluded because this intervention is designed to alter the significance of particular coronary lesions. The group of patients in the present study represents the broad spectrum of patients with coronary artery disease in terms of coronary anatomy, left ventricular function and symptomatic presentation. A summary of their baseline characteristics is shown in Table 1.

Table 1. Characteristics of Study Patients

	25th Percentile	Median	75th Percentile
Continuous Characteristics			
Age (yr)	45	51	57
Left ventricular end-diastolic pressure (mm Hg)	7	11	14
Ejection fraction (%)	37	51	58
Discrete Characteristics			
Male		81%	
Preinfarction angina		6%	
Progressive angina		34%	
Nocturnal angina		44%	
NYHA class IV angina		58%	
History of myocardial infarction		49%	
Peripheral vascular disease		6%	
Cerebrovascular disease		1%	
Q wave on electrocardiogram		39%	
Cardiomegaly on chest X-ray film		15%	
History of congestive heart failure		11%	

NYHA = New York Heart Association.

Calculation of jeopardy score. Coronary angiograms were performed in multiple left and right anterior oblique projections. They were interpreted prospectively by at least two of the same three experienced angiographers. The interpretation of each angiogram was also checked by the staff cardiologist responsible for the care of the patient. Differences of opinion were resolved by measuring the lesion, although objective measurements were not routinely used when subjective consensus was reached.

A detailed coronary artery tree diagram was completed prospectively for each patient during the study period. The coronary tree showed the exact location of each lesion in the consensus opinion of at least two of three experienced angiographers. An interobserver reliability study and pathologic correlation (23) have verified the accuracy of this process. The assignment to one, two or three vessel disease was done prospectively as reported previously (5). Lesions were graded as causing less than 25, 25, 50, 75, 95 or 100% narrowing of the luminal diameter. The degree of stenosis of a long lesion was estimated at its narrowest point. When more than one lesion was found in a single vessel, the most severe lesion was counted.

For purposes of determining the jeopardy score, the coronary circulation is considered as six arterial segments: the left anterior descending artery, the major anterolateral (diagonal) branch, the first major septal perforator, the left circumflex artery, the major circumflex marginal branch and the posterior descending artery. In patients with a left dominant system, the right coronary artery is assigned no points. Each segment with a 75% or greater luminal diameter reduction is given a score of 2 points (Fig. 1). Each vessel distal to a 75% or greater stenosis is also given a score of 2 points. For example, a patient with a significant stenosis of the left anterior descending artery proximal to the takeoff of the first major septal perforator and the first major anterolateral (diagonal) branch would be assigned a score of 6 points: 2 points for the left anterior descending artery and 2 points for each vessel distal to the lesion (septal perforator and anterolateral branch). Thus, the maximal number of possible points is 12. In our study, 75% or greater stenosis rather than a 50% or greater stenosis of a coronary artery was considered significant because of recent work (19) indicating that a 50% stenosis is of limited short-term prognostic significance.

The assignment of the coronary artery jeopardy score was made by two members of the study team (M.H. and H.P.) after reviewing the coronary artery tree. When a score could not be assigned with confidence, the film was re-

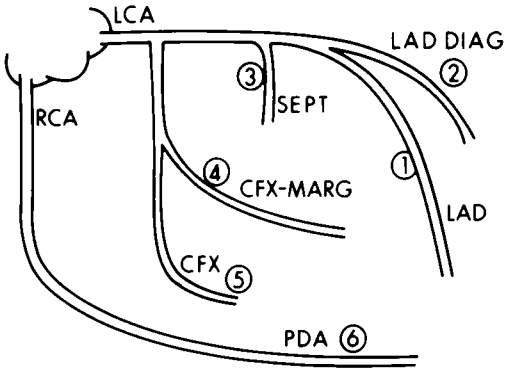


Figure 1. Diagram of coronary artery tree demonstrating the six segments counted in the jeopardy score. CFX = left circumflex coronary artery; CFX-MARG = major marginal branch of the left circumflex coronary artery; LAD = left anterior descending artery; LAD DIAG = major diagonal branch of the left anterior descending artery; LCA = left main coronary artery; PDA = posterior descending coronary artery; RCA = right coronary artery; SEPT = major septal perforating artery.

viewed. These determinations were made without knowledge of the eventual outcome of the patient.

Information system and statistical methods. The information system, definitions and method of follow-up study have been described previously (5). Briefly, a description of the history, physical examination, ancillary testing and cardiac catheterization is collected prospectively for every patient and entered into a computerized data bank. Follow-up, which is 99% complete, is done prospectively at regular intervals.

Correlations between jeopardy score and ejection fraction were evaluated using the Spearman rank correlation coefficient. Cumulative survival rates were calculated using Kaplan-Meier life table estimates from the day of cardiac catheterization (24). Patients who initially were treated medically and then underwent surgery were included in the life tables until the time of surgery and then were censored. Breslow's formulation of the Cox proportional hazards model was used to determine whether individual characteristics contributed independent prognostic information (25).

The prognostic information contained in each of three descriptions of coronary anatomy (jeopardy score, presence or absence of significant coronary disease in each artery and maximal percent stenosis in each coronary artery) was evaluated in two ways. First, each anatomic description was considered separately in the Cox model and a likelihood ratio chi-square statistic (LR χ^2) was generated (26). The magnitude of this statistic provides an index of the amount of prognostic information contained in a given variable. However, the statistic is also influenced by other factors such as sample size. Therefore, we also calculated an index of the prognostic "adequacy" or relative prognostic content of each anatomic description. This index was formed by taking the ratio of the individual LR χ^2 statistics, as just described, to the total LR χ^2 statistic resulting when two anatomic descriptions were included together in the Cox model (jeopardy score and each of the other two). The calculations were performed: 1) considering in the model only the coronary anatomic factors listed previously; and 2) after including relevant clinical variables in the model.

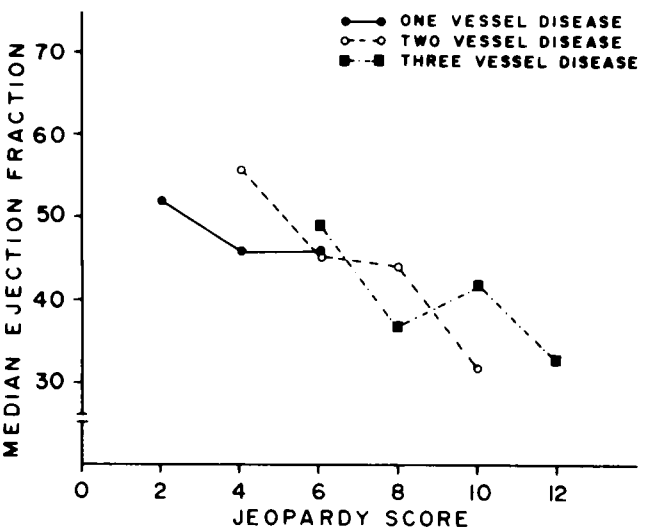
Results

Left ventricular function (ejection fraction). The relation of the jeopardy score to the median left ventricular ejection fraction for patients with a history of prior myocardial infarction is illustrated in Figure 2. Overall, a significant relation is found ($p = 0.01$). A trend toward decreasing ejection fraction with increasing jeopardy score is present when patients are grouped according to the number of diseased vessels; however, this trend reaches statistical significance only in patients with two vessel disease ($p = 0.008$).

Survival. The survival of the entire group of study patients according to the number of diseased vessels is shown in Figure 3A; survival according to the coronary artery jeopardy score is presented in Figure 3B. The figures demonstrate that both number of diseased vessels and jeopardy score effectively stratify prognosis. Corresponding yearly survival rates, the number of patients reaching each yearly interval and standard errors of survival estimates are presented in Table 2.

Figure 4 illustrates the prognostic information provided by the jeopardy score after the number of diseased vessels is known. The 5 year survival is 97% for patients with one vessel disease and a jeopardy score of 2, 100% for patients with a jeopardy score of 4 and 84% for patients with a

Figure 2. Relation between jeopardy score and left ventricular ejection fraction when patients with a previous myocardial infarction are grouped by number of diseased vessels.



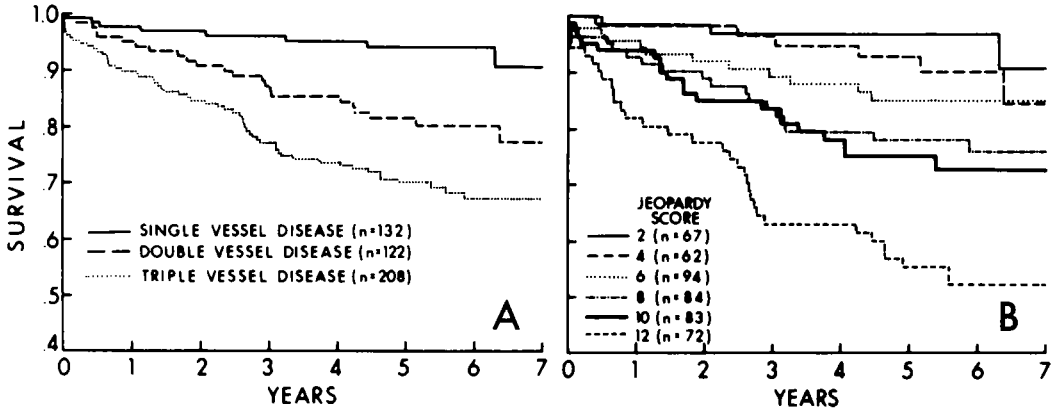


Figure 3. Survival stratified by number of diseased vessels (**A**) and by jeopardy score (**B**).

jeopardy score of 6 (Fig. 4A). For patients with two vessel disease (Fig. 4B), the 5 year survival is 86, 82, 80 and 72% for patients with a jeopardy score of 4, 6, 8 and 10, respectively. For patients with three vessel disease (Fig. 4C), the 5 year survival is 100% for the 16 patients with a jeopardy score of 6, 77% for those with a jeopardy score of 8, 75% for those with a jeopardy score of 10 and 55% for those with a jeopardy score of 12. These data ± standard errors of the estimates are presented in Table 3.

Figure 5 demonstrates the lack of additional prognostic information provided by the number of diseased vessels once the jeopardy score is known. The survival of patients with three vessel disease and a jeopardy score of 6 is shown to be greater than that of patients with one and two vessel disease and a jeopardy score of 6 (Fig. 5A). Patients with a jeopardy score of 8 or 10 (Fig. 5B and C) are shown to have similar survival curves, regardless of the number of diseased vessels. Table 4 provides details of these graphs at yearly follow-up intervals.

When the jeopardy score and the number of diseased coronary arteries are compared using the Cox proportional hazards model, the jeopardy score contains all of the prognostic information (χ^2 = 11.2). The number of diseased vessels adds no significant prognostic information (χ^2 = 0.1).

Importance of other clinical factors. Table 5 displays the results when other important prognostic characteristics from the history, physical examination, chest X-ray film, electrocardiogram and cardiac catheterization are added to the model. Although the left ventricular ejection fraction is the single most important characteristic, the jeopardy score provides independent prognostic information (χ^2 = 5.4, p = 0.02). Descriptors of peripheral vascular disease, noninvasive indicators of myocardial dysfunction and the characteristics of the patients' ischemic symptoms also contribute independent prognostic information.

Adequacy of jeopardy score. To test the adequacy of the jeopardy score as a descriptor of coronary anatomy, the presence of significant coronary artery disease in each vessel and the maximal percent luminal diameter narrowing in each coronary artery were studied with the Cox model. When only the presence of significant disease in each vessel and the jeopardy score are included in the model, jeopardy score is more important, and little information is added by the

Table 2. Effects of Number of Diseased Vessels and Jeopardy Score on Survival Rates

	Follow-up Time					
Group	n	1 Year Survival	n	3 Year Survival	n	5 Year Survival
One vessel disease	129	0.98 ± 0.01	112	0.96 ± 0.02	101	0.94 ± 0.02
Two vessel disease	115	0.95 ± 0.02	98	0.87 ± 0.03	85	0.82 ± 0.04
Three vessel disease	181	0.90 ± 0.02	141	0.77 ± 0.03	123	0.70 ± 0.03
Jeopardy score						
2	68	0.99 ± 0.01	61	0.97 ± 0.02	50	0.97 ± 0.02
4	61	0.98 ± 0.02	56	0.97 ± 0.02	49	0.93 ± 0.03
6	88	0.96 ± 0.02	67	0.89 ± 0.03	61	0.85 ± 0.04
8	75	0.93 ± 0.03	63	0.84 ± 0.04	56	0.78 ± 0.05
10	79	0.94 ± 0.03	62	0.84 ± 0.04	54	0.76 ± 0.05
12	59	0.81 ± 0.5	44	0.63 ± 0.06	37	0.55 ± 0.06

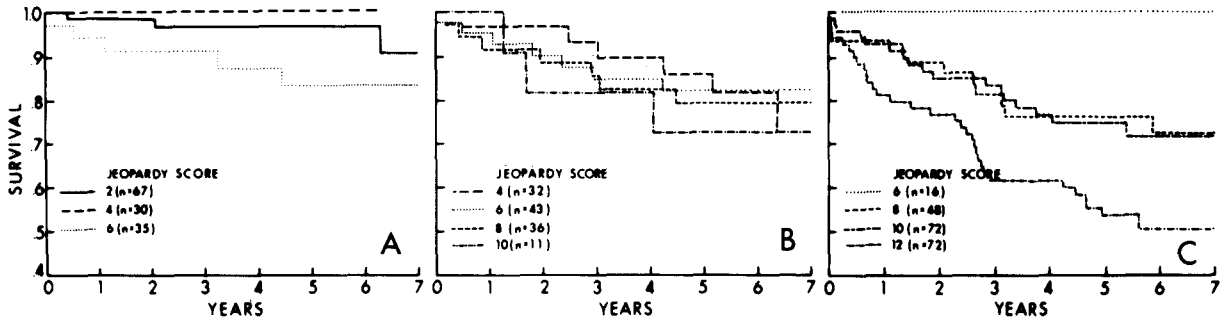


Figure 4. Survival stratified by jeopardy score in patients with one vessel coronary disease (**A**), patients with two vessel coronary disease (**B**) and patients with three vessel coronary disease (**C**).

knowledge of the presence of disease in the individual vessels. The square of the percent luminal diameter narrowing is a more potent prognostic factor than the percent narrowing itself. When only the square of the luminal diameter narrowing in each vessel and the jeopardy score are included in the model, the amount of narrowing in the left anterior descending artery ($\chi^2 = 8.63$, $p = 0.003$) and of the right coronary artery ($\chi^2 = 5.89$, $p = 0.02$) each add independent prognostic information. When the square of the luminal diameter narrowing is added to the entire model (including history, physical examination, chest X-ray film, electrocardiogram, cardiac catheterization and jeopardy score), only the amount of narrowing in the left anterior descending artery adds independent prognostic information ($\chi^2 = 4.59$, $p = 0.03$). Thus, one major inadequacy of the jeopardy score is its failure to consider the degree of narrowing in each stenotic lesion, particularly in the left anterior descending artery.

When only the presence or absence of significant disease in each vessel is considered in conjunction with the jeopardy score, without adjusting for other clinical variables (Table 6), the jeopardy score accounts for 88% of the prognostic information provided by combining these variables, while the presence of significant disease accounts for 74% of the prognostic information. By this measure, the jeopardy score is a more "adequate" descriptor of coronary anatomy than is the simple description of whether or not each vessel is significantly diseased. When the jeopardy score and the square of the percent luminal diameter narrowing in each vessel are considered, the jeopardy score is only 74% "adequate" and the percent stenosis is 90% "adequate." After adjusting for other clinical variables, the jeopardy score and the presence or absence of significant disease provide similar amounts of prognostic information, but the square of the percent stenosis provides more information than does the jeopardy score.

Discussion

The jeopardy score is a simple method of estimating the amount of myocardium at risk. The clinician can calculate it easily while viewing the results of coronary cineangiog-

Table 3. Correlation of Jeopardy Score and Survival When Number of Diseased Vessels Is Known

	Follow-up Time					
Group	n	1 Year Survival	n	3 Year Survival	n	5 Year Survival
One vessel disease						
Jeopardy score 2	68	0.99 ± 0.01	60	0.97 ± 0.02	50	0.97 ± 0.03
Jeopardy score 4	30	1.0	30	1.0	30	1.0
Jeopardy score 6	34	0.94 ± 0.04	31	0.91 ± 0.05	23	0.84 ± 0.07
Two vessel disease						
Jeopardy score 4	31	0.97 ± 0.04	28	0.93 ± 0.05	24	0.86 ± 0.07
Jeopardy score 6	42	0.95 ± 0.03	33	0.85 ± 0.06	29	0.82 ± 0.06
Jeopardy score 8	33	0.92 ± 0.05	29	0.86 ± 0.06	25	0.80 ± 0.07
Jeopardy score 10	11	1.0	10	0.81 ± 0.12	9	0.72 ± 0.13
Three vessel disease						
Jeopardy score 6	16	1.0	15	1.0	15	1.0
Jeopardy score 8	46	0.94 ± 0.03	35	0.82 ± 0.06	33	0.77 ± 0.06
Jeopardy score 10	68	0.93 ± 0.03	53	0.84 ± 0.04	46	0.75 ± 0.05
Jeopardy score 12	59	0.82 ± 0.05	44	0.63 ± 0.06	37	0.55 ± 0.06

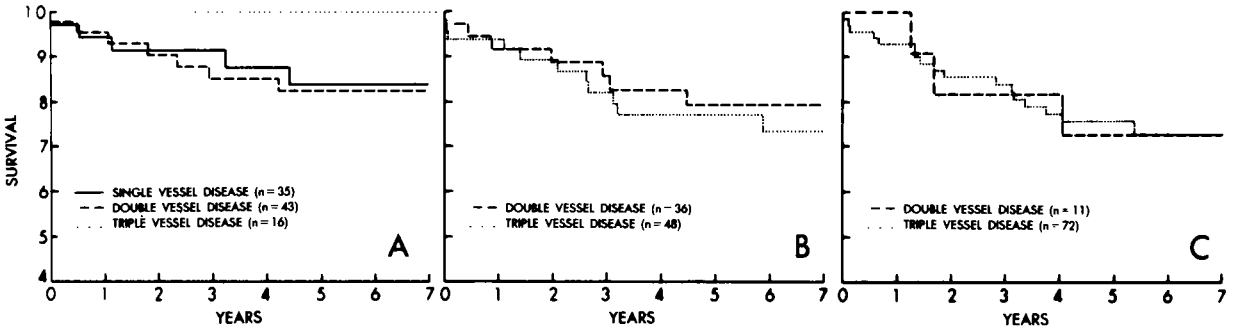


Figure 5. Survival stratified by number of diseased vessels in patients with jeopardy score of 6 (**A**), 8 (**B**) and 10 (**C**).

raphy. The jeopardy score was developed on the basis of assumptions about the importance of myocardium at risk (15). However, until now, it has not been tested as a prognostic factor in a large number of patients.

Jeopardy score versus number of diseased vessels. Our study demonstrates that the jeopardy score is superior to the number of diseased vessels as an indicator of survival in patients with coronary artery disease. The improvement in prognostic stratification probably results from the weighting of the jeopardy score, so that proximal lesions are given more weight than distal lesions and so that the left anterior descending artery and left circumflex artery are weighted more heavily than the right coronary artery. A previous study (17) had indicated that the weighting was appropriate because the amount of deterioration in left ventricular function during spontaneous or pacing-induced ischemia was related to the jeopardy score. Other studies also indicate that proximal lesions are of greater prognostic significance than more distal lesions in the same vessel. A proximal left anterior descending lesion has frequently been found at autopsy in patients dying of myocardial infarction (27). In patients with prior myocardial infarction (28) and one vessel coronary artery disease (29), the proximal left anterior descending coronary lesion has been found to be associated with an adverse prognosis.

Left ventricular function. A central theme of the jeopardy score is that the amount of myocardium that is damaged in acute infarction is related to the amount "in jeopardy" as estimated from the coronary anatomy. The finding that the left ventricular ejection fraction is related to the jeopardy score in patients with a previous myocardial infarction supports this concept. A human autopsy study (30) recently found that the amount of infarcted myocardium was directly proportional to the amount of myocardium distal to the vascular tree of the infarct-related vessel.

Survival. The multivariable analyses in our study demonstrate that in patients without left main disease, the left ventricular ejection fraction is a more potent predictor of survival than is coronary anatomy. Similar results were obtained in the Coronary Artery Surgery Study (8). Although jeopardy score adds independent prognostic information, other factors must be considered in predicting the survival of patients with coronary artery disease. In particular, the presence of peripheral vascular disease, the severity of anginal symptoms and noninvasive indicators of left ventricular dysfunction must be evaluated (5).

Our study group represents a broad spectrum of patients with coronary artery disease (Table 1). Many of the patients had progressive symptoms (58% New York Heart Association functional class IV, 6% preinfarctional angina, 34%

Table 4. Correlation of Number of Diseased Vessels and Survival When Jeopardy Score Is Known

	Follow-up Time					
Group	n	1 Year Survival	n	3 Year Survival	n	5 Year Survival
Jeopardy score 6						
One vessel disease	34	0.94 ± 0.04	31	0.91 ± 0.05	23	0.84 ± 0.07
Two vessel disease	42	0.95 ± 0.03	33	0.85 ± 0.06	31	0.82 ± 0.07
Three vessel disease	16	1.0	16	1.0	16	1.0
Jeopardy score 8						
Two vessel disease	33	0.92 ± 0.05	29	0.86 ± 0.06	25	0.79 ± 0.07
Three vessel disease	46	0.94 ± 0.03	35	0.82 ± 0.06	33	0.77 ± 0.06
Jeopardy score 10						
Two vessel disease	11	1.0	10	0.82 ± 0.12	9	0.73 ± 0.13
Three vessel disease	68	0.93 ± 0.03	53	0.84 ± 0.04	46	0.76 ± 0.05

Table 5. Relative Prognostic Importance of Invasive and Noninvasive Patient Characteristics*

	Chi-square	p
Left ventricular ejection fraction	18.9	<0.0001
Peripheral vascular disease	8.9	0.003
Characterization of angina (progressive versus stable; frequency; nocturnal; preinfarction)	5.4	0.02
Noninvasive indicators of myocardial damage (S_3 gallop, cardiomegaly, previous MI by history or ECG, ST-T wave abnormality on ECG)	5.0	0.03
Luminal diameter narrowing of left anterior descending artery	4.2	0.04
Age	<3.84	>0.05
Sex	<3.84	>0.05
Mitral insufficiency	<3.84	>0.05
Left ventricular end-diastolic pressure	<3.84	>0.05

*The jeopardy score adds a chi-square value of 5.4 when considered jointly with the other characteristics listed above. Number of diseased vessels adds no additional prognostic information to the variables in this table. ECG = electrocardiogram; MI = myocardial infarction.

progressive angina), and functional testing was not done in many of these highly symptomatic patients. For this reason, the prognostic value of functional testing is not addressed by this study. The exercise treadmill test (31), exercise radionuclide angiography (32) or exercise thallium scintigraphy (33) may add prognostic information beyond the coronary anatomy in particular subsets of patients.

Other anatomic factors. The finding that the maximal percent luminal diameter narrowing in the left anterior descending and right coronary arteries adds independent prognostic information to the jeopardy score is consistent with physiologic principles. The jeopardy score only considers the location of the lesion, and all lesions of 75% or greater luminal diameter narrowing are considered equivalent. Coronary flow, however, is limited by the percent reduction in patency (34), and "tighter" lesions may be more likely to become completely occluded (35). The results of our analysis also indicate that the degree of stenosis of the left anterior descending artery should be given greater weight in the jeopardy score. Other factors, such as the presence of serial lesions, the length of the lesions and the presence of collateral vessels, also may be important in the relation between coronary anatomy and mortality. Furthermore, quantitative measurement would certainly provide a more adequate estimate of the prognostic significance of each lesion. However, with the addition of each new factor, the calculation of the risk based on coronary anatomy becomes more cumbersome. As the difficulty in calculation increases, the likelihood that the score will achieve wider clinical usage decreases.

Previous coronary anatomy scores. Other coronary anatomy scores have been published on the basis of clinical observation or laboratory data. Humphries et al. (36) devised a scoring system in which each major arterial system was assigned a score of 1 to 5, with equal weight given to each artery. Although the score was found to be related to survival, no attempt was made to determine whether differential weighting of the left anterior descending, left circumflex and right coronary arteries would have provided a more accurate stratification of patient outcomes. Leamon et al. (37) recently proposed a coronary anatomy score that was based purely on laboratory investigation. This score has not been tested in a clinical setting. Gensini (38) has devised an elaborate system of scoring the coronary arteries that can be calculated as part of a computerized cardiac catheterization report. This grading system more effectively stratified prognosis in a large group of patients than did the number of diseased vessels (39). The relative weights for each of the anatomic factors were derived from clinical intuition. The possible improvement in quantitative prog-

Table 6. Prognostic Information in Jeopardy Score Relative to the Presence of Significant Disease or the Maximal Percent Stenosis of the Major Coronary Vessels

		"Adequacy" of				
Adjustments	Description of Coronary Lesions	I Jeopardy Score Alone χ^2	II Stenosis Alone χ^2	III Combined χ^2	Jeopardy Score*	Stenosis†
None	Presence or absence of ≥75% stenosis‡	42.6	35.7	48.6	0.88	0.74
	Maximal percent stenosis§	42.6	51.8	57.5	0.74	0.90
Other clinical variables and ejection fraction	Presence or absence of ≥75% stenosis	17.6	17.6	22.9	0.77	0.77
	Maximal percent stenosis	17.6	22.0	26.1	0.67	0.84

*Column I divided by column III; †column II divided by column III; ‡three binary variables (left anterior descending, left circumflex and right coronary arteries); §three variables describing percent stenosis squared (left anterior descending, left circumflex and right coronary arteries).

nostic ability if different weighting factors had been used was not tested.

Summary. The jeopardy score is a simple, effective scoring system for quantifying the amount of myocardium at risk. The clinician can use the jeopardy score to provide a more accurate prediction of survival than can be accomplished with using the number of diseased coronary arteries. However, the jeopardy score does not consider all the important aspects of coronary anatomy; consideration of the percent luminal diameter narrowing of the vessel, additional weighting of the left anterior descending coronary artery and other anatomic factors may further improve the ability of the jeopardy score to predict outcome. Other factors, particularly left ventricular function and the functional status of the patient, must also be considered in the evaluation of the prognosis of patients with coronary artery disease.

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References

1. Brushke AVG, Proudfit WL, Sones FM. Progress study of 590 consecutive non-surgical cases of coronary disease followed 5–9 years. I. Cine arteriographic correlations. Circulation 1973;47:1147–53.
2. Brushke AVG, Proudfit WL, Sones FM. Progress study of 590 consecutive non-surgical cases of coronary disease followed 5–9 years. II. Ventriculographic and other correlations. Circulation 1973; 47:1154–63.
3. Burggraf GW, Parker JO. Prognosis in coronary artery disease: angiographic, hemodynamic, and clinical factors. Circulation 1975; 51:146–56.
4. Oberman A, Jones WB, Riley CP, Reeves TJ, Sheffield LT, Turner ME. Natural history of coronary artery disease. Bull NY Acad Med 1972;48:1109–25.
5. Harris PJ, Harrell FE Jr, Lee KL, Behar VS, Rosati RA. Survival in medically treated coronary artery disease. Circulation 1979;60:1259–69.
6. Reeves TJ, Oberman A, Jones WB, Sheffield LT. Natural history of angina pectoris. Am J Cardiol 1974;33:423–30.
7. Hammermeister KE, DeRouen TA, Dodge HT. Variables predictive of survival in patients with coronary disease. Selection by univariate and multivariate analyses from the clinical, electrocardiographic, exercise, arteriographic, and quantitative angiographic evaluations. Circulation 1979;59:421–30.
8. Mock MB, Ringquist I, Fisher LD, et al. Survival of medically treated patients in the Coronary Artery Surgery Study (CASS) registry. Circulation 1982;66:562–8.
9. Cosgrove DM, Loop FD, Sheldon WC. Results of myocardial revascularization: a 12 year experience. Circulation 1982;65(suppl II):II-37–43.
10. Lawrie GM, Morris GC. Survival after coronary artery bypass surgery in specific patient groups. Circulation 1982;65(suppl II):II-43–8.
11. Cooperative Unstable Angina Study Group. Unstable angina pectoris: National Cooperative Study Group to compare surgical and medical therapy. II. In-hospital experience and initial followup results in patients with one, two, and three vessel disease. Am J Cardiol 1978;42:839–48.
12. European Coronary Surgery Study. Prospective randomised study of coronary artery bypass surgery in stable angina pectoris. Lancet 1980;2:491–4.
13. Takaro T, Hultgren HN, Detre KM, Peduzzi P. The Veterans Administration Cooperative Study of stable angina: current status. Circulation 1982;65(suppl II):II-60–7.
14. CASS Principal Investigators and Their Associates. Coronary Artery Surgery Study (CASS): a randomized trial of coronary artery bypass surgery. Survival data. Circulation 1983;68:939–50.
15. Hutter AM. Is there a left main equivalent? (editorial). Circulation 1980;62:207–11.
16. Dash H, Johnson RA, Dinsmore RE, Hawthorne JW. Cardiomyopathic syndrome due to coronary artery disease. I. Relation to angiographic extent of coronary artery disease and to remote myocardial infarction. Br Heart J 1977;39:733–9.
17. Johnson RA, Zir LM, Harper RW, et al. Patterns of haemodynamic alteration during left ventricular ischaemia in man. Relation to the angiographic extent of coronary artery disease. Br Heart J 1979;41:441–51.
18. Chia-Sen Lee D, Johnson RA, Boucher CA, Wexler LF, McEnany MT. Angiographic predictors of survival following left ventricular aneurysmectomy. Circulation 1976;56:12–8.
19. Harris PJ, Behar VS, Conley MJ, et al. The prognostic significance of 50% coronary stenosis in medically treated patients with coronary artery disease. Circulation 1980;62:240–8.
20. Cohen MV, Cohn PF, Herman MV, Gorlin R. Diagnosis and prognosis of main left coronary artery obstruction. Circulation 1972;45(suppl I):I-57–65.
21. Conley MJ, Ely RL, Kisslo J, Lee KL, McNeer JF, Rosati RA. The prognostic spectrum of left main stenosis. Circulation 1978;57:947–52.
22. Lim JS, Proudfit WL, Sones FM Jr. Left main coronary arterial obstruction: long-term followup of 141 nonsurgical cases. Am J Cardiol 1975;36:131–5.
23. Trask N, Conley MJ, Kong Y, et al. Accuracy and interobserver variability of coronary cineangiography: a comparison with postmortem evaluation. J Am Coll Cardiol 1984;3:1145–54.
24. Kaplan EL, Meier P. Nonparametric estimates from incomplete observations. J Am Stat Assoc 1958;53:457–81.
25. Breslow N. Covariance analysis of censored survival data. Biometrics 1974;30:89–99.
26. Cox DR. Regression models and life tables. J Roy Stat Soc (series B) 1972;34:187–220.
27. Schuster EH, Griffith LSC, Bulkley BH. Preponderance of acute proximal left anterior descending coronary arterial lesions in fatal myocardial infarction: clinicopathologic study. Am J Cardiol 1981; 47:1189–96.
28. Taylor GJ, Humphries JO, Mellits ED, et al. Predictors of clinical course, coronary anatomy and left ventricular function after recovery from acute myocardial infarction. Circulation 1982;62:960–70.
29. Califf RM, Tomabechi Y, Lee KL, et al. Outcome in one-vessel coronary artery disease. Circulation 1983;67:283–90.
30. Lee JT, Ideker RE, Reimer KA. Myocardial infarct size and location in relation to coronary vascular bed at risk in man. Circulation 1981;64:526–34.
31. Weiner DA, McCabe CH, Ryan TJ. Prognostic assessment of patients with coronary artery disease with exercise testing. Am Heart J 1983;105:749–55.
32. Pryor DB, Harrell FE Jr, Lee KL, et al. Prognostic indicators from radionuclide angiography in medically treated patients with coronary artery disease. Am J Cardiol 1984;53:18–22.
33. Gibson RS, Watson DD, Craddock GB, et al. Prediction of cardiac events after uncomplicated myocardial infarction: a prospective study comparing predischarge exercise thallium-201 scintigraphy and coronary angiography. Circulation 1983;68:321–36.
34. Gould KL, Lipscomb K. Effects of coronary stenosis on coronary flow and reserve and resistance. Am J Cardiol 1974;34:48–55.

35. Rattleubeul W, Smith LR, Rogers WJ, Mantle JA, Rackley CE, Russell RO. Quantitative coronary arteriography. Coronary anatomy of patients with unstable angina pectoris reexamined 1 year after optimal medical therapy. Am J Cardiol 1979;43:699–707.

36. Humphries JO, Kuller L, Ross RS, Friesinger GC, Page EE. Natural history of ischemic heart disease in relation to arteriographic findings: a twelve year study of 224 patients. Circulation 1974;49:489–97.

37. Leamon DM, Brower RW, Meester GT, Serruys P, van den Brand M. Coronary artery atherosclerosis: severity of the disease, severity of angina pectoris, and compromised left ventricular function. Circulation 1981;63;285–92.

38. Gensini GG. Coronary arteriography. In: Braunwald E, ed. Heart Disease: A Textbook of Cardiovascular Medicine. Philadelphia: WB Saunders, 1980.

39. Gensini G, Giambartolomei A, Esente P, Archambault T, Shaw C. Natural history of coronary artery disease. Angiographic findings in 830 patients: importance and significance of the angiographic coronary score (abstr). Circulation 1982;66(suppl II):II-369.