Statistically Important Features In Myocardial Infarction

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A certain number of clinical features in acute Myocardial Infarction were studied, and the hospital mortality was analyzed. Nine features were considered for each patient. Five easily measurable features were statistically important for constructing a Coronary Prognostic Index(CPI). The index provides: (i) a practical method of classifying each patient, on admission, in a prognostic group, (ii) a prediction for chances of survival or death following an acute Myocardial Infarction, an (iii) and easy route for evaluating the effect of new treatment measures when applied to the different prognostic groups.

1. INTRODUCTION

The incidence of acute Myocardial Infarction (M.I.) has increased in the developing countries over the last three decades or so. It is becoming one of the most common causes of death, among others, in the medical practice.

The relative prognostic significance of certain adverse clinical features in acute M.I. has prompted many investigators, like Peel et al. (1962), Huglies et al.(1963),Norris et al.(1969i, 1969ii), Chapman & Gray (1973), and Henning et al. (1979),to construct a Coronary Prognostic Index (C.P.I.) from which a mortality prediction could be reached for each patient. We conducted our study aiming: (1) to analyze the different contributing adverse clinical features to hospital mortality in acute M.I.;(2) to construct a C.P.I. for our patients; and (3) to throw light on the validity and applicability of such an index.

2. DATA AND DIAGNOSTIC OF PATIENTS

Over a period of two years, 356 patients were admitted to the Coronary Care Unit (CCU) at Al-Jahra hospital, in Kuwait. Two hundred of those patients, with acute M.I. (172 males and 28 females) were considered in this study. Acute M.I. was assumed if two of the following criteria were met: (1) characteristic prolonged chest pain suggestive of cardiac origin, (2) characteristic Electro Cardio Graphic (ECG) changes of acute M.I. and (3) significant elevation of serum creatine phosphokinase, glutamic oxalo acetic transaminase and lectic dehydrogenase. Each patient received was examined, and a chart was filled containing the personal data of the patient, the diagnostic needed to checkthe case and, in addition, to the necessary medical steps of the follow up until the patient is discharged from the hospital within two weeks, Aysha et al. (1985). A summary of all the prognostic features checked is given in Table 1.

3. CONSTRUCTION OF THE C.P.I.

All the adverse clinical features which found to be associated with mortality from acute M.I. were coded. Step-wise multiple regression analysis was applied in order to estimate the prognostic effect of each feature. Based on the step-wise regression analysis, it was found that the following adverse features were statistically significant in building up the index. Those features are: Age,Type and site of infarction, Arrhythmias including Heart Block, Systolic Blood Pressure on admission (SBP), and evidence of Left Ventricular Failure (L.V.F). Also, tests for dependence or independence were used to differentiate between the needed variables and the redundant ones. A weight was assigned to each major feature depending on the features' relative contribution. Each major feature was further subdivided and a weight was given on a decreasing or increasing scale relative to its importance in the feature (Table 2).

The C.P.I. score was found by adding up the results of multiplying the weight of the main feature (X) with the value of the subdivision of that feature Y, whether it was the actual SBP on admission, the grade of LVF, the site of M.I., the type of arrhythmia or the age of the patient in years (Table 2).

C.P.I. score = $X_1Y_1+X_2Y_2+X_3Y_3+X_4Y_4+X_5Y_5+ 40$
(40 is the constant in the equation).

In order to know how we calculate the C.P.I.

score of each patient on admission, we take the following example:

On admission, a patient was found to have: Age 70 years (Y_1=70, X_1=0.4), mild L.V.F. (Y_2=2, X_2=4), an unclassified M.I. (Y_3=1,X_3=-1),S.B.P. > 150 (Y_4=10,X_4=-2), and multiple arthythmia (Y_5=7, X_5=3). Based on the data we have

C.P.I. score = 70(0.40) + 2(4) + 1(-1)+10(-2) + 7(3) + 40 = 76.

In calculating the C.P.I. for each patient, it was possible to divide the patients into three prognostic groups with increasing mortality ranging from 0% (when the index score is less than 50) to 62.5% (when the index score is 70 or more). The higher is the score, the greater was the chance of death.

4. **RESULTS**

Based on the foregoing analysis and construction of the C.P.I., the following features were found to be of significant importance to mortality. Those feature are: (1) Age,(see fig.1),(2) the evidence of left Ventricular Failure, (3) Type and Site of the infarction, (4) Systotic Blood Pressure on admission, (see fig.2), and (5) Arrhythmias including heart block.

1. Age: The mean age was 56 years(30-90 years)with standard deviation of 13 years. The mortality was 11% below the age of 50 and rose gradually as the age advanced. It also rose steeply to 50% beyond the age of 70(Fig.1). The age contributes significantly to mortality (X^2=27 with 5 d.f,p = .0001).

2. Evidence of Left Ventricular Failure: Patients were classified into four categories of L.V.F. according to physical and radiological findings; no LVF, mild, moderate, and severe L.V.F. No heart failure was recognised if no crepitations could be heard with clear lung fields on CXR. Mild L.V.F. considered to be present, if basal crepitations and upper lobe venous dilatation on CXR were present. Moderate L.V.F. recognised if widespread cripitations were present clinically and perihilar and lower lung fields infiltrates were apparent radiologically. Severe LVF was recognised when frank, generalised, and severe crepitations with the classical radiological findings were present. No CXRs could be taken in 4 patients who had died within 1-2 hours of admission and they were assessed clinically, otherwise.

There was no statistical difference in mortality in the absence or the presence of mild LVF. The mortality raised with the moderate and severe grades of LVF with 30 and 43% respectively. The prognostic importance of L.V.F. is apparent (X^2=12.39 with 3 d.f.p=.006) and especially in the presence of anterior M.I.

3. Type and Site of Infarction: Transmural M.I. was considered to be present if the pathologic Q wave is present (>_.04 sec. duration and the amplitude is greater than 25% of the ensuing R wave), with the expected ST elevation and the subsequent T changes. Non-transmural MI was recognised if the ECG showed no changes or changes not consistent with transmural MI, but the other two criteria were present. In this study, Transmural MI showed 19% mortality compared to 3% in those cases with non-transmural MI. On further analysis, three positions were recognised with different mortality; subendocardial infarction (4.5%), anterior transmural MI (24.5%) and inferior transmural MI (9%). Those cases of infarctions, where the anatomical position was obscured by the presence of Left Bundle Branch Block (LBBB), the mortality was 37%, and no mortality was found in cases with near normal ECG changes. The study showed that the site of M.I. is important in the mortality (X^2=14.1 with 4 d.f.p. = .007).

4. Systolic B.P. on Admission: The prognostic significance of the level of the S.B.P. on admission is shown in Table 1 and Fig.2. It is evident that S.B.P. was a major adverse clinical feature (X^2=49.1 with 8 d.f. p < .0001). Most of the cases who had an unrecordable S.B.P. or readings below 80mm Hg. had died with mortality of 83% and 75% respectively. The mortality percentage declined gradually with the rise of SBP (Fig.2). Although the high SBP on admission was a reassuring feature, a second gradual rise of mortality was found with higher systolic BP readings (Fig. 2).

5. Arrhythmias Including Heart Block: The different arrhythmias encountered during the first 24 hours are shown in Table 1 with the relative mortality percentages. This adverse clinical feature

contributes greatly to the mortality percentage and with a strong correlation (X^2 = 12.3 with 10d.f.p < .0001). The results showed that all cases with high grades of heart block had the worse prognosis with a mortality of 37.5-71%. Complete heart block (CHB) showed the poor prognosis with a mortality of 71%, following by a complete LBBB or monofascicular block with 57 and 50% respectively. The occurrence of supraventricular and ventricular ectopic beats has a mortality of 4 to 8%, but those who developed ventricular tachycardia (V.T.) or fibrillation (V.F.) had mortality of 50%. If the patients who were resuscitated successfully were considered, the mortality percentage will definitely rise to above 80%. All primary V.F. were resuscitated successfully, but those who had cardiogenic shock or heart failure had succumbed.

5. CONCLUSION

There is a general agreement that CCUs have a definite role to play in the management of patients with acute M.I. The CCUs have improved the outcome and reduced the overall mortality. This is well explained in the various mortality rates before and after the establishment of CCU in many centers world-wide. The hospital mortality before CCU facilities in Kuwait was 26.9%, Yousuf and Qaraman (1969), and our study showed that a definite improvement in CCU patients has occured and the mortality found to be 18.5%. It is compatible with other studies with mortalities of 14-27%, Norris et al. (1968,1969i,1969ii), Chapman and Gray (1973), and Yousuf and Qaraman (1969). The relative contribution of sex, hypertnesion, IHD, DM, and stress hyperglaycaemia found in our study are of less statistical significance. The association of age, S.B.P., site of M.I., arrhythmias including heart block, and LVF with mortality was studied and analysed.

Many investigators had found the increasing mortality is a constant finding with increasing age and the presence of cardiogenic shock, heart failure and arrhythmia including heart block separately or in combination. All carry a bad prognosis, Emara and Al-Yusuf (1977), Yousuf et al. (1970). Our findings regarding the age (Table 1 and Fig. 1) are comparable with other investigators, Latting and Silverman (1980), Thanavaro et al. 1980), and show a constant increasing mortality with increasing age. There was a steep rise of mortality rather than a linear increase from 22% in the age group 60-69 years to 48% in 70-79 years age group. This observation was shared with a previous study conducted in Kuwait. This can be explained partly by the fact that only elderly patients with complications are brought for medical attention, whereas younger patients seek medical advice earlier whatever their general conditions .

This study shared the views, with Norris et al. (1969i), Thanavaro et al.(1980), and that mortality varies with the site of infarction. There is a statistical difference between the survival of patients with subendocardial M.I.(4.5%) and inferior M.I. (9%) compared to the anterior M.I. (24.5%) and those anatomical site obscured by the presence of LBBB (37%). This is in contrast with earlier authors who showed no such difference between anterior and inferior M.I.s because subendocardial M.I.s were not distinguished as a distinct entity.

Arrhythmias are common complications in acute M.I. with an incidence of 14-98% (most of the references), it is well recognised that the mortality from major arrhythmia has been reduced significantly with the establishment of CCU and the effective drug therapy. This is due to the earlier detection of minor arrhythmia and its effective termination, the prevention and prompt arrest major arrhythmia by electrical or chemical means.

On the other hand, heart block did not share this degree of improvement in mortality in spite of the present effective pacing facilities, which is related to the severity of the myocardial damage, Henning and Gilpin (1979), Latting and Silverman (1980), and Thanavaro et al. (1980).

Also it is known that hypotension carries an adverse prognostic feature and our results are in agreement with other studies, Norris et al. (1969i) Chapman and Gray (1973), Henning et al.(1979), Norris et al. (1968), Yousuf and Qaraman (1969), Lattring and Silverman(1980), and Thanavaro et al. (1980). Moderate and severe LVF found in this study tend to increase the mortality and it is in

agreement with other studies, Batter et al.(1980) There was a good correlation between the C.P.I. values and the mortality. Increasing values of CPI were accompained by increasing mortality (Fig.3). There was a highly significant correlation between the CPI and the mortality rate (r = o.976). It is possible to predict the mortality rate for each patient, by calculating the CPI from the first five adverse clinical features (Table 1). It is also practical to select pts. of high score who survived the first few days for specific therapeutic measures while in hospital or specific follow-up after their dis-charge.

Above all, we claim that our method of calculating the CPI, is an easy, rapid and practical procedure for mortality prediction.

Table 1. Features Considered in the study

Prognostic Feature	Total of Patients	Mortality%
1.Age		
30.39	13(0)*	0
40.49	54(6)	11
50.59	49(5)	10
60.69	48(8)	22
70.79	21(10)	48
>80	15(8)	53
2.L.V.F.		
No L.V.F.	106(14)	13
Mild	53(8)	15
Moderate	20(6)	30
Severe	21(9)	43
3.M.I.Type and site		
Normal ECG	8(0)	0
Subendocardial	22(1)	4.5
Inferior	53(5)	9
Anterior	98(24)	24.5
Unclassified	19(7)	37
4.S.B.P.		
Unrecordable	6(5)	83
70.79	8(5)	75
80.89	7(4)	57
90.99	11(3)	27
100.109	20(3)	15
110.119	17(1)	6
120.129	40(3)	7.5
130.139	31(4)	13
104.149	44(3)	16
>_150	16(1)	6

()* No of cases died

Table 1, Cont'd

5.Arrhythmia including heart block		
No arrhythmia	90(4)	4
A.F.	6(1)	17
VPCs	52(4)	8
VT/VF	10(5)	50
Multiple Arrhythmia	14(8)	57
MFB	6(3)	50
BFB	8(3)	37.5
LBBB	7(4)	57
CHB	7(5)	71
6.Sex		
Male	172(30)	17
Female	28(7)	25
7. L.H.D.		
Present	86(18)	21
Absent	114(19)	17
8.Hypertension		
Present	62(14)	23
Absent	128(18)	18
9.Diabetes Mellitus	45(11)	19.5
Stress hyper-glycaemia	32(2)	6
Non-diabetics	123(24)	24

()* No of cases died.

Table 2: Subdivision of Each Significant Feature and the Corresponding Prognostic Weight.

	Y	X		Y	X
1.Age	Years	o.4	5.Arrhythmia (heart block)		+3
2.L.V.F.		+4	No arrhythmia	1	
None	1		Atrialectopics	1	
Mild	2		SVT	2	
Moderate	3		AF	4	
Severe	4		Nodalectopics	1	
3.M.I.		-1			
Normal E.C.G.	6		Nodalarrhythmia	2	
Subendocardial	5		Occasional VPCs	1	
Inferior	1		Frequent FVPCs	2	
Septai	3		Multifocal VPC	3	
Anterior	2		Ront	4	
Unclassified	1		VT/VF	6	
4.S.B.P.		-2			
Unrecordable	1		Heart Block:		
70-79	2		First degree	1	
80-89	3		Second degree	5	
90-99	4		CHB	9	
100-109	5		RBBB	4	
110-119	6		LBBB	8	
120-129	7		LAH	6	
130-139	8		LPH	6	
140-149	9		BHB	5	
>150	10		Multiple arrhythmia	7	

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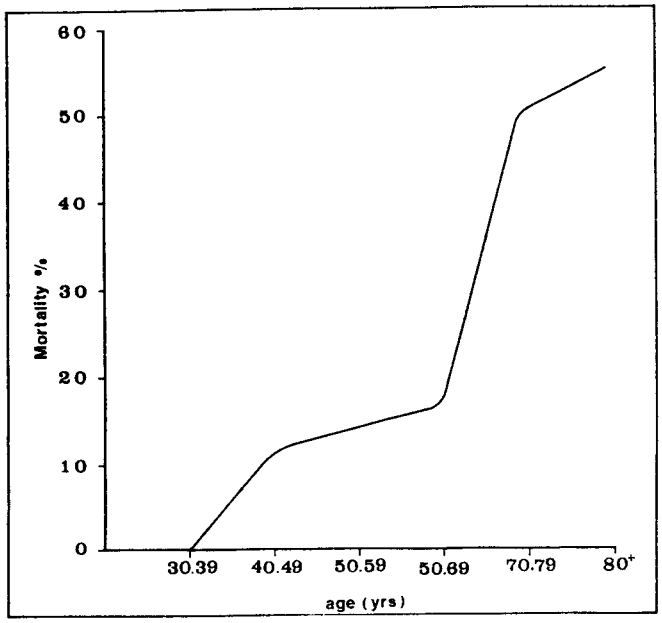

Fig. 1 — Relation of age and hospital mortality from acute M.I.

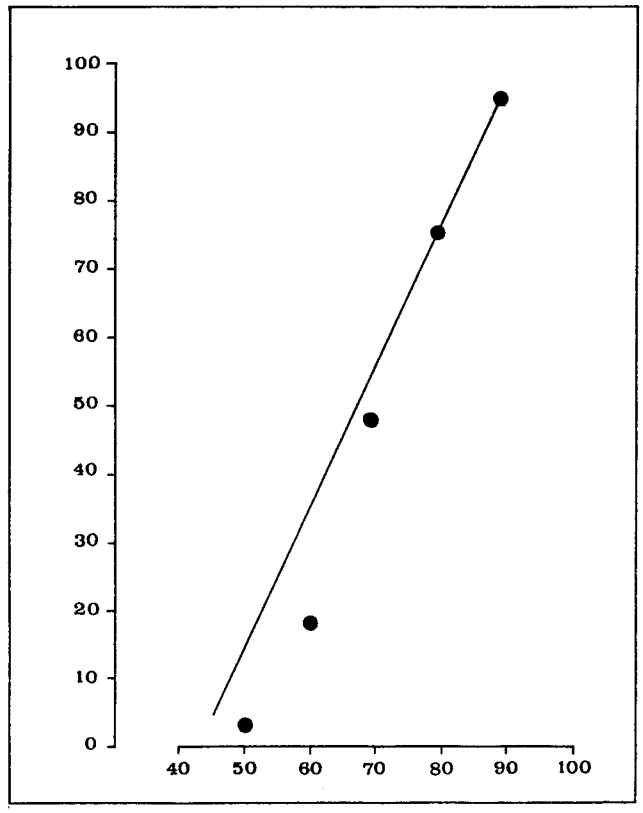

Fig. 3 — Linear correlation of hospital mortality and C P I score.

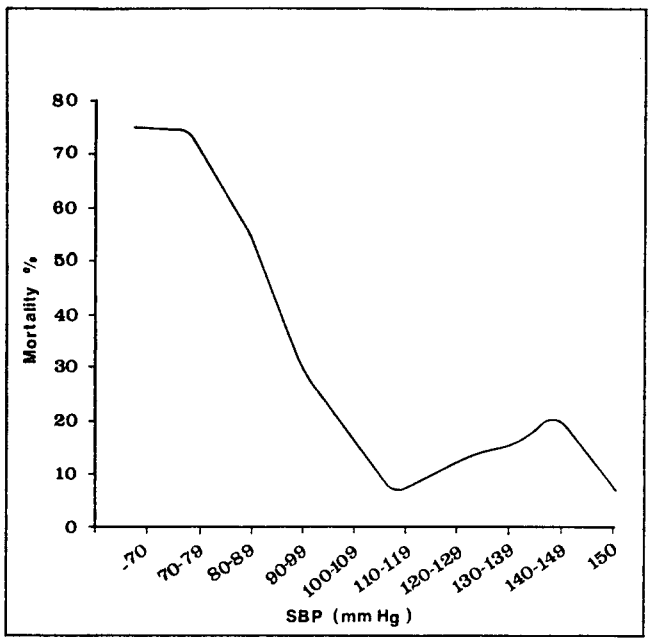

Fig. 2 — Relation of SBP on admission and hospital mortality from acute M.I.