CORONARY RISK ANALYSIS - A STITCH IN TIME

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ABSTRACT

Coronary heart disease (CHD) is the major cause of sudden death amongst adults throughout the globe. Though the prevalence of CHD is increasing steadily all over, CHD amongst Indians is peculiar in the sense that it is more prevalent, more severe and appears at younger age. Development of CHD depends upon the status of various coronary risk factors in one's body. It has been observed that to measure the impact of risk factors for the cardiac health of a person, collective impact of all the known risk factors taken together should be calculated rather than individual risk factors. DEBEL (Defence Bio-Engineering and Electro-Medical Laboratory) is developing a cardiac risk analyser to calculate the absolute coronary risk of an individual in next 2,5 or 10 years and help in managing his coronary risk status.

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KEY WORDS : Absolute coronary risk; Coronary heart disease; Coronary risk factors.

Introduction

CHD continues to be the leading cause of total deaths amongst adult population [1]. Although CHD has got a worldwide distribution, there is a lot of variation in the incidence/prevalence of CHD amongst various ethnic groups, races and nations. Amongst Indians the prevalence of CHD is very high as compared to other ethnic groups of the world as observed by recent studies [2,3]. One study observed the prevalence of CHD in Asian Indian adults aged 30-69 years as 10.2% [4], whereas in white men of the same age group it was observed to be only 2.5% [5]. Also, the high rates of CHD amongst Indians are in sharp contrast to the low rates of CHD among other Asians like Japanese [6] in whom the incidence of CHD is low despite high rates of smoking and hypertension and also amongst Chinese in whom the prevalence of CHD is considerably lower than the Indians [7]. One study observed much higher rate of CHD, even in Indian women as compared to women of Japan, China, Malaysia, France, USA, Scotland and white ethnic origin [8,9]. Further, CHD in Indians shows unusual features as it is more severe and appears at an earlier age than other ethnic groups [3].

The incidence of CHD correlates well with the presence or absence of what are called risk factors. Diabetes, high serum cholesterol, high blood pressure (BP), cigarette smoking, low High density lipoprotein (HDL), high triglycerides (TG), high fibrinogen lev-

els, left ventricular hypertrophy (LVH) in ECG, central obesity, male sex have been reported as most important risk factors favouring the development of CHD [10]. Controlling these factors by patient education, diet, exercise, change of life style and medicines will certainly decrease the incidence of CHD [3] and therefore, morbidity and mortality as proved by recent randomized controlled trials and meta analysis [11]. As CHD is multifactorial in its origin, it is important, in estimating the risk of developing or having recurrent CHD, to consider all risk factors simultaneously.

Traditionally, risk factor guidelines have been concerned with unifactorial assessment in the management of hypertension or hyperlipidemia and this has resulted in undue emphasis being placed on individually high risk factors than the overall level of risk based on all factors taken together [12,13].

Secondly, in clinical practice where a patient of CHD can be under the care of specialists in cardiology, hypertension, lipids and diabetes in the same hospital, too often the cardiologist restricts his view to coronary artery anatomy and the heart's function, and other specialists to management of single risk factors and by doing so can overlook the other major determinants of a patient's prognosis.

Thirdly, it is very important to keep a record of patient's data and keep track of a patient's health status to see whether the coronary risk of a patient is increasing or decreasing or whether the treatment given is effective or not. Also, maintaining a record

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will help in analysing the data of all patients for research. Keeping all the above mentioned factors in mind a coronary risk analyser is being developed by DEBEL, Bangalore, to calculate the absolute coronary risk of an individual.

DEBEL's coronary risk analyser will perform the following functions :

- a. Calculate the absolute coronary risk of an apparently healthy looking individual.
- b. Calculate the future coronary risk of a known case of CHD.
- c. A detailed analysis of a coronary risk profile of an individual indicating role of various risk factors contributing to his calculated absolute coronary risk.
- d. Categorizing a patient into risk categories as shown in Table - 5.
- e. Provide guidelines to the patient and / or physician regarding risk management.
- f. Guide, regarding cardiac risk status, the persons attached to high-risk professions.
- g. Store all the patient's data in the memory of PC for meta analysis and research.
- h. Function as a tool of education to the medical students.

Description

DEBEL's coronary risk analyser will be a windows based software. Visual basic programming language is planned to be used for the development of the software. The software will have an option to register the hospital or medical centre's name at the time of set up, along with the name of the doctor in-charge. The software will have the user friendly menus to enter all elaborated medical parameters of a person as name, age, sex, address, occupation, family history, personal history, general and systemic examination findings and laboratory investigations. It will calculate the absolute coronary risk of an individual based on the following parameters :

(a) Quantitative input

- i. Age and sex of individual
- ii. Diabetic status
- iii. Blood pressure
- iv. Smoking status
- v. Total cholesterol
- vi. HDL cholesterol
- vii. LVH in ECG
- viii. Fibrinogen levels

(b) Qualitative input

- i. Family history
- ii. Truncal obesity
- iii. Type A personality
- iv. Triglyceride levels
- v. Lipoprotein a
- vi. Homocysteine levels

The factors mentioned as qualitative input are taken into account to achieve a quantitative result in categorising a person into categories of low risk, mild risk, moderate risk, high risk or very high risk based on the Joint British Recommendations on prevention of CHD in clinical practice [11] and Framingham heart study results [14,16]. An authentic reproduction of algorithms and mode of calculation of absolute coronary risk as furnished by them is shown in Table 1,2,3 and 4. Since risk factors are regarded as qualitative input, nobody has been able to quantify the magnitude of cardiac risk imposed by them, they will not contribute to the quantification of cardiac risk status of a person as on now. But presence of one or more of these risk factors will prompt the system to indicate their presence in the final report. The system will be installed in a hospital with cardiology centre, and will be validated on a large population. All necessary changes identified during the process of validation will be incorporated into the system.

Secondly, as the magnitude of various risk factors may behave slightly differently on different population groups, the emphasis of the result will not be on the exact calculation of the absolute coronary risk, but to put the person in various risk categories. The system will calculate the absolute coronary risk as percentage over next 2,5 or 10 years with an indication whether the individual falls under the category of low, medium, high or very high risk as shown in Table-5. As the science of coronary risk factors is an ongoing process and from time to time new coronary risk factors are identified, the provision to include the new coronary risk factors is provided in the system for calculation of absolute coronary risk. A provision of "What if analysis" will also be kept in the system. i.e. indicate to a person as to what extent his or her absolute coronary risk will be reduced if he or she controls one or more modifiable risk factors.

Scope for Armed Forces

DEBEL's coronary risk analyser may be useful for our Armed Forces as under :

1. It may be utilised to access the absolute coronary risk status of a new recruit in routine medical ex-

TABLE 1

Coronary heart disease risk prediction chart for patients without known CAD

1. Find points for each factor

Women				Men				HDL-C (mg/dl)	Points	Total-C (mg/dl)	Points	SBP (mm Hg)	Points
Age (yr)	Points	Age (yr)	Points	Age (yr)	Points	Age (yr)	Points						
30	-12	47-48	5	30	-2	57-59	13	25-26	7	139-151	-3	98-104	-2
31	-11	49-50	6	31	-1	60-61	14	27-29	6	152-166	-2	105-112	-1
32	-9	51-52	7	32-33	0	62-64	15	30-32	5	167-182	-1	113-120	0
33	-8	53-55	8	34	1	65-67	16	33-35	4	183-199	0	121-129	1
34	-6	56-60	9	35-36	2	68-70	17	36-38	3	200-219	1	130-139	2
35	-5	61-67	10	37-38	3	71-73	18	39-42	2	220-239	2	140-149	3
36	-4	68-74	11	39	4	74	19	43-46	1	240-262	3	150-160	4
37	-3			40-41	5			47-50	0	263-288	4	161-172	5
38	-2			42-43	6			51-55	-1	289-315	5	173-185	6
39	-1			44-45	7			56-60	-2	316-330	6		
40	0			46-47	8			61-66	-3				
41	1			48-49	9			67-73	-4				
42-43	2			50-51	10			74-80	-5				
44	3			52-54	11			81-87	-6				
45-46	4			55-56	12			88-96	-7				
Other													
Cigarettes		4											
Diabetic (male)		3											
Diabetic (female)		6											
ECG-LVH		9											

2. Sum points for all risk factors (subtract minus points from total)

Age + HDL-C + Total - C + SBP + Smoker + Diabetes + ECG - LVH = Points total

3. Look up risk corresponding to point total :

Probability

Points	5 yrs	10 yrs	Points	5 yrs	10 yrs	Points	5 yrs	10 yrs	Points	5 yrs	10 yrs
≤ 1	< 1%	< 2%	10	2%	6%	19	8%	16%	28	19%	33%
2	1%	2%	11	3%	6%	20	8%	18%	29	20%	36%
3	1%	2%	12	3%	7%	21	9%	19%	30	22%	38%
4	1%	2%	13	3%	8%	22	11%	21%	31	24%	40%
5	1%	3%	14	4%	9%	23	12%	23%	32	25%	42%
6	1%	3%	15	5%	10%	24	13%	25%			
7	1%	4%	16	5%	12%	25	14%	27%			
8	2%	4%	17	6%	13%	26	16%	29%			
9	2%	4%	18	7%	14%	27	17%	31%			

4. Compare with average 10 year risk

Probability

Age (yr)	Women	Men
30-34	< 1%	3%
35-39	< 1%	5%
40-44	2%	6%
45-49	5%	10%
50-54	8%	14%
55-59	12%	16%
60-64	13%	21%
65-69	9%	30%
70-74	12%	24%

Zero points for each "no". ECG-LVH - Electrocardiographic left ventricular hypertrophy; HDL-C = High density lipoprotein cholesterol; SBP - systolic blood pressure; Total-C = total cholesterol

TABLE 2
Risk of CAD event, stroke or cerebrovascular disease death in women with existing CAD

Age (yr)	Points	Total-C (mg/dl)	Points by HDL-C (mg/dl)								SBP	Points (mm Hg)	
			25	30	35	40	45	50	60	70			80
35	0	160	4	3	3	2	2	1	1	0	0	100	0
40	1	170	4	3	3	2	2	2	1	1	0	110	0
45	2	180	4	3	3	2	2	2	1	1	0	120	1
50	3	190	4	4	3	3	2	2	1	1	1	130	1
55	4	200	4	4	3	3	2	2	2	1	1	140	2
60	5	210	4	4	3	3	3	2	2	1	1	150	2
65	6	220	5	4	4	3	3	2	2	1	1	160	2
70	7	230	5	4	4	3	3	2	2	1	1	170	3
75	7	240	5	4	4	3	3	3	2	2	1	180	3
		250	5	4	4	4	3	3	2	2	1	190	3
		260	5	5	4	4	3	3	2	2	1	200	3
		270	5	5	4	4	3	3	2	2	2	210	4
		280	5	5	4	4	3	3	3	2	2	220	4
Other		280	5	5	4	4	3	3	3	2	2	220	4
Diabetes	3	290	5	5	4	4	4	3	3	2	2	230	4
Smoking	3	300	6	5	4	4	4	3	3	2	2	240	4
												250	4

Total points	2-yr probability (%)	Average 2 year risk in women with CAD	
0	0	Age (yr)	Probability (%)
2	1	35-39	< 1
4	1	40-44	< 1
6	1	45-49	< 1
8	2	50-54	4
10	4	55-59	6
12	6	60-64	8
14	10	65-69	12
16	15	70-74	12
18	23		
20	35		
22	51		
24	68		
26	85		

amination at the time of first entry into service.

- It may serve defence personnel posted in high-tension jobs such as pilots, navigators and other sensitive posts to keep their coronary risk under control and in their management. Especially, facility of "What if analysis" of DEBEL's coronary risk analyser can be utilised for this purpose.
- Before posting a person to very remote and relatively inaccessible areas such as NorthEast, Antarctica expeditions etc. his cardiac risk analysis may be done by the system as in general, cardiac emergencies are the most common medical emergencies and immediate medical specialist help may not be available at these areas. Secondly, transporting an individual with a sudden heart attack will be again an extra burden over already limited resources and manpower available at the

places.

Scope for Hospitals and General Practitioners

- A useful tool to keep the health track of their patients as described earlier.
- To fix guidelines to manage their cardiology patients and improve their health status.
- To judge effectiveness of a treatment regime.
- To help analyse data and research activities.

Scope for Medical Colleges

A useful tool to teach medical students, the importance of coronary risk factors and risk factor management in normal persons and persons with CHD.

In practice, physicians deal with the patient as one individual and not just a conglomerate of various organs and diseases. As clusters of coronary risk factors may have a multiplicative effect, an individual with a

TABLE 3

Risk of CAD event, stroke or cerebrovascular disease death in men with existing CAD

Age (yr)	Points	Total-C (mg/dl)	Points by HDL-C (mg/dl)								SBP (mm Hg)	Points
			25	30	35	40	45	50	60	70	80	
35	0	160	6	5	4	4	3	2	1	1	0	0
40	1	170	6	5	5	4	3	3	2	1	0	1
45	1	180	7	6	5	4	4	3	2	1	1	1
50	2	190	7	6	5	4	4	3	2	2	1	2
55	2	200	7	6	5	5	4	4	3	2	1	2
60	3	210	7	6	6	5	4	4	3	2	1	3
65	3	220	8	7	6	5	5	4	3	2	2	3
70	4	230	8	7	6	5	5	4	3	3	2	4
75	4	240	8	7	6	6	5	4	4	3	2	4
		250	8	7	6	6	5	5	4	3	2	4
		260	8	7	7	6	5	5	4	3	2	5
		270	9	8	7	6	6	5	4	3	3	5
		280	9	8	7	6	6	5	4	4	3	5
Other		290	9	8	7	7	6	5	4	4	3	6
Diabetes	1	300	9	8	7	7	6	6	5	4	3	6
											250	6

Total points 2-yr Probability (%)

0	2
2	2
4	3
6	5
8	7
10	10
12	14
14	20
16	28
18	37
20	49
22	63
24	77

Average 2 year risk in men with CAD

Age (yr)	Probability (%)
35-39	< 1
40-44	8
45-49	10
50-54	11
55-59	12
60-64	12
65-69	14
70-74	14

TABLE 4

Independent effect of fibrinogen : Risk adjustment

Fibrinogen level (mg/dl)	Multiplication factor for probability estimate obtained from Table 2	
	Male	Female
< 235	0.83	0.77
235-335	1.00	1.00
> 335	1.20	1.30

TABLE 5

Grading the patients into five categories depending upon 10 year risk status

Grade	10 year absolute risk
Low	< 5%
Mild	5-10%
Moderate	10-20%
High	20-40%
Very high	> 40%

number of modest coronary risk factors may be at considerably greater risk than a subject with very high single risk factor [14], which can be assessed by calculating absolute risk over a period of next 5 or 10 years for an individual. In a survey undertaken by British Cardiac Society, it was observed that the risk factor recording and management was less than optimal and there is considerable potential to improve secondary prevention practice [15]. The coronary risk analyser being developed by DEBEL will help the medical fraternity in overcoming this weakness and will serve as an important tool to decrease morbidity and mortality from CHD.

Since this is a system under development, we welcome suggestions from readers to modify or add any of the parameters.

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