

Etiologic Factors Related to Coronary Arteriosclerosis of Inhabitants in a Mountain Area in Japan

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Recently, there has been an increasing tendency of ischemic heart disease in Japanese rural communities as well as in urban areas. It has also been stated that effective preventive plans and countermeasures are urgently needed.

Our municipal hospital has performed a mass screening on inhabitants in a secluded mountainous area in Japan over the past 5 years. From the results of the mass screening, we reported¹⁾ three years ago at the occasion of this scientific meeting that ischemic changes of ECG at rest were significantly higher in frequency in females of 40-60 years of age than in males of the same generation with a difference of up to 10%. Also this high frequency of ischemic changes in women in the mountainous area might have been explained by the fact that more than 33% of the incidence of obesity can be found in women over 40 years of age, and these obese women have problems in lipid metabolism with relatively high atherogenic index.

It is certain that ischemic changes of ECG have also been caused by such factors as hypertension, hypercholesterolemia and other risk factors relating to individual health care. In addition, some social factors can contribute to ischemic changes of ECG. These social factors can be explained as follows: Japanese agriculture is now rapidly changing largely due to mechanization with introduction of farming machines. Many farmers are now working in such side business fields as factory work, construction and local community offices. These changes have apparently affected women in farming villages as they have to take care of variable works left by their husbands, which are much tougher to handle than before. However, it may be impertinent to blame only those social factors as causes of increasing ischemic heart diseases without considering personal responsibilities of individual health care.

In this communication, we would like to report the results of the mass screening performed over the past two years and to discuss possible preventive plans and countermeasures against the ischemic heart diseases in the secluded mountainous area.

Materials and Method

The results of mass screening performed on inhabitants over 30 years of age in the same district as the previous report have been reviewed to pick up any person with obesity, hypertension, hyperlipemia and high atherogenic index. Incidences of such abnormalities also categorized by the sex and age have been correlated with the incidence of ischemic changes on ECG at rest.

In this survey, methods of calculation for the obestic and atherogenic indeces have been defined as in Table 1. The obestic, the hypertriglyceridemic and the high atherogenic have also been determined as shown in Table 2. Hypertension has been determined by the diagnostic criteria offered by WHO as is shown in Table 3. Ischemic changes on ECG were evaluated by the degree of ST-T change except the changes of the strain pattern and of the cardiac hypertrophy.

Table 1

●OBESITIC INDEX(%) : O. I.

$$O. I. = \frac{B. W. - S. B. W.}{S. B. W.} \times 100$$

$$S. B. W. = (B. W. - 100) \times 0.9$$

B. W. : Body Weight

S.B.W. : Standard Body Weight

●Atherogenic Index : A. I.

$$A. I. = \frac{\text{Total Cholesterol}}{\text{HDL Cholesterol}}$$

Table 2

Obesity : Obestic Index > 120%

Hypertriglyceridemia :

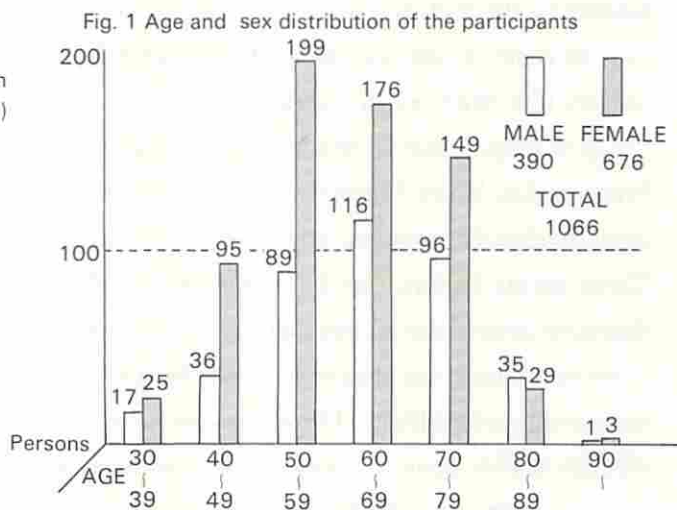
Serum Level of Triglyceride
> 150mg/dl

High Atherogenic Condition :

Atherogenic Index > 5.0

Table 3 Diagnostic Criteria of Hypertension
(offered by WHO)

Diast. B.P. (mmHg)	Syst. B.P. (mmHg)		
	< 140	140 160	> 160
< 90	Normal		
90-95	Border line		
> 95			Hypertension



Results

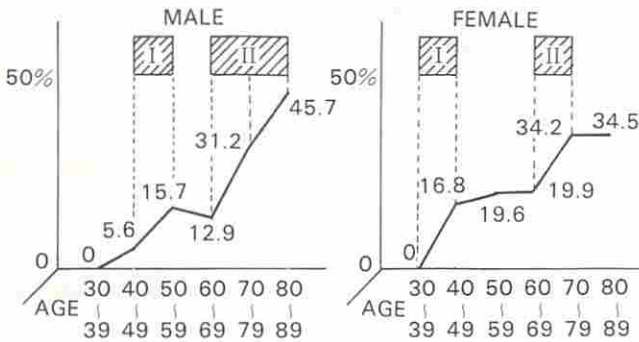
1. Age distributions of the participants

1066 persons (male : 390, female : 676), constituting 77.6% of 1737 objective inhabitants, participated in this mass screening. The participants' average age was 57.6 years (male: 59.7, female 56.3). As to the age and sex distribution in Fig. 1.90% of the participants are noted between 40-79 years of age.

2. Incidence of the Ischemic Findings on ECG (ECG (+) ratio) by the Age and Sex.

Fluctuation of ECG (+) ratios by the age and sex is shown in Fig. 2. ECG (+) ratio tends to increase with aging in both sexes. In this figure, I and II mark the periods where the ratio increases remarkably, showing a more than 10% increase in the next age group.

Fig. 2 Change in the incidence of the ischemic findings on ECG (ECG(+))ratio



I and II (the shaded periods) mark the periods where the ratio increases remarkably, showing a more than 10% increase in the next age group.

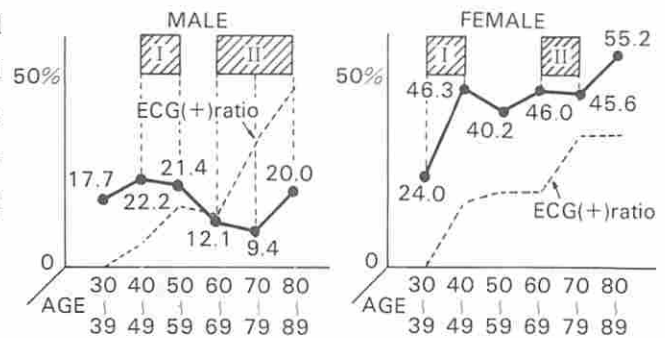
where the ratio increases remarkably, showing a more than 10% increase in the next age group. Either sex has two periods of marked increase of ischemic changes on ECG, but no remarkable increase can be seen at any other periods. For males, the first period is located in 40-50 year olds and the second period in 60-80 year olds. For females, the first is noted in 30-40 year olds and the second in 60-70 year olds.

In order to investigate the causes of these remarkable increases of ECG (+) ratio, incidences of obesity, hypertension, hypertriglyceridemia and high Atherogenic Index have been sought considering aging and sex, and then the results have been compared with the fluctuation of ECG (+) ratio.

3. Incidence of the obestic and ECG (+) ratio

As is shown in Fig. 3, in the latter half of the second period for males and the first period for females, increased incidence of the obestic persons is mostly parallel to the increase of ECG (+) ratio.

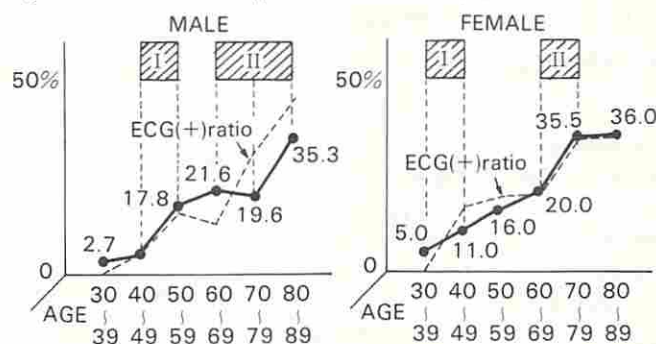
Fig. 3 Incidence of the obestic and ECG(+))ratio



4. Incidence of the hypertensive and ECG (+) ratio

As is shown in Fig. 4, in males, the increase of ECG (+) ratio in the first period and the second period is almost parallel to the increased incidence of the hypertensive in the same period. As for females, only in the second period, is a parallel relation noted between the ratio and the incidence.

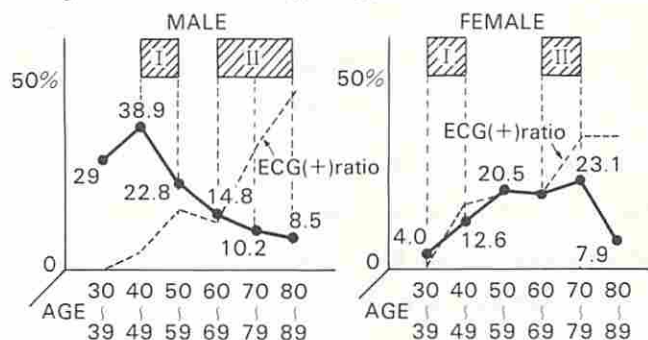
Fig. 4 Incidence of the hypertensive and ECG(+)ratio



5. Incidence of the hypertriglyceridemic (serum level of triglyceride > 150mg/dl) and ECG (+) ratio

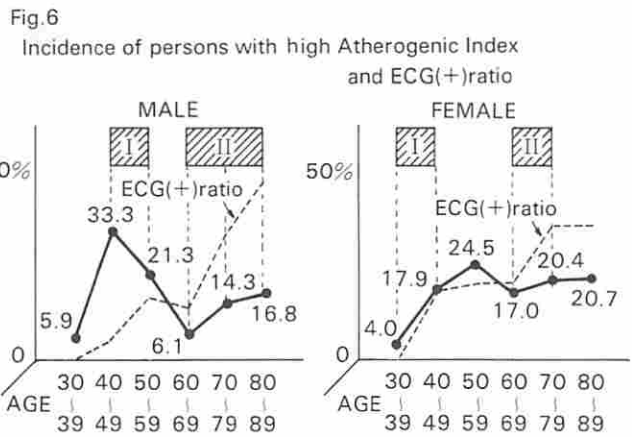
Fig. 5 shows the incidence of the male hypertriglyceridemic to be at its highest level of 38.9% in the 40-49 year old age group, tending to decrease with age. However, until 50-59 year old age group, this incidence continues at the relatively high level of more than 20%. Although this incidence of the hypertriglyceridemic does not show direct relationship with the first and the second increases of ECG (+) ratio, possible indirect relationship with some delayin time may be suggested. For females, ECG (+) ratio has shown a similar fluctuation to that of the hypertriglyceridemic until the age of 60. However, fluctuation of incidence of the female hypertriglyceridemic, unlike that of the male, has maintained the level of around 20% until the seventies age group, in the eighties, it dipped down to a level of around 8%, similar to that of the male. No direct correlation has been observed with the second period of increase, but possible indirect relationship (time-delayed) with it might also be suggested.

Fig. 5 Incidence of the hypertriglyceridemic and ECG(+)ratio



6. Incidence of persons with high Atherogenic Index (Atherogenic Index > 5.0) and ECG (+) ratio

Fig. 6 shows, the incidence of males with high Atherogenic Index (A.I.) increases remarkably in the forties age group, up to the maximal value of 33.3%. In the first period of ECG (%) ratio increasing, the incidence of the high A. I. decreases and continues to do so until the age of 60. However, at the age of 40-50, incidence of the high A. I. continues high at the level of more than 20%, which might suggest that this incidence has a correlation with the first and the second increase of ECG (+) ratio but with some delay in time. On the other hand, the females show no such remarkable increase. However, the incidence of the high A.I. demonstrates a similar fluctuation to ECG (+) ratio during the age of 30-60. After reaching the maximal level of 24.5% in the fifties age group, the incidence of the high A. I. maintains a similar level of 20% until the eighties age group.



There is no direct relationship between the second period's of ECG (+) ratio and the incidence of the high Atherogenic Index. However, there is still a possible correlation between the above two items with some delay in time, as the incidence of the high A. I. continues at the level of close to 20% during the ages of 40-70.

From the above:

- (1) In males, it can be presumed that the first remarkable increase of ischemic ECG changes at the age of 40-50 has an apparent correlation with the increased incidence of the hypertensive, and the second increase at the age of 70-80 has a significant correlation with both hypertension and obesity.
- (2) In females at the age of 30-40, the first marked increase of ischemic ECG changes has been well correlated with obesity and the second increase at the age of 60-70 has been caused possibly by the increased incidence of the hypertensive.
- (3) The remarkable increases of ischemic ECG changes at the periods of 40-50 years and 60-80 years in males and 60-70 years in females may be correlated with both incidences of the hypertriglyceridemia and the high Atherogenic Index preceding each period by 10 to 20 years.

Conclusions:

Relations of ischemic ECG changes by age and sex to incidences of obesity, hypertension and hyperlipidemia were analyzed from the results of mass screening, which was carried out on inhabitants in a sparsely populated mountainous area with heavy snow fall in Japan.

From the results of this survey, either sex has two periods of remarkable increase of ischemic ECG changes respectively.

It is reasonable to assume that preventive measures of ischemic heart disease should be postulated taking age and sex into consideration.

In order to depress an increasing tendency of ischemic heart disease in this area, the following can be postulated:

For males,

- (1) It is urgently necessary to prevent high blood pressure even in younger age groups and to set up a steady policy of restricting salt intake, reducing stress, and practicing daily exercise.²⁾
- (2) To improve the lipid metabolism over the ages of forty-fifty, their dietary program should be improved.³⁾ To avoid an excessive intake of cholesterol-rich foods and overeating is recommended, as well as refraining from smoking.
- (3) As a preventive measure for obesity after the age of seventy, overeating is also forbidden.

For females,

- (1) Preventive measures for obesity are very important and they should be practiced even in younger age groups. Particularly, young women should refrain from such excessive caloric intake as taking sweets and cakes between meals^{4),5)}.
- (2) Obese women over the ages of 40-50 in particular were characterized by a high concentration of total cholesterol and a high Atherogenic Index. Therefore, extra attention should be paid to their diet^{3),6)} and moreover, exercises⁷⁾ are recommended as preventive measures for obesity.
- (3) And at the same time one should start to restrict salt intake at the ages of forty to fifty in order to have well controlled blood pressure in the sixties, and consequently this policy will contribute to prevent the onset of forthcoming ischemic heart disease.

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日本の山村住民における冠動脈硬化症の成因について

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当院では5年前より、富山県の山村住民(平、上平村)を対象に循環器検診を実施している。

私達はすでに最初の3年間の検診結果を分析したところ、女性ことに40~60歳代の女性において安静時の心電図が、虚血性変化の所見を示すことが多いことが明らかとなった。またその原因の一つとして40歳以上の女性の1/3以上にみられる肥満や肥満に伴う脂質代謝異常が推測された。

今回は、この2年間同一の対象地域の30歳以上の男女1,066名を対象に行なった検診結果(図1)より、安静時心電図上に虚血性変化が出現する頻度を性別、年齢別に求めて、比較検討してみた。

その結果図2のごとく、心電図に虚血性変化のあらわれる頻度が著明に増大(+10%以上)するのは、男性では、I:40歳代から50歳代、II:60歳代から80歳代。女性では、I:30歳代から40歳代、II:60歳代から70歳代と男女ともそれぞれ2回づつ急増期があった。これらの急激な増大の原因を究明するために、肥満者の割合、高血圧症とか高中性脂肪血症者の出現頻度、あるいは高動脈硬化指数を示す者の率などを心電図所見と同様に性別、年代別に求め、これらの変動が心電図虚血性変化の発現頻度の増減に関係があるか否かを分析した(図3-図6)。

結果と考察

男性の40歳代から50歳代にかけて心電図虚血性変化が急増(図中のI)した原因として、
(i)直接的には、高血圧者の割合が著増。

(ii)間接的には、30から40歳代にかけての動脈硬化指数の急激な上昇。

などが挙げられる。

また、男性の60歳代から80歳代にかけての急増(図中のII)の原因として、直接的には、

(i)70歳代から80歳代にかけての高血圧者比率の増大。

(ii)70歳代から80歳代にかけての肥満者比率の増大。

また間接的には、

(iii)40歳代から50歳代に動脈硬化指数の高い人の発現頻度が20%を超えていることが、60歳代から70歳代に心電図虚血性変化が急増する一因となりうることも推測された。

一方、女性の30歳から40歳代にかけての急増(I)の原因として、

(i)肥満者比率の増大。

(ii)30歳代~40歳代にかけての高動脈硬化指数を示す者の比率の増大。

が挙げられる。

また、女性の60歳代から70歳代にかけての急増(II)の原因としては、

(i)高血圧者の比率が急増している。

ことが推測された。

以上の結果より、この地域における虚血性心疾患の予防的対策として、男性では、①若年層より、高血圧の予防が必要とされる。②30歳代から40歳代の高コレステロール血症や高動脈硬化指数を示す様な脂質の代謝異常を食生活、禁煙等の面からもっと改善していくべきである。③高齢者にとっては肥満をさけ

るべきであろう。

また、女性では、①若年層から、肥満の予防が大切である。②60歳代から70歳代の高血圧者比率の急増を考えると40歳から50歳代からの高血圧の予防も大切であると考えられた。

以上、今まで2年間の検診結果から類推しえた虚血性心疾患の予防、対策上の留意点を男女別に各年代層毎に述べてみた。