

## PHYSIOPATHOLOGICAL ASPECTS OF CORONARY ATHERO/ARTERIOSCLEROSIS IN THE ELDERLY

MIRCEA DUMITRU, SILVIA GALAFTION

*The National Institute of Gerontology and Geriatrics,  
Bucharest, Romania*

---

**Summary.** On the basis of personal studies and data from the field literature, the physiopathological peculiarities of coronary athero/arteriosclerosis with the elderly are synthetically presented in this paper.

In the context of the clinical physiopathology of the aged, the term "chronic ischemic cardioangiopathy" — CICA — to which the clinical form of the disease is associated, seems closer to the anatomic substratum and involutive changes of the heart — vascular system. The athero/arteriosclerosis reveals the kind of the process and the morpho-pathological objective condition of the elderly and aged.

The asynergism is one of the basic characteristics of the decreased contractility of the myocardium in chronic CICA elderly patients. The protodiastolic relaxation, the modified distensibility and the impaired kinetics of the ventricular wall are the main elements which account for the change in the left ventricle dynamics in coronary ischemia. The therapeutic approach is dictated by the simultaneous existence of several pathogenic and clinical facts with the aged.

---

The rapid and early occurrence of parietal changes in the coronary vessels lays a characteristic mark on the aging process in these circulatory areas.

Due to the incidence and clinical consequences of the disease, the coronary circulation represents the main area where athero/arteriosclerosis occur in the elderly.

The coronary failure is the physiopathological substratum of ischemic cardiopathy; its characteristic is the discrepancy between the oxygen and nutrient supply and requirements in the two organs.

The ischemic cardiopathy in the elderly and the aged should be integrated in the wider concept of chronic coronary ischemic cardioangiopathy (CICA), expressing the process of myocardial ischemia and its involutive hemodynamic consequences on the vascular tree and the myocardium [2].

CICA in the elderly represents in fact the geriatric physiopathology: the interference of multiple independent pathogenic mechanisms, either programmed or gained in the course of ontogenesis (Fig. 1), the synergism of which generates numerous clinical, metabolic, hemodynamic, enzymatic consequences.

I. Consequences of the coronary failure.

1. *Clinically*, the elderly and the aged display acute and chronic forms of the diseases.

The clinical consequences in acute forms are represented by separate entities:

- sudden death
- angina pectoris at rest and under stress

- angina Prinzmetal
- preinfarction
- transmural myocardial infarction.

Chronic CICA may occur in aged patients as: clinical syndrome of cardiac failure, rhythm or conduction disturbances, asymptomatic clinical forms.

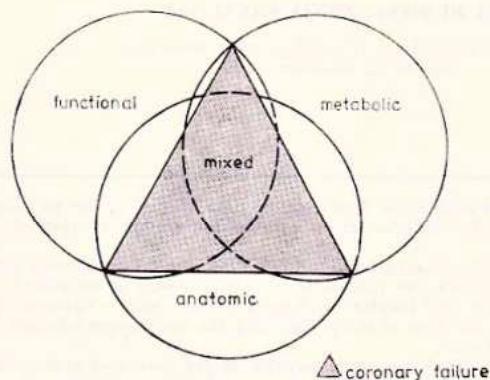


Fig. 1. - Factors that generate and hasten coronary failure in the aged.

2. *Metabolic consequences.* Certain age-peculiarities have been noticed to occur in the three stages of the energetic myocardial transformation [1]; they result from the diminution of the cellular respiration, some changes in the fermentation systems, increased myofibrillar sensitiveness toward humoral factors [3] having an important part in maintaining the functional energetic tonus. For the development of energy the oxidation of the carbohydrates is prevalent in the aged myocardium, to the detriment of fatty acids oxidation [1].

The qualitative and quantitative changes of the protein contraction with the aged, correlated with energy-formative deficiencies raise the problem of the critical elements in the transformation of the chemical energy into mechanical energy.

The studies on the metabolic consequences of chronic CICA have been focussed mostly on pyruvic and lactic acid concentrations. The oxygen myocardial post-capillary saturation was found unchanged [1] and the ischemic disturbances from different areas did not affect the general metabolic aspect. Most opinions tally with the deviation of glycolysis toward anaerobiosis, with the significant increase in lactate amounts.

Schwartz [6] pointed out that ischemia triggers the increase of intracellular  $H^+$  concentration, which can have a competitive effect on  $Ca^{++}$  in the tropo-nine-tropomyosine complex. A clear decrease has been noticed of the pH from the coronary sinus and the extracellular medium.

3. *Hemodynamic consequences.* In 1894, Porter published the results of his hemodynamic researches on the effects of the coronary arteries obstruction. The consequences of the anterior intraventricular thrombosis would be: decreasing left ventricular systolic pressure, increasing diastolic pressure, progressively decreasing systolic output down to ventricular asystole.

The disturbances in the cardiac rhythm are secondary to the decreasing contractility power and enhance the deficit of the myocardial pump.

The coronary blood flow is not uniform through all myocardial areas, hence a direct relationship with the mechanical efficiency of the ventricular systole.

Thus, the asynergism becomes one of the basic elements in myocardial hypocontractility in elderly and aged patients with CICA.

The coronarographic changes express the severity of the ventricular asynergism[2].

The following elements are responsible for the left ventricular dynamics in ischemia [5]:

a) Protodiastolic relaxation. The analysis of the isovolumetric stage of the ventricular systole in aged heart points out the delayed protodiastolic relaxation and velocity.

b) Distensibility changes. Closely related to the protodiastolic relaxation, a great variation of the end-diastolic distensibility has been noticed.

The study of the end-diastolic ratio pressure/left ventricular volume during the atrial pacing in patients with CICA, suffering an anginous crisis points out the modification of the ratio, as a result of the decreasing distensibility and residual contraction powers.

c) Ventricular wall kinetics. The local ventricular dynamics in atherosclerotic coronaropathy has been studied by means of angio-cardiographic investigations. The data included in these studies point out the asynergism of the myocardial pump as a major element. Alongside areas with normal contractility, there are other areas in which this parameter has been modified and the velocity abated

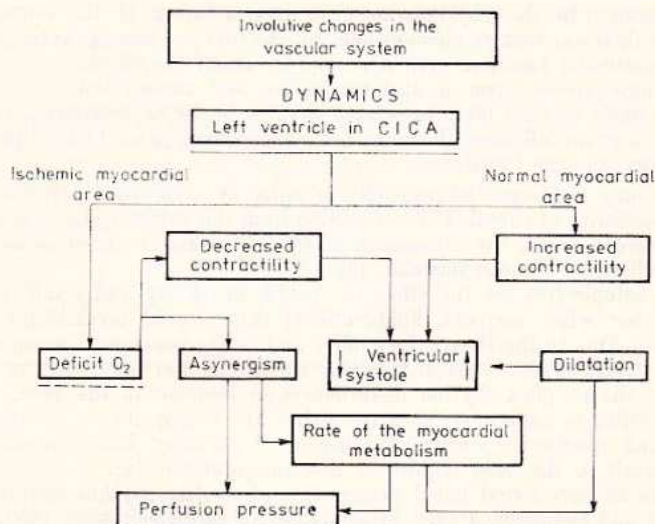


Fig. 2.—The influence of coronary ischemia on the integral pumping function (modified Rutishauer).

and delayed. In this way, ventricular dyskinesia as global concept, accounts for the global changes in ventricular dynamics with CICA patients (Fig. 2).

The filling, contractility and ventricular systolic efficiency are the main elements to determine cardiac performance in myocardial and age ischemia.

In the beginning, the normal myocardial areas try to compensate for the contraction deficiencies in the hypokinetic areas.

Based on the correlation between the hemodynamic and angiocoronarographic investigations, a transient left ventricular failure and an overt chronic deficit of the myocardial pump have been pointed out in aged patients.

The transient ventricular failure lays a characteristic mark on the aged patient with CICA, the cardiodynamic parameters of whom are below the normal limits even under so-called normal circumstances.

The hemodynamic data mark out a category of aged patients the hemodynamic parameters of whom are within normal limits when at rest, and in whom bodily exertion results in volume and end-diastolic ventricular pressure increase with well-adjusted stroke and cardiac output. Such aged persons do not present clinical complaints. The significant decrease of the stroke and cardiac output accompanies the end-diastolic ventricular pressure increase in another category of patients.

These 2 classes of patients can not be differentiated by means of coronarogram or ventriculogram, because these are obviously correlated with all the abated hemodynamic elements.

Mention should be made of the succession in time of the hemodynamic changes correlated with the ECG and the onset of anginous crises.

The timing of these data: the end-diastolic pressure modifies at 30–40 sec; the ECG changes occur within the next 2–3 min; 3–4 min later the patient feels the pain.

According to the physiopathological interpretation of the sequence the anginous pain is a secondary phenomenon, not the first one among the factors affecting the ventricular function, even if it does break off the effect.

#### 4. Consequences upon cardiac conduction and automatism.

The single or most often associated changes in the automatism and conduction of the nervous influx are the main mechanisms involved in the multiple rhythm disturbances in the aged.

The lack of electric homogeneity in adjacent myocardial areas and fibres [2] is a peculiarity of chronic CICA, resulting from the anatomical changes in different myocardial areas, the asynergism of the ventricular contraction and ununiform distribution of catecholamine [2].

The ectopic foci are the effect of electric instability and result from the action of borderline currents, unidirectional decremental mechanisms or focal reexcitation. Due to the electric instability and to the consequent unequal excitability of certain areas, a masked conduction mechanism may start to function generating the complex rhythm disturbances so frequent in the aged.

According to anatomico-clinical researches, the standpoint on the relationship rhythm and conduction disturbances/degree of coronary failure resulting from atherosclerosis in the aged requires a new interpretation [2].

Some authors found equal percentages of cardiac rhythm disturbances in unselected and hospitalized aged persons even in cardiologic units (30%) [4].

Our own observations on 2131 patients hospitalized at the National Institute of Gerontology and Geriatrics (1971–1974) pointed out 67.8% cardiac arrhythmias and conduction disturbances in the coronary athero/arteriosclerosis etio-genesis [2].

Based on Lenègre's conclusions and on some anatomico-clinical data concerning the aged patient, a special part is played by the relationship between the atrio-ventricular blocks and the condition of the coronary vessels.

At present, the coronary ischemic substratum is attributed to the blocks that complicate myocardial necrosis, or that are accompanied by anginous crises. In the genesis of sinus bradycardia and particularly in that of the atrio-ventricular blocks, the role of the Hisian junction primary degenerative lesions which had been minimized, is given more attention nowadays.

### CONCLUSIONS

1. The physiopathological peculiarities of the major clinical forms of coronary atheroarteriosclerosis in the elderly and the aged prove the complexity of the mechanisms involved and the simultaneous existence of more pathogenic facts with the geriatric age.

2. The understanding of the physiopathological implications of the atherogenous disease in the aged depends to a great extent on all the biological data of the third age and the quasi-constant evidence of the multiple pathology.

3. The consequences of ischemic coronary failure consist in some clinical, metabolic, hemodynamic and enzymatic peculiarities which reflect the morpho-functional substratum and the "milieu intérieur" of the aged.

---

**Résumé.** L'article présente dans une manière synthétique et basé sur les recherches et résultats des auteurs les particularités physiopathologiques de l'athéro/artériosclérose coronarienne chez les sujets âgés.

Dans la physiopathologie des personnes âgées, le terme « cardioangiopathie ischémique chronique » (CAIC) auquel est associée la forme clinique de la maladie, semble plus approprié aux aspects anatomiques et modifications évolutives du complexe système cardio-vasculaire.

L'athéro/artériosclérose nous révèle le type du processus et la situation objective morphopathologique des personnes âgées et des vieillards.

L'asynergisme est une des caractéristiques fondamentales de la contractilité diminuée du myocarde dans la CAIC des sujets âgés.

La relaxation protodyastolique, la distensibilité modifiée et le kinétisme défectueux de la paroi ventriculaire représentent les principaux éléments déterminant les modifications de la dynamique du ventricule gauche dans l'ischémie coronarienne. La thérapeutique est dictée par l'existence simultanée des divers facteurs pathogéniques et cliniques chez les personnes âgées.

---

### REFERENCES

1. BING J., LEB G., GULDIAMSON S., *Myocardial metabolism in old age with particular reference to coronary artery disease*, G. Geront., 1969, XVII, 10, p. 961-970.
2. DUMITRU M., *Bazele geronto-cardiologiei*, Ed. medicală, București, 1979.
3. MYERS W. W., HONIG C. R., *Number and distribution of capillaries as determinants of myocardial oxygen tension*, Amer. J. Physiol., 1966, p. 211-739.
4. PUECH P., GROLLEAU R., *Les troubles du rythme cardiaque chez le vieillard*, Symposium Problèmes en Gériatrie, Paris, 2-3.III.1968, p. 133-139.
5. RUTISHAUSER W., *Considerazioni di ordine fisiopatologico sull'insufficienza coronarica*, La cardiopatia coronarica, 15-23, 1978.
6. SCHWARTZ P., WOLFE K., *New aspects of cardiovascular disease in the aged*, J. Amer. Geriatr. Soc., 1967, 15, p. 640-650.