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EX AEDIBVS ACADEMICIS IN CIVITATE VATICANA



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ANATOMICAL AND PHYSIOLOGICAL REMARKS ON RIGHT VENTRICLE INFARCTIONS

E. CASTAGNETTA, A. FARULLA, G. NARO

SVMMARIVM — Causae, cur ventriculum dexterum summpere afficiatur dum coronaria homolateralis oclusa est, hae sunt: *a*) quod maxime vividus est sanguinis cursus anastomoticus collateralis; *b*) quod dexterum ventriculum minores quam sinistrum habet metabolicas necessitates; *c*) quod fieri potest vicarius quidam sanguinis cursus a cavo ventriculari dextero per tebesianum systema.

The peculiar interest of right ventricle infarctions is mainly connected with its rareness, since clinical and anatomical characteristics do not differ from similar changes commonly observed in the left sections of the heart.

The cases reported by a number of Authors suggest that a right ventricle infarction is quite uncommon. WARTMAN and HALLERSTEIN [1] (1948) have been able to observe only four right localizations among 235 cases of myocardial infarctions.

ZAUS and KEARNS [2] report on seven cases of single right ventricle infarctions; to these the AA. have added one personal observation. Five cases have been described by SLAPACK [3]

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(1956) and one by ZERBINI and BULGARO [4] (1960). A larger casistic is reported by WADE [5] (1959).

The rareness of right ventricle infarctions can give rise to interesting considerations concerning with the problems of the different blood supply and behaviour of ventricles in case of ischaemia.

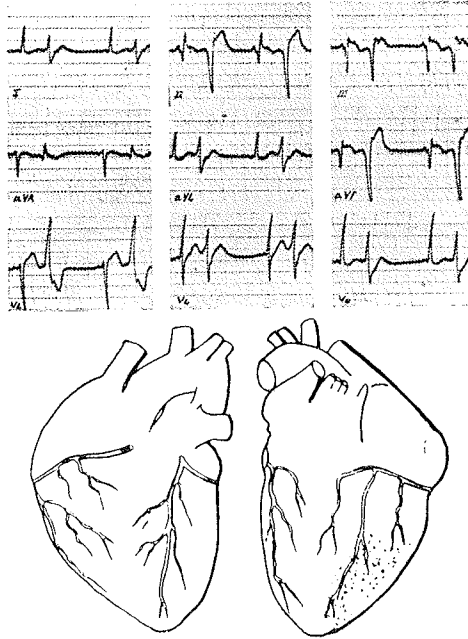
According to our opinion some interesting data can be found in the clinical and anatomical characteristics of our own cases; we have taken in consideration only cases of new necrosis, since the findings of sclerotic plates of myocardium connected with previous infarctions represent a likely but not proved event.

FIRST CASE — *C.I.*, 67 y. o.

Nephrectomy due to a kidney tuberculosis at the age of 42. Diabets since two years. Rare blood pressure controls revealed values among 180 and 200 mm/Hg. Hospitalized owing to the diabetic conditions. The patient suffered through 10 hours from a hard retrosternal pain irradiated to upper limbs. Blood pressure, 130/70. The death occurred two days later owing to serious phenomena of cardio-circulatory insufficiency.

The E.C.G. (performed the day after the onset of retrosternal pain) shows: synusal rythm with a frequency of 80 pulses per minute. Atriogram: P pointed wave in II, III and VF records; not flattening of the P-R tract. The ventricular complex shows a left prevalence. The II, III and VF records show signs of necrosis with a deep Q wave and iscahemic notes with a high flattening of the S-T tract, starting as monophasic wave from the descending branch of the R wave, 3 mm. from the isoelectric line. The set describes a lower concavity curve pursuing itself with a T negative wave. In I, VL and V₆ records, lower flattening (1-2 mm.) of the S-T tract with a diphasic T wave (- +). Furthermore the records have shown an extrasystolic ventricular bigeminism.

Anatomical remarks: heart increased in volume (510 gr.), specially in the left sections. Thin and brilliant epicardium except at the posterior wall of the right ventricles, where it is partially dark. The arterial coronaric vessels, at the touch, show an increased consistency and appear as stiff cords. Once



First case

opened the left cardiac cavity a marked hypertrophy of the wall of the left ventricle resulted. The aorta's intima shows sclerotic and ateromatic plates; the semilunar valves appear to be lightly thickened.

No changes of the remaining valvular sets. The right ventricular cavity is markedly expanded. Some thrombus having the size of a nut and presenting adhesions to the endocardium

holds the top and the medium third of the posterior wall of the right ventricle.

On this site, at the cut, the endocardium presents a faint and dry feature and appears to be of a reduced consistency like as following a recent ischaemic necrosis.

The study of coronaric vessels shows serious and extended atherosclerotic changes, somewhere reducing the arterial lumen. The phenomenon appears to be very evident at the beginning of the left coronaric artery; the right one, 2 mm. after its origin, shows a recent thrombotic occlusion growing up from an atheromatic ulcer of the wall.

SECOND CASE — S.A., 50 y. o.

Three days before hospitalization, at the end of a meal, the patient suffered from a light precordial pain, without irradiations, lasted for 15 minutes; successively a flaccid hemiparesis of the right lower and upper limbs set in. Then the patient underwent coma and death.

E.C.G. (performed two days before death): sinus rhythm with a very high frequency; heart position not ascertained. Light left deviation of the electric set; initial left ventricular prevalence. Signs of ischaemic changes in III and VF records with a monophasic wave starting 4 mm. from the B branch.

Anatomical remarks: heart lightly increased in volume (450 gr.) specially in the left sections. The coronaric arteries have a crooked course and an increased consistency. The left ventricle is dilated and presents hypertrophic walls. The aortic intima shows a number of calcified and atheromatic plates. No changes of the valvular sets. The posterior wall of the right ventricle presents, at its medium third, a small area with a faint, dried and friable myocardium. Such area is enclosed into a hyperemic ring.

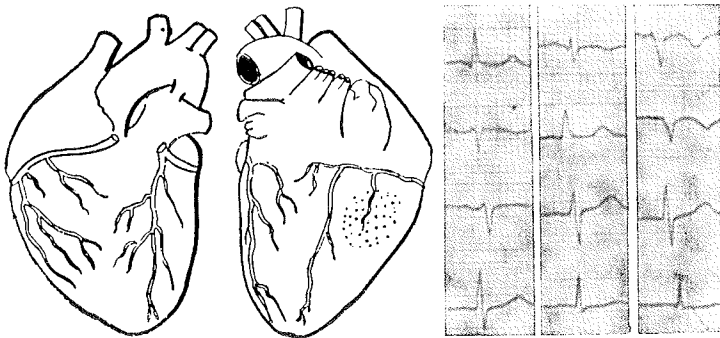
Coronaric arteries: the left coronaric artery, together with its descending and circumflex branches show many atheromatic

and calcified plates somewhere reducing the lumen of the vessels.

The right coronaric artery, 1 cm. from its origin, is completely obliterated by a recent wall thrombosis. Severe arteriosclerosis of the vessels of the brain base with cortical and sub-cortical softening of some circonvolutions belonging to the left frontal lobe and to the Kiel's insula.

THIRD CASE — *L.E.*, 59 y. o.

Since 5 years the patient was suffering from stenocardial fits. The day before hospitalization he underwent a hard retro-sternal pain followed by left arm irradiations and serious signs



Third case

of cardio-vascular insufficiency. The death occurred 8 days later.

E.C.G.: signs of ischaemic changes with necrosis in III and VF records (feature type Q_3 and T_3 ; S-T tract showing an upper convexity).

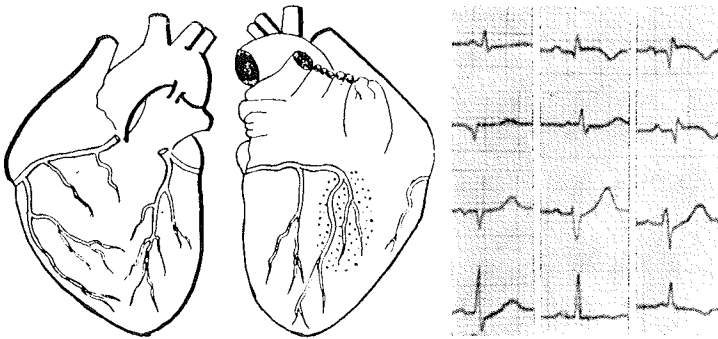
Anatomic remarks: heart fairly increased in volume (480 gr.). The sub-epicardial coronaric vessels present a crook-

ed course and a marked thickening. Cardial cavities expanded. The myocardium belonging to the upper and medium third of the posterior wall is thin, grey and friable.

The coronaric flow seems to be balanced. Ateromatic and sclerotic plates, inducing stenosis, of the sub-epicardial branches. The right coronaric artery appears to be obliterated, immediately after the obtuse edge, by a recent thrombus.

FOURTH CASE — *G.M.*, 56 y. o.

Two days before hospitalization, hard retrosternal pain lasted through 16 hours, associated with a serious shock. The death occurred the fourth day.



Fourth case

E.C.G.: signs of ischaemic changes and necrosis in II, III, VF and V_6 records with a monophasic wave starting from the R descending branch and followed by a T negative wave.

Anatomical remarks: heart increased in volume, specially in the left sections (580 gr.); the coronaric arteries present a crooked course and an increased consistency. Dilation of the

cardial cavities; the myocardium belonging to the posterior wall of the left ventricle appears to be grey, dried and friable.

Such a finding regards the outer and medium layers. The coronaric circle presents a left prevailing blood supply. The main coronaric branches show atheromatic and sclerotic plates. The left circumflex artery, fair before the posterior interventricular groove shows a recent thrombus, set up on an atheromatic ulcer.

* * *

All the cases reported regard recent infarctions of the posterior wall of the right ventricle (the last case is complicated by myomalacic changes of the interventricular sept and of the juxta-septal part of the right ventricle) with thrombosis of the coronaric artery responsible of the blood supply of the ischaemic area.

The first three cases show a recent occlusion of the right coronaric artery while the last one present the obliteration of the left circumflex branch, that, owing to a left prevalence, provided the blood supply of the posterior wall of the right ventricle.

Some other anatomical remarks can be summarized as follows: all the cases presented a less or more marked cardiac hypertrophy, prevailing in the left sections. Furthermore the thrombotic occlusions were associated with different arterosclerotic changes, producing in many sites a less or more locking stenosis.

CLINICAL CONSIDERATIONS

The uncommon finding of large infarctions of the right ventricle is not connected with vascular occlusions, which usually are shared among the main branches of the sub-epicardial coronaric arteries, though a light prevalence can be ascribed to the anterior interventricular artery.

According to the casistic presented by HIMBERT and LENE-GRE [8], the anterior descending branch, the right coronaric artery and the left circumflex one had been interested by occlusive changes, respectively 211, 167, 139 times.

The rareness of right ventricle infarctions is connected with the fact that occlusions of the right coronaric artery do not yield myomalacic changes. Some hypothesis have been suggested in order to explain the different behaviour of ventricles in case of serious coronaric troubles.

According to WHITTEN [9] the different way of coronaric artery to enter the myocardium (on the right an obliquous course, a perpendicular one on the left side) could explain the larger incidence of serious arteriosclerotic process of the sub-epicardial branches of the left coronaric artery, that, owing the anchorage of the intramural branches may undergo a higher mechanical pressure during the cardial revolution.

However the anatomical study does not support such hypothesis since the right coronaric artery too is often interested by occlusive changes. Furthermore WHITTEN is unable to explain why the occlusion of the right coronaric artery does not give rise to infarctions of the depending ventricular areas. In such cases we usually observe an infarction of the posterior wall of the left ventricle, depending, as to the blood supply, on the posterior interventricular artery.

According to PRINZMETAL et all. [10] the right ventricle myocardium, as shown by a number of sperimental works, is supplied with a large collateral anastomotic circulation, able to avoid the onset of necrotic process due to occlusive changes of the right coronaric artery.

In our opinion the rareness of right ventricle infarctions is depending on different factors. First of all one has to keep in mind that the work performed by the right ventricle is about one third lower the one carried out by the left section. Furthermore the metabolic requests of the right ventricle are lower

though both the ventricles possess the same rate of fibre-capillary blood supply.

In the left ventricle feeding occurs almost entirely during the diastolic time, while in the right one this happens, though in a reduced way, also during the systolic phase.

The blood supply area of the right ventricle has many possibilities of supplementary circulation, prevalently depending on the anterior descending artery, as to the heart tip, the anterior aspect of the right ventricle, the interventricular sept.

Almost all the cases of right ventricle infarctions due to occlusions of the right coronaric artery are associated with serious locking and obstructive sclerosis of the anterior descending artery; this association could be explained on the basis of the above mentioned anatomical conditions. A chance of collateral circulation is offered to myocardium by the tebesian vessels of which the inner layers of the right ventricle are largely provided.

Such vessels under physiological conditions represent a subsidiary discharging way of the coronaric venous system, beeing connected with the ventricular cavity and the intramural arterial vessels. In case of obstruction of a coronaric artery, the sudden fall of blood pressure in all the corresponding arterial capillary districts could allow the inversion of the blood flow in the tebesian vessels, followed by the settling of a blood supply coming from the right ventricular cavity.

A careful study of our own cases and of those reported in the litterature allows us to conclude that the onset of a right ventricle infarctions is often connected with a sclerotic conditions of the whole coronaric arterial system. Such infarctions depend on the occlusion of the right coronaric artery associated with other factors hindering the occurrence of compensation mechanisms able to avoid the onset of ischaemic phenomena of the right ventricle.

The clinical and electrocardiographic findings have not provided, in our own cases and in those reported in the litterature,

data allowing a localization of the infarctions at the right ventricle. The case reported by LEVY and HYMAN [13] get known in life and verified at autopsy is presently the only one in the world literature.

As to the infarctions of the posterior wall the electric phenomena starting from the right ventricle do not differ, whether in peripheric recordings or in the precordial ones from those coming from the left ventricle.

The infarctions of the anterior wall are even more uncommon; some useful data for a topographic diagnosis could be provided in early cases by the high right precordial, by the AP and by the CONDORELLI's right atrial recordings.

The above mentioned considerations show that presently an electrocardiographic diagnosis of right ventricle infarctions is practically impossible.

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