THE P-R SEGMENT IN HYPERTENSIVE HEART DISEASE

BY

L. HAHN

From the Out-Patient Department, Teplitz-Schoenau, Bohemia

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A recent paper (Hahn and Langendorf, 1939) on changes in the P-R segment emphasized that signs we considered typical of left auricular stress were mostly absent in arterial hypertension. On the contrary those representing right auricular stress, i.e. lowering or sloping of the P-R segment in leads II and III, often occurred. To investigate this unexpected result 200 electrocardiograms of cases with hypertension were analysed. These were selected from the records of my former Heart Clinic at Teplitz-Schoenau, Bohemia. They were recorded by the Siemens amplifying apparatus from out-patients with uncomplicated arterial hypertension, chronic glomerulonephritis, or aortic valvular disease; 160 mm. was taken as the lower limit of the systolic blood pressure and the lowest of several readings was used. There were 99 men and 101 women with an average age of 51 years and an average systolic blood pressure of 187 mm.

In the above paper we considered the displacement of the P-R segment below the iso-potential level as pathological when it reached or surpassed 0.5 mV. or when, without regard to the degree of the depression, it presented a pathological shape, i.e. a sharp rise of the P-R segment from the descending limb of the P wave followed by an arch with upward convexity (Fig. 1A, lead I ; Fig. 2A, lead I ; and Fig. 2D, lead II).

RESULTS

A pathological depression of the P-R segment was found in 148 cases, i.e. 74 per cent. In our previous paper 500 unselected cardiograms showed 24 per cent. with such changes. Its frequency in arterial hypertension is, therefore, striking. The distribution of the changes of the P-R segment according to the leads will be shown in Table I.

Examples for the various changes of the P-R segment in the different leads follow. Fig. 1 shows three cases of left ventricular preponderance with a depressed P-R segment in one lead only : the shape of the displaced segment, Fig. 1A, represents the pathological shape, i.e. a sharp rise of the P-R segment of the descending limb of the P wave followed by an arch with upward convexity.

This displacement does not seem to depend on the size of the P wave. Fig. 2 gives cases with altered P-R segments in two or three leads. In Fig. 2A there is a distinct discordance of the P-R segment in leads I and III as we described as typical in cases of "P mitrale" (Winternitz).

FIG. 1.—Depression of the P-R segment in one lead only, in cases of arterial hypertension. (A) in lead I, (B) in lead II, and (C) in lead III. Note the distinct left preponderance.

FIG. 2.—Depression of the P-R segment in several leads, in cases of arterial hypertension. (A) in leads I and II; note the discordance of P_1 and P_3 ; (B) in leads I, II, and III; (C) and (D) in leads II and III.

Table I proves that pathological changes of the P-R segment principally concern leads II and III; 43 per cent. of the entire series and 56 per cent. of all cases with displacement of the P-R segment showed the depression in these leads. By its average age of 56 years this group exceeded that of the group with changes in leads I or I and II; and the average age of all cases

showing changes of the P-R segment was slightly higher than of those with an iso-electric P-R segment. The average systolic blood pressure presented an almost identical value.

TABLE I
DEPRESSION OF THE P-R SEGMENT IN 200 CASES OF ARTERIAL HYPERTENSION

Lead	Percentage	M.	F.	Average B.P.	Average Age	Ratio of L.V.P. to R.V.P.
I and II	8.5	10	7	189	50	2.0 : 1
II	9.5	15	4	195	56	1.7 : 1
II and III	43.5	34	53	185	56	1.3 : 1
I, II, and III	12.5	9	16	183	55	2.0 : 1
Total	74	68	80	187	55	—
No depression of P-R segment	26	31	21	188	50	0.6 : 1

DISCUSSION

The frequency of these changes of the P-R segment in arterial hypertension might lead us to attribute them to left auricular stress, in agreement with the conception of Wood and Selzer (1939), who found a widened P wave of low voltage, usually bifid or flat topped, in hypertensive heart disease. They attributed the changes to left auricular stress with left ventricular failure. The application of this interpretation is opposed by the fact that the most frequent alteration of the P-R segment takes place in leads II or II and III, and not in leads I or I and II, as is usual in "cor mitrale." The small group with depression of the P-R segment in leads I and II does contain proportionately numerous cases of ischæmic disturbances of the heart muscle resulting in left ventricular failure and subsequently left auricular stress—two cases of previous coronary thrombosis, one of bundle branch block, and two of severe mes-aortitis with aortic incompetence.

To ascertain if there is any relation between the incidence of this depression of the P-R segment and the heart size, the transverse diameter of the heart and the proportion with left ventricular preponderance in the groups with or without changes of the P-R segment were determined. The former showed an average diameter of the heart of 13.2 cm. and the latter of 13.5 cm., so there was no evidence of any relation between the incidence of these changes and cardiac enlargement. On the other hand, the incidence of left preponderance was much greater in the group with changes of the P-R segment than in those who showed no such depression. Table I shows the ratio of those with left ventricular preponderance to those with right preponderance or with no preponderance.

This makes it unlikely that a secondary mitral incompetence caused by a

high-grade dilatation of the left ventricle in the first group (as well as the displacement of the electric axis of like origin) can be the only cause. On the other hand, there was no conclusive evidence that right ventricular and subsequently right auricular stress (as in "cor pulmonale") are concerned in causing the changes of the P-R segment. A combination of hypertensive heart disease with emphysema or sclerosis of the pulmonary arterioles or kyphoscoliosis occurred in both groups with about the same frequency.

We were more successful in comparing the clinical features in both groups. First, there was a small difference in the average age, and of greater importance, in the structure of ages of both groups. This is well shown in Table II.

TABLE II
AGE INCIDENCE IN THE GROUPS WITH AND WITHOUT CHANGES OF THE P-R SEGMENT

Age	Cases with Changes of P-R Segment		Cases without Changes of P-R Segment	
	Number	Percentage	Number	Percentage
10-20	2	1	0	0
21-30	5	3	3	6
31-40	4	2	10	20
41-50	28	19	7	14
51-60	57	38	21	42
61-70	43	29	8	16
71-80	7	4	1	2
81-90	1	1	0	0
Total	147		50	

In the first group 34 per cent. were over 60 and only 6 per cent. were under 40, but in the second group only 18 per cent. were over 60 and 26 per cent. were under 40 years of age.

The second characteristic of the group with changes of the P-R segment was the frequency of ischæmic heart disease ; there were 4 instances of previous coronary thrombosis and 7 of bundle branch block. On the other hand, in the group without changes of the P-R segment we found no case of those complications. As to the prognostic value of the changes of the P-R segment a small number of out-patients only admit of very cautious conclusions, but 6 fatal cases occurred in the group with changes of the P-R segment and only 2 (that is cases of chronic glomerulonephritis) in the other group. To obtain a more convincing picture of the clinical condition of the heart muscle a series of 100 cases with different types of ventricular failure or with symptoms of cerebral sclerosis, has been analysed with regard to the P-R segment and the results are shown in Table III on the next page.

The table shows that 78 per cent. belonged to the group with changes of the P-R segment, and that on the whole they were more seriously ill than the others.

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TABLE III

INCIDENCE OF CHANGES IN THE P-R SEGMENT IN VARIOUS CLINICAL CONDITIONS

Clinical Diagnosis	Cases with Changes of the P-R Segment	Cases without Changes of the P-R Segment
Orthopnoea and severe effort dyspnoea ..	24	8
Paroxysmal cardiac dyspnoea	10	2
Angina pectoris	16	8
Basal pulmonary congestion	5	4
Cerebral and other peripheral sclerosis ..	6	2
Right ventricular failure	31	4
Total (percentage)	78	22

This clinical study seems to correlate the changes of the P-R segment in hypertensive heart disease to the insufficiency of blood supply of the auricles, caused by progressive sclerosis of the auricular arteries. It is difficult with the history only to determine the onset of hypertension in any one case, but the age of the patient may give a hint. Generally the arteries of the older patients have been exposed for a longer period to a high blood pressure with its well-known consequences in producing arteriosclerosis. Pathological experience shows an increase of arteriosclerosis of all organs, the heart in particular, as age advances. Clinically and pathologically, hypertension represents a common ætiological factor in coronary thrombosis ; so Conner and Holt (1929 and 1930) found arterial hypertension in 34 per cent., Parkinson and Bedford (1928) in 49 per cent., and Levine (1929) in 40 per cent. of cases. Thus we may suggest an inadequate coronary blood flow as the most probable cause for the changes described.

SUMMARY

1. In 200 electrocardiograms from cases of arterial hypertension, depression of the P-R segment, reaching or exceeding 0.5 mV., was found in 74 per cent. of the whole series ; in 53 per cent. in lead II or in leads II and III.
2. The average systolic pressure was the same in those with and in those without these changes.
3. The average age of those with these changes in the P-R segment was rather older, and 34 instead of 18 per cent. were over 60 years of age.
4. There was a larger proportion with left ventricular preponderance.
5. The clinical condition of the heart was rather more severe in the group with these changes.
6. It is suggested that the changes of the P-R segment in hypertension result from arteriosclerosis of the auricular arteries, causing an insufficient blood supply of this part of the heart muscle.

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ERRATA

Page 101, line 15 : *for* 0·5 mV. *read* 0·05 mV.

Page 105, Summary, line 2 : *for* 0·5 mV. *read* 0·05 mV.