FACTORS CONTRIBUTING TO VENOUS VALVES REGRESSION

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The problem of the factors conditioning venous valves regression as yet remains in the sphere of hypothetic guesswork. Bardeleben (1880) relates such factors to the pressure exerted on the valves and vein wall by the blood flow through the veins, and to the pressure from outside. In his opinion, the regression of a single valve brings about overloading of the valves situated underneath with ensuing gradual disappearance of the same. Kampmeier and Birch (1927) postulate the idea that valve regression may be explained by the fact that upon growth completion, a balance between veins and their muscular surrounding is established owing to which the importance of valves decreases. The concepts just referred to are speculative since they are by no means substantiated by convincing evidence. We believe that the solution of the problem outlined might be accomplished against the background of systematic study on the localization and structure of incomplete valves which, as a rule, undergo regressive transformation (Vankov, 1962, 1968).

Material and Method

The study is conducted on human cadavers of all ages. Valves in the femoral and external iliac vein (250 extremities), and in the femoral area of the great saphenous vein (210 extremities) are investigated. A description is submitted of the localization, structural form and completeness of each valve.

Results

A total of 2281 valves are found in the studied veins, of which 1058 along the course of the femoral and external iliac vein, and 1223 — along the course of the femoral tract of the great saphenous vein. Of the total number, 455 valves are incomplete; they are partial or merely marked.

Out of the 1058 valves observed in the femoral and external iliac vein, 922 (87 per cent) are complete, and 136 (13 per cent) — incomplete. The single segments of the vein show differences in the distribution of incomplete valves. Their rate of occurrence varies from 2.5 per cent in the subtributary area of the femoral vein to 25.7 per cent in the external iliac vein. The data obtained point to the fact that the rate of occurrence of incomplete valves in the various segments is definitely dependent upon the valve index and shape of the valves.

The valve index provides information about the number of valves over a 10 cm length of the vein under study; it is a numerical expression of the valvular supply to individual venous segments (Vankov, 1968). The rela-

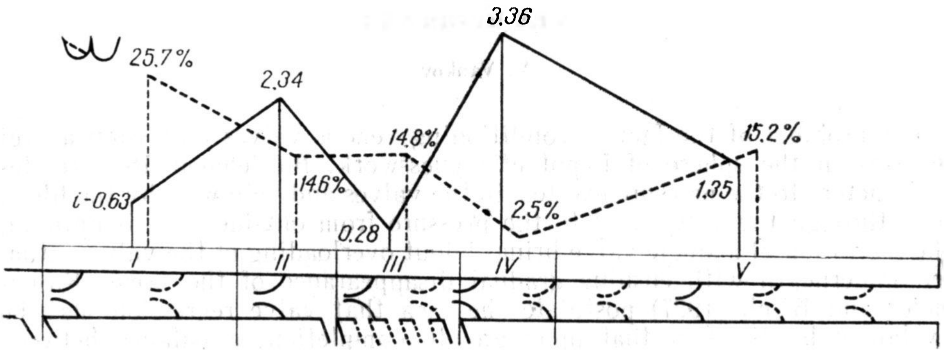


Fig. 1. Valve index and incomplete valves' rate of occurrence along the course of the external iliac and femoral vein

I — external iliac vein; from II to VI femoral vein sections — subinguinal (II), intertributary (III,) subtributary (IV) and extratributary (V). The continuous line indicates the valve index, and the dotted line — the rate of occurrence of incomplete valves.

tionship of the incomplete valves' incidence to the valve index along the course of the femoral and external iliac vein is illustrated in Figure 1. If the data concerning the four sections are compared (the intertributary one excluded), it becomes obvious that by rate of occurrence (percentage of the total number) of incomplete valves, the zones are arranged in the following manner: subtributary (2.5%), subinguinal (14.6%), extratributary (15.2%), external iliac vein (25.7%). It is our impression that this arrangement is diametrically contrary to the arrangement according to the valve index values: the external iliac vein has the lowest index, while the subtributary zone of the femoral vein — the greatest.

Data on the morphologic completeness of the various valve forms show that bicuspid valves are incomplete in very rare instances as compared to valves with atypical structure (unicuspid, tricuspid, tetracuspid and transitory). Out of 906 bicuspid valves, 77 or 8.5 per cent are incomplete, whereas from 152 atypical valves, 59 or 38.9 per cent are incomplete. This points to the fact that incomplete valves in the bicuspid forms are about 4—5 times rarer than in atypical valve forms. It is of special interest to note that the more distant a form from the bicuspid one, the higher the incidence of incomplete cases (Fig. 2). The percentage correlations between complete and incomplete valves in the various atypical forms are derived, on the whole, from a small number of valves (3 to 60), and would hardly be relevant if the difference was not so marked, and if their modification, parallel to departure from the bicuspid valve form, was not so regular. While in the bicuspid valves every 12th valve is incomplete, in the transitory bi-tricuspid valve — every eighth, in the tricuspid — every third, and in the tetracuspid — two of the three valves established are incomplete. In cases of variations in the direction of unicuspid and unshaped valves, the rate of occurrence of incomplete valves shows a clearcut alteration. Although in the bicuspid valves, as already pointed out, each 12th valve is incomplete,

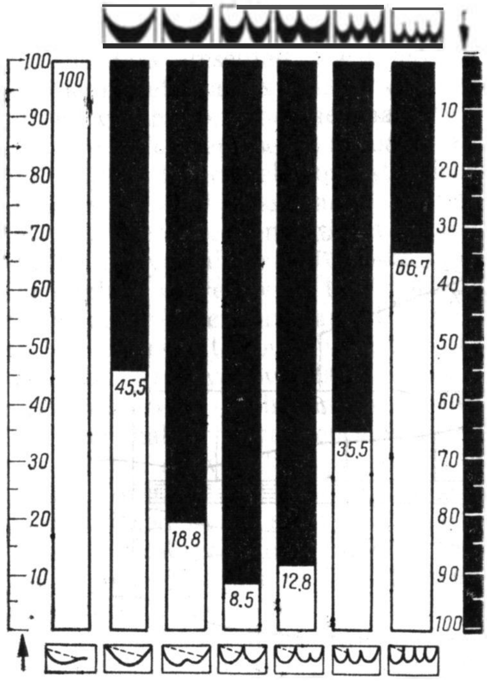
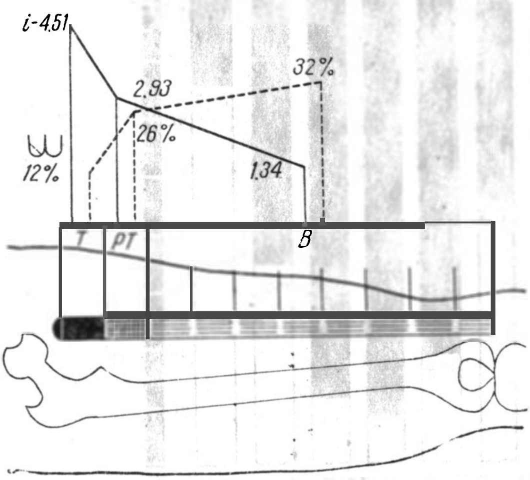


Fig. 2. Percentage ratios between complete and incomplete valves with various form of structure, found in the femoral and external iliac vein: the percentage of complete valves is presented in black, and of the incomplete — in white.

in the transitory uni-bicuspid valve every fifth or sixth one is incomplete, in the unicuspid — every second one, and in the unshaped one all valves found are incomplete. It is obvious from the data submitted that the structural form of the valves has an essential practical bearing on their morphological completeness.

It appears that the two dependences on the incidence of incomplete valves established, namely the inverse dependence on the valve index, and the direct dependence on the occurrence of typical forms, explain reciprocally their own exceptions, and considered as a whole, condition in a sufficiently comprehensive manner the rate of occurrence of incomplete valves in the various zones.

Of the total of 1223 valves established in the femoral part of the great saphenous vein, 904 (73.9%) proved to be complete, and 319 (26.1%) — incomplete. An important characteristic feature in the latter vein is the fact



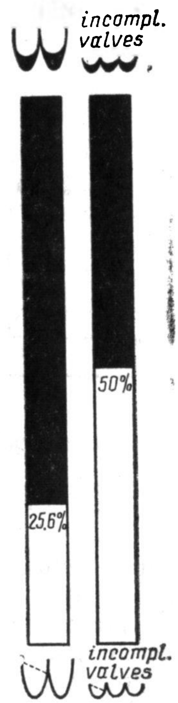


Fig. 3. Valve index and rate of occurrence of incomplete valves along the course of the femoral tract of the great saphenous vein:

T — terminal zone; *PT* — preterminal zone; *B* — basic zone. The valve index is designated with continuous line, and the rate of incomplete valves — with dotted line.

Fig. 4. Percentage correlations between complete and incomplete valves in the bicuspid and atypical structure form; the percentage of complete valves is marked black, and of the incomplete valves — white.

that merely marked valves are several times more numerous than partial ones — 270 and 49 respectively. The distribution of incomplete valves along the course of the femoral tract of the vein is presented in Figure 3. It can be seen from the figure that the incidence of incomplete valves in the various segments is inversely dependent on the valve index (i. e. on the functional loading). From the data about the completeness of the varying in form valves, it becomes evident that among the bicuspid valves 25.6 per cent are incomplete, and among the atypical — 50.0 per cent (Fig. 4). Thus it is clear that in the great saphenous vein, the two relationships referred to above and already verified in the femoral and external iliac vein in man, are absolutely valid, namely the presence of an inverse dependence of the incidence of incomplete valves on the valve index values, and a direct dependence on the occurrence of atypical valves.

Conclusion

After summing up the data presented, the inference is reached that the rate of occurrence of incomplete valves is inversely dependent on the valve index values, and directly dependent on the quantity of valves with atypical form. Since the valve index represents a quantitative expression of the functional loading of valves, the correlation established indicates that the incomplete valves mainly are those less loaded. Valves with atypical structure are incomplete much more frequently than bicuspid valves, and moreover, the more distant an atypical form from the bicuspid one, the higher the incidence of incomplete valves with this particular form. Literature reports dealing with the latter dependence are also available. Thus Pettigrew (1863) states that in the valves with four cusps, two of the latter are usually more or less rudimentary. Kruglyakov (1961) claims that unicuspid, four- and five-cuspid valves observed in the animals studied by him are very often underdeveloped; he makes no reference whatsoever to the tricuspid and transitory forms which, as well known, constitute the great majority of valves with atypical form.

The correlations established by us show that mainly less loaded valves and valves with atypical structural form undergo regression and disappearance. On the basis of such dependences it is also possible to explain the unequal rate of occurrence of the valves undergoing regression or atrophy along the course of the various venous segments investigated.

The results of our study by no means corroborate the concepts on the issue adhered to in the pertinent literature. Thus Bardeleben (1880) considers the internal and external effects on the vein wall and valves as factors causing valve regression; the disappearance of a single valve results in the overloading of those situated underneath and they disappear one by one. Our data show exactly the contrary, namely, that mainly the least loaded valves are subjected to regression. Our results are not in full agreement with the statement of Kampmeier and Birch (1927) according to which, upon completion of body growth a balance is established between the veins and their muscular surrounding as the result of which the valves lose their significance and gradually regress. The latter opinion presupposes an intensification of the process of valve regression in the middle age period which does not comply with the data obtained by us (Vankov, 1962, 1968), according to which the number of complete valves diminishes chiefly during the growth period of man. Our data are in agreement with the viewpoint of Kampmeier and Birch insofar as these authors recognize functional unloading of the valves as a cause for their regression.

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ФАКТОРЫ, СПОСОБСТВУЮЩИЕ ИСЧЕЗНОВЕНИЮ ВЕНОЗНЫХ КЛАПАНОВ

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РЕЗЮМЕ

Сообщаются данные касающиеся локализации и формы неполных клапанов, которые, как правило, атрофические. Устанавливается, что в отдельных участках по протяжению бедренной, наружной подвздошной и большой подкожной вены (в ее бедренной части) частота неполных клапанов находится в обратной зависимости от клапанного индекса на этих участках, который является показателем функциональной нагрузки клапанов. Вместе с этим устанавливается, что клапаны с нетипичной формой устройства являются неполными значительно чаще чем двухкарманные клапаны. На основании указанных данных делается вывод, что процесс обратного развития (атрофии) поражает преимущественно более слабо нагруженные клапаны, а также и клапаны с нетипичной формой устройства.