Pathologisches Institut der Universität Marburg

Myocardial hypertrophy
Light microscopic findings on the myocardium
Blood supply
Ventricular dilatation and heart failure

Herzhypertrophie
Lichtmikroskopische Befunde am Myokard
Blutversorgung
Herzdilatation und Herzversagen

W. Hort

With 3 figures

Summary

The heart is an organ with an almost constant number of muscle cells under physiological conditions. But beyond the critical heart weight (500 g) there is an increase in the number of muscle fibers (hyperplasia) and a similar increase in the number of capillaries. The relation of 1 capillary to 1 muscle fiber remains constant.

During physiological growth there is a rather close correlation between the growth of human coronary arteries and the growth of the myocardium. Under pathological conditions the growth of coronary arteries is slower than that of the myocardium. In many animal species investigated up to now there is a rather close correlation between the diameter of coronary arteries and the diameter of the heart.

As a rule, hearts with chronic insufficiency are dilated. They work under unfavourable geometrical conditions. The post-mortem ventricular volume is influenced to a very great degree by rigor mortis.

In the case of hypertrophy of the heart, muscle fiber thickness plays a leading role for the pathologist and physiologist. It is worthwhile not only taking a look at the enlarged human heart, but also to take into account the results of comparative anatomy. The measurements of my co-worker Horvath (fig. 1), for instance, are presented as a good example of various species, ranging from the mouse to the horse. Here it can be seen that the muscle fiber in adult mammals, despite the enormous difference in the weight of hearts, does not differ very much. The diameter of the muscle fiber is, for the most part, just under 20 µ. The measure-
ments for normal human hearts can be closely compared to those of the mammals, and even the largest living mammal, the whale, is not an exception to the rule. We found an average muscle fiber thickness of 17.2 µ in a Finnish whale. It can be concluded from these and other results (Ashley) that in adult healthy mammals there is no correlation between the thickness of the heart muscle fibers and the weight of the heart.

Now the question arises, what are the findings in hypertrophic human hearts? Is hypertrophy only the result of the thickening and lengthening of heart muscle fibers or is there a multiplication of fibers? Under extreme pathological conditions there is an increase of the weight of the heart from 300 g to 1000 g. In these hearts and without an increase of the number of muscle fibers the diameter should increase about a half, for example from 18 µ to 27 µ. This is a dimension that, as far as I know, has not been reached in the hearts of mammals.

We know from the fundamental examinations of Linzbach that the human heart is an organ with an almost constant number of cells. During physiological postnatal growth, the heart muscle fibers become thicker and longer, but the number of cells remains the same. During physiological hypertrophy, as is the case, for instance, in athletes or laborers who do heavy physical work the heart muscle fibers continue to grow, just as they do during physiological growth. Beyond the critical heart weight of 500 g, however, there is an increase in the number of muscle fibers, resulting in hyperplasia. The muscle fibers increase in diameter on the average only very little if at all, but there may be an increased variation in muscle fiber thickness. The earlier results with respect to hyperplastic growth of the human heart (Linzbach; Hort) have been confirmed in the meantime (Adler).

In adult mammals, not only does the thickness of the heart muscle fibers show constancy, but this is the case to an even stronger degree as far as the mesh width of the capillary network is concerned. This is already as large in a newborn child as in an adult. In newborns there are 4 to 8 heart muscle fibers in one mesh, in adults, only one. During the physiological postnatal growth, the heart muscle fiber extends finally into one capillary mesh. The thickness of the heart muscle fiber of adults and mesh width of the capillary network correspond with one another.