The cardiomyopathy of the Syrian hamster (strain BIO 8262) — hypertrophic or dystrophic?

Die Kardiomyopathie des syrischen Goldhamsters (Stamm BIO 8262) — hypertrophisch oder dystrophisch?

W. Mohr, K. Lossnitzer*, and J. Schwarz

With 9 figures and 2 tables

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Summary

Chemical as well as cytophotometric studies were carried out on myocardium of cardiomyopathic hamsters of strain BIO 8262 and of healthy control hamsters of strain CLAC. Our interest was to find out whether the cardiomyopathic hamsters suffer from hypertrophic cardiomyopathy or not. The heart muscle mass was only slightly increased in the older cardiomyopathic hamsters when compared with the controls. This increase was accompanied by an elevated content of total DNS, RNS and protein. Furthermore, the number of hyperdiploid heart muscle cells was slightly increased in the older diseased animals. However, all these changes were of minor degree. Thus, a distinct hypertrophying process in the myocardium of the cardiomyopathic hamsters can be excluded. On the other hand, the connective tissue components (polysaccharides and collagen) were distinctly increased in the hearts of older cardiomyopathic hamsters. This is in accordance with morphological investigations, in which replacement of necrotic myocardium by fibrosis could be detected.

It is known that hamsters of strain BIO 8262 suffer from a life-span reducing hereditary myopathy of the striated musculature (12). Heart involvement is characterized electrocardiographically by conduction disturbances and left heart axis deviation (13) and morphologically by severe alterations (15, 16). Since human cardiomyopathies are generally subdivided into congestive and hypertrophic ones, it was our special interest to see whether this hamster cardiomyopathy can be attributed to the hypertrophic group. The congestive form can be excluded, as clinically no congestion could be observed, although left ventricular contractility was decreased (22). Clinically as well as morphologically hypertrophy was not striking; hence, chemical and cytophotometric investigations were applied to get further insight into the disease process.

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Material and methods

The investigations were carried out in a total of 41 cardiomyopathic hamsters of the inbred strain BIO 8262 and of 40 healthy control hamsters of the inbred strain CLAC. Thoracotomy was performed under ether anesthesia and the hearts were removed.

1. Chemical investigations

Chemical analyses were done in 30 hamsters of strain BIO 8262 (15 animals between 26 and 28 days of age and 15 animals older than 200 days of age) and in 29 control hamsters (15 animals between 26 and 28 days of age and 14 hamsters older than 200 days). For the studies the left ventricular wall and ventricular septum were taken after removal of the right ventricular wall. Wet weight of the tissue was determined. Then the tissue was air dried after ether extraction of fat.

The following components of the hearts were determined:

a) DNA (method: Burton, 1965)
b) RNA (method: Ceriotti, 1955)
c) protein (method: Lowry et al., 1951)
d) polysaccharides (method: Selifter et al., 1950)

The arithmetic mean and standard deviation for each group of animals were calculated from the individual values obtained. Comparison of the mean values of control and cardiomyopathic hamsters was obtained by means of the Student t test with regard to unequal variance. Differences at the 5% level were regarded as significant. The variables were presumed to be normally distributed.

2. Cytophotometric investigations

These studies were performed on a total of 11 hamsters of strain BIO 8262 (30, 50 to 60 and 220 days old) and on an equal number of healthy controls of the same age groups.

Smears of myocardial cells were prepared after collagenase digestion. For this purpose small pieces of the left ventricular wall were digested in collagenase solution (0.5 mg collagenase, Serva No. 17449, in 1.0 ml Ringer-solution) for 1 hour. After centrifugation the sediment was smeared on slides and immediately fixed in 100% methanol for 15 minutes. As reference system thymus lymphocytes were used. The slides were stained with Giemsa solution and prepared with Feulgen-staining (hydrolysis in 1.0 n HCl for 10 min., Schiff's reagent according to Graumann, 10).

The DNA content of the nuclei was measured by two different ways:

a) Deeley-cytophotometry

In Feulgen-stained smears of myocardial cells DNA content of 300 nuclei (3 animals in each age group; 100 nuclei from each animal) was measured with an integrating microdensitometer according to Deeley (1955). No differentiation could be made between nuclei of different cells, for it was not easy to distinguish nuclei of cardiomyocytes from those of the supportive connective tissue in Feulgen-stained smears.

b) Scanning-cytophotometry

To distinguish exactly between nuclei from cells of different origin investigations were performed with a scanning-cytophotometer (Cytoscan, Zeiss). This method is superior to Deeley-cytophotometry, since cardiomyocytes are clearly detectable after Giemsa-staining. Subsequent to mapping myocardial