Aging and Scar Tissue in Human Heart Muscle

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(3), 253-258 — Histometrical estimation of scar tissue was made on 30 human
hearts obtained at autopsy in order to know possible correlations between aging
and scar tissue in the heart muscle. Estimation was made on histological
specimens of the anterior wall of the left ventricle and the posteromedial papillary
muscle, according to Chalkley's point counting method, and the amount of scar
tissue was expressed in percentage. The mean percentages were 3.11, 5.26 and
9.24 in the epicardial, endocardial parts of the left ventricle and the papillary
muscle, respectively. There were very significant differences between these 3
mean percentages. There were very significant correlations between the per-
centages of scar tissue in these 3 parts and ages. From these results, it is
concluded that the scar formation increases in the heart muscle with aging.
——— aging; histometrical estimation of scar tissue; heart muscle; point
counting method

An interest in aging has recently grown with the increase of life span. Nevertheless, the essential mechanism of aging is entirely obscure. In order to give clues to the study of aging, various effects of aging upon many organs have been studied from many aspects. It is of interest that the heart, unlike most other organs, increases in size with aging. May et al. (1968) reported clinical features in presbycardia, and Sugiura et al. (1969) made clinicopathological studies on the aged hearts. Furthermore, McMillan and Lev (1959, 1964) and Matsuoka et al. (1969) published morphological studies on the aged hearts, and Tomanek et al. (1972) reported histological observations for collagen distribution on hearts of young and old rats. However, there has been no report on histometrical estimation of scar tissue in the aged hearts. This paper deals with histometrical estimation of scar tissue in human heart muscle with aging.

MATERIALS AND METHODS

Hearts were obtained from autopsy cases at Department of Pathology, Tohoku University School of Medicine. They consisted of 17 males and 13 females, and the ages ranged from 0 to 80 year-old (Table 1). Cases with heart diseases and hearts weighing over 400 g were excluded. The series included 7 renal diseases, 5 cerebrovascular accidents,

4 lung diseases, 5 liver diseases and 9 miscellaneous ones. Heart weight of adults ranged from 250 to 400 g.

Histological specimens were made from the anterior wall of the left ventricle and the posteromedial papillary muscle of the left ventricle. For the estimation of scar tissue in the heart muscle, Chalkley's point counting method (1943) was applied. Methods were described in detail elsewhere (Sasaki et al. 1975).

RESULTS

The percentages of scar tissue in all cases were shown in Table 1. In the endocardial part of the left ventricle, they were 0.2–14.5%, the mean being 5.3% and less than 2% in 8 cases; in the epicardial part of the left ventricle, 0.3–8.2%, the mean being 3.1% and less than 2% in 10 cases. The average percentages for the endocardial and epicardial parts of the left ventricular wall were 0.3–10.6%, the mean being 4.2%. The values in the posteromedial muscle of the left ventricle were 0.5–48.3%, the mean being 9.2%.

The scar tissue was more abundant in the endocardial part than in the epicardial part in most cases except for 3 cases. There was statistically a

TABLE 1. Age, sex, heart weight, diagnosis, and percentages of scar tissue

Case	Age (year)	Sex	Heart wt. (g)	Diagnosis	Endo (%)	Epi (%)	LV (%)	Papilla (%)
1	0	M	20	Peritonitis	0.2	0.5	0.3	0.5
2	0	M	20	Immature infant	0.7	0.3	0.5	1.9
3	13	F	260	Uremia	3.2	2.0	2.6	4.4
4	18	F	260	Cushing's syndrome	0.6	0.7	0.6	1.2
5	24	F	290	C.V.A.	3.4	3.0	3.2	4.2
6	28	F	320	D.M.	4.5	1.6	3.1	19.4
7	31	M	400	Cirrhosis of liver	4.3	2.7	3.5	2.6
8	35	M	400	Nephrosis	5.2	3.1	4.1	4.3
9	36	F	390	Uremia	1.3	0.9	1.1	3.4
10	36	M	400	Uremia	1.7	1.4	1.6	13.8
11	37	M	230	Rupture of esophagus	4.5	2.9	3.7	1.7
12	40	F	310	Uremia	2.2	0.7	1.4	7.1
13	43	F	350	D.M.	6.2	5.8	6.0	7.8
14	44	M	370	Hemolytic anemia	4.4	3.4	3.9	9.9
15	47	M	245	Cirrhosis of liver	1.6	1.0	1.3	1.7
16	47	M	360	Pneumonia	1.6	2.5	2.1	1.8
17	49	M	300	Hepatic coma	3.9	2.2	3.1	7.1
18	54	M	250	Nephrosis	2.9	1.5	2.2	3.9
19	54	F	400	Acute hepatitis	1.2	1.4	1.3	6.5
20	59	M	370	C.V.A.	7.3	6.3	6.8	9.3
21	61	M	365	Sudden death	3.0	2.3	2.7	8.6
22	61	F	380	Clonorchiasis	9.7	3.2	6.5	6.3
23	65	F	370	C.V.A.	14.5	6.5	10.6	25.9
24	65	F	335	Pneumonia	7.7	2.7	5.2	12.8
25	66	M	390	Subacute nephritis	7.0	2.6	4.8	17.6
26	72	M	300	C.V.A.	10.3	4.4	7.4	13.0
27	73	F	360	Cirrhosis of liver	10.6	7.1	8.8	14.5
28	73	M	340	Pulmonary fibrosis	14.4	4.9	9.7	8.6
29	78	M	250	Pneumonia	8.4	8.2	6.3	9.0
30	80	F	330	C.V.A.	11.4	7.4	9.4	48.3
Mean					5.26	3.11	4.19	9.24

TABLE 2. *Comparison of mean values of scar tissue in heart muscles*

	mean	<i>t</i>	<i>p</i>
Epi	3.11%	2.55	$p < 0.05$
Endo	5.26%		
LV	4.19%	2.79	$p < 0.01$
Papilla	9.24%		
Endo	5.26%	2.10	$p < 0.05$
Papilla	9.24%

Fig. 1. Percentages of scar tissue in the epicardial part and age.

significant difference between the mean percentages of the scar tissue in the endocardial and in the epicardial part of the left ventricle ($p < 0.05$) (Table 2). The scar tissue was more abundant in the papillary muscle than in the left ventricular wall except for 4 cases. The mean percentages of scar tissue in the papillary muscle was statistically different from that in the endocardial part as well as the mean value of the endocardial and epicardial parts of the left ventricle ($p < 0.05$, $p < 0.01$) (Table 2).

There was a very significant correlation between percentages of scar tissue in the epicardial part of the left ventricle and heart weight (Fig. 1). Similarly, there was a very significant correlation between percentages of scar tissue in the endocardial part of the left ventricle and heart weight (Fig. 2). Therefore, there was also a very significant correlation between mean percentages of the endocardial and epicardial parts of the left ventricle and heart weight (Fig. 3). Furthermore, there was a very significant correlation between percentages of scar tissue in the papillary muscle and heart weight (Fig. 4).

DISCUSSION

Morphological studies by McMillan and Lev (1959, 1964) on aging heart were detailed, but aging changes in the myocardium were not described. Sugiura et al.

Fig. 2. Percentages of scar tissue in the endocardial part and age.

Fig. 3. Average percentages of scar tissue in the epicardial and endocardial parts and age.

Fig. 4. Percentages of scar tissue in the papillary muscle and age.

(1964) reported quantitative estimation on morphologically normal hearts without valvular diseases, hypertension and with stenotic index less than 5. They mentioned that atrial dilatation, decrease in ventricular volume, ectasia of valvular rings and thickness of valvular cusps were physiological aging phenomena. Matsuoka et al. (1969) studied probable correlations between aging and cross-diameter of heart muscle, sclerotic changes of coronary arteries and small vessels, atrophic changes and proliferation of connective tissue in the human heart muscle. They stated that the crossdiameter of heart muscle was not related to age and the sclerotic changes initiated later in intramural small vessels than in coronary arteries, and earlier in the left ventricle than in the right ventricle. They mentioned also that atrophic changes in the muscle were related to age and more pronounced in the left ventricle, but proliferation of connective tissue was not related to age. Tomanek et al. (1972) made histological observations on hearts of young and old rats in order to determine the pattern of collagen distribution, besides chemical determination of hydroxyproline content in the heart muscle. They concluded that 28% increase in hydroxyproline concentration was associated with aging and that aging was associated with marked increase in collagen concentration in the ventricular walls at the attachment sites of the atrioventricular valves and within the atrioventricular bundle, and more focally, increases occurred in the subendocardium near papillary muscles.

Our histometrical estimation revealed that there was a very definite and significant increase in scar tissue in the heart muscle in relation to age. Although there were statistical differences between percentages of scar tissue in the epicardium, endocardium and papillary muscle, the increase of scar tissue with age was quite similar. The authors (1975) have found that scar tissue increases in the heart muscle in proportion to heart weight. Although there are several cases of cerebrovascular accidents and renal diseases, it does not appear that these cases influence significantly the results, since heart weight is limited in the range from 250 to 400 g. This increase in scar tissue in the aged hearts supports the results of Tomanek et al. (1972) and findings that hydroxyproline content in the heart muscle increases with aging (Schaub 1964/65).

Statistical differences between the amount of scar tissue depending on locations within the heart muscle were also similar to those in hypertrophic hearts. As Tomanek et al. (1972) also pointed out that specific sites within ventricles were particularly prone to a proliferation of collagen, this similar distribution of scar formation suggests the presence of impaired coronary circulation in the aged hearts. Because the degree of sclerosis of coronary arteries was not examined in this study, no distinct correlations between aging, scar formation and sclerosis of coronary arteries could be elicited.

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