A STUDY OF THE MECHANISM REGULATING THE GROWTH OF ORGANS DURING EMBRYOGENESIS

III. THE EFFECT OF TRANSPLANTS FROM THE MYOCARDIAL TISSUE OF ADULT CHICKENS AND CHICK EMBRYOS ON THE MYOCARDIUM OF EMBRYO-RECIPIENTS

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As we mentioned in our first communication [1], many authors [3-5, 9] have noted that spleen tissue from adult chickens, transplanted to the chorioallantois of chick embryos incubated for nine or ten days, stimulates spleen growth in the embryo-recipients. Simonsen [6] proposes that the spleen growth induced in embryo-recipients by spleen tissue transplanted from adult chickens is due to the ability of the transplant cells to become implanted in the embryonal spleen of the recipient and to produce, under the influence of the antigens of the embryonal tissues, antibodies which induce pathologic hypertrophy of the relevant organs of the embryo.

The observations of certain authors [2, 7, 8] contradict this explanation, however, in that they show that other organs besides the spleen, when transplanted, stimulate the growth of embryonal organs. Weiss [7] and Weiss and Wang [8], for example, showed that transplants of liver and kidney tissue from chick embryos incubated more than six days can stimulate the growth of organs in 4-day embryo-recipients.

Undoubtedly, these data are important to explanation of the mechanism regulating the growth of organs in developing embryos. They do not, however, constitute an adequate basis for the solution of such a complex problem.

We decided to conduct further research investigating whether myocardial tissue, which is known to be incapable of producing antibodies, would stimulate the growth of organs in embryo-recipients.

METHODS

The recipients used were chick embryos incubated 4, 6, 8 and 10 days. The myocardial tissue donors were adult roosters and chick embryos incubated 14 and 17 days.

The experimental methods are described in detail in our first communication [1].

RESULTS

Table 1 gives the results showing the effect of myocardial tissue transplants from adult chickens on the growth of organs in chick embryos incubated 4, 6, 8 and 10 days.

As Table 1 shows, myocardial tissue transplanted from adult chickens did not in any case increase the growth rate of the heart in the embryo-recipients.

Myocardial tissues transplanted from adult chickens to chick embryos incubated 8 days caused the growth rate of the spleen to increase (63%).

We did not, therefore, observe any increase in the growth rate of the heart under the influence of myocardial tissue from adult chickens in our experiments.

It should, however, be noted that myocardial tissue does not grow on the chorioallantois as readily as does, for example, spleen tissue [1]. We therefore proposed that the lack of stimulating ability shown by the myocardial tissue might be due to its weaker rate of growth.

We decided to transplant four pieces of tissue instead of the one piece used in the first experiment in order to increase the mass of growing myocardial tissue.

TABLE 1. Weight of Chick Embryos' Organs after Transplantation of Myocardial Tissue from Adult Chickens[1]

Age of embryo-recipient	Number of embryos	Average weight of embryo organ					
		Spleen		Heart		Liver	
		Ratio of organ's weight to total weight of embryo	In percent of control	Ratio of organ's weight to total weight of embryo	In percent of control	Ratio of organ's weight to total weight of embryo	In percent of control
4-day	14	0.0006	111.1	0.0100	101.0	0.0156	91.8
Control	15	0.00054	100	0.0099	100	0.0170	100
6-day	12	0.0008	114.3	0.007	60	0.023	85
Control	18	0.0007	100	0.012	100	0.026	100
8-day	9	0.00150	163	0.0093	104.5	0.027	117
Control	21	0.00092	100	0.0089	100	0.023	100
10-day	16	0.0007	100	0.0084	98.8	0.024	92.3
Control	17	0.0007	100	0.0085	100	0.026	100

[1]In this and the subsequent tables, the figures in the squares show statistically significant changes in the weight of the organs.

Table 2 gives results demonstrating the effect of four transplants of myocardial tissue from adult chickens on the growth of organs in chick embryos.

As Table 2 shows, the four pieces of myocardial tissue transplanted from adult chickens increased the growth rate of the heart 11.1% in 4-day chick embryos.

After transplantation of four pieces of myocardial tissue to 8-day chick embryos, the growth rate of the heart was stimulated 33.3%, of the spleen, 63% and of the liver, 21.7%.

In no case did transplantation of four pieces of myocardium from adult chickens to 6- and 10-day embryos stimulate growth of the recipients' organs.

TABLE 2. Weight of Chick Embryos' Organs Depending on Amount of Myocardial Tissue Transplanted from Adult Chickens

Age of embryo-recipient	Number of embryos	Average weight of embryo organ					
		Spleen		Heart		Liver	
		Ratio of organ's weight to total weight of embryo	In percent of control	Ratio of organ's weight to total weight of embryo	In percent of control	Ratio of organ's weight to total weight of embryo	In percent of control
4-day	12	0.00055	101.85	0.0110	111.11	0.0170	100
Control	15	0.00054	100	0.0099	100	0.0170	100
6-day	16	0.0008	114	0.012	100	0.023	90
Control	18	0.0007	100	0.012	100	0.025	100
8-day	22	0.00150	163.0	0.012	133.3	0.028	121.7
Control	21	0.00092	100	0.009	100	0.023	100
10-day	14	0.0007	100	0.0072	85	0.024	92
Control	16	0.0007	100	0.0085	100	0.026	100

Therefore, transplantation of four pieces of myocardial tissue stimulated heart growth in embryo-recipients incubated 4 and 8 days, but transplantation of one piece did not cause any increase in the weight of the heart in the embryo-recipients. Transplantation of myocardial tissue to 6- and 10-day embryos, however, caused no stimulation of organ growth.

Table 3 shows how the growth of the organs of chick embryos incubated 4 and 10 days was affected by heart tissue transplanted from chick embryos incubated 14 and 17 days.

It is evident from Table 3 that transplantation of myocardial tissue from chick embryos incubated 17 and 14 days to embryos incubated 4 and 10 days did not affect the growth of the latter's organs at all.

TABLE 3. Weight of Chick Embryos' Organs after Transplantation of Heart Tissue from Chick Embryos

Age of embryo donors and recipients	Number of embryos	Average weight of embryo organ					
		Spleen		Heart		Liver	
		Ratio of organ's weight to total weight of embryo	In percent of control	Ratio of organ's weight to total weight of embryo	In percent of control	Ratio of organ's weight to total weight of embryo	In percent of control
Donor—17-day Recipient—4-day	16	0.0004	100	0.0111	99.1	0.0168	105
Control	12	0.0004	100	0.0113	100	0.0160	100
Donor—17-day Recipient—10-day	18	0.00068	119.3	0.0096	107.8	0.0241	107
Control	14	0.00057	100	0.0089	100	0.0225	100
Donor—14-day Recipient—10-day	31	0.0008	100	0.0082	97.6	0.022	100
Control	31	0.0008	100	0.0084	100	0.022	100

Our experimental results demonstrate that myocardial tissue from adult chickens, like the spleen tissue, does affect the growth rate of the organs in the chick embryo-recipients. Embryo-recipients incubated 6 and 10 days are an exception.

The effect of myocardial tissue from adult chickens is specific when transplanted to 4-day embryos and nonspecific when transplanted to 8-day embryos.

The very slight stimulation of heart growth induced by transplanted myocardial tissues is due to the poor ability of the latter to grow on the extra-embryonic membranes of embryos.

The data presented in this paper indicate, therefore, that myocardial tissue can stimulate the growth of recipient organs despite its inability to produce antibodies.

These data do not agree with the ideas concerning the mechanism of the growth-stimulating effect of chorioallantoic transplants prevalent in contemporary literature [7].

Also, like the results obtained from the experiments described in our preceding communication [1], these data indicate that the way in which the growth of embryo-recipients' organs is changed by transplantation of corresponding organs depends on the degree of development of both the recipients and the donors.

SUMMARY

Myocardial tissues of adult hens and chick embryos incubated for 14 and 17 days were transplanted to membranes of chick embryos incubated for 4, 6, 8 and 10 days. Myocardial tissues of adult hens stimulated the growth of the recipient organs, although to a lesser degree than the tissues of the spleen. This depended on the less intensive (in comparison with the spleen) growth of the myocardial tissues on the extra-embryonic membranes of the embryos, and, consequently, on the fact that the total mass of tissues affecting the embryo organism was smaller in the case of myocardial transplantation. An increase of the transplanted myocardial tissue mass leads to a much more intensive growth stimulation of heart growth in the embryo-recipients.

LITERATURE CITED

1. I. I. Titova, Byull. Éksper. Biol. i Med., No. 4 (1961) p. 107.
2. P. J. Alten and R. A. Fennel, J. Embryol. Exp. Morph. (1959) v. 7, p. 459.
3. V. Danchakoff, Am. J. Anat. (1916) v. 20, p. 255.
4. J. B. Murphy, J. Exp. Med. (1916) v. 24, p. 1.
5. C. M. Pomerat, Exp. Cell. Res. (1949) Suppl. 1, p. 578.
6. M. Simonsen, Acta path. microbiol. scand. (1957) v. 40, p. 480.
7. P. A. Weiss, Yale J. Biol. Med. (1947) v. 19, p. 235.
8. P. Weiss and H. Wang, Anat. Rec. (1941) Suppl. 79, p. 62.
9. B. H. Willer, Am. J. Anat. (1924) v. 33, p. 67.