OBSERVATIONS ON THE REGRAFTING OF SUCCESSFUL HOMOGRAFTS IN CHICKENS*

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PERMANENTLY SURVIVING skin homografts may be obtained in 5 to 10 per cent of chicks grafted during the first three days after hatching. A series of experiments has been performed, utilizing permanently surviving[1-3] feathered homografts on adult chickens. These experiments include the following:

1. Permanently surviving homografts were returned as split thickness grafts to the original donor.
2. Permanently surviving homografts were transferred to new locations on the same recipients.
3. Permanently surviving homografts were transplanted to other chickens of the same species as the original recipient.
4. Chickens on which the original homograft had sloughed were re-homografted from the same, but now adult, donors.
5. Chickens with permanently surviving feathered homografts were re-homografted from the same, but now adult, donors.

METHOD

All the permanently surviving homografts used in this experiment were the result of transplantations performed in the first few days post-hatching, had a good growth of feathers characteristic of the donor, had survived at least three months, and in most cases, for over six months post-grafting. Except in a few of the early grafts, all had been performed between two unrelated pure breeds of chickens, Barred Rocks and New Hampshire Reds. Figure 1 shows a chicken with a permanently surviving homograft.

Numerous technical difficulties of considerable magnitude were encountered. Inhalation anesthesia, using ether, which is satisfactory in young chicks, was found to cause a high incidence of irreversible respiratory arrest, occurring at any time from the moment of induction until almost complete recovery has been attained. This is believed to be the result of the development of high concentrations of ether in the accessory air sacs where poor respiratory exchange occurs, making control of the depth of anesthesia difficult. The most satisfactory anesthesia was found to be intravenous nembutal in doses of 25 mg. per Kg. of body weight, with atropine premedication in doses of 0.1 mg. per Kg. of body weight.

The skin used for transplantation was taken as a split thickness graft of 14/1000 to 18/1000 of an inch thickness. The use of the Padget dermatome in taking the grafts directly from the chicken proved unsatisfactory because of the irregularities of the contour and consistency of the donor bed

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and skin. An attempt was made to obtain a split-thickness graft of the desired thickness by excising full thickness skin, cementing it to the Padget dermatome drum, external surface to the drum, and splitting the skin on the drum. This proved tedious and only moderately satisfactory. The Brown Electro-dermatome, which flattens the skin surface while cutting with a rapid lateral vibratory motion, proved a much more satisfactory and efficient method of obtaining the split-thickness skin grafts, with more accurate control of the thickness of the graft.

FIG. 1. The above picture shows a chicken with a skin homotransplant that had survived over six months, which we have considered the duration of survival necessary for the homografts to be considered as permanent. The homografts were rotated 180° at the time of grafting, reversing the direction of the feathers. Immediately posterior to the homograft is a control autograft, similarly rotated, but producing feathers of the same color as the recipient.

The recipient bed was completely excised down to muscle in all cases to prevent regeneration from the bed. The grafts were sewn in place with fine silk and pressure dressings were applied. Control autografts were performed in almost all instances, and were considered satisfactory if there was a 50 to 100 per cent survival of the healthy autograft. The grafts were first inspected on approximately the 10th day post-grafting, and at weekly intervals thereafter.

The reading of the grafts may be difficult at times. All grafts show hemorrhagic discoloration for the first few days after grafting. Most adult homografts "take" for a variable length of time before subsequent reaction and slough. In many homografts the reaction is manifested by the sudden development of gangrene, the entire graft becoming a black scab. In other homografts the reaction is gradual and manifested by crusting and slow shrinkage. "Take" of the simultaneously performed autograft is fairly easy to recognize and changes in an adjacent homograft are made quite apparent by comparison. In homografts which slough and are then covered with host scar epithelium, there is considerable shrinkage of the graft site, the scar epithelium is thinner in texture and much more fixed when palpated. Rarely, enough of a feather follicle survives split-thickness grafting so that certain identification of a graft is made possible by the growth of a few feathers characteristic of the original skin.

A total of 35 adult chicks with permanently surviving homografts were subjected to a regrafting procedure and survived. These experiments were:

1. Permanently surviving homografts were returned as split-thickness grafts to the original donor in 14 pairs, auto-homografts in Medawar's terminology.[4]

2. Permanently surviving homografts were transferred to new locations on the same recipient in three chickens.

3. Permanently surviving homografts were transplanted to other chickens of the same species as the original recipient in seven pairs.

4. Chickens in which the original homograft had sloughed were re-homografted from the same, but now adult, donors in six pairs of chickens.

5. Chickens with permanently surviving feathered homografts were re-homografted from the same, but now adult, donors, leaving the original homografts undisturbed in five pairs of chickens.

RESULTS

In the first experiment, permanently surviving homografts were returned as split-thickness grafts to the original donor, auto-homografts, in Medawar's terminology.[4] The first attempts at grafting adult chicken skin, performed during the development of the technic, gave unsatisfactory results and should be eliminated. In two pairs, both auto-homografts and control autografts had sloughed at the initial reading. In one pair, the auto-homograft had sloughed at the initial reading and no control autograft had been performed. In one pair, the auto-homograft had sloughed at the initial reading, while the autograft "took"; however, there was a question as to whether more than one end of the original homograft had survived, and what had been considered an auto-homograft may have actually been a new homograft. In one pair, the auto-homograft "took" initially, then sloughed, but no control autograft had been performed and the graft might have sloughed for technical reasons. In two cases the auto-homografts "took" initially, and were believed to be permanent survivals; but subsequent readings were so difficult that the results were considered questionable. All but the last three of the preceding grafts should probably be discarded. In seven pairs, the auto-homograft took initially and survived permanently. In four of these, autografts had also been performed and also "took" initially and survived permanently. In three, no autografts were performed.

In totaling the satisfactory results of auto-homografting, there were seven "takes" with survival without reaction, two "takes" with possible permanent survival, and one "take" with subsequent slough. It was difficult to evaluate whether the unsuccessful graft failed for technical reasons, or as a result of the usual homograft reaction, as no control was performed in this case. In the majority of cases, surviving homografts are compatible with the original donor.

In the second experiment, three surviving homografts were moved to a new location on the same recipient, with a simultaneous autograft being performed. Both homografts and autografts survived permanently in all three cases. A permanently surviving homograft is compatible with its original recipient.

In the third experiment, seven surviving homografts were transferred to other chickens of the same species as the recipient, by performing a simultaneous control autograft. None of the homografts survived, though one "took" initially, while the autografts "took" initially and survived permanently. Permanently surviving homografts are incompatible when transplanted to another chicken of the same species as the original recipient.

In the fourth experiment, six chickens, which had previously sloughed their homografts, were regrafted from the same donor, and a simultaneous autograft was performed. In five cases, repeat homografts had sloughed at the initial reading, while there was a good "take" and survival of all the autografts. In one case the repeat homograft "took" initially, but sloughed at 14 days. Chickens which have previously sloughed a homograft are incompatible with a repeat homograft from the original donor.

In the fifth experiment, five chickens with surviving homografts were regrafted from the original donor, leaving the original homograft undisturbed. In all five chickens

the repeat homograft "took" initially. In two there was an initial "take" of the new homograft with subsequent slough, while the control autograft "took" and survived permanently. In two, there was an initial "take" of the new homograft with subsequent slough, but the control autografts also sloughed. In one chicken, there was a "take" of the repeat homograft confirmed by feather growth with permanent survival, and a "take" and survival of the autograft permanently. In these cases, in contrast to the previous experiment in which the initial homograft had sloughed, the repeat homografts from the original, now adult, donor "took" initially and subsequently sloughed at 13 to 27 days post-grafting. In none of these cases was there any detectable change in the original homograft. Repeat homografts from the original donor to chickens with permanently surviving homografts do not survive permanently in most instances, and the sloughing of the repeat homograft does not affect the permanently surviving homograft.

The preceding results are outlined in Table I.

TABLE I. *Results of Regrafting of Successful Homografts in Chickens.*

	Total Number Grafted	Permanent Survival	Slough
Auto-homografts..... (homografts returned to original donor)	10	9	1
Homo-homografts..... (homografts moved to a new location on same recipient)	3	3	0
Homo-homografts..... (Second transplanting to a new recipient of same species)	7	0	7
Re-homografts..... (To same recipient who had already sloughed the original homograft from the same donor)	6	0	6
Re-homografts..... (to same recipient with a surviving homograft from the same donor)	5	1	4

DISCUSSION

In the re-transplantation of permanently surviving homografts in chickens, the outlined results indicate that the surviving homograft is compatible with its original donor, for on return to the original donor, nine out of ten survived. The surviving homograft is compatible with its original recipient, for it can be moved to a new location on the same recipient and survive permanently. The surviving homograft is incompatible with another unrelated recipient of the same species as the original. When a new homograft is performed from the original, now adult, donor to the original recipient, which has sloughed the original homograft, the second homograft sloughs, at the initial reading in all but one of the cases, indicating early incompatibility. A new homotransplant from the original, now adult, donor to the original, now adult, recipient with a surviving homograft, "takes" initially, but then sloughs after a delay. This initial "take" and subsequent sloughing would indicate that the permanently surviving homograft had not sensitized the recipient for a repeat homograft from the same, but now adult, donor; while this sensitization may have occurred in experiment #4 where the repeat graft had sloughed more rapidly. Another possibility is that the chickens in experiment #5, with permanently surviving homografts, are genetically more similar, and consequently stimulate a response more slowly. The reaction and sloughing of the new homograft has no effect on the original surviving homograft. Our single survival in this experiment possibly represents a transfer between two genetically similar chickens.

Homotransplants of skin performed between adult chickens, which have never been previously subjected to a homotransplantation, always fail to survive permanently, though they "take" initially and survive for a variable length of time. Skin homotransplanted in the early post-hatch-

ing period in the chick, and surviving permanently, is different from skin transplanted from the same, but adult donor. The chick skin homotransplanted early and surviving permanently is compatible with its original recipient and its original donor, but incompatible with any other recipient. Such skin, on a chicken with a permanently surviving homograft, does not slough in response to the reaction stimulated in the recipient chicken by the sloughing of a repeat homograft from the same, now adult, donor. When a repeat homograft is performed from the original, now adult, donor chicken to the same recipient chicken which has previously sloughed the original homograft, the repeat graft sloughs sooner than it does in a recipient chicken which has a permanently surviving homograft. This probably indicates sensitization from the sloughing of the original graft, which does not occur if the graft survives permanently.

CONCLUSION

The skin successfully homotransplanted in the chicks in the post-hatching period has not acquired its complete specificity (probably complete antigenic pattern) and is transplanted to chicks before they have developed their full ability to resist homotransplanted tissues (probably ability to form antibody in response to an antigenic stimulus). A repeat skin homograft from the now adult original donor appears to contain antigens not present in the original graft and, therefore, either the original homograft was transplanted prior to their development, not developing these antigens, or the incompatible antigens were eliminated. The possibility that the recipient may be able to eliminate incompatible antigens must be considered, because occasional homotransplants, performed in the immediate post-hatching period, "take" initially, later developing a reaction which subsequently clears, and the graft survives permanently, producing feathers of the same color as the donor. However, this has not been observed to occur using adult chicken skin transplanted to recipients of any age, from chicks to adults. The surviving homograft does not appear to have acquired any antigens which would make it incompatible with its original donor, but it does contain antigens which make it incompatible with any other recipient.

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