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FREE SKIN TRANSPLANTATION ON A PREPARED BED

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THE success of a free skin transplantation depends mainly on the vascularity of the wound bed. It is a common experience that on a bed in which the reparative process has already developed, the grafts heal faster than on a fresh bed.

In previous papers (Šmahel, 1962, 1964) the vascular processes in the wound bed and the revascularisation of a free skin graft in the rat were described. It was ascertained that the vascular processes in the wound bed consistently develop to the stage at which

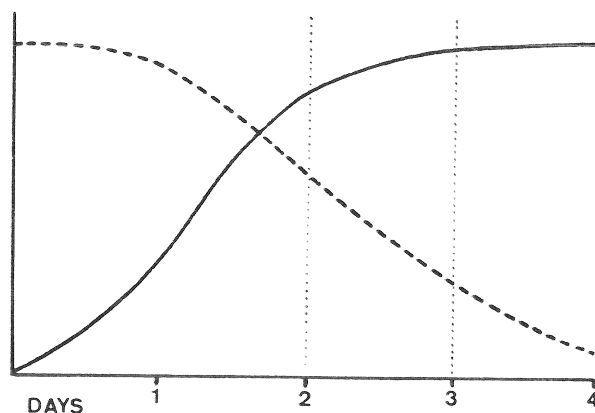


FIG. 1

Schematic illustration of a biological situation when a fresh skin graft is transplanted on a fresh skin defect. The skin defect is represented by a solid line and the skin graft by an interrupted one. Revascularisation begins between the 2nd and 3rd day.

the vascular links can be formed between the second and third day after infliction. Accordingly, the biological situation in free skin transplantation can be illustrated as in Figure 1. The fresh skin defect develops its reparative processes. The graft, deprived of blood supply, begins to lose its biological activities, degenerates and if not revascularised, undergoes necrosis between the fourth and fifth day. The revascularisation of a graft cannot start until many capillary sprouts have developed in the wound bed and a graft transplanted to a fresh skin defect must wait until this occurs.

It can be assumed that better biological combination would be achieved and better results obtained if a graft were placed on a two-day-old bed in which the reparative processes had already been triggered and many capillary sprouts had developed. In this case the vascular processes in the wound bed reach the graft when it is still in good biological condition. To verify this assumption the following experiment was performed:

Material and Method.—Animals used were 40 female rats with a weight range of 100–150 grams. On the right side of the depilated dorsum, a circular (subpannicular)

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skin defect, 10 mm. in diameter, was produced. The skin defect was covered with a free skin graft. On the second day after surgery, the graft was removed and replaced by a new full thickness one. At the same time, a similar symmetrical skin defect was produced on the left side and covered with a free skin graft, both of which had been taken on the same day; the left graft was transplanted on to a fresh bed while the right was placed on a bed two days old. The progress of revascularisation was studied in total specimens of the whole skin cleared in glycerin. The vascular system was visualised by supravital intracardiac filling with a mixture of Indian ink and gelatin as described previously (Šmahel, 1962, 1964).

Results.—Immediately after surgery both grafts had the same appearance of extreme pallor. The findings in the wound beds however were strikingly different. In the left bed, only a small number of vessels were observed (Fig. 2). In the right bed, two days old, the regenerative vascular processes characterised by formation of arcade-like networks, were fully developed (Fig. 3). The first day after surgery the left graft was still pale. In the underlying bed the arcade-like networks were in the developing stage (Fig. 4). At this time the right graft was, in most cases, already pink. The first vessels of the graft were filled with injection substance which proves that the first vascular links had been formed (Fig. 5). On the second day after surgery, the left graft was also pink and its revascularisation had begun (Fig. 6). At the same time the process of revascularisation in the right graft was distinctly more advanced (Fig. 7). Subsequently the right graft was always ahead, retaining its advantage and healing sooner than the left graft. Eight days after transplantation, the restoration of blood supply in the left graft showed some signs of imperfection. Sometimes more serious disturbances were observed followed by superficial or deep desquamation of the graft. At the same time the process of revascularisation in the right graft was completely terminated. The right graft, whose good appearance was already striking during healing, healed perfectly with no tissue loss.

CONCLUSIONS

The results obtained support the theoretical assumption that on a skin defect in which the reparative process has developed to a certain degree, and which is called in this paper "prepared", the graft finds better conditions for healing than on a fresh defect.

During the experiment the defects were covered by grafts which were slipped off on the second day. In experiments on rats such a tactic is important because otherwise a scab develops in the defect and makes the take of a graft impossible. For temporary covering of the wound bed we used with equal success auto- and allografts both fresh and refrigerated.

The healing of a graft in a shorter time period is not the main feature of the procedure just described. The main advantage is that healing in a shorter time was achieved by reduction of the stage of plasmatic imbibition. The initial stage of imbibition, called also the stage of plasmatic nutrition, lasts usually 48 hours when grafting on a fresh skin bed. When a graft is transplanted to a prepared bed, this stage is reduced to about one-half. During the stage of plasmatic imbibition, the graft is in a critical biological situation because it has no blood supply. Reduction or shortening of this stage has therefore a favourable influence on the result of transplantation. The graft heals safely and preserves very well its histological structures.

One of the factors which accompanies the stage of plasmatic imbibition is the development of vascular processes in the wound bed to the stage at which the vascular links can be formed.

FREE



FIG. 2.

Fig. 2.—Fresh skin defect filled with Indian ink and surface of the graft. A small wound bed. The graft is on the left.

Fig. 3.—Two-day-old skin defect. The graft is on the left.



FIG. 4.

Fig. 4.—One-day-old skin defect. The arcade-like network of the graft is visible. The graft is on the left.

Fig. 5.—The graft alone, 48 hours. The first vascular links are visible on the lower surface. The graft is on the left.



FIG. 6.

Fig. 6.—The graft alone, 48 hours. A few of the first vascular links are visible on the lower surface. The graft is on the left.

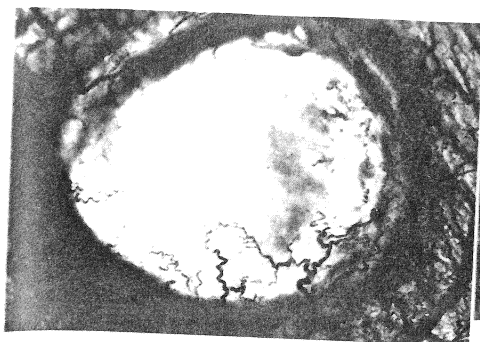


FIG. 2

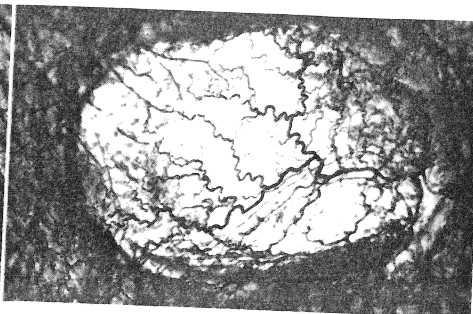


FIG. 3

Fig. 2.—Fresh skin defect with the graft. Total specimen cleared in glycerin. The vessels are filled with Indian ink and gelatin. Viewed from below, through the wound bed on to the lower surface of the graft. A small number of preserved vessels can be observed at the margin of the wound bed. The graft is pale, there is no filling of its vasculature. $\times 3.3$.
Fig. 3.—Two-day-old skin defect with the graft. The same technique and orientation as in Figure 2. In the wound bed there are fully developed arcade-like networks. $\times 3.3$.

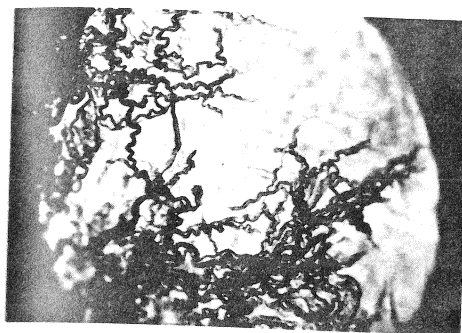


FIG. 4

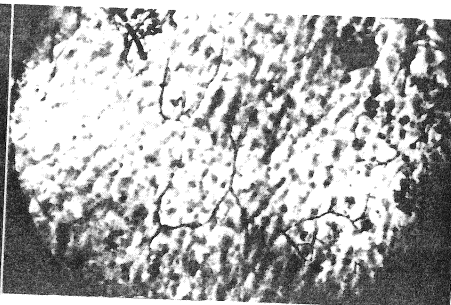


FIG. 5

Fig. 4.—One-day-old skin defect with the graft. The same technique and orientation as in Figure 2. The arcade-like networks in the wound bed are in the stage of development. The graft is pale, there is no filling of its vasculature. $\times 5.5$.
Fig. 5.—The graft alone, 24 hours after transplantation on a two-day-old bed. Viewed on its lower surface. The first vessels of the graft are filled with injection substance. $\times 5.5$.



FIG. 6

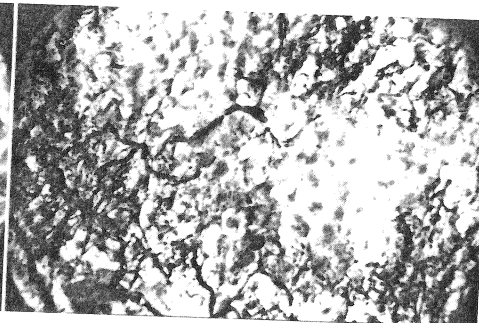


FIG. 7

Fig. 6.—The graft alone, 48 hours after transplantation of a fresh skin defect. Viewed on its lower surface. A few of the graft vessels are filled with injection substance. $\times 5.5$.
Fig. 7.—The graft alone, 48 hours after transplantation on a two-day-old defect. Viewed on its lower surface. Many vessels are filled with injection substance. $\times 5.5$.

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SUMMARY

Full thickness skin grafts placed on either freshly cut beds or two-day-old beds have been compared in rats.

On the "prepared" beds the stage of plasmatic imbibition was reduced to about one-half that on a fresh bed and healing throughout was more reliably successful.

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PREPARATION-PHENOMENON IN A FREE SKIN GRAFT

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IN a previous paper (Šmahel, 1971), the healing of a free skin autograft on a prepared bed in the rat was studied. The term prepared bed was used to designate a two-day-old skin defect. At this time the proliferation of capillaries in the wound bed reaches the stage in which the vascular links with the graft can be formed. When grafting on a bed ready for revascularisation of a graft, the initial stage of plasmatic imbibition is reduced to about one half.

The aim of the present study was to ascertain whether the interval preceding the revascularisation of a graft upon a prepared bed corresponds with the time necessary for the development of vascular anastomoses between bed and graft.

Materials and Methods.—The animals used were 118 female rats with a weight range of 140 to 200 grams. The rats had free access to food and water. All experimental

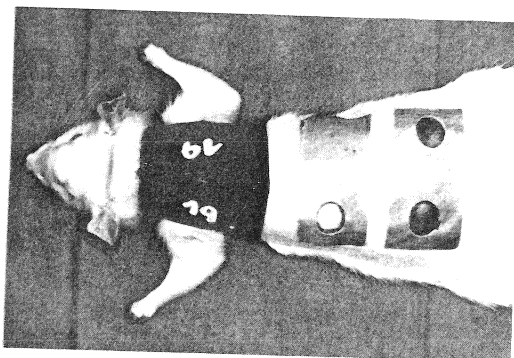


FIG. 1

The donor sites are on the caudal half of the trunk ;
prepared beds with transplanted grafts on the cranial
half.

procedures were performed under the ether anaesthesia. Three days before the experiment, the skin of the dorsum and flanks was closely clipped. The animals were not used if their skin was in the growing phase of the hair cycle (anagen). Mutilation of transplants was prevented by a rubber vest (Fig. 1).

In each rat, two symmetrical beds were prepared on the cranial half of the trunk. The subpannicular skin defects, 10 mm. in diameter, were created with the aid of Luer's forceps. The skin discs obtained were freed from panniculus carnosus and frozen with an ethyl chloride spray. After thawing, the grafts were used as temporary covering for the prepared beds. Two days after surgery, the grafts were removed and the defects prepared for the actual experiment. The difference in vascularisation between a fresh and prepared bed was shown in the previous paper (Šmahel, 1971).

Full thickness skin grafts obtained from the caudal half of the trunk, using the same

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technique, were transplanted on to the prepared beds. Moist and dry pledgets were applied in that order over each transplant and the surgical areas covered with adhesive tape (Fig. 1).

In order to determine the onset of revascularisation, the graft was removed and its undersurface inspected stereomicroscopically. Before the onset of revascularisation, i.e., during the stage of plasmatic imbibition, the grafts were pale and no blood could be detected in their vessels (Fig. 2). In grafts in which revascularisation had started, the vessels filled with bright red blood could easily be seen (Fig. 3). Fine extravasates were found near the filled vessels (Fig. 3—arrows).

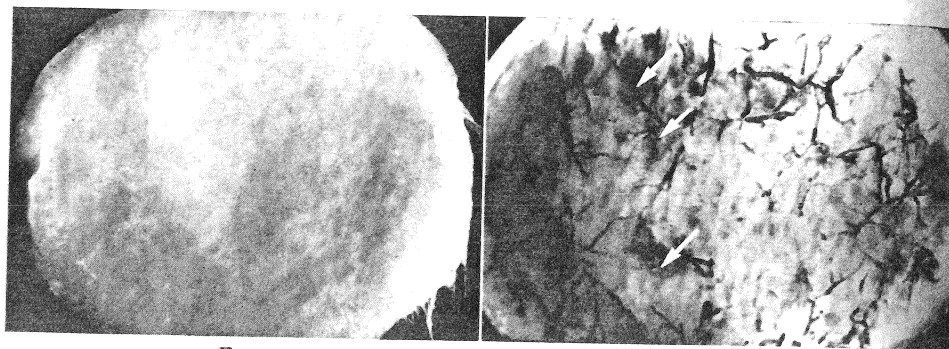


FIG. 2

FIG. 3

Fig. 2.—The undersurface of a fresh skin graft.

Fig. 3.—The undersurface of a graft after the beginning of its revascularisation. Extravasates indicated by arrows.

Results.—*Experiment No. 1.*—Forty rats were used. Fresh skin grafts were transplanted on to prepared beds. Removal and examination of the grafts were performed 14–23 hours following transplantation. Four rats (8 grafts) were used for each hourly interval. The grafts removed 14, 15 and 16 hours after transplantation were pale and there was no filling of their vasculature. The first filling of the vessels with blood occurred in 3 grafts after 17 hours. In 5 grafts, revascularisation took place 18 and 19 hours following transplantation. In all grafts the onset of revascularisation had begun by the 20th hour.

Experiment No. 2.—Twenty rats were used. Fresh skin grafts were transplanted on to prepared beds. Ten hours after surgery, the grafts on the left side were removed, rotated through 180° and replaced. These rotated grafts were in all cases pale. Fourteen hours after this procedure (i.e., 24 hours after the first surgery), the grafts on both sides were removed and their undersurfaces inspected. Revascularisation had begun in all grafts. There was no significant difference in the filling of their vasculature.

Experiment No. 3.—Twenty rats were used. Fresh skin grafts were transplanted on to prepared beds on the animal's right side. On prepared beds on the left, grafts were placed that had been taken 24 hours previously and had remained during this interval on donor sites. The grafts transferred from the donor sites on to the prepared beds were uniformly pale. Ten hours after transplantation, all grafts were removed and examined. The grafts from the right were pale, while in those from the left revascularisation had already begun.

Experiment No. 4.—Twenty-eight rats were used. Grafts taken 24 hours previously and left on the donor sites were transplanted on to prepared beds. Removal and

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examination of the grafts were performed 3-9 hours following transplantation. Four rats (8 grafts) were used for each interval. The grafts removed 3 and 4 hours following transplantation were pale. The filling of the grafts' vasculature with blood began after 5 hours in 2, after 6 hours in 3 and after 7 hours in 6 grafts. Eight and 9 hours following transplantation the revascularisation had started in all grafts.

Experiment No. 5.—Ten rats were used. Grafts were taken one day before transplantation. One-half of each graft was frozen using an ethyl chloride spray, the other half being protected. After thawing, this procedure was repeated. The demarcation between the frozen and unfrozen halves was noted on the epidermis and the grafts

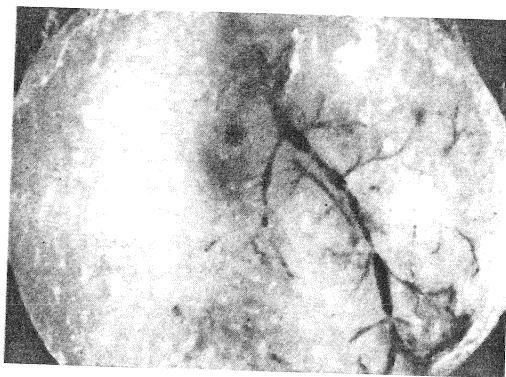


FIG. 4

Early stage of revascularisation in a graft in which the left half was frozen prior to transplantation.

were returned to the donor sites. Twenty-four hours after this procedure the grafts were transplanted on to prepared beds. Removal and examination of grafts were performed 10 hours after transplantation. The revascularisation occurred in the unfrozen halves of the grafts only. The frozen portions were pale (Fig. 4).

DISCUSSION

The filling of the graft's vasculature with blood was used as the criterion for determining the onset of its revascularisation. The filled vasculature of the graft showed a characteristic pattern as reported in another paper (Šmahel and Ganzoni, 1970). In this paper using the injection technique, it was also verified that the filling of the grafts' vessels with blood is realised via vascular links between bed and graft.

The cause of the occurrence of extravasates in the graft is not clear. The capillaries grow as solid sprouts and later become canalised. To form functioning anastomoses, the sprouts must open. The occurrence of extravasates could perhaps be explained as a malformation of the vascular links with resulting escape of blood.

In experiment No. 1 it was found that the revascularisation of a fresh skin graft on a prepared bed begins most commonly between the 18th and 20th hour. This is in agreement with the statement of Thiersch (1874) who, in man, transplanted full thickness skin grafts on to granulation tissue. He observed the onset of revascularisation 18 hours after surgery.

In experiment No. 2 the gliding layer between the bed and graft was disrupted. This procedure, performed 10 hours after transplantation, had no distinct effect on revascularisation of the graft. The experiment indicated that the vascular links between

bed and graft are not formed until the second half of the period preceding the revascularisation under our experimental conditions. It was speculated that a fresh skin graft does not stimulate the growth of capillaries in the wound bed and the capillary sprouts do not show therefore any tropism to its tissues. The graft acquires the stimulative property some hours after its taking.

This hypothesis is confirmed in experiment No. 3. The result leads to the conclusion that in the ischaemic tissues of the graft, biochemical processes develop and at a certain stage these processes act to stimulate the growth of capillaries. For these processes, of unknown nature, we have used the term "preparation of the graft". A prepared graft gives an impetus to the capillary sprouts in the prepared bed immediately after transplantation. Experiment No. 3 also indicates that the biochemical processes in the graft are not specific for any one given transplantation but rather have a more general character. The graft can be prepared on one bed (donor site in our experiments) and the preparation can be utilised on another (recipient site).

The preparation of both graft and bed for transplantation was theoretically considered by Thiersch (1874). The favourable effect of delaying a graft on the donor site when grafting on a defect of poor vascularity was presented by Hynes (1954). He believed that the graft took better when "loaded" with tissue fluid.

In experiment No. 4 it was found that the revascularisation of a prepared graft upon a prepared bed starts between the 5th and 8th hour after transplantation. This interval can be defined as the minimal time required for the capillary sprouts to traverse the distance between bed and graft and form vascular links. The revascularisation of a fresh skin graft upon a prepared bed (experiment No. 1) started between the 17th and 20th hour. Consequently, the preparation of the graft could be effected at the earliest in 9 hours (17 minus 8), and at the latest in 15 hours (20 minus 5). Nevertheless, further experiments, not included in this paper, suggest that the interval of 12 hours should be taken as the lower limit for preparation. The interval of 12-15 hours was approximately the time necessary for the preparation of the graft in our experimental conditions. Using morphological techniques it is possible to detect the existence of preparation-phenomenon in a graft. The method is, however, too rough to give precise information about the duration of this phenomenon, and the time-data in this paper should be accepted as indicative only.

Experiment No. 5 has shown that the preparation-phenomenon in a graft is strongly influenced by freezing and seems to be the result of the activity of living cells. This corresponds with the conclusions made by Ashton (1957, 1961). Nevertheless, experiment No. 5 offers parallel or alternative explanations. Capillary sprouts from the wound bed cannot form anastomoses with graft capillaries, the endothelial cells of which are no longer viable. Furthermore, the killing of endothelial cells could prevent the vessels in the graft from some kind of biological activity which might be necessary for formation of vascular links (Gibson, 1970). The possible active role of graft vasculature in the formation of anastomoses with bed capillaries is considered below.

The unfavourable effect of freezing upon the take of a graft is in agreement with the findings made by Rous (1926). In his experiments, the process of freezing and thawing was carried out three or four times. Grafts pretreated in this way were never vascularised. On the contrary, Zwicker (1959) found that a single freezing of the graft lasting 3-4 minutes did not influence its healing. The degree and duration of freezing seem to be decisive.

We also performed short-time freezing of grafts which were used as a temporary covering for beds under preparation (see Materials and Methods). The reason for this tactic was our earlier experience that this procedure suppressed the revascularisation of a graft. When using fresh skin grafts for this purpose, vascular links develop between

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From the experiments the conclusion can be drawn that a preparation-phenomenon exists in a free skin graft which determines the onset of its revascularisation. The preparation is biochemical in nature, has a more general character and requires approximately 12-15 hours. The prepared graft stimulates the growth of capillaries. The preparation is deeply influenced by freezing.

In a healing skin defect, the regeneration of blood vessels is governed by factors intrinsic to the healing of a skin wound. When transplantation is performed, the skin graft must stimulate proliferating capillaries to grow towards its tissues. It can be postulated that this impetus must present a greater attraction for the capillaries than that which already exists in the healing wound.

Several factors which could provoke the growth of capillaries have been considered by many authors. The free skin graft is deprived of a blood supply. Ischæmia of tissues was considered by Myers and Cherry (1969) as a stimulus for the delay phenomenon in a skin flap. According to Williams (1959), the principal stimulus for growth of vascular endothelium is hypoxia of a certain degree and duration. Remensnyder and Majno (1968) found that a hypoxic gradient exists across the incompletely vascularised wound. Ischæmia with subsequent hypoxia seem to be the factors promoting anaerobic metabolism rather than the specific stimuli for the growth of capillaries. Araki (1891) was probably the first who found that acidosis develops in hypoxic tissues, this being mainly caused by an increase in lactic acid. This statement was confirmed and expanded upon by many others. Rous (1926) and Tammann (1931, 1933) investigated the pH changes in free skin grafts. Acidosis developed within one hour and then remained constant. The pH values stated by Rous (1926) were 6.8 and by Tammann (1933) 6.3-6.8. The prompt development of acidosis in ischæmic tissues found by many others (Dery *et al.*, 1965; Dmochowski *et al.*, 1966; Solonen *et al.*, 1968) is contrary to the hypothesis that the acidosis of tissues is the factor stimulating the growth of capillaries. The hypothesis is definitely not applicable to the observations made in our experiments since the capillaries still showed a tropism towards the graft after 12-15 hours.

The idea that the growth of capillaries is regulated by chemotaxis was put forward by Loeb (1893). Many substances which could be vasoformative were considered by other authors. (For a survey of this concept, see Cook and Fardon, 1942, and Hegemann *et al.*, 1950.) Marckmann (1966) came to the conclusion that biochemical changes in the graft have many factors in common with the skin response to physical or chemical injury as well as with the connective tissue changes induced by ageing.

Ashton (1957) when studying the growth of vessels in the retina, formulated three basic requirements for the stimulation of capillary proliferation: (1) the presence of living cells to ensure an active metabolism, (2) a low oxygen tension to promote anaerobic metabolism and (3) a poor venous drainage to permit the accumulation of anaerobic metabolites wherein the vasoformative factor probably lies.

These requirements are perfectly fulfilled by a free graft. The author believes that three stages should be distinguished in the biochemical changes which develop in the graft after its removal: (1) the stage of aerobic metabolism whose duration is determined by the reserve of oxygen and by the metabolic activity of the grafted tissues, (2) the stage of anaerobic metabolism in which the biochemical changes are still reversible and (3) the stage of tissue degeneration leading to necrosis of the graft. When working anaerobically, cells release some vasoactive metabolites most probably proteinaceous in nature. The duration of the preparation-phenomenon could be explained either according to Ashton (1957) as the time necessary for the accumulation of vasoactive

substances to an effective concentration or that the vasoactive metabolites are not released until several hours of anaerobic metabolism have taken place and the injured cells have begun to break down their protein structures thus introducing the stage of degeneration.

The hypothetical vasoformative factor released in ischaemic graft tissues stimulates the growth of capillaries in the wound bed towards the graft. It may be presumed that such a stimulus might be acting upon the capillaries in the graft as well. The formation of sprouts at the cut surface of the graft could influence the duration of the preparation-phenomenon in a free skin graft and the onset of revascularisation.

The sprouting and growth of capillaries in the graft has been observed by Williams (1953) and by Merwin and Algire (1956) in micrografts of omentum and thyroid tissue buried in a transparent chamber. To what extent are we justified in applying these findings to a free skin graft transplanted to a healing skin defect?

Merwin and Algire (1956) remark in their paper that "such small grafts survived whether or not they became vascularized". This suggests that the metabolic requirements of the minute grafts of omentum and thyroid tissue were sufficiently covered by the tissue fluid. This could be the explanation why the capillaries in the graft were able to respond to the stimulation. When grafting adenocarcinoma (Merwin and Algire, 1956), where the metabolic requirements of the transplanted tissue are much higher, the growth of capillaries in the graft could not be detected while there was a pronounced reaction in the host vessels. Merwin and Algire conclude that "relatively anoxic conditions may have prevented any surviving vessels from forming sprouts".

I believe that this is the case in a free skin graft. The skin graft is in a critical biological situation, the retention of catabolites in its tissues is extensive with consequent acidosis and the graft dies within a few days unless early vascularisation is established. Under such conditions it seems unlikely that its endothelium would respond to a vasoformative stimulus by formation of capillary sprouts.

In my opinion the growth of capillary sprouts from the wound bed is of primary importance for graft revascularisation. On the other hand, it is probable that the endothelium at the cut surface of the graft responds to the vasoformative stimulus by some biological activity necessary for the formation of anastomoses with the sprouts from the wound bed. For this reason the term "preparation of the graft" is used to leave this question open for further more detailed studies.

The idea of conditioning the graft for transplantation is one of the oldest traditions in plastic surgery beginning with the beating of skin in India (Gibson, 1960). The effectiveness of the various procedures employed is presumably determined by the degree to which they provoke or accelerate the processes developing in an untreated graft after its removal.

Finally, the author believes that free skin transplantation on to a prepared bed—with the possibility of performing various procedures with the graft *in vitro*—is a suitable methodological approach to the study of factors governing the growth of capillaries.

SUMMARY

From experiments on rats the conclusion is reached that a preparation-phenomenon exists in a free skin graft which is biochemical in nature. The preparation-phenomenon is one of the factors determining the onset of revascularisation of a free skin graft.

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BIOLOGY OF THE STAGE OF PLASMATIC IMBIBITION

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THE revascularisation of every skin graft is preceded by an interval which was called by Huebscher (1889) the stage of plasmatic circulation. The studies of Converse *et al.* (1957) have shown that the penetration of tissue fluid is a one-way process and that the term "stage of plasmatic imbibition" is more justified. Many authors use the term "stage of plasmatic nutrition" also. According to Clemmesen (1962), the purpose of this stage is to keep the graft moist rather than to nourish it. In a recent study, Converse *et al.* (1969) suggested the term "phase of serum imbibition". Many aspects of this stage were studied by several authors but its biological significance is still not clear.

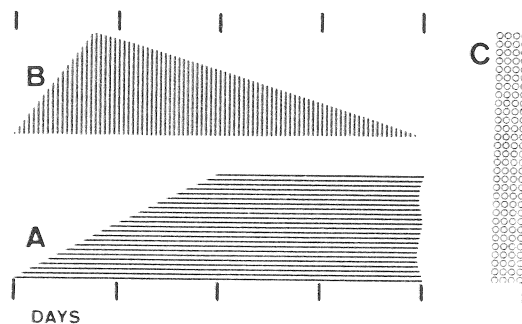


FIG. 1

Schematic illustration of factors sharing in the stage of plasmatic imbibition. A—Preparation of the bed. B—Preparation of the graft. C—Interval for formation of vascular links.

In a previous paper (Šmahel, 1971a) it was verified experimentally that accompanying the phase of plasmatic imbibition there is development of vascular processes in the wound bed up to the stage at which vascular links with the graft can be formed. The wound bed having reached this stage was designated "prepared". When grafting on a prepared bed, the phase of plasmatic imbibition is reduced to about half.

In another paper (Šmahel, 1971b) it was shown that a preparation-phenomenon exists also in the free skin graft. The phenomenon is biochemical in nature and requires approximately 12-15 hours to occur. Thereafter the graft begins to stimulate the growth of capillaries in the wound bed and direct them towards the graft. This preparation-phenomenon is a further factor determining the onset of revascularisation because the capillaries do not show any tropism to a fresh skin graft.

When a prepared graft is transplanted on to a prepared bed, the growth of capillaries towards the graft begins immediately after transplantation and the stage of plasmatic imbibition is reduced to the shortened period necessary for the formation of vascular links. In our experiments (Šmahel, 1971b) this period was 5-8 hours.

These statements suggest that three general processes share in the existence and duration of the stage of plasmatic imbibition (Fig. 1).

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- (1) Preparation of the bed (A). The interval of 48 hours shown schematically is the minimum time for this to occur.
- (2) Preparation of the graft (B). This phenomenon seems to reach its optimum between 12 and 15 hours and then to pass into degeneration and necrosis of the graft.
- (3) The formation of vascular links (C), between the wound bed and graft.

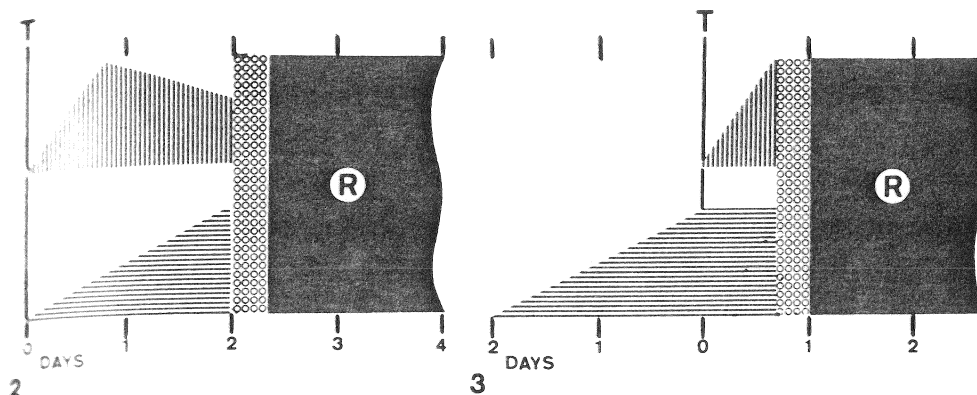
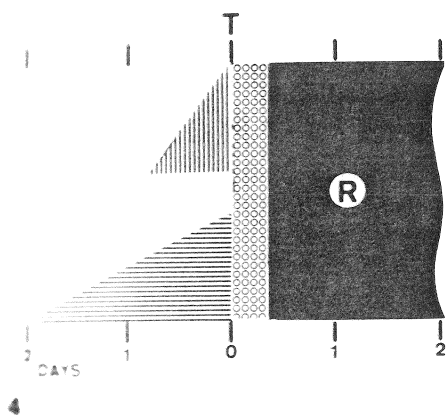


Fig. 2.—Biological situation when a fresh skin graft is transplanted on to a fresh skin bed. T—Day of transplantation. R—The stage of revascularisation.

Fig. 3.—Biological situation when a fresh skin graft is transplanted on to a prepared bed. T—Day of transplantation. R—The stage of revascularisation.

Fig. 4.—Biological situation when a prepared graft is transplanted on to a prepared bed. T—Day of transplantation. R—The stage of revascularisation.



FIGS. 2-4

The participation of these three factors in the existence and duration of the stage of plasmatic imbibition depends on their biological combination. Four different combinations are possible :

- A. Fresh graft on a fresh bed.
- B. Fresh graft on a prepared bed.
- C. Prepared graft on a prepared bed.
- D. Prepared graft on a fresh bed.

A fresh graft on a fresh bed (Fig. 2).—The duration of the stage of plasmatic imbibition is given by the sum of A and C. The interval for the preparation of the graft (B) is exceeded by the interval for the preparation of the wound bed (A). There is a biological disharmony between the wound bed and the graft which can be briefly

expressed in words: "The prepared graft waits for the preparing bed". The favourable effect of cooling a graft could be explained in the following way: through retardation of the biochemical processes, the graft reaches its peak of preparation later, i.e., more in harmony with the processes in the wound bed.

A fresh graft on a prepared bed (Fig. 3).—The duration of the stage of plasmatic imbibition is given by the sum of B and C. The preparation of the bed (A) was accomplished before transplantation and the stage of plasmatic imbibition is therefore reduced. Again, there is a biological disharmony: "the prepared bed waits for the preparing graft". This biological disharmony seems preferable to combination No. 1, because the bed has a blood supply while waiting and it does not lose its biological qualities as is the case with the graft. The most common example of this biological combination is obviously transplantation on healthy granulation tissue.

A prepared graft on a prepared bed (Fig. 4).—The duration of the stage of plasmatic imbibition is reduced to the interval C, because the preparation of both wound bed

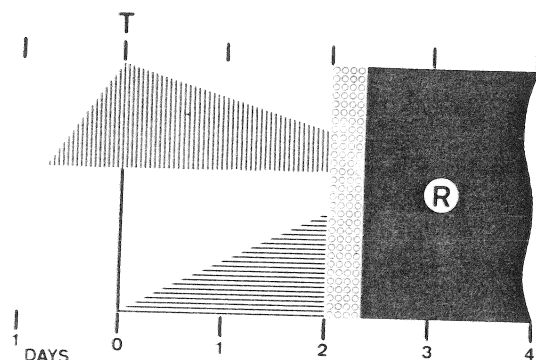


FIG. 5

Biological situation when a prepared graft is transplanted on to a fresh skin bed. T—Day of transplantation. R—The stage of revascularisation.

and graft was accomplished before transplantation. The optimal biological combination has been achieved because both partners are simultaneously ready for revascularisation. This can be realised in practice if a graft is left 12-24 hours on the donor site and then transferred to a prepared bed. While this verified the theory, it did not contribute to the success of the transplantation in our experiments, the same results being obtained as with combination No. 2. The cause of the biological ineffectiveness can be seen in that the preparation of the graft on the donor site was achieved by depriving its tissues of a blood supply. The restoration of the blood supply begins in both biological combinations (2 and 3) following the same interval after removal.

A prepared graft on a fresh bed (Fig. 5).—The duration of the stage of plasmatic imbibition is given by the sum of A and C. The preparation of the graft was accomplished before the transplantation. The biological disharmony between the bed and graft was increased and can be briefly expressed as follows: "the prepared graft again waits for the preparing bed" and is all the while degenerating. The prepared graft can provoke early formation of vascular links after transplantation and thereby precociously inhibit the development of vascular processes in the wound bed before they reach the optimal degree for revascularisation. When this combination was tested in practice, the transplantation usually met with failure, sometimes after a promising beginning. It can be concluded that a prepared graft should be transplanted on to a prepared bed.

In some papers dealing failure was probably due to fresh beds.

The time factors of from my own above-mentioned bed (A) is presumably due to recipient site. The preparation of the transplant links (C) seems to be determined by the wound bed must traverse the expected when working in the present paper was to point out the plasmatic imbibition rather than

A possible biological Three processes sharing in are described. The particular conditions in free skin transplan

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In some papers dealing with the possibility of preparing a graft for transplantation, failure was probably due to the fact that the pretreated grafts were transplanted on to fresh beds.

The time factors of the three processes under consideration (A, B, C) were taken from my own above-mentioned papers. The duration of the preparation of a wound bed (A) is presumably determined by the vascularity and regenerative capacity of the recipient site. The preparation of the graft (B) is probably dependent on the metabolic activity of the transplanted skin. The time necessary for the formation of vascular links (C) seems to be determined by the distance which the capillary sprouts from the wound bed must traverse to reach the vessels of the graft. Thus, variations can be expected when working under different experimental conditions. The purpose of the present paper was to point out the existence of the processes which affect the stage of plasmatic imbibition rather than to emphasise their time factor.

SUMMARY

A possible biological conception of the stage of plasmatic imbibition is given. Three processes sharing in the existence and duration of the stage of plasmatic imbibition are described. The participation of these processes in four possible biological combinations in free skin transplantations is considered.

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