A New Technique of Skin Transplantation and a Preliminary Evaluation of the Effects of Solcoseryl* on Graft Acceptance

G. E. FACKELMAN

Department of Equine Surgery, University of Zurich, Switzerland

MANY different methods of skin grafting have been employed in man and animals over the years. Each has its proponents and opponents, its advantages and disadvantages (Payne, 1961).

The purpose of all of them is the same: to accelerate the epithelialization of areas denuded of skin.

Meagher and Adams (1970) reviewed the various types of skin grafts used in horses, and stated that there were three reasons for their failure to take: movement between graft and recipient; haematoma formation; infection. To these, a fourth can be added: the insufficient or slow proliferation of blood vessels of the recipient bed, which are essential for the survival of the graft.

These problems have plagued veterinary surgeons for many years. One way to overcome them is to use the classical “pinch” or small skin grafts. The so called “seedling techniques” or “small deep grafts” described by Reverdin (1908), Braun (1920) and later by Davis (1940), can be used for animal patients. (Ammann, 1952, 1954, 1957; Boyd and Hanselka, 1971; Eggers, 1955; Mackay-Smith and Marks, 1968; Meagher, 1970; Neal, 1958, 1961; Roth, 1955; Schebitz, 1955; Wyere, 1959; Woolsey and Shafer, 1952). Thiersch (1886) was the first to propose the transplantation of entire pieces of split-thickness skin, and the technique still bears his name.

MacLennan (1912) proposed cutting Thiersch transplants into strips and threading these through the granulations of a defect. This “tunnelling” technique was later adapted for horses (Obel, 1951; Björk and Twisselmann, 1971).

The purpose of this paper is to describe a technique which, to the best of the author’s knowledge, has not been reported in either the veterinary or the medical literature. It can be considered as a simplification of the mesh graft technique originally reported upon by Lanz 1908, or as a further development of the “sieve grafts” devised by Douglas (1930) and later modified by Dragstedt (1937). In all these procedures, serial openings are made in the tissues to be grafted.

Lanz used a device consisting of sections of razor blades embedded in “bed of nails” fashion in a block of wood. The graft was placed on the blades and a porcelain cylinder rolled over it. The many slits thus produced resulted in a mesh—or net-like quality of the transplant and a great increase in its expandability.

At the site of removal Douglas (1930) punched holes in the skin of the donor before the graft was removed.

He then carefully incised around the punched areas thereby leaving small islands of skin still attached after the tissues to be transplanted had been lifted off.

Dragstedt (1937), after removing an elliptical piece of skin as a transplant, proceeded to make many small stab incisions in it using a scalpel. He closed the wound at the “donor site” by primary suture.

Surgical Technique

The size of the defect, or the defect created after excision of a tumour is delineated and measured. The direction of the hair growth is noted to ensure that the skin is correctly placed. A split skin graft 0.5-0.8 mm. in thickness and of appropriate dimensions is removed using an electric dermatome.

The donor site selected is either the skin of the ventral abdomen or the inner thigh. Here the skin is firmly adherent to the underlying tissues and lies flat, making it easy to resect with the dermatome, and any resultant scarring is inobtrusive. The removed skin is placed immediately between two layers of sterile gauze sponge and immersed in a 50 per cent (vol.-vol.) solution of Solcoseryl in lactated Ringer’s solution (fig. 1).

Solcoseryl is an injectable calves’ blood extract that has received considerable attention in Europe, and favourable results have been reported following its use in man (Agrotis, 1968; Gabka, 1967; Hürlimann, 1968; Kern and Obrowsky, 1965; Menna, 1964; Meythaler and Pfann, 1969; Röll, 1963; Steinhoff, 1967; Stratmann, 1963) and in several animal species (Betancourt and Lennhoff, 1965; Gabka, 1967; Halasz, 1963; Kerenyi and Yellinek, 1971; Malaker and

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* Solco Basel AG, Basel CH.
Solcoseryl is reported to have the following actions: (a) It increases oxygen metabolism at the cellular level (Jaeger, Leybold, Mittenzwei, Staudinger and Waldstätten, 1965). (b) Fibroblasts are activated and show increased proliferation (Wickingen, 1960) and (c) The capillary network within a graft remains open which results in an improved nutrition in the so-called perinecrotic zones (Fülop, 1969).

The product is described by its manufacturers as a protein-free extract of blood taken from calves with elevated RES activity. Standardization is by the Warburg method whereby Solcoseryl is added to homogenized guinea pig liver cells in a microrespirometer. The standard concentration must increase the oxygen uptake of the cells by 200 per cent.

The recommended daily dosage in man following skin transplantation is 2-4 cc. i/m or i/v. This is usually administered in conjunction with the local application of the 5 per cent saline.

Preparation of the recipient area
This is as follows: After careful shaving, cleansing and disinfection, any necessary excision is carried out with careful attention to haemostasis. The site is then protected with a sterile gauze sponge.

Preparation of the transplant
The transplant is removed from the Solcoseryl solution and placed on a sterile wooden block. Holes are then cut in the graft using a sharp-edged 5 mm. diameter skin punch (figs. 2 and 3). The openings should be placed in such a way that any three of them will form an equilateral triangle with sides 2 cm. in length.

Application and fixation of graft
The prepared graft is then placed on the recipient site and cut to conform exactly to its outline (fig. 4). The graft is secured in position with interrupted sutures using 4/0 atraumatic teflon. Eight sutures are inserted, one at each corner and one midway along each side, the ends being left long (fig. 5). Imregnated non-sticking gauze is applied to the surface of the transplant and cut to fit the outline of the defect. Additional sutures are inserted which pierce the gauze, the transplant, and the skin edges in that order (fig. 6).

Pledgets of sterile cotton wool are moistened in the Solcoseryl and lactated Ringer's solution in which the transplant was immersed, and then placed over the surface of the graft in "mosaic" fashion, until it is level with the surrounding tissue (figs. 7 and 8). Finally, a piece of sterilized sponge rubber is cut to fit the shape of the grafted area, placed over the cotton wool pack, and retained securely in position by tying the ends of the sutures that were left long (fig. 9).

DRESSINGS AND POSTOPERATIVE TREATMENT
Additional protection is provided by wrapping an appropriate amount of cotton wool in sterile gauze which is placed over the operation site and retained in position, under light pressure, with an elastic adhesive bandage.

The sponge rubber pad over the graft is injected daily with a solution of Solcoseryl and crystalline penicillin dissolved in lactated Ringer's solution. The total quantity of solution injected will be determined by the size of the area transplanted. (For a wound 10 cm. x 10 cm., 2 mill. i.u. cryst. Pen + 10 ml. Solcoseryl + Ringer's q.s. ad 20 ml. This may all be injected at one site as it diffuses readily throughout the sponge).

The dressings are removed 1 week after the operation (fig. 10) and a gauze pad coated with Solcoseryl ointment is applied. This dressing is kept in position and moistened daily as described for the original dressing. As a rule, these dressings can be dispensed with after two weeks (fig. 11). Solcoseryl ointment is applied once daily for a further two weeks.
RESULTS

This method has proved satisfactory for the treatment of seven horses with relatively large skin defects on either the face or the back. The addition of Solcoseryl to the Ringer’s solution, used to keep the graft moist, resulted in an improvement of graft acceptance when compared with previous cases (figs. 12 and 13). In those horses in which Solcoseryl was used, evidence of hair growth was seen 14 days after the operation. In those in which only lactated Ringer’s solution and penicillin were used, the areas always showed superficial desquamation and vitiligo at this stage.

DISCUSSION

The rationale for using the technique described is best presented by comparing it with the other current methods of skin grafting. As to the size of grafts relative to the size of the defect to be covered, these range from small pinch grafts (seedling grafts) to large flaps of skin which cover the defect completely. These skin flaps are of varying thickness (Hogle, Kingrey and Jensen, 1959; Meagher and Adams, 1971; Ueberreiter, 1956), but the majority are of the “split thickness” variety which includes some, but not all, of the corium.

The pinch (seedling) grafts have the advantage of remaining relatively unaffected by movements in the recipient area. They move with the underlying bed, thus maintaining close association with the adjacent capillary network. Because of their small size, haematoma or pockets of serum do not develop beneath them. They do, however, require considerable time (17-30 days) to emerge from their lacunae, spread out, coalesce and eventually cover the defect completely (Moser, 1950).

The cosmetic effect of this method is marred by the persistence of the original “islands” of skin formed by the expanding seedlings. The quality (thickness, elasticity, resistance to excoriation) of the skin, although it may be improved slightly by applying an ointment containing pantothenic acid (Wettach, 1953), is never as high as that of normal skin, and it tends to split easily. This defect in healing is obviously more important in those regions subject to excessive pressure due to harness, such as the saddle area.

The use of Reverdin or “postage stamp” transplants improves the healed appearance and reduces the time necessary to obtain complete epithelialisation of a defect. These small rectangles of split-thickness skin are, like the seedlings, not easily dislodged by movement, and they do not impede the exudation of serum or blood from the recipient bed. Furthermore, a few extra transplants can be prepared and preserved, wrapped in a moist sponge at 4°C, for up to two weeks and used to replace any transplants that have not “taken”. As with the previous technique, however, the new skin is thinner, appears “checkered”, and is less resistant to pressure or rubbing than is normal skin. In addition, it is difficult at operation to arrange the transplant “mosaic” so that the hair growth is in the same direction as that surrounding the recipient area.

Large skin grafts which cover the entire defect result in a better quality of epithelium, and the graft can be selected so as to meet local requirements of colour and direction of hair growth (Wallace, Spruell and Hamilton, 1962). However, the problems of haematoma formation or the collection of serum under the graft are serious in this type of skin grafts and can result in the transplant being lifted off the recipient bed, preventing revascularization and, in consequence, necrosis.

It is contrary to common practice to remove the transplant before the defect is created, but this is done so that the graft can remain immersed longer in the Solcoseryl bath without making the surgical procedure inefficient. Time is allowed for capillary haemorrhage in the recipient bed to cease and for the graft to be fenestrated.

No advantage is seen in delaying grafting until the recipient bed is covered with granulation tissue. In fact, this only increases the hazards of infection and decreases the chances of the graft’s survival.

This is in agreement with King (1945) who recommends immediate grafting for traumatic injuries in man, except in cases where infection is already present. The importance of holes in the graft which permit blood or serum to escape thus preventing “pocketing” and the separation of the graft from its recipient bed cannot be over-emphasized (fig. 5).

For the graft to be attached to the surrounding skin under physiological tension is considered important by Davis and Traut (1925) as it maintains the patency of the vessels in the graft and thus helps assure its revascularization. Schneider (1965) in his work on dermal grafts for hernia repair, also stresses the importance of mechanical tension in relation to the further develop-
Fig. 7. Pledgets of cotton wool, saturated in the Solcoseryl-Ringer’s solution are placed in mosaic fashion over the surface of the grafted area.

Fig. 8. Sufficient cotton wool pledgets are placed over the grafted area until they are level with the surrounding skin.

ment of the transplanted tissues. The use of suture material with a swedged-on needle facilitates stitching through the skin of the graft and prevents it from being dislodged.

In addition, the suture should always be inserted first through the graft and then through the surrounding skin. If not, every stitch will lift the graft out of its bed, which may result in air bubbles or fluid accumulating beneath it. The use of non-adherent and antiseptic gauze to protect the transplant prevents inadvertent displacement of the graft when dressings are changed, and controls infection.

The pledgets of cotton wool which are placed covering the transplanted area results in an even pressure distribution over the graft’s entire surface which is further enhanced by the sponge rubber pad. This pad acts as an additional protection for the graft should the horse rub the transplanted area. The elastic bandage assists in promoting contact between the tissues and acts as a protection against self-mutilation.

Improved capillary permeability and fibroplasia enhance revascularization and thus improve the ability of a skin graft to survive (Davis and Traut, 1925). The increased capillary permeability will help the tissue through the initial stage of “plasmatic imbibition”, while increased fibroblastic activity will result in an earlier, and more extensive, invasion of the graft by the new blood vessels.

Since the action and efficacy of Solcoseryl have been based hitherto on work in other species, and the results obtained in the horse are derived exclusively from clinical material, our evaluation of the product must, for the time being, remain subjective. A comparison of figs. 11 and 13 indicates that the product should continue to be used in equine cases requiring skin grafts, and further studies of its effects in the horse are indicated.

SUMMARY

A new method of skin grafting in horses referred to as the fenestrated graft technique is reported. It proved to be a practical method of covering the larger skin defects encountered in this species. The holes in the graft prevent the accumulation of serum or blood beneath it. Since the residual “raw patches” left by the fenestrations are small, the time necessary for the complete epithelialization of the defect is reduced.

The topical use of Solcoseryl in the preparation of the skin graft, and in its subsequent post-operative treatment, proved effective in clinical cases, and is worthy of further application and objective investigation.

RÉSUMÉ

On annonce une nouvelle méthode de la transplantation de la peau chez le cheval, une transplantation de peau “perforée”.

Cette méthode pour couvrir des plaies importantes s’est révélée positive.

Les trous dans la peau transplantée sont préventifs contre une accumulation de serum et de sang sous la peau. Le temps pour une épithélisation totale d’une intervention est réduit, car les parties crues restantes de ces ouvertures sont très petites.

L’usage local de Solcoseryl lors de la préparation d’une transplantation ainsi que dans le traitement postopératif est reconnu dans les cas cliniques comme efficace et devrait à l’avenir être appliqué et examiné.

ZUSAMMENFASSUNG

Es wird über eine neue Methode der Hauttransplanta-

tion beim Pferd, die sogenannte fenestrierte
Fig. 10. The appearance of a skin graft one week post-operatively, performed as described.

Fig. 11. The same graft as shown in fig. 10, two weeks post-operatively. Some pubescence is already noticeable on the graft.

Fig. 12. A fenestrated graft one week post-operatively that did not receive Solcoseryl treatment. Although the transplant has “taken” well, there is superficial desquamation over its entire surface.

Fig. 13. The same graft as shown in fig. 12 two weeks post-operatively. Depigmentation is marked.

Die lokale Applikation von Solcoseryl bei der Vorbereitung des Transplantates sowie bei seiner postoperativen Behandlung erwies sich bei klinischen Vorbereitung des Transplantates sowie bei seiner postoperativen Behandlung erwies sich bei klinischen Fällen als wirksam und spricht für weiteres Anwendung und objektive Untersuchung.

REFERENCES


