
EXPERIMENTAL METHODS FOR CLINICAL PRACTICE

Strategy of Surgical Treatment of Children with Extensive Deep Burns Using Cultured Allofibroblasts

L. I. Budkevich, L. Yu. Penkov, and R. S. Ktsoev

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Thirty-one children aged 1-14 years with thermal burns of the third-fourth degree on 40-85% body surface were treated using cultured human skin allofibroblasts. Combination of early surgical necrectomy with transplantation of cell culture and subsequent autodermoplasty with skin flaps with a high perforation coefficient proved to be highly effective in burned patients with deficit of donor skin. Indications for the use of this original method for skin repair after critical and supercritical burns are defined.

Key Words: *fibroblasts; burns; surgical treatment; children*

Active surgical strategy provide great progress in the treatment of patients with extensive deep skin burns. Early release of burned wounds of the third-fourth degree from necrotic tissues (necrectomy) reduces intoxication and complications of burn disease. This strategy promotes healing of burn wound, shortens hospital stay of patients with extensive burns, and reduces the incidence of lethal outcomes [5,6].

Surgical treatment of children with extensive deep burns is difficult because of highly traumatic multiple interventions, massive blood loss, and reactions to infusion media.

The main difficulties in plastic surgery for extensive deep burns involving more than 40% body surface are the severity of patient's status and the absence of donor skin resources.

Sieve grafts with a high perforation coefficient do not solve the problem, because of very slow epithelialization of perforations and graft of flap lysis and drying.

Xenografts [11], cadaveric allografts [8], synthetic film dressings [14] are not always effective, and

therefore cultured keratinocytes and fibroblasts are now used for covering burn surfaces [1,2,7,9,10,12].

Results of transplantation of cultured keratinocytes are sometimes not satisfactory. Reports are incomplete and contradictory and no data on the number on clinical observations are available.

Hence, the efficiency of cultured keratinocytes in the treatment of burns is disputed.

An original method for closing burned surfaces, which has no analogs, has been created in the 90s at A. V. Vishnevskii Institute of Surgery, Russian Academy of Sciences, at the initiative of D. S. Sarkisov. The method is based on the use of cultured allofibroblasts (CAF). CAF transplanted to wound surface stimulate proliferation of epidermocytes retained in the borderline areas and of keratinocytes in sieve transplants [3,4,13].

MATERIALS AND METHODS

Thirty-one children aged 1-14 years with thermal injuries were treated. In 3 children, the total area of burn injury (IIIAB-IV degree) was 40%, in 25 50-70%, and in 3 71-85% body surface. Surgical treatment depen-

ded on the depth of burn injury. Early surgical necrectomy was combined with CAF transplantation and autodermoplasty.

Surgical intervention included 3 stages. Stage I: dissection of necrotic tissues on days 3-7 after burn to deep dermal layers (in patients with IIIB degree burns); stage II: transplantation of CAF on carrier films. In IV degree burns surgical necrectomy was carried out so as to reach the surface fascia with subsequent transplantation of CAF on days 5-7 after the formation of granulating wounds; stage III (48 h after CAF transplantation): removal of the matrix and autodermoplasty with skin flaps with 1:4 perforation coefficient.

Necrotic tissue was removed to deep layers of the derma in 4, to subcutaneous fat in 3, and to surface fascia in 20 patients. In 3 patients admitted to the hospital in late periods of burn disease CAF were transplanted onto granulating wounds.

Single CAF transplantation was performed in 18 patients, two transplantations in 11, and 3 in 2 pa-

tients. The area of wound surface covered with cell culture was 30-3500 cm².

The efficiency of CAF application was evaluated by the total percentage of skin grafts which took in, terms of burn healing, and number of lethal outcomes after severe thermal injury.

RESULTS

Complete graft take was observed in 86% patients and partial rejection in 14%. In some patients rejection was caused by fungal contamination of the wound surface.

Treatment of boy L. (8 years) is an example of effective use of the method. The boy was hospitalized on day 2 after the injury from another medical institution. The state on admission was extremely severe. During dressing, flame IIIB degree flame burns were seen on the face, neck, trunk, upper and lower limbs (70% body surface), and thermoinhalation injury to the



a



b



c

Fig. 1. Patient L., 8 years. Flame burn (degree IIIB-IV) of 70% body surface. a) granulating wounds after fascial necrectomy and transplantation of cultured allofibroblasts; b) autodermoplasty with skin flaps perforated 1:4 one day after transplantation of cultured allofibroblasts; c) complete epithelialization of wounds (before discharge from hospital).

airways. On days 2 and 5 from the moment of hospitalization at Pediatric Burn Center, fascial necrectomy was performed on 60% body surface. Cultured allofibroblasts were twice transplanted on granulating wounds formed after necrectomy (3000 cm²) (Fig. 1, a).

After 24 h, dermal plasty with free split-skin 1:4 perforated transplants was performed (Fig. 1, b), and after a course of rehabilitative therapy the child was discharged in a satisfactory state (Fig. 1, c).

Despite the treatment, 6 (19.3%) children died, total area of burns in them was 40-70% body surface. Lethal outcomes were caused by sepsis (4 cases) acute cerebrovascular ischemic disorders with brain edema in the presence of epithelialized wounds (1 case). One patient was hospitalized on day 3 after burn with acute renal failure. Transplantation of CAF did not influence the outcome in these patients.

Previously deep burns of 35-40% body surface were considered incompatible with life. For evaluating the severity of burn disease in adults, prediction of its outcome, and planing complex treatment, "extensive", "critical", and "supercritical" burns were distinguished, involving 10-30, 31-50, and more than 50% body surface, respectively. Deep burns of 30% body surface are considered critical in young children (under 3 years) and over 40% body surface in older children. Critical area is determined by the qualification of surgeons specialized in the treatment of burned patients in each burn center, by hospital equipment and medical staff.

At our hospital, surgical necrectomy with CAF transplantation and subsequent autodermoplasty by skin flaps with a high perforation coefficient allow to save life of many patients with 60% body surface area burns.

Surgical necrectomy combined with CAF transplantation and autodermoplasty in children with deep

burns is most effective in patients with extensive skin lesions and deficit of donor skin. Active surgical strategy and CAF transplantation rapidly stabilized the patient's status, prevented infectious complications, promoted transplant take, accelerated restoration of the lost skin, shortened hospital treatment, and decreased mortality among patients with extensive burns.

Hence, the method is preferable to other methods of plastic repair of burn wounds, as it helps to attain recovery in severely burned children, before considered incurable.

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