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Challenges in surgery of deep burns

Изазови у хирургији дубоких опекотина

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SUMMARY

Introduction Full thickness burns pose a significant challenge in terms of surgical management, particularly when concurrent trauma of other organs is involved. Traditional treatment of deep burns includes early excision or debridement of necrotic tissue, followed by skin grafting or flap reconstruction. There are numerous challenges such as poor overall general condition, polytrauma, questionable wound bed viability, limited donor sites. Thus, we have to consider skin substitutes. INTEGRA^R is a acellular dermal substitute which create a native dermis. The aim of this case was to share our experience of the treatment by skin substitutes in the polytraumatized burn patient.

Case outline We present the case report of a 46-year-old man with the severe work-related contact burn wounds associated with multiple rib and vertebral fractures as well as lungs contusion with localized bilateral hemothorax. Patient suffered from third-degree burns to the lower extremities, extending to scrotal and gluteal area, which included 15% of total body surface area. Patient underwent early excision of necrotic tissues with subsequently skin autografting on right leg, however, due to partial failure of autografts we had to perform allografting followed by autografting because of limited local donor sites and poor general condition. Successive debridement and partial osteotomy resulted in left knee defect with exposed patella. Therefore, in order to reconstruct consequent defect and prevention of joint contracture, defect was finally covered by INTEGRA^R.

Conclusion Our experience has highlighted that INTEGRA^R prevents functional disability and furthermore, it leads to optimal aesthetic results.

Keywords: INTEGRA^R; full-thickness burns; exposed bone; skin grafts; reconstruction

САЖЕТАК

Увод Опекотине пуне дебљине коже представљају значајан изазов у погледу хируршког лечења, посебно када истовремено постоје и повреде других органа. Традиционални третман дубоких опекотина укључује рану ексцизију или дебридман некротичног ткива, након чега следи пресађивање коже или реконструкција режњем. Постоје бројни изазови као што су лоше опште стање пацијента, повреде других органа, упитна вијабилност подлоге ране, ограничене давајуће регије, када морамо узети у разматрање супституенте коже. ИНТЕГРА^P је ацелуларни дермални субституент која ствара нативни дермис. Циљ овог рада је био да поделимо наше искуство лечења субституентима коже код политрауматизованог пацијента са опекотинама.

Приказ болесника Представљамо приказ случаја 46-годишњег мушкарца са тешким контактним опекотинским ранама заједно са вишеструким преломима ребара и пршљенова, као и контузијом плућа са локализованим билатералним хемотораксом. Пацијент је задобио опекотине трећег степена доњих екстремитета, које су захватале скротални и глутеални део, са обухватањем 15% укупне површине тела. Пацијент је био подвргнут раној ексцизији некротичног ткива десне ноге са накнадном аутотрансплантацијом коже, међутим, због делимичног лизирања аутотрансплантата, били смо принуђени да учинимо алотрансплантацију праћену каснијом аутотрансплантацијом због ограничених места давајуће регије и лошег општег стања пацијента. Сукцесивни дебридмани и парцијална остеотомија довели су до дефекта левог колена са експонираном пателом. Дакле, у циљу реконструкције последичног дефекта и превенције контрактуре зглоба, дефект је финално покривен ИНТЕГРОМ^P.

Закључак Наше искуство је показало да ИНТЕГРА^P спречава функционалну онеспособљеност и поред тога, доводи до оптималних естетских резултата.

Кључне речи: ИНТЕГРА^P; опекотине пуне дебљине коже; експонирана кост; кожни трансплантати; режњеви; реконструкција

INTRODUCTION

Understanding of the pathophysiological abnormalities occurring not only locally but also systematically after burn injury is essential and lead to optimal treatment of burn patients [1]. Full-thickness burns pose a significant challenge in terms of surgical management in modern burn care [2]. Since burn illness may greatly complicated by the persistence of an open wound due to malnutrition and bacterial invasion, it must be promptly closed. It would be of great importance to reduce severity of hypertrophic scarring, postburn contractures, as well as

promote faster rehabilitation [3]. Therefore, as soon as the overall status of patient permits full-thickness, burns should be prepared for debridement followed by autografting or flap reconstruction. However, these options may not be suitable for each patient. There are numerous challenges, which limit standard methods of repair, such as concurrent trauma of other organs, poor general condition, questionable underlying wound bed viability, limited donor sites; thus we have to consider skin substitute. Skin substitutes remain as fundamental part of the burn therapy scheme. They vary from skin allografts over xenografts to the dermal matrix [4]. Their common role is to overcome these challenges, with the greatest possible functional and aesthetic outcomes [5].

The aim of this case was to share our experience of the treatment by skin substitutes in the polytraumatized burn patient.

CASE REPORT

We present the case report of a 46-year-old man who was crashed by glowing-metal construction on his both legs, gluteal and scrotal area, at his work place.

Firstly, patient was referred to Urgent Center as a polytrauma alert where he was examined by neurosurgeon, orthopedic surgeon, thoracic surgeon, and anesthesiologist. X-ray of thorax, ultrasound of abdomen, and MDCT of cervical spine revealed evidence of multiple rib and vertebral fractures as well as lungs contusion with localized bilateral hemothorax.

Due to nature of the injuries, the patient was admitted and evaluated in our clinic 6.5 hours after accident. Patient suffered third degree contact burns with total burned body surface area (TBSA) of 15%, including the lower extremity, gluteal and scrotal area (Figure 1A, 1B). At 5th posttraumatic day, after bilateral thoracocentesis, which had to be performed, patient underwent surgical debridement followed by autografting on his right leg to the level of fascia; the left thigh served as donor site (Figure 2). 12 days after autografting due to partial failure of autografts we had to perform allografting, because of poor general condition and limited local donor site (Figure 2A). On the 23th hospitalization day, it was performed autografting again (Figure 2B), and the result was stable epithelium on right lower extremity. All the time, dressing changes were performed. Scrotal and gluteal area were successfully reconstructed by autografting.

Furthermore, successive debridements and partial oectomy resulted in left knee soft tissue defect with exposed patella. (Figure 3A)

Our patient was not candidate for flap reconstruction, because there were scars from previous donor sites. Therefore, we consider dermal replacement matrix in order to augment and improve the regeneration of the dermis. After 30 days, anterior part of the left knee after osteotomy was covered by INTEGRA^R. Integra 20cm x15cm (Figure 3B) was placed over the gap of 7cm x5cm with exposed bone, then was affixed and covered with antimicrobial dressing.(Figure 3C) No vacuum therapy was performed. The wound was inspected 5 days after placement of the INTEGRA^R. On 18th postoperative day, the outer silicon layer was removed and neodermis was formed, which measured 22cm x 18cm. (Figure 3D) Ultrathin split-thickness skin 1:1,5 meshed autograft, which was harvested by left calf, was applied over neodermis. The wound was completely healed with stable coverage. Postoperative course proceeded with no complications, and 6 months follow-up revealed resistant tissues of both sides, right and left, respectively. With no contracture, with normal skin pliability and normal range of movement but also with superior quality of scars on the side treated by INTEGRA^R. We were more satisfied with one side covered by INTEGRA^R.

We confirm that we have read the journal's position on issues involving ethical publication and affirm that this work is consistent with those guidelines. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Written consent to publish all shown material was obtained from the patient.

DISCUSSION

Burn wound closure within the first five days is optimal, but this is often difficult to achieve in polytrauma patients, with concurrent traumatic injuries. Although debridement of full thickness burns and autologous grafting remains the gold standard for treatment of third degree burns, there are some challenging occasions, when we have to use skin substitutes with biological properties. Whenever available skin donor sites are limited or the overall patient condition does not permit coverage of excised burn wounds with autologous skin, there may still be a clinical demand for human allograft skin as a temporary biologic dressing [6]. Because there is no skin bank in our country, we were used skin allografts by human alive donors.

Regarding to depth, reconstruction of soft tissue defects resulted by debridement of full thickness burns, may extend deeper to exposed bone with denuded periosteum. These defects

don't amenable to skin grafting, thus, a flap is need [7, 8, 9], which is already standard care for lower extremity injuries with exposed bone [10]. However, this option may be unavailable because of not only inadequate adjacent tissues but also poor overall condition or is technically difficult [11]. Lee et al. presented that INTEGRA^R provides stable, long-term coverage for lower limb burn injuries with exposed structures with better aesthetic results compared with prolonged granulation followed by skin grafting or bulky tissue flaps, and allows coverage of vital structures when flaps are unavailable or not a good option [10]. Guerra et al. [11] have also noted an extraordinary capacity for INTEGRA^R to bridge avascular gaps in the wound bed in very deep burns to the extremities over small areas of bone and tendon. Interestingly, we highlighted area with exposed bone without periosteum on left knee, which had covered by INTEGRA^R, because our patient was not a candidate for flap reconstruction. Accordingly, as in our case, INTEGRA^R may be indicated to cover deep wound especially in weakened patients who would not eligible for flap rearrangement [12]. Regarding anatomical site, the knee is largely a subcutaneous joint, which have to be promptly and properly covered with well-vascularized tissue. Various options have been used in reconstruction these defects: local muscle flaps, fasciocutaneous flaps and free flaps [13, 14]. Products such as INTEGRA^R achieved optimal results in which "challenge the current gold-standard treatment" for lower extremity defects with the anti-scarring effects, thus it promotes a better aesthetic results with less resultant scarring [15].

Integra artificial skin was developed by the cooperative work of Massachusetts General Hospital and Institute of Technology in the 1970s. Additionally, the first described of INTEGRA^R was by Yannas et Burke. Integra dermal regeneration template (LifeSciences, Plainsboro, NJ) is a dual-layer regeneration template composed of cross-linked bovine collagen and glycosaminoglycan from shark cartilage coated with an outer thin temporarily epidermal substitute layer of a polysiloxane polymer (silicone) [16]. Its architecture provides ideal physicochemical conditions, leading to dead space elimination, control of bacterial invasion, prevention of water loss while simultaneously ensuring cell migration with vascular growth, which are important for neoderm formation. Since its introduction in 1981, it has been successfully used for burn injuries [17]. Infection remains the most commonly complication of INTEGRA^R usage with fact that careful wound bed excision and meticulous hemostasis are important [18]. Despite, the main reason for its limited use in the clinical practice is certainly their high cost [19]. However, since the introduction several studies have been published from all over the world proving its ability to vascularize over small areas of exposed bone and tendon [10, 11, 20, 21]. Ben-Nakhi et al. [21] concluded that Integra was easy to use, safe and effective

when used over exposed underlying structures in wound bed, including bones, tendons, and joints.

As in our case, many reports suggest that long-term results using INTEGRA^R lead to skin elasticity with no evidence of hypertrophic scar formation or clinical contracture [22]. There is some evidence which described combined application of negative pressure wound therapy (NPWT) and dermal substitutes [23]. Negative pressure wound therapy (NPWT) is the application of a negative pressure across a wound to improve tissue repair and regeneration. The first commercially available NPWT device marketed in the United States was the Vacuum Assisted Closure or V.A.C. Therefore, vacuum-assisted closure (VAC) uses the negative pressure to prepare the wound for spontaneous healing or by lesser reconstructive options.

Early surgical debridement was of great importance for patient survival. Unlike standard methods of repair, we used alternative methods such as skin substitutes, as well. Further, our case showed that INTEGRA^R prevents functional disability and furthermore, it leads to optimal aesthetic results.

Conflict of interest: None declared.

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Figure 1. Local status on admission: third degree burns to lower extremities, scrotal and gluteal area, which included 15% of total body surface area; patient on admission: A) right leg; B) left knee

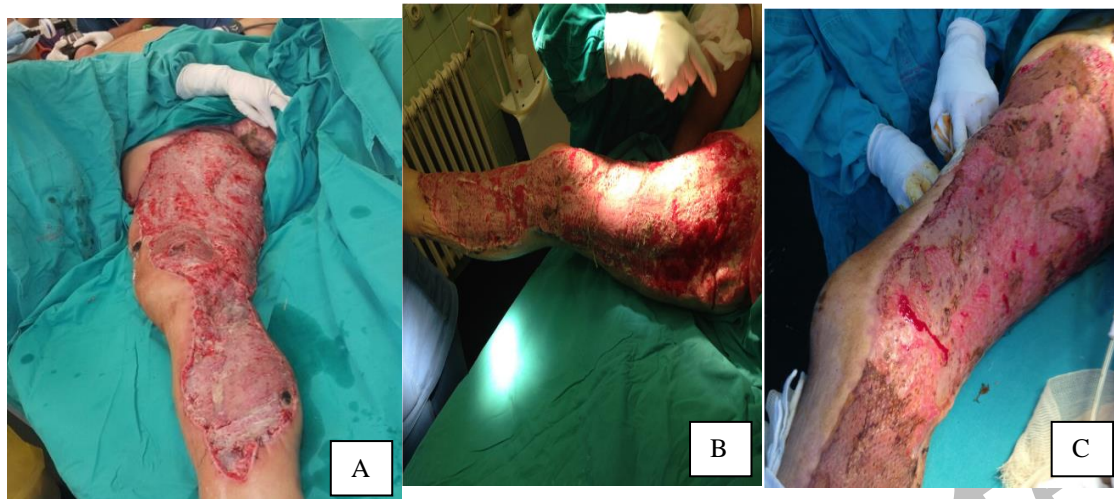


Figure 2. A: Fifth post-traumatic day – right lower extremity after autografting; B: 12th day after autografting; partial failure of autografts; we performed allografting with fresh donor skin; C: status post allografting followed by autografting



Figure 3. A: Radical debridements and partially osteotomy resulted in left knee defect with exposed patella; B: in the preoperative planning, an INTEGRA 20 × 15 cm was selected; C: placement of INTEGRA; defect of the left knee that was managed with INTEGRA; D: status – post INTEGRA placement; 18th day after initial INTEGRA placement; INTEGRA had incorporated; treated area led to neodermis, which measured 22 × 18 cm



Figure 4. Ambulatory follow-up after six months; full range of motion of the left knee joint without contracture as well as satisfactory aesthetic result (A); quality of scars, skin texture and pliability comparing right and left side are better on the left side (B)