

Role of Hybrid Reconstruction Ladder in Chemical Burns

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Abstract

A wide variety of chemicals may cause cutaneous and ocular burns and systemic effects either by absorption or inhalation, requiring in most of the cases medical and/or surgical treatment. Given the nature of the agents involved and the type of injuries (depth, lung injury, eye involvement, etc.) they produce a relevant loss of working time. Long term sequelae are, unfortunately, not uncommon.

Keywords: Chemical Burns; Hybrid Reconstruction Ladder.

INTRODUCTION

More than 25,000 chemicals are commonly used in the industry, agriculture, house cleaners and others, and many of them have been identified as having the potential to cause burns. This makes chemical burns an important risk in the household and in the industrial setting. Knowledge of the potential harm of these agents is very low in the domestic setting, whereas in the industry it is often underestimated.

In the past years, an increase has been detected in using chemical agents in aggressions involving domestic violence, mainly to women, spraying them on the face and body, with the subsequent important and disfiguring burn sequelae, but the criminal use of chemicals to assault others is not uncommon^{1,2} The variety of chemical agents is so vast that a short review cannot describe all the agents and their treatments, but we can provide general principles for the treatment of chemical injuries. The fact that they only represent near the 3% of all burns must not underscore these principles. They are present with an important morbidity (near 55% of them require surgery), commonly involve cosmetic body like face, thorax and hands, and in some series they carry approximately 30% of burns death.³ Assessment of burn depth is often difficult and the decision whether to excise the wound early is not always clear cut. The reconstructive ladder was a term coined by plastic and reconstructive surgeons to describe levels of increasingly complex management of soft tissue wounds.⁴ Theoretically, the surgeon would utilize the lowest rung of

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the ladder, that is, the simplest reconstruction technique to address a clinical reconstructive problem. The reconstructive surgeon would move up the ladder as a more complex or suitable method was required for a given reconstruction problem. We propose a hybrid reconstructive ladder that augments the traditional reconstructive ladder with regenerative medicine modalities. We theorize that there may be improved outcomes at each rung on the reconstruction ladder and these modalities may allow for the expansion of indications for each rung on the reconstruction ladder.

MATERIAL AND METHODS

This study was conducted in the Department of Plastic Surgery in a tertiary care institute. Informed consent was obtained from the patient under study. Department scientific committee approval was obtained. It is a single center, non-randomized, non-controlled study. The patient under study was a 37-years-old male, with no other known comorbidities presented with 20% chemical burns

to his face, bilateral forearm, hands, left thigh and feet after a blast injury sustained in a chemical factory. (fig. 1). Wound bed was prepared in accordance with TIMERS 5 concept mentioned in the guidelines, the ulcer was serially assessed and documented according to Bates – Jensen wound assessment tool. Infection was managed with local antimicrobials & antibiotics according to culture sensitivity. Non-viable necrotic tissue was managed with multiple sessions of surgical debridement and preparation of wound bed. Various forms of hybrid reconstruction method was applied to the wound. Those methods include, insulin therapy (fig. 2), low level laser therapy (fig. 3), prontosan therapy (fig. 4) autologous platelet rich plasma(fig. 5) heterografting with collagen (fig. 6), sucralfate therapy. (fig. 7) and skin grafting(fig. 8).

RESULTS

Wound bed gradually improved, with healing of raw areas. (fig. 9)



Fig. 1: On presentation to hospital



Fig. 2: Insulin therapy



Fig. 3: Low level laser therapy



Fig. 4: Prontosan therapy



Fig. 5: Autologous platelet rich plasma



Fig. 6: Heterografting with collagen



Fig. 7: Sucralfate therapy



Fig. 8: Skin grafting on right hand.



Fig. 9: Wound healed after skin graft.

DISCUSSION

Hybrid reconstructions have transformed the management of severe extremity injuries and have offered the extension of indications for techniques available to manage composite tissue loss. The reconstruction options that currently exist to treat such defects frequently fail to satisfactorily

address the aesthetic and functional requirements of the resulting soft tissue defects. Continued research and the development of strategies to address volumetric muscle loss are of continued interest. The utilization of biologic scaffolds may enhance the musculotendinous repair process most traditional reconstruction measures are very effective in the management of single tissue

soft tissue loss or addressing minor bone loss. However, composite tissue loss typically results in severely compromised extremity function. While a few functional muscle transfers are available (e.g., functional free gracilis transfers, and so on), many of our wound lack appropriate donor tissues and/or necessary nerves to be successful. The future of dermal regenerates includes enhancing existing technologies and adapting them to single stage procedures to manage soft tissue avulsion injuries. Spray skin technologies are being investigated as a therapeutic measure to address significant skin loss. Spray skin technologies include the use of non-culture autologous cells to promote wound healing and reconstructive procedures. Other dermal regenerate technologies that may have applications in combat casualty care include allogeneic matrices that are embedded with immortal keratinocytes, which is a continuous cell line that is virus free and non-tumorigenic. Future directions in each of the areas discussed are promising in enhancing the management of complex wounds. The future for large peripheral nerve defect reconstruction

include tolerance induction and minimal immunosuppression for nerve allografting, cell based supportive therapies and bioengineering of nerve conduits.

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