

Clinical indications of surgery in wounds

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Introduction

During the last two decades of the 20th century, reconstructive surgery was intensively developed after the pioneering anatomical works. It was shown that isolation of a flap on its vessels allowed the use of local, regional and at distance flaps. This surgical approach allowed significant changes in reconstructive surgery. During the last decade, prefabrication and perforator based flaps were elegantly proposed, adding a supplementary sophistication. In parallel, tissue repair and reconstruction respecting the different wound healing stages began to show interesting results. The philosophy of such a staging reconstruction is opposed to the rapid one step reconstructive procedure proposed previously. Tissues are rebuilt from the depth to the surface. The advantages of this attitude are progressively demonstrated in term on aesthetic results, functional results and coloration. Surgery in wounds, acute and chronic, has sometimes been submitted to excessive flap indications. In 2004, we can outline some pathways helping the reader to choose when not to operate using a radical procedure ?

Flap surgery is well established in the reconstructive surgery training programs, certainly because of reasons belonging to surgical procedures themselves, to the intense satisfaction for surgeons to get quickly a visible closure and due to the good results obtained by these techniques. Anatomical studies of the period comprised between 1970 and 1990 created a new mode of surgery, largely extending the capacities of saving life, sparing amputations, closing large difficult to heal wounds with a brilliant facility. These fantastic acquisitions were possible by the coexisting progresses of resuscitation, who allowed to operate patients in better shape, sparing or correcting quickly blood losses, efficiently managing infection. In acute wounds, these techniques began to be efficient during the 90's. In parallel, alternative techniques were developed. Negative pressure therapy was progressing in the orthopedic and traumatology departments. Some colleagues find more efficient or practical to cover the exposed area with a VAC after having reduced the fracture, checked the vascularization and fixed the bone extremities, Is it time change our practices in the next future ?

The staging reconstruction

1) Debridement

Natural evolution of a wound submitted to the healing process is formed by four successive stages, debridement, granulation tissue formation, keratinization and maturation. At the end of this process, a scar will be formed, and its aspect, quality and suppleness are determinant in preventing the recurrence or transformation into a pathologic scar. In the next future, we can anticipate a gradual awareness of the patients concerning their scars after surgery. Plastic surgeons and dermatologists see commonly during their clinics patients having been operated previously presenting psychological problems concerning their scars.

Since several years, a good surgical debridement has demonstrated its efficiency in the wound healing process, but many other techniques, initially developed for chronic wounds, have demonstrated their interest. Surgeons have to be trained to practice elective debridements using the scalpel. Alternative techniques like powerful hydrojets are becoming progressively

available in some units, even if they did not completely prove their usefulness . Debridement using alternative techniques like maggots or dressings have also been demonstrated as presenting a confirmed interest.

2) Granulation tissue

Since more than ten years, the negative pressure therapy has modified management of wounds in many directions. During the last ten years, the VAC technique has increased its penetration in many surgical disciplines. Looking at published reports on efficiency of the technique, it is obvious that colleagues involved in different disciplines have tested successfully the technique.

In trauma, results have been more than enthusiastic, changing the practices at a level which is close to revolution. Ten years ago, the number of flaps realized in emergency was important, leading to large blood loss and potential complications during the postoperative period , especially when using the microsurgically revascularized flaps. The large series presented by the pioneers (Argenta and Morykwas) were followed by smaller series confirming exciting results. Simplification of the global procedure is one of the most striking point of this technique. Versatility and adaptation to the different anatomical situations and to the etiologies (burns, degloving trauma, amputations, partial loss of substances) made the technique more and more used in trauma units. The simplification touches also the dressing procedure itself, and nurses are easily trained to control and manage the dressing changes, with or without the presence of a surgeon.

The progressive evolution of the knowledge on VAC therapy and a few biological explanations concerning the mode of action (still unknown completely) contributed to diffusion of the technique.

Most of the Plastic Surgeons , trained to flap surgery, are somehow reluctant to this changing of practices, but trauma surgeons, thoracic surgeons and most of the medical disciplines are prone to adopt it. The ideal situation should be a good collaboration between plastic surgeons trained to VAC therapy working together with other disciplines. In fact VAC therapy can be considered as the first step in the reconstructive process, even if in some situations the VAC can end in a rapid complete closure of the wound. When integrated in the staging reconstruction process, the VAC obtains a granulation tissue covering the entire surface of the wound..

The granulation tissue observed in chronic wounds or acute wounds becoming chronic (over than 6 weeks of evolution) has always been considered in the past as a potentiel source of infection. This unhomogeneous structure was always considered as « infected » , « not secure », and skin grafts put on it had to be preserved from septic postoperative complications. Since the demonstration of the germ-free granulation tissue obtained with the VAC by Morykwas and the different experiences of VAC on burnt patients, a new era has become. This granulation tissue can now be covered with skin grafts, but also by skin substitutes, highly susceptible products whose sensibility to germs is well known.

The negative pressure applied on the wound is prone to exert a regional antibacterial effect. The aspirated area is certainly more important than expected, and this could lead to a good management of what is suspected in « critically colonized wounds » ie the presence of germs in the depth of the wound. The demonstration is still lacking, but many authors using the VAC reports a rapid limitation of the inflammatory process around the wound, a rapid disappearance of oedema and the accumulation in the cannister of pus-like liquids, demonstrating the effect on the wound itself but also on the surrounding areas.

This granulation promoter can induce a red uniform granulation tissue even in unexpected situations like over bony surfaces or tendons. So its popularity has increased even in the ranks orthopedic surgeons, replacing the flap techniques in some clinical situations

Results of the Vac technique are described as pieces of a puzzle, but these publications of clinical results were enough convincing to obtain reimbursement in USA, an important starting point for Randomized Control Trials.

Obtaining a granulation tissue free of germs can be considered as a door open to the use of sophisticated and fragile techniques like artificial dermis or skin substitutes. They were progressively popularized by dermatologists in US, with trials demonstrating an effect.

3) Dermal reconstruction

Artificial dermis is now used all over the world, and the results can be considered as promising. In acute wounds, post cancer resections, as well as in burns and in resurfacing procedures, the use of artificial dermis is now accepted by most of the surgeons. Based on bovine collagen, this structure does not induce immunological problems, and can be considered as a transient scaffold progressively revascularized, issuing to a dermis covered secondarily with a thin skin graft bringing a souple aspect, with a real dissociation between the skin graft covering it and the underlying aponeurosis.

Artificial dermis has been progressively adopted as a secure technique leading, in trained hands, to a scar whose volume is very different from the one obtained with a flap. The obtained skin is flat, souple and following the movement, due to the lack of adherence to the underlying aponeurosis. Colour of the recipient site can more or less be chosen when harvesting the skin graft close to the recipient area.

Integra, and other dermal substitutes does not contain any cells susceptible to cause immunological problems or to transmit diseases. They are now proposed in various clinical situations such as after skin tumour excisions, in acute burns, in trauma and in scar resurfacing. Results begin to be published in series, even if a real randomized control trial is still lacking.

4) Epidermal formation

Since more than 25 years, the promises established by the first results of keratinocyte cultures in vitro have been confronted to the clinical situations. More than 75% of take is usually described by the authors. Many factors influence this take, and particularly the ability of the cells to promote angiogenesis. Some attempts of « boosting » the cells using gene therapy are under progress. Covering a wound using such techniques is still exceptional, but new alternatives have emerged. Skin substitutes including living dermal and epidermal cells, are now available and have demonstrated their interest in large randomized control trials in chronic wounds.

Infection

A young surgeon confronted to these difficult choices will feel somehow lost, especially if he did not get a real training in wound healing. New technologies are developing very quickly and we are now in front of solutions we did not expect some years ago.

In the area of local infection, new dressings and silver based anti-infectious topics can now help the surgeon in correcting the local disorders imposed by the germs development. The use of general antibiotics is progressively regressing, due to a better understanding of local mechanisms in bacteriology.

Discussion

The staging reconstruction concept is not very different from what was called thirty years ago the spontaneous healing process, except that the spontaneity is encouraged by solutions

adapted to the cells behaviour and respecting them. A flap will in most of the cases be considered as a foreign body when analysing the dynamics of the anatomical area of the recipient site. Results obtained after staging reconstruction looks promising, essentially because results observed at distance of surgery are more close to a natural healing.

Conclusion

A large series of researches, fundamental and clinical, are still to be done in tissue reconstruction. If for the moment flap surgery has demonstrated its usefulness in saving limbs, covering vital structures and bringing new functions to denerved and devascularized areas, it is now possible to anticipate in a short future a large choice of alternative solutions maping the surface but also the depth of the wound defect and bringing adapted solutions.