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The postoperative environment of the amputation stump

Postoperative wound dressing after through-knee amputation

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Abstract

This paper reviews different types of treatment of the amputation stump. Following an examination of the historical development there are sections on bandaging, semi-rigid dressings, rigid cast dressing and controlled environment treatment. The merits and demerits of each type of treatment are discussed.

Introduction

The considerations which have to be addressed in discussing a dressing for any terminal wound are:

1. Protection from bacterial infection.
2. Containment or reduction of oedema whether present preoperatively or as part of the tissue response to operative trauma.
3. The protection of the stump from physical trauma as exposed in the rehabilitation of the patient, and
4. Possibly, to provide attachment of prosthetic devices to permit early walking.

Historical

These factors have operated over the thousands of years during which amputations have been performed though it is doubtful if the objectives were so clearly defined, albeit intuitively encompassed, in the solution. For many centuries an additional objective was to ensure stoppage of bleeding and many solutions for this problem have been employed. These included amputation below, at, or just above the level of gangrene as employed by (Celsus *circa* 25 AD), and tourniquets of various kinds until eventually Paré electively ligatured vessels (Taylor, 1933). Cautery was also widely used but the practice, as used in the Peliponnesian wars, of applying small buckets of tar to the end of the stump combined several objectives—cautery for haemostasis, protection from infection, a fixed volume for the stump thus containing oedema, and it is believed, in some cases provision for weight-bearing by the addition of a peg attachment.

From that time on a variety of dressings were employed including lint and sea sponges. Gersdoff in 1517, as described G. Taylor (1933) advocated rabbit fur and egg white and several surgeons employed a pig's bladder. This particular method is interesting as it might cover all but one of the considerations listed above.

Bandaging of stumps has been employed for many hundreds of years. The continued use of bandages as the weeks passed following amputation was primarily directed towards producing a conical shape in the stump to meet the demands of the then conically shaped sockets. In more recent times with advancing technology a variety of wound dressings, both occlusive and porous have been produced. Equally there have been advances in bandage design and in the use of plaster of Paris. In the past fifteen years devices have been developed seeking to find more fundamental solutions.

Present methods and techniques

Today bandaging is still employed as a means of covering the stump following operation. The bandages may be non-elastic, elastic or have properties akin to the traditional Unna's paste bandage producing a semi-rigid structure. Rigid dressings in the form of plaster of Paris casts are used widely and in more recent time a controlled environment treatment technique has found favour in some units.

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Bandaging

The problem inherent in any bandaging technique is the danger of creating an adverse pressure gradient. Very often that adverse pressure gradient is a direct result of the need to ensure that the bandage does not slip. Voluminous padding applied between the bandage and stump may avoid this danger but the bandages still tend to work loose and appear to offer nothing more than a cover for the wound.

There can be no doubt that a properly applied bandage is beneficial; provided that the bandage pressure does not exceed intravascular hydrostatic pressure, bandaging will limit the formation of oedema but will not increase the vascular resistance to the detriment of blood flow. Intracapillary pressure in the recumbent position is of the order of 15–20 mm Hg but varies with posture (Chant, 1972) thus requiring a bandage which provides graded pressure as devised by Wood (1968). Spiro et al, (1970), Husni et al, (1968) and Johnson (1972) all advocated pressures in the 10–20 mm Hg range as being maximal. Isherwood et al, (1975) in comparing the efficacy of three different types of stump bandages, studied the pressures produced by both skilled and unskilled bandagers. Not surprisingly the skilled bandagers performed better and the results varied with different bandages, but the striking result was the fact that pressures as high as 140 mm Hg were produced even by skilled bandagers. In the light of that evidence there are clear grounds for careful consideration of the implications of the use of a bandage.

Semi-rigid "dressings"

Ghiulamila described this type of dressing as applied to an amputation stump in 1972 and has remained an enthusiastic protagonist since then at different levels of amputation, including the through-knee amputation. Essentially he uses a modified Unna's paste bandage with the classic ingredients of zinc oxide, glycerine and gelatin. Once applied this bandage forms a semi-rigid dressing which, while flexible, is inextensible in terms of volume. It adheres well to the skin and makes for a stable situation with respect to the wound.

Lippman and McMaster (1972) in a well considered contribution cover the theoretical and practical aspects of applying a Unna's paste bandage. As with other bandages considerable skill is required in its application but once the pressure gradient is achieved it tends to be sustained, they point out that no more than 1 cm H_20 pressure is required to dissipate oedema.

The air splint

This is a device designed as an emergency splint for stabilizing fractures. It was first recommended as an immediate post-operative dressing by Little (1970) over rolled cotton wool and bandages and inflated to a pressure of 25 mm Hg. Sher (1974) reported on a similar technique; he used a towel wrapped around the thigh to absorb moisture and prevent maceration of the skin.

Hard foam dressing

This technique employs a stocking incorporating a zip (Blömer, 1978). A polyurethane foam mix within the stocking forms around the stump; it can be used immediately following surgery.

Rigid cast dressing

Coincident with the concept of immediate post-operative fitting of prostheses there was clearly a need to apply a rigid wound "dressing" as an integral part of the technique. Berlemont (1961) first described the technique and through the experiences of Weiss (1966) Burgess and Romano (1968) and many others the technique has become widespread. Many have abandoned the early prosthetic fitting for a variety of reasons, but the rigid cast dressing remains in use. There are many varieties but that decribed by Romano and Burgess is well received. A silicone impregnated wound dressing is applied and is overlaid with a quantity of fluffed gauze; and elasticated sock is then pulled over the stump. Felt pads in strategic positions are applied and elasticated plaster of Paris bandages are laid on without tension ensuring that the cast conforms well to the shape of the stump. As the plaster hardens it is carefully moulded around the femoral condyles. Especial care is required over the posterior aspect of the femoral condyles in the through-knee amputation.

Mooney et al, (1971) compared the use of the rigid cast with soft dressings in a series of 182 below-knee amputations performed on diabetic patients. In this well controlled study it appeared that the rigid cast was a positive factor in achieving a healthy wound. Baker et al, (1977) conducted a similar study on 51 patients with below-knee amputations and found that neither

wound dressing technique proved superior, with healing rates almost indentical.

Controlled environment treatment

This technique and the associated device were developed at Roehampton, England by Redhead (1973) and Redhead and Snowdon (1978). Essentially the stump without dressing is placed inside a sterile bag or sterishield which has a proximal internal apron which prevents ingress from air outside and permits sterile air at a known temperature and pressure to be pumped in. The motor, pump and filter are conveniently housed within a control consul which permits the clinician to select the appropriate pressures (cycled if need be) and temperature. Troup (1980) recorded an experience with use of the device in 100 patients and, while noting the practical difficulties of setting up a randomized controlled trial, believed the results were better than with rigid dressings.

Discussion

The amputating surgeon, sensitive to the problems that may arise, will choose a method of stump environment which will be least likely to harm his patient and, if possible, provide some control of oedema. In the Northern hemisphere, where the great majority of amputations are performed for vascular disease, where he seeks to perform the amputations at the lowest possible level and where skin perfusion pressures are marginal, the decision will depend largely on his competence in bandaging, whether it be a soft bandage, a Unna's paste bandge or a plaster of Paris bandage. While Baker et al, (1977), showed that wound healing was no different with a soft or plaster dressing, they did note that the rehabilitation of patients with wounds that healed primarily with plaster started sooner. They noted that patients with soft dressings almost uniformly had some oedema despite wrapping with an elastic bandage and the persistence of this oedema postponed the beginning of walking training. For these reasons they normally used a plaster dressing. It seems therefore that if soft dressings are to be used and the stump is bandaged over these soft dressings in such a way as to avoid an adverse pressure gradient, then the penalty must be poor dissipation of oedema. If the surgeon is accustomed to handling plaster of Paris then he will probably elect to use a rigid cast dressing in the knowledge that it provides an effective barrier to infection, permits the patient to move about freely in the course of his rehabilitation without risk of damage to the stump and has a good record in so far as control of oedema is concerned. At the same time, if much oedema is present at the time of amputation, the fit of the plaster cast on the stump will be lost with all the dangers to bony prominences as a result of the incongruity.

Where oedema is present and particularly if through-and-through drains are employed the surgeon may elect to use a Unna's paste bandage, as it is readily replaced and amenable to removal of drains but affords less protection for the stump. For those who are concerned to avoid adverse pressure gradients and are not accustomed to using plaster of Paris then an air splint or hard foam dressing would appear to offer a reasonable alternative. The tendency to sweating inside the air splint must be a disadvantage because of its possible influence on infection.

The advantages of controlled environment treatment are unequivocal as no skill is required in its application, there is control of pressure and temperature, sterility is maintained and the wound can be observed throughout the treatment. It would seem to have a marked advantage in patients where oedema is a feature. However the apparatus is expensive, the patient is much less mobile and this can lead to distressing frustration and it can prove to be a environmental hazard for staff.

Finally it should be noted that there is no need to confine oneself completely to one technique or another. For example, in the diabetic patient with marked oedema it might be wise to use controlled environment treatment for a few days until the oedema is controlled and thereafter to apply a rigid cast to permit more rapid rehabilitation of the patient. One's main concern must be to avoid an adverse pressure gradient.

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