PRESSURE BANDAGES AND SPLINTS

by

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There is current interest in inflatable splints as first-aid for athletic and other injuries. There is an equal call for consideration of the factors involved. An interest in the appropriate tightness of bandages and splints has been stimulated by the apparently considerable stakes to be won or lost. It is arguable that for every limb prejudiced by allegedly too tight bandaging many thousands are stiffened by swelling, probably preventable by suitable pressures. The premium thus set upon the correctness of pressures applied to injured limbs cannot be lightly discounted.

In applying pressure to damaged tissues the advantages must not only outweigh the dangers, both should be recognised. Further it is essential to know the optimum pressure and helpful if its mode of action can be understood.

The danger of constricting an extremity, or from causing excessive pressure to bear on a part, falls within common, but not within universal, knowledge. Ignorance of the fact that various tissues cannot survive deprivation of arterial blood for a correspondingly variable period of minutes or hours is the danger. Recognition of this hazard is, however, usually a deterrent inhibiting effective bandaging.

The advantage of applying the correct pressure to an injury is unfortunately as difficult to estimate as the danger is obvious. The origin of the empirical acceptance of firm bandaging as a benefit in preventing or treating swelling is lost in medical history. There does indeed appear to be no reason to doubt this acceptance, but a few illustrations are worth repetition. The 'Jones Bandage' is a traditional technique in orthopaedic surgery (Jones 1915). In common with many traditions it often obtains only lip service. There is even a risk that bandaging might become a lost art in an ever widening therapeutic armamentarium; or the gains to be had from it forgotten or misjudged. The following quotation is offered for more than its eloquence: 'The surgeon knows, when he bandages a broken limb, that his bandage is doing something more than merely keeping the parts together: and that the even constant pressure

which he skilfully applies is a direct encouragement of growth and an active agent in the process of repair. '(Thompson 1961). Post-traumatic swelling bears a direct relationship to stiffness, 'Oedema is "glue".' (Watson-Jones 1962). In practice the patients' expression of relief from pain is probably the original evidence. In practice too bandages or splints, whether inflatable, which afford this pressure provide adequate protection (Nicol 1962, Leader 1966).

The mechanism whereby a compression dressing might be beneficial to an injured limb is obscure. There is at first sight a conflict between the apparently obvious reason for applying pressure in anticipation of swelling and the fear of simultaneously impairing a disturbed circulation. On second thought the supposition is that there is an optimum pressure between the ineffectual and dangerous levels. Reference to the anatomy and physiology of limb circulation indicates how blood flow in adverse circumstances following injury might be improved by external pressure. An early effect of injury is haemorrhage or exudation leading to an increase in tissue fluid pressure. In certain sites there can be no expansion to accommodate. In others, elastic expansion allows equalisation of pressure. Even in these latter circumstances, however, so long as swelling is continuing there will be a centre of high pressure with a gradient from it. When such centres of high pressure exist communicating channels allow deviation of blood flow to vessels in uninjured or superficial parts (Parkes 1945). The application of external pressure will raise the pressure in the tissues equally throughout and remove the gradient. The tendency to by-pass is avoided and a restoration of circulation through the damaged area can occur. A familiar example of deviated return circulation is seen in the prominent, but not varicose, superficial veins of athletes at rest when the blood is not coursing through the large, deep, muscular veins. Other clinical observations of such shunts have been reported (Mercer 1962).

Standard reference books are of no help in giving a figure for the correct tightness of a bandage; refuge is taken in the words 'firm', 'even', 'suitable' and 'from experience'. An early attempt at defining the proper pressure was made by Dr. Gamgee in describing the use of the tissue which bears his name and it is still relevant: 'The soothing surgical pressure is like that which you interchange with the hand of a lady. Your hand adapts itself to hers, and gently presses it wherever it can touch it, but nowhere squeezes it for fear of offending.' The upper limit of safe pressure is more easily defined than the lower limit of effectiveness and is of the order of 70mm.Hg. so as not to surpass diastolic arterial pressure. A comparable figure, 50mm.Hg., was arrived at by other means in the development of pneumatic sleeves to correct chronic oedema (Brush et al 1959). Since there appears to be little reason for seeking the lower limit

of effectiveness it is probable that the optimum pressure is equal to the upper limit of safety. In applying this an immediate difficulty arises over what allowance need be made for the lowering of blood pressure in shock. This indeed can only be met by blood pressure measurement. There are some saving considerations. The more the reduction of blood pressure by shock the greater is the likelihood that effective splintage of an injured part will aid the recovery from shock. Further, diastolic pressure has been considered, not systolic, and provided the latter is not exceeded a tourniquet effect is avoided. Finally, if systolic pressure is of the order of 50 - 70 mm. Hg. concern is for life rather than limb; and the casualty is unlikely to survive long enough to sustain damage from excessive pressure on the injured limb. The instruction to inflate pneumatic splints by mouth only is made in the interest of safety and commonly leads to the achievement of pressures around 50 - 60 mm. Hg. It must be realised, however, that even by mouth it is possible to produce pressures above the normal systolic level. Safety in this regard will only be obtained by incorporating some valve to leak above the determined level.

Conclusions

There would accordingly appear to be both dangers and advantages of considerable degree to be had from applying pressures to injured limbs. An advantage of the pneumatic method is the even distribution of pressure. The art of bandaging by conventional methods lies in the ability to produce this even pressure. The use of pneumatic splints has helped to define a figure for optimum pressure. Further, a useful technique for practising bandaging is provided by applying a pneumatic (sphygmomanometer) cuff, connected to a manometer, to a limb and then covering it by bandaging to raise the manometer from zero to 60mm. Hg.

'Air-splints' have thus certain benefits in addition to being clean, light, strong and even transparent. The danger from arterial obstruction is probably more theoretical than real provided pumps are avoided. In their long term use unfavourable maceration occurs from sweat and special measures to control this are beyond the present context. There is a final, possibly theoretical, risk from applying 'air-splints' over broken glass where puncture could be fatal in communication with a wound (air embolism).

'He either fears his Fate too much, or his Deserts are small,
'That puts it not upon the touch, To win or lose it all'.

(James Graham, Marquis of Montrose).

References

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