FIRST-AID PROPHYLACTIC TREATMENT OF THE COMPRESSION SYNDROME ("CRUSH SYNDROME")

BY

DAVID H. PATEY, M.S.Lond., F.R.C.S.

Surgeon with charge of Out-patients at the Middlesex Hospital;
Surgeon, E.M.S.

AND

J. DOUGLAS ROBERTSON, M.D., D.Sc., D.P.H.

Clinical Chemical Pathologist to the Middlesex Hospital

(From the Wards and the Courtauld Institute, Middlesex Hospital)

The destruction of civilian property by air raids has been responsible for the recognition of a new clinical syndrome with characteristic features and often running a typical and fatal course. There is a history that the patient was in a building which collapsed after a bomb hit, and that a limb was pinned down by a beam or heavy object for several hours before release. Immediately on rescue the victim may look surprisingly well despite burial under debris for many hours. But some hours later the patient becomes gravely ill from shock, and, if this phase is successfully overcome, within 24 hours or so fresh anxiety arises owing to haematuria and a low urinary output. Despite measures directed towards stimulating diuresis, the oliguria becomes progressively more marked, terminating in anuria and death from uraemia. The limb that had been pinned down becomes very swollen and hard with oedema soon after its release from the pressure, and is partly or completely paralysed from nerve compression.

Aetiology: A New Conception

This syndrome has been referred to as the "crush syndrome," perhaps incorrectly; for crushing and pulping of the tissues is not a striking feature. On the contrary, it is much more typical for the limb to show no evidence of damage except for some skin abrasions at the site of the compression. A more accurate descriptive term would be "compression syndrome." The cause of this syndrome has given rise to much speculation, and most theories incline to the view that it is the result of a toxin produced in or by damaged tissue. Treatment based on this hypothesis, however, has been very disappointing, and most surgeons in charge of such cases have had the distressing experience of seeing their patients pass from a good general condition to death from anuria despite heroic measures to re-establish the urinary flow. After similar experiences, in March, 1941, we considered that the toxic theory and the treatment based on it were wrong. Instead of the toxic theory based on the release of toxic metabolites from damaged muscles, we thought the compression syndrome might be simply due to a loss of blood constituents from the circulation into the tissues of the limb, the capillaries of which had temporarily lost their function through the long compression. Certain findings seemed to support this conception, including a depletion of the plasma proteins and a very marked swelling of the limb. Indeed, the swelling of the limbs in the fatal cases was so pronounced that small abrasions in the skin were weeping plasma copiously. It became obvious that fluids given intravenously drained into a toneless flaccid limb, the fluid capacity of which must be enormous.

Treatment by Positive Pressure

While we were unable to give a complete explanation of the renal phase of the syndrome, we decided to introduce a new form of treatment based on this new conception of the problem. The treatment aimed at restoring extravasated fluid back from the oedematous limb into the circulation. The particular method we used was intermittent positive pressure up to

60 mm. Hg applied through a specially made large blood-pressure cuff firmly bandaged to the limb and connected with a pavaex motor. In June, 1941, we published reports of two cases successfully treated on these lines.

Since this publication we have had no opportunity of treating additional cases. Strong experimental support for our view, however, appeared in a recent paper by Duncan and Blalock (1942). Employing dogs, they have produced a condition similar to the compression syndrome of man. These authors found that if the affected limbs were immediately placed in a pneumatic cuff with a pressure of 40 mm. Hg approximately 75% of the animals recovered, whereas in the control series the recovery rate was only approximately 5%. We (Patey and Robertson, 1942) have recently drawn attention to the confirmatory work of Duncan and Blalock and suggested that routine treatment on the principle we originally recommended is now justified.

Application of the Method

The object of the present communication is to consider the application of the principles outlined by us to first-aid treatment. On our views there would seem to be a justifiable hope that if a simple standard form of first-aid treatment were adopted as soon as a limb had been released from compression many cases of the syndrome would be prevented. But the mere advice to "apply a firm bandage" is not enough. We have studied the question by bandaging on top of a blood-pressure cuff applied to a limb, and noting the increase of pressure produced. With different types of bandage applied in different ways, a wide variety of pressure readings were obtained, varying from ineffective pressure to dangerous pressure occluding the arterial circulation. The factors concerned in pressure produced by bandaging are, first, the force with which the bandage is applied; secondly, the elastic force of the bandage and the degree to which this is stretched; and, thirdly, the number of turns to any given length of limb. We started from the basis that on the facts at present available the pressure to be aimed at was somewhere between 40 mm. Hg (used in dogs by Duncan and Blalock) and 60 mm. Hg (used by us). After this we rejected a number of types of bandage as unsatisfactory—the domette because of its lack of elasticity; the crêpe because of its tendency to stretch and lose its elasticity; and rubber bandages because of the danger of too great pressure and occlusion of arterial supply. We also thought an adhesive bandage undesirable as not allowing for adjustment and reapplication.

Finally we decided on an elastic web bandage made to the pattern of Dickson Wright (by Messrs. Down Bros.), the width of which is a fraction under 3 in. This is a strong bandage of standard strength and elasticity, the latter of which is not easily lost. If this bandage is applied from below upwards, stretched to double its unstretched length, with each turn partially covering the previous turn so that 3/4 in. of the lower edge of the latter projects below the fresh turn (see Fig.), an approximate pressure of 40 to 60 mm. Hg is obtained. One or two small practical hints may be given. The bandage should be applied direct to the limb without the intervention of clothing, which will interfere with the effective pressure. The degree of stretch can easily be assessed if the bandage is marked along its lower edge at 1/2-in. intervals. Most people can easily judge 1 in., the distance to which the marks have to be stretched: as a simple check, a halfpenny coin is 1 in. in diameter. Care should be taken to see that the stretch is equal all round; there is a tendency to stretch the bandage to the correct distance in front but not to stretch it sufficiently at the back and sides. We have found that this error is best avoided by applying the bandage in short segments at a time rather than in long loops. The 3/4-in. margin can

be assessed by noting some convenient longitudinal line on the bandage. Only a light force with the forearm is required to stretch the bandage to the correct degree, and it should be possible with a little practice for even the inexperienced in bandaging to apply it correctly. In order to avoid oedema below the lower limit of the bandage, the foot and hand should be included. We have found that 2 or 3 bandages are required to cover completely the lower limb, and 1 or 2 for the upper limb.

The question next arises of the further treatment of the case after admission to hospital. If the bandage has been immediately and correctly applied no further local treatment should be required. How long the bandage should stay on will have to be determined by experience. But at present it would seem that it should remain at any rate for some days, and possibly then be reapplied at slightly less pressure. Finally, there is the question of the treatment of the case admitted to hospital with an established oedematous limb either because prophylactic first-aid bandaging has not been used or has been used inefficiently. As already noted, we employed in our two original cases intermittent rather than continuous positive pressure, because we thought on theoretical grounds that the pump-like action of intermittent pressure would be more efficient than continuous pressure, particularly in a paralysed or semi-paralysed limb, in getting rid of established oedema. If this view is confirmed, some other motive force than a pavaex motor will have to be devised before our technique can be generally adopted, owing to the limited number of those machines available. We are investigating the possibility of developing a simple water-pump which fulfils the same purpose.

Summary

The compression syndrome ("crush syndrome") is due to loss of blood constituents into the affected limb.

The principle of treatment should be by positive pressure, to prevent oedema and get rid of any already existing fluid.

The elastic web bandage applied in the way we have described is the simplest efficient means of exerting this positive pressure in a standard manner as a first-aid measure.

First-aid parties should be equipped with these bandages and taught the proper technique of their application. The importance of applying the bandage immediately the limb has been released from compression should be stressed.

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The social welfare policy in Sweden is being continued despite the present strain, and the new Swedish State Institute for Public Health in Stockholm was inaugurated by the King last year. The institute is organized in three departments: one for general hygiene, one for occupational hygiene, and a third for the scientific control of foodstuffs. In addition to their intelligence service all three branches carry on scientific research. The first-mentioned department provides education in social hygiene for public health officers, including maternal and child welfare, housing hygiene, tuberculosis care, water, and drainage. The task of the department for occupational hygiene is to investigate and prevent ill-health and accidents arising from unsuitable working conditions. In the sphere of food the prime task of the institute is to prevent the manufacture and sale of products dangerous to health and to assess the value of various foodstuffs from the standpoint of nourishment. Special attention is devoted to investigation and control of vitamins in foodstuffs, fodder, and medicinal preparations. The new institution has at its disposal over 100 laboratories, as well as an animal house, which is said to be the largest in Europe. It employs a staff of about forty persons, not including the medical students studying there, and its head is the well-known Swedish physiologist, Prof. Ernst Abramson. The institute, which is situated within the big "medical city" built in the last few years on the northern outskirts of Stockholm, has cost over £118,000. Part of this has been defrayed by the Rockefeller Foundation.

VAGINISMUS: ITS MANAGEMENT AND PSYCHOGENESIS

BY

JOAN MALLESON, M.B., B.S.

The number of marriages which are legally annulled must be very small compared with the number which are not in fact actually consummated. It is by no means uncommon for women who have been married many years to seek advice on account of dyspareunia, conjugal dissatisfaction, or sterility, and for examination to reveal a hymen partially or totally intact. A large proportion of such patients are genuinely astonished when this fact is made known to them. It would be difficult to assess whether such cases are due more frequently to failure on the part of the husband or that of the wife; because, although one partner may be initially responsible for the difficulty, more often than not this trouble is, so to speak, emotionally "infectious," or, at any rate, accentuated by the other partner being under-competent, over-anxious, or too forbearing. This article will deal with those cases in which the trouble comes mainly from the woman's side, on account of coitus being rendered impossible by spasm of the introital vaginal muscles.

Clinically, the term "vaginismus" denotes a condition of vaginal spasm varying from a constriction at the beginning of coitus (so slight that it may merely discomfort the woman herself) up to the extreme case in which the spasm causes acute pain to the woman and entirely prohibits any penetration by the husband: indeed, the introitus may be so constricted that even the tip of the examining finger can gain no entrance. The spasm may affect the perineal muscles exclusively or may be felt as a varying constriction of the levator ani right up to the vaginal fornices. Accompanying this spasm there is usually a definite adduction of the thighs, even up to the point of cramp-like spasm of the adductor muscles, and invariably the lumbar spine is extended in the position of lordosis. In severe cases the posture adopted is one almost of opisthotonos. A concomitant of the syndrome is a greater or lesser degree of hysterical hyperaesthesia. Rarely, this may be absent, but in some cases it may be more prominent than the spasm itself. The hyperaesthesia is usually of the "glove and stocking" variety, starting exactly at the vaginal introitus, but in extreme cases it may be registered all over the vulva and even over adjacent parts of the abdomen and thighs. Vaginismus need have no relation to an unstretched hymen, and can occur with equal severity in the woman who has borne children as in the virgin. It is known to appear as a secondary protection to some physical lesion (such as urethral caruncle, salpingitis, etc.) which would otherwise cause dyspareunia, but such cases are rare compared with the "idiopathic" vaginismus, and will not be dealt with here.

It is important to realize that a true vaginal spasm cannot be voluntarily produced—that is, it cannot be consciously employed by a woman to evade coitus—and it may appear in spite of the utmost *conscious* willingness to accept the coital act. Fortunately, as will be discussed later, it can very largely be modified by conscious control.

The entire syndrome must, of course, be accepted as psychogenic. Often these women display additional neurotic symptoms, and after marriage many of them develop symptoms of anxiety neurosis, typically precipitated by sexual frustration, although in this case the frustration is self-inflicted. Hence, certain of these cases have of recent years found their way to treatment by psychotherapy or psycho-analysis. Experts in this work assert that the aetiology of the condition appears to be varied, because—as with so many neurotic symptoms—there is a tendency to "over-determine" the original fear against vaginal acceptance.

Observation of a series of cases has suggested a possible common factor which has not yet received recognition. Before outlining this it will be convenient to comment upon the clinical