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PROPHYLAXIS OF VENOUS THROMBOSIS AND PULMONARY EMBOLISM IN PATIENTS WITH ACUTE TRAUMATIC SPINAL CORD LESIONS

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Abstract. Twenty-one patients with acute traumatic spinal cord lesions, who were admitted to our spinal unit during 1974, have been treated with calcium heparin, using a dosage of 5000-7500 i.u. at 12-hourly intervals from the first days after the lesion until the use of a wheelchair, as a prophylactic measure in order to prevent venous thrombo-embolism. Of these 21 patients 18 received this treatment continuously, with a resulting 0 per cent of venous thrombosis and 0 per cent of pulmonary embolisms. In the three remaining cases, treatment had to be temporarily interrupted and in one case clinical thrombo-phlebitis was clearly evident. No case of pulmonary embolism was registered. We consider this technique to be very useful in the prophylaxis of thrombo-embolic complications in this type of patient. The use of this type of prophylactic therapy, results and conclusions are discussed.

Introduction

THE high incidence of deep-vein thrombosis and its complications in patients subject to stress with immobilisation and circulatory deficiency, as well as the need for prevention of the same, explains the considerable amount of medical literature available on this question (Wright, 1952; Gibbs, 1957; Hobbs, 1960; Sevitt, 1962; Wessler, 1962; Harris, 1967; Evarts, 1971; Salzman, 1971; Boneu, 1972; Kakkar, 1972; Potrom, 1973; Simon, 1974; etc.). Generally, 50 per cent of pulmonary embolisms do not present clinical evidence of venous thrombosis and in 65 per cent of autopsies carried out for various reasons, evidence of thrombosis is discovered in the veins of the limbs.

In patients with acute paraplegia who are subject to a state of spinal shock, external pressures caused by bed rest and immobilisation, associated traumatisms and who are influenced by racial, climatological and metabolical factors etc., different authors have shown an average of 15 per cent of thrombosis and 5-10 per cent of pulmonary embolisms which they have attempted to treat by the use of different therapeutic methods (Walsh, 1965; Watson, 1968, 1974; Phillips, 1973; Chahal, 1974; Hachen, 1974; Silver, 1974). The objective of this paper is to report a study of the administration of calcium heparin at a dosage of 5000-7500 i.u. at 12-hourly intervals as a method of antithrombo-embolism prophylaxis.

Material and Methods

Clinical Trial

At the beginning of 1974 we initiated a clinical investigation in patients with acute traumatic spinal cord lesions with a view to preventing thrombo-embolic accidents. For this we used techniques based on the studies of Kakkar (1970, 1972), using low-dose heparin—in this case 5000-7500 i.u. of calcium heparin at

12-hourly intervals from the first days after the lesion until the patient was adapted to a wheelchair.

We submitted 21 patients to this treatment—18 men and three women. Their ages ranged from 17 to 81 years and 12 of them were under 30 years of age. The mechanism of lesion was in all cases traumatic, with predominance of car accidents and accidents at work. In three cases the injury was caused by misjudged dives into swimming-pools and one was caused by a fire-arm.

The level of clinical lesion varied from a C4 to an S3. The segment distribution was nine cervical, seven dorsal, four lumbar and one sacral.

The spinal cord lesion was complete in 20 of the 21 cases. Significant associated traumatic lesions were present in five cases (one fracture of the tibia, two cranial fractures, two rib fractures).

As regards associated illness, we found arteriosclerosis in two cases, spinal osteo-arthritis and spondylosis deformans in three cases and pneumoconiosis in one case.

Radiographic studies of the osseous spinal column revealed compression fractures and compression-burst fractures in 12 cases, dislocation and fracture in six cases and chronic cervical spondylosis without fracture in three cases.

The phase of spinal shock varied from 1 to 45 days, with an average of 16 days. Muscular tone at the end of the treatment showed 14 patients to be in a spastic state and seven in a flaccid state.

The period of treatment with heparin using 5000-7500 i.u. at 12-hourly intervals varied between 37 and 121 days, with an average of 66 days.

All the patients had simultaneous treatment with different drugs and all received daily physiotherapy in the form of passive, active assisted or resisted mobilisations, according to muscular groups and level of lesion, together with respiratory physiotherapy.

Use was made of 'Egerton'-type electric beds with postural changes every 2-3 hours during 24 hours a day.

Clinical control of the appearance of early signs of venous thrombosis was achieved by serialised measurement of the perimeter of the lower limbs at thigh and calf level. We did not use the fibrinogen-uptake test with I-125 or I-131 (Kakkar, 1972; Hobbs, 1973) as at present we have only limited experience of this technique. The control of pulmonary embolic complications was carried out by auscultation and radiographies and the control of haemorrhagic complications in the digestive and urinary systems by studies of faeces and urine.

Results

Of the 21 patients, 18 received treatment without interruption and no case of clinical thrombo-embolism occurred (0 per cent). Of the three patients whose treatment was temporarily suspended, one showed a clear case of clinical thrombophlebitis (4·7 per cent). Complications of pulmonary embolism were not present in any of the cases and haemorrhagic complications attributable to heparin were not observed. The mortality rate of the patients for other reasons was nil.

Discussion

Technique, Results, Complications

Heparin (doses of 5000-7500 i.u.) was used for the following reasons:

1. The objective was to prevent venous thrombi. The development of such thrombi is affected primarily by factors of coagulation and therefore they are

susceptible to modification by the use of anti-coagulants, as opposed to arterial thrombi, in which platelet aggregation factors have more effect and which are therefore susceptible to modification by the use of platelet aggregation inhibitors (Welch, 1887; Hilden, 1961; Sevitt, 1962; Emmons, 1965; Marcus, 1965; Jorgensen, 1967; Evans, 1968; O'Brien, 1968; Marcus, 1969).

2. The properties of heparin as regards rapidity of action, management, dosage, lack of interaction with other drugs and easy neutralisation as compared with oral anticoagulants (Lee, 1950; Weiner, 1950; Stirling, 1951; O'Reilley, 1964; Weiner, 1967; Goth, 1968; Hachen, 1974).

3. Convenience of not needing to carry out serialised coagulation controls (Howell's time, thrombin time) which are not modified with the use of this technique (Potrom, 1973; Hachen, 1974).

4. Thrombo-embolic and haemorrhagic complications observed previously in our spinal unit due either to lack of use of prophylactic anticoagulant medication or to the use of oral anticoagulants with their possible modification by drug interactions (analgesics, tranquillisers, antibiotics etc.) which these patients also need in general in their daily evolution.

5. The good results obtained with this technique in the investigations of Kakkar (1972) and Potrom (1973) in post-operative cases and confirmed in patients with spinal cord lesion by Hachen (1974).

6. The reflex action return observed in the majority of patients once the phase of spinal shock is passed has a positive pumping effect on the blood, improving circulation and preventing stasis. Guttmann (1958) and Guttmann and Silver (1965) found the reappearance of reflex contractions of the intercostal muscles to be of help in the increase of vital capacity of the lungs.

7. We believe that the ending of this treatment when the patient advances to activities outside the bed is justified, due to the fact that greater physical activity and postural changes together with the muscular reflex activity, the increase in respiratory movements, reduction of external pressures and of the complications affecting patients in bed (Browse, 1962), permit a security margin in the prevention of thrombo-embolisms, although the possibility that these can occur does still exist.

In different spinal units favourable results have also been obtained using various types of prophylactic techniques. Hachen (1974) in Geneva, using 10,000 i.u. of heparin during 3 weeks followed by sintrom until wheelchair activity was achieved, recorded a reduction in thrombosis from 21 per cent to 6 per cent. Silver (1974) in Stoke Mandeville, using phenindione during a period of 12 weeks, recorded a reduction from 25 per cent to 5 per cent. The Sheffield group (Watson, 1968, 1974) using physiotherapy and continuous observation, without using anticoagulants in a prophylactic manner, obtained 12 per cent. Chahal in India (1974) did not use prophylactic anticoagulants because thrombotic complications rarely occur in that country, due probably to racial, climatic and dietetic factors.

We consider the results obtained with our therapy to be very good, as the percentage of complications in the patients receiving this treatment in a continuous manner was nil. Of the three cases in which we had to temporarily withdraw treatment, one case of clinical thrombo-phlebitis occurred. The first of the three mentioned cases was an American male, 38 years of age, with a complete D6 lesion caused by a fire-arm and who suffered from bad psychological readjustment. This patient developed haematuria due to the tearing out of the catheter, in this case a permanent one, during an agitation crisis. Two days after withdrawal of heparin treatment a clinical thrombo-phlebitis appeared, requiring curative

treatment. The second case was a male patient, 25 years of age, with a C6 lesion caused by a car accident, who developed haematuria due to bladder distension. After 3 days, a difference of 3 cm in the perimeters of the lower limbs was observed, without signs of inflammation, and which returned rapidly to normal without requiring any treatment. The third case was a male patient of 35 years of age with a C6 lesion caused by a car accident and from whom the heparin treatment was temporarily withdrawn due to the patient being submitted to plastic surgery to treat sacral pressure sores, without there being any thrombotic complications.

Hachen (1974), using heparin and later sintrom, found that some cases of thrombosis occurred during the change-over from one to the other, recommending strict observation. Silver (1974) observed cases of thrombosis after the termination of treatment. In our case load, another patient, a 76-year-old woman with a C6 lesion, suffered a clinical thrombo-phlebitis 1 month after the normal treatment was finished, when she had been once more confined to bed due to urinary complications.

Of the above-mentioned patients from whom treatment was withdrawn temporarily, none developed clinical pulmonary embolism and all recommenced the prophylactic treatment without further suspensions until wheelchair activity was achieved.

Conclusions

The continued prophylactic use of calcium heparin with doses of 5000-7500 i.u. at 12-hourly intervals from the first days after the lesion until wheelchair activity in patients with acute traumatic spinal cord injury has been shown to be completely favourable in a clinical trial carried out in 18 patients. Special care should be observed with patients who must be temporarily withdrawn from treatment. Out of three patients, one developed clinical thrombo-phlebitis.

Direct haemorrhagic complications are not to be expected. Complications of pulmonary embolism were not present in any of the 21 cases.

Résumé

21 malades avec lésion traumatique aiguë de la moelle épinière, admis à notre Service de Paraplegiques pendant l'année 1974, furent traités par l'héparine de calcium (dose: 5000-7500 UI) touts les 12 heures depuis les premiers jours aprés la lésion, jusqu' au moment de passer au fauteuil roulant, comme mesure préventive pour éviter des complications thrombo-emboliques veineuses. De ces 21 sujets, 18 ont recu un traitement continu, le résultat étant de 0 pour cent de thromboses veineuses et 0 pour cent démbolies pulmonaires. Dans les 3 autres cas, le traitement a dû être temporairement interrompu (dans un cas une thrombo-phlébite olinique s'est présentée). Nous n'avons observé aucun cas d'embolie pulmonaire. Nous considérons que cette technique est très utile pour la prophylaxis des complications thrombo-emboliques chez ce genre de malades. L'usage de cette thérapie prophylactique, les resultats et les conclusions sont exposées.

Zusammenfassung

Der dauernde preventive Gebrauch von Calcium Heparin mit Dosen von 5,000-7,000 i.u. in 12-stündigen Interval von den ersten Tagen nach der Verletzung an bis zur Fahrstuhl-Aktivität hat sich in 18 Patienten mit akuten Rückenmarksverletzungen aüsserst günstig erwiesen. Spezielle Beobachting muss Patienten gegeben werden, bei-denen die Behandlung zeitweise unterbrochen wird. Von 3 Kranken entwickelte einer klinisch Thrombophlebitis. Haemorragische Komplikationen wurden nicht beobachtet. Keiner der 21 Patienten bekam eine pulmonale Embolie.

REFERENCES

BONEU, B., CATHALA, B., JORDA, M., BIERME, R. & LARENG, L. (1972). Réanimation des malades à haut risque hémorragique et thromboembolique. *Nouv. Presse. Méd.* **1**, 29.

BROWSE, N. (1962). Effect of bed rest on resting calf blood flow of healthy adult males. *Brit. Med. J.* **1**, 1721.

CHAHAL, A. (1974). Proceedings of the Annual Scientific Meeting of the International Medical Society of Paraplegia. Discussion. *Int. J. Paraplegia*, **12**, 202.

EMMONS, P., HARRISON, M., HONOUR, A. & MITCHELL, J. (1965). Effect of dipyridamole on human platelet behaviour. *Lancet*, **2**, 603.

EVANS, G., PACKHAM, M. & NISHIZAWA, E. (1968). The effect of acetylsalicylic acid on platelet function. *J. Exp. Med.* **128**, 877.

EVARTS, C. & FEIL, E. (1971). Prevention of thromboembolic disease after elective surgery of the hip. *J. Bone Joint Surg.* **53**-A, 1271.

GIBBS, N. (1957). Venous thrombosis of the lower limbs with particular reference to bed-rest. *Brit. J. Surg.* **45**, 209.

GOTH, A. (1968). *Medical Pharmacology*. C. V. Mosby Company, p. 398.

GUTTMANN, L. (1973). *Spinal Cord Injuries—Comprehensive Management and Research*. Blackwell Scientific Publications, p. 178.

GUTTMANN, L. & BELL, D. (1958). In *Suspension Therapy*, ed. M. Hollis & M. Roper. Bailliere, Tindall & Cox, London, p. 107.

GUTTMANN, L. & SILVER, J. (1965). Electromyographic studies on reflex activity of the intercostals and abdominals in cervical cord lesion. *Int. J. Paraplegia*, **3**, 1.

HACHEN, H. (1974). Anticoagulant therapy in patients with spinal cord injury. *Int. J. Paraplegia*, **12**, 176.

HACHEN, H. (1974). Proceedings of the Annual Scientific Meeting of the International Medical Society of Paraplegia. Discussion. *Int. J. Paraplegia*, **12**, 202.

HARRIS, W., SALZMAN, E., DESANCTIS, R. (1967). The prevention of thrombo-embolic disease by prophylactic anticoagulation. *J. Bone Joint Surg.*, **49**-A, 81.

HILDEN, I., IVERSEN, K. & RAASCHOU, F. (1961). Anticoagulants in acute myocardial infarction. *Lancet*, **2**, 327.

HOBBS, J. & DAVIES, J. (1960). Detection of venous thrombosis with 131-I labelled fibrinogen in the rabbit. *Lancet*, **2**, 134.

JORGENSEN, L., ROWSELL, H. & HOVIG, T. (1967). Resolution and organization of platelet-rich mural thrombi in carotid arteries of swine. *Amer. J. Path.*, **51**, 681.

KAKKAR, V., CORRIGAN, T., SPINDLER, J., FOSSARD, D., FLUTE, P., CRELLIN, R., WESSLER, S. & YIN, E. (1972). Efficacy of low doses of heparin in prevention of deep-vein thrombosis after major surgery. *Lancet*, **15**, 101.

KAKKAR, V., HOWE, C., NICOLAIDES, A., RENNEY, J. & CLARKE, M. (1970). Deep-vein thrombosis of the leg. *Am. J. Surg.* **120**, 527.

KAKKAR, V. & JOUHAR, A. (1972). Thromboembolism diagnosis and treatment. Churchill Livingstone, Edinburgh, p. 101.

LEE, C., TREVOY, L., SPINKS, J. & JAQUES, L. (1950). Dicumarol labeled with C-14. *Proc. Soc. Exper. Biol. & Med.* **74**, 151.

MARCUS, A. (1969). Platelet function. *New Engl. J. of Med.* **280**, 1213.

MARCUS, A. & ZUCKER, M. (1965). The physiology of blood platelets: recent biochemical, morphologic and clinical research. Grune (ed.), New York.

O'BRIEN, J., (1968). Effects of salicylates on human platelets. *Lancet*, **1**, 779.

O'REILLEY, R., AGGELER, P., HOAG, M., LEONG, L. & KROPATKIN, M. (1964). Hereditary transmission of exceptional resistance to coumarin anticoagulant drugs. *New England J. Med.* **271**, 809.

PHILIPPS, R. (1963). The incidence of deep-venous thrombosis in paraplegia. *Int. J. Paraplegia*, **1**, 116.

POTROM, G., SEYS, A. & LARDENNOIS, B. (1973). L'Héparinotherapie sous mini-dose. *Cahiers de Medecine*, **14**, 219.

SALZMAN, E., HARRIS, W. & DESANCTIS, R. (1971). Reduction in venous thromboembolism by agents affecting platelet function. *N. Engl. J. Med.* **284**, 1287.

SEVITT, S. (1962). Venous thrombosis and pulmonary embolism: their prevention by oral anticoagulants. *Amer. J. Med.* **33**, 703.

SILVER, J. (1974). The prophylactic use of anticoagulant therapy in the prevention of pulmonary emboli in one hundred consecutive spinal injury patients. *Int. J. Paraplegia*, **12**, 188.

SIMON, T. & STENGLE, J. (1974). Antithrombotic practice in orthopaedic surgery—results of a survey. *Clin. Orthop.* **102**, 181.
STIRLING, M. & HUNTER, R. (1951). Pharmacology of bis 3-3-(4-oxycoumarinyl) ethyl acetate (tromexan). *Lancet*, **2**, 611.
WALSH, J. & TRIBE, C. (1965). Phlebo-thrombosis and pulmonary embolism in paraplegia. *Int. J. Paraplegia*, **3**, 209.
WATSON, N. (1968). Venous thrombosis and pulmonary embolism in spinal cord injury. *Int. J. Paraplegia*, **6**, 113.
WATSON, N. (1974). Anticoagulant therapy in the treatment of venous thrombosis and pulmonary embolism in acute spinal injury. *Int. J. Paraplegia*, **12**, 197.
WEINER, M. (1967). The rational use of anticoagulants. *Pharmacol. Physicians*, **1** (11), 1.
WEINER, M., SHAPIRO, S., AXEIROD, J., COOPER, J. & BRODIE, B. (1950). The physiological disposition of dicumarol in man. *J. Pharmacol & Exper. Therap.* **99**, 409.
WELCH, W. (1887). The structure of white thrombi. *Trans. Path. Soc. Philadelphia*, **13**, 281.
WESSLER, S. (1962). Thrombosis in the presence of vascular stasis. *Amer. J. Med.* **33**, 648.
WRIGHT, H., OSBORN, S. & HAYDEN, M. (1952). Venous velocity in bedridden medical patients. *Lancet*, **2**, 699.