SOME IMPRESSIONS OF THE VALUE OF HEPARIN IN THE SURGICAL TREATMENT OF PERIPHERAL ARTERIAL OBSTRUCTION

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Acute obstruction of the main arteries of the extremities occurs fairly often, and may involve the tragic loss of a limb. The attempt to relieve such an obstruction of the blood flow by surgical means is evidently indicated, but it is often frustrated by various factors. One important factor determining the surgical outcome is the distal and proximal progression of the clot, which occludes important collaterals, and particularly the distal vascular tree. This prevents the establishment of main arterial circulation by the deviation of the blood flow round the site of obstruction through dilated collaterals, or re-establishing it by extracting the obstructing clot or bridging the gap by means of some type of graft.

The results on a small series of cases do not allow of statistical conclusions but, when results are definite, certain impressions are valid and worth while recording. The value of heparin in preventing progression of thrombosis and thereby enhancing the chances of successful surgery has been reported by others. My own experience with heparin in 3 recent cases of acute circulatory deficiency of the lower extremity has impressed me with its value and I propose to report and discuss these cases.

CASE REPORTS

Case 1. European male 50 years old. In 1951, before coming to South Africa, he developed deep thrombosis of the right leg, with repeated thrombo-embolic episodes, and eventually recovered after 3 months' critical illness in hospital. In July 1953 after an attack of influenza he developed a deep thrombosis of the left leg, followed soon by a major pulmonary embolism. To forestall the grave danger of a second, possibly fatal, embolus, bilateral ligation of the superficial femoral veins was advised, and carried out the same evening, under local block anaesthesia. In the left leg, the loosely adherent clot, extending up the common femoral vein, was extracted and the superficial femoral vein ligated and transected. Heparin administration was started intravenously at this stage. The left femoral vein was fibrosed and densely adherent to the artery, which had to be separated with some difficulty and went into extreme spasm. The danger was borne in mind of losing the artery and accidently including it in the ligature under these circumstances. The superficial femoral vein was ligated and

transected. The administration of heparin was continued. The patient was returned to his bed at about 10 p.m. When he was visited next morning at about 10 o'clock the right leg, from the knee downwards, was found to be completely ischaemic. Lumbar block failed to improve matters, and ruled out the possibility of severe reflex arterial spasm.

At about noon, therefore, the artery was re-exposed, under general anaesthesia, and it was found that notwithstanding the precautions taken the artery had been included in the ligature and transected. Continuity was re-established by means of an end-to-end anastomosis, and this was followed by a lumbar sympathectomy. The peripheral pulses returned, and circulation has been normal ever since.

He incidentally developed an acute intestinal obstruction one week later, and an adhesive terminal ileal obstruction was found and released. Complete recovery followed, with full use of limbs.

In March 1954 the patient suddenly developed pain, numbness, and lameness in the left leg one morning at 10 o'clock. The left leg was ischaemic from below the groin downwards, and femoral and distal pulses were absent. No heparin could be given until he came to operation at 3 p.m. Under general anaesthesia the common iliac artery was exposed extra-peritoneally and an old partially-organized clot completely obstructing the flow at the junction of the external and internal iliacs was extracted. After arterial suture the external and internal iliacs pulsated normally as far as they were accessible. A lumbar sympathectomy followed. Heparin was given intra-arterially and intravenously after arterial suture had been completed.

On return to the ward ischaemic phenomena gradually shifted to below knee level and the femoral pulse became palpable. Next morning from about 8 o'clock the ischaemia extended higher and the condition of the leg deteriorated. The possibility that this later deterioration, with the femoral pulse present, might be due to the lodgement of another clot at the fork of the common femoral artery seemed to justify further exploration of this segment. At 10 a.m. the common femoral artery up to below its bifurcation was exposed, under local block anaesthesia. Pulsation stopped at the fork, the distal superficial femoral being contracted and pulseless. The usual bulging of a lodged clot was absent. The superficial femoral artery was opened and only a thrombus of recent formation extending downwards could be extracted. Pulsation was present in the exposed segment of the superficial femoral, after successful arterial suture. After this some slow improvement of circulation occurred, so that a below-the-knee amputation could be undertaken, after demarcation. Heparin administration was continued for 5 days and then replaced by dicumarol medication carefully controlled every day.

The origin of the thrombus could not be definitely established. Clinical, radiological and E.C.G. examination failed to suggest intracardiac origin. Presumably atheromatous ulceration of the aorta acted as the initiating site of origin.

Case 2. European male aged 78 years. In the early hours of 12 December 1953 he developed sudden pain and lameness in the right leg. His doctor, who diagnosed an arterial embolus, consulted me by telephone. He was advised to give heparin immediately; this was about 1 hour after the onset. I had to travel a considerable distance to the patient, and he only came to operation at about 4 p.m.—11-12 hours after the onset. All peripheral pulses on the right leg, except the femoral in the groin, were absent. Ischaemic phenomena were well marked from the knee downwards. Under local femoral block anaesthesia, the femoral artery was exposed. Pulsation was absent beyond the superficial femoral origin and the usual bulge of a lodged embolus was seen at the bifurcation. An old clot was extracted and the arteries were allowed to flush through. No recent extension of clot-formation in the distal arterial segment was noticed at operation. After successful arterial suture, notwithstanding some atheromatous changes with hardening, the superficial femoral and profundus pulsated satisfactorily. Heparin, 50 mg., was given slowly through a fine needle into the artery above the line of suture before closing the wound. The patient was turned on his left side for the administration of a novocain lumbar block. While I was busy finding the landmarks with the needle, before actually making the injection, the patient developed a rigor and went into peripheral circulatory collapse. The procedure was therefore abandoned and the patient returned to his bed. He recovered from this state of collapse in about an hour's time, after which the foot became warm and the peripheral pulses gradually returned.

He recovered uneventfully and regained full use of the limb. As no cardiac pathology, possibly acting as a nidus for the thrombus formation, could be detected, it was again presumed to have originated in the aorta.

Case 3. European male aged 83. He was admitted to the Boksburg-Benoni hospital on 25 August 1954 and was seen by the assistants on duty in my department. The right leg had suddenly become ischaemic from just below the knee downwards. The popliteal pulse was felt, while those of the dorsalis pedis and posterior tibial were absent. The possibility of an embolus was considered, but it was argued that the high level of ischaemia could not be accounted for by an arterial obstruction at the level of the popliteal fork, and that more extensive local thrombosis must have occurred. He was therefore heparinized and lumbar blocks with only slight effect were given. When I saw him on 27 August, marked ischaemia of the leg was present. When the popliteal pulse was felt, prominent pulsation was immediately noticed, and on closer examination it was evident that there was a popliteal aneurysm, which had escaped notice by the previous examiners. Sudden local clotting up of the aneurysm, with obstruction of the distal and collateral blood-flow, would explain the rather sudden onset of ischaemia 2 days before. At about 3 p.m. the popliteal artery was exposed under local popliteal nerve block. After mobilization of the fusiform aneurysmal sac, the superior and inferior genicular were seen to arise from the upper and lower borders respectively of the aneurysm. After evacuation of the clot, the sac was excised. The intima round the ostia of the collaterals, which were patent, were noted to be intact. Recent clotting into the distal arterial tree was present. After this was extracted, a good-sized lubricated ureteric catheter was introduced distally and the arterial tree washed out with saline containing 50 mg. of heparin. Some smaller clots were dislodged this way and washed out. Saline with heparin was then forced through the distal arterial tree. By trimming away all the atheromatous destroyed intima up to the level of the intact intima a gap of 2 inches was created which could only be bridged by a graft. The most suitable popliteal vein was prepared for grafting and sutured into place. After successful arteriovenous suture the remnants of the posterior wall of the sac were wrapped and sutured round the graft as reinforcement. Good pulsation through the graft and into the distal artery, as far as accessible, was present. A lumbar novocain block, followed by 10% phenol, was administered. The ischaemia gradually disappeared and by the next morning the leg was warm up to the toes. The patient was kept on heparin for 5 days after operation. The limb, except for a necrotic distal phalanx of the big toe, has fully recovered and he has full use of it.

The venous graft has become somewhat dilated, but is functioning well. Its ultimate fate still has to be decided. It might prove necessary to replace it with an arterial graft.

DISCUSSION

The administration of heparin as an adjunct in the treatment of arterial obstruction, although generally advised, has also been opposed, notably by Professor Boyd of Manchester, who has warned against possible deleterious effects, particularly if the drug is used without strict control. The estimation of clotting time, by Lee and White's method, can be learned and carried out by any doctor. It is generally advised that heparinization is adequate when clotting time is prolonged to 2 or 3 times its original level. Some Swedish authors, however, have pointed out that the clotting time does not necessarily truly reflect the complex intravascular clotting tendency, and that comparatively small doses of heparin, without producing an appreciable change in clotting time, can still give protection against intravascular clotting. Without going into the arguments for and against the different methods of administration, my experience has convinced me that in practice the Cosgriff method is the most practicable and the safest. This is the method that I employed in these 3 cases.

An intravenous priming dose of heparin (25-50 mg.) followed in an hour by 3-hourly subcutaneous injections of relatively small doses (the 1st 50 mg., the 2nd and others 30 mg.) produces a moderate and fairly well sustained prolongation of clotting time.

It is generally accepted that the chance of success rapidly decreases after the first 6 hours following onset, and that after 10 hours it is practically nil. Roughly the times that elapsed between the onset of obstruction and successful release in these 3 cases was 14, 10 and 15 hours respectively. Case 1 is particularly instructive and suggestive, because in the same patient the 1st attempt succeeded after 14 hours had elapsed whilst the 2nd attempt failed after only 6 hours had elapsed and thrombus formation had already occluded the distal arterial tree, as confirmed by operative findings. The only apparent difference on the 2 occasions was the early heparinization on the 1st occasion and its absence on the 2nd. Not only was the time interval on the 1st successful occasion more than twice as long, but local conditions also favoured thrombus formation at the site of arterial suture; it was not possible to excise the traumatized and devitalized ends of the artery because this would have prevented end-to-end approximation.

At the execution of the 2nd unsuccessful attempt in case 1, the idea of washing out the distal arterial tree with saline containing heparin had not yet occurred to me. I feel that this is a helpful measure for getting rid of additional obstructing thrombi and maintaining patency. There is experimental and clinical reason to believe that heparin when brought into direct contact with a thrombus has a lytic effect.

A perusal in the literature of the experience of others, particularly of such an experienced worker in this field as Sir James Learmonth, gives a rather gloomy impression of this subject. The successful outcome of 3 cases of arterial obstruction within 1 year induces me to believe that the early administration of heparin had something to do with it. Technical differences can be taken as excluded and sheer chance does not seem a likely explanation.

CONCLUSION

Alertness on the part of the practitioner, and close collaboration with the surgeon, can often avoid the tragic loss of a limb, or even a life, as the result of arterial obstruction. The diagnosis should be made promptly, and this can be done if the possibility of arterial obstruction is borne in mind and the limb is at least examined for ischaemic phenomena.

The normal popliteal artery is not easily palpated. Excessive prominent pulsation felt on palpation should immediately suggest the possibility of an aneurysm and invite further investigation (case 3).

All obstructive arterial lesions of the lower extremity below the level of the aortic fork can be dealt with under local anaesthesia. Although a large percentage of these cases are suffering from pathological conditions of the heart, very few will be too ill to stand the operation under local. There is no objection to general anaesthesia if the patient's condition allows it, but spinal is contra-indicated lest release of spasm should permit the embolus or part of it to slip further down. As pointed out, heparin administration at the earliest possible moment is essential. If given carefully under control, according to Cosgriff, its benefit in my opinion far outweighs its possible dangers.

I have not found oozing to be uncontrollable at operation where the patient was heparinized beforehand; if it were so it could easily be overcome by the intravenous administration of protamine sulphate.

The washing-out of distal clots with saline and heparin through a ureteric catheter is a valuable adjunct for procuring and maintaining patency and thereby ensuring success.

After removal of the obstructive lesion, some form of sympathetic denervation should follow, according to circumstances and the patient's condition.

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