AN OPERATION FOR EMBOLUS.

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THE chapter of surgery dealing with the operative removal of emboli lodged in the trunk arteries has still to be written. Yet many surgical operations which are now matters of daily occurrence must have seemed equally impossible of achievement only a few years ago.

In 1894 Professor Severeanu¹ of Bucharest, in cases of amputation for gangrene due to arterial obstruction, advised that a bougie should be passed for some distance from the cut surface of the stump, into the divided proximal end of the main artery, so as to ensure its patency, to remove clots, and to minimize the risk of gangrene of the flaps. Severeanu's paper appears up to the present to constitute the literature of intra-arterial surgery.

Lilienthal² has suggested that in threatened gangrene due to embolism of the popliteal artery, end-to-end anastomosis of the proximal end of the divided superficial femoral artery with the distal end of the divided external saphenous vein might re-establish the circulation in the affected part. The suggestion is based upon the work of Carrel³ on the union by suture of severed arteries, and upon the successful experiment of Carrel and Guthrie,⁴ who, in a dog, reversed the circulation in a limb by dividing the main artery and vein, and subsequently joining up the proximal end of the artery with the distal end of the vein and vice versa. Lilienthal's suggestion does not seem promising.

In the case now to be described an attempt at the removal of the offending foreign body—in my opinion the most rational treatment—was made with some temporary glimmer of success. I place the case on record because it seems one of those pioneer failures on which ultimate success so often rests.

Attempted Operative Removal of an Embolus lodged at the Bifurcation of the Abdominal Aorta: Temporary Restoration of the Blood Current in the Femoral Artery.

A man, aged 65, was admitted into the Middlesex Hospital under my care, with a strangulated hernia situated in the line of the linea alba, 1 in. above the umbilicus. The obstruction had existed for five days, and no flatus or faeces had passed for forty-eight hours. The vomit was not faecal. The patient was a most unfavourable subject for operation. His lungs were emphysematous and his chest hyperdistended. His ears were full of tophi and the joints of his hands were much deformed by chalk stones. Nevertheless, his arteries did not seem to be specially atheromatous.

Operation showed that the hernia contained only small intestine; the absence of large intestine and omentum, so unusual for a hernia in this situation, was doubtless due to the fact that the transverse colon was displaced upwards so as to lie between the diaphragm and the liver. The herniated intestine was not tightly strangulated, and it was possible to return it into the abdomen after division of the stricture. A radical cure was then performed.

Twenty-four hours after operation the patient complained greatly of pain in his left foot, but I could find no objective signs. The skin was not discoloured, and its temperature appeared normal. The patient's general condition was fairly good. In the light of subsequent events, this pain was probably due to the lodgement of one or more small emboli in the smaller arterial branches of the foot. At the time I considered it due to an attack of gout.

Twelve hours later the House-Surgeon (Mr. Mawson) found that the whole left lower limb was cold and discoloured from a point 3 in. below Poupart's ligament. I was unable to feel a pulse in the common femoral artery, or in any of the arteries below it. Judging by the temperature of the limb, the obstruction had occurred three or four hours previously, during the night. It was evident that the whole of the limb was about to become gangrenous. The pulse was quick and feeble, and amputation of the limb would have been immediately fatal.

In this desperate condition I thought a last effort might be made to restore the circulation in the limb by attempting the removal of the arterial obstruction. The pulse in the right common femoral was normal, and it was therefore evident that the upper limit of the obstruction was situated not higher than the bifurcation of the abdominal aorta.

The patient was immediately taken to the theatre, and was lightly anaesthetized. I am inclined to think that local anaesthesia by infiltration would have been somewhat preferable. A vertical incision 3 in. long was made over the left common femoral artery with its centre

at the origin of the profunda femoris. The external circumflex branch of the profunda was exposed, ligatured, and divided transversely on the proximal side of the ligature. No bleeding occurred—a fact of ill omen, since it showed that secondary thrombosis of the arteries of the limb had occurred below the point of obstruction. A flexible tube about the size of a No. 4 catheter was passed upwards through the divided proximal end of the circumflex artery into the common femoral artery. The end of the tube was connected to an aspirator, and some soft blood-clot was sucked up into the tube. No blood flowed, and the tube was withdrawn. It was decided to attempt to dislodge the obstruction by a stream of saline solution. In order to obtain better access and a freer reflux, it seemed necessary to divide as large an artery as was compatible with the subsequent maintenance of nutrition in the limb. The profunda femoris was, therefore, divided at its origin and its distal end ligatured. The abdominal aorta was compressed at the level of the umbilicus through the abdominal wall, so as to safeguard the right common iliac from obstruction. A Kelly's ureteral catheter was now introduced through the divided proximal end of the profunda artery. It was cautiously passed upwards along the common femoral, the external iliac, and the common iliac artery until, as judged by previous measurements on the skin, it had reached the bifurcation of the abdominal aorta. A forcible stream of saline was sent through the catheter, and returned freely through the divided end of the profunda. The point of the catheter was moved about within the artery, so as to detach the clot within it. Some fragments of recent clot escaped, but relaxation of the pressure on the abdominal aorta was not followed by a jet of blood. The aorta was again compressed, and the washing-out process was continued. Relaxation of the pressure on the aorta was now followed by the escape through the divided profunda of a forcible, pulsating stream of bright-red blood.

Encouraged by this partial success, I next attempted to clear the lumen of the superficial femoral artery. The common femoral artery was compressed. A small incision was made over the popliteal artery, and one of its branches was divided so as to provide a point of outflow for the saline solution with which I proposed to flush out the artery from above. The catheter was passed easily in from the divided end of the profunda downwards along the whole length of the superficial femoral artery, and almost as far as the bifurcation of the popliteal. Unfortunately, the general condition of the patient, desperate to begin with, forbade me to persist any further. The catheter was withdrawn, and the divided branch of the popliteal was ligatured. On removal of compression from the common femoral no blood flowed, and it was evident that the obstruction higher up had only been partially and temporarily displaced. Had the patient's condition allowed, I should have attempted to pass long crocodile forceps up to the bifurcation of the aorta, to seize the clot, and to drag it out, a proceeding which is certainly practicable. Under the circumstances, I tied off the divided end of the profunda and sutured the skin incisions. The patient died twenty-four hours later in a typhoid condition, with commencing gangrene of the limb.

At the necropsy, made by Dr. Lakin, the left auricle contained a shred of *ante-mortem* clot in one of its recesses. The orifice of the left common iliac artery was blocked by a decolorized and adherent mass of clot which exhibited transverse markings apparently corresponding to the muscular pectinati of the auricular appendix. The clot projected some little distance into the abdominal aorta. Below it the arteries were filled by soft, non-adherent clot. The rest of the *post-mortem* appearances need not be detailed. The herniated intestine had retained its vitality, but the lower part of the large intestine was intensely congested and its vessels were filled by *ante-mortem* thrombus. Evidently one or more emboli had lodged in the arteries of this portion of the gut.

I have long waited for an opportunity to attempt the surgical removal of an embolus lodged in a trunk artery, but it is probable that the methods I employed in this case are capable of improvement. My old friend and master, Mr. Jacobson, with whom I discussed the matter, suggested that it might be possible to cut directly down upon the embolus, to remove it, and subsequently to suture the artery. Whatever the method adopted, instant diagnosis and immediate operation, in order to anticipate inflammatory changes in the intima of the embolized artery, must always remain essential conditions to success. Fortunately in many cases the symptoms are so striking that these conditions are not impossible of attainment. In any future case, adopting a hint from Sir A. E. Wright's work, I should make use of sodium citrate solution of about 1 per cent. strength dissolved in normal saline to wash out the vessels, in order to minimize the risk of subsequent thrombosis.

REFERENCES.

- ¹ Severeanu, *Le Cathétérisme des Artères, Le Progrès Médical*, 1894, No. 32. ² Lilienthal, *End-to-end Arteriovenous Anastomophy, Annals of Surgery*, January, 1907. ³ A. Carrel, *Les anastomoses vasculaires, leur technique opératoire, Rev. Méd. de Canada*, 1904 5, viii, 29-32. ⁴ Carrel and Guthrie, *The Reversal of the Circulation in a Limb, Annals of Surgery*, February, 1906.