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ADRENALECTOMY OR AMPUTATION?
EXPERIENCES IN THE TREATMENT OF
PERIPHERAL ARTERIOSCLEROTIC
GANGRENE

BY
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INTRODUCTION

The surgery of the peripheral arteries was widely discussed at the 29th meeting of The Scandinavian Surgigal Society, held in Helsinki 1959. Arterial resection, by-pass operation or thromboendarterectomy were the procedures of choice, but when the arterial occlusion was peripheral or multiple, sympathectomy or amputation were the only possibilities. If sympathectomy was performed early enough and the high lumbar technique described by SEIRO (1955) was used, it was possible to postpone amputation and reduce the frequency of higher amputations (HOLOPAINEN 1959). Claudication, however, was usually left unchanged, thus indicating that it was mainly the skin circulation and not that of the muscles that improved after sympathectomy.

On the other hand, it is known that the increase of blood flow obtained immediately after sympathectomy gradually diminishes (literature reviewed by BARCROFT and SWAN 1952). This may be due to a) the arteries becoming supersensitive to circulating adrenaline b) their supersensitivity to an unknown hormone or c) a direct effect on the contractile process of intrinsic changes in the smooth muscle. According to DUFF (1952), the skin vessels especially very readily contract in response to adrenaline. Could use be made of this observation in the treatment of impending arteriosclerotic gangrene by performing adrenalectomy?

OPPEL (1922) was the first to perform unilateral adrenalectomy for the treatment of a patient with Raynaud's disease. His result was poor, but since then LERICHE, and after him by many other authors, have published their experiences of adrenalectomy or adrenomedullectomy — some of these bilateral — in the treatment of periperal vascular diseases (e.g. DURANTE 1952, KISS, DEGRELL, SINKÓ and KUDÁSZ 1954, SERVELLE, ROUGEULLE and

DELAHAUE 1954). In Scandinavia, only BØGGILD (1948) and PAABY and NORING (1956) have presented their results on some patients treated by adrenalectomy for Raynaud's or Bürger's disease. In the latter series there was also one case of arteriosclerotic occlusion.

The author of the present paper came to perform his first adrenalectomies under circumstances where the condition of the arteries precluded any reconstructive operations, where in most cases sympathectomy had already been performed and where impending arteriosclerotic gangrene demanded prompt action, but the patients refused amputation. The purpose of this paper is to present the authors' experiences obtained with ten patients, in all of whom peripheral arteriosclerotic gangrene was treated by unilateral adrenalectomy.

PRESENT SERIES

The present series consists of ten patients aged 51—72 years. The oldest patient was a woman, the others men. The duration of symptoms before adrenalectomy, mainly aching and claudication, was 3/4—10 years. In addition to arteriosclerosis patient No. 8 probably also has Bùrgers' disease; this was suggested by histological examination of an artery from the amputated leg. All the patients had rather advanced generalized arteriosclerosis. One patient (No. 2) had had myocardial infarction twice, another (No. 3) once before adrenalectomy. The severity of the arteriosclerotic changes in the present series is also indicated by the fact that in case No. 8 the right thigh had been amputated two years, and in case No. 10 the left II—V toes removed seven years before adrenalectomy.

Gangrene in toes or foot was evident in all ten cases. Infection or necrosis was seen in eight patients and four of them had osteitis of one toe bone. Of course, there was no question of attempting to cure the bone infection by adrenalectomy but only of getting more rapid demarcation and thus reducing the length of leg to be amputated. The extremely poor condition of the patients is seen from figures 1 and 2, which show the extent of the necrosis.

Preoperative angiographic studies — omitted only in case No. 1 — showed that either the arteriosclerotic occlusion was situated very distally or the sclerotic changes or complete occlusion were so widespread that reconstructive surgery was out of the question (Table 1, Figs. 3, 4 and 5).



Fig. 1

Fig. 1. The left foot is swollen and all the toes suppurating in case 8. Osteitis in the great toe.



Fig. 2

Fig. 2. The left 1st-3rd toes blue with osteitis in the great toe in case 10. The 2nd-5th toes partially amputated after sympathectomy seven years before adrenalectomy.

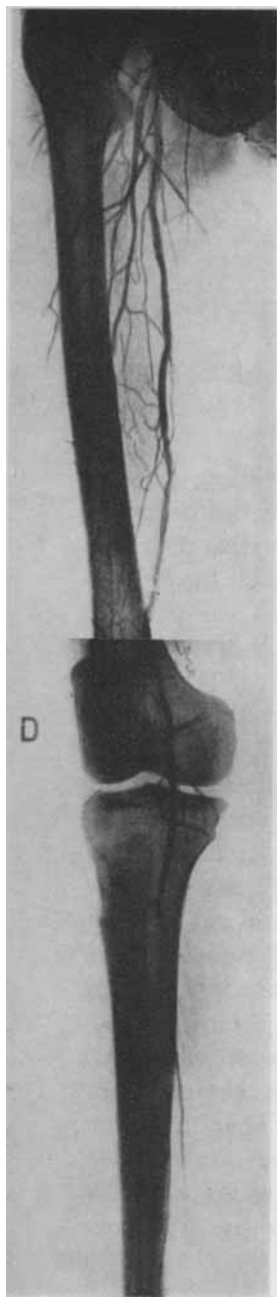


Fig. 3

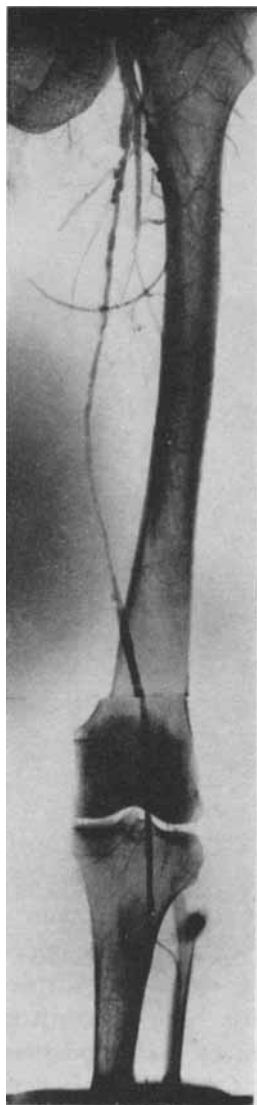


Fig. 4

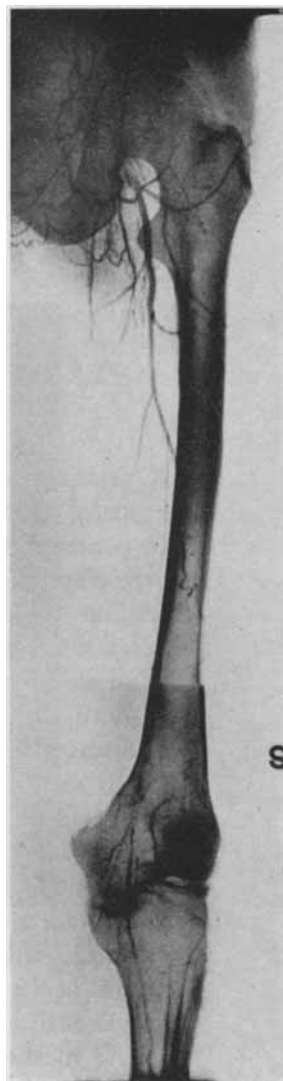


Fig. 5

Fig. 3. Angiogram of the femoral and popliteal arteries on the right side in case 4, showing arteriosclerotic plaques in the lower part of the femoral artery and in the popliteal artery, and complete block in the mid-calf.

Fig. 4. Angiogram of the femoral and popliteal arteries on the left side in case 6, showing severe arteriosclerotic changes in the femoral artery. The popliteal artery is fairly smooth but there is complete occlusion in the middle of the leg.

Fig. 5. Angiogram of the femoral and popliteal arteries on the left side in case 8. Arteriosclerotic changes in the femoral artery until the middle of the thigh, where occlusion begins to be complete. Distally of the knee only a few collaterals.

OPERATIVE TECHNIQUE AND POSTOPERATIVE MANAGEMENT

Operations were performed using the muscle-splitting incision originally described by SEIRO for high lumbar sympathectomy. The peritoneum was kept intact and pushed away so that the crura of the diaphragm came into view and the side faces of the lumbar vertebrae could be felt medially down to the fifth vertebra. By dissection through the fat pad close to the upper pole of the kidney the whole adrenal gland and its vessels were exposed. The vessels were tied with one or two silk ligatures (Fig. 6), and the adrenal gland was then removed intact.

As is seen in table 1, in six cases lumbar sympathectomy had been performed two months to nine years before adrenalectomy. In four patients it was done simultaneously with adrenalectomy. To be able to control the completeness of the previous sympathectomy, adrenalectomy was in all cases performed on the side where the gangrene was. During the operation, immediately after removal of the gland, 25—100 mg of hydrocortisone was injected intravenously. The dose of hydrocortisone was determined according to the amount of the blood pressure drop, which was never very significant. On the day of operation no other substitution therapy was necessary. On the first day after operation 50—150 mg of hydrocortisone was given and this dose was then gradually reduced during the following days and completely discontinued after a week. The postoperative course was uneventful in all cases.



Fig. 6. Operative field in adrenalectomy performed through high lumbar sympathectomy incision by SEIRO. Note good view and ligature round suprarenal artery.

RESULTS

The condition of the leg immediately after operation looked favourable in nine cases. Preoperative pain got easier, oedema disappeared in a week or two and in those patients who later had amputation of a toe, demarcation appeared in a week. Only one patient (No. 2) did not even experience transient improvement. Gangrene was getting worse and amputation at the level of the thigh had to be done ten days after adrenalectomy. Two other patients made favourable progress for a week but then the pain returned and the gangrene, which had seemed to be arrested, began to progress again. One of these patients had thigh amputation two weeks, the other lower leg amputation three weeks after adrenalectomy (Table 1). The latter patient had osteitis in his big toe.

Postoperative improvement could also be confirmed by angiography. An example is the 56-year-old man (case 5), in whom, in addition to occlusion of the peripheral arteries, the so-called interference phenomenon was observed in arteriograms before operation. After the injection of the contrast material the lumen of the popliteal artery was seen to have the form of a pearl necklace (Fig. 7), a picture which appears in connection with great peripheral resistance (THEANDER 1960). On postoperative angiograms this interference phenomenon was not present, the flow of the contrast material was more rapid and the peripheral vessels could be seen better than before adrenalectomy (Fig. 8).

Follow-up studies showed that the patient who had the longest observation period (3 1/2 years) was able to start physical labour 1 1/2 months after adrenalectomy. At the time of writing he is still able to do the same work. He has some calf pain from time to time but no infection. Four other patients report that they started work

TABLE 1. *Present series of 10 patients with peripheral arteriosclerotic gangrene, surgical*

Case	Sex Age	Duration of symptoms before adrenal-ectomy (years)	Gangrene	Angiography	Sympath-ectomy	Adrenal-ectomy
1.V.J. ¹	M 56	3/4	The right foot swollen. Necrotic ulcer in the sole.	Not performed	August 1958	8. 10. 58
2.A.L. ¹	M 63	1 1/4	Necrotic ulcer on the lateral side of the right tibial malleolus	Complete obliteration from the common iliac artery to the middle leg	February 1959	19. 8. 59
3.F.V.	M 60	5	Right great toe suppuration for two years. Osteitis in the distal phalanx.	Complete obliteration from the femoral artery to the lower part of the leg.	1955	18. 1. 61
4.U.P.	M 51	1 1/2	The right great toe suppurating.	Arteriosclerotic changes distally from the popliteal artery. (Fig. 3)	May 1960	23. 3. 61
5.K.K.	M 56	3	The right foot and toes swollen, the nail of the great toe dark.	Arteriosclerotic changes from the femoral artery to the periphery. Interference phenomenon (Figs. 7 and 8)	19. 4. 61	19. 4. 61
6.R.R.	M 57	10	The whole foot pale, cold and aching.	Arteriosclerotic changes from the femoral artery to the periphery. Complete obliteration in the mid-calf (Fig. 4)	27. 4. 61	27. 4. 61
7.R.T.	M 56	1 1/4	Necrotic suppurative ulcer on the lateral side of the sole.	Arteriosclerotic changes from the femoral artery to the mid-calf.	12. 5. 61	12. 5. 61
8.V.R.	M 52	10	The left foot swollen. All toes blue, swollen and suppurating. Osteitis of the great toe. (Fig. 1)	Complete obliteration from the femoral artery to the mid-calf. (Fig. 5)	1952	17. 5. 61
9.M.L.	F 72	1 1/4	Suppuration of the 3rd and 4th toes for 4 months. Osteitis in the 4th toe.	Complete obliteration from the common iliac artery to the popliteal artery.	19. 5. 61	19. 5. 61
10.A.H.	M 60	7	The 1st to 3rd toes blue on the left side. The skin of the great toe black (Fig. 2). Osteitis of that toe.	Lumen of the arteries patent until the lower leg. Peripheral block.	1954	2. 12. 61

¹ Operated at Valkeakoski Hospital, Valkeakoski

treatment and results.

Primary Results	Amputation	Late Results	Follow-up time (years)	Remarks
Oedema and aching disappeared. Gangrene diminished.	— —	Able to work from 15. 11. 58. Occasional pain. No necrosis or suppuration.	3 1/2	—
Not better	Femoral 29. 8. 59	Arteriosclerotic necrosis of the foot on the left side leading to femoral amputation 1961	3 1/4	Myocardial infarction twice before adrenal-ectomy
Pain disappeared for a week, thereafter a recurrence	Below knee 9. 2. 61	Stump clean	1 1/2	Myocardial infarction once before adrenal-ectomy
Pain disappeared in a week and suppuration in two weeks	—	Able to work from 23. 5. 61 on. No symptoms	1 1/2	
Pain disappeared immediately, oedema in a week	—	Able to work from 1. 6. 61 on. Occasional pain. Right ankle moderately swollen	1 1/2	Pulmonary tuberculosis.
Aching and pain disappeared in a week and flesh colour reappeared	—	Claudication after 30—50 metre's walk	1 1/2	Pulmonary tuberculosis and emphysema. Peptic ulcer of the stomach
Suppuration and tenderness gradually diminished. Recurrence after half a year	5th metatarsal bone 4. 5. 62	Wound clean but foot tender. Not yet at work	1 1/4	
Better for a week, then recurrence	Femoral 30. 5. 61	Stump clean	1 1/4	Right femoral amputation in 1959 for arteriosclerotic gangrene. Bürger's disease. Severe pulmonary emphysema.
Pain disappeared, gangrene became dry and demarcation was accelerated.	4th toe 2. 11. 61	Able to walk 1/2 km without stop. No suppuration or necrosis. Occasional pain	1 1/4	Pain reappeared in autumn 1961
Oedema and pain disappeared in a week. Demarcation was accelerated	The distal part of the great toe 9. 1. 62	Able to work from 12. 3. 62 on.	3/4	The 2nd—5th toes partially amputated in 1954 for arteriosclerotic gangrene and frostbite



Fig. 7



Fig. 8

Figs. 7 and 8. Demonstration of the effect of adrenalectomy by angiograms. Fig. 7, which was taken before adrenalectomy, shows a typical interference phenomenon in the right popliteal artery, the wall of which resembles a pearl necklace. The vessels distally of the popliteal artery are not well seen. Fig. 8 was taken after adrenalectomy, the interference phenomenon is no longer present and the peripheral vessels are better visualized.

about two months after the operation. Patient No. 4 is completely without symptoms. Two patients affirm that they have only occasional aches in their legs and feet; in one case the main trouble is claudication pain occurring after 50 metre's walk and in winter even sooner.

In cases 9 and 10 amputation of one toe was performed six months and one month respectively after adrenalectomy. Both had osteitis in the toes subjected to amputation. The former patient, owing to her age — 72 years — is no longer at work but she is able to walk half a kilometre without resting. After toe amputation she no longer has infection but sometimes legache. The latter patient has been doing manual work for more than half a year and has no symptoms. In case No. 7 bone infection and pain reappeared 6 months after adrenalectomy. Half a year later, amputation of the fifth metatarsal bone was performed. The wound is now, 1 1/2 months after the procedure, completely healed, and there is no infection or aching but the foot is still painful on walking and the patient has not yet returned to work.

DISCUSSION

Peripheral arteriosclerotic gangrene is a thankless task for the surgeon. Thanklessness, however, is by no means typical of the individual patient. In the present series all the patients — even those who later lost their legs — were appreciative of the endeavour made to avoid amputation.

Statistically the results of adrenalectomy or adrenomedullectomy are not very good. Comparison between the present series and earlier results is difficult, because adrenalectomy has usually been used in the treatment of Bürger's or Raynaud's disease. In DURANTE's material — most of the patients were under 50 years of age — there were 68 pregangrenous and 123 gangrenous cases. In 42 of these, gangrene reappeared after adrenomedullectomy. SERVELLE et al. performed 43 adrenalectomies but in all cases sympathectomy and splanchnicotomy were also done. All patients were under the age of 50. Amputation was avoided in many cases and the authors also make the following statement: »Nous avons plusieurs cas de ce genre où la surrénalectomie nous a permis des amputations d'orteils ou d'avant-pied.»

It is difficult or quite impossible, as PAABY and NORING point out, to estimate the differential effect of adrenalectomy and sympathectomy when they are performed simultaneously. In some cases of the present series amputation was avoided even when sympathectomy had been performed previously. KREMER (1959) says in his monograph that »alleinige Nebennierenoperationen ohne Sympathektomien sind sinnlos». However, the author of the present paper has seen a patient with impending arteriosclerotic gangrene, who was operated on by SEIRO, and adrenalectomy was

the only measure undertaken (unpublished). The effects of the operation were about the same as after sympathectomy, — pain and oedema disappeared. From the monograph by SIVULA (1961) it is evident that the connection between the adrenal hormones and peripheral arteries is still not completely understood even in health and still less in pathological conditions. For example, the effect of noradrenaline on the peripheral vessels of a healthy man may be constriction, dilatation or failure to react at all.

Adrenalectomy as a treatment for thromboangiitis has been defended on the ground that there must be some kind of functional hyperactivity and hyperplasia of the adrenal glands in these cases (TIGAUD and CARLES 1952). In the present series of arteriosclerotic patients all the glands removed were examined histologically but nothing abnormal was found. FERRAND and ELBAZ (1957) claim on theoretical grounds that hyalinosis and arterial constriction induced by mineralocorticoids together with adrenaline can be reduced by unilateral adrenalectomy. However, they prefer the bilateral procedure. LERICHE's opinion is that in severe and acute arteritis, when other therapeutic measures have been tried and the threat of amputation still exists, bilateral adrenalectomy is indicated.

In the present series only unilateral operations have been performed, because a second adrenalectomy was considered too late in the patients who had to undergo amputation, and in the other cases amputation became unnecessary without further measures. Substitution therapy after bilateral adrenalectomy would be more complicated and continuous; in unilateral cases it is easy and is only required for about a week.

It is a well known fact that elderly patients with arteriosclerosis find it difficult, if not impossible, to learn to use a prosthesis after amputation. The loss of one or two toes is, of course, much less significant and it is the author's considered opinion that more extensive amputation was avoided in some cases of the present series. Therefore it seems reasonable to continue the policy of offering a patient adrenalectomy — without, of course, promising

anything — if reconstructive surgery is not suitable, sympathectomy has already been done and peripheral arteriosclerotic gangrene is progressing. It is worth seriously considering whether adrenalectomy should be performed on such patients at the same time as the sympathectomy.

SUMMARY

Unilateral adrenalectomy has been performed on ten patients over the age of 50 with peripheral arteriosclerotic gangrene. In six cases sympathectomy had been done previously; in four it was done simultaneously. Preoperative angiograms showed that arterioplasty or thromboendarterectomy were not possible. Two patients had thigh amputations, and one a below-knee amputation 1—3 weeks after adrenalectomy. The other seven improved and are able to work because major amputation was avoided. Three had amputation of a toe or metatarsal bone. The follow-up time has been 1/2—3 1/2 years. It is the author's opinion, that unilateral adrenalectomy is worth trying when an arteriosclerotic patient has impending gangrene due to poor skin circulation and all other conventional therapeutic measures except amputation have already been used.

RÉSUMÉ

La surrénalectomie unilatérale a été pratiquée pour la gangrène artériosclérotique des membres inférieurs chez 10 malades, âgés de plus de 50 ans. Dans 6 cas, la sympathectomie avait été réalisée auparavant, dans 4 cas celle-ci a été faite simultanément. L'artéroplastie ou la thrombo-endartérectomie n'étaient pas justifiées par les clichés angiographiques préopératoires. 2 malades ont subi l'amputation fémorale et 1 malade l'amputation sous-patellaire au cours de 1—3 semaines après l'intervention. L'état de sept malades s'est amélioré et ils sont capables de travailler, parce que les amputations

majeures ont été évitées. Dans trois cas, on a pratiqué plus tard l'amputation digitale ou métatarsale. Les malades sont suivis cliniquement de six mois à 3 ans. L'auteur conclut que la surrénalectomie unilatérale est justifiée chez les malades souffrant d'une gangrène imminente, devenue rebelle aux traitements conventionnels excepté l'amputation.

ZUSAMMENFASSUNG

Eine unilaterale Nebennierenexstirpation wurde bei zehn über 50-jährigen Patienten, an peripheren arteriosklerotischen Gangrän leidendem, durchgeführt. Bei sechs von denen war schon vorher eine Sympathektomie gemacht worden, bei vier wurde sie gleichzeitig durchgeführt. Die preoperativen Arteriographien haben erwiesen, dass die Lage der Arterien keine Arterientransplantation oder Thrombendarteriektomie erlaubte. Bei zwei Patienten war man gezwungen, eine Oberschenkel- und bei einem eine Unterschenkelamputation in 1 bis 3 Wochen nach der Nebennierenexstirpation vorzunehmen. Die weiteren sieben sind nach einer Observationszeit von 1/2 bis 3 1/2 Jahren arbeitsfähig, wennauch man gezwungen war, bei 2 von denen die Amputation einer Zehe und bei einem des fünften Metatarsusköpfchens in 1 bis 12 Monaten nach der Nebennierenexstirpation vorzunehmen. Nach der Meinung der Verfasser dass in ähnlichen Fällen, besonders wenn bei der Hautzirkulation eine Arteriosklerotische periphere Gangraene drohend ist, ist es der Mühe wert, eine unilaterale Nebennierenexstirpation zu versuchen, wenn alle andere Behandlungsmethoden versagen.

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