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THE SYNDROME OF THROMBOTIC OBLITERATION OF THE AORTIC BIFURCATION

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ONE OF US HAS DESCRIBED, in 1940,[6] a very peculiar and typical syndrome related to thrombotic obliteration of the end of the abdominal aorta. This new syndrome has no relation to the dramatic and well-known "saddle embolism" seen in cardiac patients and long since described in textbooks. The thrombotic disease appears to be a disease with a long course, presenting, for a long period, symptoms which have no meaning for the physician, unpleasant as they may be for the patient. It may remain compatible for years with a seemingly almost normal life. From the scarcity of reports in the world literature, it might be assumed to be rare. On the contrary, our feeling is, that its occurrence is not infrequent, and that adequate knowledge of its components will help to discover a fair number of cases which otherwise would remain misunderstood.

CLINICAL FEATURES

These appeared very clearly in our original cases (Leriche, 1940)[6], and they appear in all observations published since (Martorell, 1942, André Morel, 1943, Delannoy, Ameline, 1945, Moulonguet, 1945, Peycelon & Gallavardin, 1945, Frieh & André Morel, 1946, Servelle, 1946, Christophe, 1947 as well as in unpublished cases of our own).

As a rule, patients are young adults (the youngest of ours was 29); mostly males—but Delannoy reports a woman, aged 41.[3] In general, their past history is irrelevant. They come to the physician for one or the other of the following symptoms:

In the male: inability to keep a stable erection, the blood flow being insufficient to fill the spongious processes. (This sign is often met with in patients with high located arteritis of the ilio-femoral trunk, and is caused by vasospasm of the major pelvic arteries. It is not permanent, and sometimes disappears following bilateral lumbar sympathetic ganglionectomy, with favorable results). If the disease is left to itself, sexual impotency will soon be permanent.

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Extreme liability to fatigue of both lower limbs. It is not the well-known "intermittent claudication," but an extreme weariness, which comes quickly on walking, sometimes even in ordinary standing position.

Usually a *global atrophy of both lower limbs* which it is difficult to appreciate as a normal limb lacks as a term of comparison. One must be on one's guard, not to overlook bilateral atrophy.

No trophic changes, either of the skin, or of the nails. Toes look normal. It is difficult to believe that the circulation is severely impaired. An important fact must however be noted: if there is an error in the diagnosis, and if an incision is made in the limb for peri-arterial sympathectomy (inadvisable in such cases), or any other operation, *the wound heals either very sluggishly or not al all.*

Pallor of the legs and feet, even when standing. At rest, the limb looks as if a Martin rubber bandage had just been released. When the legs are raised to the vertical, the pallor becomes striking, being like ivory or marble.

The *clinical investigation* reveals, moreover:

—that no pulse can be found, either in the leg, or in the groin. The iliac pulse is not felt. That of the aorta will be perceived very high-up, above the umbilicus.

—that oscillometric findings are: no oscillations in the leg or thigh; a slight thrill close to Poupart's ligament.

—that blood pressure is a trifle high in the upper limb; without any renal disturbance.

DIAGNOSIS

One should never diagnose a "neuritis" or a "polyneuritis" of the lower limbs, unless one has carefully examined the femoral pulses and the oscillometric curve. Bearing this in mind, diagnosis is easy. In fact, when a patient complains of impotency, or of severe fatigability of the lower limbs, or of pain in the thighs on exertion, if the physician finds alterations in the peripheral pulses, the provisional diagnosis of thrombotic obliteration of the aortic bifurcation may be made. When no pulse has been found on either side, in the dorsalis pedis, tibial, femoral and iliac arteries, when oscillometry at ankle, calf and thigh is confirmative, the diagnosis is probably accurate. Indeed, since our first description, the above-mentioned authors have discovered and diagnosed their cases with these simple means of investigation. The only difficulty is the recognition of an obliteration localized in both common iliac arteries, but, as thrombosis of the whole bifurcation often begins thus, inaccuracy of the diagnosis is of no consequence.

In almost all cases, clinical data, a shrewd study of the patient's history, and oscillometry, will lead to the discovery of the origin of all troubles. AORTOGRAPHY, as originally developed by Reynaldo Dos Santos,[4] will give a new and precise support to the diagnosis. It should be performed under short barbiturate anesthesia. If the patient is heavy, or presents signs of diminished

cardiac output, or has cyanotic legs with violaceous blurs, aortography is to be avoided, because in such instances its performance may lead to the extension of thrombosis, with fatal result. In properly selected cases, aortography gives a neat picture of the lesions, of their extent, of the thin net of anastomoses and by-ways which, through all subcutaneous, muscular, diaphragmatic, epigastric, ilio-lumbar, etc., arteries, allow a very scanty, though vital blood supply, to reach the ischemic limbs. Aortographies in man often show the same pictures as in Luigi Porta's hundred-year-old book (ligatures on animals, Milan, 1845).

PROGNOSIS

Aortic thrombosis, although apparently very well-borne for years (5 and even 10) always ends in gangrene. The onset of gangrene is not sudden, and not always bilateral. It is usually preceded by an increase in muscular atrophy of legs and thighs, and by a growing impairment of walking. Muscles vanish in a few weeks or months. There then appear edema, a general violaceous hue of the legs, with ecchymotic suffusions, and soon, sores on all pressure points, not only on the sacrum and back, but also on iliac crests, the rotula, the malleoli, the heel. Finally, gangrene supervenes, *i.e.*, dry gangrene, in the extremities, and in plates on leg, trochanter, and sides of the foot. Such an outlook of scattered and widespread dry gangrene, is typical enough. Lesions progress slowly accompanied by deep suffering which nothing can soothe, and death comes at length through heart, lung or kidney. The prolonged survival can be explained by the above-described anastomoses. The onset of the terminal period is due to upward and downward extension of the thrombosis, and sometimes to associated peripheric venous thromboses.

PATHOLOGY

The pathologic characteristics have been revealed in a small number of cases by postmortems, and mostly by the findings at operation. In some cases, the thrombosis seems to begin in one of the common iliac arteries. It then extends upwards, reaching the aorta and hampering the blood flow to the opposite side, but without, for a long time, stopping it totally. The final result is obliteration of both iliacs and aortic bifurcation.

In less frequent instances, the disease is at first on the aorta, and the iliac thrombosis is secondary. Whatever the beginning, thrombosis finally lies on at least 2 or 3 cm. of the aorta, and extends to both common iliac arteries, the obliteration of which is complete. Sometimes, the common iliacs have become hard, string-like sticks in which no lumen can be found. In some instances, the external wall of the artery is smooth and even, but there often exists, around the thrombosed aorta, an intensive peri-arteritis which attaches the vessel to prevertebral fibrous tissues, encircling the neighboring veins and lymphatic ganglia, and reaching the fourth sympathetic ganglion and the chain above. The aortic wall often bears atheromatous plates which will hinder the completion of the operative treatment. In such cases, the aortic lumen often con-

tains a big moulded, organized clot, which extends upwards in the aortic cavity, without adhesion to the intima in the portion of the vessel above the level of the thrombosis.

TREATMENT

One of us (Leriche) wrote, in 1923, that the ideal treatment of this condition, would be to resect the obliterated zone, and to bridge the vascular defect by graft. This could be accomplished if the thrombosis did not always strike the iliacs as well as the terminal aorta. In the present state of technic such an achievement seems impossible.

Nerve Supply Reduction. Efforts have been made to improve the peripheral circulation, through reduction of vaso-constrictor nerve supply to collateral ways and to trunks below the obliteration; and an attempt has been made to stop the fatal spread of thrombosis, *by removal of the thrombotic zone.* At the same time, vasoconstrictor impulses which originate in the aortic wall and result in vaso-spasm in the still free channels, ought to disappear. Such a procedure finds its justification in the experiments carried out by one of us with his co-worker Stricker in 1933 on dogs:[6] removal of the aortic bifurcation with its branches, with and without concomitant bilateral lumbar ganglionectomy: The latter condition produced gangrene, while the former yielded no severe troubles. With this objective in mind, we have performed bilateral ganglionectomies, and moreover resected the aorta and the obliterated iliacs.

Upper lumbar ganglionectomy. Up to 1946, we have practiced the upper lumbar ganglionectomy in 14 cases, the lower in five. Upper lumbar ganglionectomy was preferred. First, because it seemed desirable to meet as few collateral arteries, which should at all costs remain intact, as possible. By a lateral approach, just underlying the last rib, one usually reaches the sympathetic chain without destroying any vessel of notable size. Second, because, in view of nervous action, it seems advisable to operate as high up as possible, in order to enlarge the lumbar arteries as well as those of the lower limbs. The results proved satisfactory in the long run. The following case history is an example.

Case 1. (summarized) (Leriche). Melv. . . ., 35-year-old male, complains of troubles in walking, and sexual impotency (total) for 3 years. Claudicatio intermittens (100 meters). Examination on June 5, 1936: severe global atrophy of both lower limbs. When legs raised to the vertical, legs and feet turn ivory white. No pulse felt anywhere in the lower limbs nor in the iliac fossae, nor on the midline, except above the umbilicus, where it is felt very strongly. No oscillations (Boulitte's apparatus) in the lower third, upper third of the leg, nor in the thigh. Very small oscillations close to Poupart's ligament. No trophic changes except on nail of left big toe. Provisional diagnosis: Aortic obliteration.

June 13, 1936. *Operation.* Removal of first lumbar ganglion on the right side. Presence of an important number of large arteries in parietal muscles and in subperitoneal space. Owing to this, exposure of splanchnic nerve, which was originally planned, is given up.

Follow-up: Patient out of bed on 3rd day. Feels much better on operated side. Discharged on 10th day.

February 15, 1937. Demands to be treated for left side (same symptoms on left, as were formerly felt on right side: cramps, cold fingers, small ulcerations around nails).

February 16, 1937. *Operation.* Removal of 1st and 2d lumbar ganglia on left side. Same operative findings as on opposite side. Follow-up: Heals per primam.

In January, 1940: Feels well, does not suffer any longer in lower limbs, can walk longer. But afraid lest he should suffer same trouble in his hands (feels cramps, cold, numbness, moderate pain).

May, 1940: Very good condition; warm feet, good trophicity, walks well. Blood pressure 170/110 (this probably accounts for the symptoms in his hands).

Results are not always as good as in this case; nevertheless, one can say that patients always feel a functional improvement, and that some of them recover their sexual abilities.

The objection to upper lumbar ganglionectomy as the sole operation is that owing to this high approach, one cannot have a near vision of the aorta, nor confirm the diagnosis, nor decide on the possibilities of an aortic resection. We believe that aortectomy, whenever feasible, ought to be performed in order to check the spreading thrombosis, and to suppress arterio-arterial vaso-constrictor reflexes. A point to be noted is that when the pathologic aorta has not been removed, patients often continue to complain of pain in the back. This does not usually remain after aortic resection, and is probably due to peri-arteritis.

Having said that, we must acknowledge that the results of the bilateral lumbar ganglionectomy are good in the long run, if it is not performed too late. In addition to Case 1, two of our patients, after three years, lead a normal life, except that walking ability is reduced, though improving year after year. When this type of operation comes too late, there sometimes remains pain in a foot, intermittent pain which does not always hamper professional activities, but often compels the patient to take drugs at night. The man, who pre-operatively could no longer sleep, and spent his nights in an arm-chair, is then able to sleep in bed. He often remains liable to nightmares.

—*Terminal aortectomy with bilateral lumbar ganglionectomy.* The elaborate operation which consists in: terminal aortectomy, removal of one lumbar chain, section of the other, the whole being performed through one single incision, is sometimes practicable. We used it in the following case:

Case 2. (summarized) (Leriche) G. M. . . ., male, age 61, first seen in July, 1939, with the commencement of gangrene in right foot, and very severe bilateral pain. *Claudicatio intermittens* for several years. In 1936, noticed that right small toe became alternately white and blue; then, later on, painful at night; then, afflicted with a periungueal ulceration. A surgeon performed bilateral perifemoral sympathectomy, with subsequent suppression of all symptoms, except claudication. Improvement lasted for 2 years. In December, 1938, pain in both feet. His surgeon accomplished iterative periarterial sympathectomy—with subsequent aggravation: Left foot remained painful, cyanotic, with black spot on 4th toe. Exulceration of operative scar.

Examination on July 8, 1939: Patient in bad condition, tired, but no severe symptoms in viscera. B.P.: 180/100. Normal upper limbs. Lower limbs: Emaciated, cold, cyanotic in their lower part, mostly on left side. Torpid ulcer of operative scar on left

thigh. On the generally bluish color of left leg and foot, one can see four small gangrenous spots. On basal articulation of big toe, skin is necrotic, bordered by a torpid ulceration. All toes are violaceous; the 4th bears on its tip a spot of dry gangrene. Foot is icy cold, even under blankets. Skin is dry and squamous. Nails are thick and brittle. Neither pulse nor oscillations up to the groin. Both inner and outer sides of foot, show small veins which do not empty on pressure.

Left lower limb shows same alterations, though less advanced. Patient declares: no erection for 10 years; not the least sexual concern.

July 20, 1939. *Aortography* (under evipan anesthesia): Shows neat block of thorotrast shadow on edge of 3rd lumbar vertebra; from this point, there starts on left side a clearly-defined vessel which plunges into pelvis and gets lost there in numerous anastomoses. One of these anastomoses (originating on right side), seems to fill the left internal iliac artery, and, through it, perhaps the external iliac, as one can perfectly well see small branches which seem to belong to the hypogastric system, and inosculate with branches from internal aspect of thigh. The iliac circumflex is filled up on its whole course, and posteriorly, gets linked with two lumber arteries. On opposite side, the arterial network is less clear, more fragmentary, but of similar type. The diagnosis is clear; the case seems beyond the possibilities of a bilateral lumbar ganglionectomy; in order to try and soothe the pain and stop the extension of the disease, an attempt at aortectomy is decided upon.

Operation. July 24, 1939. Left iliac incision. Dissociation of external oblique muscle. Section of internal oblique and transverse muscles. Subperitoneal approach. Easy removal of left lumbar sympathetic trunk (from 2nd inclusive to 4th ganglion inclusive). Exposition and dissection of terminal aorta, which is surrounded by a *very dense periaortitis.* It is obliterated to a length of about 5 cm. Once it has been dissected, first from sclerous fat, then from the vena cava, it is ligated at about 1 cm. above the beginning of thrombosis. Crushing the artery with the ligature is very difficult, as one gets the impression that the arterial wall will not give way; then, abruptly, the wall collapses and the ligature is tied. The operator then follows the common iliac artery, carefully separating it from veins. The common iliac artery is obliterated, the external iliac too; a pulse is felt in the internal iliac. A ligature is tied just above the bifurcation of the common iliac artery. The removal of the common iliac (right) is then begun: Same findings as on opposite side. Use of same procedure: ligature above bifurcation of common iliac. From then on, the aortic bifurcation lies between three ligatures. Transection of left common iliac is troublesome, because of the presence of a hard calcified plate at this level. Section is performed just above, the aorta is also cut across, and the whole is retracted upwards and overturned to the right, in order to separate the right common iliac artery from the vein. Finally, section of right common iliac. All this has been done without the slightest bleeding. The right sympathetic chain is then looked for. It seems impossible to progress on the external aspect of the vena cava, owing to a large collateral which lies there. One passes under the vena cava, going from the midline to the external side of the column. Section of the chain. Local hemorrhage (stopped by muscle plug) prevents removal of 4th ganglion. Parietal closure without drainage.

Max. B. P.: Initial: 180; terminal: 170.

On removing patient from table: Both legs very warm; right foot: warm; left foot: warm, except on toes, which are cold.

Same findings on evening of operation; toes move.

On following day: Same condition, but patient slightly listless.

Right foot: Normal temperature and color; no pain.

Left foot: Cyanosis extends. Amputation is certainly necessary.

August 6, 1939. Amputation at upper third of thigh. Almost no bleeding from muscles. Artery and vein are thrombotic. Presence of many small vessels in posterior muscles.

Dissection of specimen: artery and vein, femoral and popliteal, are obliterated. Microscopic study (Pr. Gery, Strasbourg): "On the whole, arteries offer a picture of slow chronic endarteritis, the higher located, the more important and the more irregular. The muscular wall is affected with widespread sclerosis, mostly on big trunks. No mediaverkalkung. Larger veins: Recent thrombo-phlebitis (from 10- to 15-day old): It is less and less advanced as one progresses distally. Smaller veins: chronic vegetating endophlebitis in numerous points. Sciatic nerve: no changes, no sclerosis."

Follow-up: slow evolution of the amputation wound, as is the rule in such cases. No inflammatory reaction, no infection. At the end of August 1939, healing had hardly begun.

Owing to war, to the evacuation of the hospitals of Strasbourg, and to subsequent events, we do not know what has become of this patient. From our point of view, this does not alter the fact, that circulation in the right lower limb was considerably improved by aortectomy, with preservation of leg and foot on this side.

Such an aortectomy with bilateral sympathectomy, has been accomplished a number of times since this case. Cid Dos Santos in Lisbon had a patient who healed very easily, and, one year later, remained in excellent health. Delannoy operated upon a 41-year-old woman: in the first stage left lumbar ganglionectomy; in the second stage, transperitoneal aortectomy; very good result: three years later, she could do her shopping herself, and even occasionally "enjoy a short run."[3]

One of us used a slightly different technique in his first case:

Case 3. (summarized) (Morel[13]). Per. . . ., male, age 26, a truck driver. Past history: irrelevant. Very good health. First trouble two years ago: suffered from "cramps" in legs, on walking and running; was treated by family doctor, for "sciatica." Suffered very intensely in both legs, could not sleep for nearly three months.

Present condition: Running is impossible. Walking for a few hundred metres is stopped by very painful cramps. Feels cold in the legs, even in bed. Pain at night. For past few weeks: inability to reach a complete erection; coition hardly possible, ejaculation "unsatisfactory." Examination on February, the 12th, 1942: general condition seems good. Both feet are cold, toes are marble-white (patient states they are such at any time, and this is one of his major concerns). No abnormal perspiration. The anterior tibial, posterior tibial, popliteal and femoral pulses, not found, on either side. Subjective symptoms more severe on the left. In the upper extremities: the left radial pulse is better felt, and stronger, than the right. Oscillometry: no oscillations at all in the legs; very minute oscillations in both thighs. Blood pressure (left arm): 150/70. Normal heart. No neurologic symptoms.

Diagnosis: Juvenile arteritis thrombosans, with probability of obliteration of the aortic bifurcation.

February 16, 1942. Left lumbar sympathetic block—(nupercaïne)—: immediate warmth of foot, leg and thigh. Feeling of warmth present for two days. During these two days, can ride a bicycle with much rarer cramps. No sexual improvement.

February 20, 1942. Left lumbar block (nupercaïne): progressive warming-up of originally marble-white foot, which becomes red (1st and 2nd toes last of all). Feels better for one day.

February 23, 1942. Right lumbar block (nupercaïne): apparently no immediate action; 20 minutes later, foot becomes very warm, and remains normal for two days.

March 5, 1942. *Operation.* Spinal anesthesia (nupercaïne). Left iliac incision (subperitoneal approach). The sympathetic chain is very thin, but clearly recognizable. Resection on 4 cms. Dissection of the left common iliac artery, which looks abnormal, surrounded by a dense, reddish, adhesive cellulitis. No pulse seen nor felt. No blood

on puncture. The artery is very much like a big, solid rope-like structure. It is then resected (as high-up as possible towards the bifurcation). In the specimen: brown-red adherent clot, thick walls, yellowish, brittle inner layer). Parietal closure layer by layer.

Follow-up: Warm limb immediately following operation (objective and subjective warmth). Patient leaves Clinic on 13th day.

In the beginning: short walks; perfect result on operated side: no more cramps. Then, with longer walks, feels cramps again, but less severe than before operation. Above all, sexual condition much better. Coition possible.

May 2, 1942. Patient seen in consultation with Prof. Leriche. On this particular occasion (cold weather): left foot (operated side) is cold; right is *icy*. Pr. Leriche advises same procedure to be followed on opposite side.

May 4, 1942. *Operation* (Morel). Spinal anesthesia. Same approach as before, but on right side. Easier dissection than on left side (cellulous adhesions less dense and less troublesome). Right lumbar chain is resected on 5 cm. Then, the external iliac artery is found—a painstaking procedure, as it is a dry, rigid cord, about the size of a vas deferens. Distal section as low-down as possible, upwards dissection, liberation of bifurcation of the common iliac artery. The internal iliac seems to be thrombotic too, but, 2 or 3 seconds after it has been cut through, a severe bleeding occurs through its peripheral stump. Digital compression on pelvic margin for a few minutes, then quick seizure of stump with forceps, and ligature. Common iliac artery is then dissected about 3 cm., ligated as high as possible, and resected. Abdominal wall closed by layers.

Follow-up: Back home on 12th day.

August, 1942: Though all symptoms have not subsided, patient feels satisfied with present result. First of all, he can enjoy a very active life: does his job and drives a truck for most of the day; can walk about around his truck during loading and unloading. Circulation better or worse, following rest or fatigue, but, on the whole, he feels much better than before operations. Sleeps well, neither pain nor cramps in bed. On exertion, feels from time to time cramps in the calves, but they are milder and of much shorter duration than before. He states that sometimes, when walking is stopped because of a cramp, if he stops for a while, he is then able to resume his walk, with the feeling that he could go for miles without getting tired. Psychic condition much better. But the greatest improvement lies in the sexual abilities: the erection is readily obtained and kept; coition is normally accomplished, as it was before the onset of the disease. Potency but slightly diminished.

Examination: Both lower limbs are warm, feet are rosy. No abnormal sweating.

January, 1943: Patient gets married.

July, 1944: the couple has a child.

In January, 1946, patient states his good condition has undergone no change. Works very hard.

Pathology of specimen of left artery (Pr. J. F. Martin, Lyon): "Endarteritis thrombosans with no specific histologic findings."

This is a very safe procedure. The surgeon does not run the risk of a painstaking cleavage of a very adherent aorta, with subsequent severe shock. But, on the whole, when feasible, removal of the pathologic aorta is preferable. Such an operation was performed in the following case, with an excellent result:

Case 4. (summarized) (Frieh & André Morel)[5] Vou. . . ., 43-year-old male, a solicitor, is first seen on December 22, 1943, complaining of severe impairment of walking. Past history, irrelevant. Moderate drinking habit. Smokes heavily.

Since 1 year, claudicatio intermittens, which becomes more and more severe. (During winter preceding onset of disease, noticed that feet were usually cold though that winter was mild). At present, cannot walk more than 100 metres, without feeling a cramp.

Patient consults Dr. Gallavardin in Lyon, who diagnoses an arteritis of the lower limbs (April, 1943), and notes: "no pulses in dorsalis pedis and posterior tibial arteries; pulse hardly perceivable at the groin. Oscillometry: maximal oscillations: right ankle, 2 — left ankle: ¾ of a division—right thigh: 3 divisions; left thigh: 1½ division. Dr. Gallavardin notes on December, the 17th, 1943: "condition has become worse; no pulses felt in either lower limb."

Patient first examined by Dr. Frieh on December, the 22nd, 1943: no pulses at all in both lower limbs: aortic pulse, felt at the umbilicus.

Oscillometry: No oscillations at all. Both feet are white and cold. When put in dependent position, color is restored, but remains for several minutes even with feet raised above the horizontal. No pain, no trophic changes.

Sexual activity, reduced to nought. Diagnosis: probable obliteration of the aortic bifurcation.

January 7, 1944. *Operation.* Dr. Frieh, Dr. Morel. Local anesthesia (procaine). Iliac approach (left side). The left iliac artery is exposed subperitoneally: peritoneum is dissected up to the aortic bifurcation. Exposure and dissection of the vessels are difficult, owing to adherent lymphatic channels and small veins. The external iliac artery is ligated distally, and cut through; then its posterior aspect is freed, a maneuver which leads to the internal iliac (obliterated), which after dissection of 2 cm., is ligated and cut through. The common iliac artery is then freed upwards, the aortic bifurcation is exposed, and freed of posterior adhesions. Same procedure is applied to the right common iliac artery, which is ligated distally as far as possible, and cut. The aortic bifurcation does not "beat"; a ligature is drawn just above, and tied. A transverse section of the aorta is then performed just below the ligature (section through a very adherent clot). No bleeding at all. The last two ganglia of the left sympathetic trunk are removed; a drain is left in the vascular bed.

Follow-up: Uneventful recovery; foot warm on evening of operation; remains such on following days. On the 15th day, patient declares he has recovered his sexual abilities.

March, 1944: *Operation.* Ether anesthesia. Right lumbar ganglionectomy. Quick recovery.

September 28, 1945. Patient in very good condition; lower limbs are warm; claudicatio intermittens still exists; but cramps appear only after 300 meters. Good strength of lower limbs. Considerable exertion possible, provided it be of short duration. Patient has resumed all his professional activities. Sexual abilities: normal.

We have used a procedure of this type many times since (Leriche), and we are very satisfied with it.

Let us now try and see how the different types of operations should be used:

THERAPY — INDICATIONS

The scheme we are trying to outline is not meant to represent the ultimate truth. Our experience to date is of some value, as one of us happens to be among the men who have seen and treated the greatest number of patients afflicted with this too-little-known syndrome. No doubt our ideas will be subject to change, as they have already gradually changed since the first of our cases. But, at present, this is how we see the problem:

Indications should be outlined in particular according to anatomical and clinical data in every case. Schematically speaking, patients can be divided in three groups:

1. Good Cases. Patients who are still young, whose symptoms are essentially functional: fatigability of the lower limbs, disturbance of thermo-regulation thereof, genital troubles which are the more noticeable since they appear in full youth; obliteration of the bifurcation as demonstrated by clinical and oscillometric examination. Yet the tissue changes in the ischemic limbs, are still at their beginning: one could say they are liable to revert to the normal. At operation, the surgeon will find an easily cleavable aorta. The procedure will be completed without trouble on a good-risk patient.

Our opinion is that, in such instances, the surgeon should not hesitate. If everything seems suitable, after careful premedication, and, if judged advisable after a series of lumbar procaïne blocks, the *ideal* operation will be preferred—through left subperitoneal iliac approach, dissection of external, internal and common iliac arteries, freeing of the bifurcation, and removal, in one piece, of the whole aortic bifurcation and of its obliterated subsequent branches. Removal of the left lumbar sympathetic chain. Depending upon each case, but depending mostly upon the abdominal bulk and general condition of the subject, the operator will merely perform the section of the right lumbar chain, just above the pelvic margin; or, if the right lumbar chain is left intact in this first stage because of the difficulties of its approach, a few days later, the right lumbar ganglionectomy will be performed through a right, subperitoneal iliac approach.

Thus, the maximum chance of immediate and long term improvement will have been given the patient, in a very short time.

Such a procedure is usually very well tolerated. If gently and methodically carried out, under spinal anesthesia, which greatly helps to retract the abdominal muscles and gives a perfect relaxation, it will be followed by a simple and uneventful recovery in these cases, which—and we stress this point—are *good* cases.

2. Medium Cases. Patients are seen or diagnosed later in life: tired, thin subjects, whose circulation in the lower limbs is bordering on ischemia; patients aged over 40 and whose lower limbs begin to show trophic troubles, moderate but significant for the expert eye: meagre, marble-like feet, whose veins appear in hollow, small periungueal ulcerations, important callosities of the sole, striking atrophy of the muscles of the lower limbs. Blood urea rate is often a little above the normal, though the urinary output seems little affected.

In these cases, at operation the iliac arteries will be found to be embedded in a dense peri-aortitis, of which it will be very difficult to rid them. The bifurcation, above all, is stuck to the vertebral column, narrowly adherent to the vena cava. In these instances, considerable risk attends the complete freeing of the vessels and the removal of the thrombotic zone, *i.e.*: danger of a vascular tear causing hemorrhage which it is impossible to check in a deep

wound containing fragile tissues, which break under the forceps; or danger of severe post-operative shock, which sometimes causes death, whatever the treatment.

In these cases, we should advise the operation which, without severe risk, usually ensures a remarkable functional improvement: in a first stage, by a high-located incision (underlying the 12th rib, without resection of the rib, which is not necessary), removal of the 1st and 2nd right lumbar ganglia. A few days later, large left iliac approach (subperitoneal), and as extensive removal as possible, of the left lumbar chain (at least 3rd and 4th ganglia). At this moment, it will be easy to expose the vessels; perhaps the "ideal" aortectomy will be feasible, but if this entails a risk, it will be deliberately abandoned. If the dissection of the external and internal iliac arteries seems easy, they can be resected on the left side. But, again, if the least difficulty is encountered in these fragile patients, the surgeon will remember that the margin is narrow, between the successful operation, and a disastrous failure. Above all, one must insist on the important point: the action on the sympathetic innervation.

3. Poor Cases. Patients nearing 60, or adults seen in an advanced stage; patients emaciated through several months' suffering and insomnia; pale, listless at times. And especially patients who bear lesions of gangrene or pregangrene, such as those we described above. Such patients are dreadfully fragile. A careful medical preparation will be more than ever necessary, as well as a minute local treatment of the lower limbs in order to clean the ulcerations, to induce a subsidence of the lymphangitic processes, before any operation is attempted. At the time of operation, local anesthesia should be preferred, combined with a slow, atraumatic technic and a careful hemostasis. Following operation, rehydration, fulfillment of the metabolic needs of these subjects whose balance is always uncertain, are very necessary. And, sometimes, one will succeed in dragging back to life patients who seemed near their end.

What can be done with such patients? The great point is to divide the operative stages as much as possible: firstly, one should perform, on the side where the gangrene threatens most, a lumbar ganglionectomy through a high approach (in this way, one passes as far as possible from the dangerous zone and from the infected lymphatic ways); in a second stage, the opposite chain will be removed. If the condition of the patient improves sufficiently, it may be possible to use an iliac (low) incision and to perform at the same time the removal of the common iliac artery. Later on, this procedure will perhaps be feasible on the opposite side. Amputation of the definitive lesions of the extremities will thus be postponed as long as possible; the sympathetic and arterial operations will have improved the blood supply of the future amputation flaps; thus it will be possible to amputate at a lower site, than would have been practicable in the beginning. Healing will be infinitely better and quicker. When actual gangrene is present, amputation, preceded or followed by a lumbar sympathetic ganglionectomy, sometimes ensures a long survival.

A man, operated upon in 1932 (Leriche) (bilateral amputation at the thigh), still runs a garage, wheeling himself about in a special car. Another one, who underwent amputation on one side in 1939, had to be amputated on the other in 1947 (lumbar ganglionectomy had been unilateral).

On the whole, in instances so different, there should be no single way of proceeding, even if the general principles of therapy, as at present conceived, remain unaltered. These are: 1st, to improve the circulatory and trophic conditions, through distant sympathetic actions; and, secondly, to remove, whenever possible, the vascular lesions which are the origin of untimely pathologic reflexes.

Of the groups of patients which we have just endeavored to describe, one should remember that it is *time* which created them, time elapsed since the onset of symptoms, time lost in using minor therapeutic procedures or in overlooking the diagnosis. The syndrome is sufficiently clear-cut, to ensure an early accurate diagnosis, which allows an easy operation and an excellent cure. The study of all our cases leads us to the conclusion that, the earlier the necessary operation is performed, the better the results.

As regards the cases in which the pathologist discovers a thrombo-angiitic origin, we feel more and more inclined to advise the performance of an adrenalectomy in addition to the aforesaid therapeutic measures. Adrenalectomy slows down or stops the progress of the disease. It is, as a rule, followed by an improvement in the general condition of the patient, with subsidence of the erratic pain which often teases those who underwent a plain ganglionectomy.

Contraindications. In view of the choice of the operation, let us insist on some contraindications, which are very important, because of the fragility of such patients:

—During the operation, no ligature should be tried nor trusted, on easily-breakable aortas, of the "chicken's trachea-type": no safety can be expected from this sort of vessel, and it is better to leave the thrombotic part untouched, without attempting any resection.

—No attempt should be made to remove the pathologic zone when there exists too dense a peri-aortitis; attempts at dissection "at all costs" often give birth to severe shocks.

—No operation should be undertaken in *cases seen very late:* emaciated, dehydrated listless patients, who will not stand anything, and who are doomed to die, whatever the treatment.

TECHNICAL DATA

Incisions. When we say: *High* incision, we mean the type of incision we use for the surgery of the lumbar sympathetic ganglia, of the splanchnic nerve and of the adrenal (Leriche). The patient is disposed just as for an urologic lombotomy; the incision underlies the 12th rib and is parallel to it, cutting across the flank. The muscles are cut or dissociated (transverse); the

peritoneum is cleaved and retracted forward, and the lumbar chain is exposed in the bottom of the wound.

The *Low* incision is that described by one of us with his associate Fontaine (Presse Médicale, Paris, 1933, No. 92): curved incision, oblique inwards and downwards, nearing the iliac spine by two thumbs' breadth. Aponeurotic and muscular sections as in a MacBurney's incision, except that internal oblique and transverse are cut across after they have been carefully separated from the underlying fascia. The fascia will then readily be incised without opening the peritoneum, which is dissected from the internal iliac fossa, and retracted towards the midline.

For both these incisions, broad and curved retractors are necessary; we also advise the use, in addition to the scialytic light, of a portable projector, or spotlight, with parallel rays, which should be placed behind the operator's right shoulder, and which ensures a perfect vision of the deep planes.

Hemostasis of the Aortic Section. It seems best to insert, if possible in a normal zone above the thrombosis, or, if not, through the thrombotic zone, a sturdy braided silk ligature, which, for some time, will not slip. Under cover of this ligature, a continuous suture of the aortic section with a curved atraumatic "intestinal" needle (same as for the closure of a duodenal stump in gastrectomy) will be accomplished with fine silk; and then a second continuous suture hiding the first row, in order to suppress all chance of leakage. It is, of course, advisable to remove, after ligature and section of the aorta, the crushed clot which appears in its lumen and which would hamper the completion of the suturing process.

Hemostasis of the section of the iliacs. We insist upon the importance of always ligaturing a big vessel before its section, even if this vessel seems to be completely thrombotic and to no longer possess a lumen. In our Case 3, the distal end of the internal iliac was thus the origin of an hemorrhage which could have been fatal. We think that strong braided silk is the choice material for such a step.

SUMMARY

1. A new pathologic syndrome, first described in 1940 (Leriche) is depicted, and special emphasis put on its clinical features.

2. The evolution thereof is usually very severe, and operative measures should be preferred for its treatment.

3. Case reports illustrate the possible therapeutic measures.

4. Indications and contraindications in the treatment are discussed.

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