DENERVATION OF THE ADRENAL GLANDS FOR NEUROCIRCULATORY ASTHENIA

TECHNIQUE AND CLINICAL RESULTS

GEORGE W. CRILE, M.D.

Reprinted by special permission from SURGERY, GYNECOLOGY AND OBSTETRICS, *54:294-298, February 15, 1932.*

Based on favorable results of experimental investigations of the adrenal-sympathetic system and on conclusions drawn from operations on the thyroid-sympathetic system in cases of hyperthyroidism, we have sought to control certain analogous energy-transforming diseases, particularly those due to pathological activity of the adrenal-sympathetic system. To this end, we have performed operations on the adrenal-sympathetic system in 126 cases. On this occasion, however, we shall report the results obtained in one group only, namely, cases of neurocirculatory asthenia.

In the war a certain number of officers and men became incapacitated during their service at the front on account of a baffling disorder which was designated "soldier's heart," the principal features being rapid heart beat, nervousness, and fatigue. In the stress of civilian life there are seen many cases of this same condition which is usually given the descriptive name, "neurocirculatory asthenia." This disease resembles, and is often mistaken for mild hyperthyroidism, especially in those cases in which there is a goiter and a moderate increase in the basal rate.

Neurocirculatory asthenia is a pathological state in which there is an excessive stimulation of the adrenal-sympathetic system, and since other kinds of treatment have failed uniformly, we logically concluded that since hyperactivity of the thyroid — hyperthyroidism — could be reduced, then hyperactivity of the adrenals could likewise be reduced.

In association with Dr. E. P. McCullagh, a critical study has been made of the effects of certain operations on the adrenal gland and sympathetic nerves, the basis for these operations being, as stated, the conception that neurocirculatory asthenia is an example of pathological physiology, analogous to the conception that hyperthyroidism is an example of pathological physiology. Jonnesco, many years ago, resected the cervical-sympathetic ganglia for hyperthyroidism — an outstanding example of an attempt to modify pathological physiology. So too, an adrenalectomy performed by

Downloaded from www.ccjm.org on June 6, 2025. For personal use only. All other uses require permission.

me 19 years ago, was an attempt to modify certain cases manifesting symptoms of pathological physiology, by surgery. Leriche, of France, Hunter and Royle, of Australia, Adson, Craig and Learmonth, and others are advancing this field of the surgical control of pathological physiology.

About 19 years ago, I first tested the effect of the removal of one adrenal gland in certain cases which manifested symptoms of pathological physiology, in some cases supplementing adrenalectomy by thyroidectomy and resection of the cervical sympathetic ganglia. The results gave promise, but in some cases the good effects tended to disappear in time, just as after unilateral thyroidectomy for hyperthyroidism the clinical results are good at first, then tend to disappear.

After following these patients for a period of years and undertaking new lines of investigation, it was found that a more effective procedure was bilateral denervation of the adrenal glands, the two denervations being separated by an interval of a week or more.

Since we consider that the adrenal glands constitute the power stations or brain of the sympathetic system, and that in neurocirculatory asthenia this power station is pathologically stimulated just as the sympathetic ganglia are too active in Raynaud's disease, we tested this conception by severing the nerves emerging from the adrenal glands.

Our first task was clearly to differentiate neurocirculatory asthenia from a group of diseases which present many symptoms in common. We clearly excluded the diseases analogous to neurocirculatory asthenia, the mechanism of which involves changes in the action patterns in the brain. Among these excluded diseases are psychoneuroses, psychoses, neuroses, hysteria, maladjustments, in short all mental and psychic diseases. We thus limited our attack to that pathologically excessive activity of the adrenal-sympathetic system which produces a classical picture of abnormal nervous excitation, abnormal palpitation of the heart, abnormal nervous fatigue. The analogy to hyperthyroidism is at once apparent, since either the division of the sympathetic nerve supply to the thyroid, or of the adrenal nerves, profoundly modifies the hyperplasia of the thyroid gland, the metabolic rate, and all the symptoms of hyperthyroidism; while on the other hand, abnormal stimulation of the adrenal-sympathetic system easily reactivates the thyroid. That is to say, any one of the several links of the kinetic system may become the site of pathological physiology. This is especially true of the brain itself.

Theoretically, it is clear that pathological physiology of the

Downloaded from www.ccjm.org on June 6, 2025. For personal use only. All other uses require permission.

brain can not be relieved by denervation of the adrenal nerves. We have tested this most important clinical point and have found that after adrenal denervation psycho-asthenia, psychoses, psychoneuroses, oddities of action patterns, and hysteria are not in the lease benefited, just as these psychic and mental states are not benefited by thyroidectomy, by ganglionectomy, etc.

The theoretical and the practical indication for denervation of the adrenal glands is found in those individuals whose mental and psychic mechanism falls within normal range, but whose sympathetic system is under an otherwise uncontrollable stimulation analogous to that present in hyperthyroidism and in Raynaud's disease.

Anatomy

The technique of adrenal denervation requires a precise knowledge of the anatomy of the adrenal glands especially in relation to their nerve and blood supply, and to their position with relation to other organs (Fig. 1).

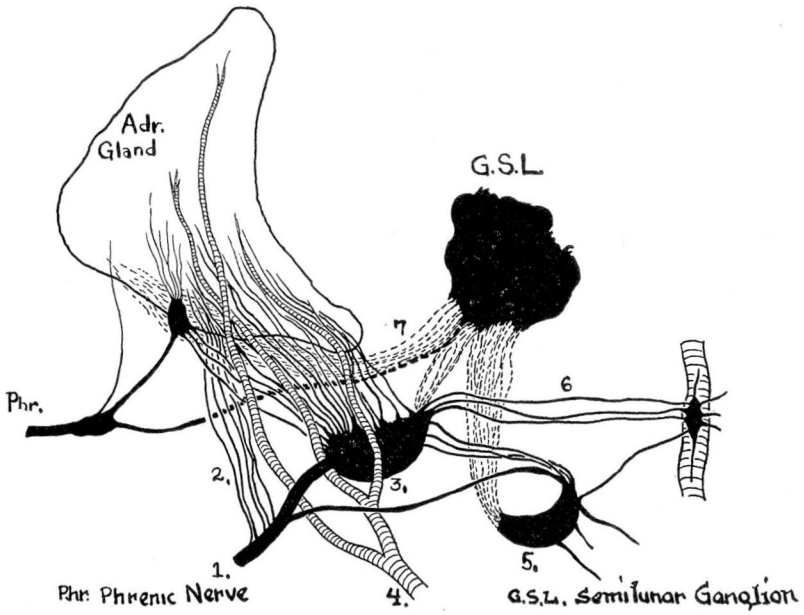

Fig. 1. The anatomy of the adrenal gland. 1, Greater splanchnic; 2, direct fibers of greater splanchnic going to adrenal gland; 3, principal adrenal ganglion; 4, inferior capsular artery; 5, supernumerary ganglion; 6, anastomosis of kidney and adrenal nerves. Note that the solid lines from 3 to the adrenal gland represent the main posterior pedicle. The dotted lines from G. S. L., to the adrenal gland represent the secondary or internal pedicle. (Redrawn from Latarjet and Bertrand, Lyon chir., 1923, xx, 452.)

Downloaded from www.ccjm.org on June 6, 2025. For personal use only. All other uses require permission.

The adrenal gland is a diminutive yellow pancake, golden in color, soft, friable, and vascular. As indicated by its name, it is situated adjacent to the upper posterolateral aspect of the kidney and always close to the vertebral column. An arrow piercing both adrenal glands would pass approximately through the center of gravity of the body. The gland is held in place by the strands of the sympathetic web, by the slender fibers from the neighboring fascial planes, and by its blood vessels. It is completely embedded in fat, and, on palpation, the adrenal border gives an impression unlike that of any other organ except the external ear to which it is similar in contour and motility.

The right adrenal gland lies in proximity to the diaphragm, the vena cava, the liver, the head of the pancreas, the duodenum, the kidney and the vertebral column. The left adrenal gland lies in proximity to the tail of the pancreas, the spleen, the aorta, the diaphragm, and the spinal column.

When the fascial sheet which binds the kidney to its halo of fat is opened, long blood vessels may be seen passing downward at the side of the kidney toward the vertebral column. These vessels are arrows which mark the trail to the adrenal gland. Generally there is an artery at the outer border of the adrenal and one also at the inner border, the largest artery being underneath, like the stem of a toadstool. From the adrenal glands thirty or more nerves emerge, and these are found on all aspects of the gland except the anterior surface where they appear at the borders.

In hyperthyroidism, the adrenal gland is greatly changed as to its vascularity, its adhesion to neighboring tissue, its appearance, and its texture, just as in hyperthyroidism the hyperplastic thyroid gland differs from the normal gland in respect to vascularity, adhesion, texture, and appearance.

In the course of manipulation incident to the exposure of all aspects of the adrenal gland and to the division of the nerves, oozing and sometimes smart bleeding are encountered. In no case, however, have we found it necessary to tie a vessel because, happily, in this deep operative field clotting is spontaneous. This may well be accounted for by the fact that adrenalin facilitates the clotting of the blood, as demonstrated by Cannon.

Many years ago in researches on blood pressure, I found that, during manipulation of the adrenal gland, an immediate rise in the arterial blood pressure occurred and that immediately after manipulation the arterial blood pressure fell.

I found from these researches that the only gland or tissue in the splanchnic area, the manipulation of which caused a rise in

Downloaded from www.ccjm.org on June 6, 2025. For personal use only. All other uses require permission.

blood pressure, was the adrenal. The manipulation of every other gland in the splanchnic area caused either a fall in blood pressure or produced no effect.

Technique

Except in cases of high blood pressure, spinal anæsthesia is the method of choice for denervation of the adrenal glands, since it produces complete relaxation and lessens bleeding. The alternative to spinal anæsthesia is local and regional block anæsthesia combined with analgesia or with nitrous oxide or ethylene. If the operation is being performed under local and regional anæsthesia, then the adrenal glands, themselves, are blocked with novocain, since, although they lie among tissues which are only slightly sensitive to pain, they themselves are sensitive.

In several cases, with the patient in the prone position on the table, we have made the approach along the lumbar muscles through a vertical incision, believing that in this way we would approach the gland on its posterior aspect and by a shorter route. The special advantage of this method was that the nerves and blood vessels could be seen more directly, but the procedure had limitations due to the position of the patient on the table.

We have also made a vertical incision toward the anterior aspect of the adrenal along the tip of the twelfth rib but this method entailed too much contact with the peritoneum.

Recently, our method has been to make a modified kidney incision. This incision, running from behind forward, terminates at about the middle of the twelfth rib, and is then carried downward vertically (Fig. 2). The incision must be large enough to admit the hand into the renal space. Every bleeding point must be securely tied before the deeper dissection is begun. Since good exposure is essential, by means of a right-angled retractor, the twelfth rib is raised and the bloodless field is disclosed. After the renal fascia has been adequately incised, a long vessel may be seen in the renal fat, the vessel which, as stated above, marks the trail to the adrenal gland. The first step is to mobilize the upper pole of the kidney and to depress the entire kidney when usually the yellow curved edge of the adrenal pancake may be seen. If the adrenal is not seen, the hand is introduced, and by palpation toward the vertebral column and the great abdominal vessels, the external earlike border of the adrenal will be felt. At this point special instruments are introduced — namely, long, slender dissectors at one end of which is a dull dissecting blade and at the other end a blunt hook. In addition, we use a pair of blunt nerve hooks on a long shaft, a pair of French

Downloaded from www.ccjm.org on June 6, 2025. For personal use only. All other uses require permission.

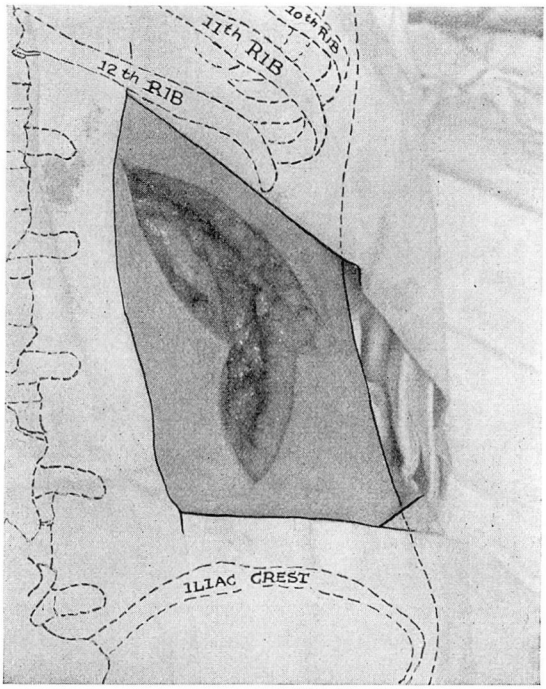

Fig. 2. Incision for denervation of the adrenal gland.

intestinal forceps, a tonsil dissecting knife, a fork retractor, and a pair of curved tonsil scissors (Fig. 3). These special instruments were constructed by Mr. V. B. Seitz, of the Cleveland Clinic.

The softness and brittleness of the gland precludes grasping it in an instrument in order to hold it and orientate its position and also, owing to the nerve and blood vessel attachments, the gland can be moved only within a very short radius. For these reasons the operation must be carried out essentially *in situ*.

After the gland has been exposed by separating the fat, the blood vessels are identified, and then, by means of the blunt nerve hooks, tonsil scissors and a long-handled tonsil knife, the nerves are divided. When this procedure has been completed, the adrenal gland will be quite mobile. It can then be raised up vertically from the vertebral column for a considerable distance.

Owing to the loose retroperitoneal tissue and the danger of oozing, we have usually inserted two cigarette drains, in the lumen of which iodoform gauze has been placed. The iodoform is used to prevent the contamination of the blood serum along the drains

Downloaded from www.ccjm.org on June 6, 2025. For personal use only. All other uses require permission.

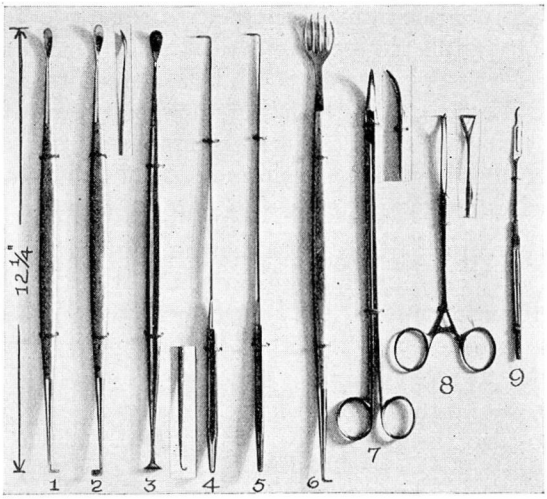

Fig. 3. Special instruments used for denervation of the adrenal gland: 1, 2 and 3, long slender dissectors at one end of which is a dull dissecting blade and at the other end a blunt hook; 4 and 5, pair of blunt nerve hooks on a long shaft; 6, a fork retractor; 7, pair of curved tonsil scissors; 8, pair of French intestinal forceps; 9, tonsil dissecting knife.

from a staphylococcus infection from the skin. The important point to remember is that, in approaching the glands, rigid attention should be paid to land marks and the operating field should be bloodless.

Immediate Operative Results

Since the operation is performed in a territory of meager sensory innervation, and the blood loss is slight, there is but little shock. In 126 cases, there have been no deaths from anæsthesia, pneumonia, shock, or hæmorrhage. There have been two physiological deaths, but such deaths are now easily avoidable.

It is most important to state again that the clinical results in cases of diseases of mental or psychic origin, which may be confused with neurocirculatory asthenia, are negative. The differential diagnosis can be made with reasonable certainty by a careful history and physical examination.

The first point in the diagnosis is to make certain that the mental and psychic mechanism is normal. Then if an unstable heart is found, as manifested by tachycardia induced by trivial causes, or by no apparent cause such as by changing posture, by turning over in bed, by standing up, by slowing of the heart rate when the patient

Downloaded from www.ccjm.org on June 6, 2025. For personal use only. All other uses require permission.

bends over, by any alterations in the heart beat up to and including paroxysmal tachycardia; if the pupils dilate as the result of pressure on the region of the epigastrium; if hippus, tremors, sweating and cold hands and feet are present, if there are unaccountable nervousness and tremors; if there are intermittent nervous excitation and fatigue; if infections and heart lesions are excluded, then the diagnosis of neurocirculatory asthenia may safely be made.

The heart can not initiate tachycardia, but tachycardia is imposed upon it; so the sympathetic system can not initiate stimulation, stimulation is imposed upon it. Our purpose in these cases, therefore, is to interfere surgically with this pathological stimulation by denervating the adrenal glands, and we are finding the clinical results comparable to the results of thyroidectomy in cases of hyperthyroidism. So also "soldier's heart" could have been relieved by adrenal denervation.

The day following the first denervation the patient will notice a lessening of consciousness of his heart; he will experience a diminution of the feeling of nervous tension; he will observe a lessening of the cold sweat; a warming of the skin; and the nurse will notice that the patient is less restless — a sequence similar to that which is observed after thyroidectomy for hyperthyroidism. If the first denervation produces none of these beneficial results, it will be because the diagnosis is incorrect and the second denervation need not be performed. In correctly diagnosed cases, the second denervation will be followed by further improvement along the same lines, and the general improvement in cases continues steadily, just as in the cases of hyperthyroidism.

Among the inconstant but frequent results is the disappearance of constipation and indigestion.

End-Results

As to the end-results in our cases, 1 patient has remained well for 14 years after unilateral adrenalectomy; 1 for 4½ years after unilateral denervation; and of the 21 cases of bilateral denervation performed within the past 18 months, 18 patients have remained well to date, in 2 cases the results are negative, and 1 patient we have been unable to trace. The final decision as to the potency of adrenal denervation must await the test of time.

Downloaded from www.ccjm.org on June 6, 2025. For personal use only. All other uses require permission.