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OF

EXSECTION OF THE BRACHIAL PLEXUS OF NERVES

FOR THE RELIEF OF

PAINFUL NEUROMA OF THE SKIN.

BY

F. F. MAURY, M.D.,

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AND

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CLINICAL LECTURER UPON DISEASES OF THE SKIN IN THE UNIVERSITY OF PENNSYLVANIA.

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UNDER the name of Painful Neuroma of the Skin, one of us (Dr. Duhring) reported in this Journal for October, 1873, a case remarkable for its many peculiarities. In that report the subject was discussed from a dermatological point of view only; in the present communication the question will be considered in its surgical aspect, as to the means of affording relief to the excruciating sufferings of the patient.

When first described, the case was deemed to be an unique example of disease, and, after further investigation, there appears to be no reason to question the accuracy of that belief. It seems to stand alone in literature, with its distinctive symptoms, apart from all other cases to which, at first glance, it might be likened. To thoroughly comprehend the affection it is essential that its whole course be carefully investigated in all its details; for, without accurate study of the various symptoms, viewed subjectively as well as objectively, it is impossible to arrive at a just appreciation of its nature. In the number of this Journal just referred to will be found an accurate representation of the disease, as well as certain statements which should be borne in mind.

In addition to the remedies already stated to have been tried, electricity and galvanism have been used perseveringly, with no perceptible amelioration of the symptoms. Quinia has also been administered, both in tonic as well as in larger anti-periodic doses, without benefit. Preparations of iron and arsenic, various quantities of the bromide and iodide of potassium, all have been administered in turn, without effect.

The signal failure of all remedies, both constitutional and topical,

led to the consideration of the propriety of resorting to a surgical operation for the relief of the unbearable suffering which the patient endured. It was thought that by this means only was there a chance of affording any relief. The question presented itself: What operation could be performed with this end in view? It will be remembered that the area of suffering extended over the shoulder, radiating to a certain extent to the integument of the thorax anteriorly, and posteriorly to the scapular region, and down the entire arm, the central seat of pain being upon the arm at a point corresponding to the insertion of the deltoid muscle. It will be seen that a very large tract of surface was thus involved. After a careful study of the distribution of nerves to these regions, in which Dr. S. Weir Mitchell rendered valuable assistance, it was evident that to afford the best chance of subsequent immunity from suffering, it would be necessary to divide the entire brachial plexus of nerves; or better, to exsect a sufficient portion of nerve tissue to preclude any likelihood of reunion. It will be recalled to memory that the fourth, fifth, sixth, seventh, and eighth cervical nerves, together with the first dorsal, combine to form the plexus, these uniting by two main trunks or cords. During this investigation it was also found that the third cervical nerve supplied a portion of the integument of the neck and shoulder posteriorly; but it was seen to be entirely impracticable to divide this nerve by the same operation that would reach the brachial plexus at its most eligible and desirable point. It may be mentioned here that the only recorded case for which any operation has been instituted for a kindred, but not like disease, is that of Drs. Sands and Seguin, of New York, carefully reported in the *Archives of Scientific and Practical Medicine*, No. 1, 1873. The operation in this case, however, was done for a traumatic neuritis.

The free consent of the patient was obtained, after a clear and truthful statement of the risks and dangers had been made, and the operation determined upon.

On the 25th October, 1873, the patient was placed under careful surveillance, and the following notes recorded:—

7 A. M. Patient had three paroxysms during the night, and one after dressing this morning. They each continued from ten to fifteen minutes. 5 P. M. Has had six paroxysms since this morning's note, two of which lasted thirty minutes, two fifteen

minutes, and the remaining two eight and ten minutes. Patient is fearful that the proposed operation will be of no benefit to him; nevertheless, is willing to risk death rather than continue to suffer.

26th, 8 A. M. Had three paroxysms through the night, one of which was very severe, and continued one hour; the others lasted each twenty minutes. 5½ P. M. Had two paroxysms to-day, fifteen and thirty minutes in duration.

27th, 8 A. M. Had two paroxysms during the night, and one this morning, of about fifteen minutes.

28th, 8 A. M. Five attacks of pain since last note, two of which the patient states, were the most severe he has ever endured.

29th. 8 A. M. The day appointed for the operation. Five paroxysms since yesterday, three of which were very severe. 11 A. M. Is prepared for the operation. Is calm and in good spirits, thinking only of the pain that he may suffer after the operation. Has had two paroxysms within the last three hours.

The operation was performed by Dr. F. F. Maury, assisted by Drs. W. H. Pancoast, J. H. Brinton, and S. W. Mitchell, in the amphitheatre of the Philadelphia Hospital in the presence of the clinical class.

The patient having been thoroughly anæsthetized with ether, the following steps may be noted: The shoulders were well elevated, and the head allowed to drop backward with the face strongly inclined to the sound side, the integument of the neck of the affected side being rendered tense. This is a point of importance, causing the sterno-cleido-mastoid muscle to be prominently displayed. It is, moreover, especially desirable that the posterior border of this muscle be clearly defined as a landmark for the first incision. The next important step consisted in rendering prominent the course of the external jugular vein, which commences in the substance of the parotid gland, upon a level with the angle of the lower jaw, and runs perpendicularly down the neck in the direction of a line drawn from the angle of the jaw to the middle of the clavicle. The finger of an assistant pressed immediately above the last-named point rendered this vein distended. The incision was L shaped, with the long arm extending along the posterior border of the sterno-cleido-mastoid muscle, beginning three inches above the clavicle; the short arm following the course of the collar bone, as in the operation for the ligation of the subclavian

artery. The length of both skin incisions is to be regulated by the size of the neck of the patient. The knife was carefully guided, so that it divided only the skin, under which conspicuously appeared the external jugular vein; this was pulled aside by the finger. The handle of the knife and the finger were then used to tear and separate the fascia in searching for the tendon of the omo-hyoid muscle, the next important guide. Immediately underneath the posterior belly of the omo-hyoid muscle, which it was not necessary to cut, being readily held aside by the finger or a blunt hook, were found the two cords of the brachial plexus. The outer or upper cord, composed of a faciculus from the fourth, with the fifth, sixth, and seventh cervical nerves, was elevated by means of a curved aneurism needle armed with a silk ligature; the needle was withdrawn, the ligature left and loosely tied around the cord, was given to an assistant. The index finger of the left hand was then placed in the wound, and the exact position of the subclavian artery ascertained; it was found, and held well out of the way and carefully protected. The trunk was next divided with blunt-pointed scissors, as near the finger of the left hand as possible, which was effected without difficulty.

Another division was made above the point of the ligature as far up as practicable, care being taken not to interfere with the scalenus anticus muscle, across the body of which passes the phrenic nerve, which was not seen. By this means four-fifths of an inch of nerve substance, carefully measured *immediately* after exsection, was removed, and the marked retraction of the cut ends gave a space two and a quarter inches from each extremity. The inner cord was then sought for and found directly underlying the outer; this cord, it will be borne in mind, is composed of the eighth cervical and first dorsal nerves. It was secured by needle and ligature in the manner already mentioned, and the same amount of nerve exsected. Even greater care should be observed here in the protection of the subclavian artery, as it lies in immediate proximity with the inner cord. No vessels were divided, not even the transversalis colli, it being held carefully aside with the posterior belly of the omo-hyoid. The operation was therefore bloodless; no ligature was required.

The operation occupied one hour and a quarter, from the time of commencing etherization to the dressing of the wound. The incision was brought together, and covered with a pledget of oakum

soaked with olive oil. The finger nails of both hands were stained with nitric acid, for the purpose of noting the growth of the nails. 5 P. M. Patient still more or less under the influence of the anæsthetic. The arm is completely paralyzed, and without pain. 10½ P. M. Has had no severe pain since operation; is restless. One-fourth of a grain morphia given hypodermically.

30*th*, 7 A. M. Rested well through the night. Suffers no pain of any kind. 7 P. M. Has been comfortable through the day, and has eaten heartily. Ordered xl grs. bromide of potassium.

31*st*, 7 A. M. Slept well through the night until four o'clock, when he awoke and shortly after experienced a slight paroxysm of pain on the *top of shoulder*. It lasted five minutes, and was similar in character to the old pain. 4 P. M. Has been free from pain during the day; feels comfortable.

Nov. 1, 7 A. M. Just after getting asleep last night, he was awakened with pain about the top of the shoulder; it lasted fifteen minutes. Had slight pain an hour ago.

2*d*, 8 A. M. Did not sleep well; had a ringing sensation in his head. Complains of a tingling sensation in his arm. Slight paroxysms this morning. Wound of neck somewhat reddish.

3*d*, 7 A. M. Restless last evening; was ordered xxx grs. brom. pot., with ¼ gr. morphia. Was annoyed with pain three times during the night, but the attacks were light.

4*th*, 8 A. M. Rested well all night. While dressing this morning a paroxysm came on.

5*th*, 8 A. M. Had pain during the early part of the night, but slept comfortably during the night. Slight paroxysms while dressing wound. Stitches removed. Wound has united by first intention.

6*th*, 7 A. M. One very light paroxysm through the night.

7*th*, 7 A. M. Slept comfortably. One short attack of pain an hour ago.

8*th*, 7 A. M. Had one paroxysm during the night. It may here be observed that all the pain has been seated about the top of the shoulder.

11*th*. Still complains of the tingling sensation in the arm.

17*th*. Has been doing quite well, but has had one or two slight paroxysms during the twenty-four hours. The appetite is good, and he sleeps well. The finger nails have not grown at all upon

the left hand (side of disease and operation), while on right hand they have grown an eighth of an inch. Strong tincture of aconite root was ordered to be applied as a continual dressing to the top of the shoulder.

24th. No relief has been obtained from the tincture.

29th. Is in good general health and spirits. Still continues to have one or two slight paroxysms through the day. The left forearm has been somewhat œdematous for several days past. It has been rubbed with an ammonia liniment, the unpleasant numbness and tingling in the part being greatly relieved by this means.

April 29, 1874. Since the foregoing notes were recorded, now five months, the patient has been under constant observation. During the month of January, a carbolic acid dressing, consisting of one part of the acid to three of glycerin, was applied to the painful shoulder. Vesication was produced, but without affording any relief.

May 12*th.* Within the past twenty-four hours the patient has experienced one paroxysm, which came upon him without apparent cause. He has also suffered four very slight attacks, all of them produced by external causes, as a draft of air, nervous excitement, and the like.

13*th.* A repetition of yesterday's symptoms exactly.

The following table exhibits, in a condensed form, the state of the pulse and the temperature of the body before and after the operation. The temperatures were taken with great care, the portion of the bulb of the thermometer not in contact with the skin being surrounded and protected from the air by a piece of scooped out cork. The thermometer was allowed to remain in position from ten to fifteen minutes.

"Pulse and Temperature," degrees Fahr. before Operation.

	Pulse.	Temperature.				
		Left axilla.	Right axilla.	Left palm.	Right palm.	Surface of left shoulder.
1873.						
Oct. 25th, 7 A.M.	68	98¼	98¼	96		
" 25th, 5 P.M.	80	97⅘	97⅘	94		
" 26th, 8 A.M.	70	98	98	95		
" 27th, 8 A.M.	76	98⅜	98⅜	95		
" 28th, 8 A.M.	80	97⅔	97⅔	94		
" 29th, 8 A.M.	80	97⅔	97⅘	94	94⅔	

After operation.

Oct. 29th,	5 P. M.	80	100⅔	98	99	91	98½
" 29th,	10 P. M.	88	101⅔	100	100	97	100⅔
" 30th,	7 A. M.	92	99⅔	98	98¼	98	99
" 30th,	7 P. M.	80	100⅕	99⅗	99⅔	98⅗	97⅗
" 31st,	6 A. M.	76	98⅗	97¼	97⅖	96½	96½
" 31st,	4 P. M.	80	99¼	98⅖	99⅖	98⅖	97⅔
Nov. 1st,	7 A. M.	76	98	97½	97	96⅗	96½
" 1st,	5 P. M.	80	99¼	98⅖	98½	96¼	99½
" 2d,	8 P. M.	80	99	98⅖	97⅖	97	97⅔
" 3d,	7 A. M.	84	98½	97⅖	97	96¼	95⅗
" 5th,	7 A. M.	76	97¼	97½	96⅔	96⅔	
" 6th,	7 A. M.	72	98	97⅖	97⅖	96⅔	
" 9th,	7 A. M.	80	97⅔	97½	97	96⅔	
1874.							
April 29th,		96	99½	99¼	94¼	99¼	
May 2d,		...	...	95¾	92¼		
" 3d,		...	...	97¼	87¾		

The thermal observations here given settle conclusively the mooted points as to the effect in man of nerve sections on temperature. They coincide strikingly with the results obtained by Dr. Weir Mitchell in a case of section of median nerve (see present number of this Journal), and again fulfil the prediction made on this subject by the above-named author.[1]

Before the operation and section in our own case, the left palmar temperature ranged from 94° to 96° F. It rose within three or four hours after the section to 99° F.; at 10 P. M. it was 100°, and up to Nov. 9th was never, save once, as low as 96⅔°, being usually a degree or more above that of the right palm. When again in April the temperature was taken it was, at 8 P. M., after a period of some pain and re-excitement; left palm 94¼°; right palm 99⅔°. Upon May 2d it was even lower; left palm 92¼°; right palm 95¾°; and the following day the left palm was only 87¾°; the right do. being 97¼°.

The result of the operation may be summed up as follows: Our patient suffers but one painful paroxysm, and some four slight attacks of pain, in the course of twenty-four hours. This statement may be received as an average of his sufferings since the operation, and the symptoms appear to be neither abating nor increasing at the present time. The general health is excellent. As a rule he

[1] Injuries to Nerves, p. 177.

sleeps quite comfortably through the night, now and then awaking from an attack of pain.

The muscles of the shoulder are conspicuously wasted, that of the deltoid being most notable, so that the head of the humerus has dropped at least an inch out of the glenoid cavity. The great and general œdema of the whole limb masks the lower atrophies in the forearm; but on removing the œdema by a bandage the muscle-losses become plain, as well as the bone-like hardness of their contracting tissues.

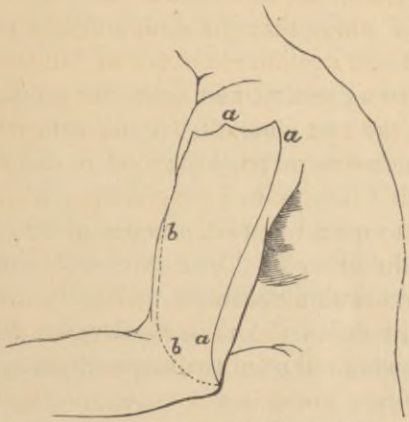
For two days after the operation an induced current of full power moved all the forearm muscles, but this capacity to respond declined by degrees, and at the fourth day a powerful galvanic current, interrupted and reversed, was needed to show them. The downward current acted best. April 29, no severity of any form of current moved the muscles, nor did they stir when galvanized through needles passed into their substance (75 cells), interrupted and reversed current.

The skin of the arm and forearm is very dry and desquamates slightly. The fingers of the hand are all contracted, more or less, the third, fourth, and fifth most, partly owing to an old injury, but chiefly following the operation. The skin of the hand, especially about the knuckles, is reddish and smooth, accompanied with desquamation of the epidermis. There is marked incurvation of the nails on both sides (turtle-back nails), but especially on the left side, where they are very greatly curved. The difference in the growth of the nails is still very evident from the old staining; it is a difference of at least one-half.

As regards the appearance of the skin of the shoulder, and the nodules upon it, there is little change to note since the operation. It still retains its characteristics as described in connection with the history of the case, without any decided appreciable alteration.

A careful study was made by Dr. Perry, the hospital resident, of the region of lost sensation; and in April Dr. Weir Mitchell and one of us (Dr. Duhring) repeated this examination, with no notably different results. Touch and pain, as tested by needle points, were absent in a region of skin which included all of the forearm and hand and face of the arm, bounded by an irregular line on the two sides, and above, on the front of the shoulder, by a still more irregular limit. The whole back and inner surface of

the arm to the elbow was sensitive to touch and to the needle; but more so above than below. Even in the anterior arm space, where the needle entered painlessly, there were here and there regions in which distinct and well-localized pain was felt when Dr. Mitchell inserted needle points into the dermis, and transmitted through them the current of 50 to 75 Collat. cells. The wire brush on the dry skin yielded us no signs of feeling. The diagram gives an idea of the limiting lines which bound the areas of lost or lessened feeling.



The line *a*, *a*, *a*, on the outer surface of the arm, marks the boundary above and outside of which sensation is preserved. The *dotted* line *b*, *b*, marks the same for the *inner* surface of the arm.

No new tubercles have appeared on the arm, though several small new ones are observed upon the back, about the scapular region; they are the size of split peas, and as yet are only painful upon pressure.

When we consider then the state of our patient before the operation, and his present condition, there is every reason to feel gratified with the result; for although the suffering has not been completely removed, the relief afforded has been so great and so decided as to admit of no question. The patient himself bears frequent and willing testimony upon this point, stating that he is well satisfied with the success of the operation, and thankful for the ease obtained. He is now able to live in at least comparative comfort, whereas before he was in continuous pain, and this of so grievous a character as to be almost intolerable. The complete paralysis of the arm is of but little moment to the patient, and is scarcely worthy of consideration in comparison to his previous

sufferings; for the limb had not only to be guarded, but preserved as free from all movement as possible, the least exertion or motion being followed by paroxysmal pain. We remark here, that absolute relief from pain was not expected from the division of the nerves operated upon; for, as is known, the third cervical nerve gives off branches which supply the skin of the top of the shoulder, which would still continue to exert its influence. The result has realized the views entertained upon this point previous to the operation. It is, without doubt, from the cutaneous branches of the third cervical nerve that the pain which the patient now experiences proceeds.

Concerning the operation, two practical points may be briefly referred to. In the first place, the facility with which the cords of the brachial plexus were reached; the procedure being by no means so difficult a task as was imagined. Secondly, it is of particular interest to note the total absence of shock following the operation, a condition which it was expected might readily follow such a serious systemic disturbance.

Through the kindness of Dr. R. M. Bertolet, we are enabled to present the appended report of the microscopic examination of the exsected nerve:—

"The excised portions of the nerves were, after the operation, at once placed in a 2 per cent. solution of chromic acid and hardened for section. Transverse cuts, stained in carmine and mounted in damar varnish, revealed the existence of what, at first sight, appeared to be an abnormally thick, hypertrophied enveloping sheath (neurilemma); but upon closer study, and on comparing with sections of the normal brachial plexus, it was evident that this apparent excessive development of the connective tissue sheath was no more than proportional to the increased size of the nerve trunk itself in this region.

"The connective tissue septa arising from the neurilemma, and subdividing the nerve trunks into secondary bundles, were scarcely, if any, more strongly developed than ordinarily; no marked proliferation of the connective tissue corpuscles existed. In the secondary fasciculi of the nerve, however, at many places were seen accumulations of young migratory cells ('granulation' of Virchow). The aggregation of these elements between the primitive nerve fibres was so great, at not a few points, as to press them widely asunder

and lead to a corresponding atrophy of the individual fibres. The axis-cylinders were seen distinctly in every instance; the atrophy having taken place mostly at the expense of the surrounding medullary substance. The nerves that underwent these atrophic changes presented a very bright, highly refractive, glassy appearance under the microscope, strongly reminding one of amyloid degeneration, yet the iodine test failed to give any reaction; this if present, however, would not have responded on account of the preservative fluid employed. These bright spots occurred in circumscribed areas of the nerve bundles, while in the remaining portions the nerve fibres were unaffected; there having been just the faintest suspicion of commencing proliferation of the interstitial substance.

"In this specimen we do not have the same material growth of connective tissue, nor the attendant fatty metamorphosis, usually seen in marked cases[1] of *neuritis interstitialis;* yet the alterations found are sufficient to indicate that this nerve has already fully entered the earlier stages of these inflammatory changes."

In conclusion, we desire to express our thanks to Dr. Mitchell for valuable suggestions offered, as well as for the interest manifested in the study of the case. For the careful attention to the patient, and for notes after the operation, our thanks are tendered to Dr. H. M. Perry, one of the House-Surgeons to the Hospital.

[1] Virchow's Archiv, Bd. 53, p. 441.