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# A Contribution to the Surgery of the Spinal Cord

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*presented by the author*

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# A Contribution to the Surgery of the Spinal Cord.<sup>1</sup>

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THE surgery of the spine is one of the new chapters soon to be written, from which much may be expected. As yet, however, so little work has been done or published that statistical tables upon the subject are untimely and of little profit.

It should be a surgical axiom that every novel case of operative interference should be published, and I shall therefore present concisely, for our study, two cases that have recently come under my care, deducting such practical lessons as may be deemed important. I have the pleasure of showing you the patients themselves.

*Extra-dural tumor of spine—Paraplegia complete—Operation—Recovery.*—The first case of note is a man, aged twenty-two, who was in excellent health up to January of last year, when pain in his back was his earliest symptom. He had no other symptom when admitted to St. Luke's Hospital, in March following. The spine was flexible and

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<sup>1</sup> Read before the New York State Medical Society, February 7, 1889. This case was shown to the Surgical Society of New York, October 10, 1888, and mentioned in the New York Medical Journal, November 24, 1888.

without deformity. A slight fulness was thought present in the soft parts of the right of the spines of the ninth and tenth dorsal vertebræ, where tenderness on pressure and some pain on motion were apparent.

Dr. Kinnicutt, under whose care he came, treated him by iodide of potash, quinine, blisters, and other remedies, though unable to elicit any history of syphilis or tuberculosis, and quite soon diagnosed a tumor of the spine. Four weeks later the swelling of the soft parts had markedly increased, so as to make an induration of the parts two inches wide by three inches along the spine. Tactile sensibility now began to be disturbed in both legs, and then muscular power began to go. At the same time there was a line of hyperæsthesia around the abdomen which marked the limit between the anæsthesia of the legs and the normal abdominal skin. Two weeks later he could not stand without support. After this his power in the legs rapidly disappeared. He had annoying, uncontrollable twitchings of the legs, which were cyanotic when allowed to depend from the bed. The spine became rigid and very painful. The legs absolutely anæsthetic; abdomen tender and hyperæsthetic. A wasting hectic had set in. On May 10th he was growing rapidly weaker; had constant intercostal pain in the lower ribs, with girdle pains about the limiting line of disease. There was involuntary muscular twitching, with increasing incontinence of urine and fæces. By May 25th, affairs had gone from bad to worse, the man lay in an apathetic condition, suffering from the slightest motion of the spine, and with girdle and intercostal pains unabated. The presence of an active hectic led one to fear a serious general infection. A final consultation was held May 29th, at which Drs. Seguin, Weir, Peters, Kinnicutt, Bull, Ridlon, Murray, Shaffer, and myself were present. Previous explorations of the swelling had shown nothing, but to-day a drop of thick, shreddy pus was obtained, and on the following day I operated.

May 26, 1888.—Under ether, an incision was made,

six inches long, close to the spines, from the sixth to the twelfth dorsal. The laminæ being uncovered, some thick broken-down tissue and pus were scraped away. The laminæ were already bare of periosteum, and the spines and laminæ of the eighth, ninth, and tenth were cut away by rongeurs. This revealed a dense mass of tissue and desiccated pus, occupying the entire calibre of the canal and extending up and down in all two and a half inches. This compressed the cord tightly against the anterior wall. It was rapidly and thoroughly removed by a sharp Volckman spoon, until sound bleeding tissue was left on every side. The cord was not seen to pulsate. The cavity was packed with iodoform gauze—after bichloride irrigation—and an antiseptic dressing and plaster of Paris jacket applied.

On the eighth day sensation began to return. In the fourth week he began to move his left leg and the toes of the right. His fever rapidly left. Pain disappeared, and appetite returned. In six weeks he moved both legs well. In ten weeks he went about in a rolling-chair. The third month, walked with crutches. At four and a half months, walked pushing a chair.

It is now eight months, and you see he walks well without support, is stout and hearty, and since the operation absolutely without fever, or evidence of tuberculosis. The tumor tissue was examined for bacilli, but nothing but cellular-tumor elements and pus found.

The clinical evidence leads me to believe the neoplasm began between the theca and the posterior arch of the vertebræ, and then broke down, involving the bone. The bodies of the vertebræ are perfectly sound.

*Intractable brachial neuralgia, nerve stretching, amputation, and finally, intra-dural division of posterior roots of the sixth, seventh, and eighth cervical nerves—Improvement.*—This second patient is one whose malady is more complicated, whose recovery is not yet so brilliant, but whose operation stands, thus far, quite unique.

Mr. I. R. T— is forty-four years of age, an iceman. He was referred to me three months ago by Dr. C. L.

Dana, of New York, to see if I were willing to undertake an operation, conceived by him, to relieve the patient of one of the most intractable of neuralgias of the right brachial plexus, appearing in the arm and forearm. The essential features of the operation were carried out as planned from the first by Dr. Dana. The patient's history is as follows :

Prior to this trouble he had no disease—rheumatism, malaria, or specific. During the war an exploding shell left a small piece of itself in his left shoulder, which was extracted on the field, and left only a small flesh scar ; never otherwise injured. One year ago last May, he spent a day putting a zinc lining in a butcher's large refrigerator, and on the night following he first had a throbbing pain, localized in a single spot on the posterior surface of the right forearm, above the middle. The pain kept him from sleep. It was continuous at that site, but about one week later there was added a paroxysmal pain giving a peculiar twitching sensation in the thumb, index, and middle finger of the same hand. He was treated by electricity, blisters, counter-irritants, and internal medication, by excellent doctors, but his arm grew steadily worse. The pain was still localized over the forearm, and supplemented by the paroxysms of painful twisting sensation. There seems to have been distinct muscular spasm with the sensation of pain.

During the spring of last year there had ensued a disablement of the hand. The fingers were not readily closed nor extended. The hand was kept in a stiff position, the fingers semiflexed. The forearm and hand were slightly emaciated. There was atrophy of muscle in the interosseous spaces. Dr. Dana and others then saw him, and a diagnosis of ascending neuritis was arrived at. At this time he came under the care of Dr. W. T. Bull, at the New York Hospital. After a week the patient begged an operation, and the doctor stretched the posterior interosseous and ulnar nerves. The pain was not improved. If anything, it was worse.

On July 16th, at the patient's earnest request, the arm was amputated by Dr. Bull above the humeral insertion of the deltoid, and above any site of local pain heretofore complained of. The wound healed by first intention. As far as the eye could judge, all nerves in the arm were in a normal condition. When the wound had healed it was found there was no abatement of pain. It still had a "drawing" character, and he could feel the fingers twist just as if they were on. He left the hospital August 1st, if anything, complaining of more pain than before. He then came under the care of Dr. William Kemp, of New York, who again sought Dr. Dana's counsel. The patient had now got in the habit of taking morphine, one half grain every hour, to destroy the pain.

Of this interview Dr. Dana writes me thus :

"On September 25th I examined him again. The arm had been removed. The patient said he felt no better. There were twitchings and tonic contractions in the muscles of the stump. The patient had the Brauch-Romberg symptom, swayed in standing, and had a tendency to fall to the right when walking with eyes closed. Knee-jerks exaggerated and ankle clonus in right leg, all of which might be due to the morphine he was taking. There was much stiffness in the neck muscles. The patient could not rotate his head completely to the right, nor draw the head down to the right shoulder. The diagnosis, so far, had been neuritis—and of this there could be no doubt. The question was whether it might be due to a tumor or inflammatory process, either extra-spinal or extra-dural. An exploratory operation was advised with the idea, if no tumor was found, of cutting the posterior roots of the nerves transmitting pain. If it were a tumor, *that* could be removed. If it were ascending neuritis, cutting or resecting the nerve might stop it; while cutting the posterior roots would cause an ascending degeneration and destroy the sensory tract, even into the spinal cord."

At this juncture he went to Dr. Seguin for a month,

and returning to Dr. Dana, was sent to me at St. Luke's Hospital. His condition then was as follows :

November 2d.—Had grown thin, was careworn and hollow under the eyes. Appetite fair, tongue coated. No fever. He gives evidence of sharp pain, every few minutes, in the stump of his right arm, and usually doubles over and grasps the stump with the other hand. When asked about it, says it jumps and the stump draws to his side when the pain shoots into the hands and fingers, as if they were still on, and he can feel them all drawn up. The pain seems to be genuine, and the recurrence every five or ten minutes. He says also that it keeps up all night. Muscular atrophy is beginning to be marked about the shoulder, either from disuse or degeneration. The deltoid, supra- and infra-spinati, and biceps are atrophied; while the latissimus dorsi and pectoralis major are short and thin, but still act strongly when called upon. A small, tender neuroma of the musculo-spiral nerve in the stump, can be felt, and on pressure gives the same pain as is generally complained of.

November 7th.—Dissected out the neuroma under cocaine.

November 24th.—Not relieved by the removal of the neuroma. Urine 1.024, no albumen or sugar. Some oxalates.

December 31st.—Operated under ether, Dr. Bangs assisting, in the presence of a number of prominent neurologists and surgeons.

The usual surgical precautions were carried out. An incision was made along the ligamentum nuchæ, on the right side, from the third cervical spine to the first dorsal. The soft tissues were quickly separated from the spine, and the right half of all the laminæ well out on the articular processes. With rongeurs the laminæ were quickly gnawed away from the spine to articular processes—thus bringing into view the rather full pulsating dural membrane of the cord.

The seventh, sixth, fifth, and half the fourth vertebræ were thus treated. Severe venous bleeding from under

the latter was only controlled by an aneurism-needle protected by cotton and hooked up beneath the bone. Over two inches of dura was exposed. It was soft and allowed the finger pressure to feel the cord. No tumor was thus detected, nor did a director passed up and down the canal feel anything like tumor. There was no inflammation or disease of the hard parts. With a heavy curved hook I then explored the intervertebral foramina, and drew back the sixth nerve by hooking under it and pulling gently, so that a short loop of it was raised on my hook outside its point of exit from the dura, but inside the vertebral canal. Upon this root, thus raised, I applied a small metal electrode, while the opposite pole (a sponge electrode) was held on the back. Dr. Dana noted the effect. The same was tried on the seventh nerve, with less effect. My own observations, as did those of Professor Markoe and others, coincided with Dr. Dana's. He writes: "On the day of operation, a faradic battery of one cell, moderate current, was used. A sponge electrode on the back, a metal point electrode on the nerve. When applied to the sixth nerve, just external to the dura, it caused contraction of the supra and infra-spinati, rhomboid, latissimus dorsi, pectoralis major, teres, and deltoid. The results of electrizing the seventh nerve were not so satisfactory, it not being certain that the point reached that nerve alone (on account of fluid that collected around the electrode). It was impossible to drag out the fifth nerve without exciting more hemorrhage from the venous sinus." The eighth nerve also was hidden below the bone, and it was thought enough had been done. The sixth and seventh were then again raised up from their beds and cut square across just outside the dura. Both motor and sensory roots lie together at this point, so that they must have been severed. The wound was packed, entirely open, with iodoform gauze covered by a voluminous gauze dressing. He bore the operation well, but soon found his old pain seemed much the same—still low down in the hand.

January 2d.—Forty-eight hours after operation I felt that I ought to divide at least one more branch (the eighth), if I could do so, in order to reach the lower arm pain, and if possible to examine the spinal cord, inasmuch as Horsley had not detected the tumor in his celebrated case until he had opened the dura. I therefore determined to proceed as follows: place the man prone, without ether, and open the dura, so as to get a clue to the sensations of the nerve-roots when handled. With the assistance again of Drs. Dana, W. T. Bull, and others, I operated.

The patient was placed under a brilliant light, face downward, so as to maintain the operated part as the highest of the spinal axis. I carefully removed the packing, revealing a large, clean, dry wound, at the bottom of which lay the dura, throbbing and sound. Puncturing it with a knife, I slipped in a fine director and slowly let out the spinal fluid until it ceased to run. Then I slit up the dura for one and a half inch. The cord and membranes looked sound. The effect of evacuating two ounces of spinal fluid (carefully collected and measured) was practically *nihil*. The pulse did not change, and he experienced no sensations or pain. The dura was scarcely at all sensitive to cutting. I now picked up the roots of the eighth nerve within the dura at the level of the seventh nerve outside.

It looked normal, but I cut it close to the posterior columns of the cord, and then snipped off one-fourth of an inch for microscopical examination. Handling this nerve-root gave him the greatest pain of anything I had done, and of a kind exactly corresponding with that which he constantly suffers. I had reason to hope, therefore, we had reached the offender. In addition I cut also the posterior roots of the seventh nerve, close to the columns of the cord.

In two operation, therefore, I had cut the sixth nerve, both roots, outside; the seventh, both roots outside, and also the posterior root inside; the eighth posterior roots

only inside the dura. It was observed that the contact of even a blunt instrument to the posterior columns gave a sharp agonizing pain over the entire body, the patient crying out, "Ah! I *can't stand* it."

We again tried the battery, and with regard to it Dr. Dana writes: "On the second trial, the patient being conscious, stimulation in the same way—of the peripheric end of the cut sixth nerve—caused contraction of the supra- and infra-spinati and rhomboid. Of the seventh nerve contraction of the pectoral, latissimus dorsi, and adductors of the arm, with pains such as he usually suffers. Of the eighth nerve, similar contraction and intense 'drawing pain,' exactly such as is usually felt."

The slit in the dura was now sutured with fine catgut. A little cocaine had been injected subcutaneously along the cut half an hour before, and this allowed of painlessly suturing the entire length of the wound. Immediate union was thus obtained by second intention, and leaves a small linear scar. The patient had more or less of pain in the arm in the next ten days, but it changed in character. It no longer went down into the fingers. It was a "drawing of the stump," as he expressed it. It ceased to go up on the shoulder as it once did. He was allowed enough morphine to quiet pain for eleven days, when I deemed it best to let him sit up and stopped the drug entirely.

He missed it, but quickly got used to it, and since has had even less pain than when he was getting his morphine to quiet it. He walked freely at the end of the third week, and soon went in the open air. His gait is now as steady as for months past, and he can walk a crack in the ward any distance.

His temperature was  $101^{\circ}$  F. on the second day, and  $102^{\circ}$  F. on the fourth, but declined from that to normal on the tenth. The appearance of the upper arm and stump is one of increasing atrophy. There is no voluntary movement of the supra- or infra-spinatus, deltoid, or biceps, but there is of the latissimus and pectoral, though both are shrunken from disuse. There is anæsthesia of

the skin of the entire outer side of the arm from the deltoid region downward, extending across the neck from the centre of the clavicle to the centre of the scapula. This area of the skin showed a short period of irritability, without sensation, from the fourth to the eighth day after the root section, as shown by getting quickly and persistently suffused when brushed over or handled; but when pinched retaining an extreme blanching at that point, which did not recover for two or three minutes. This entire area is now, however, normal in appearance.

In considering the lessons drawn from these cases it is to be remembered that in any path of study knowledge never comes entire at once, but piecemeal. Truth presents herself in fragmentary form, and we put the pieces together; so that, while I do not present the case of cervical operation as a brilliant result as yet, so far as completely relieving the pain goes, I offer it as a unique case making a quick recovery from an operation, as conceived by Dr. Dana, at once simple and scientific.

The other case of spinal pressure from a degenerating tumor successfully operated on, and restoring the man to health, is the only one I find on record in this country, though others have been recorded abroad—MacEwen, of Glasgow, claiming to be the first to accomplish this result, five years ago. Since that time he has operated on five cases, two of whom died of tuberculosis.

Most cases of pressure-myelitis have no striking hectic fever. Yet two of MacEwen's cases had at the time he operated, and these two died. He, therefore, draws the conclusion that no case is "fit for operation in which the temperature does not run an even, regular, and continuously afebrile course." He shows thereby a suspicion that the pressure-myelitis paraplegia, plus the hectic, indicates a diffusion of tuberculosis. The case you have seen, therefore, stands of itself as an argument to refute this error, for the removal of the one focus of trouble entirely dispelled the hectic.

MacEwen's cases show, happily, that improvement

does not cease at six months. His patients, just able to get along without crutches at six months, can walk many miles two or three years later.

With regard to the case of neuralgia of the arm, no indisputable diagnosis had been made prior to my operation.

The man had neuralgia, but the cause of it, even such eminent neurologists as Drs. Dana, Seguin, Amidon, Starr, and others, were not united on.

It was believed to be ascending neuritis, but might be spinal tumor, or a delusional pain (Seguin) aggravated by morphine.

The language of pain is not at all times plain. If it were an ascending neuritis, could we expect to relieve it either by nerve-stretching, amputation, or neurectomy?

It has always been acknowledged difficult to get ahead of a neuritis of this type. The late Dr. Sands operated once on a case similar to this man's, by excision of all the roots of the brachial plexus in the neck, but found it very hazardous and unavailing. It also left the arm powerless. It seems to me reasonable that the posterior roots should be severed alone, as they alone transmit sensation to the cerebrum.

The operation has endorsement from neurectomies of the sensory fifth nerve for the cure of tic douloureux.

In the report of the examination of the excised posterior root of the eighth nerve, made by Dr. John H. Thacher, Pathologist of St. Luke's Hospital, he says: "The sections show inflammatory exudation in moderate degree on the surface of the nerve-root and along the larger vessels inside of the fasciculus." Thus the diagnosis of neuritis is established.

There remains one point for consideration which this case of section of the sixth and seventh nerve will help to elucidate.

The exact supply of the nerve-roots to the muscles of the arm has been somewhat a matter of conjecture, and frequently subject to revision.

William Thorburn, of Manchester, has only very recently published the results of study of many cases of fractured cervical spines, in which nerve-roots were injured with varying paralyses. The conclusions from this attractive and well-observed series of cases seem to leave some gaps in testimony, and errors which further study will correct. My case gives some points of value.

Thorburn places the pectoralis major and latissimus dorsi muscles in the supply of the sixth root. Yet in my case these are not paralyzed, though I have cut the sixth and seventh. Therefore these must be largely innervated from the fifth.

That there was no error in identifying the sixth, is shown by the supra- and infra-spinati supply and the anæsthetic area.



