

The Classic

Gunshot Wounds and Other Injuries of Nerves

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Silas Weir Mitchell (1829-1914) lived a long and productive life in Philadelphia, making his mark as a scientist, physician, and writer. A product of a medical family, seven physicians in three generations, he received his medical degree from Jefferson Medical College in 1850. Following graduation, he spent a year traveling and studying in Europe, where he attended the lectures of Claude Bernard. His early medical practice was scant, which allowed him time for his scientific experiments on snake venom, curare, and comparative physiology. Mitchell joined the army as a contract physician in 1862 and was assigned to a hospital in Philadelphia by his friend, William K. Hammond, the Surgeon General.

In May 1863, Hammond set aside some wards in the U.S. Army Hospital, Christian Street, Philadelphia, for the treatment of diseases and injuries of the nervous system. This categorization and grouping of patients with similar problems in special hospitals greatly facilitated patient care and the study of their diseases. Mitchell and George R. Morehouse were assigned the care of patients on these wards. They were joined later by a young intern, W. W. Keen. One of the fruits of their work was a small volume, *Gunshot Wounds and Other Injuries of Nerves*, which contained the first description of causalgia. This term was coined by Mitchell from the Greek, "Kausos" (heat) and "algos" (pain). In 1872, Mitchell published an expanded version of this work, *Injuries of Nerves and Their Consequences*.^{*} The lasting value of this work was recognized when it was reprinted by the American Academy of Neurology (Dover Publications, Inc., New York) in 1965. As a result of his many early contributions to neurology, he was elected as the first president of the American Neurological Association.

The later years of Mitchell's life were taken up by his popular and literary writing. His output included nineteen novels and eight books of poetry, in addition to numerous other papers. His most popular novel, *Hugh Wynne*, Free Quaker, published in 1896, was a historical novel of the Revolutionary War. It can still be read with pleasure.

Mitchell died in 1914 in his beloved Philadelphia after adding luster to its medical and literary community for half a century.

LEONARD F. PELTIER, M.D.

Pain, in the shape or neuralgia like the darting, typical pain or tic douloureux, is a common sequence or nerve wounds. It assumes all kinds or forms, from the burning, which we have yet fully to describe, through the whole catalogue or terms vainly used to convey some idea of variety in torture. Except the darting pain, that which most men call aching pain is the most common.

Long after every other trace of the effects of a wound has gone, these neuralgic symptoms are apt to linger, and too many carry with them throughout long years this final reminder or the battlefield. Neuralgic pain from wounds has received more attention than most or the minor results of gunshot injuries. Moreover, its treatment and symptoms differ so little in most respects from those of the neuralgias met with in civil practice, that it would be treading on old ground were we to venture upon its lengthened study here. We shall, therefore, adhere to the rule which has governed us throughout, and only treat fully of points which are novel, or upon which our own clinical experience enables us to cast a clearer light.

For these very reasons we have here set apart for distinct consideration that kind of pain which we have before spoken of as burning pain. It is a form of suffering as yet Undescribed, and so frequent and terrible as to demand from us the fullest description. In our early experience of nerve wounds, we met with a small number of men who were suffering from a pain which they described as a "burning," or as "mustard red hot," or as "a red-hot file rasping the skin." In all of these patients, and in many later cases, this pain was an associate of the glossy skin previously described. In fact, this state of skin never existed without burning pain.

Recently we have seen numbers of men who had burning pain without glossy skin, and in some we have seen this latter condition commencing. The burning comes first, the skin change afterward; but in no case of great depravity in the nutrient condition of the skin have we failed to meet with it, and that in its forms of almost unendurable anguish. The terms here used may seem strong to those who have not encountered these cases; but no one who has seen them will think that, as regards some of them, it would be possible to overstate their most wretched condition.

We have some doubt as to whether this form of pain ever originates at the moment of the wounding; but we have been so informed as regards two or three cases. (see Case 22.) Certain it is that, as a rule, the burning arises later, but almost always during the healing of the wound. Of the special cause which provokes it, we know nothing, except that it has sometimes followed the transfer of pathological changes from a wounded nerve to unwounded nerves, and has

then been felt in their distribution, so that we do not need a direct wound to bring it about.

The seat or burning pain is very various; but it never attacks the trunk, rarely the arm or thigh, and not often the forearm or leg.



FIG.1. Silas Weir Mitchell (1829-1914)

Its favorite site is the foot or hand. In these parts it is to be found most often where the nutritive skin changes are met with; that is to say, on the palm of the hand, or palmar face of the fingers, and on the dorsum or the foot: scarcely ever on the sole of the foot or the back or the hand. Where it first existed in the whole foot or hand, it always remained last in the parts above referred to, as its favorite seats.

The great mass or sufferers described this pain as superficial, but others said it was also in the joints, and deep in the palm. If it lasted long, it was referred finally to the skin alone.

Its intensity varies from the most trivial burning to a state of torture, which can hardly be credited, but which reacts on the whole economy, until the general health is seriously affected.

The part itself is not alone subject to an intense burning sensation, but becomes exquisitely hyperasthetic, so that a touch or a tap of the finger increased the pain. Exposure to the air is avoided by the patient with care which seems absurd, and most of the bad cases keep the hand constantly wet, finding relief in the moisture

rather than in the coolness of the application. Two of these sufferers carried a bottle of water and a sponge, and never permitted the part to become dry for a moment.

As the pain increases, the general sympathy becomes more marked. The temper changes and grows irritable, the face becomes anxious, and has a look of weariness and suffering. The sleep is restless, and the constitutional condition, reacting on the wounded limb, exasperates the hyperaesthetic state, so that the rattling of a newspaper, a breath of air, another's step across the ward, the vibrations caused by a military band, or the shock of the feet in walking, give rise to increase of pain. At last the patient grows hysterical, if we may use the only term which covers the facts. He walks carefully, carries the limb tenderly with the sound hand, is tremulous, nervous, and has all kinds of expedients for lessening his pain. In two cases at least, the skin of the entire body became hyperaesthetic when dry, and the men found some ease from pouring water into their boots. They said, when questioned, that it made walking hurt less; but how or why, unless by diminishing vibration, we cannot explain. One of these men went so far as to wet the sound hand when he was obliged to touch the other, and insisted that the observer should also wet his hand before touching him, complaining that dry touch always exasperated his pain.*

Since the above was written, the advance of General Grant has filled our wards with recent nerve wounds, among whom are several cases of burning. One of them is a mere lad, whose repetition of all the peculiar and singular statements of older sufferers is a strong confirmation of the truth of their complaints. As the present case had never been in a hospital before, and as when he entered our wards there were no marked cases of burning, he could have had no previous chance of acquiring knowledge sufficient to enable him to repeat in detail every singularity of our former cases.

Cold weather usually eased these pains; heat and the hanging down of the limb made them worse. Motion of the part was unendurable in some of the very worst cases; but, for the most part, it did no harm, unless so excessive as to flush the injured region.

The relations of burning pain to altered nutrition have already received attention from us. It appears quite certain that in cases of glossy skin, burning always exists. It is also certain that it may exist without association with diseased skin; but that in these instances the evidences of depraved nutrient states will be very likely to follow upon the pain, should that symptom last very long. The temperature of the burning part we have always found to be higher than that of surrounding parts, sr. than that of corresponding points on the other half of the body.

The rationale of the production of this form of pain was at first sought for among reflex phenomena. It then seemed to us probable that a traumatic irritation existing in some part of a nerve trunk was simply referred by the mind to the extreme distribution of this nerve, agreeably to the well known law of the reference of sensations. Further study led us to suspect that the irritation of a nerve, at the point of wound might give rise to changes in the circulation and nutrition of parts in its distribution, and that these alterations might be themselves of a pain-producing nature. The following considerations tend to strengthen the view, that the immediate cause of burning pain lies in the part where the burning is felt.

If the burning were a referred sensation it would sometimes be met with in cases of complete division of nerves, and, therefore, in parts devoid of tactile sensation. But we have encountered no such cases; and, on the other hand, the burning pain is often accompanied with hyperaesthesia, while motion and touch may remain unaltered. Is it not probable that the depraved nutrition, often so marked in the congested, denuded, and altered skin, may give rise to a disease of the ultimate fibres of the sensitive nerves?

Just such a pain comes when we attack the cut is with irritants; and, let us add, that the agents which help these cases of burning are those addressed to the spot where the pain is felt, and not to the cicatrix.

We have again and again been urged by patients to amputate the suffering limb. Were such a step needed, -and we know of one case, not treated by us, in which the sufferings observed might justify it, -the above considerations would demand attention, since if the real cause of the burning be in the cicatrix, it would be in vain to amputate a member while the scar lies beyond it in a part like the neck, which could not be attacked by the knife of the surgeon.

We feel that we may be supposed to have exaggerated somewhat in delineating these hitherto undescribed neural disorders. Surgeons who have happened to encounter a single one of the worst of them, have been so surprised at the character of the suffering as to suspect that such extreme hyperaesthesia must be due, at least in some measure, to a desire on the part of the patient to magnify his pains. In answer to this we have only to ask attention to the details of the cases which we have added to the chapter on altered nutrition and to this present section of our essay.

We infer from all that we have here tried to prove, that the skin, like the muscles, has its nerves of specific function and its nutrient nerves, and that disorders of the latter may occasion extensive changes in the cuticle; that these changes are often associated with what seems to be a disease of the ultimate extremities of the nerves of pain which gives occasion to the hyperrsthesia and to the violent burning which we have described.

Duration. Many cases of burning pain last but a few weeks; when associated with diseased skin, they are very enduring. We have seen one instance in which the pain had existed for twenty-one months.

If we be not mistaken, this form of neuralgia is hitherto undescribed. Perhaps no pen can do it justice without the more life-like details of cases. We beg to refer the reader to Cases Nos. 18, 20, 21, and 22, to the following case, and, finally, to that of Marks, No.31, which we have appended to the chapter on treatment.

Injury of Brachial Nerves, Resulting in Nutritive Changes and in Burning and Neuralgic Pains

CASE 24. Hiram Weston, aet. 42, Co. E, 18th Mass., enlisted May, 1861. Healthy until wounded, in the Wilderness, May 5, 1864. He was moving at a double quick, and was shot in the left arm. The ball entered three and a half inches immediately above the internal condyle of the humerus. It emerged directly below the anterior angle of the axilla, two and a half inches lower. The ball passed over the nerves, and injured the ulnar nerve especially.

He felt violent pain throughout the limb, which was instantly flexed at every joint, and so continued for fifteen minutes, when it was extended by the aid of the other hand. The pain which then began has never left him. The arm soon lost motion entirely; but within a few days regained so much as it has now. As to sensation, he can tell us nothing, except that probably it was only damaged in the ulnar range of nerve supply.

Present state. It is now fifty days (June) since this man was shot. Of the intervening period, he gives a very clear account. Immediately after the wounding, the whole limb swelled; but this rapidly subsided, and the hand was no larger than its fellow, until about the fortieth day, when it became rapidly edematous. The pain has consisted all along of darting pangs from below or under the elbow, down into the hand, but not in the anterior surface of the forearm. In the hand, the pain is burning and tingling, or, as he phrases it, "prinkling." It is intense, and is increasing. It is worse in daytime and in hot

weather, and when the hand hangs down. Noise and excitement increase it; but it has not reached the state of hyperaesthesia to which it is certainly hastening. The burning lies in the whole or the fingers, back and front, except the little finger, which is devoid of sensation; but it is worst in the palm. The entire hand is sore to touch everywhere; but tact is unimpaired, save in the little finger and ulnar side or the third finger. The burning pain certainly dates back to the moment of the wounding. The nutritive changes did not become well marked until about the forty-fifth day; they are now obvious, and in time will no doubt give rise to the glossy skin, to which we have so often referred.

The hand is swollen. The palm is red and dotted with patches of thickened epithelium. The redness is limited sharply at the borders of the palm in some places, and especially between the fingers. It occupies their palmar face alone, extending halfway round each finger, excepting the fourth only. The junctions of the fingers and the crease at the base of the thumb are ulcerated, and in two places there is pus under the palmar cuticle. The nails are laterally much arched, the skin at their bases is retracted, and at their extremities the line of union with the skin is deeply notched. The back of the hand is eczematous, and mottled in tint. The joints are exquisitely tender, and very stiff and swollen. The patient has kept the hand wet ever since he was hurt. Are any of the phenomena caused by the prolonged humidity? Perhaps the eruptions may be due to it; and even as to this there may be doubts. All the other symptoms have been seen repeatedly in cases which had never used water at all.

Tactile sensation is perfect throughout the hand, except in the fourth finger and the ulnar side of the third.

This patient is now undergoing a course of blisters. His case has been given thus unfinished, because it shows the relation of the nutritive changes and the burning pain, and because of the exemption from burning or parts in which sensibility was lost. Were the burning a reflex sensation, having its sole cause in the wound itself and merely referred, in obedience to a well-known law, to the distal distribution of the nerves implicated, we should have been as likely to find it in this case in the ulnar distribution as elsewhere. We have said nothing, in stating the case, of the amount of motion possessed by the patient. In fact, all movement was so painful that it was impossible to prevail on the man to use such voluntary power as he really enjoyed.

CASE25. Jos. H. Corliss, late private Co. B, 14th N. Y. S. M., aet. 27, shingle dresser, enlisted April, 1861, in good health. At the second Bull Run battle, August 29, 1862, he was shot in the left arm, three inches directly above the internal condyle. The ball emerged one and a quarter inches higher, through the belly or the biceps, without touching the artery, but with injury to the median and ulnar nerves. He was ramming a cartridge when hit, and "thought he was struck on the crazy-bone by some of the boys, for a joke." The fingers of both hands

flexed and grasped the ramrod and gun tightly. Bringing the right hand, still clutching the ramrod, to the left elbow, he felt the blood, and knew he was wounded. He then shook the ramrod from his grasp, with a strong effort, and unloosened with the freed hand the tight grip of the left hand on the gun. After walking some twenty paces, he fell from loss of blood, but still conscious; attempted to walk several times, and as often failed. He was finally helped to the rear, taken prisoner, lay three days on the field without food, but with enough of water to drink, and had his wounds dressed for the first time on the fourth day, at Fairfax Court House.

On the second day the pain began. It was burning and darting. He states that at this time sensation was lost or lessened in the limb, and that paralysis of motion came on in the hand and fore-arm. His statement is unsatisfactory and indistinct. Admitted to the Douglas Hospital, Washington, D.C., September 7, 1862. The pain was so severe that a touch anywhere, or shaking the bed, or a heavy step, caused it to increase. The suffering was in the median and ulnar distribution, especially at the palmar face of the knuckles and the ball of the thumb. Motion has varied little since the wound, and as to sensation he is not clear.

Peter Pineo, Surgeon U. S. V., now Medical Inspector U.S.A., excised two or three inches of the median nerve at the wound. (See Army Medical Museum, Specimen No. 959.) The man states, very positively, that the pain in the median distribution did not cease, nor immediately lessen, but that he became more sensitive, so that even the rattling of a paper caused extreme suffering. He "thinks he was not himself" for a day or two after the operation. It seems quite certain that the pain afterward gradually grew better, both in the ulnar and the median tracts. Meanwhile the hand lay over his chest, and the fingers, flexing, became stiff in this position.

About a week after he was shot, the right arm grew weak, and finally so feeble that he could not feed himself. He can now, April, 1864, use it pretty well, but it is manifestly less strong than the other. The left leg also was weakened, but when this began he cannot tell. He gives the usual account of the pain, and of the use of water on the hands and in his boots, as a means of easing it.

Present condition, April 21, 1864. Wound healed. Cicatrix of the operation two and a half inches long over median nerve. The forearm muscles do not seem to be greatly wasted. The interosseal muscles and hypothenar group are much atrophied, and the hand is thin and bony. The thenar muscles are partially wasted.

The skin on the palm is eczematous, thin, red, and shining. The second and third phalanges or the fingers are flexed and stiff; the first is extended. Nails extraordinarily curved, laterally and longitudinally, except that of the thumb.

Pain is stated to exist still in the median distribution, but much less than in the ulnar tract, where it is excessively great. He keeps his hand wrapped in rags, wetted with cold water, and covered with oiled silk, and even tucks the rag carefully under the flexed finger tips. Moisture is more essential than cold. Friction outside of the clothes, at any point of the entire surface, "shoots" into the hand, increasing the burning in the median, sometimes, and more commonly, in the ulnar distribution. Deep pressure on the muscles has a like effect, and he will allow no one to touch his skin with a dry hand, and even then is careful to exact a tender manipulation. He keeps a bottle of water about him, and carries a wet sponge in the right hand. This hand he wets always before he handles anything: used dry, it hurts the other limb. At one time, when the suffering was severe, he poured water into his boots, he says, to lessen the pain which dry touch or friction causes in the injured hand. So cautious was he about exposing the sore hand, that it was impossible thoroughly to examine it; but it was clear to us that there was sensibility to touch in the ultimate median distribution, although he describes sensation as somewhat lessened in this region, and states that he has numbness on the inner side of the palm, and in the third and fourth fingers (ulnar tract).

When the balls of the first and second fingers were touched, he said he felt it; but, on touching those of the third and fourth fingers, he refused to permit us to experiment further, and insisted on wrapping up and wetting the hand. He thus describes the pain at its height: "It is as if a rough bar of iron were thrust to and fro through the knuckles, a red-hot iron placed at the junction of the palm and thenar eminence, with a heavy weight on it, and the skin was being rasped off his finger ends."

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