“TRANSIENT PARAPLEGIA FROM SHELL EXPLOSIONS.”

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AMONG the injuries caused by high shell explosions in the present campaign on the Continent is a form of transient paraplegia, which has already led to mistakes in diagnosis in its early stages, and which will be still more difficult to recognize in the men who are invalided home with only the history that they can give as a guide to a correct opinion.

The chief features of the condition are as follows: Numbness and complete paralysis of the legs are complained of when the injured man receives help from his comrades immediately after the explosion, and yet there is no manifest wound of the body. The arms are generally unaffected, but the legs remain powerless, so that the patient has to be carried from the field on a stretcher. Within a week movement and sensation are returning in the legs, and after the lapse of a fortnight the soldier as a rule can walk about again, though he continues to complain of extreme tenderness in the lumbar region, and aching pains that shoot up the back. There is rarely any trouble with the sphincters. During the paralysis the leg muscles are slightly flaccid, and both the superficial and deep reflexes are depressed, while there is nearly always an area of hyperalgesia encircling the abdomen above or below the level of the umbilicus. The plantar reflex is never extensor.

The slightness of the objective signs and the prominence of the subjective features of pain and tenderness, especially in the lumbar spine, lead naturally to the belief that the paraplegia was functional and the residual tenderness is neurasthenic. That diagnosis is often made, and it is the most likely one to be chosen when the invalided man is first met with in England. In some cases it is undoubtedly correct, for hysterical and neurasthenic breakdowns are frequently met with in men who have been exposed to the shattering effects of the great German shells. An example of this nature is quoted later to illustrate the points of distinction between the true and the functional paraplegia.

A second diagnosis that is tentatively made at times is that of “gassing,” which ascribes the weakness to a toxic action of the fumes evolved in the explosion. The bursting of these large shells is accompanied by a dense cloud of dark smoke, which may completely blacken the faces of those who are nearly exposed to it. A crater is formed in the earth 10 ft. to 25 ft. across and from 5 ft. to 10 ft. deep. The soil from this is thrown up more or less in a fine spray, so that it does not crush or bury those standing near to it. But when the shell explodes by the side of a deeply cut trench its commotion drives inwards the sides of the latter, and thus buries alive or crushes the men who were hoping for shelter within it. Death or direct injury may be caused in this way. “Gassing” would be expected to produce unconsciousness, followed by headache, giddiness, and a weakness or peripheral neuritis of general distribution. I have not heard any suggestion made by men returning from the trenches that they have suffered in this way from the German shell fire, and the explanation cannot be applied to the type of injury with which this account deals. The first example quoted is typical of the group:

CASE I.

No. 2047. Reservist, aged 34, in 1st Battalion King's Royal Rifles; a well developed man, who had formerly been army instructor in gymnastics.

October 30th. He was in a narrow trench and sitting, with bent back and legs fully extended, in his “dug out,” a small recess excavated under the earth backward from the trench, but not timbered, as a protection against shrapnel. At 8 a.m. a “Black Maria” burst on the trench and covered him up to the chin in heavy, clayish soil. His comrades quickly built up the breach in front of the trench, and then dug him out, some twenty minutes after the explosion. His legs were powerless and numb, and he felt sick but did not vomit. There was no smell of gas about, and he did not feel dizzy or troubled in the head. He had no pain in the small of the back. When darkness came he was removed on a stretcher to the field hospital, and he arrived thence at the base hospital on November 3rd. There had been no difficulty with micturition.

November 4th. Power beginning to return in the legs.

November 6th. Examined. Slight movement in knees, ankles, and toes. Muscles somewhat atonic, and passive movements of the legs caused much pain in the small of the back. Knee jerks and ankle-jerks were weak, especially on the left side. Both plantars flexor. Left cremasteric reflex weaker than right. Left leg a little more numb than right, but impairment of sensation only slight. Left lower abdominal reflex lost. Band of hyperalgesia over left side of abdomen below umbilicus (eleventh and twelfth thoracic segments), especially to painful pin scratch and to deep pressure. On the right side this hyperalgesia was present to a much less degree. On the back there was slight discoloration of the skin from deep bruising over an area from the eighth thoracic to the second lumbar vertebrae. The spines of the tenth and eleventh thoracic vertebrae were acutely tender when pressed upon, and the pains radiated widely up and down the back.

November 12th. He could move both legs fairly well, but was unable to raise them from the bed with knees extended. The legs could not bear the weight of the body in attempted walking. Reflexes still slightly depressed. Slight hyperalgesia of left side above Poupart's ligament, and an area of slight skin numbness over the front of the thigh below the anterior inferior iliac spine (first lumbar). No localized tenderness over the vertebrae, but only diffuse pain on deep pressure.

It is easy to picture what happened to this soldier. Sitting with bent back in his shelter, he received on his body the violent impact of the mass of earth that was pushed laterally from the crater excavated by the bursting of the shell. The vertebral column was forcibly flexed, its ligaments stretched, and haemorrhages produced in the great muscles of the back. The spinal cord itself received transitory damage at the usual weak spot of greatest bending, near the twelfth thoracic vertebra, and the roots of the cauda equina were probably injured in their passage through the vertebral foramina.

Similar injuries are met with in pit accidents at home, where a fall of stone and earth from the roof may break a man's back or cause only a moderate paraplegia by contusion; and the less severe cases of such injury in the pits are notoriously difficult to distinguish from those of neurasthenic or deliberate simulation.

The next example was of a more severe and fatal nature.

CASE II.

November 1st. Buried beneath earth by the explosion of a “Black Maria.” When dug out his legs were numb and powerless.

November 5th. Examined at base hospital. He was too ill to give a connected account of his accident, but he was positive that subsequently to it he had passed no water. Bladder not distended. Legs flaccid and almost completely paralysed. All reflexes obtained, though feebly. Abdomen immobile, slightly tender, and the seat of continual pain. The patient's blanched appearance suggested internal haemorrhage, and consequently the abdomen was opened, but only a little blood-stained fluid was revealed.

November 6th. Died. At autopsy the right clavicle and the symphysis pubis were found to be smashed. The right lung, the right kidney, and the hepatic flexure of the colon were deeply bruised. Complete reflex anuria had resulted from the damage to the kidney. The erector spinae muscles were deeply infiltrated with blood right down to the sacral spines, but there was no actual deformity of the vertebral column, and the spinal cord appeared to be quite normal. The roots of the cauda equina were not examined.

The next example was intermediate in its severity between (1) and (2). An arm was involved in the paralysis as well as the legs, and the eruption of a small crop of herpetic vesicles showed that there was injury, probably a haemorrhage, of the posterior root ganglia of the cauda equina. Yet even in this case there was a strong inclination on the part of those in medical control of the patient to regard the phenomena as chiefly hysterical.

CASE III.

No. 5492. Sergeant in the 20th Hussars.

November 1st. In company with other dismounted cavalrymen he was chasing some Germans with the bayonet over turnip fields that were being pitted in all directions by fire from high explosive shells. This was at 9 a.m. on Sunday morning. He next found himself alone in a small house in a neighbouring village, to which his comrades must have carried him while in a state of unconsciousness. His face was blackened with smoke, and his clothes were covered and filled with soil. The bottom of his haversack had been torn off, which led him to imagine that he had been struck by some missile in the back. There was, however, no wound nor sign of bruising. His left arm was weak, and his legs powerless and numb. After staying in this house some time he was found by a scouting party of English, and at sunset was removed to a field hospital. That night the passage of water caused him pain, but there was no blood in the urine and no haemoptysis.

November 6th. Examined at base hospital. Legs completely paralysed and very numb. Knee-jerk and ankle-jerk obtained

only on right side and with difficulty. Both cremasteric reflexes weak. Pain felt in back on passive movement of legs, which were moderately flaccid. Zone of hyperalgesia around body on both sides just above Poupart's ligament, but most acute on the left side. Lower abdominals weakened on left side. Pain felt in lower part of the abdomen when bladder was full and at the onset of micturition, but no pain in penis. Pain and paresis of left arm but no numbness. Tenderness on pressure over lumbar and cervical vertebral spines. No bruising seen.

November 9th. Arm movements much freer. Can move right toes.

November 12th. Arm fairly powerful, and legs much stronger for movements at all joints. Still has pain with full bladder. Cannot quite stand or walk on legs. Three herpetic blisters on skin of left thigh from 3 to 6 in. above the knee (second or third lumbar segment). Hyperalgesia now only on left side of abdomen above Poupart's ligament. Legs still numb, so that the patient is completely unable to appreciate the position of the joints in passive movements. Movements of wider range still caused severe pain in the small of the back.

The final example is one of hysterical simulation of the true paraplegia, which can be at once recognized by the state of the deep reflexes, and a definite prognosis consequently given of the speedy recovery which will emphasize the distinction between it and the more prolonged results of real injury. Functional disorders of the nervous system are far from rare in the fright caused by a big shell explosion, and they assume very diverse forms. The man may become blind, or deaf, or dumb; he may be seized by a violent and coarse tremor that shakes his body for days; or he may be paralysed with a hemiplegia or paraplegia.

CASE IV.

No. 10348. 2nd Welsh Fusiliers.

November 4th. Was in the trenches when a large shell burst and killed the man next to him. He himself was not covered by soil, but he lost consciousness, according to his own statement, and afterwards was paralysed in the legs.

November 7th. Examined at base hospital. Legs incapable of movement, but not atonic. Deep and superficial reflexes all increased. No definite zone of hyperalgesia on the trunk. Headache and pains in the back of the neck. Hands tremulous.

November 9th. Up and walking about freely. Practically well.

Diagnosis is, therefore, easy in the first or second week after the injury. The functional paralysis reveals itself by an increase of tone in the leg muscles and by exaggeration of the knee and ankle jerks, with a tendency to clonic or coarse tremors. Tenderness and pain may be complained of, but they are felt all over the back, and not localized to the area from which spring the nerves that supply the paralysed limbs. Organic damage, on the other hand, depresses all the reflexes and lowers the tone of the muscles. There is generally a band of hyperalgesia at the upper limit of the area of numbness, and the back is acutely tender, but only over the corresponding spines. The worst cases may conceivably show change of electrical reaction, and subsequent wasting of muscles, but I have not been able to examine this point. Nor have the men been sufficiently long in France to follow the later history of their recovery.

The evidence is insufficient to determine whether the injury was confined to the spinal nerve roots, or whether it affected the lower segment of the cord itself. The absence of an extensor response and the freedom from paralysis of the bladder suggest that the cord was not injured. In Case III the outbreak of herpetic vesicles on one side made it certain that the posterior root ganglia were injured, and this would be at a level some inches below the corresponding part of the lumbar cord. On the other hand, the band of hyperalgesia around the body tends to support damage of the cord itself. But the lack of symmetry in the interference with function, and the fact that the hyperalgesia persisted much longer on one side than on the other, while it was in Case I associated with a unilateral root area of actual skin numbness, are all in favour of the view that the injury is one of the spinal nerve roots, perhaps as they pass through the foramina rather than while they lie free in the cauda. Damage of this character would explain the escape of the bladder, since its motor and sensory nerves pass by the sheltered second sacral roots.

The pain before micturition, which was complained of by Case III, is of interest in this respect. It was felt vaguely in the lower part of the abdomen as the result of a full bladder—that is, in the region of the hyperalgesic lumbar nerves. There was no pain in the penis, such as would have been expected with hyperalgesia of the sacral

nerves. It further shows that the hyperalgesia affects the visceral as well as the ordinary nerves of the trunk.

Lumbar puncture was not made to ascertain whether haemorrhage had occurred around the spinal cord. There was no obvious bleeding either within or without the spinal cord in the single case examined *post mortem*.

However, the distinction between damage of the spinal roots and of the cord itself is one of no great practical importance. The cases recover. But the clinical diagnosis of injury is important, for it is only fair to the injured men that they should not be classed with the neurasthenic or hysterical.

ANTISEPTICS IN WAR.

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ALL my experience in South Africa made me confident that wounds ought to receive efficient disinfectant treatment as soon as possible after their infliction and that they should not be treated only by the application of an antiseptic dressing.

That was the conception of Lord Lister, who gave me a supply of double cyanide of zinc and mercury to be used as a powder on the field. I found powder impracticable; wind and rain prevented it from reaching the wounds and its application to the under surfaces of parts was impossible without turning over the patient or limb. Hence I made the powder into a paste by mixing it with 1 in 20 carbolic acid and used it with complete success in many minor fights. The wounds healed beneath a mixture of paste and blood clots were beautiful to see. The surrounding skin was also well treated with the paste and retained its position for days. The dye with which the powder is stained acts as a mordant, and by it the chemicals are more firmly fixed in the tissues.

On my return I placed the paste into the collapsible tubes from which artists squeeze their paints. Although no oil and no fatty substance was inserted into the tubes I am describing, the paste remains to-day of the same consistency as it did fourteen years ago. The tubes have not been altered by the contained chemical.

Personally I am very sorry to see that our troops are being supplied with iodine solution as a disinfectant. Many wounds have arrived in this country in a disgraceful condition after the early application of iodine. I believe that iodine has proved a failure in treating large wounds.

Since being at Haslar I have made perfect—at least from my point of view—a better solution than iodine. It is a mixture of 1 in 20 carbolic acid and 1 in 500 mercury perchloride in absolute alcohol. It is coloured with rosaline. The value of this combination is as follows: 1 in 20 carbolic acid is a solvent of fat as well as a germicide. Mercury perchloride is a most powerful germicide. Rosaline has an important action in being a mordant. Wherever the dye is seen mercury perchloride is present even weeks after application. Alcohol dries sooner than water, it does not macerate the tissues so much, and it appears to encourage greater penetration of the antiseptic. No case has suffered from mercurial or carbolic acid poisoning, although it has been applied frequently and freely to large granulating wounds.

If a solution is to be carried by the soldier, this would be better than a solution of iodine. It is more efficient and absolutely non-irritating, and can be applied safely to the scrotum, eyelid, and other parts liable to show the results of irritants. Pure carbolic acid cannot be applied to skin, and there is every reason to be convinced that, in a wound splashed with mud, the mud and the bacteria it contains are also on the surrounding skin. A friend of mine here blistered his skin with pure carbolic acid, although it was at once washed off with spirit. I have seen cases become infected with *B. pyocyaneus*, although washed with saline solution and hydrogen peroxide. The *B. pyocyaneus* at once disappeared on the application of 1 in 2,000 mercury perchloride, or on the application of the rosaline solution I have described in this article. I do not like the constant application of hydrogen peroxide to wounds; the granulation tissue under its influence becomes anæmic and swollen. It may have its uses in removing blood clot and sloughs, but that is another matter.