

GUNSHOT INJURIES OF THE SPINAL CORD

A PRELIMINARY REPORT UPON FIVE CASES

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THE following cases of gunshot injuries of the spinal cord were observed at the Hospital of the American Ambulance in Paris during the autumn of 1914.

CASE I.—J. G., aged twenty-three. On September 22 at 6 A.M., the patient was standing in an open field, clad in uniform and great coat. He heard a rifle report and at once felt a sharp, cold sensation in his legs. He fell upon his face and was not able to move his legs or arms. After ten hours he was removed from the field. He became incontinent of urine and feces. He was catheterized for the first time, four days after his injury.

On September 27 he was admitted to the American Ambulance in Paris.

On October 2 slight power of sensation was noted over the left leg. Complete motor paralysis of both lower extremities.

On October 14 slight sensation was elicited over the outer aspect of the left thigh to the knee, otherwise there was complete sensory paralysis of both lower extremities up to the level of the anterior superior spines of the ilia. Very slight power of contraction of left psoas muscle, otherwise complete motor paralysis of both lower extremities. Flaccid paralysis of bladder. Paralysis of anal sphincter and rectum. Reddening of skin over lower sacrum, otherwise no trophic disturbances.

There is a small circular healed wound of entrance in the left flank, 5 cm. from the vertebral column, and on the level of the twelfth dorsal vertebra.

The X-ray (Figs. 1 and 2) shows a rifle bullet at the lower level of the twelfth dorsal vertebra, lying directly in the spinal canal, with its base against the anterior wall of the canal, its point directed backward and slightly downward and to the left. Apparently the bullet was deflected, by the body of the twelfth dorsal vertebra, more than a right angle from its original course.

Operation (October 16).—Under ether anæsthesia, an incision 10 cm. in length was made between the tenth dorsal and fourth lumbar vertebræ, just to the left of the midline of the back, and carried in depth to the deep lumbar fascia. This fascia was then divided in the same line, and the erector and multifidus spinæ

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muscles freed from the spinous processes and laminae of the included vertebrae on the left side of the spine, and retracted laterally. The point of the bullet was readily discovered between the laminae of the twelfth dorsal and first lumbar vertebrae, and the extraction of the bullet by means of a dressing forceps was a simple matter. The space occupied by the bullet led down to the right side of the dura, where compression of the cord must necessarily have existed. The dura appeared to be intact, so no further exploration was attempted. Several small fragments of loose bone from the lamina of the twelfth dorsal vertebra were extracted. The muscles were allowed to fall back into place and sutured to the periosteum of the spinous processes with interrupted chromic gut, a gauze drain being inserted down to bone in the middle of the wound. The fascia was closed in a similar manner, the skin with interrupted silkworm-gut.

October 17: Skin over lower sacrum, 5 cm. in diameter, broken down. Gauze drain removed from wound.

Subsequent Course.—The wound healed by primary union. During the first week after operation, there was a slight return of sensation in both thighs down to the knees. There was also a slight return of muscular power in the flexors of the hip-joint, more especially on the right side, so that the patient could raise his right knee from the bed. From that time on the improvement was very gradual. The last examination made by Dr. Craig on November 15, a month after operation, showed a complete flaccid paralysis of both legs, neither flexion nor extension of the feet being possible. The calves are atrophic. The thighs are weak, but when the legs are passively extended or flexed they can be moved weakly in the opposite direction. The power of the adductors is very good. Reflexes in knees and ankles absent. No plantar response. Sense of position lost in right ankle and toes of both feet, but preserved in left ankle. There is a slight return of sensation in both bladder and rectum, but no return of control. The sacral bed-sore has not extended, but remains unhealed.

CASE II.—J. A., aged thirty-one. On October 6 at 3 p.m., near Arras, the patient was lying face downward in a field, clad in his uniform and great coat. He suddenly felt a sharp stinging sensation in the back, but heard no sound. He immediately lost all sensation in his lower extremities, and was unable to move them. He lay there until 9 p.m. when he was moved to the rear. He was catheterized that night.

On October 15 he was admitted to the American Ambulance in Paris.

On October 16 examination showed marked œdema and ecchy-

mosis of the skin of the back. No point of tenderness or deformity made out along the spine. There was a small circular wound of entry posterior to the angle of the left scapula. Complete motor and sensory paralysis below the waist, with an absence of reflexes. Fecal incontinence and a greatly distended bladder, containing thirty-two ounces of urine.

On October 17 examination elicited very slight sensation along the outer aspect of the right thigh to the knee, and along the lower half of the inner aspect of the same thigh.

The X-ray (Fig. 3) showed a bullet with its base imbedded in the intervertebral disc between the first and second lumbar vertebræ, and its point directed upward and backward and to the right. The bullet had evidently crossed the canal from left to right, and had been deflected more than a right angle in two planes of its course. An exploration of its course was deemed advisable.

Operation (October 18).—Under chloroform and ether anæsthesia, an incision 15 cm. in length was made between the tenth dorsal and fifth lumbar vertebræ, just to the left of the midline of the back, and carried in depth through the deep lumbar fascia. The muscles on the left side of the spine were stripped from their attachments to the spinous and transverse processes along the whole length of the incision, and retracted laterally. The left transverse process of the twelfth dorsal vertebra was found to be fractured, as well as the body of the first lumbar vertebra. On following the bullet sinus from this point downward and to the right, the dura was found to be in shreds, and the cord divided except for a few nerve filaments. Several small bone fragments were removed from the spinal canal. The bullet had apparently passed from this point in a downward direction, and from left to right, through the posterior portions of the bodies of the first and second lumbar vertebræ. No effort was made to find the bullet. The muscle and fascia were closed with interrupted plain gut sutures, a gauze drain being introduced down to the bullet sinus. The skin was closed with interrupted silkworm-gut.

Subsequent Course.—Four hours after operation the patient's condition became very bad, and during the night he developed œdema of the lungs. Under forced stimulation his condition improved, and in twenty-four hours' time it became satisfactory. The wound became infected with the bacillus pyocyaneus, which yielded to treatment. He developed a large sacral bed-sore, and one over each trochanter. He also developed a cystitis, which improved under treatment.

An examination on November 8, three weeks after operation, showed a complete flaccid paralysis of both lower extremities, with an atrophy of all the muscle groups of the legs, thighs and

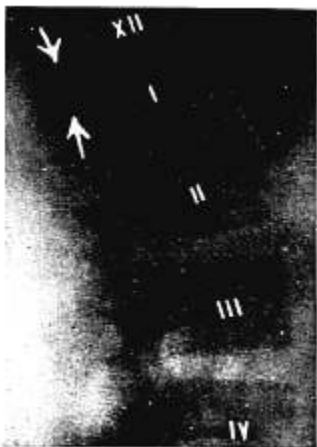


FIG. 1.—Case I. Lateral view. Rifle bullet penetrating spinal canal between the spines of the twelfth dorsal and the first lumbar vertebrae.

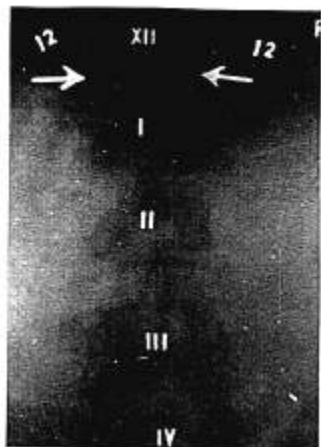


FIG. 2.—Case I (see Fig. 1). Anteroposterior view. Rifle bullet in spinal canal.

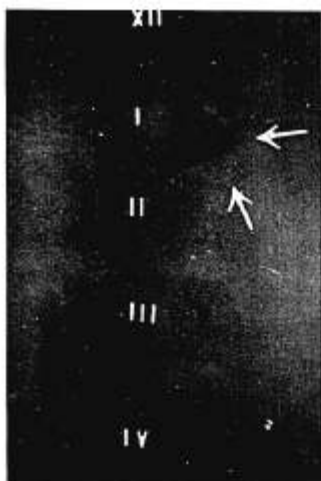


FIG. 3.—Case II. Rifle bullet in intervertebral disc between first and second lumbar vertebrae.

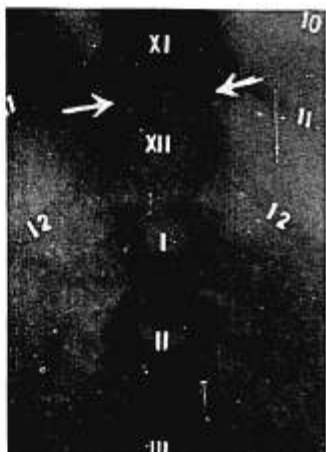


FIG. 4.—Case III. Anteroposterior view. Shrapnel ball in spinal canal between eleventh and twelfth dorsal vertebrae.

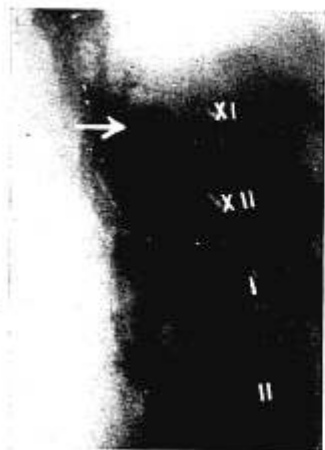


FIG. 5.—Case III. Lateral view. Shrapnel ball in spinal canal between eleventh and twelfth dorsal vertebrae.

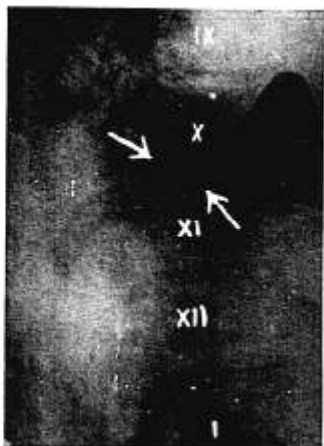


FIG. 6.—Case IV. Lateral view. Metal rivet imbedded in intervertebral disc between tenth and eleventh dorsal vertebrae.

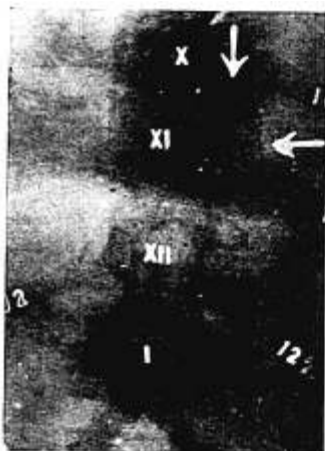


FIG. 7.—Case IV. Anteroposterior view. Metal rivet imbedded in intervertebral disc between the tenth and eleventh dorsal vertebrae.

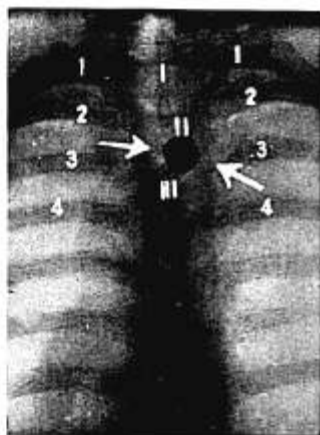


FIG. 8.—Case V. Anteroposterior view. Shrapnel ball in spinal canal at level of intervertebral disc between second and third dorsal vertebrae.

buttocks. He has irregular attacks of lancinating pain; beginning at both knees and extending to the waist. There is a complete absence of muscle sense in both lower extremities. All reflexes are abolished, and there are no pathological reflexes. Light tapping of the patella tendon is said to produce severe pain in the lumbar region. No improvement since operation.

CASE III.—A. L., aged twenty-seven. On October 9, at Lens, the patient was lying face downward in a field, when he heard an explosion and at the same time felt a hot sensation in his back. He remained on his face, with no sensation in his lower extremities, and unable to move them. After ten hours he was taken to the rear. He had incontinence of urine and fæces.

On October 29 he was admitted to the American Ambulance in Paris. There is a circular healed wound of entry, on a level with the tenth dorsal vertebra, over the posterior surface of the left chest wall. There is œdema of the soft tissues of the lower part of the back. The patient presents a complete flaccid paralysis of both lower extremities, with an absence of reflexes and loss of muscular sense. The epigastric reflexes are preserved, the other superficial reflexes are absent. There is considerable atrophy of the muscles of the thighs and buttocks. There is a paralysis of the bladder with retention, and a paralysis of the rectum. Over the sacrum and coccyx there is a bed-sore, measuring 10 cm. by 6 cm., over which the skin is gangrenous.

The X-ray (Figs. 4 and 5) shows a shrapnel ball lying entirely within the spinal canal, directly in the midline, and opposite the intervertebral disc between the eleventh and twelfth dorsal vertebrae. There is also a small piece of shrapnel under the skin on the level of the ninth dorsal vertebra.

Operation (November 1).—Hemilaminectomy. An incision 10 cm. in length was made between the eighth dorsal and first lumbar vertebrae, and the usual exposure gained to the left side of the spinal column. The lamina of the last dorsal vertebra was removed. Its upper border was found to be injured as well as the lower border of the eleventh; undoubtedly caused by the entrance of the ball into the spinal canal at this point. Careful probing did not divulge the location of the ball, so the lamina of the first lumbar vertebra was removed, but without success. Upon removal of the lamina of the eleventh dorsal vertebra, the ball was discovered lying opposite the intervertebral disc, between the eleventh and twelfth, and was easily removed. At the point where the bullet lay, the dura was badly lacerated, and the cord was of the consistency of pulp. Closure of muscle and fascia with interrupted plain gut, closure of skin with interrupted silkworm-gut. Gauze drain down to muscle.

Subsequent Course.—The wound healed by primary union. No improvement since operation, except that the bed-sore presents a clean granulating base.

CASE IV.—P. N., aged twenty-eight. On October 29 the patient was standing, when he heard an explosion nearby. He threw himself to the ground, and as he was falling, was struck. He experienced a dull, heavy sensation in the back, and lay on his face, unable to move his lower extremities. He was taken to the rear at once, and was not catheterized before his admission to the American Ambulance in Paris, forty-eight hours later.

October 31: There is a small irregular-shaped wound of entry in the left flank, on the level of the tenth dorsal vertebra, and 5 cm. from the midline. The patient presents a complete flaccid paralysis of both lower extremities, bladder and rectum. The sense of position is entirely absent, as are the knee and ankle reflexes. There is a slight dorsal extension of both great toes, on stroking the soles. There is a faint response also to Oppenheim's method.

The X-ray (Figs. 6 and 7) shows an oblong piece of metal at the level of the intervertebral disc between the tenth and eleventh dorsal vertebrae, directed downward, backward, and to the left, and encroaching upon the anterior portion of the spinal canal.

Operation (November 14).—Laminectomy. An incision 10 cm. in length was made between the ninth dorsal and third lumbar vertebrae, and carried through the deep lumbar fascia. Parallel longitudinal incisions were made through the muscles on either side of the spinous processes, and the muscles separated from the laminae and retracted laterally. The spinous processes of the twelfth dorsal and first lumbar vertebrae were divided, and the muscle-bone flap reflected downward. In the same way the spinous processes of the tenth and eleventh dorsal vertebrae were divided and a similar muscle-bone flap reflected upward. The laminae of the first lumbar and eleventh and twelfth dorsal vertebrae were removed, and the dura opened longitudinally. The cord was found to be partially severed opposite the eleventh dorsal vertebra, and from the mutilated portion of the cord several fragments of bone were extracted. A metal rivet, which was firmly imbedded in the intervertebral disc between the tenth and eleventh dorsal vertebrae, was removed. The dura was closed with continuous plain gut suture. The muscle-bone flaps were brought together with plain gut sutures, and sutured laterally to the muscle edges. A gauze drain was introduced down through the muscle. The lumbar fascia was closed with interrupted plain gut, and the skin with interrupted silkworm-gut.

Subsequent Course.—The wound healed by primary union. No improvement since operation.

Subsequent to the operation, the patient told us that at the time he was wounded, his bayonet, which was hanging from the left side of his belt, was smashed to pieces. It was, in all probability, a rivet from his bayonet which was driven into his spinal column.

CASE V.—J. B. V., aged twenty-six. On November 26 at 3 P.M., the patient was standing, when he felt a dull heavy blow, and was thrown down. He experienced at once a loss of sensation in both lower extremities, and was unable to move them. He was moved to the rear at 7.30 P.M.

On admission to the American Ambulance Hospital, on November 28, examination showed a circular wound just above the supero-internal angle of the left scapula. Complete sensory and motor paralysis of both lower extremities, with absence of reflexes. The loss of sensation extends upward to the level of the fifth dorsal vertebra. There is a flaccid paralysis of the bladder and fecal incontinence.

The X-ray (Fig. 8) shows a shrapnel ball lying completely within the spinal canal, slightly to the right of the median line, and at the level of the intervertebral disc between the second and third dorsal vertebrae. (The radiographic print showing the lateral view was too dark for reproduction.)

Operation (November 29).—Laminectomy. An incision 10 cm. in length was made down the midline of the back, with the second dorsal vertebra as a centre. The aponeurosis was opened to either side of the spinous processes, and the muscles stripped laterally from the spines and laminae. The spinous processes of the second and third dorsal vertebrae were removed. The ball was seen between the laminae of the second and third dorsal vertebrae on the right side. It was easily removed from the spinal canal, through the aperture which it had caused by fracture of the lamina of the right side of the second dorsal vertebra. The laminae of the third dorsal vertebra were removed, and a blood clot found and removed from around the dura. The dura was opened to the extent of 2.5 cm., exposing an oedematous arachnoid membrane. The cord itself did not appear to be damaged. The dura was left open, and the muscles and aponeurosis closed with interrupted plain gut sutures, and the skin with interrupted silk-worm-gut.

Subsequent Course.—On the sixth day some of the skin sutures in the middle of the wound were removed, and the wound spread open at this point. Several other sutures were taken to bring the edges together again. The patient's temperature remained between 100° and 102°, with no explanation. On December 9 an abscess was discovered in the left buttock, which was opened. The patient became very much worse and died the next day.

December 11: Autopsy:

Heart: Flabby. The pericardial cavity is filled with a small amount of cloudy, yellow fluid. The parietal pericardium shows numerous small ecchymoses, irregularly distributed. The tricuspid valve admits two finger tips.

The right auricle and ventricle contain clotted blood. The blood content is entirely out of proportion to the size of the heart. On aspirating blood for culture, numerous air bubbles come up with the fluid aspirated. The mitral valve admits two finger tips easily. The left ventricle contains clotted blood in small amount. Post-mortem thrombus in pulmonary vessels and aorta. Pulmonic valves intact.

Left lung: Dilated. The pleural cavity is normal. Ecchymoses are irregularly distributed throughout the entire left lung, most marked in the anterior lobe and over the posterior margin of the diaphragmatic surface. On section the pulmonary vessels are found filled with blood clots. On sectioning the lung there are areas which stand out very prominently. These are infiltrated with blood and deep bluish-black in color. They are present in the upper and lower lobes, with marked congestion and oedema of the lower lobe. Pulmonary thrombosis is present, leading down to consolidated areas. The bronchial glands are swollen and soft.

Right lung is voluminously distended. There are numerous areas of hemorrhagic consolidation. These areas are more marked in the lower lobe.

Tongue: Negative.

Tonsils: Slightly enlarged but otherwise normal.

Larynx and trachea: Catarrhal inflammation of the mucosa.

Thyroid gland: Enlarged, no struma.

Cervical glands: Enlarged.

Oesophagus: Normal.

Spleen: Greatly enlarged, soft, somewhat flabby. Weight, 380 gm. The notches stand out very prominently. Soft and very friable on section.

Suprarenals: Negative.

Right kidney: Large. The capsule strips very readily. The cortex is slightly congested and increased in size. The markings are somewhat pale and cloudy. The pelvis is thickened and injected.

Left kidney: Swollen and injected. The cortex is markedly congested. Small yellowish, circular areas, surrounded by reddish areolas, and coalescing in spots, are seen on section.

Ureters: The mucous membrane is injected, and there are marked inflammatory changes in the lower third.

Liver: Parenchymatous degeneration. Hemorrhagic infiltration of the periportal tissues.

Mesenteric glands: Enlarged.

Small intestine: There is slight congestion of the duodenum, and ulcerations of the jejunum and ileum. The follicles of the ileum stand out very prominently. The blood-vessels are markedly injected throughout the intestinal tract. Numerous areas of hemorrhage are present.

Large intestine: The walls are thickened.

Brain: On removal of the calvarium, the vessels of the scalp bleed profusely. The dural vessels are injected. The vessels of the pia contain

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numerous gas bubbles. The posterior cerebral fossa contains an increased amount of serosanguineous fluid.

Spinal cord: Removed.

A circular wound is present just above the supero-internal angle of the left scapula, which passes obliquely downward, inward, and slightly forward to the level of the second dorsal vertebra. The dura mater overlying this area is injected and surrounded by tissue filled with blood clots.

An area of discoloration, with a solution in the continuity of the skin, is to be seen over the left buttock. The buttock is markedly swollen, and on section reveals a track lined with necrotic, discolored tissue, which leads down to about the level of the ischial tuberosity of the left side, where an abscess cavity of the size of a small orange is found. This cavity contains a thick, chocolate-colored, grumous pus, and is lined by an area of bluish-black discolored muscle. The discoloration extends for the distance of 10 cm. in depth. The muscle of this area is dry, cloudy and somewhat discolored, giving the appearance of boiled beef.

The tissues over both heels are dry and bluish-black in color.

The cause of death was an infection from the bacillus *aërogenes capsulatus*, having its origin in the abscess in the buttock.

In reporting these cases, I am much indebted to Dr. Craig for his careful neurological examination of the patients and his advice at operation; to Dr. Jaugeas for his excellent radiographs; and to Dr. Jablons for his complete autopsy report.