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Original Articles.

LAMINECTOMY.

A FURTHER CONTRIBUTION.*

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BOSTON.

Five years ago, at the Columbus session of this Association, I reported 18 cases of laminectomy for various conditions. To these I can add twelve more operations, including two sections of the posterior cervical roots, five acute crushes, myeloma of the spine, a fracture of the odontoid process, etc. There is very little that is new that I can offer to-day, but there are, however, one or two suggestions that have come to me in studying my cases that I believe point to the possibility of the existence of certain clinical phenomena seen at operations, that have not been and probably can not be demonstrated in the laboratory nor on the cadaver. These observations, if accurately made, may help to settle the question of operative benefit *per se*, that has been so bitterly fought on the one side by the neurologist and on the other side by the surgeon. I still believe that a simple technic, as emphasized in my first paper, has much to do with the comparative harmlessness of the operation.

FRACTURE-DISLOCATIONS.

If we collect the various scattered cases that have been reported within the last few years, favorable results following operation come more and more into evidence. It is useless at this time to go into a discussion of the question as to the possibility of equally good results in corresponding cases treated conservatively. The partisans on both sides are still too unyielding in their views. Being a partisan on the side of interference, I merely wish to present, as fairly as I can, the question as it appears to me personally. Fractures in the lower dorsal and in the lumbar regions are especially open to surgical interference, because of the relative harmlessness of laminectomy and because there is no valid reason for not subjecting the elements of the cauda equina to the same operative relief as in the case of any peripheral nerve. In the cervical fractures, however, there is much greater risk to life, whether operation is done or not. In watching quite a considerable number of injuries at this level, in the last few years, not subject to operation, I have been impressed with the fact that they die a day or so earlier and that they suffer no less than similar patients who have had a laminectomy. In several instances it has been possi-

ble to watch the progress of two patients—one operated on, the other not—as nearly similar in injury, age and physical conditions as is possible, using one as a control experiment, as it were. This impression has not a scientific basis; it is merely the general impression of a partisan observing the cases in hopes of being convinced that he advocates interference unnecessarily.

In studying the cases of cervical and high dorsal injuries treated without operation at the Boston City Hospital within the last ten years, I found that, of 30 patients, only one lived and partially regained his functions; 24 died within eight days of injury. The remainder, not including the one recovery, lived from three weeks to five months. In that same period I have seen, at the same hospital, at least three practically complete recoveries where a laminectomy was done. I have included the high dorsal injuries with the cervical because clinically the progress appears to be exactly the same. When we get below the mid-dorsal region, however, the story is a far different one.

Lloyd, in 1901, and various authors since that time, have reported recoveries after operation where the indications pointed to complete crushing of the upper cord. In addition, I have knowledge of a few more in the practice of my colleagues that help to confirm my views that, if the patient otherwise is able to undergo operation, it is better in the long run to offer him that chance; but the surgeon and the patient should realize all the time that at the very best the outlook is extremely poor.

Lloyd places great stress on withholding interference where shock is an element of danger, and I emphatically believe he is right. Some of these cases, as soon as they react from shock, show improvement in their cord symptoms, and should be let alone; but with a halt in the progress or a retrogression, operation should be done at once. His dictum that patients with a complete obstruction of the cord should be let alone ought to be modified, because these symptoms are occasionally misleading. This is shown in the recent report of two cases by Mixter and Chase. In one "there were present all of the clinical symptoms on which authorities had previously based their opinion that operation was contraindicated because it suggested total transverse lesion with a crush of the cord beyond repair." Nevertheless, there was marked and steady improvement following operation for eleven months, when death from septic nephritis took place.

A most interesting series of sections of the cord showed that "normal sensory and motor axons exist at the seat of the lesion, though their functions were interrupted at the time of injury, which suggested total destruction of the cord." Their second case, in a similar way, exhibited all the symptoms of complete transverse crush, yet he recovered sufficiently to return

* Read at the Fifty-fifth Annual Session of the American Medical Association, in the Section on Surgery and Anatomy, and approved for publication by the Executive Committee: Drs. DeForest, Willard, Charles A. Powers and J. E. Moore.

to his business. Walton, in 1902, stated that "though we may value the classification of Kocher, Bastian, Thorburn and others, the terms complete and incomplete lesions should not imply that the symptoms of the former are necessarily incapable of amelioration." "All of my patients with acute crush of the cervical cord have died, whether operated on or not, but the recovery that followed operation in two of my chronic cases indicates that there is something effected by removal of pressure not produced by the bony parts, by which the functions of the cord are restored; and it is not wild reasoning to conclude that if laminectomy can accomplish so much good after prolonged pressure, whatever its nature may be, it may accomplish as much good, relatively, when done within the first few days after injury.

In the first of these cases the local cervical symptoms having persisted for a year in spite of conservative treatment, disappeared gradually after laminectomy. The second case, under hospital treatment for nine weeks, for paralysis from the arms downward, without any benefit, steadily improved after operation until he is now practically well. All that was found in this case was a collection of fluid under a distinct arachnoid membrane. A similar condition was found in a case of syringomyelia reported in my first paper, and yet the removal of this insignificant pressure produced marked amelioration in the pressure symptoms. If to these we add the total disappearance of a paraplegia following the removal of myeloma insignificant in its bulk, soft, not penetrating the dura, I am inclined to think that there is a something that produces grave paralysis that is demonstrated clinically, appears totally inadequate, and for which we have no corresponding experimental nor postmortem explanation.

My two cases of section of the posterior cervical roots for severe brachial neuritis, both followed slowly by a Brown-Séquard paralysis, have taught me that in future the operation would be better performed in two stages. At the first sitting all the work down to exposing the dura could be done. A few days later, when the danger of even slight oozing would be over, the dura could be opened in a dry field, the roots divided and ligated if necessary and the dura closed. In cervical laminectomies there is always more hemorrhage than at lower levels and certain types of oozing are impossible to control without prolonged packing. The consequences of that oozing or the adhesions of the pia consequent on packing is later paralysis, which may or may not disappear.

These few meager conclusions are all that I feel justified at present in deducing from my own observation. More experimental work is demanded in this line of cases, but what I believe is equally important is that a corresponding amount of work in clinical observation is necessary, no matter how discouraging and hopeless it is by its very nature.

CASES OF ACUTE FRACTURE-DISLOCATIONS.

CASE 1.—Man, aged 36, was seen at the Somerville Hospital in consultation with Dr. Buffum and Dr. J. J. Thomas, in May, 1902.

History.—Two days before I saw him he had been struck in the head by a bale of leather, bending it acutely forward. He was not rendered unconscious, but suffered pain in the neck. At first he had fair motion in the legs and was able to control his bladder. The hand grasp was fair and the knee jerks were present. The day following he was obliged to be catheterized and the motion of the legs diminished. He suffered great pain on motion of the head, in his neck and between the scapulae.

Examination.—There was flexion and extension of the wrist and fingers, extension of the forearm and partial flexion of the thigh. Respiration was diaphragmatic. Knee jerks were normal. No ankle clonus. Babinski reflex of both sides. Pain and touch sensations were slightly diminished up to the third rib and along the ulnar side of the hand and forearm. There was no zone of hyperesthesia. The neck was slightly tender over the lower cervical vertebrae, but there was no abnormal bony prominence. Diagnosis of probable temporary dislocation of the cervical and the dorsal spine.

Operation and Result.—At operation, under ether, the seventh, sixth, and part of the fifth cervical laminae were removed. The dura was tense, not pulsating, translucent and thin. It was not opened. There appeared to be no local bony compression and the wound was closed, with temporary drain. On the following day his temperature rose and there was slight delirium, from which he recovered, and the mental condition became normal. No improvement in his physical condition followed, however, and he died some weeks later after progressive wasting from bedsores.

CASE 2.—Woman, aged 18, was aroused by fire in her house, jumped from the window, falling three stories, and was brought to the Boston City Hospital at once. At entrance she was unconscious and in profound shock, with a pulse of 180.

Examination.—There were scalp wounds, but no fracture of the skull could be determined. The abdomen was tympanitic and lax, and sensation as tested by a pin was apparently normal throughout. Under stimulation the patient slowly regained consciousness and about twenty-four hours after injury there was found complete paralysis of both legs and abdomen, with absence of sensation in the right leg and diminished sensation in the left thigh, increasing to absence of sensation below the knee. Sensation was practically absent on the abdomen and back up to a line at the level of the xiphoid cartilage, above which the sensation and motion were normal. Urine was passed involuntarily. Deep and superficial reflexes of the legs and abdomen absent. No ankle clonus. Complete loss of pain and temperature was also found.

Operation.—Under ether a laminectomy was done, the fifth dorsal spine being found loose and the fifth lamina on the right driven forward against the peridural fat. The fourth to the seventh laminae, inclusive, were removed. The peridural fat was found infiltrated with blood, bulging slightly and containing a few clots; and though there was a persistent hemorrhage from some hidden vessel in the peridural tissue, it did not seem to be sufficient to account for the cord lesion. The dura was opened and an excessive quantity of clear serum escaped. No pressure elsewhere on the cord could be found. The peridural space was packed with gauze to control hemorrhage and the wound closed, allowing for temporary wicks. The patient stood the operation without shock.

Result.—No improvement in the paralysis followed for about a week. Then she developed beginning sensation in the lower extremities. The temperature was irregular all this time, varying from normal to 103; the pulse remained persistently at about 120. Two weeks after operation she complained of pain in the right side and a slight pleurisy was found. The wound healed kindly, but a bed sore, in the lower lumbar region, developed and increased gradually in size. A month after operation vomiting began, the bedsores increased, cystitis developed, and two and a half months after operation she died, without any improvement in her condition.

CASE 3.—Man, aged 44, fell about ten feet, striking his head and shoulder on the pavement, and was paralyzed in his lower extremities at once.

Examination.—He was taken to the Boston City Hospital relief station and anesthesia below the level of the nipples was found, with knee jerks present on both sides. Ankle clonus and plantar reflexes were absent. The abdomen was distended and tympanitic. A day later he was transferred to the main hospital. The knee jerks had disappeared, and paralysis of the sphincters came on. At first the temperature was elevated. At the end of two weeks his condition remained the

same as regards his anesthesia and paralysis, but he was steadily losing ground and operation was advised.

Operation.—A laminectomy was done under ether and the sixth and seventh cervical laminae were removed. In the muscles were evidences of old hemorrhage and laceration. No fracture was found in the spine. The dura was opened and a small amount of fluid escaped. Pushing up against the dura was a firm arachnoidal membrane, beneath which there was a large amount of clear fluid. This was opened and drained. The cord itself appeared normal. The wound was closed with a temporary rubber tissue drain. There was practically no shock. The temperature rose on the afternoon after the operation, but rapidly fell to normal, and there was considerable escape of fluid from the wound.

Result.—He developed the ability to flex and extend the forearms slightly, which before operation were completely paralyzed, but had no control of the hands. A beginning bed sore developed at the base of the spine about three weeks after operation. The operation wound healed by primary union, but the bedsores steadily increased, and his general condition grew worse. He developed incontinence of urine and feces, mild delirium supervened, and about five weeks after operation he died.

CASE 4.—Man, aged 22, fell from a team, striking on the top of his head, and broke his neck.

Examination.—He was brought to the Boston City Hospital with total paralysis of the upper and lower extremities and anesthesia below the second rib. Reflexes were absent. In front of the neck, on deep pressure, a projection of the displaced body of a vertebra could be felt. The head could be rotated and was not held in the position of a simple dislocation. He was conscious.

Operation.—Under ether a laminectomy was performed. A wide space was found between the fifth and sixth cervical laminae, admitting the finger easily to the dura. The fifth lamina was removed; the fourth lamina, found to be pressing on the cord posteriorly, was removed also. Above or below this no compression could be determined by exploration. An attempt to reduce the dislocation of the vertebral body was made, but was unsuccessful, the deformity probably being due to a crush as well as a dislocation. There was no extra-dural bleeding and there appeared to be no indications for opening the dura. The wound was closed, allowing for a capillary drain. There was no shock.

Result.—A few hours afterward the patient, who had been comfortable, was suddenly seized with pains, the head was drawn back, and he became unable to swallow. The pulse rose to about 130, but gradually grew weaker and slower, although the temperature rose to 107 degrees. He became unconscious and died about twelve hours after operation.

CASE 5.—Man, aged 33, entered the Carney Hospital in November, 1903, after falling downstairs, striking the side of his head and neck.

Examination.—He was unconscious for a few moments and was instantly paralyzed in his arms and legs. He vomited a few times and required the catheter for the first few days. There was flaccid paralysis of both upper extremities and paresis of both lower extremities. Dr. Bullard examined him and found the right pupil larger than the left, sensation stronger on the outer and dorsal surface of the arm and forearm than along the inner surface. On the right forearm the posterior surface seemed duller than the anterior; on the left, sensation was essentially the same. On the top of the shoulders sensation was stronger. All sensation, however, seemed diminished, but his answers were not fully reliable. Triceps reflex negative. Left patella reflex present. Right patella reflex slight. No ankle clonus. A diagnosis of crushed cord was made. He became delirious (evidently alcoholic) and nothing was done for eight days after entrance, until he had recovered from the delirium. Examination of the eyes by Dr. Kilburn showed the right pupil larger than the left under all circumstances. The pupillary reflexes were excellent and nothing pathologic was found in the fundus.

Operation.—At operation by Dr. Bottomley the fifth, sixth

and seventh cervical spinous processes were removed with their laminae; the dura was found distended with clear fluid, which escaped in considerable quantity. Over the cord, at the level of the fourth and fifth vertebrae, was a thin blood clot, adherent and several days old. The wound was closed, allowing for a rubber tissue drain to the subdural space. Patient recovered well from the operation, but soon developed bedsores and passed bloody urine for several days. Nine days later the temperature suddenly rose, vomiting began, and he gradually failed, and died twelve days after operation.

No autopsy was obtained.

FRACTURE OF THE ODONTOID PROCESS.

CASE 6.—Man, aged 42, entered the Carney Hospital in April, 1904.

History.—Two years ago the patient fell from a staging, landing on the top of his head. Ever since the accident he had been compelled to hold his head flexed, with the chin resting on his chest, being unable to rotate it actively or passively without pain.

Examination.—He had lost the power of extending his head voluntarily, although there was no paralysis of the muscles. Over the second cervical spine there was marked prominence. There had been no paralysis, and a year before I saw him the left posterior neck was explored by the orthopedic department, with negative results. He was then fitted to a form of chin support which held the head in normal position. As soon as this was removed the head immediately fell forward and the patient was unable to extend it voluntarily. For about a year he had complained of pain in his left shoulder, arm and leg, varying in severity. He was not so strong as formerly in his arms and legs, and he had been unable to work on account of the impairment of his head motion. He entered the hospital seeking operation and we hoped that possibly some relief might be obtained.

Operation.—Under ether an incision was made down to the spinous process of the axis. This was apparently normal, as were also the third and fourth spines and laminae. The vertical distance from the tip of the second spinous process to the posterior tubercle of the atlas appeared normal. The atlas rotated with the occiput through a normal arc. Extension and flexion of the occiput on the atlas were normal. By directly pushing the head backward the atlas moved with the occiput without change of their mutual relations, but the atlas slid backward on the axis so that its posterior tubercle lay in the same plane as the second spinous process or, in other words, the atlas slid backward and forward on the axis for at least one-half an inch, their vertical relations remaining normal. It seemed clear that this could be accounted for only by a fracture of the odontoid process at its base, allowing the structures above to move forward and backward within the limits of the anterior and posterior ligaments between the occiput, atlas and axis. Although rotation without ether was limited, under ether it was free in both directions. It did not seem possible that the normal position of the bones could be restored and maintained by any operative procedure, so the wound was closed in layers and the patient returned to the ward. He recovered quickly and was discharged in ten days, wearing the chin support and claiming that the pain in his shoulder was not so severe as before operation.

SUBACUTE FRACTURE-DISLOCATION.

CASE 7.—Boy, aged 14, entered the Boston City Hospital in August, 1902.

History.—Nine weeks before the patient, an acrobat, while turning a back somersault from a man's shoulder, fell, landing on the back of his neck. He arose immediately to his knees, but was unable to rise any farther. He was then carried to the anteroom and since then had been unable to walk. He recalled that he was unable, positively, to move the lower extremities on the day following the injury, but that he could use his hands awkwardly. Three days after the injury he went to a hospital in Virginia, where electricity was applied to his arms and legs. Since the accident he had remained in bed, the forearms and hands becoming atrophied. His appetite

had been good and he had been able to control his rectum. For six weeks he had incontinence of the bladder, and for a short time after the accident he had had pain in the neck.

Examination.—At entrance to the City Hospital he lay completely relaxed. Pain, tactile, hot and cold sense, and stereognostic sense were normal in his upper and lower extremities. The pupils were normal, knee jerks lively, and the cremasteric reflex was present. The motions of the head and neck were complete. Flexion and extension of the forearm were strong, but there was atrophy and weakness of both the flexors and the extensors of the fingers. Extension of the wrist was incomplete, the hand grasp was weak, and the muscles of the thumb, especially, were atrophied. In the thighs there was complete paralysis, at times flaccid, at other times spastic. There was slight prominence of the seventh cervical vertebra.

Operation.—At operation the seventh cervical and first dorsal laminae were removed. The dura was translucent, not pulsating, and on being opened a small quantity of fluid escaped. Pressing against the dura was an arachnoidal sac, with much serum under pressure. The arachnoid was attached to the dura and laterally to the cord and nerve roots, so that in freeing it fresh bleeding took place. It was freed as far as a probe could reach, and opened. Both membranes were left open and drained by a small rubber wick carried out at the lower angle of the superficial wound, which was closed. The wound healed by primary union after a few days' drainage of serum.

Result.—His general condition improved, but he did not regain control of his legs at once. Three weeks after operation he began to see improvement in his arms, and was discharged four weeks after operation, relieved. After his return home the paralysis of the lower extremities disappeared, he steadily gained, and when seen nine months after operation he was at work, able to run, walk, and use his hands almost normally, exhibiting only a slight atrophy of the back of the forearm.

CHRONIC CERVICAL PACHYMENINGITIS.

CASE 8.—Man, aged 40, entered the Carney Hospital in March, 1904.

History.—Twenty years ago he had had syphilis, for which he was treated successfully at the time. Sixteen months ago he noticed a slight weakness of the left arm, which gradually increased until he lost control of the left hand and arm. The right hand began to grow weak two months ago and the patient complained of severe pain in the back of his neck and the base of his head, which was especially marked on walking, relief being obtained by lying down.

Examination.—There was no ataxia, but some pain in his feet and toes. Dr. Bullard's examination showed that the pupils were equal, reacting normally. The external orbital muscles were normal. There was slight unsteadiness of the right eye on convergence. No tremors of the tongue. Numbness below the occiput, stiffness of the muscles of the posterior neck, especially on the right side. Pains shooting up the right neck to the right ear. Occasionally very difficult swallowing. The right side of the neck posteriorly appeared flattened. The right shoulder was slightly lower than the left; the sides of the chest were about equal. Passive motion of both arms normal. Both triceps reacted normally. Some diminution of the sense of touch and pain in the left arm; some atrophy of the left upper extremity, most marked in the left hand, but the interossei were not affected. Atrophy of the thenar and hypothenar eminences. Left arm smaller than the right. Knee jerks active. No clonus. Babinski absent. Left arm 1 cm. smaller than right. A little later some diminution of sensation was found over the left deltoid and the upper two-thirds of the anterior and outer surfaces of the left arm; there was, possibly, slight diminution of pain. Still later, a week before operation, there was involuntary twitching of the left posterior muscles of the neck, more marked on the left than on the right. Atrophy of the right shoulder more marked. Triceps reflex in the left arm better than in the right. There was diminished sensation over the left deltoid. He complained of a dead pain from the left shoulder down the left arm. The pains in the right posterior part of the neck were increased on walking, but disappeared immediately when lying down.

Operation.—At operation by Dr. Bottomley the fifth and sixth cervical laminae were removed. The dura bulged and was evidently under considerable pressure. On incision a clear fluid spurted out, several ounces escaping. The probe passed downward met with no obstruction, but on being passed upward met with fairly firm adhesions, which were broken up by the probe. There was free hemorrhage from the veins of the dura, controlled by hot wicks. The dura was partially closed with catgut and the wound closed, allowing for a temporary drain.

Result.—By the end of two weeks the grasp of the right hand began to improve and in another two weeks the patient went home, with still more marked improvement and with beginning improvement in the left hand. Since that time he has steadily been gaining.

SECTION OF POSTERIOR ROOTS FOR PARALYSIS. TWO CASES. THREE OPERATIONS.

CASE 8.—Man, aged 55, has been reported in detail by Dr. Morton Prince,¹ and from his account I will condense a few details that concern us surgically.

History.—The patient, struck by a train, received a Colles fracture of the left wrist and developed a complete paralysis of nearly the whole left arm; the paralysis, typical of a neuritis of the brachial plexus, had persisted for over a year. The most diseased fibers were apparently from the fifth, sixth and seventh cervical segments, while those from the eighth cervical and first dorsal were partially implicated. He suffered most intensely from pain located chiefly in the thumb and forefinger.

Treatment.—He was under treatment in the clinic for nervous diseases of the Boston City Hospital for a long time, and for the relief of the pain, which was intense, three different operations were undertaken at various times; that is, the radial was stretched in the forearm without relief; later he underwent some other operation at another hospital, the nature of which could not be learned; later still, fifteen months after the accident, I explored the brachial plexus in the axilla and found that all the nerves looked normal, except the ulnar, from about three inches from its origin downward. It had lost its striated, opaque look, was translucent in the center and somewhat crinkled. There was thickening about the humerus, apparently from cicatricial tissue of the soft parts. The plexus was thoroughly freed from the scar tissue and the wound closed.

Operation.—He derived no benefit from this operation and, at Dr. Prince's suggestion, in October, 1899, a laminectomy was done under ether. A long incision was required because of a thick, fat neck. There was much bleeding in the first part of the operation, requiring tedious hemostasis. The sixth, fifth, fourth, and part of the third cervical laminae were removed. On opening the dura at the lower angle some vessels of the subdural space were injured and caused troublesome venous bleeding that could be controlled only by packing under the lamina. So far as could be determined, the left posterior roots of the seventh, sixth and fifth nerves were found and freely cut close to the cord. The dura was then sutured, but not completely closed, and the wound closed except for a wick, which was placed down to the subdural space to control oozing. The operation was long and tedious, but the patient had comparatively little shock. The wound closed aseptically, and from the moment of coming out of ether the patient was free from pain in all the previously affected areas.

Result.—After he began to get about, however, it was noticed that he exhibited a limp and weakness of the left leg, and examination showed a moderate Brown-Séquard paralysis. Dr. Prince, at the time of operation, feared the possibility of a clot forming within the dura and called my attention to it at the time, and it is probable that the paralysis was due to pressure from this source. Gradually the patient developed severe pain posteriorly in the neck and at the time of discharge from the hospital, three months after operation, he still suffered from severe pain, though in a different region from that

1. Brain, 1901, p. 116.

originally affected; the cause of the pain in the neck, according to Dr. Prince, being undoubtedly due to a neuritis following injury to some nerve at the time of operation or during healing. Although the arm itself was free from pain, it was useless, and the patient was anxious to have it removed. This was promised if he was unable to make use of it at the end of a year. Five months after operation Dr. Prince examined him and found great improvement in his condition and that the operation had relieved his pain, for which it was undertaken. At the same time the neck pain had also disappeared, but he complained of pains about the shoulder, due, probably, to the weight of the paralyzed arm dragging on the capsule. The Brown-Séquard paralysis had improved very much, although the left leg was still weaker than the right. He still desired to have the arm amputated. Dr. Prince has made an interesting and able study of the areas of the anesthesia, for which reference to the original article must be made. About a year after operation the patient, probably dissatisfied with his general condition, committed suicide. No autopsy was obtained.

CASE 9.—Man, aged 29.

History.—In 1898 his right arm was burned between two hot rollers and amputated at once at the Massachusetts General Hospital. Nine months later he entered the City Hospital for painful stump. At various times neuromata were removed from the median and from the ulna nerves. The median, ulna and internal cutaneous nerves were injected with osmic acid and in May, 1900, portions of these nerves were removed. A year later there was reamputation of the stump and severing of the nerves high up. From none of these operations did he derive relief. The patient was markedly hysterical and probably unreliable in his statements throughout. A marked hyperesthesia was found over the scapula, shoulder and anterior portion of the deltoid and the stump, where he could not bear the slightest touch on the skin. In spite of his marked general neurotic condition he was advised to have the posterior nerve roots cut to relieve his pain.

Operation.—In February, 1902, under ether, the laminae of the fifth to the seventh cervical vertebrae, inclusive, were removed. On opening the dura much clear fluid escaped. As well as could be determined by previous careful measurements the sixth, seventh and eighth cervical posterior roots were cut. There was very slight bleeding from the stumps for a few moments. The dura was not sutured. The upper angle of the wound was packed with gauze tape, as there was a slight persistent oozing of blood from this point that could not be otherwise controlled. The wound was closed throughout, allowing for the wick and for a small rubber tissue drain to the subdural space at the lower angle.

Result.—Apparently pain in the stump diminished to a considerable extent, as it could be handled when the patient was asleep without arousing him although he winced if it was touched when awake. He complained of pain in his neck and head after operation but there was no satisfactory explanation therefor. The wound closed except for a superficial stitch abscess due, probably, to the through-and-through silkworm-gut sutures. On their removal healing progressed satisfactorily. A month after operation the patient showed some delusions and at one time was so noisy that he was transferred to a lower ward. This passed away gradually and his general condition improved except as regards his neurotic symptoms, and two months after operation he was discharged, with very slight hyperesthesia of the stump; to be treated by the neurologic out-patient department. Several of the neurologists who examined him considered that the trouble was "cerebral" rather than confined to the nerve tracts.

Subsequent History.—Three months or more after operation a paraplegia of the lower extremities developed gradually, and since July, 1902, he had not been able to stand, and at times complained of difficulty in micturition. He also complained that pain in the right upper extremity had returned.

Examination by Dr. W. N. Bullard, neurologist to the Carney Hospital, showed a total paraplegia of the lower extremities, with rigidity in extension, but with normal sensation to touch and pain. In addition there was a spinal epilepsy of

the lower extremities, a knee clonus on the right, but on the left it could not be obtained on account of the rigidity. Ankle clonus and Babinski present on both sides; cremasteric reflex on the right, not obtained on the left. No numbness was obtained over the back or chest. There was hyperesthesia to light touch on the right upper extremity, but the sensation of pain was normal.

Second Operation and Result.—At the second operation at the Carney Hospital, 1904, an incision was carried down through the scar, which was found adherent to the cord posteriorly, not involving the left roots, but slightly involving the region of the right roots. The adherent tissue was easily freed from the cord, but posteriorly there was no evidence of any spinal fluid until the level below the former operation was reached. The left posterior roots appeared normal. The cord itself appeared of normal size and consistency, but without evidences of any pial vessels. In the lower third of the wound were fibers of probably the first dorsal root, which had not been cut at the preceding operation. Above this the root stumps were atrophied, lying flat, adherent to the cord, except one small fiber, which apparently had not been cut or else had reunited. This fiber and the intact root below it were severed and the stumps trimmed down to a level with the cord. The remains of the dura were then freed laterally from the cord above and below and some fine silver foil placed against the cord, over which the dura was sutured with catgut. The wound was sutured in layers and a cocoon dressing applied.

After operation the patient was sitting up early and the wound united *per primam*.

Examination ten days later showed that the pain in the upper extremity had diminished, that there was diminution of sensation to pain from the fourth to the sixth space in the right nipple line, no hemianesthesia on the right and abdominal sensation normal. The paraplegia remained as before operation, though some voluntary motion of the toe was reported. No hyperesthesia of the stump was found. Slight diminution of sensation all down the right back and thigh was found, but as it varied at different times, it probably was functional.

MYELOMA OF THE SPINE.

CASE 10.—Man, aged 39, was seen with Dr. Hunting of Quincy, in consultation with Dr. J. J. Thomas, in December, 1900. It was reported before the American Neurological Association by Dr. Thomas in June, 1901, and from his article I shall quote freely.

History.—The patient, a lawyer, without any previous history of importance, in August, 1900, was seized by severe pain in the shoulders, which confined him to bed for four or five days. Since that time there had been more or less pain, but not confining him to his bed. Beginning with October of the same year, he noticed slight uncertainty in the use of his legs, and once, while stooping, fell on the floor. This was more noticeable in the dark than in the light. He had noticed numbness in the feet and tightness about the abdomen, together with difficulty in holding his urine after the desire to micturate had come on, and at times there was difficulty in starting the urine.

Examination.—The pain in the back was aggravated on motion and diminished with rest. Sensation to touch and pain was diminished below the level of the spine of the eighth dorsal vertebra on the eighth rib.

Treatment and Result.—The diagnosis of pressure on the cord, probably from tumor, was made and he was placed on anti-syphilitic treatment and a plaster jacket was applied. A month later the gait had become slightly ataxic, with incoordination. The knee jerks increased, the other reflexes varying at different times. Pain and temperature sense became diminished and the patient complained of an increase in the uncertainty in his gait. A month later the gait was slightly spastic and ataxic. The pupils at this time reacted rather sluggishly to light and the left was slightly the larger. There was a slight swelling on the left fifth rib, which had been noticed before, but it was not tender.

Operation.—Operation was advised and done on December 20

at the Quincy Hospital. On the day of operation the urine, which had previously been normal, was suddenly found to give a heavy precipitate, with heat, disappearing partially on boiling the urine. This was thought to be albumose and its presence was confirmed later. At operation the first, second, third and fourth dorsal laminae were removed. The lamina of the fourth on the left side was thin and bluish, with the cortex destroyed on the upper posterior surface over a small area. The medulla of the spinous process and the lamina was filled with a soft reddish material and on being traced to the left it was found extending anteriorly through an opening alongside the head of the rib, admitting a finger, the rib itself not being eroded. This tract continued to the left side of the vertebral body, where the bone was loose and rough, easily bleeding and evidently infiltrated with a new growth. In all probability some of the same growth lay anterior to the lamina, pressing on the dura, but otherwise without infiltrating it. The dura looked healthy and was not tense. Through the unopened dura the cord felt normal. There was no evidence that the growth had pushed anteriorly to the posterior mediastinum. As much growth as possible was curetted out, the cavity in the vertebral body packed with iodoform gauze and the wound closed, allowing for the gauze drain. The patient stood the operation well and the pulse was excellent at the close.

Result.—Following operation the patient developed a complete paraplegia, with retention of urine. This gradually improved and the wound healed well. Two weeks later, when seen by Dr. Thomas, all movements of the legs and feet were performed normally and with good strength, and there was marked gain in sensation. Heat, cold, pain and touch were perceived fairly well almost everywhere, though in various small areas the improvement was not so great as in general. He could control the bladder for the most part. Careful analysis of the blood, urine and growth was made—for which the reader is referred to Dr. Thomas' original article—the urine showing albumose and examination of the tissue showing myeloma. Dr. Hunting then placed the patient on bone marrow and Coley's toxin and by March he was attending to his business and was feeling as well as ever in his life. At various times myelomata appeared in one rib and another, but there were no more symptoms of cord pressure.

Dr. Thomas has carefully examined the literature of these cases, which will not be considered in this article.

On June 1, 1904, Dr. Hunting wrote me as follows: "About one month after operation I began treatment with bone marrow and Coley's serum, increasing up to 15 minims, dependent on the reaction produced. I gave it at first three times a week, then twice, and during the summer I stopped it altogether while the patient was away in the country. For the last two years he has had about 7 minims of the serum once a week. At first the injections caused fever, delirium and pain at the point of myelomatous swelling. Of late, however, only pain and a feeling of malaise is produced, which passes off in about a day. He has had a good many points of pain, swelling and tenderness on different ribs, with three or four subcutaneous fractures. There is quite a marked kyphosis at the fourth dorsal vertebra, due, probably, to collapse of the vertebra and lack of support from the ligaments of the spine. He has refused to wear a jacket, as it presses on the tender points in the ribs. He has had several twists and falls, a severe bronchitis, and recently a mild pneumonia. He has attended to his business except when temporarily laid up, has a good appetite and digestion and sleeps well, his urine varies in quantity, but is always increased and contains from a trace to $\frac{1}{2}$ per cent. of albumin, albumose and globulin. His present condition is fair. He attends to business, but is easily tired, occasionally but not often complains of weakness and numbness of the legs and feet. Most of his pains are apparently due to intercostal neuralgia or to collapse of the vertebrae."

DISCUSSION.

DR. F. B. LUND, Boston—Dr. Munro has rightly stated that these cases are among the most discouraging that a surgeon has to treat. There can be very little question but that in

many cases falls from heights form a large proportion of the causes. There are some cases in which the cord is pressed open where the symptoms do not differ from those of a crushing of the cord itself. Many of the Army surgeons advocate letting these injuries alone. It is difficult to get at the laminae and elevate them without damaging the cord. I have seen a burly ice man who had fallen from a great height brought to the hospital with sufficient pressure on the spine to probably cause death from shock. By properly constructed forceps the operation may be done with moderate shock, and in cases in which the patients come into the hospital in a state of shock it is well to wait a certain length of time. I have seen a case where the cauda equina was pressed on, and removal of the lamina against which the cauda equina was pressing enabled the patient to walk out of the hospital. I have had no fatalities from similar cases, but know in some that I did no good. If one does not remove the bone nor attempt to see how badly the man has been hurt, one has not done his duty to the patient nor given him a chance for recovery.

DR. HARVEY CUSHING, Baltimore—Cases of hematomyelia must be carefully selected from those of fracture.

RUPTURE OF MESENTERIC GLANDS DURING TYPHOID FEVER

SIMULATING INTESTINAL PERFORATION; REPORT OF A CASE WITH OPERATION AND RECOVERY.*

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The profession has long recognized that among the various lesions which may produce a peritonitis in the course of typhoid fever, rupture of the mesenteric glands is one, and yet in the many text-books which have been consulted there is not a reference given to a specific reported case. Nothnagel's "System" and Osler's "Practice," for example, fail to give a single instance of a mesenteric gland producing peritonitis; but each mentions it as a possible cause of such a complication in enteric fever. Keen¹ records references under this heading, but all of them prove to be cases of obscure peritonitis of unknown origin, where the reporter has only suggested the possibility of a ruptured mesenteric gland being the cause. It would, therefore, seem that such an occurrence is very uncommon, and a search through the recent literature on the subject tends to confirm this view, for I can find but one recorded case, and another unpublished record from the Episcopal Hospital notes. These two cases terminated fatally. I therefore propose in this article to review the theories advanced for enlargement of the mesenteric glands during enteric fever, and to discuss the probable causes which lead to perforation of the mesentery with a resulting peritonitis.

ANATOMY.

The mesenteric glands constitute one of the most important glandular centers in the human system.² Their number varies from 130 to 150, and they may be divided into three more or less distinct groups, which vary in importance and significance.

1. The primary group comprises some small glands placed in the course of the terminal arterioles springing from the last anastomotic arch of the vessels. This

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1. Surgical Complications and Sequelæ of Typhoid Fever.

2. Porriere, Cuneo and Delamere: The Lymphatics, English translation by Cecil H. Leaf.