AN ACCOUNT
OF AN
ARTERIO-VENOUS CYST IN THE
POPLITEAL NERVE,
FOR WHICH THE LIMB WAS AMPUTATED.

BY
CHARLES H. MOORE, F.R.C.S.,
VICE-PRESIDENT OF THE SOCIETY.

Received Nov. 30th, 1865.—Read Jan. 23rd, 1866.

THE case described in this paper was one of Traumatic Varicose Aneurism, but the characters of that disease were masked by the prominent peculiarities of the tumour as a cyst, and by its strict limitation within the textures of the nerve. The novel combination of the symptoms thus produced occasioned difficulty in distinguishing the nature of the disease, as well as unusual interest in the treatment of it.

Before the patient came under my care she had been attended by my friend, Dr. James D. Rendle, the medical officer of the Queen's Prison at Brixton, who twice gave me the opportunity of examining her, and who has since favoured me with an account of the early history of her case.

Caroline C—, æt. 31, presented herself to Dr. Rendle on the 10th of March, 1863, with a painless, smooth, tense, oval tumour, of the size of an egg, in the left popliteal space. In

every respect it so nearly resembled a bursal tumour, that it was pronounced without hesitation to be a chronic enlargement of a bursa connected with one of the hamstring muscles.

The woman gave the following clear history of her case :— On the 22nd of May, 1862, whilst she was at work with several other women in turning a crank-pump, she received a blow on the back of her knee from the rotating pump-handle. The blow caused pain, which increased during the day, and then ceased. Just a fortnight after the injury she accidentally noticed at the part which had been struck a painless swelling of the size of a hazel-nut. Her belief is that at this period the swelling was movable, and situated in the middle of the ham. It gradually increased, and by the end of November was of its present size.

June 10th, 1863.—After prolonged rest in bed, leeching, and blistering, the tumour has not diminished in size, but it has altered in character. Its deepest part feels firm and indistinctly nodulated; and it conveys the impression that underneath the smooth soft superficial swelling there may now be a solid deposit of scrofulous matter in the glands of the region. Her general health is unimpaired.

August 5th.—She has been well fed, and has taken a scruple of iodide of potassium daily for the last two months. The tumour has nevertheless somewhat increased in size. She has also been kept in bed; but she is now restless and tired of the constant confinement, and to-day she has left it and gone out.

September 1st.—She returned to Dr. Rendle's care. Since the last date she has been up for a part of every day. The tumour has again increased a little in size. She suffers pain in the bottom of the foot.

December 1st.—There has been no material change in the form of the tumour; but the impression again given on handling it is, that it is certainly fluid and bursal. Upon the introduction of a small trochar at the outer side of the swelling, a little oily, bloody fluid escaped, and afterwards a few drops of pure blood. The swelling afterwards was less tense, and

to the patient felt smaller. No severe pain was occasioned by the introduction of the instrument. A little ecchymosis was noticed around the puncture on the following day, but nothing unfavorable followed.

January, 1864.—By the middle of this month the tumour had considerably increased, and was as large as an orange. Dr. Rendle punctured it again, using an ordinary hydrocele trochar. Again a little oily and bloody fluid first escaped, as on the former occasion of puncturing, and then issued a stream of pure venous blood. This operation caused intense suffering, the pain being chiefly referred to the sole of the foot. The puncture readily healed, but the tumour was not materially diminished in size by the operation.

February 12th.—During the last fortnight there has been a considerable change in the tumour. No longer slow in growth, it has been rapidly enlarging and producing such intense pain that there seems to be a probability of the disease requiring the removal of the limb.

24th.—On her admission into the Middlesex Hospital under my care, the woman was thirty-three years of age, dejected in spirits, pale and pasty in countenance, but not emaciated. She had no appetite, and she took her food as a duty without relish. She had little sleep, and almost constant pain. Her pulse was feeble. There were syphilitic scars on both lower extremities. She laid her knee bent on the outside, and kept it carefully still. The tumour, which had now existed for twenty-one months, was no longer movable. It occupied the whole of the left popliteal space. It expanded the hamstring muscles, and protruded backward in two principal lobes, being grooved down the middle as by a nerve or a vessel. There was no pulsation or redness about the tumour itself, and no œdema, or altered arterial beat, or venous congestion below it. The prominences were tense and elastic; whether they fluctuated was a matter of dispute. To different persons and to the same person at several times a different impression was conveyed. I myself thought I distinguished at one examination the elasticity of medullary cancer; at another, and especially on further flexing the

knee, fluctuation ; and I was rather dissatisfied at having, as I supposed, made a mistake, than led to ascertain distinctly if the tension of such a tumour could be made to vary. There was, moreover, difficulty in this, as the woman experienced peculiar suffering from compression or prolonged handling of the tumour, and from raising the limb. When certain parts were touched, she sometimes, though not always, cried out and started, as if a nerve were pricked. Her pain too, that which came on when the swelling was not touched, was of a stabbing and pricking character ; it was greatest in the sole of her foot, and it sometimes came on suddenly. The movements of the knee-joint were natural, but limited by the bulk and painfulness of the great swelling behind it. Flexion of the knee slightly lessened the tension of the prominences of the tumour.

29th.—She has improved in her general condition ; but to-day, after a night of great suffering, the tumour is still larger, and there is a dark violet discoloration of the skin over it, which fades into a light red on the adjoining portion of the calf ; here and there on the leg, and especially on the foot, the skin is unevenly marked with streaks and patches of a brick-red colour, which, though very superficial, is permanent. The foot, to-day, is benumbed.

Feeling an indistinct fluctuation, I thrust a grooved needle into the largest and highest prominence. It entered a cavity. A yellow serous fluid, tinged red, came freely along the groove. Gradually the red tint predominated, and after half an ounce had escaped the fluid was venous blood. It poured as freely forth when six ounces had issued as it had done at first, and, the tension of the tumour being relieved, I withdrew the needle. Although for the most part at ease during this little operation, yet, from time to time, while the needle was being held quite still, she suddenly and bitterly cried out that I was hurting her foot. Blood continued to flow by the puncture after the needle was removed, until stopped with lint soaked in collodion. In three or four minutes after the withdrawal of the needle the tumour was as tense as before ; and it was evident that there was some source of

free hæmorrhage within, by which the sac was again filled. The whole of the fluid coagulated in a few minutes. Under the microscope I found in it blood-globules, and one cell, having six times the diameter of a blood-corpuscle, broken on one side and containing a nucleus and nucleolus.

March 2nd.—After the administration of chloroform and the application of a tourniquet, I cut on the inner prominence through smooth bright fascia into a thin cyst, and let out some serum and thin blood. On enlarging the opening black clot escaped, and I put in my finger and turned out a mass of soft fibrin, some small, smooth, and soft white fragments, and more black clot. Fluid blood of a venous character flowed abundantly, washing out clots with it, and had it been bright it might have been supposed to be issuing from a pulseless aneurism. But the tumour was thin and cystic, the lymph was soft and loose, and not laminated, and the blood flowed without jet in a continuous stream. I compressed the lips of the wound around my finger to prevent further hæmorrhage, while I explored the cavity. It was that of a single cyst, with cord-like ridges and sacculated interspaces on its walls, and with other isolated cords, only the ends of which were attached to the walls as in the right ventricle of the heart. Clots lay in the sacculated recesses at the surface of the cyst. The wall itself seemed thin, and, though uneven, was smoothly lined like a bursa. The popliteal artery could be felt immediately in front of the cyst, but there was no aperture in it, and no gush of warm blood was to be felt in any part. The tourniquet, when quite tight, controlled the hæmorrhage, but seemed to augment it if partially screwed up.

The tumour thus proved to be a cyst, which communicated with one or more veins. In what structure it had originated I could not discover, for it had spread its thin wall abroad into close contact with almost every structure in the ham, and was nowhere based on a solid morbid growth. I gave up the hope of dissecting it out; and as the hæmorrhage had been rapid and copious, and its source was deeply seated, I desisted after a brief attempt to search for the bleeding

vessel. Recalling the antecedent history of the patient, whom I knew to be one of a class of persons who readily die of a surgical operation, and who can ill bear a copious suppuration, I decided at once to remove the limb. Amputation exposed her to the least immediate risk, and also freed her from the uncertainty still remaining as to the nature of the disease, which might even yet imperil her recovery.

Examination of the limb.—All the bursæ were found healthy; the popliteal artery and its branches healthy, the vein a little thickened and adherent to the front of the cyst, but otherwise healthy. The posterior tibial nerve, as it approached the tumour, spread out into a hollow cone, which formed the uppermost part of the cyst. The substance of the nerve was continuous with the cyst, some of its separated cords passing in the wall, and others in the cavity of the cyst. Near the soleus the cyst contracted, and the scattered nerve-cords reunited in a cone pointing downwards, from the apex of which the nerve passed under the muscle, compact and white again, and only differing from a healthy nerve in being a little tumid. The cyst was everywhere thin, and was for the most part connected with areolar tissue. It was composed of an external fibrous layer, which appeared to be the hypertrophied investment of the nerve, and of a glistening thin lining membrane. At one part it was attached to the external muscular portion of the gastrocnemius by white œdematous tough lymph. The muscle in this situation was paler than elsewhere, and had in it many circumscribed dots which resembled small trichinæ; while the adjoining portion of the tumour appeared to be composed of old tough white lymph, mixed with spots of red which gave it the appearance of the vascular or erectile tumours of muscle. These appearances were, however, deceptive; the dissection demonstrated the original connection of the tumour with the nerve. Under the microscope some of the trabeculæ in the cavity were found to be nerve-cords; these were near the nerve: others were fibrous only; these adjoined the muscle. No epithelial cells were seen, but a few small oval cells having indistinct nuclei.

Two vessels were found opening into the cavity of the cyst. One was a vein, of the calibre of the basilar artery, and nearly an inch in length, which opened at one end near the middle of the front of the cyst, and at the other end into a sural vein. Its course was upward from the cyst to the vein; but, although the direction of its channel corresponded with the ascending venous current of the limb, the mechanism of its two orifices favoured only the descent of blood into the cyst. For the extremity opening into the cyst was oblique, thin, and valvular, like the vesical orifice of the ureter, while the upper end was rigid and patent, being in a part where the sural vein was thickened and opaque. Moreover, there were no valves in the whole venous channel between the cyst and the popliteal vein. All the other vessels of the region were minutely examined, and one artery, about equal in size to the *superficialis volæ*, was found curving horizontally half round the upper cone of the cyst and beneath its fibrous tunic. It then projected for about one eighth of an inch into the cavity, and finally opened into it by a circular orifice. The only compact fibrin in the cyst was collected in the upper cone, where this artery opened. The most minute examination failed to discover the orifice of any vessel with which either the open artery or the vein could have been conterminous.

Remarks.—Encysted tumours, resembling that just described in two particulars, have occasionally been met with. They have been found filled with blood, and having corded and saccular walls, more or less like one of the cavities of the heart. But they have not been discovered in a nerve or communicating with vessels. In some of these, as in a large blood-cyst within the femur, depicted in Mr. Stanley's work on the bones, the wall may have been alternately sacculated and ridged by mere distension: in none has a normal structure been recognised crossing the cavity, as, in this tumour, isolated nerve-bundles stretched from end to end. The only case of a sanguineous cyst in a nerve with which I am acquainted is recorded by Bertrand in his '*Thèse de la*

Faculté de Paris,' 1837, No. 220. It was as large as a hen's egg, and was found after death in the upper part of the right median nerve. The patient, a man *æt.* 80, had not complained of pain in it, and he had played the violin a few days before death. When cut into, there issued from the tumour "un flot de sérosité sanguinolente, mêlée à des caillots de sang." Bertrand's description shows that in its form, in the thinness of its walls, and in its smooth internal surface, the tumour resembled that which is the subject of this paper; but he says nothing of isolated nerve-fibres in the cavity, or of the distension of its intermediate portions into sacculi, and he gives no account of the vascular source from which the blood had proceeded. Smith, in his great work on 'Neuroma,' refers to no instance of the kind but that of Bertrand.

Accordingly, this singular case receives no illustration from known diseases of the nerves. Most of the difficulties in it, however, were at once explained by the discovery of the cystic nature of the disease, and its relations to the popliteal nerve and to the vessels. A cyst in communication with vessels was in some manner formed in the interior of the nerve. The pressure of the entering current of blood progressively distended it, separating the nervous cords, and expanding even more into sacculated protrusions the thinner tissue between them. By continued distension some of the cords were at length isolated through the removal of the delicate connective tissue around them; and thus a resemblance of the interior of the cyst to an auricle or ventricle was produced, not by the growth of new tissue in the form of cords, but by the separation of the natural structures of the nerve from one another. This mechanism accounts for the form of the tumour, the progressive increase in the rate of its growth, its gradual fixedness as it filled the ham, the varying degree of its tension, the double character of the fluid which issued when it was punctured, the peculiar sudden anguish during that operation, the exquisite sensitiveness of the tumour, and the prominent distal pain which it produced, the freedom of the principal vessels of the limb from

connection with it, and the failure of remedies to cure or to arrest it.

The state of the contents of the cyst corresponded with that in which the vessels were found. By so small an artery fresh blood was but slowly introduced into the cavity. Its exit by the vein, though ready so long as the arterial and venous orifices were near together, became eventually difficult, and perhaps intermitting. For as the tumour increased, the outflow in a direction contrary to the valvular orifice of the vein may have been quite prevented; if, indeed, occasionally the stream rushing up the popliteal vein did not regurgitate along the easy channel into the cyst. It is even possible that, at last, the venous current may have pressed permanently into the cyst, as in the last month the enlarging tumour more and more hindered the escape of its own contents by compressing the popliteal vein, while at the same time the popliteal artery continued without obstruction. However this may have been, there could not have been any churning of the blood by the entering stream, as in an ordinary sacculated aneurism, or any passage of a rapid current through it, as in the case of a fusiform aneurism or of a large arterio-venous communication. The greater part of the contents of the cyst must have lain in a state approaching quiescence, which was only disturbed when the canula supplied a free outlet from the cavity. When the cyst was laid open and its pressure removed, the abundant venous hæmorrhage proved clearly enough that there could be regurgitation through the vein.

The origin of the tumour is chiefly obscure on account of its singularity. It must have begun in the nerve, being to the last entirely confined within the disparted nervous textures, but in its primary condition it may have been either a cyst or a ruptured vessel. The patient distinctly associated its commencement with the stroke of a piece of iron. If it originated in that violence, it could hardly be a cyst, for cysts do not so arise. It is, therefore, more likely that the primary lesion was the rupture of one or more vessels within the nerve. The growth of a cyst may indeed have preceded

the blow, and a vascular communication with it have been opened by that injury ; but, as there had been no local ache before the accident, and the characteristic nervous pain was not established until several months after it, such an explanation is not probable. Neither is it credible ; for a cyst is one of the rarest morbid productions in a nerve, and two such occurrences as a disease of that nature, and the violent opening of a communication between it and a blood-vessel, form a combination as unlikely as it is uncommon. The only conclusion remains that the entire disease resulted from the rupture of an artery and a vein together within the nerve at the time of the injury, and that it must be regarded as an arterio-venous aneurism. The smooth cyst-like character of the membrane lining the cavity, although unlike that of an aneurism, comports with the unusual conditions of the case. It was the result of the long duration of the disease and the unruffled quietude of its contents, which allowed of its organisation in the manner of any surface within the body which remains long free and undisturbed. The absence of pulsation does not render this even unlikely, for the quantity of blood which could be driven by so small an artery into a cyst, having practically no outlet, must have been less than would have produced an appreciable pulsation.

After these remarks upon the nature of the disease it appears unnecessary to argue as a doubtful question the propriety of amputating the limb. The tumour could not have been extirpated, and it must, after the closure of the bleeding orifices by ligatures, have been left to suppurate. But the inflammation preceding that process would have involved every separate fibre of the posterior tibial nerve, and occasioned an intolerable amount of suffering. Upon eventual mischiefs in the foot, in the popliteal vein which was adherent to the cyst, and in the many adjoining structures of the ham, it were superfluous to speculate.