Remarks

ON THE

SURGICAL TREATMENT OF ARTERIO-
VENOUS ANEURYSM.

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ARTERIO-VENOUS aneurysms are of comparatively rare occurrence, and of recent years their rarity has become more and more marked. This latter fact has depended upon the circumstance that in past times the most common cause of arterio-venous aneurysm was an accidental puncture of the brachial artery during the process of bleeding from the median basilic vein. Since indiscriminate bleeding has ceased to be a feature of medical practice the unintended consequences of that measure have also ceased to be of frequent occurrence. It is apparent, moreover, from the records of the past that not a few examples of this aneurysm were due to stabs from knives and daggers, and since these weapons have been less frequently used in brawls and discussions the results of these unseemly wounds have also become less common. Bramann's often-quoted statistics show that in 144 cases no fewer than 108 were due to stabs and punctures, while 29 followed upon gunshot wounds, 5 upon contusions, 1 upon abscess, and 1 developed in a stump after amputation.

The introduction of the bullet of small calibre into warfare has once more made arterio-venous aneurysms as familiar as they were in the past, and in the surgical records of the war in South Africa numerous examples of this condition are to be found.

I have ventured to describe the following cases which have come under my care in connexion with the present war, because it would appear that the value of operative interference in aneurysms of this type is in need of fuller demonstration. Of the four cases two are examples of aneurysmal varix—that is, of direct communication between the artery and the vein, and two are instances of varicose aneurysm—that is, of indirect communication between the injured vessels through the medium of an aneurysmal sac.

From the reports of cases it would appear that the prognosis is more favourable in the varicose aneurysm than it is in the aneurysmal varix. It is, however, clear that in neither variety can the outlook be said to be other than unfavourable. Spontaneous cure in these forms of so-called aneurysm does not appear to occur.

The mortality from arterio-venous aneurysms is not nearly so high as is that depending upon those aneurysms in which the artery is alone concerned. Gangrene is quite rare in the arterio-venous form, and rupture is comparatively uncommon. On the other hand, the aneurysmal conditions now under notice lead to great functional troubles and to considerable and increasing local disturbances. This is especially seen when the lower limb is concerned. The muscles waste, the limb remains swollen and painful; it becomes more or less useless, and is apt to find itself rigid in a vicious position. Ulcers form, and other troubles fall upon the part which are the outcome of a greatly disturbed circulation. A condition of solid oedema, which occasionally merits the term "elephantiasis" is not unusual, and the uselessness of the limb, together with the pain and discomfort of which it is the seat, have in some instances led to amputation. It becomes a matter of necessity, therefore, that the patient should be relieved of this trouble at as early a period as is convenient. In some examples the condition is practically incurable or the relief given is of necessity incomplete. In the majority of instances, however, a cure of the condition may be anticipated. The only method of treatment is by operation.

Old records contain accounts of numerous cases treated by rest, posture, bandaging, and persistent compression. The results of these measures are negative, when not actually deplorable, for in more than one instance persistent compression has done harm. The Hunterian ligature, or

ligature of the affected artery at a distance, has been attempted with sufficient frequency to establish the fact that the measure is to be condemned.

Dr. Curtis' gives an excellent summary of the results of operative treatment in arterio-venous aneurysms. It would appear that in 51 cases in which the Hunterian ligature was employed, 23 patients died, 18 were left unimproved, 2 were benefited, and 8 only were cured. It must be remembered that these records are mostly concerned with the operations of days before Listerism was established, and that they are, therefore, much exaggerated on the side of the mortality.

The only operative measure which is to be commended in these cases is ligature of the vessel or vessels at the wounded spot. The ideal procedure is that in which both the affected artery and the vein are ligatured above and below the point of the abnormal communication. It is obvious that this cannot always be done. When the condition is that of varicose aneurysm it is as well that the sac between the vessels should be excised. Dr. Curtis gives 15 examples from various records of ligature of the artery immediately above and below the wounded spot. Of these, 9 were cured, 2 relapsed, 1 recovered after amputation for gangrene, and 3 died. Here, also, it must be remembered that most of the collected cases belong to the period before antiseptics. He gives 7 instances of ligature of both artery and vein, with a result of 6 cases of cure and 1 of relapse. The same writer has tabulated 17 cases which were treated by incision of the sac and ligature of vessels; of these, 5 died, 11 were cured, and 1 recovered after amputation.

In the admirable article on arterio-venous aneurysm by Delbet in the *Traité de Chirurgie* by Dentu and Delbet (tome iv, 1897), a full analysis of the various methods of treatment is given, but the results differ little from those just detailed.

The four cases of arterio-venous aneurysm which are described in this paper were due to wounds received in the present war. In each instance the injury was inflicted by a bullet—by a Mauser bullet in 3 cases, and by a Lee-Metford bullet in the fourth. In all of the 4 examples the missile penetrated the part and escaped without damaging any bone, and the resulting wound healed by first intention.

The first 2 cases are examples of varicose aneurysm, while in the third and fourth cases an aneurysmal varix was discovered. It was quite impossible to diagnose the precise character of the arterio-venous communication before the part was exposed by operation. I venture to doubt if the precise differential signs which are detailed as means for distinguishing one form of arterio-venous aneurysm from another are met with, with any frequency, in actual practice.

In the first of the following cases the superficial femoral vessels were involved; in the second case the lesion concerned the popliteal artery at its point of bifurcation; in the third case the bifurcation of the common femoral was the part injured, and in the fourth example a branch of the external carotid artery had been damaged.

From the point of view of the actual operation case No. III presents the greatest interest. The problem here presented concerns the course which should be adopted when both the superficial and the deep femoral vessels are involved at their precise point of origin. This case and the last one of the series serve to show what satisfactory results may follow upon operative measures which are themselves short of perfection. In neither of these examples was it possible, for different reasons, to carry out the perfect measure and ligature the involved vessels both above and below the point at which they had been wounded.

THE CASES.

CASE I.—This case I have already briefly reported in the BRITISH MEDICAL JOURNAL, in one of the letters written from the seat of war. The man, a private, was wounded at the battle of Colenso on December 15th, 1899. After the evacuation of the camp at Chieveley he was taken to the Fort Napier Hospital at Pietermaritzburg, and here I saw him on December 23rd. He had been hit by a Mauser bullet about the middle of the thigh. The bullet had passed through the limb without injuring the bone. A considerable swelling of the thigh had followed the wound. There was great pressure of work in the field hospitals after the battle of Colenso, and the nature of the injury to the vessels in this soldier was not recognized until he reached Fort Napier.

When I saw him there was still a very large swelling of the thigh, especially about the middle and lower thirds. There was some oedema of the leg. No pulse could be felt at the ankle. The weather was very hot at the time, and no coldness in the limb was complained of. The whole of the extremity was absolutely powerless, and was the seat of considerable pain. The swelling in the thigh was situated over the main vessels, was very tense, gave a sense of fluctuation, and was of indefinite outline. It was the seat of a feeble pulsation, which could be only felt directly over Hunter's canal. In all parts could be heard the harsh buzzing *bruit* which indicates a communication between the artery and the vein. The characteristic vibratory thrill was also to be felt. At the invitation of the officer in charge of the case I operated upon the patient without delay. I first of all exposed the common femoral and placed a temporary ligature around that artery. It was evident that there had been a considerable extravasation of blood at the seat of injury, and I thought it probable that some difficulty would be experienced in finding the damaged parts of the vessels. The exact track of the bullet having been noted, I made a free incision in the line of the main artery from one end of the swelling to the other. A great quantity of extravasated blood was exposed. It was in no way encapsuled, and was cleared away after much sponging. The point at which the artery and vein had been penetrated was discovered, and here was a small enclosure which just merited the name of a sac, and which had without doubt limited further extravasation. The seat of the lesion was in the lower part of Hunter's canal. The holes in the artery and vein were made manifest. The artery was ligatured above and below the wound, and the vein on the proximal side only. The injury to the vein was of less degree than that to the artery. Before the incision was closed the temporary ligature on the common femoral was removed. I had occasion to visit Pietermaritzburg again fourteen days after the operation. The wound had then healed, and the patient was doing well in every particular. I heard of him some two months after the operation, and was told that he was "perfectly well."

CASE II.—A cavalry officer, aged 21, was shot through the upper part of the right leg, at a range of 1,100 yards, on May 3rd, 1901. The bullet was probably from a Lee-Metford rifle in the hands of the enemy. The officer was mounted at the time, and his horse was killed. The wound bled very freely, but the haemorrhage was checked when the part was tied up. He mounted another horse and rode seven miles. There then followed a journey of four days in an army ambulance wagon until the most advanced base hospital was reached. By the twentieth day after the injury the wound was well healed, and the patient was up and on crutches. On the twenty-second day the signs of an arterio-venous aneurysm were discovered. From that day the patient took to the recumbent position and never put his foot to the ground. He came to England, and I saw him in July, 1901. The point of entrance of the bullet was just behind the head of the right fibula. The point of exit was close to the inner border of the tibia. The track of the missile was transverse, was behind the bone, and about on a level with the lower end of the tubercle of the tibia. A skiagraph showed that the bones were perfectly sound. The ankle was swollen and stiff, the knee was stiff, the muscles of the entire extremity were wasted. No definite swelling was present at the site of the injury, but pulsation was visible in the popliteal space and in the upper third of the calf. An intense buzzing *bruit* was to be heard, and the characteristic harsh thrill was to be felt. It was evident that there was an arterio-venous aneurysm at or about the bifurcation of the popliteal artery. The patient was in excellent health. The limb was free from pain, but throbbed on movement. The recumbent position had been most strictly observed. The operation was performed on July 23rd, 1901. A long median incision was made on the posterior aspect of the limb over the lower part of the popliteal space and the upper part of the calf. An arterio-venous aneurysm was exposed at the bifurcation of the popliteal artery. The sac was thin, was very well defined, and was about the size of a walnut. The vessels involved were the posterior tibial artery, the posterior tibial vein, and the anterior tibial vein. The anterior tibial artery had escaped. The sac was excised entire. The posterior tibial vessels were ligatured above and below the communication (four ligatures being therefore ap-

plied). The anterior tibial vein was also ligatured above and below the communication. The securing of the distal end of this vein involved some difficulty. The operation occupied one hour and forty-five minutes, and I had the great advantage throughout of the very able assistance of Mr. Charles Bond of Leicester. The patient made a perfect recovery, and when last seen, on December 7th, 1901, the limb was in excellent condition. The patient could walk many miles at a stretch, could play eighteen holes at golf, could ride, and, indeed, could report himself as well. When the artery was put on the stretch by extending the knee to the utmost, a very faint whistling sound could be heard over an area equal to that of a five-shilling piece. On the least relaxation of this forced position the sound vanished. It was evidently due to compression of the distorted, and no doubt narrowed, artery. There was not the faintest trace of any pulsation, and the limb was free from any sense of discomfort.

CASE III.—A young officer was shot at the battle of Colenso on December 15th, 1899. The bullet—a Mauser—entered the left groin and passed out at the postero-external side of the limb without damaging the bone. There was considerable haemorrhage at the time. As soon as he reached the base hospital at Pietermaritzburg—some few days after the battle—an arterio-venous aneurysm in the left groin was discovered. I saw him at Pietermaritzburg during a visit made to that place between the engagements of Colenso and Spion Kop. There was a pulsating swelling in Scarpa's triangle, over the situation of the bifurcation of the common femoral artery. The veins were becoming prominent. There were the characteristic harsh buzzing *bruit* and the vibratory thrill which are associated with a communication between an artery and a vein. There was nothing to be felt like an aneurysmal sac. There was some pain in the limb, and it could not be used without discomfort. In due course the officer returned to England, the limb since the battle having been kept off the ground and the patient as much as possible in the recumbent position. When I saw him in June, 1900, the local condition had become in all particulars exaggerated. The swelling in the groin had much increased, pulsation was visible over a larger area, and the veins of the thigh were very prominent and varicose, and those nearest to the site of the wound showed pulsation. The limb had become powerless, largely, no doubt, from disuse; it felt cold, and if allowed to hang down soon became tense, purple, and painful. I operated upon the patient on June 7th, 1900. The condition found was that of an aneurysmal varix. The point of communication between the artery and the vein or veins was precisely at the bifurcation of the common femoral. I ligatured the common femoral artery above the communication and the superficial femoral artery below it. Owing to the large size of the veins at the injured spot and their disposition around the main arteries, a view of the profunda artery was very difficult to obtain. The two ligatures, when applied, entirely stopped all pulsation in the district, and caused the characteristic thrill to vanish. More precise examination, however, of the seat of injury made it almost certain that the bullet had damaged the main artery exactly at its point of bifurcation, and that the commencement of the profunda artery was involved in the arterio-venous communication. I was unable to determine whether two veins were implicated or only one. It was obviously out of the question to apply a ligature to the profunda artery, and having in view the future of the limb, I was not disposed to ligature any one of the veins exposed. The operation, therefore, consisted solely in the ligaturing of the common femoral and the superficial femoral arteries. The wound healed by first intention, and the cure appeared for a while perfect. At the end of fourteen days after the operation a careful examination of the groin revealed no sign of any arterio-venous communication. There was no pulsation below the upper ligature, the veins were no longer prominent, nor, indeed, visible; there was no *bruit* to be heard, nor could any thrill be felt. The limb, still kept at absolute rest, was covered up for another week. At the end of that time—that is, twenty-one days after the operation—an examination revealed a return of the *bruit* and of the vibratory thrill over an area 3 in. in diameter. A very faint pulsation could be felt, but none was visible. At the end of five weeks from the day of the operation the condition was unchanged, and the patient commenced to get up and to use the limb. He made rapid pro-

gress. I saw him on January 23rd, 1901. The *bruit* and the thrill were precisely the same. There was no increase in the area over which they could be noted. There were no prominent veins; the limb was free from oedema and from any discomfort. The patient could walk a moderate distance and could ride. The very faintest possible pulsation could be detected on close observation beneath the scar. An examination of the patient made on October 12th, 1901 (one year and four months after the operation), revealed a still better state of affairs. The very faint pulsation was still to be observed, but it had not increased. The *bruit* and the thrill were still present, but were still limited to an area with a diameter of 3 in. There was no swelling, no oedema, no evidences of any abnormality of circulation, and no discomfort. No prominent veins were to be seen. The officer was on remount duty. He could ride and could walk well. The only thing he complained of was that after long or unduly quick walking he experienced a pain in the calf.

CASE IV.—A private soldier was wounded in one of the engagements before Spion Kop, and was brought directly from the field into the field hospital to which I was attached. This was in January, 1900. He had been shot in the neck by a Mauser bullet. The point of entrance was over the ascending ramus of the right inferior maxilla, about 1 in. in front of the lower end of the lobe of the right pinna. The point of exit was over the second left rib, $\frac{3}{4}$ in. to the left of the median line of the sternum and 1 in. below the clavicle. The bullet had passed through the mouth, as shown by a wound just behind the right wisdom tooth. The inferior maxilla was not fractured. There was a considerable haemorrhage from the mouth, which continued at intervals for seven days. There was some loss of voice for three weeks. I saw the patient the morning after his admission. He said as soon as he could speak that he had been disturbed that night by the breathing of a man who was dying on the ground outside his tent. There had been no man lying outside his tent, and the noise he heard was the *bruit* following the injury to his vessels. This *bruit* had, therefore, made itself manifest to the patient within twenty-four hours of the injury. Before he was removed to the base, in the retreat which followed the battle of Vaal Krantz, he presented all the signs of an arterio-venous aneurysm about the upper part of the neck in the vicinity of the angle of the lower jaw. In due course he came to England, and I saw him in London in October, 1900. The right external jugular vein was enormously distended, and showed very distinct pulsation. The veins about the upper part of the neck and the whole of the right side of the face were also very prominent. A soft spongy and pulsating swelling (evidently made up of dilated veins) occupied the neck about the angle of the jaw. The right side of the face was puffy and of a purplish hue. A very distinct harsh *bruit* of a characteristic type could be heard in almost any part of the right side of the head and neck, and the typical vibratory thrill could be felt. Both the *bruit* and the thrill reached their greatest intensity about the angle of the jaw. The patient complained of headache, of severe neuralgic pains in the right side of the face, of giddiness, and of a frequent sense of confusion. Above all he complained of the incessant buzzing in his ears, which was worse when he stooped or when he was lying down, and which disturbed his sleep. The pulsation in the veins was very prominent, and extended beyond the temple upwards to the right eyebrow and eyelid and downwards to the clavicle on the same side. The man was totally unable to do work of any kind, and was much distressed by the constant noise in his ear, and by his giddiness and uncertainty of movement. I operated upon him on November 4th, 1900, a little more than nine months after he had been wounded. I made an incision the whole length of the neck. The involved veins were very large, and obscured every step of the operation. I was unable to determine from the symptoms that the internal carotid had escaped injury. I therefore, in the first place, exposed the bifurcation of the common carotid artery. I found that compression of the internal carotid artery had no effect whatever upon the pulsating mass in the neck, whereas compression of the external carotid artery at once arrested all the phenomena observed about the seat of injury. Carrying the investigation further, I found it next to impossible to locate the exact seat of the arterio-venous communication.

The whole operation area was occupied by large thin-walled pulsating veins which were difficult to deal with. Following strictly the line of the external wounds—as made by the bullet—the damaged vessel should be close to or behind the ascending ramus of the lower jaw. This district was the least easy to investigate as it presented the condition of a vascular sponge owing to the numerous veins which covered the parotid region and filled the hollow of the neck below that area. I thought it best, as a preliminary step at least, to cut off the blood supply of the external carotid district so far as that was possible to be done. I placed two ligatures upon the external carotid on the distal side of the superior thyroid branch and divided the vessel between the ligatures. I then ligatured the superior thyroid and facial arteries. Knowing how free the collateral circulation is in this region no veins were ligatured. The patient was informed in due course that a second operation would have to be contemplated. The patient was for a time so much improved after this procedure that he regarded himself as cured. The pulsation, the *bruit*, and the vibratory thrill all vanished, and the distended veins were no longer to be seen. The headache and giddiness also left him. The operation had been performed in a private nursing home, thanks to the generosity of the lady who owned the home. The patient remained at the home many weeks and then was sent to the seaside, being still apparently quite cured. In time, however, the symptoms began to return, and when I saw him in March 1901 the phenomena of arterio-venous aneurysm were in full evidence. The manifestations, however, were very much less marked. The distension of the veins was comparatively trifling and the patient could only hear the *bruit* when he was lying down with the head upon the affected side. The second operation was performed on March 23rd, 1901. The centre of the incision made was opposite to the angle of the jaw. After some trouble I convinced myself that the arterio-venous communication concerned the internal maxillary artery at some distance behind the ramus of the jaw. It was impossible to reach the vessel without dividing the jaw, and it was a question if mere division would have sufficiently exposed the injured artery. It appeared to me that I was scarcely justified in interfering with the jaw. By means of a free dissection, and by drawing the ramus of the mandible forwards, I opened up the district behind the jaw, but not to an extent which enabled me to reach the damaged vessels. The whole area was obscured with dilated and pulsating veins, and an operation upon the jaw itself would have involved no little risk from haemorrhage. I therefore proceeded to cut off the blood supply from the area as far as was possible. The external carotid was ligatured on the proximal side of the origin of the internal maxillary. Ligatures were also placed upon the temporal arteries and upon the occipital and lingual arteries. The veins issuing from behind the mandible were also ligatured. The second wound healed, as did the first, without any complication. The patient's condition after the operation may be said to be satisfactory. I examined him last on March 18th, 1902, that is, a year after the second operation. The right side of the face is a little red, and a few small varicose veins are to be noticed in front of the pinna and at the outer angle of the orbit. No pulsation of any kind is to be seen or felt in any part of the affected area. No *bruit* is to be heard, nor is any vibratory thrill to be felt. In front of the pinna is a large vein or veins. This vessel is not visible, but it can be made out on palpation. Pressure on this vein with a stethoscope elicits a *bruit*, and when the patient lies upon this side of the face he can hear the *bruit*, but he recognizes that it is not the intense buzzing sound with which he was familiar before the operation. He has no headache, no noises in the ear, and no giddiness, and is in regular employment on some golf links. He describes himself as "very well indeed."

REFERENCE.

¹ *American Journal of the Medical Sciences*, February, 1891.

DONATIONS AND BEQUESTS.—The late Miss Lydia Winterbotham Hale, of Blackheath, has bequeathed £200 each to St. Thomas's Hospital, Charing Cross Hospital, and the Central London Ophthalmic Hospital; also £100 each to the Blackheath and Charlton Cottage Hospital and the Central London Throat and Ear Hospital.