ON A CASE
OF
ANEURISM OF THE EXTERNAL CAROTID,
IN WHICH,
AFTER FAILURE OF THE LIGATURE OF THE COMMON
CAROTID, THE OLD OPERATION WAS SUCCESSFUL.

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THE first paper in the first volume of the 'Medico-Chirurgical Transactions,' which was read January 29th, 1806, is on "A Case of Aneurism of the Carotid Artery." It is the well-known case of Sir, then Mr., Astley Cooper, in which, on November 1st, 1805, he applied the ligature to the lower part of the common carotid of the right side. The case ended fatally; unfortunately, for this reason amongst others, that the operation of tying the carotid artery was in its infancy, and its application in the treatment of aneurism was then for the first time on its trial. Sir Astley, however, pointed out that the cause of his patient's death "was the inflammation of the aneurismal sac and the parts adjacent, by which the size of the tumour became increased so as to press on the pharynx and prevent deglutition, and upon the larynx so as to

excite violent fits of coughing, and ultimately to impede respiration." But, he continues, "A similar event, however, may be in future prevented by performing the operation when the tumour is small, and pressure has not been made by it upon important parts, or if it is of considerable size, as in this case, *by opening the tumour and discharging the coagulum as soon as the inflammation appears.*"

In the same volume (p. 222) is the account of a second case of carotid aneurism by the same author, in which, in 1808, he tied the left carotid for a smaller aneurism than the first and with good result.

Though it appears from the foregoing quotation that the suggestion of resorting to the old operation for aneurism in cases of aneurism of the carotid arteries was thus made by one of the most renowned Fellows of this Society at its first meeting, I do not find in any volume of the 'Transactions' the report of a case in which the treatment has been adopted. It is well known that Mr. Syme reported in the forty-third and forty-fifth volumes of the 'Medico-Chirurgical Transactions' cases of axillary and iliac aneurisms so treated, and has by his practice and writings recommended a return to the "old operation" in certain cases. Mr. Birkett, too, has in the fiftieth volume described a case of large femoral aneurism which he treated successfully by the old operation, and which I had the good fortune to see him perform.

It is also well known that Mr. Syme in his 'Observations in Clinical Surgery' has related a desperate and, from its attendant consequences, what may even be called a romantic operation, in which he cut into a large traumatic aneurism of the common carotid, and by so doing saved the life of his patient as well as that of his patient's assailant. There are doubtless other cases in which the operation has been done for traumatic carotid aneurism, and Mr. Holmes refers to a successful one by Dr. George E. Frothingham, which is reported in the 'American Journal of Medical Sciences' (October, 1876, p. 433).

The following is an abstract report from the notes of my dressers, Messrs. Harratt and Deane, of a case of spontaneous aneurism of the external carotid :

Elizabeth P—, æt. 45, was admitted, under Mr. Morris, into the Middlesex Hospital, on May 20th, 1879. She had been married sixteen years, and had had two children, one of whom, aged fourteen years, was living. She was an intelligent, healthy, but not robust-looking woman, of good physique and dark complexion ; but she had the worn appearance of recent suffering, and was decidedly lachrymose and nervous in manner. Her thoracic and abdominal viscera were healthy ; but eighteen years ago she had diphtheria, and for several years she had been prone to occasional sore throat. Four years ago she vomited on one occasion a large quantity of blood (her statement being two quarts), and this was followed by a severe illness. Recently her hair has been rapidly coming off, and she has had slight sores on her tongue, and a papular rash on her face, which has now disappeared. There was no existing evidence of syphilis. It was stated by her husband that for a long time past she had been very intemperate, but the relations between them seemed to be such that neither's statements of the other could be taken with entire confidence. She gave the impression of being a well-regulated woman and one superior to her class in life.

Present illness.—About eight months ago she noticed a small swelling on the right side in the line of the cervical vessels, and opposite the hyoid bone ; and she some time afterwards became an out-patient under Mr. Clark. The swelling was painful when touched, and also when she turned her head sharply. It increased slightly in size up to eight weeks ago ; since then it has been enlarging more rapidly. It is now about the size of a walnut, pulsatile and expansile, and covered by the edge of the sterno-mastoid muscle. When the chin is in a line with the sternum the swelling can be seen pulsating and the pulsation is completely controlled by pressure on the

common carotid. She complains bitterly of pain all over the right side of her head and neck, and of a distressing feeling of dryness about the throat and fauces. She cannot swallow anything solid without much suffering, and she describes the food as sticking in her throat and requiring a quantity of fluid to wash it down. With the exception of slight hoarseness and a rather whispering tone, there is no difference in her voice, sight, or taste. There is no appreciable difference between the pulsation of the right and left temporal arteries.

During the first part of her stay in the hospital she sometimes complained of the sensation of a swelling on the left side of the neck also, and of the same kind of pain over the left as over the right side of her head; the pulsation of the carotid on this side is very forcible, but no dilatation could be detected.

Several trials were made of digital pressure upon the right common carotid, but these were borne so badly that compressive treatment, excepting under chloroform, was quite out of the question with her. Anodyne ointments, a regulated diet, rest in bed, and grain doses of acetate of lead three times a day, was the treatment adopted.

June 20th.—The tumour was harder, but still pulsated distinctly. She complained of throbbing and pain over the whole front of the neck, and of frequent dryness of the mouth. When the pain was worse the dryness was also worse. The throbbing, which was always most felt by the patient below the right angle of the jaw, was aggravated by lying down, and was then felt as high on the right side as the zygoma.

27th.—All her pain was concentrated in the centre of the right cheek.

July 14th.—Gradually it has become impossible for her to swallow anything solid because of the dryness and pain in her throat. She is very dispirited and sleeps badly; is in constant pain, and often has an unbearable sensation as if her head must burst. The aneurism has not increased much, if at all, in size.

16th.—Chloroform was given at 1 p.m., and the common carotid was tied with a catgut ligature immediately in the line of the omohyoid, the muscle being pulled downwards for the purpose. As soon as the edge of the sterno-mastoid was drawn aside the artery was seen to be greatly distended. All pulsation in the aneurism ceased after tightening the ligature. The ends of the ligature were cut short, the wound was closed by three catgut sutures, and covered with a pad of boracic lint, and over this carbolised gauze. Thirty minims of Liquor Morphiæ were given an hour afterwards. At 5.40 p.m. there was faint pulsation in the right temporal artery, and also in the aneurism, and she was complaining of numbness of the right hand. 6.50 p.m.: pulsation in the aneurism rather more marked. 9.45 p.m.: the numbness of the fingers of the right hand continued; she was in no pain, but complained of soreness of the throat. She had had some quiet sleep. Pulse 93, temp. 99°.

17th (10.50 a.m.).—Had a restless night. Pulsation in tumour very feeble, in the right temporal not very marked. Dryness of throat and numbness of right hand continue. Face flushed; skin hot; tongue moist; very thirsty. Pulse 128, temp. 101·8°. Dressings changed; wound uniting.

18th.—Pulse 114, temp. 100·4°. Right temporal still pulsating feebly. No distinct pulsation in the tumour. Complains of great difficulty in swallowing, and of throbbing pain and dryness in the throat.

20th.—Aneurism pulsates distinctly, but is smaller and harder than before the operation. Wound looks well; the sutures were removed yesterday. A trace of pus escapes from the midpoint. Temp. 99·6°, pulse 96. Complains of headache and difficulty of deglutition.

23rd.—The aneurism still pulsates, and is not quite so hard as it was two days ago; it is about the size of a Kentish cob-nut. Right temporal pulsates distinctly but feebly. Patient is suffering from a severe attack of catarrh, and has a violent pain over the mastoid process of

the right temporal bone. A little discharge escapes from the centre of the incision. In a few days the catarrh and the pain behind the ear had gone. She went on slowly convalescing, but varying from day to day as regards headache, dryness of throat, difficulty of deglutition, and degree of pulsation in the aneurism.

August 12th.—The outline of the aneurism was quite lost, but there was a faint pulsation in the line of the artery in its situation. A sinus leading to the ligature on the carotid was daily discharging a bead or two of pus, sometimes blood-stained.

18th.—The patient detected blood trickling from the sinus; about 3j escaped; it was readily checked by cold-water dressing. The blood was supposed to come from the florid and exuberant granulations which lined and surmounted the orifice of the sinus. A lotion of chloride of zinc (gr. ij ad 3j) was ordered to be applied.

25th.—There has been daily since last note a deeply blood-stained discharge from the sinus, and last night about 3ij of blood escaped. The granulations around the orifice of the sinus form a small fungous tumour. Chloride of zinc lotion still applied.

September 11th.—A small, hard, flattish lump marks the seat of the aneurism, and is very tender on pressure. The patient is again suffering from shooting pains along the neck and right side of the head. The sinus still discharges a little blood-stained pus. There is pulsation on the distal side of the ligature as low down as the upper part of the cicatrix.

She leaves the hospital to-day as it is thought change of air may hasten the healing of the sinus.

After this she came once a week to see me, each time complaining of considerable and widespread pain, like that she suffered before the operation, and the lump above described was increasing in size, but did not pulsate.

October 11th.—She described the pain on the right side of her head and neck as maddening and unbearable, and she felt weak and dejected. The swelling at the angle of

the jaw did not pulsate, but had increased in size and extended both upwards and backwards. It was very tender. About this time she was seen by Mr. Christopher Heath who kindly communicated with me about the case. As he very justly remarked, the condition of the neck as he saw it suggested the idea of a malignant tumour, and this view would, I think, have been taken by any one who had not known the previous course of the case.

16th.—She went to Eastbourne, and whilst there slept for two nights exposed to a draught; then the swelling increased considerably and the pain became even more severe. She returned home on October the 22nd in a very critical and exhausted state. There was still a little discharge from the sinus. The skin over the tumour had become red and œdematous, but no fluctuation or pulsation could be detected; the pain was never ceasing, and deglutition, even swallowing saliva, was difficult. Remedies failing to relieve her, or diminish the inflammation, Mr. Hulke concurred with me in thinking that pus, though deeply seated, had formed and that an exploratory incision was demanded. Further, if it was found that the sac of the aneurism was so far involved that blood-clot or fluid blood escaped from it, it was decided that the aneurism should be freely laid open and the vessels tied. On the 30th, therefore, ether was given and an incision two and a half inches long was made through the brawny œdematous skin, and a small incision into the deeper tissues, whereupon pus oozed up into the opening; dressing forceps were introduced and withdrawn expanded, and more pus escaped; warm lead poultices were then applied over the swelling. For some days after this the pain ceased, and the swelling rapidly subsided, though a good deal of induration remained below the angle of the jaw. The quantity of pus discharged altogether was not large. Her constitutional condition greatly improved, indeed became very good, and the old sinus in the original wound had finally closed by November 2nd.

November 14th.—The recent incision has healed with

the exception of a sinus surmounted with fungus granulations and constantly discharging a little blood-stained matter, very much resembling that which had existed so long in the first wound. Along the front of and above what remained of the swelling there was very distinct pulsation, yet the patient was free of pain and described herself as altogether better than she had been for a very long time past. But this improvement was not to last. The next day the pain returned and subsequently recurred at short intervals.

December 3rd.—After sitting up for a short time a little bleeding took place from the sinus, and again a little more at 2 a.m. December 4th. Some hours later the headache and pain in the neck were as severe as ever, and from this time the swelling rapidly increased again, and continued to pulsate—the pulsation being expansile, while the skin over it became red and œdematous once more.

5th.—I sought a consultation with all my surgical colleagues as to the necessity of laying open the sac of the aneurism. It was decided that the application of ice and the administration of morphia should be tried for twenty-four hours longer, and that then, if no improvement had taken place, the operation should be undertaken. The next day, however, the operation was again delayed, as it was thought the tumour was somewhat harder. It seemed to me, however, that the swelling had extended further beneath the jaw, and the pulsation both in front and behind the line of the upper cicatrix was very marked.

7th.—It was clear the aneurism was still growing, the superficial tissues becoming more tense, and that, in addition to her sufferings and inability to take food, the patient stood in imminent risk of severe and even fatal hæmorrhage at any moment. Accordingly, at 3 o'clock in the afternoon, and with the full concurrence and assistance of my colleagues, I made an incision three inches long over the aneurism through a considerable

thickness of condensed, brawny, and infiltrated tissues, which were very vascular and bled readily. At one spot soft black blood-clot, continuous with the clot in the sac, reached up very nearly to the surface. A second short incision was then made upwards and forwards from the first, so as to get to the front of the sac, and the facial artery, being thus found running off from the aneurism, was secured with a catgut ligature. Search was next made a little lower down, and a second vessel, probably the common trunk of the lingual and superior thyroid, also springing from the inner side of the sac, was treated similarly. The blood-clot was now turned out of the aneurism, and at once there escaped large gushes of arterial blood, which, with the help of Mr. Hulke and Mr. Lyell, was controlled by digital pressure. It soon became evident that this blood flow, which was profuse and in a large stream as soon as the pressure was relaxed, came from the upper end of the aneurism chiefly. A tenaculum was made to fix and raise this part of the sac and had the effect of stopping the bleeding. Two or three attempts to apply a catgut ligature around the vessel above the sac failed, until the incision was prolonged upwards above the level of the angle of the jaw. I had wished to avoid this, for owing to the state of the tissues it was quite impossible to distinguish one structure from another. In doing so I cut across a vein, to which I applied a pair of torsi-pressure forceps, and an artery which was torsioned; this was probably the occipital. It was now easy to apply a silk ligature above the sac, and to remove the tenaculum without further hæmorrhage. A probe was passed down from the sac into the common carotid for a short distance as far as it was pervious. The internal carotid was not seen during the operation, but it was evident that no blood was arriving at its lower end. The torsi-pressure forceps and the end of the ligature were left hanging from the upper part of the wound, the wound was brought together with two or three sutures, and a drainage tube was inserted at its lower end. The next day the temperature

was 101.6° and the pulse 130; she had passed a fairly good night. The tongue was protruded towards the left side. The torsi-pressure forceps were removed.

From this time all went well; the sutures were removed on the second day, and the ligature on the seventeenth day, and she was allowed to sit up in bed on the eighteenth day after the operation. Then convalescence was retarded by a severe attack of quinsy, excited, in all probability, by the thick fog of Christmas day, irritating a part which had for years been prone to disease, or possibly, as she herself thought, by a draught felt during the temporary removal of her bed screen. The right tonsil suppurated and burst; the left recovered by resolution. By January 18th, she had recovered from the quinsy, a week later she was allowed to leave her bed, and on the 10th of February the note runs: "Is getting stronger daily, and feels well. There is very little induration about the cicatrix." On February 12th she was discharged well.¹

Remarks.—The difficulty, admittedly great, of deciding whether an aneurism, situated just above the bifurcation of the common carotid, involves the internal or external carotid was in this case cleared away by the operation. From the absence of pulsation in the pharynx, and from the want of any evidence of pressure upon the jugular vein, there was an inference that the external carotid was the seat of the disease. This inference was confirmed at the operation.

It should be remarked that the catgut ligature effected the complete and permanent closure of the common carotid. Not only was the vessel just above the ligature impervious at the time of the last operation, but never after the application of the ligature did the pulsation on the distal side extend lower than the upper end of the the original cicatrix *i.e.* $1\frac{1}{4}$ inch at least above the liga-

¹ May, 1881.—The patient was shown at the Society's meeting in October, 1880. Since then I have seen her two or three times; she is remaining quite well.

ture. The return of pulsation in the sac a few hours after applying the ligature; the slow consolidation of the aneurism; the feeble pulsation in the vessel on the proximal side of it, but its entire absence immediately above the ligature; the subsequent growth of the aneurism in spite of the complete obliteration of the main vessel; and the violent hæmorrhage, at the last operation, from the orifice of the distal side of the sac, together with the absence of any bleeding at the lower part of the internal carotid prove how important a part the anastomotic circulation of the external carotid plays in aneurisms of the carotid near the bifurcation of the common trunk. So direct is the communication between the branches of the right and left external carotids, and between some of these branches and other vessels on their own side; so quickly is the full anastomosis established; so large is the quantity of blood which may be thus brought to the aneurism by branches springing close to, if not absolutely from, the sac; and so confused must be the whirl, within the sac of an aneurism of the external carotid, of the blood thus reaching it in so many directions, that I think *it would be best in carotid aneurisms near the bifurcation of the common trunk to ligature simultaneously the common carotid and such branches of the external carotid as are easily accessible, viz. the facial, superior thyroid, and lingual, which may all be reached through one oblique incision; and the temporal.*

Whether the aneurism be of the external or internal carotid this proceeding would be safer and simpler than the old operation; and it may be justly inferred from Mr. Porter's and Mr. Syme's cases that the force of the reflux of blood through the branches of the external carotid is sufficient to produce pulsation in aneurisms of the internal carotid as well as of the external.

The return of pulsation in these aneurisms after the application of a ligature to the common carotid has been usually attributed to the anastomosis of the internal carotid within the skull; and it has been said that this

anastomosis is not only much freer than in the external carotid, but that it is "*capable of still conveying the impulse of the heart.*" The answer to this is, I think, that if this be so why is it, considering the size of the internal carotid where it forms part of the circle of Willis, that the pulsation does not return in the aneurism within a few minutes, or why does it ever cease? and why is it that after the common carotid has been tied some time the internal carotid in the neck and in its petrous part right up to the origin of the ophthalmic artery has been found occluded; whilst the external carotid with all, or some, of its branches has been found pervious?¹

The conditions of the circulation in the carotids after ligature of the common trunk are peculiar, and differ from those in other vessels after ligature of a main artery. For instance, in the case of the femoral artery the blood which is brought into the vessel beyond the ligature diffuses itself through the capillaries and into the veins. But, after ligature of the common carotid, blood rapidly reaches the external carotid by its terminal as well as its proximal branches, and is thus running away from the capillaries towards the parent trunk. What, therefore, is to become of it if it meet at the bifurcation of the common carotid with a strong reflux current down the internal carotid? If there be no such reflux, in time, the circulation will adapt itself to circumstances whether the internal carotid is closed or not. Again, it is more in accordance with the requirements of the several parts to suppose, if there be a through channel maintained from one primary branch to

¹ See the post-mortem report of Sir Astley Cooper's second case in 'Guy's Hospital Reports,' vol. i, p. 53; of Mr. Porter's case of "Aneurism of the External Carotid in the Neck," in Porter's treatise 'On Aneurism,' p. 153 and of Mr. Syme's case of "External Aneurism of the Internal Carotid," in 'Lond. and Edin. Monthly Journal,' November, 1842. See also the beautifully injected preparation in the Hunterian Museum of Mr. Heath's case, showing the carotid vessels some years after ligature of the carotid trunk; the common carotid is obliterated, but all the branches of the external carotid are patent, and some of them much enlarged.

the other, that the direction of the current would be from the external to the internal carotid instead of the reverse. The parts supplied by the external carotid can at once be nourished by the anastomoses of the external vessel without drawing off blood from the circle of Willis; besides, the blood reaches the circle of Willis under conditions which prevent any significant degree of compensatory enlargement of the vessels on their way to it.

The second case of Sir Astley Cooper, referred to above, has several points of resemblance to the case of Elizabeth P—. 1. The situation of the aneurism just above the bifurcation of the common trunk. 2. The symptoms before the application of the ligature. 3. The delay in the healing of the wound where the ligature was applied, owing to the existence of a sinus and the fungus granulations around it.¹ 4. The continuance of pulsation in the aneurism for several weeks after ligation of the common carotid.

Sir Astley considered the pulsation "to be the effect of the return of blood by the internal carotid artery from the brain." After expressing his opinion that the aneurism was seated in the internal carotid artery, he goes on to say: "And this led me to hope that the regurgitation of the blood, although at first sufficient to produce a slight pulsation in the tumour, would not continue to support its growth, because as the internal carotid passes through a foramen in the skull a little above the swelling, it could not dilate at that part to bring down any additional quantity of blood into the sac; so that its first effect was likely to be as great as any it could produce. But if the aneurism had been of the external carotid artery, owing to the number of communicating vessels, I should not have been equally sanguine in my expectation that the pulsation would have ceased, as I have known two instances, one of a wounded radial

¹ This was observed in many cases: it occurred in Lyford's, Coates', and Vincent's; and in Post's, of New York, quoted by Hodgson in his work on 'Diseases of the Arteries.'

artery, and the other of aneurism of the anterior tibial, in which the tumour continued to grow by anastomosis after the arteries had been tied above the swellings." But if I may say so without being thought too presumptuous, I think it is doubtful whether the aneurism in Sir Astley's patient was of the internal and not of the external carotid; and that his explanation of the recurrence of pulsation in it is not the most probable. There is the authority of Mr. Holmes for saying that "no trustworthy diagnostic sign has been pointed out by which it can be determined whether the aneurism is seated on the internal or external carotid or one of the branches of the external carotid artery." Sir Astley's patient lived for thirteen years after the operation, and the post-mortem examination ('Guy's Hospital Reports,' vol. i, p. 53) by no means disfavours the view that the aneurism was in the *external* carotid. Moreover, in the clinical report of this case it is noted about a month after the operation that "the facial and temporal arteries on the left side (the side of the aneurism) cannot be felt;" and eight months later the same absence of pulsation in them was observed. Now, from the rapidity with which pulsation often returns in the temporal artery after ligation of the common carotid, and from the fact that the absence of pulsation in the facial and temporal arteries of this patient is not mentioned until the date at which the pulsation in the aneurism "was with difficulty perceived," I venture to think that the return of the pulsation in the sac was due to the anastomosis of the branches of the external artery,¹ that

¹ In the discussion which followed the reading of this paper, Dr. Hilton Fagge referred to an unpublished case, which had come under observation at Guy's Hospital, and which he thought confirmed my opinion with regard to the collateral circulation after ligature of the common carotid. The case was that of a patient who was admitted with aneurism of the internal carotid and aphasia; the common carotid was tied, and the aphasia, which had existed for some days, passed off. The conclusion was, that before the application of the ligature the pressure of the aneurism, which was of the sacculated form, prevented blood finding its way through the internal carotid to the brain; but that after its application the aneurism contracted, pressure was relieved, the

the temporal and facial arteries became obliterated by extension of clot from the aneurism, and that this extension of clot into these vessels was a most important factor in the cure of the aneurism.

It seems to me that the absence in my case of any bleeding from the internal carotid at the time of laying open the aneurism, together with the fact that there was no extension of clot from the common into the internal carotid artery, throws considerable doubt upon the possibility of the anastomosing flow of blood through the arteries within the skull *ever reaching as low down as the origin of the internal carotid in the neck*. Again, in Sir Astley Cooper's case it was found at the post mortem that only about half an inch, and that the cerebral part of the internal carotid, was pervious, while the superior thyroid and the commencement of the external carotid was filled with injection from the arteries of the opposite side; but why, if the anastomosing current had kept open the superior thyroid for so many years, should the flow round the circle of Willis (the vessels of which on the aneurismal side were widely dilated and larger than those on the other side) have maintained a channel along only half an inch of the internal carotid of the affected side. Haller's case, quoted in Hodgson's treatise (p. 314), as well as those of Syme and Porter before alluded to, shows also that the internal carotid is contracted into a slender cord as far as the petrous canal, while into the external carotid the clot extended no further than to the "origin of the labial artery." I may also refer to a case under Mr. Poland's care, in which, when house-surgeon at Guy's Hospital, I had to tie the common carotid artery for violent hæmorrhage from an abscess in the neck. The patient died fifty hours after the ligature had been applied, and at the post-mortem examination the internal carotid where it formed part of the circle of Willis was plugged by ante-mortem clot.

channel of the artery was again open, and the anastomosing circulation by the branches of the external carotid brought the blood again to the affected side of the brain through the internal carotid.

A case which seems to support the same view, viz. that blood does not arrive in the cervical part of the internal carotid from the circle of Willis, is recorded in Joseph Hodgson's work on the 'Disease of the Arteries' (pp. 335 *et seq.*). A man was gored by a cow; the internal carotid and all the primary branches in front of the external carotid were lacerated; bleeding was not immediate, but it came on some time afterwards. Mr. Abernethy tied the common carotid, and the bleeding was stayed. The man died, however, in thirty hours from other causes, and it was found that the internal carotid was torn across, and the superior thyroid, facial and lingual were torn off from the trunk. It is fair to suppose that thirty hours was not sufficient for the anastomoses to be established through the branches of the external carotid after the collapse and hæmorrhage of the accident, but this can hardly be thought of a vessel the size of the internal carotid, which itself forms part of the circle of Willis. Surely here was an opportunity of blood escaping at the lower end of the upper fragment of the artery from the cerebral vessels, almost as easily as from the upper end of the lower segment direct from the heart. But it was not so. Guthrie, in a clinical lecture in the 'Lancet' (vol. ii, 1850, p. 143), quotes a case which, whilst it shows the importance of the collateral circulation of the superior thyroid branch of the external carotid, suggests the absence of any reflux along the internal carotid trunk. "During an operation at Westminster Hospital the external carotid was opened a little above its bifurcation. A ligature was placed upon the common carotid; the bleeding was not in the least arrested. A ligature was then placed upon the external carotid above the hole in the artery, which still continued to pour out blood. *A third ligature was placed upon the internal carotid without success.* A fourth ligature was then applied on the external carotid below the hole in it, including the superior thyroid, after which the bleeding ceased and never returned." In Case 123, also referred to in the same

lecture, the internal carotid throughout nearly its whole length was empty, and Guthrie supposed that a "ligature on the external carotid might have been sufficient"—the common carotid having been previously ligatured.

And if it were the case that blood can escape from the skull along the internal carotid after the ligation or other occlusion of the common carotid, would not the additional deprivation to which the brain would be thus subjected tend to produce cerebral softening more often than we find it following the application of the ligature to the trunk vessel? For then not only would one quarter of the whole supply to the brain be cut off, but more than this, by as much as escaped down the internal carotid. The effect of injections after death are not reliable in reference to this question, because the force of the injection and the difficulty of escape of the fluid by the capillaries into the veins of the brain, which are full of blood, would assist the flow into any large and empty tube, even though it ran off a nearly horizontal plane to take the zigzag course of the upper end of the internal carotid.

Further, it ought to be borne in mind that in the living subject there is a strong *vis-a-fronte* force at work to draw blood off from the circle of Willis into the brain substance and its membrane, as well as into the orbit and to the eye; whereas there is an almost complete absence of anything like capillary attraction at work on the internal carotid as it passes through the petrous bone and along the neck.

With reference to the treatment of aneurisms of the carotid near the bifurcation, however, it must be admitted that whether Sir Astley's case was one of aneurism of the external or internal carotid, the result of the case gives some encouragement to the employment of the ligature on the common carotid alone. And Mr. Porter's case does the same in aneurism of the internal carotid. But it should be borne in mind that Sir Astley's did not recover until the facial and temporal arteries became plugged; and the perusal of Mr. Porter's successful case, as given

in more detail in the fifth volume of the 'Dublin Hospital Reports,' leads one to the opinion that the patient had a very narrow escape from suppuration of the sac, and that it was the pressure of the tumour upon the external carotid and its branches, which finally worked the cure of the aneurism.

I therefore cannot help coming to the conclusion that in all such cases the chances of success of the ligature of the common carotid will be much increased if we cut off at the same time the collateral circulation through the branches of the external carotid; and that if this be not done there is a very great probability that after a short time the aneurism will again begin to grow and set up the chain of serious consequences witnessed in the case just related, and in others alluded to in this paper, and which nothing but the operation of Antyllus is sufficient to overcome.

Perhaps to some it may seem uncertain whether Sir A. Cooper, in recommending that the tumour should be opened, and the coagulum discharged as soon as inflammation appears, had in view the old operation, or only a means of relieving the more urgent symptoms of local inflammation.

But the mere incision for the discharge of coagula into an inflamed aneurism which has been treated by the proximal ligature, makes no provision against the effects of collateral circulation, and of the hæmorrhage which is likely to occur from the vessels on the distal side of the sac.

In a case reported by Mr. Vincent in the tenth volume of the Society's 'Transactions,' in which inflammation occurred round an aneurism at the bifurcation of the right carotid, we find that death followed immediately the incision of the aneurism, though the artery below the ligature was completely obliterated. Again, in Mr. Coates's case, reported in the eleventh volume of the 'Med.-Chir. Trans.,' an aneurism of enormous size, which probably commenced in the external carotid, was incised for suppuration of the sac, and the man died after repeated severe hæmorrhages; the

ligature had occluded the artery, which "seemed to be converted into a solid incompressible substance," and at the post-mortem examination an artery, almost certainly the facial, was divided in detaching the skin from the lower maxilla; this artery "readily received a probe, which passed into the cavity of the sac." Mr. Coates in reviewing the circumstances of his case, came to the conclusion that in a similar one he would open the sac earlier, and gives his reason for doing so in the following words: "For it appears that the coagula produced the severe symptoms of local inflammation, which caused the enlargement of the anastomosing vessels, and subsequent hæmorrhage." Not a word about the possibility of the anastomoses having been established prior to the inflammation, as the result of the aneurism itself, or of the ligature used for its cure. Not a word about the necessity of taking steps to prevent distal hæmorrhage after turning out the clot. Yet, after carefully reading his case, one cannot resist the conclusion that had ligatures been applied above the sac, and to the branches communicating with it, at the same time as, or even within some days after the incision of the aneurism, the life of his patient might possibly have been spared.

Mr. W. H. Porter ('Treatise on Aneurism,' p. 154) describes a very melancholy case in which after ligature of the common carotid very low down, and suppuration of the sac, he made a free incision into the tumour "with a view to discharge the matter, turn out all coagula, and then by applying pressure externally seek the obliteration of the sac." Though he thought there was "no cause for apprehension beyond the wearing and wasting hectic that would probably be established," the man bled to death. On examining the cavity at the time of the first hæmorrhage he saw "several streams of arterial blood passing in different directions through a broken clot at the bottom of the sac," and his impression was that "*some branches opened into and communicated with the cavity.*"

In further illustration of the importance of the collateral

circulation in carotid aneurisms, though from a negative point of view, another historical case may be referred to, viz. that recorded by Wardrop in the thirteenth volume of the 'Med.-Chir. Trans.,' in which he first applied the *distal* ligature for a carotid aneurism. In this patient, a woman, aged seventy-five years, the skin over the aneurism ulcerated and a quantity of clot was discharged, but she recovered without having any active hæmorrhage whatever.

It is not too much to suppose, had there been no ligature on the distal side of the aneurism, *even though the vessel on its proximal side was entirely occluded*, that the same fatal hæmorrhages would have followed the ulceration in Wardrop's case as followed the incision in Coates's and Porter's and Vincent's cases.

It was by stopping the flow of blood into the distal side of the aneurism that Elizabeth's P—'s recovery was ultimately obtained; and by not doing so at the time when the common carotid was ligatured, that the subsequent growth of the aneurism was possible. For these and other reasons stated in the text, I should be disposed, if a similar case presented itself to me, to ligature the accessible branches of the external carotid at the same time that I applied the ligature to the common carotid itself.