A CASE
OF
EXTIRPATION OF A LARGE NON-
PULSATING ANEURYSM
INVOLVING THE COMMON, INTERNAL, AND EX-
TERNAL CAROTID ARTERIES OF THE RIGHT
SIDE OF THE NECK
WITH
REMARKS ON NON-PULSATION IN ANEURYSMS AND
THE TREATMENT OF ANEURYSMS BY
EXTIRPATION
BY
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I MAY say at once that neither by myself nor my colleagues was the swelling in this patient's neck diagnosed as an aneurysm. Indeed, it was only at the operation undertaken for the purpose of exploring and, if possible, of removing what was believed to be probably a malignant tumour, that the true nature of the swelling

was discovered. There was absolutely no pulsation to be felt, and although there was some difference of opinion as to whether the swelling was malignant or innocent, all who saw it considered that it was a solid growth, probably of glandular origin.

A. B—, a ship's steward, 49 years of age, was sent to me by my friend Mr. W. H. Johnson, under whose care he had been for some time. He stated that some six years ago he first noticed a little lump in the right side of the neck, which had grown slowly and without pain until four months ago, since which time it had begun to increase rapidly. At first it was hard, painless, not tender on pressure, and felt to Mr. Johnson like an enlarged gland. Some of the teeth on the right side were discovered to be carious, and two were extracted, but without influencing the swelling.

The patient, a stoutish, florid, short-necked, and healthy-looking man, had hitherto enjoyed excellent health, and his family history was good. There existed on the right side of the neck, extending from below the right ear and angle of the jaw almost down to the clavicle, a swelling the size of a cricket ball. It reached nearly to the middle line in front, and behind passed deeply beneath the sterno-mastoid muscle. It was roughly globular in shape with a somewhat irregular surface, and was generally hard in consistency, but soft and semi-fluctuating in places. The skin over it moved freely, and although it clearly had deep connections it was not fixed to bone, nor to the larynx, which moved independently both vertically and laterally. No pulsation was present, and nothing in the form of a primary growth was discoverable either in the mouth, pharynx, or larynx. Breathing and swallowing were quite natural; the pupils were equal; and nothing was noticed abnormal in the pulse; in short, the only trouble complained of was the inconvenience in moving the neck, due to the large size of the swelling, and a shooting pain, like earache, in the right ear at night-time. A medium-sized exploring syringe was passed

deeply into the tumour at one of the soft spots, but only a little glairy fluid was obtained, the piston being sucked back when released from pressure. I came to the conclusion that the swelling was primarily glandular, and that its recent increase made it probable that it was now malignant in nature. The patient was placed on medium doses of liquor arsenicalis, and in November, 1895, he was shown at our weekly consultations, when those of my colleagues who were present considered the tumour was now probably malignant. There appeared some doubt, however, whether it might not be merely inflammatory, and the majority advised that an exploratory incision should be made. All agreed that if the growth were found malignant the incision should be closed, as it was felt, considering the size of the growth and its evident deep connections, that its extirpation under these circumstances could only be accomplished with extreme difficulty and risk.

The state of the case having been fully placed before the patient, he decided, after consultation with Mr. Johnson, to have an exploratory incision made. On December 5th, 1895, with the assistance of Mr. Berry, our then surgical registrar, I proceeded to explore the growth. Having placed the patient under chloroform I made an incision about three inches in length over the tumour along the anterior border of the sterno-mastoid. The tumour when first exposed appeared to be well encapsuled though slightly adherent to the neighbouring parts. When cut into it was of a greyish colour and firm consistency. Seeing that the growth was well encapsuled and was now obviously not malignant, I determined, with the concurrence of Mr. Berry, to attempt its removal. Mr. Berry at this stage of the operation was of the opinion that we were probably dealing with an old thyroid cyst. Whilst, however, cautiously continuing the enucleation, a sudden gush of darkish blood took place from the exploratory incision previously made in the tumour, but was controlled by the fingers, sponges,

and gauze. For the first time it dawned upon us that we were dealing with an aneurysm ; we felt, however, at this stage of the proceedings there was nothing left but to complete its extirpation.

Accordingly, whilst Mr. Berry controlled the hæmorrhage, I cautiously dissected downwards towards the clavicle till the common carotid was discovered entering the lower and outer part of the sac. Two stout silk ligatures were applied, and the artery divided between them. The tumour was now freed from its deep connections, special care having to be taken in dissecting off the vagus nerve, which ran along and was adherent to the outer wall of the sac. The internal jugular vein was not seen ; it was certainly not adherent to the tumour, and was not tied. It may have been obliterated by the pressure of the aneurysm. The dissection was next continued around the upper part of the tumour, and this was the most difficult step in the operation, since the tissues were a good deal matted together, and the aneurysm ran very deeply under the jaw and upwards towards the parotid gland. Finally, the dissection left the aneurysm at its upper part attached by only a pedicle about as large as a little finger, which was evidently the dilated internal carotid artery, the main external carotid artery having probably been tied amongst the number of large vessels which had to be secured during the dissection at the upper, anterior, and internal part of the tumour. After ligature of the pedicle the aneurysm was cut away, a very small piece of the sac being left with the stump. The operation lasted about an hour. Towards the end the patient got rather faint, especially when the vagus nerve was being handled, but the loss of blood was not great. The aneurysm wall was well marked everywhere. It was thinnest at the inner and back part close to the pharynx. At the anterior part the clot was very dense and was decolourised, but at the back and inner part it was dark and recent. It was evident, therefore, that the aneurysm was extending backwards and inwards, and that

before long it would probably have ruptured into the pharynx or cellular tissue of the neck. The huge wound, having been thoroughly irrigated and cleansed with perchloride of mercury solution (1 in 2000), was closed, except at its lowest part, where a drain-tube was inserted. A voluminous pad of sal-alembroth gauze and wool was firmly bandaged on, so as to ensure as much as possible the tissues being in contact. The subsequent history of the case was uneventful. The temperature, with the exception of a rise to 100° on the second day, remained subnormal throughout. The wound healed by the first intention save at the situation of the drain-tube and at one other spot a little above, which subsequently opened, and from which some of the deep ligatures continued to be discharged for some weeks. The patient was kept for the first fortnight with his head fixed between sand-bags on moderately low diet, so as to reduce arterial tension as much as possible. He was discharged from the hospital on January 19th, 1896.

Remarks.—I was fortunate in having asked my colleagues to see this case with me in consultation, or I might have laid myself open to the charge of having carelessly overlooked an aneurysm. The fact that the tumour might be an aneurysm had not escaped me. Before puncturing with the exploring syringe I carefully examined for pulsation, and noted at the time in my case-book that there was none present. My surgical colleagues who saw the case with me, Mr. Berry, and the house surgeons, can also vouch for the absence of pulsation. Even when the sac was fully exposed in the exploratory incision and during its enucleation no pulsation was detected. The absence of pulsation, I take it, was due to the aneurysm having become almost consolidated except at its upper and back part, where it was encroaching on the pharynx, and it seems possible that had a finger been passed down that cavity pulsation might have been felt through the pharyngeal wall. The mouth, pharynx, and larynx were explored with the

laryngoscope for the purpose of excluding a primary growth in these situations, but as nothing was seen and the patient had no difficulty in swallowing, a digital examination was not made. The non-escape of blood on puncture, I presume, was due to the needle having entered the consolidated portion. Non-pulsation in an aneurysm, except when it has become consolidated, diffused, or inflammation or suppuration has occurred in the sac, is apparently a somewhat rare phenomenon, for my friend Mr. Miles has made a search for such in medical literature, and the only recorded instances he has been able to find are those mentioned by Mr. Holmes in his 'System of Surgery,' those related by the late Mr. Marrant Baker in the fifteenth volume of 'St. Bartholomew's Hospital Reports,' a case recorded by Dr. Karewski in the 'Berliner klinische Wochenschrift,' and a case of Dr. Schopf in the 'Wiener klinische Wochenschrift.' "Sometimes," says Mr. Holmes, "after an aneurysm has ceased to pulsate and become stationary, it will again commence to grow, and the pulsation will recur. In a case of this kind which was furnished by a preparation to the museum of St. George's Hospital, an increase in size was noticed without any return of pulsation. The artery had been tied above the tumour, and the increase of the latter, which was very marked, from the size of a hen's egg to that of an ostrich's in twelve months, led to the suspicion that the diagnosis had been mistaken, and the disease not aneurysmal but malignant. After death the accuracy of the original diagnosis was established, but the cause of the absence of pulsation remained obscure."

Mr. Holmes also quotes a case of a woman under Mr. Vincent's care at St. Bartholomew's Hospital, in which the absence of pulsation was attributed to the orifice being at the deep surface of the tumour, and the force of the stream probably broken by clots. The diagnosis of aneurysm in this case was at length verified by an exploratory incision, and amputation was performed.

Mr. Morrant Baker, in his instructive paper in the 'St. Bartholomew's Hospital Reports,' relates two cases under his own care in which, on account of the absence or feebleness of pulsation, much doubt existed as to whether the tumour was an aneurysm or a malignant growth, and one under the care of Mr. Hulke in which like difficulty existed. He also refers to three other cases, two known to Mr. Maunder, and one to a friend whose name is not given. The sequel showed that these cases were aneurysmal. Mr. Baker believed that the absence of pulsation in them was due to leakage and the consequent effusion of blood into the tissues. In the three cases that came under his own cognizance this explanation seems probably correct, but it hardly applies to my case, in that the wall of the sac was everywhere well marked though thinned posteriorly.

The case related by Dr. Karewski in many respects resembles my own. The aneurysm was of large size, reaching from the jaw almost to the clavicle; it involved the carotid arteries, and there was absolutely no pulsation nor bruit. During the operation no pulsation was felt, and on puncture with an exploring trocar blood flowed in a black non-pulsating stream. It was thought to be either a growth or a blood-cyst in connection with a vein, and its aneurysmal nature was only discovered, as in my case, during the operation. The carotids were tied, the clots turned out, and the wound plugged, the patient making a good recovery. Dr. Karewski offers no satisfactory explanation of the absence of pulsation. In Dr. Schopf's case there was no pulsation, neither could any history of such be obtained. It was consequently diagnosed as a growth, and only discovered to be an aneurysm at the operation undertaken for its removal. The absence of pulsation may be attributed to the thickness of the wall of the sac and the presence of firm blood-clot in the interior. The aneurysm seems to have been undergoing a process of consolidation.

The treatment of spontaneous aneurysm by extirpation

has received some attention during the last few years, and several cases have been recorded in which this method has been successfully employed in the treatment of spontaneous aneurysms in the extremities, but I have only been able to discover two cases in addition to my own in which a spontaneous aneurysm of the carotid has been dealt with in this way, namely, the case of Dr. Karewski already referred to, and that of Mr. Henry Morris in the sixty-fourth volume of our 'Transactions.' In Mr. Morris's case a return of pulsation and increase in size had occurred after ligature of the common carotid, and the old operation of laying open the sac, turning out the clots, and securing the vessels feeding the aneurysm was successfully performed. Mr. Morris in his paper refers to the well-known cases of Mr. Syme and Mr. Frothingham, in which traumatic aneurysms of the common carotid were successfully incised, and Mr. Briggs in the 'Journal of the American Medical Association' for 1886, and Herr Saltzmann in the 'Finska läkaresällsk förh.,' vol. xxiv, relate somewhat similar cases.

In the cases of Karewski, Morris, Syme, Frothingham, Briggs, and Saltzmann, however, the old operation of laying open the sac and turning out the clots was employed; but in a case of *traumatic* aneurysm recorded by M. Delargnière the tumour was dissected out after the common carotid had been divided between two ligatures as in my own case. In my own and in Karewski's case it was not known previous to the operation that we were dealing with an aneurysm. In Delargnière's case the dissecting out appears to have been undertaken deliberately. Had the aneurysmal nature of the swelling been recognised in my own case I do not think it would have been possible to apply a ligature to the common carotid for want of available space between the tumour and the clavicle; and had it been possible I doubt if it would have been successful, since, as in Mr. Morris's case, so many large vessels opened into the upper part of the sac. At the same time I do not know that I should have

cared to undertake what would have appeared to me with my then experience the very formidable operation of dissecting out the sac. But from the comparative ease with which the enucleation was performed, the only trouble we had being that from the escape of blood through the exploratory incision in the sac, I would submit that in the case of large aneurysms in this situation in which the common carotid cannot be ligatured, and in which the aneurysm involves several large vessels as here, extirpation holds out the best chances of success; and I am not sure that even in the case of small carotid aneurisms it would not be safer to dissect out the sac than to ligature the carotid, since by so doing the risk of setting free emboli, as pointed out by M. Delarivière, would be probably much diminished. Had there been no hæmorrhage from the sac to control, nothing would have been easier than the enucleation, for after the proximal artery had been divided between the two ligatures the sac was readily dissected up from the neighbouring structures, the large vessels communicating with its upper and inner part were secured without any particular difficulty, and by drawing the sac down from beneath the angle of the jaw the main internal carotid was brought well into view. The only real trouble lay in controlling the bleeding from the wound in the sac during the necessary movements involved in dissecting it out, and thus keeping the field of operation clear of blood.

A consideration of my case led me to review the wider question of extirpation of aneurysms in general, so with the help of my friend Mr. Ernest Miles I looked up the cases of aneurysm treated by extirpation that have been published during recent years. A large number have been recorded. The majority of these, however, are of traumatic origin, and many of quite small size and situated on medium-sized vessels, as the radial or tibials. Since such aneurysms present no particular interest I have not tabulated them. I have myself dissected out

five or six small traumatic aneurysms during the last year or so, and I imagine that most surgeons have had a similar experience.

Dismissing, then, the traumatic aneurysms, I have collected and tabulated thirty-three cases of large idiopathic aneurysms treated by extirpation. I know of others, the notes of which, however, are too brief to be of use, and I have been unable to gain access to the periodicals, &c., in which an original account of them is published.

Of the thirty-three cases of spontaneous or pathological aneurisms here tabulated all except two were apparently the result of atheromatous changes in the artery in which they were situated. Seventeen involved the popliteal, six the common or superficial femoral, three the common carotid, two the junction of the external iliac and femoral, two the subclavian and axillary, one the subclavian, one the upper part of the posterior tibial, one the third perforating branch of the profunda. The operation of extirpation was undertaken in ten cases on account of other surgical methods, such as compression, flexion, or ligature, having previously failed; in four on account of the aneurysm having become diffused; in four because rupture of the sac seemed imminent; and in six because the aneurysmal nature was not recognised, and the swelling was thought to be a new growth. In nine the reason for the choice of operation is not stated.

In five cases, including my own, the aneurysm was removed by first tying the artery on the proximal side in two places, dividing the artery between the two ligatures, dissecting out the sac, and removing it after the artery or arteries had been ligatured on the distal side.

In fifteen the sac was exposed, the artery ligatured on the proximal and distal side of the aneurysm, and the sac then removed entire.

In three cases leaking had occurred and a false sac formed. This was laid open, the clots were turned out, the artery was then tied at the proximal and distal sides of the true sac, and the latter removed entire.

In three cases after the sac had been exposed and the artery tied on the proximal and distal side, the sac was opened, the clots turned out, and the sac plugged. In seven cases the sac was opened, the clots turned out, and the artery then secured on the proximal and distal side. In four of these the sac was not removed; in the other three it was removed entire or piecemeal.

Thus three chief methods of extirpation were employed :

1. The old operation of laying open the sac, turning out the clots, and ligaturing the artery above and below.

2. The same operation *plus* the removal of the sac by dissection.

3. Removal of the sac after the artery had first been tied above and below.

The last method, slightly modified as in my case and in four others, I would submit is the ideal way of extirpating an aneurysm. For after two ligatures have been applied to the artery on the proximal side, and the artery has been divided between them, the aneurysm, which remains full of blood and retains its form, can be more readily dissected up from its deep connections than when the sac has been previously opened, and each step of the dissection can be clearly seen, since the ligature on the stump of the vessel entering the sac prevents the sac collapsing. By working round the sac from the proximal towards the distal end, the distal artery is more readily discovered than it is by searching for it at the distal part of the sac, and with less disturbance of the parts; and any large secondary branches that may enter the sac are easily found in the course of the dissection, and can be promptly secured.

All the cases recovered except three, and in one of these fatal cases death was due to erysipelas and supuration of the knee-joint, the result of the wound becoming septic; in another to gangrene of the limb, amputation being refused; and in another to erysipelas of the wound and the formation of a second aneurysm at

the seat of proximal ligature. In the first of these cases the wound was left open and plugged, and the patient was an alcoholic. The treatment of the wound in the second case is not stated, but the vein was wounded and tied. In the third case the wound became infected with erysipelas, and the patient died one hour after ligature of the innominate and carotid, which was undertaken to arrest the bleeding from the second aneurysm, fifty-nine days after the operation of extirpation.

Gangrene occurred in only three cases (and in one of these was limited to a small patch on the sole of the foot) although in twelve of the cases a portion of the vein corresponding to the aneurysm was extirpated or tied. There does not appear, therefore, to be more risk of gangrene after extirpation than there does after the Hunterian ligature; indeed, it is possible there is less, since the extirpation of the tumour is likely to relieve pressure on the collateral vessels. There is, moreover, less danger of emboli, and in that the main artery is obliterated at only one spot instead of at two, there is better chance of an efficient collateral circulation becoming established.

In thirteen cases the wound healed by first intention. In twelve cases a plug was employed and the wound healed by granulation. In one secondary hæmorrhage occurred. In this case the sac was laid open and not removed. In one a second aneurysm formed above the proximal ligature.

The aneurysms for which extirpation would appear most suitable are these:

1. Where there is insufficient room to apply a ligature to the artery on the proximal side, or where a proximal ligature is attended with great risk, as ligature of the innominate for subclavian aneurysm.

2. Where a number of large vessels communicate with the sac.

3. Where other methods have failed to cure the aneurysm.

4. Where the aneurysm, as in the popliteal artery,

has become diffused, or rupture of the sac or gangrene of the limb is threatened.

5. Where the setting free of emboli, as in carotid aneurysms, would be attended with risk of cerebral softening.

Lastly, the extirpation of an aneurysm in a suitable case, *versus* ligature of the proximal or distal artery, holds out the further advantage that, inasmuch as the whole aneurysm is got rid of, the cure is radical, and all risk of recurrent pulsation, passive enlargement without pulsation, secondary hæmorrhage and inflammation and suppuration of the sac, and later, cicatricial contraction with consequent involvement of the nerve trunks and the impairment of the mobility of joints is removed. From a review of the cases, and from the experience gained in my own, I think it is shown that the operation of extirpation, although no doubt a more formidable one than simple proximal ligature, may, if all modern surgical precautions are taken, be looked upon as a most successful method of treating an external aneurysm, and is perhaps the best that can be adopted for the conditions that have been mentioned. Such a review, however, hardly supports the contention of those surgeons who advocate that the excision of an aneurysm should be the routine treatment. For an ordinary popliteal aneurysm without complications, enucleation can hardly be compared with such a simple and, as a rule, satisfactory procedure as ligature of the popliteal, or even of the femoral, at the apex of Scarpa's triangle. Thus on referring to the tables it is seen that though in some of the cases the enucleation was accomplished readily, in others there was much difficulty in freeing the sac from the external and internal popliteal nerves and the popliteal vein. Indeed, in several cases the vein was injured, or was so adherent that some inches of it had to be removed, whilst in other cases the sac walls were found so thin that the enucleation could not be accomplished, and the sac had to be laid open, with the attendant difficulties. In one case the operation is said to have

taken three hours. In one the sac ruptured during the dissection, and alarming hæmorrhage occurred. Between ligature of the proximal vessel, when this is applicable, and the old operation of extirpation by opening the sac, turning out the clots, and seeking for the artery above and below, at any rate, there can hardly be any comparison.

A table is appended of the thirty-two cases of spontaneous aneurysms treated by extirpation; and a second table of nine cases of carotid aneurysm, both spontaneous and traumatic, treated in like manner. All these nine cases recovered. In two the sac was dissected out after the artery had been tied above and below. In the remaining seven an incision was made into the aneurysm, the clots turned out, and the vessel then secured. Three were spontaneous aneurysms, and are already quoted in the first table; the other six were traumatic.

TABLE OF CASES.

Nine Cases of Carotid Aneurysm

No.	Reference.	Surgeon.	Sex.	Age.	Cause.	Artery affected.	Other treatment adopted.
1	Unpublished, 1895	Walsham	M.	49	Spontaneous	Common carotid	None
2	Arch. Prov. de Chir., p. 225, 1896	Delar-genière	F.	16	Traumatic	Common carotid	None
3	Observations in Clinical Surgery	Syme	—	—	Traumatic	Common carotid	None; recent case
4	Amer. Journ. Med. Sciences, vol. ii, p. 433	Frothing-ham	—	23	Traumatic	—	Recent case
5	Journ. of Amer. Assoc., p. 553, vol. vi, 1886	Briggs	M.	Young	Traumatic	Common carotid	None; five weeks' duration
6	Med.-Chir. Trans., vol. lxiv, 1881	Morris	F.	45	Spontaneous	External carotid	Common carotid tied
7	Finska Läkare-sällsk förh., xxiv, p. 56, 1885	Saltzmann	—	—	Traumatic	Carotid	Not stated
8	Berl. klin. Woch., 1891, S. 909	Karewski	—	—	Spontaneous	Common carotid	—
9	Brit. Med. Journ., vol. i, 1898, p. 517	Annandale	—	—	Traumatic	Common carotid	None; not room to secure carotid below sac

Twenty Cases of Spontaneous Aneurysm in which Sac was exposed,

No.	Reference.	Surgeon.	Name.	Sex.	Age.	Locality.	Artery affected.	Other treatment adopted.
1	Frenken, Über Aneurysme und die Chirurg., Inaug. Diss., Bonn, 1886	Trendelen-burg	—	M.	40	Thigh	Femoral	Digital compression

treated by Extirpation.

Symptoms.	Operation.	Result.
Large non-pulsating swelling; no signs of aneurysm	Sac dissected out after common carotid divided between two ligatures	Recovery.
Well-marked sac size of orange	Sac dissected out after common carotid divided between two ligatures	Recovery.
Large extravasation into neck	Incision; clots turned out; artery ligatured	Recovery.
Large extravasation into tissues of neck becoming circumscribed and pulsating	Incision; finger passed into sac to control bleeding; artery and vein tied above and below wound	Recovery.
Pulsating swelling in neck	Incision; sac opened; artery tied above and below	Recovery.
Recurrent pulsation and increase in size	Incision; clots turned out; arteries tied above	Recovery.
Not mentioned	Incision	Recovery.
Thought to be a tumour or cyst; no pulsation; no bruit	Incision; clots turned out; artery ligatured above and below	Recovery.
Diffuse aneurysm following ligature of common carotid for sarcoma of face	Incision; clots turned out; artery tied above and below	Recovery.

Artery tied on Proximal and Distal Side, and Sac removed.

Symptoms.	Operation.	Result.	Remarks.
Pulsating swelling, size of hen's egg; usual signs of aneurysm	Longitudinal incision over swelling; sac exposed; artery ligatured above and below sac; sac removed; entire; wound closed	Wound healed by primary intention. Recovery complete	The sac was readily dissected up, as there were no adhesions. ? Traumatic.

No.	Reference.	Surgeon.	Name.	Sex.	Age.	Locality.	Artery affected.	Other treatment adopted.
2	Hoppe, Über Behandlung der Aneurysmen, Greifswald, 1885	Löbker	—	F.	8	Left popliteal space	Left popliteal artery	Not mentioned
3	Beiträge zur klinischen Chirurg., 1892, vol. ix	E. Kübler	T. R.	M.	56	Right popliteal space	Right popliteal artery	Forcible flexion of leg upon thigh; digital and instrumental compression
4	Ueber Extirpation von Aneurysmen, Inaug. Dissert., Berlin, 1886	Köhler	—	M.	29	Right popliteal space	Right popliteal artery	Digital and instrumental compression
5	Jahresbericht der Chirurg. Abtheilung, Basel, 1891	Socin	Z.	M.	63	Left popliteal space	Left popliteal artery	Not mentioned
6	Bull. et Mém. de la Soc. de Chirurgie, Nos. 9 and 10, 1895	Heurtaux	—	F.	11	Femoral aneurysm, left	Common and superficial femoral	Not mentioned. No disease; a traumatism suggested from early infancy
7	Unpublished	Walsham	A. B.	M.	49	Right side of neck, extending from jaw to near clavicle	Common carotid	None

Symptoms.	Operation.	Result.	Remarks.
Pulsating swelling; pulsation very violent, and loud systolic bruit audible	Longitudinal incision over tumour; sac covered by internal popliteal and perineal nerves; nerves drawn aside, sac dissected up, artery ligatured above and below; the sac removed entire	Wound healed by granulation after being packed with iodoform gauze. Recovery complete	No history of an injury could be obtained to account for the occurrence of an aneurysm in so young an individual.
Large pulsating tumour size of hen's egg; usual signs of aneurysm; compression of artery above failed to arrest pulsation	Incision 6 inches long over tumour; sac exposed; artery ligatured above and below sac; sac then extirpated entire	Wound healed by first intention. Recovery complete	The Hunterian operation was not thought advisable, since compression failed to arrest the pulsation.
Large pulsating swelling size of goose's egg; skin over tumour discoloured; some oedema of leg and foot	Longitudinal incision over tumour; femoral artery ligatured above sac; anterior and posterior tibials ligatured below; sac extirpated; 2 inches of the popliteal vein which was adherent to the sac was also removed	Wound healed well. Perfect recovery. No untoward result from interference with vein	The whole popliteal artery was occupied by the aneurysm, which necessitated ligature of femoral and tibials.
Large pulsating tumour size of goose's egg; had existed 1½ years	Incision 6 inches long over tumour; artery ligatured above and below sac; sac removed entire; wound drained	Wound healed well. Patient left hospital in 4 weeks	In spite of advanced age, and therefore greater risk of atheroma in the arteries generally, patient made good recovery.
Tumour extended from 2 inches below groin to lower part of Hunter's canal. Had been growing 15 months	Esmarch's tourniquet; incision 8 inches long; artery ligatured above and divided two places; sac dissected up; sac removed entire after ligature applied to popliteal; upper part of sac ruptured during operation; alarming hæmorrhage; abdominal aorta compressed; 5½ inches of femoral vein removed	Good recovery	Sac was adherent; 35 dilated arterial branches secured and tied during dissection.
Large non-pulsating swelling; no sign of aneurysm present	Exploratory incision; tumour cut into; enucleation begun; gush of blood. Discovered to be an aneurysm. Carotid tied below with two ligatures, divided between; sac dissected up, and several arteries and main internal carotid tied distal side and sac removed	Wound healed by first intention, except where drain-tube inserted, and at one spot above where some ligatures came away. Recovery complete	Sac fairly easily dissected up except above, where some adhesions; adherent vagus dissected off sac. Tumour before operation thought to be a growth in glands, probably malignant.

No.	Reference.	Surgeon.	Name.	Sex.	Age.	Locality.	Artery affected.	Other treatment adopted.
8	Wiener klinische Rundschau, March 15th, 1896	Maydl	B. K.	M.	45	Popliteal space	Left popliteal	None
9	Ibid.	Maydl	W. W.	M.	44	Popliteal space	Left popliteal	None
10	Ibid.	Kopfstein	J. K.	M.	35	Popliteal space	Right popliteal	None
11	Revue de Chirurgie, ix, 1889	Mollière	—	—	—	Popliteal space	Popliteal	—
12	Ibid.	Peyrot	—	F.	50	Popliteal space	Popliteal	—
13	Arch. für klinische Chirurgie, xlv, 1892	Schmidt	G.	M.	36	Popliteal space	Left popliteal	—
14	Ibid.	Schmidt	„	„	„	Popliteal space	Right popliteal	Distal compression; flexion
15	Léon Comte, Thèse de Lyon, 1885, and Archiv für klin. Chir., 1892	Polloson	—	M.	42	Popliteal space	Popliteal	Digital and instrumental compression
16	Verhandlungen der deutschen Gesellschaft für Chirurgie, xxi Congr., Berlin, 1892	Rehn	—	—	—	Popliteal space	Popliteal	Not stated
17	Verhandlungen der Berliner medicin. Gesellschaft, Oct. 16, 1895	Israel	—	F.	62	Back of thigh	Third perforating branch of profunda	None

Symptoms.	Operation.	Result.	Remarks.
Pulsating swelling size of hen's egg; usual signs of aneurysm	Esmarch's bandage; longitudinal incision; nerve separated; artery and vein ligatured above and below; sac removed; wound plugged	Wound healed by granulation	Delirium tremens. Recovery.
Pulsating swelling; usual signs of aneurysm; oedema of limb	Longitudinal incision; nerves separated; artery and vein ligatured above and below; sac dissected out; wound closed	Healed by first intention	Delirium tremens. Recovery.
Pulsating swelling; usual signs of aneurysm	Esmarch's bandage; longitudinal incision; nerves separated; artery and vein ligatured above and below; sac removed; wound closed	Healed by first intention	Delirium tremens.
Diffused aneurysm; great size; about to burst	Esmarch's bandage; extirpation	Wound healed in 20 days	Complete recovery.
Very large; usual signs of aneurysm; oedema of limb	Artery and vein tied above and below; sac extirpated	Wound healed; complete cure	Artery above sac gave way on applying ligature. Complete recovery.
Very large; about to burst	Esmarch's bandage; longitudinal incision; vein separated; artery tied above and below; sac removed	Wound closed; deep sutures. Operation lasted 3 hours	Easily separated from its connections. Complete recovery.
Pulsating swelling	Esmarch's bandage; longitudinal incision; vein separated; artery tied above and below; sac removed	Wound closed; some slight suppuration; healed in 9 days; complete recovery	Difficult to separate vein; vein wounded; lateral ligature.
Not stated	Vein and artery tied; sac extirpated; wound plugged with iodoform gauze	Wound became septic; knee suppurated; death	Erysipelas, alcoholism, emphysema.
Not stated	Sac extirpated; artery and vein tied. Details not given	Gangrene; amputation refused; death	Vein wounded, tied.
Pulsating swelling in parts; thought might be sarcoma	Esmarch's bandage; puncture; longitudinal incision; sac opened; sac enucleated; third perforating artery led into sac; wound plugged	Wound healed well	Very difficult to separate from great sciatic nerve.

No.	Reference.	Surgeon.	Name.	Sex.	Age.	Locality.	Artery affected.	Other treatment adopted.
18	Annals of Surgery, July, 1898	Moynihan	H. S.	M.	31	Subclavian region	Third portion of right subclavian	Iodide of potassium; rest
19	Wiener klin. Wochenschrift, Sept., 1891	Schopf	—	M.	46	Subclavian region	Subclavian and part of axillary	None
20	Bulletin of Johns Hopkins Hospital, July and August, 1892	Halsted	—	M.	—	Underneath clavicle	Subclavio-axillary	None

Three Cases in which Sac was exposed, Artery tied on Proximal and

1	Frenken, Inaug. Dissert., Bonn, 1886	Trendelenburg	N. N.	M.	—	Right groin, extending up under Poupart's ligament	Common femoral	?
2	Progrès Médical, 1891, 2nd series, 13, 14, p. 346	Bazy	M. R.	M.	44	Inguinal	Inguino-femoral	None (?)

Symptoms.	Operation.	Result.	Remarks.
Smooth round tumour size of hen's egg, firm, elastic, and pulsating; bruit	Curved incision over clavicle; flap dissected up; clavicle divided in two healed up, and all places and pulled down-wards; anterior scalenus retracted; pleura and veins separated; two ligatures applied to second portion of subclavian; artery divided between; aneurysm dissected up; axillary tied; sac removed	Erysipelas; wound infected, but healed up, and all well till 59th day, when second aneurysm formed and bled, on which the common carotid and innominate were ligatured. Patient died 1 hour after operation	Catgut ligature used. Extensive disease of arterial vessels.
Soft, elastic swelling size of fist; no pulsation, no fremitus; no radial pulse, no œdema, no cyanosis; pulsation had never been noticed	Exploratory incision; pectoral divided; found to be an aneurysm; artery on distal side already obliterated; proximal vessel tied high up under clavicle; axillary vein separated with difficulty; sac removed	Wound healed by first intention	Sac thick-walled, filled with firm blood-clots.
Large, solid, but elastic swelling, overlapping middle third of clavicle; feeble pulsation; thought to be a growth	Subclavian tied in two places above clavicle, artery divided between; aneurysm, with clavicle and piece of deltoid, dissected up, with 6 centimetres of subclavio-axillary vein; distal (axillary) artery ligatured	Wound healed in ideal way	—

Distal Side, Sac then laid open, Clots turned out, and Sac plugged.

Large pulsating tumour; pulsation in sac so forcible that rupture seemed imminent	Longitudinal incision over tumour, commencing 2 cm. above Poupart's ligament; sac exposed; external iliac artery ligatured above sac and femoral below; sac then laid open and clots turned out; sac not removed but plugged	Wound healed by granulation; recovery complete	The sac could not be readily dissected up, so it was left <i>in situ</i> . ? Traumatic.
Inflamed, œdematous	Incision over external iliac; peritoneum turned back; artery and vein tied above and below; attempt to dissect out sac; hæmorrhage; sac opened and plugged; wound partly closed, partly plugged with iodoform gauze	Wound healed in a month	No after trouble.

No.	Reference.	Surgeon.	Name.	Sex.	Age.	Locality.	Artery affected.	Other treatment adopted.
3	Berl. klin. Wochenschrift, 1891, p. 908	Karewski	H.	M.	30	Neck	Carotid	None

Three Cases in which a False Sac was laid open, Clots turned out, True

1	Lancet, 1894, vol. ii, p. 1143	H. Littlewood	—	M.	40	Left thigh, 4 inches below Poupart's ligament	Superficial femoral	Medicinal
2	Lancet, 1894, vol. ii, p. 1143	H. Littlewood	—	M.	63	Popliteal space (right)	Right popliteal	The aneurysm having become diffuse no other treatment was indicated
3	Schmidt, Inaug. Diss., Greifswald, 1890	Helferich	—	—	—	Calf of leg	Posterior tibial	Femoral artery ligatured; elastic compression

Symptoms.	Operation.	Result.	Remarks.
Slight fluctuation in places; no pulsation; thought to be a blood-cyst or enlarged glands	Sac exposed; common carotid, external and internal carotid tied; sac laid open; clots turned out; plugged	Healed completely; plug removed on 4th day	Huge size. Only discovered to be an aneurysm at operation.

Sac discovered, Artery tied above and below, and True Sac removed.

Pulsating swelling size of lemon; pain and tenderness over tumour; systolic bruit, but no thrill; pulsation in both popliteals synchronous and equal. Three weeks later swelling suddenly became diffuse; upper two thirds of thigh discoloured from blood extravasation; lower limb œdematous; no pulsation in arteries below	Longitudinal incision over swelling, and transverse incision inwards for 6 inches; sac laid open, clots turned out; original rent in sac then seen; artery above and below sac ligatured and sac removed; wound closed and drained	Complete recovery. Wound suppurated, and small portion of skin sloughed; healed by granulation	In this case the patient was suffering from a thoracic aneurysm. When the femoral aneurysm became diffuse the entire limb was threatened with gangrene, the pulsation having ceased in the popliteal and tibial arteries. The only other alternative was to amputate through the thigh high up, which would probably have been fatal.
Rounded and somewhat diffuse pulsating swelling about the size of half an orange; skin discoloured from blood extravasation; pressure on femoral arrested pulsation	Incision over the whole course of popliteal; sac opened, clots turned out; original rent in sac found on a level with middle of condyles, and opposite to a pyramidal piece of bone attached to the external condyle; artery ligatured above and below sac, and sac extirpated; wound closed with sutures and drainage-tube inserted	Complete recovery. Wound healed without interruption.	This was a case of diffuse aneurysm, the sac being ruptured by pressure against the spicule of bone. As the patient had a fall 20 years previously, in which he injured the right knee, the joint always remaining somewhat stiff afterwards, it is probable that the aneurysm was indirectly dependent upon that injury.
Pulsating swelling; had increased in size since ligature of femoral artery; after elastic compression suddenly became larger and pulsation ceased	Longitudinal incision over tumour; sac exposed and incised; when clots were turned out the sac was found to be adventitious, the original sac seen behind it; the artery having been secured above and below the true sac, this was removed entire	Wound healed by granulation; recovery complete	It is probable that rupture of the sac had been caused by the elastic compression made over the sac. The swelling increased so rapidly in size that gangrene of the limb was feared.

Three Cases in which Sac was opened, Clots turned out, Artery

No.	Reference.	Surgeon.	Name.	Sex.	Age.	Locality.	Artery affected.	Other treatment adopted.
1	Deutsche med. Wochenschr., 1886, S. 82.	Sonnenburg	—	M.	49	Right popliteal space	Right popliteal	Digital compression
2	Deutsche Zeitschrift für Chirurgie, Band xxii, 1885	Scriba	D. A.	M.	38	Popliteal space	Popliteal	None
3	Brit. Med. Journ., vol. i, 1897, p. 1161	Littlewood	—	M.	37	Popliteal space	Right popliteal	None

Four Cases in which Sac was opened, Clots turned out, Artery

1	Lancet, 1876, p. 597	Thomas Annandale	A. M.	M.	37	Left groin, just below Poupart's ligament	Common femoral	Compression; ligature of external iliac, after which pulsation returned
2	Lancet, 1896, vol. ii, p. 599	Macgillivray	—	M.	64	Inguinal region	External iliac and common femoral	Ligature of external iliac; subsequently, on recurrence of pulsation, ligature of four vessels on distal side
3	Lancet, 1898, vol. i, p. 228	Raymond Johnson	—	F.	12	Scarpa's triangle	Common femoral	None
4	Med.-Chir. Trans., vol. lxiv, 1881	Morris	—	F.	45	Neck	Common carotid	Common carotid tied

ligatured on Proximal and Distal Side of Sac, and Sac removed.

Symptoms.	Operation.	Result.	Remarks.
Large pulsating tumour size of apple; pulsation so violent that rupture of sac feared	Longitudinal incision over tumour; sac exposed and opened, clots turned out; artery ligatured above and below sac; sac removed piecemeal	Localised gangrene of foot; slough separated and wound healed	The gangrene ascribed to thrombosis of popliteal vein found at operation.
Fluctuant in places; no pulsation; thought to be a sarcoma or ruptured aneurysm	Esmarch's bandage; clots turned out; vessels (11) above and below sac tied; aneurysm was arterio-venous; sac extirpated; wound sutured with Czerny's sutures	Wound healed in 22 days after. Death 2 months after operation from tuberculous lung affection	Ruptured arterio-venous aneurysm.
Large diffused aneurysm; great pain	Incision; clots turned out; artery tied above and below; sac excised	Complete recovery. Wound healed rapidly	The aneurysm had been noticed for 6 weeks.

ligatured on Proximal and Distal Side of Sac; Sac not removed.

Pulsating swelling having deep attachments, size of hen's egg; all characteristic signs of aneurysm present	Longitudinal incision over tumour; sac laid open, clots turned out; four arteries then seen to arise from interior of sac; each of these was ligatured outside of sac; sac not removed	Wound healed by granulation. Eleven days after operation smart attack of secondary hæmorrhage, 9 oz. of blood lost. Complete recovery	In this case not only had compression failed to cure the aneurysm, but ligature of the external iliac was attended with no better result. Patient previously had aneurysm of right femoral cured by compression.
Large recurrent aneurysm	Sac opened; vessels supplying aneurysm tied; sac plugged	Granulated. Perfect recovery	Sac could not be dissected up.
Aneurysm, probably embolic; well-marked signs	Sac opened; artery ligatured above and below; sac not removed (?)	Good recovery	External iliac controlled by finger passed through linea semilunaris.
Recurrent pulsation and increase in size	Incision; clots turned out; arteries tied above	Recovery	Artery on proximal side already obliterated.

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' Third Series, vol. xi, p. 72.)