ANEURISM OF THE INTERNAL CAROTID AND THE LIGATION OF THE CAROTIDS

BY

Prof. ULRICH KARELL, M. D.

TARTU 1936

K. Mattieseni trükikoda o.-ü., Tartu, 1936.

In spite of the great total experience in the ligation of the larger vessels of the neck, the question whether the common or internal carotid artery should be ligated, if there is a choice, still remains a subject of controversy. The cerebral complications frequently following the ligation are the source of the controversy. According to Dorrance, at the moment of ligation, or immediately thereafter, the patient may experience a sense of fainting combined with nausea and vomiting, cold sweat, ringing in the ears, and darkening of the fields of vision. These symptoms may be of a few seconds' duration only or may be associated with homolateral headache, aphasia, partial or complete contralateral hemiplegia with anaesthesia and paraesthesia, and persist for days and weeks. The majority of these symptoms have a tendency toward improvement and usually disappear completely after a longer or shorter period of time. Too numerous are the patients, however, who develop permanent haemiplegia, with or without aphasia, blindness, and mental deterioration. Too frequent also are the cases where the above symptoms precede by a few minutes only a deepening and slowing of respiration, generalised convulsions, and death. If none of these signs or symptoms complicates the operation itself, the surgeon must still face an uncertain period of several days, extending to a week or ten days, during which the signs of severe cerebral disturbance may suddenly occur, with hemiplegia or with death closing the scene. The following six theories are given as an explanation of these cerebral complications:

(1) Anaemia because of anomalies of the Willis' circle.
(2) Thrombosis and embolism.
(3) Vasoconstriction because of sympathetic irritation.
(4) Circulatory stasis.
(5) Intracerebral haemorrhage.
(6) Cerebral injury independent of ligation.

As regards the first theory, we might mention that in the respective studies of Mitchell [1] and others the rarity of such anomalies in comparison with the occurrence of cerebral complications

[1] Mitchell, Journ. Nerv. Ment. Dis. 14: 44, 1889.

has been noted. Friedemann and Elkeles [2], Pfeiffer [3], and others are of the opinion that the anomalies of the Willis' circle do not adversely affect the blood supply to the brain. Le Fourmenstreux [4] believes such anomalies to be of little importance, as considerable variation is compatible with functional efficiency. Pfeiffer demonstrates, macroscopically and microscopically, a regulating mechanism of an extremely complicated but purposeful architecture within the brain. For equalizing pressures between two or more remotely situated capillary beds, there are vessels of greater calibre than capillaries, and these connecting vessels possess the ability to reverse currents. There are also anastomoses, in all parts of the brain, between arteries and between arteries and veins. Consequently, a reduction in the total volume of blood reaching the basal vessels would evenly affect every area of the brain. With the recognition of these facts it is difficult to ascribe all the reported complications, after ligation of the carotids, to an anaemia of the brain due to the anomalies of the Willis' circle only. As regards the second reason — thrombosis and embolism — we have but to remember the dictum of Aschoff [5], that "thrombosis is the function of a number of variables". They are: (1) slowing of the blood-current, (2) changes in the vessel wall, (3) changes in the blood plasma, and (4) changes in the blood elements. It is agreed that not all of these factors are operative in each and every case of thrombosis and that none of these factors is in itself sufficient to produce thrombosis. Malyschew [6] and others have demonstrated that blood in the doubly ligated vessel remains fluid over a period of days. Also we must accept the fact that slowing and stagnation alone do not produce thrombosis. According to Aschoff, the media of arteries is rich in thromboplastic substances, and necrosis of a vessel may be an aseptic process and still produce thrombosis. Torraco [7] and Barcaroli [8] found thrombi constantly present

---

[2] Friedemann & Elkeles, Klin. Wchnschr. 10: 2249, 1931.
[3] Pfeiffer, Journ. f. Psychol. u. Neurol. 42: 1, 1931.
[4] Le Fourmenstreux, Bull. et Mém. Soc. Nat. Chir. 57: 1580, 1931.
[5] Aschoff, L., Thrombosis, Arch. of Int. Med. 12: 503, 1913.
[6] Malyschew, Virchow's Arch. 283: 213, 1932.
[7] Torraco, Arch. Ital. di Chir. 23: 693, 1929.
[8] Barcaroli, Il Policlinico 38: 653, 1931.

when they used coarse or redoubled ligatures. A higher incidence of thrombosis was noted also when the clamping of an artery preceded its ligation. We think that both the last factors listed by Aschoff as causes of thrombosis may be neglected in the ligation of the great vessels of the neck. There is no more reason to anticipate thrombosis after ligature of the carotid arteries than after a ligature elsewhere.

As to vasoconstriction due to sympathetic irritation in the production of the sequelae of the carotid ligations, it is necessary to refresh our memory about the physiology of the sympathetic nerve. Stimulation of the sympathetic cord in the neck produces dilatation of the pupils, protrusion of the eyes, paleness of the face and neck, dryness of the mouth, and acceleration of the heart. Stimulation of the superior ganglion, or the carotid nerve, produces constriction of the cerebral branches of the homolateral internal carotid, and an increase in blood pressure. These symptoms are not identical with those occurring after the ligation of the great vessels of the neck which are described as shock, faintness, low blood-pressure, slowing of pulse, nausea, and cold sweat. This is a picture of the over-activity of the vagus more than that of the sympathetic nerve. The studies of Gollwitzer and Schulte [9] upon the changes the retinal vessels undergo under conditions similar to the ligation of the internal carotid show that as the systemic blood-pressure begins to fall there occurs a constriction of the retinal vessels, but when the blood-pressure continues to fall rapidly, the constriction of the retinal vessels passes and a relaxation and dilatation takes place. Taking into consideration that the ophtalmic artery is a part of the cerebral system of arteries, we may assume that its reactions are identical with those of the anterior and middle cerebral. The authors ascribe these effects of the decreasing of the blood-pressure and the slowing of the pulse to the pressure of the so-called carotid sinus. Thomas Lewis [10] showed that the slowing of the heart rate evidently takes place through the vagus, as, after paralysis of the vagus terminals by atropine, no slowing of the heart occurs, but the blood-pressure remains lowered. The lowering of blood-pressure is accomplished by active vasomotor dilatation involving chiefly the splanchnic

[9] Gollwitzer und Schulte, Archiv f. Path. u. Pharmak. 165: 685, 1932.
[10] Lewis, Brit. Med. Journ. 1: 873, 1932.

and cerebral areas. The vasodilatation is associated with an inhibition of adrenalin secretion.

The cerebral sequelae after carotid ligations, therefore, cannot be explained by simple sympathetic irritation. The clinical picture is that of the stimulation of the carotid sinus. Mandelstamm & Lifschitz [11] showed that a very marked degree of the lowering of the blood-pressure may be obtained by pressure upon the region of the bifurcation, especially in older patients. They demonstrate also that in the same way the heart can be brought to stop. The investigations of Wright and Kremer, Danielopolu, Hering, and many others [12] show that in the carotid sinus we have a perfectly normal structure whose activity is so far-reaching that it must be considered in any procedure upon the neck, especially in clamping and ligation of the carotids.

The last theories interpreting the cerebral disturbances as intracerebral haemorrhage and cerebral injury, independent of ligation, may be admitted without objection, inasmuch as cerebral injuries themselves, *e. g.*, meningitis, sepsis, *etc.*, cannot be ignored.

Turning back to the first assumed cause of the cerebral sequelae after the ligation of the carotids — the anomalies of the Willis' circle — which is rather a feeble explanation, we must state that, in spite of its weakness, we owe to this idea many interesting observations. So, in order to avoid this probability, Dorrance [13] and about twenty others [14-24] after him found that the ligation of the common carotid immediately causes a retrograde flow in the

---

[11] Mandelstamm und Lifschitz, Wien. Arch. f. Inn. Med. 22: 397, 1932.
[12] Quoted after Dorrance, Ann. Surg. 1934.
[13] Dorrance, G. M., Am. Journ. Ophth. 13: 8, 1930; Ann. Surg. 1934.
[14] Caudry, G., Presse méd. 28: 886, 1920.
[15] Freeman, L., Ann. Surg. 74: 316, 1921.
[16] Katz, Handb. d. spez. Chir. d. Ohres u. d. ober. Luftw., 1913.
[17] Keegan, J. J., Surg. Gyn. Obst. 57: 368, 1933.
[18] Krampf, F., Deutsche Zeitschr. f. Chir. 199: 152, 1926.
[19] Lenormant, Presse méd. 36: 648, 1928.
[20] Le Fourmenstreux, Bull. et Mém. Soc. Nat. Chir. 57: 1580, 1931.
[21] Matas, R. Ann. Surg. 17: 403, 1920.
[22] Perthes. Arch. kl. Chir. 114: 403, 1920.
[23] Romanis and Mitchiner, Science and Practice of Surgery, 1933.
[24] Stierlin und v. Meyenburg, Dtsch. Zschr. f. Chir. 152: 1, 1920, and others.

external carotid and its multiple branches. This most important and fascinating phenomenon we had the lucky chance to prove

Fig. 1.

in operating upon our last case, which, besides its extreme rarity, deserves to be reported as offering many other interesting observations. But let the lady speak for herself.

CASE REPORT.

Patient L. S., female, aged forty-three, housewife in a farm, was admitted to the First Surgical Clinic in Tartu, January 29, 1935, with a tumour of the left side of the neck about four years old. Until two or three months ago the growth did not cause any trouble. Since then the patient has from time to time had headache, pains in the throat, in the left ear, and sometimes in the left arm. During the last two weeks troublesome pains in swallowing and hoarseness.

She had had abdominal typhus fifteen years ago; for about a year, some skin-disease with reddish spots all over the body which disappeared by themselves in a short time. Married, five births, one child dead from abdominal typhus at the age of 2½.

Examination. Well-developed woman in good nutritional condition; the skin and the visible mucous membranes clean; a slight oedema in the malleolar and dorsal foot regions both sides.

On inspection there was a visible pulsating tumour of the size of an orange in the left carotid fossa. The upper part of the tumour reached the submaxillary region and the retromandibular fossa. The lower margin was on the level of the laryngeal region, and from its lateral surface one could see through the skin the outlines of the sternocleidomastoid muscle pushed aside. On turning the head to the left, one distinguished just at the inner margin of the sternocleidomastoid muscle the pulsation of the common carotid artery. On palpation, one felt exactly the expansile pulsation of the formation: when two fingers were placed upon the tumour, they were seen to be separated from each other with each pulsation. It was rounded in shape with a smooth and tense surface on account of which it was difficult to prove its fluctuation. One could freely catch the lower third of the somewhat lifted sternocleid muscle between the finger tips. One also distinctly felt thereby the pulsation of the common carotid artery with all three fingers. The carotid felt perfectly resilient and was also lifted from its normal site, and lost its way in the lateral lower part of the swelling. It was also impossible to find out the bifurcation. The trunk of the common carotid was easily compressible between the fingers. On compression, the tumour became less tense and smaller and its pulsation could be diminished and arrested; but when the compression of the vessels ceased,

the tumour rapidly regained its former size and tension, in from three to four bounds, synchronous with three or four heart

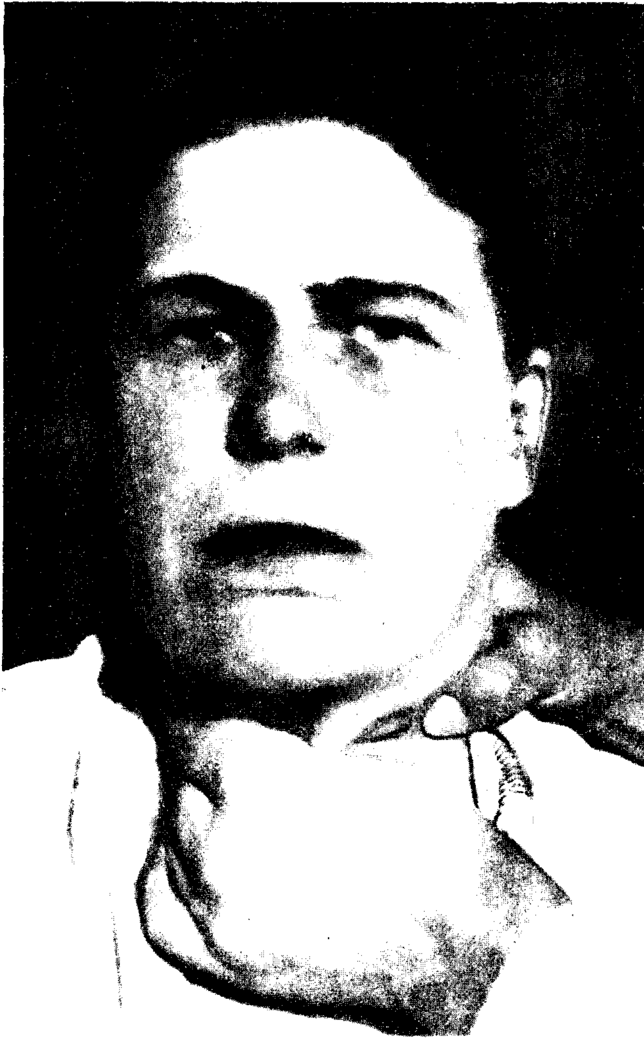

Fig. 2.

beats. The swelling could be reduced in size by gentle pressure, and if this was done while the trunk was compressed proximally, it could be nearly squeezed out. (Fig. 2.) But one could not do it completely because by pressing upon the swelling till it disappeared

the trunk would slip out of the fingers too. If one succeeded in keeping the compression of the common carotid and, after having squeezed the swelling, released the pressure upon the latter, it would increase in size again in spite of the compression of the trunk. However the aneurism did not now fill so promptly in bounds and not to such a degree of tension and size as at cessation of the compression of the trunk, but it filled quietly without pulsation to a more moderate size and remained so. Now there was a definite fluctuation too. The whole tumour could be moved across the neck to a slight degree, but not longitudinally. There was no thrill on palpation, unless the trunk was lightly compressed. In this case there was heard also a loud and hoarse systolic murmur. On examination it was noted that there was no pulsation upon the left superficial temporal artery in contrast with the right one. The pulse of the left external maxillar artery was smaller than that of the right one. The radial pulses were equal and synchronous. The blood-pressure of the left arm was 150/80 and that of the right one 135/70. The pulse was 68 in the left forearm irrespectively of whether or not compression was applied to the common carotid artery. Two Wassermann reactions were negative both with blood and spinal fluid. Also after the reaction was provoked. Erythrocyte sedimentation reaction (Westergren) 5 mm an hour. The right palpebral fissure was noted to be larger than the left, the right pupil somewhat larger and the right eyebrow higher than the left. There was a certain amount of cardiac enlargement, but no marked cyanosis was noted anywhere. No other cardiac abnormality or pulmonary lesion was found. Because of the slowly but steadily increasing size of the tumor mass, operation was decided upon. Accordingly, on February 2, 1935. she was operated upon by the author assisted by Doctors Saks and Kõre. She was given local anaesthesia — ½ per cent novocaine with adrenalin hypodermically. The preoperative diagnosis was sacculated aneurism of the external (or internal?) carotid artery.

OPERATION. — An incision was made, starting at the thyroid cartilage, extending outward to the most prominent point of the tumor and from there back and upward to the occipital region. The skin and subcutaneous fascia were reflected laterally, and in order to provide adequate exposure, the following muscles

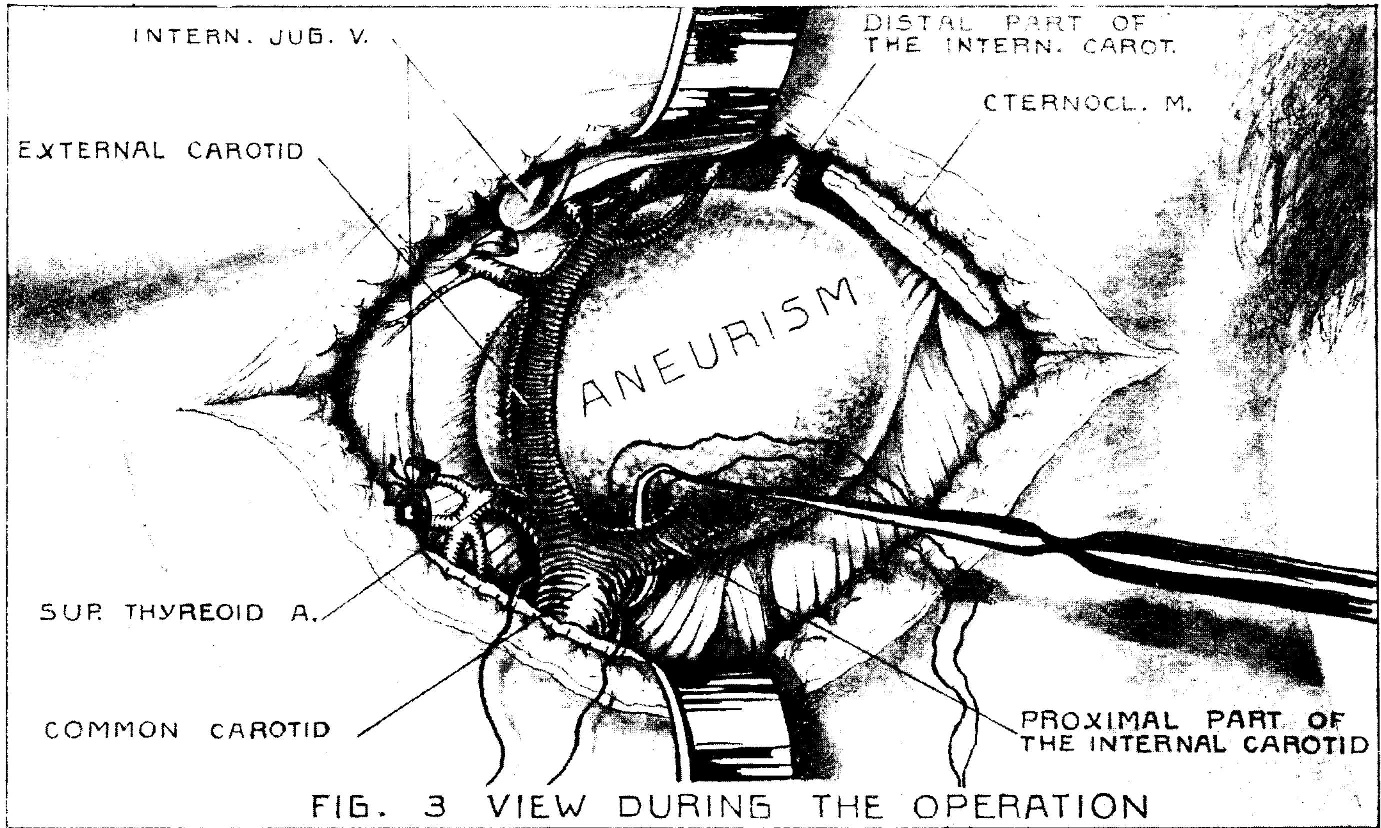

Fig. 3.

with their respective fascial planes were divided — the platysma, the anterior belly of the omohyoid, and the sternocleidomastoid. The external and internal jugular veins were ligated and divided. The lateral surface of the sack of the aneurism was freed from the surrounding tissue. The common carotid artery, the bifurcation, and both the internal and external carotids were searched for, and an attempt was made to visualize their course. The bifurcation was discovered and the trunk freed from its sheath, and a strip of tape was placed under the same for emergency control of haemorrhage. The capsule of the sack resembled the wall of an artery and was thick and elastic, so the separation of both the carotids from it succeeded without much trouble. It was noted that the external carotid artery with its branches had apparently been flattened out by the pressure of the aneurism. The internal carotid was freed as far as its opening into the aneurismal sack, to the length of about 1 inch. Another strip of tape was placed under it. (Fig. 3.) In order to complete the exposure of the sack, a soft rubber-covered clamp was put on the common carotid and gently compressed. Now, as before the operation, the patient could bear without any discomfort the compression of the common carotid. So the pulsation of the sack stopped and, as its size had diminished under pressure, it was easy to free its inner wall also, which succeeded without marked bleeding. The distal part of the internal carotid was followed upwards as far as possible, and it could be separated for a length of about 1,5 cm. It was noted that the proximal part of the internal carotid artery was almost twice as large in diameter as the distal part. Now it was possible to catch the total aneurism in the fist and to squeeze it out. Left alone, it became full again in about 10 to 15 sec., the common carotid always being compressed by the clamp. (Fig. 5, Comb. I.) Another clamp was placed upon the proximal part of the internal carotid and, after compressing this too, the sack was squeezed out again. Left alone, it filled itself again in about 50 to 60 sec. (Comb. II.) In that way we could prove the retrograde flow of the blood through the distal part of the internal carotid. This was important in order to determine our further procedure. Now we squeezed the sack out once more and placed a third clamp on the distal part of the internal carotid. (Comb. III.) The sack remained empty and folded. Now the proximal part of the external carotid above the

origin of the superior thyroid artery was compressed for about a minute too. The patient could bear it well. (Comb. IV.) Assured that there were no other sources now to fill the sack any more, because it remained empty for some minutes, we removed the clamp from the proximal part of the internal carotid, and the aneurism became full again in about 12 to 16 seconds. (Comb. V.) During the operation the patient was asked repeatedly about symptoms of the insufficiency of the brain supply of blood, and she always gave negative answers. In view of the large size of the aneurism — about the size of an orange — it seemed quite impossible to unite the cut off ends of the artery after removal of the aneurism, so we determined not to try it. Double ligatures were placed on both the proximal and distal part of the internal carotid and both were divided. On removing the clamp from the common carotid, immediate and lively pulsation upon the whole course of the external carotid and its branches was noted. All the divided muscles and fascias were sutured with catgut and the skin tightly closed with silk. Just after the operation the temporal pulse came back again. And the pulse of the external maxillar was equal on both sides. There was no trouble in the course of recovery. Only the night after the operation the patient complained of headache and pain in the wound, which disappeared after an injection of caffein and morphine. On the third day *post operationem* light pharyngitis (prof. Saareste), which subsided the next day. After the beginning of the fifth postoperative day no complaints at all. Blood-pressure on the right arm 130/80 and 135/80 left. On February 13, on the eleventh postoperative day, the patient went home cured.

It can be seen from the last photograph, that the eyebrows are quite symmetrical and the blepharoptosis of the left eyelid has vanished too. (Fig. 6.)

As to the aetiology of the aneurism, it is stated in all papers on this subject that the causes of this condition are two in number: first, changes in the vessel walls, which result in their becoming weakend and less elastic, and, secondly, a rise in the blood pressure. Arteriosclerosis due to syphilis or gout is supposed to be the great predisposing cause. These conditions usually will give rise to aneurisms in men of middle age, whose heart function is strong and blood pressure high. Also a life of heavy phys-

ical strain, especially if intermittent, is another predisposing cause, but there appears to be no evidence that steady muscular effort and regular exercises are responsible. It is rather the repeated and sudden raising of the blood pressure that does the damage. This condition is seven times more common in men than in women and occurs most frequently in sailors, navvies, and dock labourers, and usually between the ages of thirty and fifty. But the greatest influence is ascribed to syphilitic *endarteritis obliterans.* It is found to be present in over 75 per cent. of the cases. Romanis and Mitchiner[23] state that "it is most unusual to find an aneurism in a woman unless she is syphilitic". In our case, which seems to be an exception to prove the rule, the Wassermann reaction was negative even after provocation both in blood and in spinal fluid. In addition to this, we found at the operation no signs of an arteriosclerosis or endarteritis at all. On the contrary, the carotids were found to be youthfully resilient. Thus, in this case we must have another predisposing cause for the development of the aneurism. In the previous history of the patient it is stated that she had had abdominal typhus 15 years ago. That typhus can cause changes in the walls of the vessels was noted by Strümpell [25], who ascribes the frequently occuring oedema of the feet and legs in typhus to that account. That changes in the vessel walls occur in typhus is evident from the report of Röper [26], who describes a bullose haemorrhagic dermatose in a definitely diagnosed case of abdominal typhus. But degenerative changes occur in typhus also in the great and middle-sized arteries. Thus, Gastewa [27] records that he found in autopsy on two cases of abdominal typhus, in the walls of the great and middle-sized arteries, primary hearth-shaped (herdförmige) degenerative changes of the elastic fibre, degenerations of the cellular and connective tissues, and necrosis of the intima. Thrombosis, fissures and ruptures of the wall may arise from that. Taking into consideration that people on farms often begin strenuous work too early after typhus, we think that in our case the repeated raising of the blood pressure by hard work most probably caused

[25] Strümpell, Spez. Path. u. Ther., 1922.

[26] Röper, München. Med. Wchnschr. 48: 2030, 1931.

[27] Gastewa, Virchows Arch. 289, 1933.

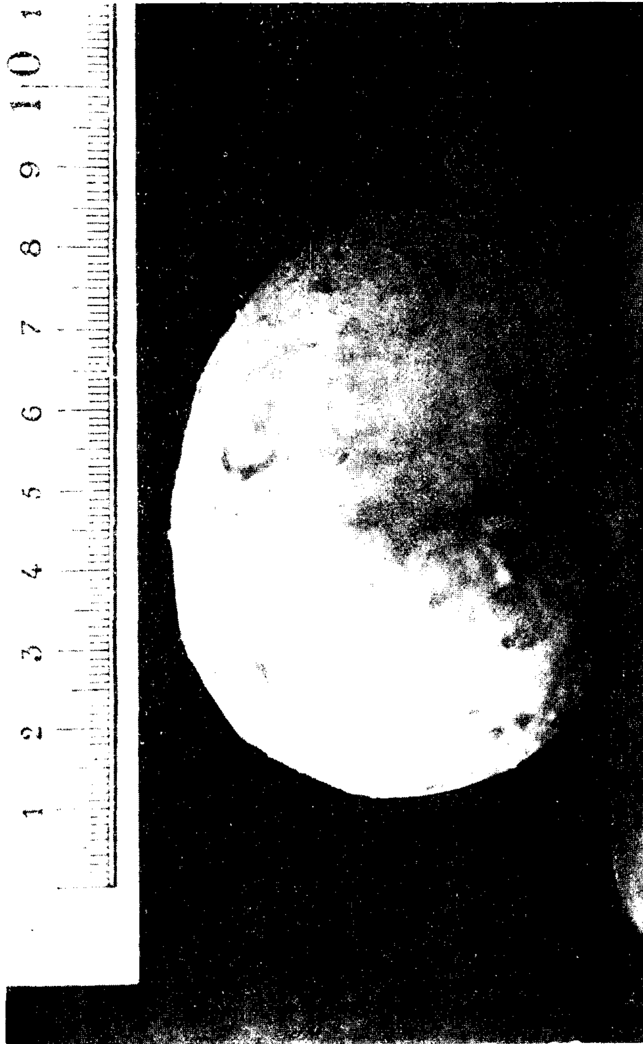

Fig. 4.

in the weakened wall of the internal carotid the aneurismatic dilatation.

Turning to the symptomatology of our case, it is to be noted that, in spite of the characteristic classical symptoms of aneurism in general, such as the expansile pulse, shape, localization, *etc.*, it was impossible to make the exact diagnosis of the internal ca-

rotid aneurism. The smaller pulse upon the external maxillar and the absence of the superficial temporal pulse as well as the absence of visible or perceptible pulsation in the left tonsillar region seemed rather to speak for aneurism of the external carotid. We confess, we did not at all appreciate at first the lowering of the left eyebrow and the left blepharoptosis as a symptom, because we did not remember it mentioned in any text books, and were surprised to see it vanish after the operation. (*Vide:* both the photographs taken before and the one taken after the operation.) In the case report of Lee, Mitchell, and Peacock [28], upon a case of a traumatic aneurism of the left subclavian artery we read: "... The right palpebral fissure was noted to be larger than the left and the right pupil twice as large as the left". This symptom as a part of Horner's syndrome is probably caused by the pressure of the aneurismal tumour on the cervical sympathetic trunk.

From the description of our operation one can conclude that we had not only the chance to re-prove the phenomenon of the retrograde flow from the external carotid into the internal after the occlusion of the common carotid (Fig. 5, Comb. I), but could also demonstrate the r e t r o g r a d e f l o w from the i n t e r n a l carotid, which phenomenon, so far as we know, has never been observed before. Even the contrary has been maintained. So, Lenormant [29] comments upon an operation in which he assisted Petit-Dutaillis to resect an aneurism of the bifurcation with an immediate end-to-end anastomosis of the stump of the external carotid with that of the internal carotid. He remarks that in the course of the operation the clamp slipped off the internal carotid and he was surprised to see practically no bleeding, indicating a very small pressure down the internal carotid. From this contradiction we have to come to the conclusion that the vascularisation of the brain varies greatly in individuals. The same fact teaches us also another thing: that, although the ligation of the internal carotid should be regarded as the most dangerous of all the ligations upon the great vessels of the neck and should be avoided if possible, in those cases where there is no other choice we can at least calculate the prognosis approximately. In cases similar to ours there is the possibility of choosing one of three

---

[28] Lee, Mitchell, and Peacock, Ann. Surg. 100: 91, 1934.

[29] Lenormant, Presse méd. 36: 648, 1928.

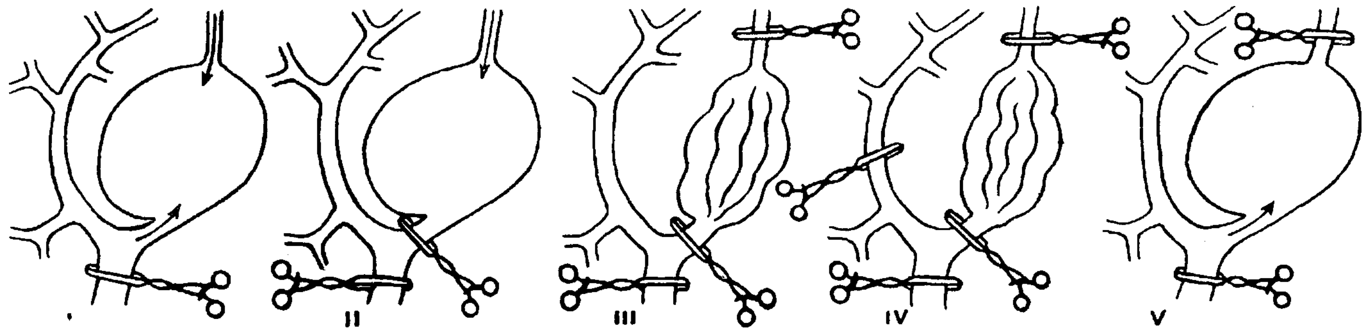

FIG. 5 SCHEME OF THE VARIOUS COMBINATIONS OF CLAMPING

Fig. 5.

ways, to ligate, to try a suture, or anastomosis between the two ends. As indicated above, anastomosis proved impossible because of the too great distance between the two ends of the internal carotid displaced by the mass of the aneurism. This impossibility, one might object, is not an indication that one should choose the most dangerous ligation of all: yet there remains a number of methods to be employed, *e. g.*, to use the sack of the aneurism itself for building a new channel between the two ends of the vessel by any commonly known method, or to try a plastic between the freely liberated ends of the external carotid. Heidrich [30] states that, even taking into consideration the risk of thrombosis, it is safer to suturate than to ligate, because, as he thinks, although the thrombosis often occurs after the suturation of the vessels, occludes the vessel as well as the ligature, and makes the suture illusory, the suture, nevertheless, has one great advantage over the ligature, namely that of a slow, gradual interruption of the flow. In this way one gives the collaterals enough time to dilate themselves. According to Heidrich, the suture with subsequent thrombosis has one advantage more, *viz.* that of organisation and vascularisation, by which the re-establishment of the original circulation can take place. There is nothing to object to or add to the wise advice of our esteemed master except one thing, perhaps, that in exceptional cases exceptional measures but prove the rule in general. We are far from proposing ligation of the internal carotid as the method of choice, as we are fully aware of its dangers in general. If Heidrich nevertheless takes the thrombosis into account and estimates by the way the anastomoses and their dilatation, he does it certainly basing himself on the assumption of the existence of the anastomosing communications between both the systems of the internal and external carotids. That these anastomoses exist we are taught by the experiments of Elschnig [31], who showed that when in the cadaver the ophthalmic artery was divided from the internal carotid, the latter tied, and a liquid, under low pressure of 60 mm of water, was injected into the external carotid or internal maxillary of the same side, such liquid could be seen to flow from

[30] Heidrich, Leopold, Bruns Beitr. 124: 638, 1921.
[31] Elschnig, Mediz. Klinik, September 1911.

the cut end of the ophthalmic in a relatively short time, and that finally both orbits and both sides of the face were filled with the

Fig. 6.

injected fluid. He concluded that the ocular blood supply must be in part derived from the external carotid, the branches of which communicate freely on both sides. Dawbarn[32] remarks

[32] Dawbarn, Treatm. of Mlign. Growths, Philad., Davis, 1908.

that "it is known to everyone that there are thousands — myriads — of nameless little vessels interlocking at the median line by which the freest anastomoses are quickly restored. Even after bilateral ligation of the external carotids, the resulting anaemia is of short duration only and after complete excision of the superficial carotids on both sides with each of the eight branches on both sides separately controlled, there remained twenty-nine distinct routes by which blood could still enter the area from outside systems". Leaving open the question whether these myriads of little vessels can at once replace one single ligated internal carotid, the diameter of which is certainly many hundred times smaller than that of their total diameters, or whether they want a certain period of time to become dilated, they cannot help, if in the brain itself there is not enough of the anastomoses to distribute the blood evenly over all parts: from Pfeiffer's experiments we know that those anastomoses exist. But in spite of all there are reports enough of cases finishing fatally after ligation. If we ignored them, we did so because we based ourselves on our own experiences prior to the operation, and mostly upon the experiments made during the operation itself. We had two reasons for acting in this way: first, we knew already prior to the operation that our patient could perfectly bear the occlusion of the common carotid; everybody cannot do so, but in view of the retrograde flow through the external this fact alone did not matter so much, and in general the ligation of the common carotid is regarded as most harmless. Yet, taking into consideration that one of its branches (we did not know exactly) should have been already partly obstructed by the aneurism mass, we stood before an alternative. In case the aneurism had its origin from the external carotid, it would have partly, at least, compressed the internal one, and the brain should have been accustomed to the reduction of supply through this vessel; also the retrograde flow, in this case, during the compression of the common trunk should have had its way through the aneurism itself too. Consequently, the flow could not be perfectly reliable. Also, we were sure to a certain degree that if the patient bore the compression of the common carotid well, there must already have been a dilatation of the "myriads of nameless anastomoses". On the other hand, if the aneurism sat upon the internal, it would have inhibited the

circulation through this vessel too and by its body have, in this case, partly compressed the external. This is again an argument for the existence of the dilated anastomoses through the angular ophthalmic and their collaterals. Thus, the ligation of the internal carotid could not inflict an important loss of the supply to the brain of our patient. — These were our calculations about the case prior to the operation. But the greatest value of all theoretical calculations consists in their being proved by practice. As seen from the case report, we could state during the operation, by various combinations of the clamps, not only that both carotids were partly obstructed — the external by the passive compression through the body of the great aneurism, and also the proximal part of the internal carotid overstretched and flattened upon the surface of the lower party of the aneurism — but also that the distal part of the internal carotid was almost twice as small in diameter as the proximal part. It was noted also that the proximal part was not larger than usual. But we got the greatest certitude by clamping in combination IV, *i. e.* by occluding not only the common trunk and both the proximal and distal parts of the internal carotid, but also the external one as far from the heart as possible. If the patient could in this way bear the loss not only of all the blood carried by the common trunk but also of that carried by the superior thyroid, without any bad sensation, it would have been positive evidence of the reliability of the dilated collaterals. In addition to that, the fact that there was a proved retrograde flow through the distal part of the internal carotid also clearly indicated that the cerebral anastomoses were perfect too.

One can say the best is more than good, and demand why we, nevertheless, did not try a re-establishment of the normal conditions by making a plastic end-to-end anastomosis between the external and the stump of the internal carotid.

First, because in view of the perfect elasticity of the vessels and the experimental data acquired during the operation, we got the assurance of achieving our object in the shortest and simplest way by ligation. Secondly, because the distal part of the internal carotid was too short, scarcely one and a half cm and deeply situated, and also too small in diameter to be sutured. Should we have used the sack for building a channel? Well, but in view

of its large size the strip cut out of the wall would have been too long without division and without resection of a part. In short, in this way we would have had a longitudinal suture plus a ring-formed one, which would have immediately been under considerable pressure because of the difference in calibre of both the stumps. The more sutures, the more possibilities there would have been for thrombosis and embolus of the brain too.

SUMMARY. — (1) Based on the bibliographical records, the probable causes of death occurring after the ligation of the carotids are discussed. The damage of the carotid sinus appears to play an important rôle in the occurrence of these sudden deaths.

(2) Report of a case of an aneurism of the internal carotid artery cured by removal of the aneurism and ligation of the internal carotid.

(3) Besides its rarity, the case seems to be the result of abdominal typhus which the patient had had fifteen years previously.

(4) By various combinations of the clamps during the operation the retrograde flow in the distal part of the internal carotid, which justified the ligation in this case, was proved.