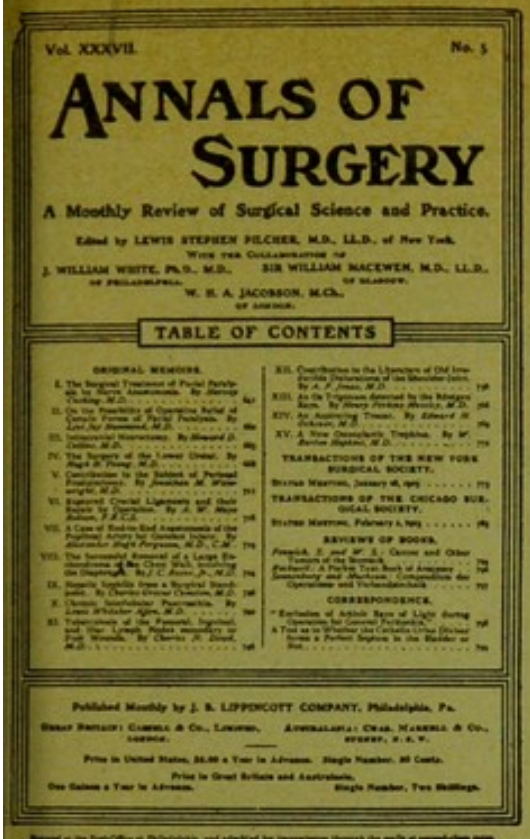
Tumors of the carotid body / by James G. Callison and John Edmund Mackenty.



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TUMORS OF THE CAROTID BODY

BY JAMES G. CALLISON, M.D.,

OF NEW YORK,

Pathologist of the Manhattan Eye, Ear and Throat Hospital,

AND

JOHN EDMUND MACKENTY, M.D.,

Surgeon of the Manhattan Eye, Ear and Throat Hospital.

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TUMORS OF THE CAROTID BODY*

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A BODY 5 millimetres long, 3 millimetres wide and 2.5 millimetres thick, lying in the bifurcation of the common carotid artery, of doubtful embryological derivation, of undetermined function, inconstantly present, but occasionally giving rise to tumors of a definite structure—that is the substance of our knowledge of this gland, so-called. Because of this uncertainty as to embryological derivation or physiological function, carotid body seems a better term to use than carotid gland.

Anatomy.—The carotid bodies are found in embryos of 20 to 30 millimetres long. They are variable in size, shape and position, and may be absent on one or both sides in embryo or adult. They increase in size as the individual grows, because of increase of connective tissue, blood-vessels and parenchyma. Reaching a certain size between 20 and 30 years, they remain stationary for a time and then the connective tissue only increases. The interlobular blood-vessels thicken, and sclerosis and atrophy results. The consistence of the carotid body varies, but usually it is moderately hard and elastic. In color it varies from a reddish-gray to a reddish-brown.

When present, the carotid body is found most commonly a little posteriorly to the bifurcation of the common carotid artery, lying between the internal and external carotids, and more closely united to one or the other of these. It is attached to the one on which it lies by the " ligament of Mayer,"

* Read before the New York Academy of Medicine, April 23, 1913.

through which it receives its blood supply. The body is surrounded by a dense fibrous (white and elastic) connective tissue capsule, from which prolongations are sent in, dividing the body into lobes, which are again subdivided into lobules. These delicate strands of connective tissue pass to the lobules and surround the "zell-ballen" of the Germans. These complete the alveolar arrangement of the structure, and are irregular groups of large, rounded or polyhedral cells, epithelioid in character, lying closely adjacent to the endothelial layer of the capillary tufts. They have a clear protoplasm, and contain large, round, well-stained nuclei. The afferent artery, running in the "ligament of Mayer," subdivides to pass to the lobes and lobules. Here it breaks up into a rich capillary network or tuft lying about and intimately associated with the "zell-ballen."

The nerve supply is abundant and is connected with both the cranial and sympathetic systems. It receives branches from the vagus and glossopharyngeal, superior laryngeal, and superior cervical sympathetic ganglion. Fibres pass from the vagus, glossopharyngeal and sympathetic to form a plexus in the angle of bifurcation just in front of the carotid body. Many fibres from this plexus penetrate the capsule of the organ. The capsule contains both medullated and non-medullated fibres, and these pass in freely to the glomerular tufts and "zell-ballen." Ganglion cells are scattered and few in number.

Embryology.—That the carotid bodies are derived from the sympatho-chromaffin system anlage, which buds off from the central nervous system in embryos of 20 to 30 millimetres, is the view expressed by Zuckerkandl.[2] He says: "The glandula intercarotica is associated with the plexus intercaroticus. That it belongs to the chromaffin system was recognized by H. Stilling. . . . Any attempt to derive this gland from a branchial pouch or from a thickening of the wall of a vessel must fail, since chromaffin cells can only be produced from sympatho-chromaffin tissue. . . . A. Kohn derives the chromaffin elements of the glandula inter-

carotica from the nerve anlage which passes from the upper cervical sympathetic ganglion between the two carotids. In a 44 millimetre pig embryo he finds in this plexus ganglion cells, some of which have a large and feebly staining nucleus, and believes that these latter cells represent the specific elements of the carotid gland. Up to this time only scattered observations have been made on the glandula intercarotica in man. R. Paltauf investigated an embryo of 15 millimetres and a fœtus of 45 millimetres. In the former the gland had not yet appeared, but it was present in the latter. According to Kohn, the cells of the anlage of the gland in a 19 millimetre (N. L.) embryo resemble neither the small, deeply staining ganglion cells of the intercarotid plexus nor the chromaffin cells." McMurrich,[3] Bailey and Miller,[4] and Heisler,[5] agree with this view as to the derivation of the carotid body. Keith[6] does not definitely commit himself, but suggests a derivation from the sympathetic nervous system.

Of historical interest is the view, supported by Steide,[7] Rabl,[8] de Meuron[9] and others, that they are derived from the third or fourth branchial cleft; and the later view of Kastschenko,[10] Paltauf,[11] and Monckeberg[12] and others, that they are derived from the perithelium of the carotid arteries.

The above view of Zuckerkandl is strongly supported by Stilling's[13] demonstration of cells in the "cell balls" and in the stroma cells which stain brown with neutral salts of chromic acid. Kohn[14] confirmed Stilling's observation and calls these "chromaffin" cells. Similar cells are found in the medulla of the adrenal, in the pituitary and in the ganglia of the sympathetic nervous system. This group of structures, including the carotid bodies, is referred to as the "chromaffin" system.

Physiology.—As to the physiology of the carotid body there is but little positive knowledge. All investigations have proceeded along the line suggested by Stilling's demonstration of chromaffin cells in its substance. As the type of the chromaffin system, the suprarenal capsule, has to do with the regulation of blood pressure, as judged by its extract, the in-

vestigations into the function of the carotid body have been conducted along that line. Mulon,[15] in 1904, prepared a watery extract of the carotid bodies of horses. With this, by injecting it into the veins of rabbits, he was enabled to produce a rise of blood pressure, and sometimes an acceleration of the force and rate of the heart beat. Gomez,[16] working in 1907 and 1908, prepared a glycerin extract of carotid bodies. With this he produced a fall of blood pressure in cats.

Frugoni,[17] in 1911, 1912, and 1913, prepared an extract of carotid bodies of young sucking calves in Ringer's solution, 4 c.c. of which was equivalent to the carotid bodies of a calf. By injecting this into the veins of rabbits, he was able to certainly cause the death of a rabbit of medium size with 4 to 6 c.c. Death occurred in about five minutes, and the prelethal symptoms were inconstant convulsive seizures, respiratory paralysis, arrest of circulation, and hyperæmia of internal organs (anaphylaxis?). Intravenous injection of nonlethal doses caused a slight initial rise of blood pressure, followed by a fall of 20 to 30 millimetres of mercury. These phenomena are accompanied by feeble respiration and weak pulse. The same effects were obtained after severing the vagus and other depressor nerves. With isolated organs he was able to demonstrate a vasodilator effect. On the whole, he doubts the existence of an important internal secretion.

Its not constant presence, the contradictory results of experimental work, and the lack of clinical observation, indicate that the function, whatever it may be, is not important. However, the different parts of the chromaffin system, while of common embryology, possess different functions. Thus, the medulla of the adrenal affects blood pressure, the cortex has to do with the development of the sexual apparatus, the pituitary seems to exert a trophic influence, etc. These varying functions of the different parts of the chromaffin system, together with the fact that the carotid body atrophies at or soon after puberty and full body development, suggest that when its function is established it will be in some way connected with trophic stimuli in body development.

Pathology.—Pathological studies on the carotid bodies

are limited to the tumors, of which 60 have been reported, including the one described at length in this paper, and four cases furnished by prominent New York surgeons. Gomez [16] observed some cases of sclerosis of the body, particularly in cases of arteriosclerosis, but this was not more marked than the change in the intima of the arteries in other locations. I have recently had an opportunity of observing a case of tumor of the carotid body occurring in the service of Dr. John Edmund MacKenty, at the Manhattan Eye, Ear and Throat Hospital, where the patient applied for relief from the throat symptoms. These observations and the study of the case form the basis of this paper.

Clinical History.—The patient, P. McD., male, Irish, driver, aged forty-one, presented himself at the clinic on January 14, 1913, for a tumor of the neck, with aphonia and difficult breathing, pain in the throat and difficult swallowing.

The family and past history were negative. The present illness began four months previously with loss of weight and increasing weakness. Six weeks previously he had noticed a hard tumor on the right side of the neck. The subjective symptoms had been noticed three weeks previously. In the four months he had lost twenty pounds in weight and had been compelled to give up work on account of weakness.

Examination.—Patient was a large robust man of 170 pounds. There was no marked evidence of cachexia. On the right side of the neck a hard tumor extended from the level of the angle of the jaw above to the clavicle below, and from the thyroid gland internally well into the posterior triangle. On palpation this tumor was board-like in hardness, there was no pulsation, and it was not movable in any direction, although the skin was freely movable over it. Auscultation over the tumor did not show any increase in the carotid bruit. Laryngeal examination showed paralysis of the right cord, and the larynx was displaced to the left. The chest was negative; pupils equal and reacted to light; no involvement of the facial nerve. The Wassermann and Noguchi reactions were negative.

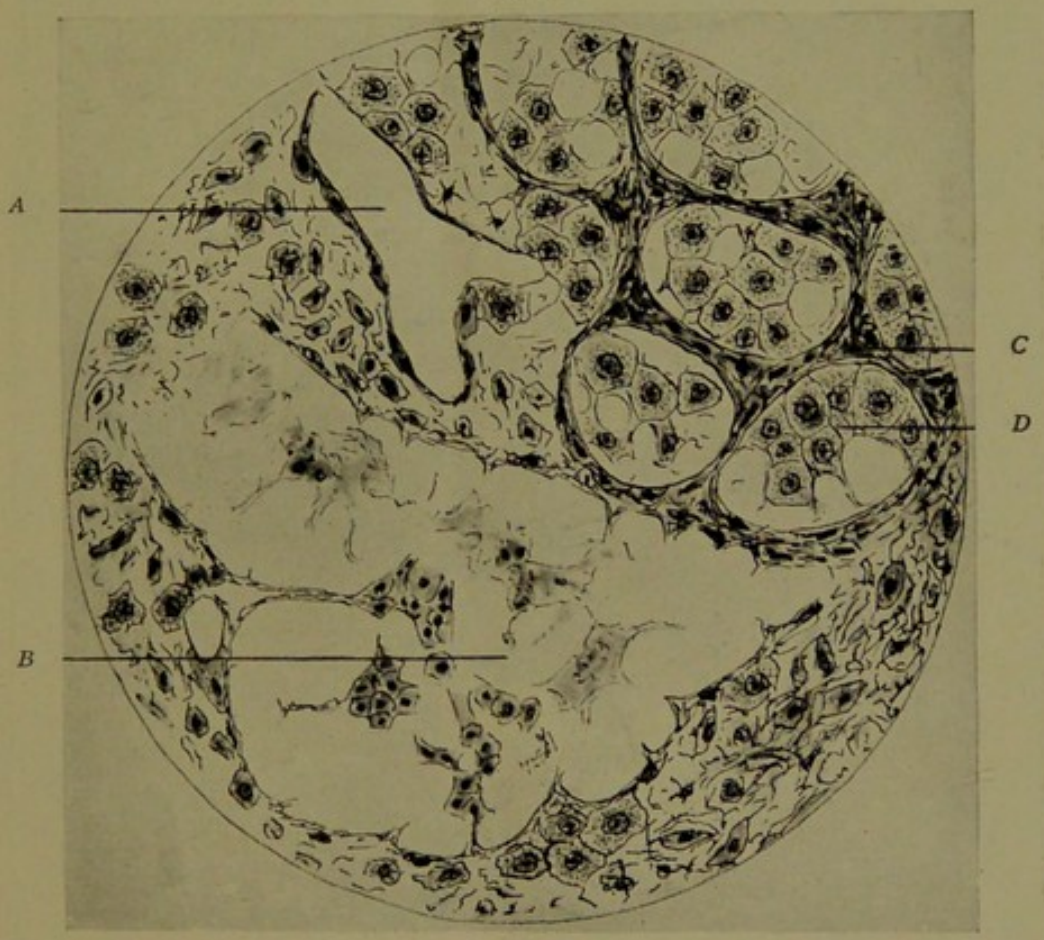
He was sent to the hospital and a fragment of the tumor removed for diagnosis. In the laboratory this was divided into

two parts, one of which was hurried through the fixing solutions, the other being carried along slowly to secure more perfect fixation. The first part, cut into thick sections, showed a lymph node, much of which was normal or nearly so in structure. In places where the capsule was absent there was a definite infiltration of the surrounding fatty tissue with small, dense, closely packed round cells. From this appearance, and the definite, sarcoma-like tumor, a diagnosis of probable lymphosarcoma was made. The second piece, which was not sectioned until after operation, revealed a structure such as will be described below.

On the basis of this report the patient was readmitted to the hospital on January 23 for operation. The incision was carried along the anterior border of the sternomastoid from the angle of the jaw to the clavicle, and along the superior border of the clavicle to the trapezius. The skin, superficial and deep fascia, and the sternomastoid, were reflected in one flap. Raising this flap revealed a tumor extending from the upper border of the hyoid bone above down to and under the clavicle below. Anteriorly it was in contact with the thyroid gland, while posteriorly it extended to the transverse processes of the cervical vertebræ. Roughly the tumor was 14 centimetres long by 10 centimetres wide. The neoplasm was covered with a fibrous capsule. The surrounding tissue was adherent to the capsule, however, so that the line of demarcation was not sharp. It was lobular, dense, slightly elastic, friable. In color it was reddish-gray to red on section. An attempt was made to dissect it up from behind, but the growth was found to include the common carotid artery, internal jugular vein, pneumogastric and recurrent laryngeal nerves, and this attempt was abandoned. An incision was then made in the course of the common carotid artery and down to the artery and sheath, and an attempt was made to dissect the mass away from these structures. The neoplasm was so firmly adherent, however, that this was impossible. The portion of the tumor anterior to the vessels was then dissected away; hemorrhage, which had been free and troublesome, but not dangerous, was checked, drainage inserted and the wound closed. The exposed common carotid was irregularly eroded and had the appearance of a badly rusted iron pipe.

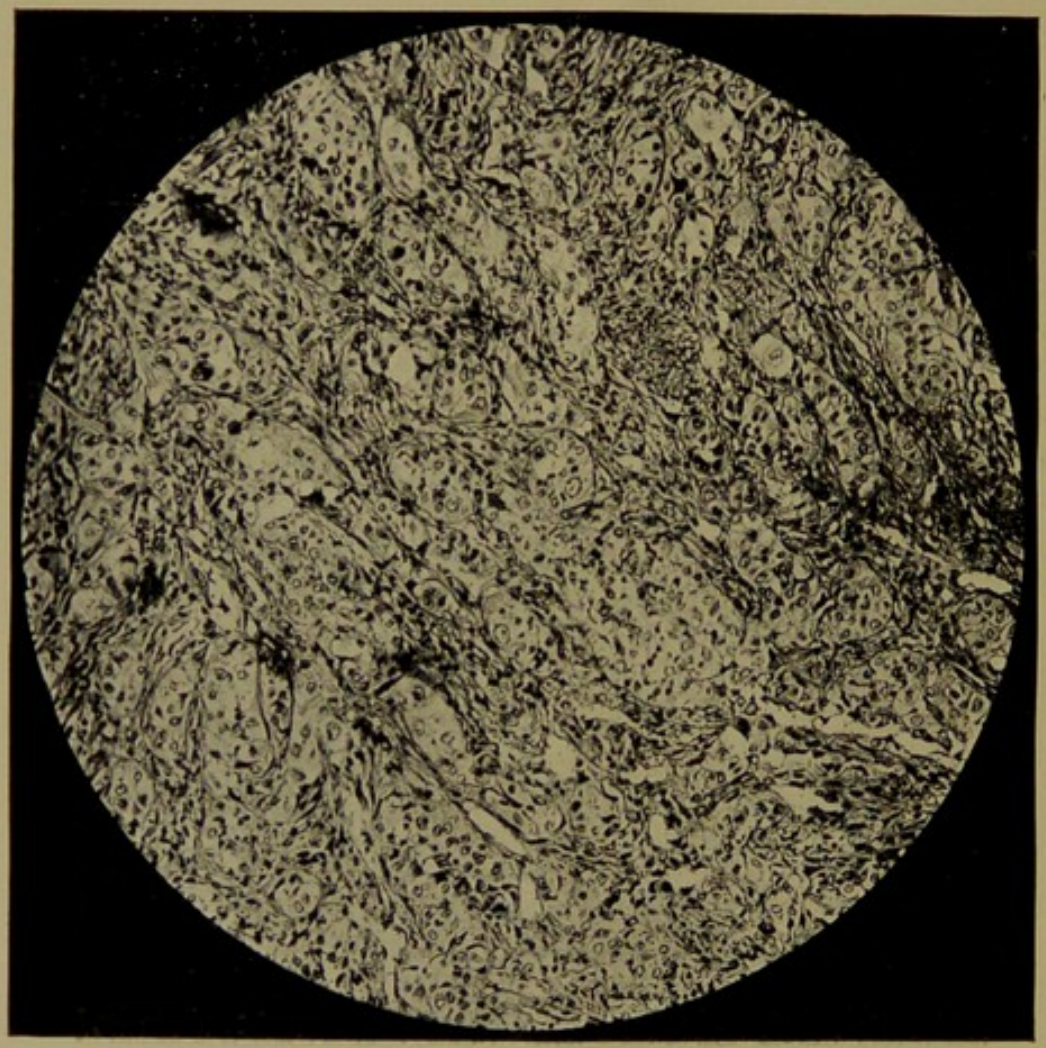
Recovery from the anæsthesia and post-operative shock was rapid and complete. There was no increase of laryngeal paral-

FIG. 1.



Composite drawing of typical fields of the tumor. *A*, blood space in intimate relationship with the cells of the alveoli; *B*, embryological remnant of gland; *C*, newly formed connective tissue cells making up the trabeculæ; *D*, vesicular cells filling the alveoli.

FIG. 2.



Microphotograph of tumor of the carotid body. Magnified 120 diameters.

ysis, and no lung complications. The patient did well until January 30, when erysipelas intervened, with wound infection. There was rapid sloughing of flaps, with destruction of tissue, and the patient continued to grow weaker. On February 8 there was a slight hemorrhage from the wound. On the 9th a more severe hemorrhage necessitated tight packing, and there was a continuous troublesome oozing. On the next day the patient was taken to the operating room to stop the bleeding, which now had become serious. When the packing was removed and the wound opened there was a violent hemorrhage. A finger was inserted into the bleeding point to stop the hemorrhage and it entered a hole in the common carotid. Ligatures were placed below and above the bleeding point. An intravenous infusion of 1000 c.c. of saline was given and the patient returned to the ward. The next day, February 11, the patient suffered from a left-sided paralysis, was comatose, and gradually weakened till death on February 13, three weeks after the operation.

Pathological Findings.—The tissue sent to the laboratory was an irregular, torn mass half as large as a man's fist. In color it was red to reddish-gray. The torn surface presented a succession of lobules, appearing much like a mass of fish-roe. Extending over one side was a dense capsule, but no lobed appearance was visible. The specimen was hardened in formalin and alcohol, and embedded in celloidin and paraffin. Sections were stained with hæmatoxylin and eosin.

On microscopical examination the sections presented along one side a thick connective tissue capsule, with connective tissue bands extending from this into the depth of the tumor. These bands divided and subdivided, forming an alveolar structure. The connective tissue cells of these septa and of the capsule were long spindle-cells of sharp outline, with a lance-shaped, slightly vesicular nucleus. Scattered through these bands in groups were many younger connective tissue cells, without definite cell body, and with oval, vesicular nuclei.

The vascular supply of the tumor was abundant but anomalous. At no place were there well-formed blood-vessels, but the appearance was rather a succession of new formed blood spaces. Those running in the connective tissue stroma had a poorly defined vessel wall and were lined by irregular, jagged endothelial cells. Those in more intimate relationship with the alveolar part of the neoplasm presented only the endothelial lining, and the picture was the same as will be described in connection with the alveoli. Capillaries were present everywhere in the tumor, but were particularly abundant in those parts of the new growth which were richest in fibrous bands and septa. Many of the smaller

blood spaces and capillaries had only a thin membrane between the lumen and the cellular elements.

The alveolar arrangement varied in different parts of the tumor. In places near the capsule the alveolar structure was regular and definite, while in older parts of the neoplasm this shaded off to a more diffuse, sarcomatous appearance. Some of the cell groups were round or irregular in shape, while others appeared as columns of cells. But always, due allowance being made for the variations present in malignant growths, the structure was the same. The relationship between the tumor cells proper and stroma was definite and intimate, fibrils seeming to pass from the stroma between the cells of the alveoli, and in places fibrils seemed to pass out from these to join the stroma. The cells in the alveoli were large and irregularly polyhedral. The centrally placed nucleus filled but a small part of the cell. The nucleus was round or oval in shape, was vesicular, possessed a prominent nuclear membrane and a well-marked nucleolus. About this was a fibrillar network of protoplasm. From the angles of these polyhedral cells fibrils seemed to pass between adjoining cells and into the stroma. The size of these cells varied, but not more so than is usual in rapidly growing neoplasia. Evidences of mitosis were present in both stroma and the enclosed cell groups, but more frequent in the latter. Some of the alveoli seemed to be grouped about or were intimately related to the blood spaces. In such places there was a layer of intimal cells. Outside of this were one or two layers of smaller spindle-shaped to polyhedral cells and then the alveolar cell nests. Within and between the cells of the alveoli were many vacuole-like spaces. Those within the cells were doubtless artefacts of fixation, but those between the cells present some evidence of being blood spaces. Monckeberg pictures them as such, but I think in my preparations the evidence was not conclusive. Whether his sections presented clearer pictures of this than my own, I am unable to say.

Occasionally, there were small areas of the tumor resembling the embryological carotid body. These consisted of wide blood spaces without walls, within which were columns of polyhedral cells. These resembled in structure the columns of cells and blood spaces of the liver, except that in proportion to the cells the blood spaces were much wider.

On the whole, the appearance was that of an endothelioma, but in places the structure was that of a loose sarcoma. The sections were variously diagnosed by competent men as carcinoma, sarcoma, endothelial sarcoma and endothelioma. This latter agreed with my own opinion, but I was never quite satisfied. When I took sections to Prof. James Ewing, of Cornell University Medical College, he suggested a tumor of the carotid body. Comparison of the structure of the tumor in this case with other reported tumors of the carotid body convinced me of the correctness of this diagnosis.

The Literature.—American literature on the carotid body begins with the careful paper by Keen and Funke[1] in 1906.

Previous to this Charles L. Scudder, of Boston, reported a case of tumor of the carotid body in 1903, and Funke and McPhatter each one in 1904. Keen and Funke collected 27 cases in the living and two cases which had been discovered at autopsy. I have been able to collect 31 additional cases, 28 cases in the living, one examined at autopsy, although known to exist before death, and two discovered at autopsy. These are, numbering consecutively with Keen's cases, as follows:

30. Cecca.[18]—The patient, a man forty years of age, about four years previously had begun to notice a small pulsating tumor in the right carotid region. This slowly attained the size of a hazel-nut. There was an autopsy, as the man died of pneumonia. The tumor was found to be inclosed in a thick fibrous capsule, lying at the bifurcation of the common carotid, and was closely connected with the common carotid by a vascularized pedicle. The microscopic examination showed the tumor to be a primary angiosarcoma, which had developed at the expense of the carotid body.

31. Rivet.[19]—A woman, forty-nine years old, seven years previously had first noticed a swelling the size of a hazel-nut, at the level of the jaw, behind the ascending ramus. It was not painful, but had recently grown to the size of a turkey's egg. The skin over it was movable, and the pulsations of the external carotid could be felt through it. At operation the tumor was dissected away from the carotid arteries. There was free hemorrhage, and after the operation there was aphonia and difficulty in swallowing. The removed tumor had the appearance of a goitre, but on consulting the literature it was identified as a tumor of the carotid body. The clinical diagnosis had been a parotid tumor or aberrant thyroid.

32. Cook.[20]—The patient, J. W., a mulatto, aged 29, had a slowly growing, painless lump on the side of his neck. This was a large mass extending from the tip of the mastoid to the level of the cricoid cartilage, and from the side of the thyroid gland to within 1.5 inches of the ligamentum nuchæ. The mass had a peculiar, elastic feel, was slightly compressible but not movable, and had a pulsation synchronous with the heart beat and expansile in all directions. A harsh bruit was heard over the left common carotid, beginning beneath the clavicle and extending to the tumor, while over the tumor a softer murmur was heard. At the operation hemorrhage was troublesome from the beginning, there being a constant oozing which could not be controlled with hæmostats. The carotid arteries and internal jugular vein were ligated, but this did not control the hemorrhage. The patient died within an hour of the operation. The removed tumor was 7 x 5 centimetres in size. Only in places was there a definite capsule. It was dark red on the surface;

on section, pearl gray tinged with red. The clinical diagnosis was probable carotid aneurism.

33. Cathcart.[21]—The patient, a white male, aged thirty-three, was operated on two years before the case was reported. When first seen there was a firm, movable tumor on the left side of the neck the size of a pigeon's egg, but two months later this had increased to the size of a hen's egg. This mass was not tender and he complained of no pain. There was some interference with swallowing, and he was deaf on the left side. At the operation there was free bleeding from the whole exposed surface, and as this could not be controlled it was found necessary to ligate the common, internal and external carotids. This new growth extended from half an inch below the bifurcation to two inches above, and surrounded all three arteries. The tumor and arteries were removed intact. As the jugular vein and pneumogastric nerve were not involved these were not injured. There was a well developed fibrous capsule sending septa within the structure, dividing it into alveoli-like spaces. There was no recurrence in two years. No diagnosis was made previous to operation.

34. Zondek.[22]—In the case of a man sixty-three years of age a tumor had been noticed for nine years. It was on the right side of the neck at the level of the larynx. The swelling, which surrounded the common carotid at its bifurcation, gave rise to no symptoms, aside from a slight sensation of pressure. At operation the carotids were all ligated and cut. The patient made a good recovery, and was discharged three weeks after operation.

35. Licini.[23]—A man, aged twenty-eight, had a tumor on the right side of his neck for nine years. After the tumor had existed for five years, under the impression that it was an enlarged gland, the pulsating mass was incised. There was free hemorrhage and a diagnosis of angioma was made. As the tumor continued to grow, and caused pain and dysphagia, the patient travelled from his home in Brazil, to Kocher, in Berne, Switzerland, to be operated on. On the basis of its location in the bifurcation of the common carotid artery, which could be traced through the tumor by palpation, and on the pulsation and elasticity, Kocher made a diagnosis of tumor of the carotid body. A tumor the size of a hen's egg was dissected out of the angle of bifurcation, which had been much widened by its growth. It was bluish in color and had the appearance of a soft sarcoma. The patient made a good recovery. On the basis of the histological findings it was called a "struma" of the intercarotid gland.

36. Beitzke.[24]—This case of tumor of the carotid body was found accidentally at the autopsy of a woman fifty-six years of age. It had caused no symptoms during life, and the woman's death was due to severe general pemphigus complicated by pneumonia. A brownish-red tumor the size of a plum, of moderately solid consistence, was found in the angle of bifurcation of the left carotid artery. It was surrounded by a fibrous capsule, and was closely applied to the branches of the carotid, which showed no changes aside from a few yellowish spots,

the size of a lentil, on the intima. Upon the basis of the histological findings, the author proposes to designate this form of tumor as "struma of the carotid gland," or "struma intercarotica."

37. Douglas.[35]—A. E., female, aged twenty-three years, American. The tumor was painless, but increased slowly in size. There were no symptoms until one week before operation, when hoarseness developed. He found a mass 3.5 x 2.5 x 1.5 centimetres on the right side of the neck at the anterior border of the sternomastoid muscle. This was firm, smooth and freely movable laterally but not vertically. The skin was freely movable over the tumor, it was not tender, and a slight transmitted pulsation could be felt. At operation this tumor was found in the bifurcation of the common carotid artery. The capsule, which was exceedingly vascular, was adherent to the sheaths of the vessels, but was removed without injuring them or any of the nerves. Paralysis of the left vocal cord followed the operation, but recovery was complete. The clinical diagnosis before operation was tuberculous cervical lymph gland. The pathological diagnosis, by Dr. Norris, of Bellevue Hospital, was perithelioma of the carotid body.

38. Coley and Downes.[36]—The patient, a man thirty-five years of age, four months before admission to the hospital noticed a swelling in the left sternomastoid muscle near its insertion. There was some difficulty in breathing while sleeping, and during the last two or three days there had been pain, in the muscle rather than in the tumor. Examination showed a tumor the size of an egg, on the left side of the neck, just internal to the angle of the jaw and apparently lying beneath the upper portion of the sternomastoid. It was smooth and symmetrical in outline, firm in consistence, and not tender. Examination of the pharynx showed a similar swelling on the left side nearly as large as the external tumor, pushing the tonsil and uvula over to the right side. At operation the external carotid and several branches were ligated. The tumor, exceedingly friable and matted to surrounding structures, was removed piecemeal, partly with a curette. The vessels were distorted, soft, and eroded. Recurrence took place promptly, and death occurred after four months. The removed tumor was of an alveolar type, and very malignant, causing death in eight months from the time it was first noticed.

39. Coley.[36]—L. P. F., male, aged fifty-three, had a small tumor in the left parotid region for six years. This tumor, hard, painless, slightly movable, caused no inconvenience. As the tumor seemed to be getting larger and less movable, an operation for its removal was performed March 30, 1906. The deeply situated mass was enucleated, carrying with it the buccal branch of the facial nerve, which was entirely embedded in the growth. Paralysis of the buccinator and levator anguli oris occurred on the day following the operation, succeeded soon afterward by inability to close the left eye, and a little later by difficulty in pronouncing the letter "p." Later there was almost complete paralysis of the facial nerve and some branches of the fifth. The tumor recurred locally, followed by death in eight months with symptoms of brain involvement. Microscopically the tumor is described as a "a sarcoma of the mixed-cell variety.

A great part of the tumor is made up of fibrous tissue, which more or less surrounds the sarcoma cells. In the centre of the sarcomatous areas are patches of degeneration. The alveolar arrangement of the large sarcoma cells lead one to conclude that their origin is from the tissue surrounding the blood-vessels."

40. GREEN.[27]—Miss A., aged seven, had a tumor the size of a pullet's egg on the right side of the neck, just beneath the sternomastoid muscle, on a level with the bifurcation of the common carotid artery. It had been growing very slowly for two years, but gave rise to no symptoms. The tumor was removed by ligation of the three carotids, which it involved. This was followed by right sided paralysis, from which she never entirely recovered. The tumor was very vascular and bled freely.

41. GREEN.[27]—Mrs. B., aged forty-five, had had a slowly growing tumor on the side of her neck for 17 years. It was lying beneath the anterior border of the sternomastoid muscle, was movable, elastic, and slightly pulsating. At operation it was found to extend from the angle of the jaw to near the clavicle. It was bluish in color and very vascular, bleeding freely whenever injured. The carotids were surrounded and the internal jugular vein and pneumogastric nerve were attached to its surface. As removal would have involved ligature of all the carotids and the internal jugular vein, with probable injury to the pneumogastric, hypoglossal, glossopharyngeal and descending noni nerves, it was left *in situ*. The clinical diagnosis had been a vascular tumor. Neither of Green's cases were examined histologically.

42. MAKARA.[28]—A boy eighteen years old, had, two years previously, first noticed a small tumor on the right side of his neck. At the time of operation this had reached the size of a pigeon's egg, and interfered with swallowing. The tumor was excised by ligation of the common, internal and external carotids, the jugular vein and nerve trunks being preserved. On the second day after operation the patient developed fever, promptly followed by hemiplegia and dysphagia. Death resulted on the third day from softening of the brain due to interference with the blood supply. The removed tumor was 4 x 3.2 x 3 centimetres, enclosed in a fibrous capsule. Histological examination showed the usual alveolar structure of a tumor of the carotid body. The clinical diagnosis had been an accessory thyroid.

43. ALEZAIS and PEYRON.[29]—These authors report a case of malignant degeneration of a tumor of the carotid gland. The tumor, discovered at the autopsy of an adult, was adherent to the three carotids, the internal jugular vein, and the aponeurotic muscular sheaths. In places there was the ordinary perithelial type of neoplasm of the carotid gland; in other places a tumor of the type of pavement epithelium, tubular or lobulated. The two types were intermingled, but the first type was more abundant near the periphery, while the second type was more abundant in the deeper parts. The cortical layers contained areas showing transition from the usual type of carotid gland tumor to the epithelial type.

44. KUZNETSOFF.[30]—A female, aged forty-eight, had a right-sided tumor which had existed for two years, and which grew rapidly in the past six months. There was a swelling the size of a walnut in the course of the common carotid artery, which was movable laterally but not horizontally. She suffered occasionally from sticking pains. The patient was operated on in 1907. The external carotid was ligated, the tumor being dissected away from the other carotid arteries. The removed tumor was encapsulated, and was the size of a large plum. Recovery was complete without complications. The clinical diagnosis was between a cervical lymph adenitis and a tumor of the carotid gland.

45. LIGIN.[30]—Kuznetsoff refers to a case in which he assisted a Dr. Ligin to remove a tumor from a young soldier. It had been necessary to resect all the carotids. He classes it as a tumor of the carotid gland with recovery.

46. DOBROMISLOFF.[31]—A male, forty-one years old, had a left-sided tumor for 17 years, with rapid growth for one year. This tumor was in the superior carotid triangle. It was operated on in 1900 by Salishteff. All three carotids were ligated and removed. The internal jugular vein and pneumogastric nerve were cut. The tumor grew about the common carotid artery, and when removed it was egg-shaped, 7 x 5 x 4 centimetres in size, very firm, reddish-gray on section. It had been diagnosed as a tumor of the thyroid gland. Death occurred one day after operation.

47. DOBROMISLOFF.[31]—A female, aged twenty-five, had a tumor on the left side of her neck for seven years. Two years previously it had taken on rapid growth. It was located at the bifurcation of the common carotid, beneath the sternomastoid muscle, and extended up to within a finger's breadth of the lobe of the ear. The larynx was displaced to the right. There was transmitted but not expansile pulsation. Lateral movement was free, but vertical movements were restricted. At operation, in 1906, many veins were ligated and the arteries dissected out. While the posterior portion was being dissected hemorrhage was free. It was an encapsulated tumor 9.5 x 8 centimetres. The patient recovered, but the left pupil remained dilated and the conjunctiva injected.

48. WOOLLEY and FEE.[32]—A woman, sixty-eight years old, had suffered from goitre five years. Two years ago she noticed a tumor on the right side of her neck. When examined it was 2.5 inches long by 1.5 inches wide. The larynx was pushed to the left. When the patient was examined on her back a bruit was heard over the tumor, but when her face was down this disappeared. There was a transmitted but not expansile pulsation. Vertical movement was free, but there was no horizontal movement, as the tumor was attached to the thyroid gland. The consistence was that of a large, non-pulsating lymph gland. At operation the tumor was removed, together with the bifurcation of the common carotid artery. The removed tumor was 6.5 x 3 x 3 centimetres and weighed 35 grammes. On microscopic examination there was distinct evidence of a sarcomatous change occurring in the tumor.

The patient did well for a while after the operation, but died 23 days later from an apparent septicæmia.

49. SINUSHIN.[35]—In a paper read before a Moscow medical society Sinushin refers to a second case coming under his observation. The patient was a woman forty-eight years old, and the report was made two years after the operation. There were no symptoms other than a gradually increasing swelling. At operation a typical tumor of the carotid body was found in the bifurcation of the common carotid artery, pushing the branches wide apart. The data given is very meagre, but gross and microscopic photographs leave no doubt as to the nature of the growth.

50. CHIARI.[36]—The patient, a man thirty-nine years of age, had noticed a tumor the size of a hazel-nut on the left side of his neck three and one-half years previously. It was smooth, freely movable, and the only symptom was a slight burning sensation. After a few months' duration it began to grow slowly, and about once a week he had attacks of pain radiating to the left side of the chest. As the tumor continued to grow these attacks became more frequent, often occurring several times in the 24 hours, and the pain became so intense the patient was unable to work. On examination Chiari found, in a position corresponding to the bifurcation of the common carotid, a hard smooth tumor the size of a pigeon's egg. It was only slightly movable, and a transmitted pulsation could be felt through it. At operation the tumor was matted to the surrounding tissues. The external carotid was ligated, and the descending branch of the hypoglossal nerve divided. The tumor was then dissected away from the internal carotid and lifted out of the widely distended angle of bifurcation. Microscopical examination revealed the usual structure of tumors of the carotid body. He rejects the idea of a hyperplasia of the normal gland, as not all the elements of the normal structure enter into the tumor formation. Notable is the absence of ganglion cells in the tumor.

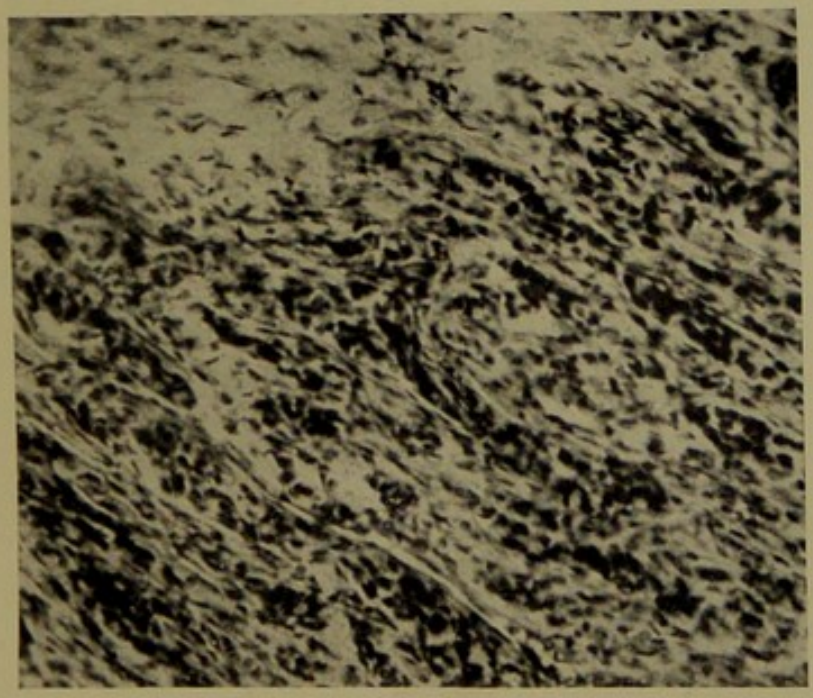
51. HOLLAENDER.[37]—On May 22, 1912, Hollaender demonstrated a tumor of the carotid body before the Berlin Medical Society. The tumor, the size of an egg, had occupied the upper triangle on the left side of the neck of a young actress. The only complaint of the patient was the disfigurement, but on examination a mild exophthalmus was observed. The larynx was displaced to the right. At operation the tumor was found to surround the external carotid, but was dissected away from it and the widened angle of bifurcation without sacrificing either of the carotids or any of the nerves. A mild disturbance of the recurrent nerve persisted for several days, but disappeared completely. No diagnosis was made previous to operation.

52. RANDISI.[38]—The patient, a woman fifty-five years of age, nine years previously had noticed a tumor on the right side of her neck, at the level of the thyroid cartilage. This swelling had very slowly increased in size, but aside from the deformity there were no symptoms. At examination there was a tumor the size of a lemon, of regular, rounded shape, and elastic on palpation. There was a faint pulsation, transmitted but not expansile. As aneurism and malignant growth could be ruled out from this history and the

FIG. 3.

Dr. Lilienthal's first case. Endothelial tumor of carotid body, long standing. Note absence of cachexia.

FIG. 4.



Dr. Mathew's case. Microphotograph of section removed at time of operation.

examination, an operation was decided on. The tumor was found lying on the anterior surface of the carotid arteries, involving the upper two-thirds of the common and a considerable distance along the internal and external. Paralysis of the right vocal cord followed the operation, although there had been no injury of the recurrent laryngeal nerve. From the histological examination the author calls the tumor an angio-myxoperithelioma.

53. Boni.[39]—A woman, thirty-four years of age, four years previously had first noticed the presence of a small swelling on the right side of the neck. This was the size of a small nut, was free from pain, spontaneously or elicited by pressure, and it was on a level with the angle of the jaw. Four months before coming under observation this tumor began to enlarge, became painful, and the patient became conscious of pulsation. On examination a soft, elastic tumor the size of an orange was found, pulsating synchronously with the carotid artery. It was somewhat reducible on pressure, but did not fluctuate. The location of the tumor in the bifurcation of the carotid, its intimate relation with the artery, the pulsations of which it transmitted, suggested a tumor of the carotid body. The tumor was removed by ligation of the common, external, and internal carotids, the jugular vein and pneumogastric and sympathetic nerves being dissected away from it. There were no post-operative sequelæ, and the patient remained well at the time of the report, two years after the operation. The histological examination suggested a fibrohæmangio-endothelioma. The author is in doubt as to the correct histological diagnosis, and leaves the question open as between a carotid perithelioma and a carotid adenoma.

54. Mathews.[40]—The patient, H., a male, twenty-five years old when first seen, was unable to definitely fix the appearance of a tumor on the left side of his neck, but thought there had always been a fulness there. The history, however, was quite definite of a growth for three years. In recent months there had been a modification of the voice. Examination showed a man in fairly good health. There was a swelling under the left sternomastoid muscle, which was ill defined and extended upward to the jaw and base of the skull and downward to the thyroid cartilage. Over this there was a bruit synchronous with the carotid pulsation. Pressure over the carotid suppressed the bruit, but did not reduce the size of the tumor. The left tonsil protruded to the median line, was smooth, not inflamed, and hard. The left side of the tongue was paralyzed and atrophied. Dr. Mathews attempted an oper tion at the General Memorial Hospital on May 9, 1911. The external jugular vein was ligated, and some pieces were removed from the mass, which infiltrated the surrounding tissue, leaving no definite outline to the tumor. Venous bleeding was profuse, although the internal jugular was about empty. As removal of the entire growth would have required extirpation of the common, internal and external carotids and the internal jugular vein, with all the important nerves of that side, and probably also the lateral wall of the pharynx, the wound was closed, leaving the tumor *in situ*. Primary union followed. This patient visited Dr. Duncan

MacPherson in the summer of 1913 for a growth in his left ear, which was removed at the Post-Graduate Hospital July 1, 1913. The operation was interfered with by the severe pulsatile bleeding. No histological examination was made of the growth, owing to loss of the specimen. Following a positive Wassermann, two injections of salvarsan were given with some apparent improvement. The patient continues to work as a street-car conductor, but has a contracted pupil on the left side and there is a stiffness of the neck. (Microscopical examination of a poorly prepared section from the mass removed by Dr. Mathews convinces me this is an undoubted tumor of the carotid body.) (Presented before the New York Surgical Society, October 22, 1913.)

55. DaCosta.[41]—March 3, 1913, before the Philadelphia Surgical Society, DaCosta presented a specimen of a tumor of the carotid body, which he had removed from a woman thirty-six years of age. The tumor had been noticed 16 years previously, but growth had been slow until six months before operation. During this six months the tumor had grown more than in the 15½ years before that time. The diagnosis, made before operation, was based on the slow growth for years; the carotid pulsation, which lifted the tumor at every beat of the heart; the absence of expansile pulsation; the free movement laterally but not vertically. The tumor, the size of an English walnut, was removed by ligation of the external carotid, it being dissected away from the internal carotid and jugular vein. The pathological diagnosis was perithelioma.

56. Lilienthal.[42]—A woman, M. C., about thirty-eight years old, was admitted to Mt. Sinai Hospital in April, 1906. Ten months before she had first noticed a tumor the size of a marble which at first increased slowly in size, but for ten weeks before admission had grown so rapidly that when she entered the hospital it was enormous, extending from the trapezius posteriorly across the median line in front. There were severe "neuralgic" pains in the head and there was hoarseness from paralysis of the right vocal cord. The tumor felt hard and solid but was not attached to the skin. There was no discoloration. On April 6, Dr. Lilienthal removed a specimen for examination, considering the case inoperable. On July 6, in order to relieve suffocative symptoms, Dr. Elsberg, his associate, attempted to extirpate the mass and succeeded in removing about half of it. She left the hospital about three months later, returning the following March with a huge fungating mass. She died the same month of repeated hemorrhages. Dr. Mandelbaum, pathologist to the hospital, examined the original specimen and also the larger portion which had been later excised. His report is hæmangioma arising from perithelium. The cells are uniform, varying but little in size and appearance, thus differing from the usual type of malignant tumor.

57. Lilienthal.[43]—October 8, 1913, before the New York Surgical Society, Dr. Lilienthal presented a case of tumor of the carotid body, with the following report: "This woman was presented by me in the spring of 1909 before this society. At that time she was fifty-six years old, and stated that she had had a small lump in the side of her neck for 30 years. For five years before she had consulted me this had increased considerably in size, and during one year it had grown rapidly, so that

she became alarmed. The diagnosis of tumor of the carotid body was made before the operation because of the hardness, the location, the long history, and because I had had the opportunity to examine a similar case, and afterward to operate on it, some years before. That patient died about two years after the operation of relapse with cachexia, but with no secondary or metastatic growths. The histological diagnosis, as in the present case, was made in the laboratory of Mt. Sinai Hospital. The tumor in my patient to-night was the size of an egg at the time of the first operation. There were firm adhesions to the internal jugular vein and to the carotid artery, so that it was necessary to ligate both of these vessels close to the clavicle, and using them and the freed tumor as tractors it was possible to shell out the pneumogastric nerve and ligate the internal and external carotid arteries and also the jugular vein in their upper portions. The day after the operation there was aphasia and well-marked right hemiplegia. The left eyeball was soft and its pupil contracted. In a few days all symptoms except the contraction of the pupil had disappeared. The pupillary contraction was probably due to injury of the superior cervical sympathetic ganglion. The aphasia was central. There was no aphonia. . . . DaCosta states that the apparent pulsation in these tumors is transmitted from the arteries. In the patient presented here to-night it appears to me that the tumor itself undoubtedly pulsates. I consider the case inoperable, and the patient now shows signs of cachexia."

58. GRAHAM.[43]—A male, age twenty-seven, was admitted to Lakeside Hospital, Cleveland, October 27, 1906, with a tumor on the right side of his neck that had existed for ten years. The tumor, not visible but palpable in its early stages, was free from pain and discomfort, and had been discovered accidentally. There had been severe headaches, the eye had been inflamed and the pupil irregular. During the six weeks previous to admission to the hospital the patient had suffered from sharp, shooting pains radiating to the left ear. At the operation, by Dr. Crile, a tumor 5 x 4 x 3 was removed by ligation of all the carotids. The recurrent laryngeal and the superior cervical sympathetic nerves were divided. The hypoglossal nerve was adherent to the tumor and was deflected from its course. During the operation there had been free bleeding, difficult to control, and at its conclusion the patient was suffering from severe shock. The next day the left pupil was contracted and the left eye paretic, and the patient suffered marked hoarseness. Weakness of the calf muscles and the arm developed after ten days, but recovery was complete. There has been no recurrence to date. Histological examination showed the growth to be a tumor of the carotid body.

59. GRAHAM.[43]—A male, aged twenty-seven, was admitted to the Lakeside Hospital March 12, 1913, with a diagnosis of tumor of the right tonsil. The tumor was known to have been present for seven years, and during that time it had not increased much in size. There was no pain and no difficulty in breathing or swallowing. The growth pushed far into the pharynx, reaching to the uvula. Externally it extended from the ear to the angle of the jaw, was smooth, round, and about the size of a small egg. It was slightly movable from side to side but not up and down. The right submaxillary glands were enlarged. Dr. Crile

removed the tumor, 5.5 x 4.5 x 2.5 centimetres, by ligation of the external carotid artery and internal jugular vein. A portion of the vagus was resected, the hypoglossal nerve laid bare but not injured. After the operation the right pupil was contracted and irregular, and there was marked hoarseness. Both these conditions were present at the time of discharge, one month later. Histological examination showed a typical tumor of the carotid body.

60. CALLISON and MACKENTY.—The case reported in this paper.

Recapitulation.—In the 60 cases of tumor of the carotid body four cases (28, 29, 36, 43) have been found at autopsy. Two (25, 30) were examined post mortem, although the existence of a tumor had been known when death occurred from other cause. The remaining 54 cases have come to operation. In four (41, 54, 56, 60) the tumor was laid bare, only to find such extensive involvement that nothing could be done. All three carotids were ligated in 32 cases, the external only in seven cases. In 15 cases the tumor has been dissected away from all the vessels, or dissected away from the common or internal carotids after ligation of the external. In eight cases recurrence took place, in six of these (5, 7, 14, 24, 37, 39) after the tumor had been dissected away from the blood-vessels, in two cases (38 and 57) after complete removal of all the carotids. In one case examined after death (26) there were metastases in the liver. Of the 54 patients operated on, 42 have recovered and 12 died. But to these twelve deaths must be added four from recurrence and six other speedy deaths in prospect from recurrences known to exist when the case was reported, or 22 deaths in 54 cases. In one other case the patient probably died as a result of the tumor. The causes of death have been: In cases 1, 6, 11, 23, pneumonia, in all of which the pneumogastric was divided or resected at the operation; in cases 3, 32, and 56, hemorrhage; in cases 22 and 41, cerebral anæmia; in case 27, acute œdema of the lungs; case 45, not stated; in case 47, septicæmia; in case 60, infection and hemorrhage.

In addition to this mortality, however, other accidents have arisen in the patients who survived. In cases 2, 12, 26 and 40 the patients have had hemiplegia with aphasia. In

four the voice has been affected, and there has been more or less dysphagia. In one there has been such tracheal irritation as to produce a constant cough. In five the tongue has deviated to one side. In four there has been an altered pupil, in one conjunctival injection. In four cases the face has been partly paralyzed.

Etiology.—The etiology of tumors of the carotid body is wrapped in the same obscurity that envelops the causation of other neoplasia. A study of the ages of reported cases seems to offer some justification for von Heinleth's [34] observation that the carotid body reaches full development between 20 and 30, and then either atrophies or goes on to tumor formation. These ages, by decades, are: Up to 20 years, 3 cases; 21 to 30 years, 13; 31 to 40, 12; 41 to 50, 14; 51 to 60, 10; over 61, 5. In three cases the age is not stated. It is thus seen that in 57 cases in which the age is given, 39 occurred between the ages of 20 and 50. This is accentuated by a study of the duration of the cases. In the younger individuals, the duration is short, while in older persons the duration is of much greater length, 17 years in cases 39 and 45. The sexes are equally affected—31 males and 28 females, with the sex not stated in one case.

The Nature of the Growth.—These tumors usually have a long history of slow growth. During this period they may manifest the characteristics of a benign neoplasm. They are encapsulated, do not invade the surrounding tissues, do not return if completely removed, and give rise to no symptoms other than the deformity. Complete removal is, of course, difficult on account of their location. Later they may take on rapid growth and assume the characteristics of a mildly malignant tumor, recurrences and metastases being reported, but the cachexia and anæmia of a malignant growth are not present. Considering this history, and on the histological structure, Beitzke, in his case, and Kocher, in the case reported by Licini, designate the condition as a "struma." Their uniform classification in one of the tumor groups is not possible because of the varying structure of the tumor in some of

the cases. They have been most usually diagnosed as endotheliomata or peritheliomata. The structure of the case here reported is more closely allied to the endotheliomata than any other form of tumor. Leithoff,[33] in the case reported by von Heinleth, and Woolley, in his own case, lay stress on the sarcomatous change occurring in the new growth. Alezais and Peyron describe a change in their tumor which seems to be carcinomatous. This is, so far as I have been able to discover, the only recorded case in which apparent epithelial change was present. Cecca reports his case as primary angiosarcoma. Until a more definite determination of their nature has been made, the best term to use in their diagnosis is simply "tumor of the carotid body."

Symptoms.—The symptoms of tumor of the carotid body are both subjective and objective.

Subjective Symptoms.—The patient may present himself at an early stage of the growth, because of the deformity, and desire cosmetic betterment; he may come at a later time, because of fear of the consequences of a rapidly growing tumor of the neck; or he may only present himself for relief from some of the symptoms caused by the progressive damage done by the tumor, as in the case here presented.

In the first case he will complain of no symptoms but the deformity of a tumor of the neck. There is no pain or tenderness, and he only asks for cosmetic improvement.

In the second and third stages the symptoms are due to involvement of the cranial and sympathetic nerves. The number and severity of the symptoms will depend upon the extent to which the tumor has grown. There may be difficulty in phonation or swallowing, or an annoying cough may be present. He may complain of deafness or conjunctivitis. There may be, at a late stage, some pain as nerve trunks are being included in the growth. On the whole, the subjective symptoms are surprisingly few.

Objective Symptoms.—The objective symptoms are more numerous and constant than the subjective. The findings on examination will vary according to the stage at which the patient presents himself. In the early stage there is a tumor

from the size of a robin's egg to one that can just be palpated. It is underneath the sternomastoid, or at its anterior margin, on a level with the upper border of the thyroid cartilage. It is egg-shaped, single, discrete, firm, elastic, movable laterally but not vertically. There is a pulsation, transmitted but not expansile. A stethoscope placed over the tumor will reveal a distinct bruit in most cases. As the tumor progresses the picture changes, and more and more structures are involved. Perhaps the most constant of the later symptoms is the paralysis due to involvement of the recurrent laryngeal while its fibres are still within the vagus. These reveal themselves as paralyses of the cords and other laryngeal and pharyngeal muscles, leading to difficult phonation and deglutition. The larynx may be congested and catarrhal. The pupils may be irregular and fail to react to light on the affected side. When the tumor becomes more extensive and invades surrounding structures its mobility may be distinctly less. At this stage the larynx may be pushed to one side, or the tumor may bulge into the pharynx.

Differential Diagnosis.—The first difficulty in the way of making a diagnosis of tumors of the carotid body is their rarity. Were they more common the diagnosis would be comparatively easy. But when one is encountered its true nature is not suspected. Seven have been recognized before operation. These were by Reclus and Chevassu, Kopfstein and Maydl, Da Costa (two), Kocher in the case reported by Licini, Boni, and by Lilienthal in his second case. Kuznetsoff narrowed his tumor to a lymph adenitis or a tumor of the carotid body. Keen thinks he would recognize another one if it should come under his observation.

Tumors of the carotid body must be differentiated from cervical lymph adenitis, early metastatic carcinoma of the lymph glands, sarcoma, particularly lymphosarcoma and sarcoma of the lymph glands, lipoma, fibroma, aneurism, branchial cyst, gumma, Hodgkin's disease, aberrant thyroid and Bezold's perforation of the mastoid. It is only when these conditions occur in the superior carotid triangle that a differentiation must be made.

Cervical lymph adenitis is usually multiple, and as a rule these nodes invade the surrounding tissues and are matted together. They may be tender. Reclus says they are entirely hard or entirely soft. If the nodes attach themselves directly to the large arteries of the neck, and are very hard, there may be a transmitted pulsation. Finally, the history, with the subcutaneous tuberculin test, with its associated rise of temperature and aggravation of the local picture, may decide their nature.

In carcinoma the primary focus can usually be located, the nodes are usually multiple, are rapidly growing, of stony hardness, and later there will be increasing cachexia and anæmia. Carcinoma usually invades the surrounding tissues, so that motion in all directions is limited.

Sarcoma is rarely limited to one lymph node, but several closely connected glands will be involved. There is movement in all directions in the early stages, and no transmitted pulsation. Pulsation and murmur rule out lymphosarcoma, according to Kopfstein.

Fibromas are more superficial, harder, and more movable than carotid tumors, and are rarely found in this location. Should one occur, however, its differentiation would be difficult.

Lipomas have a woolly feel, are softer, more superficial and less uniform. They lack the pulsation of a carotid tumor, and are movable in all directions.

Branchial cysts are usually superficial, but they may reach to the deep structures of the neck. As a rule they are congenital. Fluctuation is usually present. After being satisfied that the condition is not an aneurism, aspiration will demonstrate the nature of a cyst, as either a light colored or cloudy fluid will be obtained.

Hodgkin's disease gives multiple nodes, movable, and is bilateral from the first. In density they are intermediate between malignant tumors and tuberculous glands. The nodes feel like lipoma, but are more deeply situated.

Syphilis of the glands gives an adherent, hard, matted

mass, and there is usually other evidence of syphilis. The Wassermann and Noguchi reactions will aid in the diagnosis, when positive, or a therapeutic test may establish the nature of the swelling.

Aneurism gives rise to an expansile pulsation, the pulse on the affected side is delayed in the temporal arteries, and there is a gurgling murmur over the tumor.

Kopfstein excludes aberrant thyroid by the absence of an enlarged thyroid gland. Reclus says he has never seen aberrant thyroid gland as high as the thyroid cartilage.

The differential diagnosis, hard as it is on paper, is yet more difficult in actual practice. After the surgeon has exhausted every diagnostic means at his command, he will still be in doubt as to the nature of the tumor he is considering. It then becomes necessary to remove a fragment of tissue for pathological diagnosis, or to proceed in ignorance of the nature of the growth with which he is dealing.

Surgery.—The detailed surgical treatment of tumors of the carotid body is beyond the proper bounds of this paper. Yet some suggestions from a pathological viewpoint may not be amiss. The history of this tumor shows it to be, in its early stages, a benign tumor, which later takes on a malignant growth. The surgical treatment, therefore, for purposes of consideration, can be divided into two cases. A diagnosis is rarely made in the early, benign stage, but an operation is attempted under some mistaken diagnosis, and then the true nature of the tumor is discovered. If now the tumor is not closely adherent to the arteries, except through the "ligament of Mayer," it seems safe to dissect it away from the bifurcation. Keen advises against this, but I can see no objection if a close watch is kept for recurrence and then such further operative procedures taken as the case may demand. On the other hand, if the tumor surrounds the arteries, is closely adherent to the wall, and other structures are included in the surface of the growth, then an attempt to dissect away the mass must be condemned. Five recurrences out of fifteen in which this has been attempted argue strongly against it.

The surgeon may now close up the wound, leaving the tumor *in situ,* as Green did; or he may remove the tumor and arteries together, the usual course pursued. This involves ligation of the common, internal and external carotid arteries, also probable ligation of the internal jugular vein, and the attendant danger of injuring the pneumogastric, hypoglossal and other nerves. The surgery now changes from that of a tumor of the carotid body to that of the carotid artery. As this is one of the most formidable and dangerous operations the surgeon is called upon to perform, each must decide for himself the course to be pursued.

In closing I wish to thank Drs. Mathews, Lilienthal, and Coley for the personal cases they have given me; Prof. Ewing for his suggestions as to the nature of the tumor; Dr. H. T. Brooks for suggestions in the preparation of the paper, and Mr. Wm. S. Dunn, of the Photographic Department of Cornell University Medical College, for furnishing the microphotograph used in the illustration.

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