LECTURES

ON

THE HISTOLOGY OF THE EYE:

(BEING THE ARRIS AND GALE ANATOMICAL LECTURES.)

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BY

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LECTURE III.

MR. PRESIDENT AND GENTLEMEN,—Having gone over the normal anatomy of the eyeball in man, and noticed the structural modifications of the organ in other vertebrata, I would now invite your attention to the anatomy of disease, and, to-day in particular, to the histology of the new growths which originate on or in the eyeball. No other organ offers the same opportunities for observing some kinds of tumours in their early stages, of noting the changes which attend their growth, and of marking the alterations to which they give rise in the parts invaded by them.

Here, as elsewhere, it is natural and convenient to group the tumours in two primary divisions: cystic and solid. The latter are the more common, and by far the more important.

Cystic Tumours.—Excluding the not infrequent cyst-like bulgings of the iris, consequent on exclusion of the pupil and retention of accumulated inflammatory exudation between the iris and lens, and the vacuities filled with serum, which are sometimes present in solid growths of a distinctly inflammatory origin, such as those occurring in the solid fibrous mass which sometimes fills the space between a strongly coarcted retina and the choroid, and is a product of long-continued choroiditis (neither of which kinds of spaces has distinct saccules of new formation), true intraocular cysts have come under my own observation only in connection with the iris and in the retina; and this, I think, accords with the experience of others. Retinal cysts are extremely rare. I am indebted to Mr. Lawson for the only opportunity which I have ever had of examining them. In dissecting an eye which had been excised on account of a chronic painful condition depending on choroid inflammation, eleven cysts were found in the retina, the largest of the size of a small pea. One which I examined microscopically had a distinct membranous sacculus, lined with a pavement-epithelium, composed of a single layer of flat polyhedral cells. The retina was slightly separated from the choroid by a thin stratum of serum, into which the cysts projected, protruding more from the outer than from the inner surface of the retina.

Three similar cases were communicated by Ivanoff to the Ophthalmological Congress held at Heidelberg in 1864, but the cysts differed from that which I examined in the absence of a distinct sac. They appear to have been simply cavities formed by the separating of the retinal tissues by an inflammatory exudation. Cavities like these I have more than once found in coarcted retinæ, but I did not regard them as true cysts.

The development of cysts in the iris and ciliary process is much less uncommon than in the retina. Wecker some time since published a summary of all which had been recorded at that time, and I myself published, in the *Royal London Ophthalmic Hospital Reports* in September 1867, a *précis* of twenty collected from various sources, with an account of two new cases which had then been recently under my notice. To these I can now add two others which I have since seen, making a total of twenty-four cases. Most of these were plainly developed in the iris, but a few appear to have arisen in the ciliary processes, and thence to have advanced through the iris into the anterior chamber.

Cysts originating in the iris (and I myself have seen such only) form a semi-transparent bladder, slightly pearly or reflecting in a faint shadowy manner the colours of the iris in which it arose. The growing cyst projects from the plane of the iris towards the cornea, spreads across the pupil, and fills the anterior chamber. Before or by the time this happens, it generally provokes iritis. After simple evacuation of their contents by puncture, these cysts soon refill, and they do not less

certainly form again after incomplete excision. The chances of a successful removal are therefore greatest where the cyst is small, and when its connection with the iris is limited, because these conditions are most favourable for its complete extirpation. In the case which I have tried (with very imperfect success) to illustrate by this diagram, these conditions were present, and the cyst never returned after removal. This, and also a second iris-cyst which I have microscopically examined, had a distinct sacculus, composed of a delicate structureless membrane, lined with a delicate pavement-epithelium of flat polyhedral cells, varying greatly in size and in form in different parts of the cyst. Externally, the cyst was overlaid by the stretched and unravelled tissues of the iris. I could not doubt that in both these instances the cysts arose in the iris, and this agrees with the origin of a similar cyst described several years ago by Mr. Bowman, in his *Lectures on the Parts concerned in the Operations on the Eye*, which, he says, was developed between the muscular stratum of the iris and the uvea.

Wecker gives a different explanation of the origin of such cysts (Knapp's *Archiv für Ophthalmologie*, etc.). He looks upon them as sacculations of the iris, placing them, as it appears, in the same category with the bulgings of the iris caused by the accumulation of exudation behind it, when the posterior chamber has been shut off from the anterior one by the adhesion of the iris to the lens. He assumes, as the first step in their development, an annular adhesion of the uveal surface of the iris to the anterior capsule of the lens. This is followed by distension of the piece of iris thus circumscribed, until it forms a sacculus, the interior of which is lined by an epithelium, which is the modified uvea. I venture, however, to submit that this view of their origin is not borne out by their true anatomy; and I think, also, that their clinical history sharply separates them from the localised bulgings of the iris consequent on pupillary synechie. With a single exception, so far as my knowledge of them reaches, all the recorded iris cysts have been simple, and their contents generally serous. The exception to which I refer is a proliferous one, described by Professor von Graefe in the *Archiv für Ophthalmologie*, Bd. iii, S. 212. It contained a pulaceous substance, consisting of squamous epithelium mingled with short stiff hairs. Its contents agreed, therefore, with the dermoid cysts so common about the orbit. We have yet much to learn about the etiology of cysts of the iris. In eighteen of twenty cases, I found that the appearance of the cyst followed an injury. This held good, not only of the serous cysts, but also of this proliferous one, which is the more remarkable, because the clinical history of the periorbital dermoid cysts, and also that of those in other regions, always points to a congenital origin. They may remain dormant for a long period, scarcely increasing until something rouses them to a more active growth. I have more than once seen this enlargement of a dormant cyst of this kind coincide with the accession of puberty. It may be that this dermoid iris cyst was also congenital, and that the wound supplied the stimulus which roused it from latency into activity.

Solid Tumours.—Most of the solid tumours of the eyeball arise inside it. Those which spring up on its exterior are few compared with those having an internal origin. I have seen a very small number of melanotic and unpigmented sarcomata begin upon the ciliary region and extend along the surface of the sclera and cornea; but invasion of the eyeball by continuous infection by sarcomatous and cancerous tumours arising in the caruncle or eyelids, and about the optic nerve behind the eyeball, is more frequent. The least infrequent of the tumours arising on the outer surface of the eyeball are, I think, those called dermoid, from their resemblance to skin. I have seen several such—most of them had a simple hemispheric form, and none of them exceeded the size of a split pea. Most of them were seated on the junction of the cornea and sclerotic. These little tumours have a dry surface like skin, rather than conjunctiva, and some of them bear a few hairs. In a vertical section they are seen to have an external skin enclosing a little mass of areolar tissue containing a few fat-cells. A lobulated variety of this kind of tumour is rarer. It is softer, it contains more fat, and in this approaches to a lipoma. All of this kind which have come under my notice have been seated wholly on the sclerotic, but loosely attached to it, and easily dissected off it. The overlying conjunctiva was less skin-like than in the first form, indeed scarcely altered. From their structure it might be predicted that these tumours would not return after excision, and experience corroborates this.

All the commoner intraocular tumours fall into three groups; they are gliomata, sarcomata, and cancers. I must premise, in order to avoid being misunderstood, that I use these terms in the restricted sense in which Virchow employs them in his lectures on Morbid Growths, the most valuable contribution to onkology in recent times.

By *glioma* is meant a soft vascular tumour, originating in the neuroglia—the delicate interstitial connective tissue of nerve. A *sarcoma* is

a tumour having for its type the commoner form of growing connective tissue, and it differs anatomically from cancer, chiefly in the presence of a true intercellular substance. A *cancer* is a tumour the active elements of which are cells referable to an epithelial type, packed in the spaces of an areolated or alveolar stroma, without a true intercellular substance. The definition of these terms rests on the bases of origin and structure, and it has not any reference to clinical history. Glioma, sarcoma, and cancer each have a characteristic structure, and cancer is not convertible with malignant tumour. Measured by their power of infecting near and also distant parts, glioma and some sarcomata of the eye are as malignant as the most virulent cancer.

Gliomata are soft vascular tumours, often formerly, and still sometimes, confounded with medullary cancer, and in one of their phases with tubercle. The rough appearances of a tumour are not always an infallible clue to its firm structure. Hirschfeld, who has written an excellent monograph on glioma of the eyeball, and Knapp, whose treatise on intraocular tumours is a model of laborious clinical study and of exact histology, have only observed glioma of the eye in children. The oldest child mentioned in Hirschfeld's tables was thirteen years old, and all Knapp's cases were children under five years. This is also my own experience. I do not remember to have seen a retinal glioma in a child more than ten years old, and I have seen more in children under five than between this and ten. It is not very infrequently observed in infants a few weeks old, and in some cases the growth had already made such progress that there was a strong presumption in favour of its having begun *in utero*. Such cases have also come under my own notice. Although often restricted to one eye, it occasionally attacks both. In the few examples of this which I have seen, the glioma was more advanced in one eye; in one instance it protruded as a fungating tumour from the right eye, while the left eye had not yet burst. As it is commonest in very early childhood, when slight visual defects are seldom soon discovered, and as it does not betray itself until it has attained some size, the earliest stages of retinal glioma have been rarely observed. In one case only, I saw it begin in the form of small, opaque, white raised spots, which grew, ran together, and became two large knots. Usually, after a short time, the retina becomes separated from the choroid by a serous effusion, the vitreous humour wastes, and the retina, transformed into a solid gliomatous mass, occupies the axis of the eyeball. Continuing to grow, it thrusts the lens forwards, produces a glaucomatous condition of the eyeball, and escapes in front, either by the cornea sloughing, or, which is less frequent, by its becoming infected and involved in the gliomatous mass. After this, the tumour grows very rapidly, and soon forms a large ulcerating and fungating mass, which projects between the eyelids, and often attains a very great size. The choroid and sclerotic are infected and destroyed in a similar manner, and tuberos masses form outside the eyeball around the optic nerve. The nerve itself is usually infected at a very early stage, and the gliomatous growth spreads along it inside the skull, infecting the optic commissure and neighbouring parts of the brain. If the child survive long enough, secondary tumours spring up at a distance from the primary source. I have seen them in distant parts of the brain and in the diploe of the skull; the lymphatic glands become infected, and secondary deposits have been found by Knapp in the liver. I formerly thought that glioma spread only by continuous infection, and that this was one of the features in which it differed from true cancer; but increased experience has shown me my error. (Fig. 5.)

Occurring at an age when growth is rapid, and being abundantly vascularised, these retinal gliomata often make quick progress, and death occurs seldom later than at the end of the second year, and usually, I think, much earlier. They are very prone to fatty and earthy metamorphoses, which produce small yellow and earthy specks. These are sometimes very abundant, and they give the glioma a rough resemblance to caseous tubercle.

In the living eye, a glioma, when it has attained some size, attracts the attention, even of the unobservant, by a peculiar yellow brightness of the pupil, which is often compared to that of a cat, and it is for this the children are often brought, the visual defect being unnoticed. With the ophthalmoscope in the earlier stages, and under focal illumination with a collecting lens at a later period, the projection of the tumour into the vitreous humour and its vascularity are easily detected. Histologically they consist of small cells, about the size of a blood or lymph corpuscle, scattered through or densely crowded in a homogeneous or very firmly fibrillated intercellular substance. Numerous observations have placed their retinal origin beyond doubt, but we still need information respecting the precise situation in which they begin, and the particular retinal tissues out of which they are evolved. Knapp refers them to the outer granule-layer, while Hirschfeld relegates them to the inner granule-layer. I am unable myself to speak on this point, for I have not had an opportunity of microscopically examining a glioma in the

very early stage. In the orbital part of the optic nerve, and also in its intracranial course, I have observed the diffusion of glioma along the neuroglia, and the evolution of its corpuscular elements out of the corpuscles of this connective substance. The histology of the secondary tumours closely resembles that of the primary, only the corpuscles are often rather larger.

Sarcoma.—Most of the intraocular tumours occurring in adults fall into the group of sarcomata, and these, in my experience, without exception, originate in the choroid. They are soft, vascular, mostly pigmented, and less often pigmentless. When devoid of pigment they

Fig. 5.—*a*. Cross section of the Optic Nerve in a case of Glioma Retinæ. The neurilemma is filled with glioma-cells. *b*. Section of a Retina affected with Glioma.

have often been mistaken for medullary cancer, and when pigment-bearing they are very often confounded with melanotic cancer. Under the common name *melanosis*, I have met with very few examples of the pigmentless form. They all occurred in young adults, and were all composed of spindle-cells. In most of the melanotic sarcomata of the eye, spindle-cells also predominate. The pigment is granular, and lies within the cells; it is as if it were a something superadded, apparently not essential to the sarcoma, for the amount of it varies extremely, some cells being choked with it, while it is wholly absent from neighbouring cells, and it is not a very unusual appearance for some parts of a tumour to be black and others white.

Melanotic sarcoma of the eye, and also melanotic cancer, are, I believe, unknown in childhood. No instance of a large, round, cell sarcoma has yet come under my notice. Both varieties of sarcoma fill the eyeball, and soon cause coarctation of the retina; they burst forth in front, then grow rapidly and fungate, infect the other ocular tissues, and break through the sclera into the orbit and fill it, destroying its bony walls by infecting them and by pressure; they extend along the optic nerve into the skull; and they give rise to secondary tumours in near and remote parts. I have been so often able to trace the remains of the choroid on

both surfaces of intraocular sarcomata, that I have no sort of doubt that they usually arise in its stroma. I have long been disposed to regard the lymphoid cells, which are always present here, as their starting point.

Cancerous tumours form a very small group. I have myself seen very few; most of them were melanotic, and where I had the opportunity of examining them before they had infected the other tissues, and before they had filled the eyeball their origin within the choroid could not be doubted. They manifest the same diffusibility by continuous and remote infection as cancer does when it arises in other organs. I do not know any better illustration of the truth of Virchow's aphorism, that a necessary connection by no means always exists between the external form and the inner nature of a morbid growth, than that afforded by the intraocular sarcomata and cancers—both are soft vascular tumours, both have a melanotic and unpigmented variety. If we cannot always distinguish them by their rough appearances on coarse dissection, neither are there any ophthalmoscopic signs by which we can differentiate them in the living eye. The unpigmented forms of sarcoma and cancer alike beginning in the choroid, project from the plane of its inner surface, and, soon advancing in front of the posterior principal focus of the eyeball, reflect in divergent pencils the light which falls upon them, and make the pupil to shine with a bright metallic glow. The colour is a dirtier and less pure yellow than that of glioma. While the media remain clear and the retina overlying the tumour continues transparent, we are in some instances able to distinguish the blood-vessels belonging to the tumour from those of the retina by their different distribution, which is

a

b

Fig. 6.—*a*. Cross section of an Optic Nerve in Cancer of the Eyeball. The interstitial tissue between the inner and outer sheaths is infiltrated with Cancer-cells. *b*. Sclera infiltrated with Cancer-cells.

a valuable aid in diagnosis. Unfortunately the retina soon becomes, in many cases, detached from the choroid, and coarcted. In some cases, the retina is detached throughout its entire extent and coarcted, forming a slender funnel, the point of which is tied to the sclerotic foramen, and

the wider end is applied to the back of the lens. When this has occurred, the detached retina may mark the tumour concealing the true nature of the case, and this is the more likely to happen when the retina has become opaque, and when the choroidal tumour is small. (Fig. 6.)

In such cases as these the tensile condition of the eyeball may, as Von Graefe has pointed out, give a valuable clue. In uncomplicated detachment of the retina, the tension of the eyeball is seldom excessive; the eyeball is seldom hard; while, with a detached retina complicating a postretinal tumour, excessive tension of the eyeball, shown by undue hardness, is often present. Unnatural softness of the eyeball, which is not uncommon with detached retina, does not often go together with intraocular tumour. On the other hand, hardness of the eyeball is not peculiar to intraocular tumour, but is one of the signs of a disease common in and after middle life—I mean glaucoma. So in a soft eyeball, the presence of tumour is not likely, while in a hard eyeball its presence is, so far as concerns this sign, not improbable. I have known many experienced surgeons enucleate neuralgic eyeballs, spoiled as was thought by uncomplicated glaucoma, in which on dissection tumours were found. Indeed, I once fell myself into this error. In several cases I have found only a partial detachment of the retina, and in some of these the separated portion was that which originally overlaid that part of the choroid from which the tumour sprang; but in other cases (and I think these were more numerous), the retina adhered to the surface of the choroidal tumour, allowing it to be seen with the ophthalmoscope while the rest of the nervous membrane was separated. Melanotic tumours, in proportion to the intensity of their pigmentation, absorb the light which falls upon them; and, under the ordinary illumination of unconcentrated daylight, are not, when small, observable by an untrained person, as a glioma is, unless they spring from the front of the choroid. Under the more intense illumination of the ophthalmoscope, while the media are clear, their diagnosis is not more difficult than that of unpigmented tumours.

To sum up; there are three common kinds of intraocular tumour, of which one, primarily seated in the retina—glioma—is restricted to childhood, and two originating in the choroid—sarcoma and cancer—almost exclusively occur in grown persons. Sarcoma is generally of the spindle-cell variety. It and cancer occur in two forms—one pigmentless, which is rare; the other melanotic and common. All three kinds of tumour manifest in varying degrees by spreading into near and remote parts, irrespectively of differences of tissue, that destructive diffusibility which constitutes them, in surgical parlance, malignant. The colourless sarcomata are, according to my experience, the least hurtful in this respect.

In conclusion, Mr. President and gentlemen, let me thank you for the kind consideration you have shown me. I am too fully aware of my own imperfections not to be sensible how much your kind indulgence has lightened my labours.

[FIGURES 3 and 4, shewing a section of the optic nerve and the changes which it undergoes in inflammation, were accidentally omitted from the second lecture. They illustrate the description of the sheath of the optic nerve, page 243, column I, of the JOURNAL for Sept. 3rd.]

Fig. 3.—Cross section of the Optic Nerve, shewing its double sheath and internal neurilemma]

Fig. 4.—*a*. Cross section of an Inflamed Optic Nerve. The intestinal connective tissue between the inner and the outer sheaths is infiltrated with exudation-corpuscles. *b*. Portion of the interstitial tissue with exudation-cells, evolved out of the connective tissue corpuscles. *c*. Granular and fibrillated exudation.

ON STRANGULATION OF THE UTERUS.*

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UNDER the term "strangulation" of the uterus, I propose to describe a pathological condition of that organ of great importance, hitherto, I believe, I will not say absolutely unrecognised, but unexplained as regards the mechanism of its occurrence, and certainly undervalued in regard to the influence which it exercises in the production of uterine suffering and the origination of some of the most troublesome maladies to which women are subject.

It is well known that, if one of the fingers be forcibly kept in a state of extreme flexion for a few hours, the result is, that the finger becomes swollen, congested, and painful; the pressure due to this flexion impeding the circulation and producing these effects. Similarly, a bandage tied round the arm produces congestion and pain in the hand, even when the pressure is kept up for a short time only.

Now, the forcible bending of the uterus is attended with results of an analogous character. Flexion of this organ at its centre similarly interferes with the circulation in its tissues, leading to the effects now to be described under the term "strangulation" of the uterus.

A moment's reflection on the anatomy of the uterus and the arrangement of its vascular supply leads necessarily to the inference that any compressing force applied at or about the middle of the uterus will inevitably lead to obstruction in the circulation of the organ above that point; the result being an engorged congested condition of the body and fundus of the uterus. In a lesser degree, also, such compression will give rise to like results in the cervix and neighbourhood of the os uteri, where the circulation must be also materially interfered with. A reference to the beautifully executed illustrations of the vessels of the uterus in Dr. Savage's work *On the Female Pelvic Organs* (Plate VII, 2nd ed.) will lend force to this explanation. Let it be supposed, for instance, that a ligature were applied, not very tightly, round the uterus at about its middle: the congestion referred to would occur just as certainly as when a bandage is applied round the arm in the operation of venesection.

Now, acute flexion of the uterus produces a result very analogous to that which would occur were a ligature applied round the uterus. If the organ be bent backwards, for instance, a constriction will occur at the seat of the flexion, which will be intense and severe in proportion to the degree of the flexion. The passage of blood to and from the fundus uteri is impeded from the simple fact that the opposite sides of the blood-vessels are brought into contact, and the passage of the blood obstructed. The bending of a tube composed of non-rigid materials necessarily produces more or less occlusion of that tube; and so it is with the vessels of the uterus when that organ is in a state of acute flexion.

Strangulation of the uterus is most intense when the organ is sharply bent backwards and assumes a shape like that of a chemical retort; and the strangulating effects are most marked when such flexion has been rather suddenly brought about. But it exists also, though to a less degree, when the uterus is sharply bent forwards; the reason for the difference residing in the circumstance that the anatomical relations of the uterus allow a more extensive and a sharper degree of flexion backwards.

I maintain, then, that a necessary result of acute flexion of the uterus is a strangulation of the organ, which will be characterised by various degrees of congestion, according to the rapidity with which the lesion is brought about, and which will be influenced by other circumstances too obvious to require special mention.

Congestion of the uterus due to strangulation, and brought about by the mechanism above described, will, and frequently does, aggravate and intensify the flexion, the two mutually increasing as the disease advances. The original cause of the flexion is various; but I do not hesitate to say that, in the numerous cases which have fallen under my notice, a mechanical pressure upon the fundus uteri from above was in almost all cases demonstrable by careful scrutiny of the history of the individual case. An accidental increase in the size of the uterus, such as is present in weakly women for some weeks after parturition, or such as is present during menstruation, or from the presence of chronic congestion of the uterus from any other cause,—under any one of these conditions, an accidental slip, or fall, or strain, or unusual exertion of any kind, will supply the determining and actual cause of the flexion. Increased size of the uterus, then, coupled with a lax, pliable condition of the organ, is, from my point of view, the predisposition; while mechanical pressure from muscular exertion of the walls of the abdomen or other mechanical agent is the exciting cause of the flexion. The flexion, once produced, determines the effects which I describe under the term "strangulation".

Strangulation of the uterus is temporary or permanent, according to circumstances. The more ordinary circumstance is, that the uterus so affected is sometimes in what may be termed a condition of acute strangulation, which lasts for a certain time, but, on the patient taking rest and remaining quiet, the acute state passes off, leaving a less severe degree of congestion present. Undoubtedly, after the lapse of time, the flexed uterus becomes rather less liable to attacks of acute strangulation, if I may so express myself; but a sudden exertion of any kind may, even in cases of long standing, give rise to this degree of the affection.

An account of the symptoms of strangulation of the uterus will at the same time furnish an opportunity for explaining the relation between this condition and inflammation of the uterus.

In acute strangulation of the uterus, the patient complains of an intolerable pain in the back, which absolutely prevents motion. There may be tenderness on pressure over the hypogastric region, which is sometimes very sensitive indeed to the touch. On touching the uterus from the vagina, it is found extraordinarily sensitive; but this sensitiveness is found to be really almost limited to the displaced fundus, which can be felt behind the vagina, swollen, large, acutely sensitive to the slightest touch. The very acute cases are always cases of *retroflexion*.

* Read in the Midwifery Section at the Annual Meeting of the British Medical Association in Newcastle-upon-Tyne, August 1870.