Gulstonian Lectures

ON

THE NATURE AND AFFINITIES OF TUBERCLE.

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BY

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LECTURE II.

Tubercle in Bone.

ALTHOUGH at first calculated to surprise us, perhaps the second best illustration of the course of tubercle, under conditions of greatest moisture, is to be found in bone-tissue. The favourite nidus of tubercle in bone is the medullary substance; and the disease, therefore, occurs especially in the spongy bones, and in their spongy cancellous parts, thus principally affecting the vertebræ, the articular ends of the long bones, the tarsus and carpus, and the skull-bones of children. At its late, as at its early stages, the tubercular nature of the affection is difficult of recognition; for large cretaceous masses are never formed; the grey granulations usually pass into ulceration before they can be observed; and macerating the bone, the method of investigation generally adopted, brings out the ultimate feature of the caries, the bubble-like perforation, into bold relief, but completely obliterates the structural changes most characteristic of the disease. And, further, those tunnelings and thorny persistent bony ridges, so aptly designated by the name of teredon or spina ventosa, are appearances pretty nearly as often attained by scrofulous or other ulceration of bone as by the tubercular process.

There is, however, a significant clinical symptom which may serve to distinguish the tuberculous disease of bone; namely, the relative absence of periosteal thickening about the painful part. The bone itself becomes swollen and tender long before its periosteum sympathises with it.

Necrosis chronica sive occulta was a very sound definition of this affection, given to it by Ter Borch (F. G. ter Borch, *Verhandeling over de Necrosis*, Amsterdam, 1821, p. 104).

The admirable description of the disease by Corn. Black assists us greatly towards understanding the manner in which the tubercle-growth is developed, not out of an exudation, but in the substance of a tissue. The medullary cavity is every where filled with a vascular membrane. This is a fine areolar tissue, which contains the blood-vessels, and extends through the Haversian canals, passing by direct continuity of structure into the fibrous matrix of the bone. In its state of highest perfection, this membrane presents, as he (C. Black) says, "a basement structure, and is surmounted by a layer of flattened, irregular shaped cells."

Now (compare Quain and Sharpey, vol. i, p. 123), cancellous or spongy bone differs only from the compact by the predominance in it of soft interstructures relatively to the consolidated. The bones of the

fetus do not possess the perfected medullary tissue of the adult. They are filled with a transparent reddish fluid, which is only a little more tenacious than bloody serum; and the younger a bone is, the softer and more embryonal is this vascular areolar lining tissue.

It is found that, in the bones of young subjects, tubercle can develop itself in the soft and medullary substance without this undergoing any previous change; but in adults, when the tissue is firmer and more consolidated, a stage of active congestion and softening, a step backwards towards the embryonal state, precedes the miliary formation—a point of interest which I cannot forbear mentioning. The tubercles, as Nélaton* describes them, are first met with as small, clear, grey, scattered granules, which a little later may be grouped together. They degenerate quickly into an opaque yellow material, with which the products of ordinary inflammation are combined in all proportions. The walls of the cancelli, the vascular membrane, the cavities, lacunæ, and canaliculi, become stuffed with cells, free nuclei, granular matter, and oil-globules of various sizes, the larger ones sometimes completely filling a lacuna.

The circulation is greatly impeded, and in parts completely arrested; the blood then flowing in extra quantity through other channels. So that, in one part, degeneration and absorption of tissue can be taking place; in another, growth of osseous tissue, or exostosis from the walls of the cancelli, through an increased supply of nutritive materials; and thus it is that secondary sclerosis takes place around the sites of the tuberculous growths.

If the crops of primary growths are numerous, and the conditions of surrounding softness and vascularity such as principally favour their early degeneration, as obtains in the bones of young children, which are nearly altogether composed of spongy tissue, the whole may be speedily converted into an ill-conditioned pus-like fluid. Virchow has given an admirable description of a phalange being thus entirely destroyed.

But with adults, and in more completely formed bones, the compact substance, as above described, is reconverted into a soft granulation-tissue, in which the miliary growths develope; and it is this anticipatory red swelling of the bone which confers an appearance of encapsulation of the tubercle crops described by Nélaton (*lib. ant. cit.*, p. 15), itself probably no distinctive feature of the tuberculous process. The disease may ultimately lead to the necrosis and separation of small portions of spongy bone-tissue through fistulous passages; and, when the external air has once gained access, secondary simple bone-abscess, with all its attendant phenomena, may ensue. The articular cartilages are never, so far as I know, implicated in the tuberculous process, but may be hypertrophied, if in close proximity to the new growth. So, too, they may secondarily ulcerate, through the interposition of a false membrane between the synovia and the cartilage; the supply of nutritive fluids being then intercepted.

As a rule, the disease in bone is one in which the new-growth stage is of very short duration. Caseous material is less frequently formed by this than by the scrofulous process; indeed, it may be accepted upon Professor Virchow's assertion (*lib. ant. cit.*, p. 712), that the large cheesy accumulations about diseased vertebræ are scarcely ever of tuberculous origin, but are rather due to osteo-myelitis scrofulosa. As to the resolution and prognosis of the two affections, this much can be vouchsafed upon

* "Recherches sur l'Affect. Tuber. des Os." Paris, 1836. P. 22.

the same authority, that the scrofulous disease is capable of complete self-cure; but that, although the tubercular bone-ulcer may possibly heal, the loss of substance it has caused never is repaired.

Tubercle in Nerve-Substance.

Tubercle in nerve-substance presents us a very good example of this growth-development under conditions of neither excessive moisture nor dryness, when the tendency is for it to become a caseous mass. Since its matrix-tissue is the neuroglia (the interstitial connective tissue of nerve-substance), it may begin almost any where, and extend in every direction. Its site of predilection, however, is certainly the grey substance, whether of the brain or of the spinal cord.

When tubercle occurs in the cerebellum, as it often does, it is sometimes difficult to distinguish the young tubercle-cells from the nuclei of the large ganglion-cells of this part; and, again, at a later stage of their existence, the growths, which are apt to be superficially situated, and to attain to considerable size, are liable to be confounded with syphilitic gummatous tumours. The features which serve for their interdistinction are as follows. The gummy tumour, as its name implies, is of a gelatinous nature; it is uneven in shape, and from all sides passes by gradual transition into the surrounding brain-substance. The conglomerate brain-tubercle presents a round smooth surface, and is encapsulated by a highly vascular false membrane of close connective tissue, which is the matrix-tissue of the successive growths.

It is a matter of no little interest, that tubercle is most apt to form in the human brain in infancy and early childhood; that is, at that period of life during which we know this organ undergoes its most rapid nutritional interchanges, and, therefore, when a development of the neuroglia in a wrong direction need least of all surprise us.

Whether the primary miliary granules begin in the connective tissue of the brain, or in the sheath of the smaller arteries, is quite uncertain; for the commencement of the growth in these parts is still involved in complete uncertainty.

The earliest trace observed is a little caseous mass surrounded by a capsule. In this cyst-wall, crops of young nodules are found, which, in the course of their growth, run into each other and degenerate, forming a layer which closely enwraps the central mass.

With the death of each zone of new growths, the capsular wall pushes out fresh nodules, which are continuously laid in contact with the former layers, and adhere to them; hence, a section of these formations shows them to consist of several lamellæ.

The mass increases by a process of very slow, and possibly of very irregular, development; at one time, and under particular conditions of the general health of the subject, pushing forward and making rapid progress, and at another, remaining dormant, encysted, and unirritating.

The length of time that conglomerate tubercle of the brain remains in a caseous state, the size it reaches, and its presence among such important structures unattended by serious symptoms, form its principal characteristics.

Such caseous and cretaceous masses are often lighted upon in the brain in the course of *post mortem* examinations, when their existence has been least of all anticipated; but, on the other hand, they occasionally excite the gravest possible symptoms during life. They sometimes break down into a fatty pulp, and produce active inflammation in the cerebral substance, or give rise to an extensive meningitis; and

one, too, that is apt to be attended by a crop of secondary growths upon the pia mater. Their calcification is not uncommon; but, since cysticerci may thus be included, we should be slow to assume that every calcified adventitious substance forthcoming in the brain must of necessity be of tuberculous origin.

Tubercle in Kidney.

The last example I shall trouble you with is from the kidney; it is illustrative of the progress of tubercle in the parenchyma of a solid organ; and I know of no instance in which the constituent elements remain longer in their cellular stage, with the exception, of course, of that mixed growth of tubercle with hyperplastic fibrous tissue in the substance of a serous membrane already adduced from the mesentery.

The external conditions here do not favour a so rapid degeneration into the caseous state, that we are unable to watch the several steps of the process.

The kidney presents to the naked eye minute white semitranslucent dottings scattered throughout its substance. These are found to consist of multiplied nuclei massed together, and can sometimes be traced to a direct proliferating source in the connective tissue. Spreading from numerous centres, the growths extend through the interstitial tissue of the organ, separating the tubules and capillaries more and more from each other. The nutrition of the renal cells within the tubes is thus interfered with, and these degenerate into fine granules. The blood then ceases to circulate through the capillaries of the part, and flows elsewhere through other channels. Shortly, the outline of tubules and vessels involved in the new growth becomes less and less distinguishable, until, at last, these highly organised structures are converted into a finely granular material, such as entirely corresponds with the central masses of ordinary miliary tubercle.

Finally, the scattered nodules, which for a time looked so like little fibrous tumours, extend into each other; their centres becoming yellow and opaque, until a caseous conglomerate is formed, which has nothing in it significant of the tubercle growth, and might, from its aspect, be esteemed a simple abscess.

To follow the various developments of tubercle any further, would oblige me to enter upon a detailed account of its manifestations wherever it occurs; a task which I could not fulfil within the limits of the present lectures. Neither shall I attempt a discussion here of the various views that have been entertained upon the origin of tubercle.* Almost all the older ideas of tubercle were based upon the too exclusive study of lung-affections; and, although I am far from asserting that this growth is rare in these parts, yet I must agree with Virchow, that it is always difficult of recognition in pulmonary tissue; that it occurs in its typical state only in the walls of the smaller bronchi, before these enter the alveoli in the interstitial, interlobular structures; and that the conditions of its development are those which favour its most speedy metamorphosis or degeneration.

Further, under the name of Phthisis, or Pulmonary Consumption—a term of large embrace—there are at present comprehended a multitude of morbid lung states, some of which doubtless are due to tubercle, but many of which are produced by chronic pneumonia, and appertain much more strictly to the scrofulous than to the tuberculous habit of body.

Two terms were made use of by me in speaking of the origin of tubercle, which I noticed at the time

* This was done at much greater length in the Lectures as originally delivered.

required further explanation. I said that tubercle was a heteroplastic growth, as distinguished from a hyperplastic formation. I must introduce a little physiology to make my meaning clear, and take some few steps backwards before this can be explained; but the larger and more comprehensive pathological views thereby attainable will really justify the digression, and put into our hands information which is indispensable to an investigation of the nature and affinities of tubercle.

Cytogenesis, or cell-development, appears to me to be conducted upon two different plans; and I attribute the highest importance to their exact comprehension. The one is the fissiparous, or homologous mode; the other, the endogenous, and for the most part heterologous.

In cells which multiply upon the homologous or divisional plan, the parent cell-wall, endoplast and periplast together, enters into the composition of the walls of the several child-cells. The point of importance is this, that, although growth to almost any extent can take place in this way, no higher and no different development is thus attainable; the ultimate products are always *facsimiles* of their parents. Hyperplasia, or increase in quantity of like forms only, is thus reached. Examples will be at once apparent. Cartilage, bone, connective tissue, cells, all increase thus.

But, in those cells that multiply upon a heterologous or endogenous plan, the external wall, the periplast of the parent cell, forms no part of the external wall of the brood-cells. Now, by this method of development, the greatest possible differentiation or variation of the offspring may result; the young brood-cells possessing different aims and attributes to those with which their parents were endowed. It is thus that the ovum segments, producing that most potential blastodermic membrane, thus that the seminal filaments are formed; thus that cartilage, and bone, muscle, and nerve, develop out of an embryonic connective tissue; thus that the red blood-cell comes out of the white; thus that gland-cells separate their secretions; and that lymphoid cancer- and tubercle-cells are all directly derived from connective tissue elements.

I can now proceed to the affinities of tubercle with some hope of being intelligible. I have already shown this to be a heterologous growth proceeding by endogenous development out of connective tissue-cells. The young brood do not follow the steps of their parents, or pursue similar structural changes or become like them. They are foci of dissent, which multiply in their turn by continuous fission, but never return to the perfection of connective tissue elements again; they appropriate nutriment to themselves, grow and multiply in their turn by division, but they are degenerate and short-lived, conceived in haste, and having no power of endurance.

It is in this very matter the heteroplasticity, as Virchow calls it, of its development, that we perceive a close relationship between tubercle and cancer; and, as Mr. Paget has shown in his *Pathological Lectures*, there exist several other features in which they strongly resemble each other. Both possess a blood dyscrasia peculiarly their own; in both there exists the disposition to get rid of some morbid material by planting it out, bad weed-like, in isolated groups. Then the body presents sites of proclivity to this *materies morbi*, and these sites vary with the age of the individual. Both are extrauterine; never, so far as my own researches extend, congenital diseases; both are strictly hereditary; they also tend to develop, in obedience to their hereditary nature, at a similar age in the child as in the parent, or at one somewhat earlier. Both infect the tissues in their

immediate neighbourhood first of all; both extend through the body secondarily from their respective centres of infection; both induce ulceration, and an ulceration which has little inclination to heal; both may well be called malignant diseases. I do not mean malignant in the sense of parasitism of the new development; there exists no abnormal growth in the body that is without its normal homologue also in it. Malignancy is merely serious heterologism or heterochronism. "Elemental parts are abnormal only in the time or place in which they occur or in the method of their grouping." (Virchow's *Allgem. Pathol.*, vol. i, p. 332.)

Rokitansky was of opinion that these two dyscrasias exercised a kind of mutual exclusion upon each other, a circumstance which the experience of others has not altogether confirmed. The truth appears to be that the tuberculous diathesis of itself confers no immunity from other diseases, and exerts no special excluding influence; but that in proportion as any particular cachexia is strongly marked, any one form of new growth widely scattered throughout the body, the proclivity to other modes of structural error is diminished. This at least holds true of cancer, of tubercle, of lymphosarcoma, of the enchondromata, of fatty, and of fibrous tumours.

After cancer the tubercle growth might be said to present more points of resemblance to the scrofulous tumour than to any other; but of this hereafter. It is advisable for me to defer any description of scrofula, until I have briefly reviewed that group of cognate growths which Professor Virchow has classified together under the heading of lymphatic tumours.

Now all these developments possess certain features in common; they are principally composed of lymph-cells, these cells being bound together in larger or smaller groups by a reticulum of connective tissue. They are built upon the physiological pattern of ductless glands, and to their proper comprehension some knowledge of the anatomy of these glands is indispensable; the solitary follicles of the intestines and the Malpighian bodies of the spleen are examples of the simplest single form; while the compound form is only a repetition of similar lymph-cell groups, combined together, as these are normally found in the ordinary lymph-glands and in the spleen itself.

There is a dense fibrous capsule which encases the whole, and from this fibrous septa, dip in to divide the interior into segments or follicles; in the ordinary lymph-gland, as will be remembered, these septa form a distinct cortical follicular, and a central medullary portion.

This, then, is the type which we must hold before our eyes. The tumours developed upon this plan possess like elements and are projected upon a common scheme, but fall into two clearly distinct subclasses: the one comprehends the hypertrophies of normally pre-existing parts; the other includes new or heteroplastic formations. In both cases the component elements proceed out of connective tissue and are in themselves identical or highly similar. But the importance that must attach to them is obviously much greater in the event of the occurrence of the development in parts which ought properly to present nothing of their kind.

In the one subclass, Virchow places the leukæmic lymphoma, the typhous lymphoma, the scrofuloid lymphoma (e.g., the simple hypertrophied tonsil), lympho-sarcoma, scrofulous glands; and, in the other subclass, tubercle of man and the pearl distemper of ruminating animals.

I must reserve my separate description of their individual characteristics and of their relationship to tubercle for another week.