On the pathological histology of the semilunar and superior cervical sympathetic ganglia / by W. Hale White.

Seminiferous Cervical
ganglia
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ON THE

PATHOLOGICAL HISTOLOGY

OF THE

SEMILUNAR AND SUPERIOR CERVICAL SYMPATHETIC GANGLIA.

BY

W. HALE WHITE, M.D.,
ASSISTANT PHYSICIAN TO GUY'S HOSPITAL.

Read April 28th, 1885.

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Wishing to discover whether or not the sympathetic ganglia were affected in certain diseases, I have been occupying my spare time during the last two years in preparing a number of sections, in all over a hundred and fifty, of the semilunar and superior cervical ganglia, with a view to discovering how far the structure of these bodies might vary within normal limits. Inasmuch as this subject is very cursorily referred to in any text-books, with the exception of one or two Italian ones, I thought the results of my investigations might be of use to some members of our profession.

In order to avoid any bias I adopted the following method of procedure. As soon as the post-mortem examination was made the specimen was put into a bottle which was numbered, whilst the description of the post-mortem was entered in a book against this number. The

sections were in due time cut and a description of the appearances presented was written out; after this was done, by reference to the number of the post-mortem, the disease of which the patient died could be discovered. It will thus be seen that in no case was I aware of the cause of death when I described the microscopical appearances.

Before going any further I would point out that the size of the ganglion, whether superior cervical or semilunar, is of no pathological significance whatever. Thus I have seen the superior cervical vary from a quarter of an inch to more than an inch in length, and in the latter case the width was increased in proportion; again I have noted that the middle cervical, which is usually so small, may be actually larger than the superior. In the case of the semilunar I have always cut the sections so as to get the largest area, and whilst the largest measures an inch and a half by rather over half an inch, the smallest is no larger than the section of a split pea. The size bears no relationship to the cause of death, for in some instances in which I have cut sections of the same ganglion from different cases of the same disease, the size has varied considerably.

As a rule the shape of the superior cervical is that of a spindle, and that of the semilunar, like the thumbnail; but I do not think that any importance should be attributed to differences in shape, for very often the semilunar is of such a shape that it cannot be likened to any object whatever, and I have seen the middle cervical so irregular that it might have been mistaken for a small semilunar. Giovanni[1] practically agrees with what I have said, for although he says that alterations in the quantity of the constituent elements of the ganglia alter their size, he points out, what his tables show, that the variations in volume are too great to be of any service to pathology.

The naked-eye vascularity of the sympathetic system is of no pathological significance, for the vessels are so small

[1] 'Patalogia del Simpatico,' di A. De Giovanni.

that no constant arrangement can be described; thus, sometimes the artery before entering the ganglion will run on it for some little distance, whilst in others it will enter it directly. What I have here pointed out is markedly shown in my preparations; thus, in making the post-mortem on a case of myxœdema, the middle cervical ganglion appeared so vascular that all who were present thought it abnormal. Microscopic examination showed no increased vascularity; it was merely an anatomical accident that the vessels were running some way over the surface before entering the ganglion. The greatest vascular engorgement I have ever seen occurred in a case of diabetes, but this was only to be noted after microscopical examination, not being visible to the naked eye. That apparent hyperæmia is valueless is also seen from the fact that Giovanni records that it existed in pleuro-pneumonia, tubercle, cardiac disease, atheroma, chronic nephritis, typhoid fever, cancer, puerperal peritonitis, hydrophobia, and diphtheria. A condition present in such a variety of diseases cannot have much significance.

I do not think it is possible to say much about œdema of the ganglia, at least as being visible to the naked eye. This is not surprising when we remember their small size, the denseness of their capsule and of the interstitial connective tissue; as in the case of hyperæmia, Giovanni's enormous number of ganglia which he says were œdematous show that either it can be of no importance, or, what I suspect is probably correct, that he has recorded many which were really quite normal as œdematous.

With regard to surrounding fat, the superior cervical ganglion has none, and that around the semilunar varies very much in quantity, but without affecting the internal structure of the organ any more than does that around the kidney or heart. The ganglia are generally of a solid firm consistency. I have not noticed any variations in this respect in the various specimens I have examined.

I have met with no case of adhesion of the ganglia to the surrounding parts.

It will thus be seen that I have come across no example of any external appearance of the ganglia being of any significance whatever either as an indication of obvious disease or of what we may expect to find internally; in fact, I should be inclined to say that the only possible cases in which the external appearance of the ganglia could be of any importance are, firstly, those in which one or more of them were implicated in, or affected secondarily by, some morbid growth such as carcinoma or sarcoma; secondly, those in which an aneurysm, abscess, tumour, or other new formation pressed on them; thirdly, those in which a mechanical injury has affected them; fourthly, those in which some chronic inflammatory or malignant process either spread into them from surrounding parts, or by contraction of the newly-formed fibrous tissue pressed upon them; fifthly, those in which an enlargement was caused by something internal, such as an abscess or a tumour. It will be seen that all the above are theoretical affections of which we have very little knowledge; they are introduced chiefly to show how rare any morbid affections of the ganglia visible to the naked eye must be. The trunk of the sympathetic is more often implicated as is seen in some cases of aneurysm. It is of course conceivable that sometimes the sympathetic should be affected by general conditions such as tubercle and lardaceous disease, but of this I have no experience.

We now come to the microscopic appearances of the ganglia, and the nerve-cells, as they are of so much importance, will first of all occupy our attention.

The typical ganglionic nerve-cell from the sympathetic ganglia is like a nerve-cell from elsewhere. It is large, takes the logwood stain well, is rounded, has one or more processes, and a distinct nucleus and nucleolus. I find that among the cases which I have examined the following are marked as presenting cells which exactly correspond to the above description :—Cancer of bladder, aortic disease, sarcoma of breast, double phthisis, bronchopneumonia, chronic Bright's disease (two cases), cancer of œsophagus,

rupture of intestine, stricture of urethra, diphtheria, and scald. It is especially to be noted that in the two cases of chronic Bright's disease, the description of the cells states that they are exceptionally typical, for Dr. Saundby[1] has written a paper in which he says that in chronic Bright's disease the ganglion cells are abnormal, being pigmented and degenerate. He also refers to a paper by Drs. Da Costa and Longstreth, in the 'American Journal of Medical Science' for July, 1880, and states that these authors go so far as to attempt to explain the phenomena of Bright's disease by these changes in the cells. My experience is that patients dying of this malady are not more liable than any others to have abnormal cells in their sympathetic ganglia. The two cases of diphtheria and scald were children, the cells were exactly similar to those from adults.

I do not think any importance can be attached to the number of the cells found; for, in the first place they are so irregularly scattered about in the ganglia that we can never be sure that one section shows them in their maximum number, sometimes the section happens to be taken through a part which consists of little else than nerve-fibres and some fibrous tissue; in the second place, ganglion cells may so often be found in what is to the naked eye sympathetic nerve trunk, that even if we were inclined to think the ganglion contained but few cells, it is quite possible that this deficiency would be compensated for by a large number of cells being present in the nerve trunk. It is far more common to see sympathetic ganglion cells without processes than with them, the absence does not appear to be connected with any particular disease and is I think of no pathological value.

Often no nucleus or nucleolus can be seen in an otherwise healthy cell; there is no present evidence to show that the presence or absence of the nucleus is of any more importance than the presence or absence of processes.

The typical nerve-cell from either of the sympathetic

[1] 'Brit. Med. Journal,' Jan. 13th, 1883.

ganglia now under consideration is larger and more rounded than an anterior cornu cell from the cervical spinal cord. Its difference in shape is clearly due to its not sending off so many processes. Sometimes the cells may be smaller, even half the size, and still, as far as one can judge, they are capable of functional activity. In specimens from the following cases the cells appeared to be of a normal size: anthrax, cancer of bladder, aortic disease, sarcoma of breast, double phthisis, broncho-pneumonia, cirrhosis of the liver complicated with granular kidney, another case of granular kidney (concerning these specimens I have made the note that I have seldom seen better examples of normal cells), rupture of the intestine with peritonitis, stricture of urethra, phthisis, tumour of brain, another case of granular kidney where it is likewise remarked that the cells are remarkably good, diphtheria, scald.

In all the above the size of the cells is normal over all or nearly all the specimens. In some other cases they are small in one part and large in another. It must also be borne in mind that the size of a cell will depend somewhat on the direction of the section. When a cell is small, that diminution in size is nearly always due to pigmentary degeneration, which we will consider presently; some cells are, however, pigmented without any alteration in size. In cases dying of the following diseases the cells were diminished sufficiently in size for the diminution to be noteworthy: diabetes (four cases), idiopathic anæmia (two cases), abdominal aneurism (superior cervical ganglion, the cells are reduced to a minute mass with no resemblance to the original), broncho-pneumonia, sarcoma of pelvis, gangrene of foot from atheroma, malignant disease of the bladder, aneurism of abdominal aorta (semilunar ganglion), aortic disease, myxœdema, general malignant disease.

On contrasting this list with that in which the cells are not diminished in size, it will be seen that the second enumeration contains many more wasting diseases than

did the first: thus there are four cases of diabetes and three of malignant disease. So we may say that as a general rule wasting of cells is most marked in wasting diseases, but that this is subject to many variations.

We now come to the degenerations of the cells, of these the only one of any importance is the pigmentary. This may or may not be accompanied by diminution in size. In all the specimens above mentioned, as showing a decrease in size, some or other of the cells were pigmented; in slides taken from the following diseases the cells were pigmented although not diminished in size: anthrax, cancer of the bladder (two cases), aortic disease, sarcoma of breast, phthisis (two cases), chronic Bright's disease (three cases), purpura, broncho-pneumonia, cancer of œsophagus, abdominal aneurism, rupture of the intestine, tumour of the brain.

Pigmentation occurs in specimens taken from people dying of almost any disease, and in consequence of its almost universal presence, in greater or less quantity, in the cells of almost all specimens of sympathetic ganglia one is compelled to look upon it as of no pathological importance. The only thing to be noted is that it is entirely absent in the two cases in which the ganglia of children were subject to examination. It is just possible that the interpretation of this almost universal pigmentation is that it is connected with the smaller ailments from which none of us are free. This might perhaps apply to the semilunar ganglia with more force than the cervical, but both seem to be with equal frequency pigmented. Reference to Giovanni's work will show that age has very little to do with the quantity of pigmentation, so that perhaps it is no more than an accident that the two cases of children which I examined show no pigment.

This pigmentary degeneration usually occurs as small, roundish, bright yellow masses in the nerve-cell; frequently it may be observed that whilst part of the cell has undergone pigmentary degeneration part is quite free and well stained with logwood, which agent has no effect

on the degenerate part. The intensity of the yellow colour is liable to fade if the specimen has been kept long. If the change be extreme the cells are represented by little masses of yellow pigment shrunk away from the capsule, bearing but little resemblance to the original cell, which thus sometimes looks like the section of a vein with a little blood-pigment in it. I do not think that this condition can be shown to be associated with any particular condition of the blood-vessels or surrounding tissues.

Sometimes the cell has a fine granular appearance. I am unable to connect this with any particular disease. Considering that the pigment tends to disappear the longer the specimen is kept, I am inclined to think that these granules may be pigmentary ones from which the colouring matter has become dissolved out.

Often the cell presents a vague, ill-defined outline, so that it is almost impossible to define its margin. It is more common for this condition of border to exist at one part of the cell only, it may, however, exist all over. It is frequently coexistent with absence of the nucleus; in such cases the contrast between a healthy cell with a well-defined nucleus and the vague non-nucleated misshapen one is very striking. Like the other variations of the cell this vague condition cannot, as far as I know, be connected with any particular disease. Although I have occasionally seen what I have taken to be fat granules present in a cell, I certainly should not think fatty degeneration to be so common as one would infer from Giovanni's statements. Of other degenerations of nerve-cells in sympathetic ganglia I have no experience. In some of the best specimens the nucleus does not stain at all, but stands out as a bright colourless spot with a dark nucleolus in the centre, in others the nucleus stains dark.

From a study of the cells one is driven to the conclusion that in the present state of our knowledge their varying appearance cannot be said to be of any significance; either the variations may be very great and the cell be still normal, or, in at least four fifths of the cases examined,

the cells were abnormal; and if the latter hypothesis be true we are still unable to connect the abnormal condition of cell with any particular disease or symptoms.

Taking next the nerve-fibres they are quickly disposed of. It is often difficult to distinguish them from the connective-tissue fibres, but it is to be remembered that they usually run in much more regular parallel bundles than the latter, these parallel bundles when cut contract up and give an appearance very like that of geological strata that have undergone a little upheaval. Although the majority of the fibres are grey, a few white ones may be occasionally seen. I have never seen pigmentary degeneration of nerve-fibres, nor indeed have I seen any changes in them of which I could speak with much confidence. When it is remembered that they are irregularly mixed up with the connective tissue of the ganglion the difficulty of distinguishing any sclerosis of the nerve-fibres in the ganglion will at once be apparent.

With regard to the fibrous stroma of sympathetic ganglia one can never give an opinion as to whether the quantity is abnormal or not, for not only does it vary very much in different parts of the same ganglion, but the amount present varies much in different ganglia, a fact which is not surprising when we remember how they themselves vary in size. Then, again, the fibrous tissue may appear to be more than it really is from the section having been so cut as to include a great deal of connective-tissue fibre, for that is more abundant at the surfaces than elsewhere owing to its forming a fibrous sheath for the ganglion. In some sections which I have examined the space which generally exists between the nerve-cell and its capsule has disappeared, and this would seem to be due to the connective-tissue stroma pressing down the capsule tightly on the cell. This state of things was observable in sections taken from cases of cancer of the bladder, glioma of the brain, myxœdema, and chronic Bright's disease. Whether or not this is to be regarded as abnormal and can be looked upon as evidence of in-

creased interstitial tissue, is, I think, very doubtful, seeing that it occurs in such widely different diseases in which there is no reason to suspect any sympathetic change. It is, however, the only evidence, slight though it be, of increased connective tissue, that I have found. Then, again, as we have been unable to decide whether the specimen shall be considered abnormal when the cells have undergone pigmentary degeneration, we ought to hesitate before we say too much about slight pressure on them. Perhaps of all the specimens I have examined one of the semilunar ganglion from a case of abdominal aneurism shows most fibrous tissue, and in this one the nerve-cells are much atrophied, although the capsule is not pressed in. This is mentioned because of the possibility that it may be connected with pressure on nerves by the aneurism. Sometimes the capsule around the cell stains well and shows numerous nuclei, at other times but little of it is to be seen.

Next comes the consideration of the vessels. In the first place let it be borne in mind that vessels are much more numerous in the superior cervical than in the semilunar ganglion. As might be expected, considering their varying shape, I have not been able to discover any constant arrangement of the vessels in the semilunar, whilst in the superior cervical the normal arrangement is for a good-sized vessel to enter at the side, as the central artery of the retina enters the optic nerve, and then to run vertically down the centre of the ganglion in its long axis; this artery gives off several branches and is accompanied by a vein and a good quantity of connective tissue in the form of a sheath. If the small vessels be very evident it may be taken as evidence of congestion. In one diabetic specimen they were so numerous and seemed so dilated that although there was no blood in them, one was forced to the conclusion that there was congestion, and that the blood had dropped out in the preparation of the specimen. The most extreme congestion I have seen was from other cases of diabetes; here

the vessels were very numerous and all crammed with blood-corpuscles. Diabetes is the only disease in which the congestion has been sufficient to be noteworthy. I have not been so fortunate in finding hæmorrhage as Giovanni, for I have never seen it in the substance of the ganglion and only once in its sheath; this occurred in sections of the superior cervical ganglion in a case of abdominal aneurism, but not the same one as I have just mentioned as having the increased fibrous tissue in the semilunar ganglion. In some examples of chronic Bright's disease the minute arteries have their walls thickened, but, in this disease, I have generally found that, with this exception, the ganglion is healthy.

We have now to treat of inflammation of the ganglion. Only acute inflammation calls for consideration, for we have seen how difficult it is to pronounce on chronic hyperplasia of the fibrous tissue. The characteristic of acute inflammation is the presence of innumerable small cells quite obscuring the section, so that the component nerve-cells can with difficulty be distinguished; this may be accompanied by congestion. Very many of these cells are undoubtedly white blood-corpuscles, for in some sections they may be seen in the act of passing out of the vessels; but it is very probable that some are due to a proliferation of the cells of the connective tissue, for there is an undoubted increase of the elongated nuclei of the connective tissue which forms a sheath for the bundles of nerve-fibres. I have recorded elsewhere[1] that I have found this condition of inflammation in diabetes; I have also seen it to a slight degree in one case of each of aortic disease, tumour of the brain, and in a child who died from the effects of a scald, but excepting in diabetes it has not been present in an extreme degree save in a case of purpura hæmorrhagica. Considering the lessons we have learnt as to the great variations which may be present, yet the ganglion must not be set aside as abnormal, I should not be disposed to make much of the three cases in which the inflammation was slight,

[1] 'Path. Trans.,' vol. xxxvi.

perhaps it was connected with some trivial ailment. Before discussing the case of purpura hæmorrhagica it would be better to have more examples, this one shows, however, undoubted extreme inflammation. Cases of idiopathic anæmia which I have examined do not show any inflammation. The last condition I have to mention is that in two cases of sections of the semilunar ganglion from children I have found little masses of lymphoid tissue in the ganglion. These masses are not diffuse but each has a distinct capsule. It would seem as though one of the very numerous small lymphatic glands near to the semilunar ganglia has got inside instead of outside of it. As a result of the examination of many sections of semilunar and superior cervical ganglia I may, I think, say that the only lesion which can be positively said to be abnormal is the acute inflammatory condition just described, in which the section is crowded with small cells: therefore the only diseases in which I have found the ganglia undoubtedly deviating from the normal are diabetes and purpura hæmorrhagica. In chronic Bright's disease the vessels in the ganglia are thickened, otherwise the ganglion is healthy.

This is I feel a poor result for so much work as I have gone through, but that is one reason why I have brought this paper before the Society, so that others may be saved the trouble of going over the same ground that I have.

The fullest descriptions of the pathological histology of the sympathetic with which I am acquainted are given by A. De Giovanni, 'Patologia del Simpatico,' and by Foa in the 'Rivista Clinica di Bologna,' 1874, p. 206.

Polaillon[1] in an article which is not of much interest from a pathological point of view, gives a very good historical summary of the knowledge of the normal structure of sympathetic ganglia up to 1866. He says that the granules so frequently seen in the nerve-cells are due to post-mortem affection of the proper substance of the cell. There is, I think, however, no doubt that this is not so, for if it were it should be present in all the ganglia

[1] 'Journal de l'Anatomie et de la Physiologie,' 1866.

that I have, for they were all prepared the same way, and also it should be present in other nerve-cells such as those of the spinal cord. Virchow also thinks that these changes in the nerve-cells are ante mortem; he describes them in fevers and old age.

Dickson suggests that in locomotor ataxy the gastric cases may be due to the affection of the semilunar ganglia. This may or may not be so, but the evidence he adduces is not proof, for he says Dr. Clarke has found in some cases great pigmentation and that these observations have been fully confirmed by those of MM. Poincaré and Henry Bonnet.[1] I have already shown that pigmentation is of too universal an occurrence to be of any importance in explaining any rare malady such as the gastric crises of locomotor ataxy. The French authors just mentioned found changes in general paralysis of the insane. Dr. Savage[2] who has had a large experience, has discovered no changes in the sympathetic which can be constantly associated with insanity.[3]

[1] 'Annales Médico-Psychologiques,' 4me série, Tome 12me, 1868.

[2] 'Insanity, and allied neuroses,' Lond., 1884.

[3] Whilst this paper was passing through the press, Dr. Long Fox published a book on 'The Influence of the Sympathetic on Disease.'

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' New Series, vol. i, p. 436.)

DESCRIPTION OF PLATE III.

(On the Pathological Histology of the Semilunar and Superior Cervical Sympathetic Ganglia, by W. Hale White, M.D.)

Fig. 1.—Section of a semilunar ganglion from a case of anthrax. Normal. × 250 diameters.

Fig. 2.—Section of a semilunar ganglion from a case of carcinoma of the breast. Normal. Shows processes well. × 250 diameters.

Fig. 3.—Section of a superior cervical ganglion from a case of abdominal aneurism. Shows the extreme atrophy of the cells, which are reduced to mere masses of pigment in the centre of their capsules. × 250 diameters.

Fig. 4.—Section of a superior cervical ganglion from a case of atheroma of the arteries and gangrene of the leg. Shows extreme granular pigmentation of cells. × 300 diameters.

Fig. 5.—Section of a semilunar ganglion from a case of purpura hæmorrhagica, showing the abundance of leucocytes and proliferation of nuclei. × 300 diameters.

Fig. 6.—Shows the contrast in size between the largest and smallest semilunar ganglia met with.

Fig. 7.—Shows the contrast in size between the largest and smallest superior cervical ganglia met with.

Fig. 1.

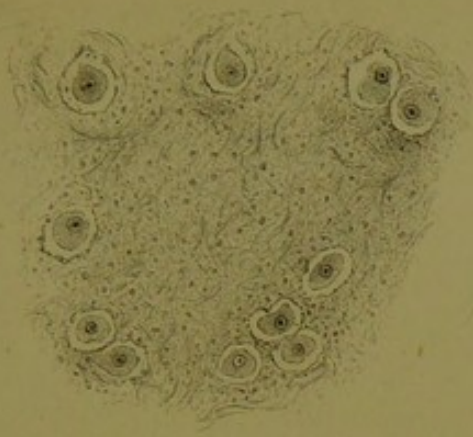


Fig. 2.

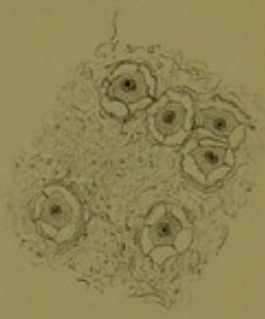


Fig. 3.

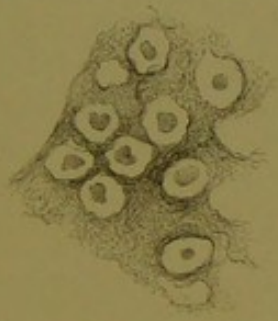


Fig. 4.

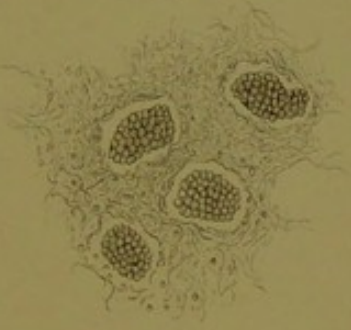


Fig. 6.

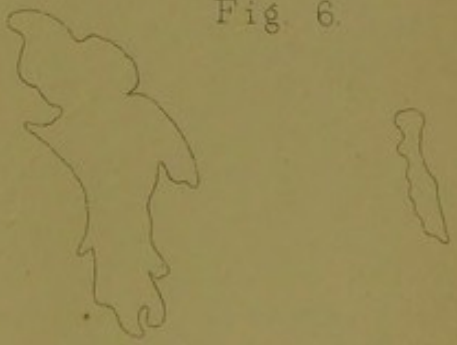
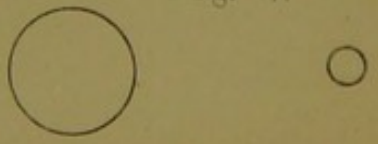


Fig. 5.

Fig. 7.



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