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RETINAL MICRO-ANEURYSMS AND
PUNCTATE HAEMORRHAGES*

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IN several recent papers we have directed attention to the minute red dots occasionally encountered in the retinopathy of diabetes, and included in the so-called deep, punctate haemorrhages which form part of the ophthalmoscopic picture of that disorder.

Certain observations of the unstained retina, examined in bulk, raised doubts of the haemorrhagic character of these spots, and, without being able to differentiate the lesions clearly, we concluded that some, at least, were aneurysms. Further study of the material has now made it possible to define more clearly the characters which distinguish punctate haemorrhages from aneurysms, and to show that the latter may be of outstanding importance in the diagnosis of diabetes.

In the initial observations of the unstained retina, viewed on the flat, the lesions in question took the form of perfectly round, mulberry-like collections of red blood corpuscles, enclosed in an

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envelope, sometimes represented by a thin structureless membrane (Fig. 1), sometimes by a thicker wall of double contour (Fig. 2), and sometimes by a wall of considerable thickness (Fig. 3). Some of the bodies were surrounded by a yellowish zone, due to diffuse blood pigment, others were associated with haemorrhage (Fig. 6).

The difficulty in determining the true nature of these bodies lay in our failure at first to find any connection with a blood vessel; and they were described as "encysted haemorrhages." In these first instances the bodies were discovered accidentally, and had not been identified with a previously observed ophthalmoscopic lesion. The difficulty of tracing the vascular connection will be appreciated by those who examine the unstained retina by this useful technique. Naturally the histological details only become apparent on somewhat prolonged study, employing variations in the diaphragm aperture, obliquity of the illumination and other manoeuvres; but the visibility of the smaller retinal vessels depends almost entirely on their content of erythrocytes. It is very difficult to see the capillaries unless they contain sufficient red corpuscles to enable one to trace their course. In favourable cases the complete capillary networks can be followed, while in others no trace of capillaries can be found. Figs. 1, 3 and 4 give examples of micro-aneurysms, with their capillary connections thus indicated by a more or less broken series of red corpuscles.

Even after we were able to find the capillary connection in a sufficient number to demonstrate the aneurysmal character of the bodies, it remained to identify them with the so-called punctate haemorrhages of the fundus picture, and to establish their characteristics in sections of the retina cut and stained in the usual way. The illustrations give a convincing demonstration of the true nature of the lesions.

We shall deal in this paper with their ophthalmoscopic and histological characters, and not with their significance as a diagnostic feature of the diabetic fundus.

In Fig. 5 we have a characteristic appearance and grouping of the spots, as seen with the ophthalmoscope, in the central area of the fundus. Most of them have no visible connection with a retinal vessel, but in a few instances they appear to be attached to the finer twigs of the small peri-macular vessels. Often, as in this case, two distinguishable lesions occur together; small perfectly round bodies, sometimes recognised to be globular by the presence of a central light reflex, and other spots, of similar or larger size, round or polygonal in form, and often of mossy outline.

The former are the micro-aneurysms to which we wish to call attention, the latter are petechial or punctate haemorrhages. These two lesions can be easily distinguished in the bulk retina viewed on the flat, and we often find them together as in Fig. 6, where

the aneurysm has obviously ruptured to form what no doubt appears ophthalmoscopically as a "punctate haemorrhage."

In the fundus from which Fig. 5 was taken, the number of micro-aneurysms has varied very little during the two years of regular observation; but it is probable that the actual number is greater than we can see.

Fig. 7 is a map of the fundus of another case, as seen with the slit-lamp in the post-mortem specimen; but even this does not give

FIG. 5.

Ophthalmoscopic view of micro-aneurysms around the macula. Case of diabetes.

a complete idea of their number, for serial sections of a portion of the same retina, 3 mm. in diameter, showed as many as thirty such aneurysms.

Coming to the stained sections, which were made both on the flat (Fig. 8) and in the vertical direction (Figs. 9, 10 and 11), we have the same difficulty in tracing the vascular connections of the aneurysms; but sometimes this can be seen in the shape of a procession of erythrocytes or a strand of endothelial cells (Figs. 3, 4, 8 and 12).

It has been customary to describe these punctate lesions as *deep* haemorrhages, but it is interesting to note that they are to be found, almost without exception, in the inner nuclear layer. A

few may be discovered in the nerve fibre and ganglion cell layers (Fig. 10), and still fewer in the outer molecular (Fig. 11). They occur, in fact, on the capillaries which link the more superficial capillary network in the nerve fibre layer with the deeper plexus at the outer boundary of the inner nuclear layer.

The sections confirm certain features of the lesions which have been observed in the bulk specimens of the unstained retina; for example, the clear outline and rounded form, the varying thickness of the enclosing envelope, and the occasional escape of blood

FIG. 7.

Fundus of the excised eye as seen with the slit-lamp. Micro-aneurysms and haemorrhages.

by rupture or by leakage. They also throw light on a phenomenon sometimes observed ophthalmoscopically to which attention has already been drawn (2). If these micro-aneurysms are watched over a long period one occasionally sees the appearance of a faint halo, which gradually becomes whiter and broader, encroaching on the surface of the red dot, until this latter is covered and converted into a white spot.

In microscopic preparations we sometimes observe a transformation in the aneurysms which may explain the formation of such white spots. This takes the form of a proliferation and

FIG. 1.

Micro-aneurysm in unstained retina. Viewed on the flat. The capillary connections can be seen.

FIG. 2.

Micro-aneurysm in unstained retina, viewed on the flat. No vascular connection can be traced.

FIG. 3.

Micro-aneurysms in unstained retina, viewed on the flat. They are attached to capillaries (a) 35μ (b) 26μ in diameter.

FIG. 4.

Retina in bulk, unstained, seen on the flat. Branching capillary with two micro-aneurysms.

FIG. 6.

Retina in bulk, unstained, seen on the flat. Micro-aneurysm with haemorrhage.

FIG. 8.

Section of the retina on the flat, with micro-aneurysm in inner nuclear layer. Capillary connection visible.

FIG. 9.

Vertical section of retina with micro-aneurysm in inner nuclear layer.

FIG. 10.

Vertical section of retina with micro-aneurysm in ganglion cell layer.

FIG. 11.

Vertical section of retina with micro-aneurysm mainly in outer molecular layer.

FIG. 12.

Vertical section of retina with micro-aneurysm in inner nuclear layer which has become thrombosed. Capillary connection visible.

swelling of the endothelium with subsequent thrombosis, and formation of a cicatricial nodule (Fig. 12). The formation of the micro-aneurysms is preceded by changes in the vascular endothelium which lead to venous and capillary stasis, and the result is somewhat similar to the sclerotic changes which appear as sheathing of the retinal veins when stagnation of the circulation has resulted from thrombosis. Thrombosis may be both a result and a cause of the circulatory stasis: in other words, a vicious circle may be established in consequence of an initial pathological change in the vascular endothelium. Both in the bulk specimens and in sections, the older, thrombotic, aneurysms are associated with deposits of haematogenous pigment.

The sections show not only the almost invariable occurrence of the aneurysms in the internal nuclear layer, but also a remarkable uniformity in their size. They range in size from 30 to 90 μ , but most of them measure from 50 to 60 μ , and they are contained entirely within the inner nuclear layer.

Proof of the identity of the micro-aneurysms with the bodies seen in ophthalmoscopic examination, and in the unstained retina in bulk, is completed by the examination of uninterrupted serial sections, in which it can be shown not only that they are compact and well defined bodies, but that they are spherical in shape. This helps to distinguish them from small haemorrhages. The latter often occur in the middle layers of the retina and may, in individual sections, have a round or oval form, resembling the aneurysms, but if they are followed through successive sections they will be found to vary in size and shape, and to be without any enclosing membrane. Viewed on the flat, such haemorrhages sometimes assume the form of an irregular network.

Uninterrupted serial sections also serve to distinguish micro-aneurysms from retinal vessels, which may readily, in single sections, be mistaken for aneurysms.

The globular micro-aneurysms are, of course, only one variety of the *ectasiae* which occur on the retinal capillaries. Sometimes relatively long segments of the capillaries are so dilated as to form sausage-shaped loops, or they may form complex coils or networks which are apt to be partly obscured by haemorrhage. These, however, are usually associated with the grosser forms of retinal vascular disease and their consequent haemorrhages and exudates.

The diameter of the micro-aneurysms may be as much as 10 or 15 times that of the parent capillary, and it is not surprising that the wall is often stretched so thin as to be scarcely recognisable; nor is it surprising that it allows blood to escape either by diapedesis or by rupture.

Summary

It can be shown that many, if not most, of the so-called punctate haemorrhages characteristically seen in diabetic retinopathy are actually capillary aneurysms.

By examination of the unstained retina in bulk, as well as in vertical and flat serial sections, these bodies are seen to be compact collections of red blood corpuscles, globular in form, and with an average diameter of 50 to 60 μ , enclosed in a wall of varying thickness. With few exceptions they occur in the inner nuclear layer, in the course of the capillaries which link the deeper and more superficial capillary plexuses of the retina.

They may be a source of haemorrhage by diapedesis or by rhexis, and many of them are seen to undergo a process of thrombosis and cicatrization. They represent a stage in the vicious circle in which changes in the capillary endothelium lead to a stasis in the circulation which, in turn, causes further vascular changes, especially on the venous side of the retinal circulation.

REFERENCES

1. BALLANTYNE, A. J. and LOEWENSTEIN, A.—The Pathology of Diabetic Retinopathy. *Trans. Ophthal. Soc. U.K.*, Vol. LXIII, p. 95, 1943.
2. BALLANTYNE, A. J.—Retinal Haemorrhage, with special reference to its sources and distribution. *Irish Jl. of Med. Sci.*, p. 551, October, 1943.

A SIMPLE METHOD OF DEMONSTRATING NYSTAGMUS IN CERTAIN MINERS*

BY

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A LARGE experience in the assessment of cases claiming compensation under the Workmens' Compensation Act for miners' nystagmus has convinced me that in the vast majority the complaints of subjective symptoms, headaches, dizziness, loss of sleep, etc., are real and not feigned, though, of course, some allowance must be made for obsessional cases, and perhaps more recently a new form of resistance has arisen among some of the Bevin lads who have been picked by ballot from among recruits for the forces and ordered to go down the pits after a short training and testing period.

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