MARGINAL HAEMORRHAGE ON THE DISC. PARTIAL CROSS TEARING OF THE OPTIC NERVE. CLINICAL AND HISTOLOGICAL FINDINGS

BY

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BLUNT injuries of the eye lead to different ophthalmoscopic pictures. Retinal and choroidal haemorrhages combined with blood in the vitreous body are common, as are choroidal rupture and retinal detachment. Rupture of the posterior ciliary arteries, evulsion of the optic nerve and bleeding within the optic sheath are found less frequently. The latter occurs in the frequent cases of fracture of the base of the skull and is frequently combined with papilloedema. But even very gross skull fractures do sometimes occur with insignificant changes at the disc.

H. Knapp (1868), according to Wagenmann, described a case with red optic disc and a ring-shaped haemorrhage. A short note by Bunge (1905) mentions a case of basal skull fracture with papilloedema, haemorrhages within the disc and surrounding it. The disc became pale and a red half-ring remained. Bunge assumed that a bleeding of the optic sheaths occurred within the sclera.

Describing an ophthalmoscopic picture which is not mentioned in the literature as far as we are aware, we put forward an explanation on the basis of some seemingly new histological experiences.

Cl. C., aged 38 years, was injured, while at work, by a long nail falling upon his right eye from a considerable height. His vision was blurred. When he was admitted to the clinic on September 12, 1942, a perforating wound was found in the sclera at "4 o'clock," 2 mm. from the limbus. The cornea was clear, anterior chamber deep, 2 mm. hyphaema, pupil small, not reacting, lens clear, a dull reflex from behind without showing any fundus details, severe hypotonia. Vision right = fingers at $\frac{1}{2}$ m. Vision left = 6/6. X-ray negative. Atropine did not dilate the pupil more than 5 x 4 mm. Fourteen days later, besides dark diffuse vitreous opacities, a clear red arcuate band was visible at the temporal margin of the disc from "11 to 7 o'clock" (Fig. 1). The breadth was approximately that of the central vein, with both ends slightly thinned. The shining red arc was outlined temporally by delicate specks of the pigment ring. On October 7, 1942, the picture was much clearer, as the blood in the vitreous had mostly

FIG. 1.

Arcuate haemorrhage at the disc with radial retinal bleeding.

disappeared. The marginal haemorrhage was unchanged and remained so during the next two months of observation. Three fine radially striate haemorrhages, which seemed more superficial, were present temporal, nasal and inferior to the disc (Fig. 1). The inferior one was the last to be discovered (October 13, 1942). The radial haemorrhages were persistent too, but were becoming fainter on November 13, 1942, and had vanished entirely by November 27, 1942, while the arcuate marginal haemorrhage remained unchanged. The vitreous body was much clearer, and some floating opacities were visible in the lower half.

The field of vision in the left eye was full with normal blind spot, while the field of the right eye showed slight concentric shrinking, more in the nasal part. I was unable to determine the blind spot of the injured eye. The question of the Jensen scotoma remains unsolved, unfortunately, due to a lack of collaboration on the part of the patient.

As we had not the opportunity of making a histological examination in this case, we are forced to analyse this picture by speculation only, drawing our conclusions from other histological findings. The first and nearest conjecture is that the red crescent is caused by a bleeding within the optic sheaths, subdural or subarachnoidal—infiltrating Elschnig's border tissue. As is well known, the latter separates sclera and choroid from nerve tissue. The pigment epithelium often contains less pigment near the optic nerve, or ceases entirely. In this case, such a border tissue haemorrhage would shine through the pellucid lamina vitrea choroideae, and the marginal haemorrhage would be outlined temporally by the pigment ring. We cannot offer any histological proof for this assumption.

Ballantyne (1942) has shown that in cases of intracranial subarachnoid haemorrhage, subdural and subarachnoidal haemorrhages in the sheaths of the optic nerve, as well as those in the retina, occur as independent effusions. He has found nothing to prove that a subarachnoid haemorrhage may track forward from the blind end of the optic vagina into the border tissue or surrounding sclera. He found once only (his Case 1) rows of red blood corpuscles within the nerve fibre and ganglion cell layer close to the disc tracking from the border tissue into the retina. This case was observed by Ballantyne ante mortem ophthalmoscopically. Haemorrhages crossed the lower temporal margin of the optic disc. No arcuate haemorrhage was visible.

It seems necessary to remind ourselves that neither retina, choroid nor sclera are in direct touch with the tissue of the optic nerve. Choroid and sclera are separated from the nerve by Elschnig's border tissue, while the retina ends a short distance from the nerve. This distance is filled with Kuhnt's intermediary

tissue. *The only membrane of the ocular tissue reaching the optic nerve directly is the lamina vitrea choroideae (Bruch). It butts closely against the optic nerve.*

Studying the histological material of injured eyeballs collected in the Tennent Institute, I did not discover a case of bleeding in the border tissue. But I found a remarkable lesion of the optic nerve in three cases—all three at the very place where Bruch's membrane terminates at the optic nerve.

Case 1

Do. P., aged 40 years. While drunk he was attacked from behind and struck with a knife or some instrument, which hit his left eye. Rupture of the sclera in lower outer quadrant with prolapse of uvea and retina. Anterior chamber full of blood. Tension = -2, amaurosis. Excision of the eye.

Histological examination :—Subepithelial granulation mass containing uvea, vitreous body, polynuclear leucocytes, erythrocytes and haemorrhagic retina. Iris ruptured at its root. No lens. Retina totally detached, covered on both sides with blood, its vessels well filled. The optic nerve is torn temporally at the level of the hexagonal layer. The gap runs transversely in general. The tear is step-shaped, notched (Figs. 2 and 3). The steps are at intervals, whose breadth is that of an optic nerve bundle group. The gap is filled with blood. A smaller tear is found at the nasal side. Between the ends of both cross tears is normal nervous tissue.

FIG. 2.

Case 1. Tear crossing the nerve fibres temporally. Low power.

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FIG. 3.

Case 1. High power. Notched cross tear, gap filled with blood. The rupture is the direct continuation of the pigmented epithelium.

FIG. 4.

Haem. Eos. 150X. Haemorrhagic glaucoma with complete retinal detachment. Partial tear in direct continuation of Bruch's membrane. Gap filled entirely with blood.

A perforating injury with prolapse of the contents of the globe and complete retinal detachment caused an incomplete cross tear of the optic nerve on both sides at the spot where Bruch's membrane encloses tightly the optic nerve.

Case 2

F. M., aged 62 years. Bilateral glaucoma discovered in 1931. Left eye trephined, 1931, right eye, 1936. Both eyes quiet till 1939, when a haemorrhagic glaucoma attack occurred in the right eye. The next (January, 1940) was followed by blindness. Excision of the painful right eye, February 3, 1940. Histological findings:—No anterior chamber, uvea entirely cellular infiltrated, retina, convolvulus-like, detached by an extensive subretinal haemorrhagic fluid. Leucocytic and lymphocytic infiltration of retina and optic nerve. Cross-tear of the optic nerve (Fig. 4) of 90μ length. At its broadest part the distance between the side of the gap is 45μ . The whole gap is filled with blood. The tear is the direct continuation of Bruch's membrane.

A haemorrhagic glaucoma with endophthalmitis and haemorrhagic retinal detachment revealed a short tear of the optic nerve at the very insertion of Bruch's membrane. The gap is filled with blood.

Case 3 (for which I am indebted to Dr. McGregor)

C. M., aged 79 years. Bilateral immature cataract. Blood pressure 198/160 mm. Left eye combined extraction. Eight hours later expulsive haemorrhage. Enucleation after three days.

FIG. 5.

Case 3. Partial cross rupture in expulsive haemorrhage. Low power.

FIG. 6.

Case 3. Partial cross rupture in expulsive haemorrhage.

Anatomical examination :—Prolapse of ciliary body with retinal tissue in the corneo-scleral wound, extensive subchoroidal and subretinal haemorrhage, retina completely detached. The nasal third of the optic nerve is ruptured (Figs. 5 and 6) exactly at the level of Bruch's membrane. The gap is partly filled by red blood corpuscles and runs parallel to the fibres of the cribriform plate. The outlining of the gap is notched. The tissue of the optic nerve in front of and within the lamina cribrosa is cavernous. Both central vessels are filled with blood.

An expulsive haemorrhage led to prolapse of the contents of the globe, subchoroidal and subretinal haemorrhage, complete retinal detachment. The nasal side of the optic nerve was torn to the extent of about $\frac{1}{2}$ mm. exactly at the ending of Bruch's membrane.

These three cases of a tear in the optic nerve at the insertion of Bruch's membrane were discovered in a relatively small number of eyes examined histologically. They happened to occur in three different conditions : (1) trauma, (2) haemorrhagic glaucoma, and (3) expulsive haemorrhage. Subretinal haemorrhage with an instantaneous propulsion of the retina, especially as corollary of arterial bleeding, seems to be the common cause. In all three cases the tear occurred exactly at the insertion of Bruch's membrane. Our Case 2 revealed a tear and haemorrhage of about 90μ length

at the periphery of the nerve. If that happens in an eye with translucent media and retina in situ we can expect an ophthalmoscopic picture similar to that which we have put at the head of this paper. Such a haemorrhage may give rise to an intraretinal bleeding, too. The striate character of the latter is explained by the thick radial nerve fibre bundles at the optic disc margin. The retinal haemorrhage is thinner than the blood column in the rupture, therefore more quickly reabsorbed. It is a pity that the search for a Jensen scotoma, corresponding to the tear in the nerve fibre, was frustrated by the lack of co-operation of the patient.

Cross ruptures of the optic nerve have been reported by von Michel (1901) in the area of the cribriform plate in two cases. Both cases were perforating injuries. In the first, the whole nerve was cut at the anterior level of the cribriform plate. The second case showed two incomplete tears on opposite sides, both filled with blood—like our Case 1.

It seems that the insertion of Bruch's membrane is a point where tears of the optic nerve may occur more easily than anywhere else. Not only a traction from the detached retina may produce a tear. If the nerve is pushed backwards by a stronger force—for example, a foreign body such as a bullet—the nerve fibres may rupture at the same place. Actually we know that appearance as *evulsio nervi optici* clinically and anatomically. Salzmann (1903) described it, and many such cases have been published. Good ophthalmoscopic pictures are available in Lagrange's and in von Szily's books on war injuries, and in Würdemann's text book. The often considerable space between the retracted optic nerve and the retina is filled in fresh cases with blood, substituted later by glial and connective tissue. I remember eight cases, notes of four of them being at my disposal. Two are injuries by bullets, two birth traumata. The youngest (9-year-old boy) was the only one with a very deep "cup." Two were cases with intensive proliferant retinitis, one with optic atrophy. In all these cases the mechanism of the rupture is understandable. The force behind the bulb pulls the nerve backwards and (or) pushes the bulb forwards. The rupture of the optic nerve occurs at the *locus minoris resistentiae*, the insertion of the nerve at the retina. If the acting force is not strong enough to cause an evulsion of the optic nerve, complete or incomplete tears occur, as in von Michel's two cases, in front of the cribriform plate. The tear in our three cases was caused by an instantaneous subretinal haemorrhage.

Summary

A seemingly unknown ophthalmoscopic picture, marginal arcuate haemorrhage at the periphery of the disc, is described. It is explained as a tear of peripheral nerve fibres at the insertion

of Bruch's membrane at the optic nerve. Three cases of partial cross ruptures of the optic nerve are reported histologically. All three are discovered at the very insertion of the lamina elastica chorioideae. The tear was caused in all cases (traumatic, expulsive haemorrhage and haemorrhagic glaucoma) by an instantaneous, probably arterial, subretinal bleeding. Traumatic retropulsion of the optic nerve or propulsion of the bulb causes cross ruptures of the optic nerve, too, occurring at the same spot and leading to evulsion of the optic nerve.

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ORTHOPTIC TREATMENT OF ANOMALOUS PROJECTION

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WHILE theory concerning the nature of abnormal retinal correspondence or anomalous projection has been considerably developed in the last ten years, notably by the writings of Chavasse, Verhoeff and Travers, practice in its treatment has hardly kept pace. In this paper an attempt is made to outline briefly the theoretical conceptions which prove to be of most practical value in guiding an extension of training methods. Of the many names under which the phenomenon goes, Verhoeff's term, "anomalous projection," is adopted as being most in accordance with these conceptions.

Ordinary binocular vision, in which both visual axes are always directed on the same object by reflex fusion mechanism, is an innate habit, for although it develops after birth, it does so along predisposed lines. The same applies to the mental processes that interpret the two images received, one by each macula, as being a single object (if the images are similar), or as representing two