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VITREOUS IMPLANT FOR RETINAL DETACHMENT

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The well-known basic treatment of simple retinal detachment entails diathermy coagulation of the retinal tear(s) and the underlying area of choroid. The sub-retinal fluid is then evacuated through a perforation made in the sclera and choroid. This allows the retina to fall back into position. The ensuing inflammatory reaction causes choroido-retinal adhesions that seal the retinal tear(s). Anything preventing the retina contacting, or maintaining contact with, the choroid in the coagulation area will result in failure. Among procedures employed to maintain this contact are the various types of scleral 'resections' and the intra-vitreal injection of air, saline and even cerebrospinal fluid. Vitreous itself was first extensively used for this purpose by Shafer.[1] The intra-vitreal pressure after air or saline injection soon drops as the air or saline is absorbed. Since vitreous is not absorbed by the retina and has a colloidal viscous nature, it maintains its osmotic tension. It therefore has the advantage of maintaining a better intra-ocular pressure.

Shafer obtains the vitreous from eyes donated to the eye bank. It is collected by aspiration through a No. 18 BD needle, taking aseptic precautions. About 2 ml. of vitreous are obtainable by this method, and this is stored in glass vials at 4°C. It has been found suitable for use for up to 3 months ; 48 hours before operation the vitreous is cultured to ensure its sterility.

TECHNIQUE

At operation the eye is first treated by diathermy to coagulate all retinal tears, and is then prepared for the vitreous implant as follows: A small incision (2 - 3 mm.) is made through the sclera, 8 - 9 mm. from the limbus, exposing the uvea in either the upper or lower temporal quadrants. Two opposing mattress sutures are placed in the sclera in readiness to seal the incision later. Drainage of the sub-retinal fluid is effected by scratching a small opening through the sclera in the detachment area to expose the choroid, which is then carefully perforated. The uvea in the prepared scleral opening is now punctured with a Graefe knife, and the vitreous is injected, using a No. 18 BD needle introduced through the opening and directed towards the centre of the eye. One mattress suture with a half-hitch is drawn by an assistant to seal the opening before the vitreous is injected. The implant is done slowly to raise the intra-ocular pressure a little above normal. This is maintained for a few minutes to allow all the sub-retinal fluid to drain. The tension is then reduced to about the upper limit of normal by relaxing the pressure on the syringe. The assistant maintains the tension on the half-tied suture to close the scleral wound as the needle is withdrawn. The second suture is then tied to make doubly sure that there is no leak.

This procedure can have its intricacies. The suture material must run easily through the tissue so that the incision is quickly closed as the needle is withdrawn, to prevent a great reflux of vitreous. Even so, with the suture well tied, the wound might not be completely sealed. A single half-hitch is better than a double half-hitch, i.e. the first stage of a surgical knot, since a knot might stick before the wound is properly closed. A single half-hitch, on the other hand, might slacken as the second hitch is being tied. Excessive zeal on the assistant's part can easily break the suture.

Moffatt[2] and Shapland[3] have modified Shafer's technique in the following respects: The perforation for draining the sub-retinal fluid is made by catholysis with a needle 0·5 mm. in diameter. The implantation of the vitreous is through a specially designed 18 BS gauge needle that has a stop 1 cm. from a special sharp cutting point.

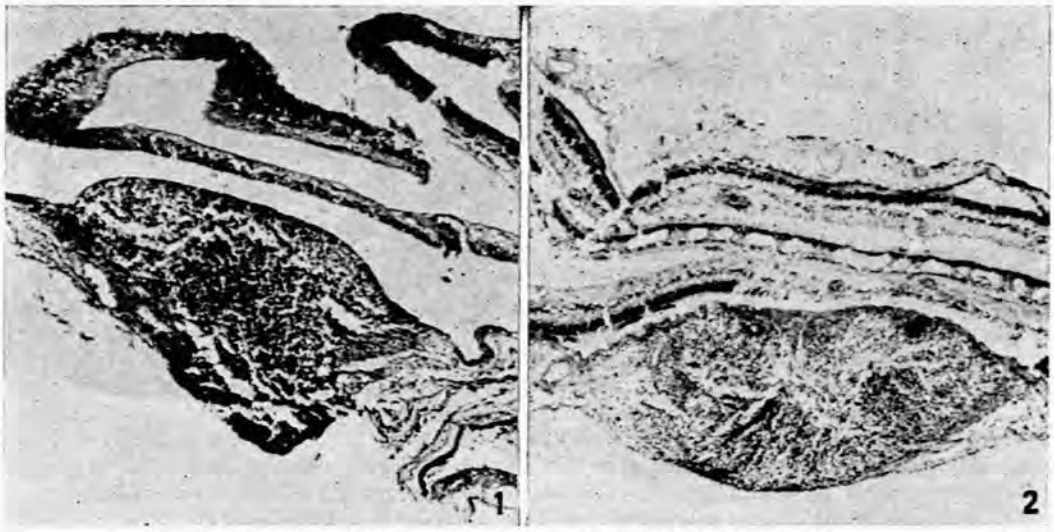
Their method of obtaining donor vitreous, however, is radically different. The donor eye, enucleated preferably within 6 hours of death, is placed in a penicillin-streptomycin suspension in liquid paraffin for 2 hours. Then, with all aseptic precautions, the eye is removed from the container, rinsed in Ringer solution and stored in sterile liquid paraffin after a culture has been taken from the limbus and attached bulbar conjunctiva. At the operation the stored eye is rinsed in sterile normal saline. The globe is perforated with a cautery, making an opening large enough to admit the nozzle of a 2 ml. record syringe. Then, with pressure on the globe and suction by the syringe, about 2 ml. of vitreous can be aspirated ; this is implanted.

Their experience has been that vitreous obtained from eyes prepared and stored in this fashion has been sterile. However, vitreous obtained in this manner is potentially dangerous, as will be described below.

The aspiration of more than 2 ml. of vitreous by a syringe is extremely difficult, and practically none can be so obtained from a child's eye. There is thus a large proportion wasted (the average vitreous body contains about 5·5 ml.) and the vitreous so obtained is very thin and liquid.

Modified Technique

For these reasons my method of collection is as follows: The stored eye, having been used for corneal grafting, is rinsed again in penicillin-streptomycin solution. All the remaining corneal, conjunctival and limbal tissue is removed. The iris is torn from its attachment. Loose pigment and debris is washed away by means of a pipette with the penicillin-streptomycin solution. The lens is then removed intracapsularly ; this is easily done in all cases and is good practice for the registrar. Another wash with



Figs. 1 and 2. Localized choroidal abscesses (haematoxylin and eosin × 45).

the antibiotic solution follows. The globe, held in a sterile gauze square, is inverted over a medicine glass and gently squeezed. The bulging hyaloid is cut with pointed scissors which are also used to cut the vitreous as it prolapses further. As soon as there is a suggestion that retina, uvea or tissue fluids might present and contaminate the vitreous, the process is stopped, but repeated, using a second medicine glass to try to collect more uncontaminated vitreous. In this way as much as 4 - 5 ml. of vitreous is obtained from one eye.

The vitreous in the glass is now poured into a 20 ml. dismantled syringe, which is held with its nozzle directed into the small sterile bottle in which the vitreous is to be stored. The plunger is now inserted into the syringe, and with a little force the vitreous suddenly passes through the nozzle. The bottle is sealed with a rubber bung and a metallic screw-cap, and is also covered with a sterile fingerstall. Forty-eight-hour cultures are taken before use.

The vitreous so obtained and stored is more viscid than that obtained by the other methods described. Furthermore, it has been, as it were, converted from a gel to a sol phase and now can pass through a No. 26 BSG needle. Thus the use of thicker needles and the preparatory scleral incision and mattress sutures are unnecessary. The Tolia cannulated needle-knife (Grieshaber) can be used very effectively. It is extremely fine with a really sharp cutting point. The recipient eye can be pierced extremely obliquely through the sclera and ciliary body, so that the puncture becomes self-sealing after removal of the needle. The extra-sharp point and cutting edge is specially important when perforating the ciliary body, for in a soft eye (the sub-retinal fluid has already been tapped) a not-so-sharp needle is more likely to produce tears and more damage than desirable.

As mentioned above, the vitreous can now pass through a No. 26 BSG needle. However, before the actual implant is done, it is advisable to 'test-inject' all the vitreous through such a needle. Small fragments of tissue or abnormal coagula of vitreous can thus be removed. Naturally, several needles must be available for this procedure.

On one occasion, after the vitreous had been collected, the remains of the donor eye were examined, and 6 small whitish nodules, miliary in size, were noted in the choroid. The other eye from the same donor showed 4 similar features. From the macroscopic appearance these nodules were thought to be early secondary tumour growths. The cause of death of the donor, however, was recorded as cerebral thrombosis — haemorrhage. The patient had been unconscious for several days before death. No autopsy had been done. Culture of the

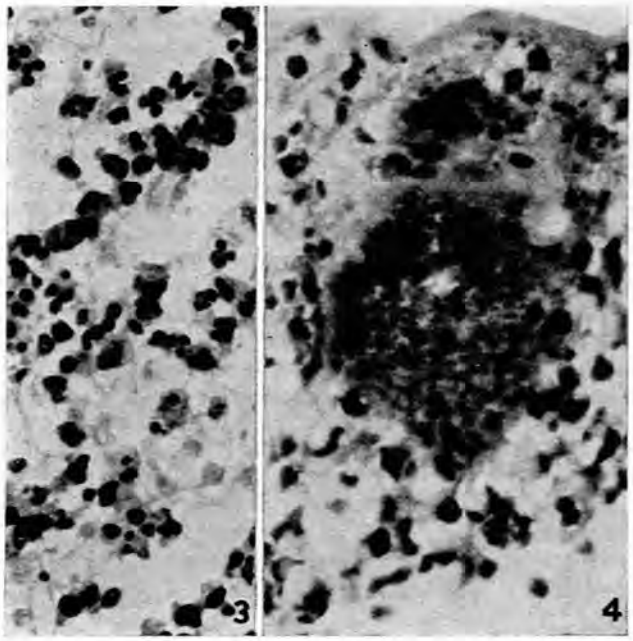


Fig. 3. Inflammatory-cell infiltrate at the edge of an abscess. Note the large number of polymorphonuclear cells (haematoxylin and eosin × 600).
Fig. 4. A mass of micro-organisms, probably cocci, in one abscess (haematoxylin and eosin × 750).

vitreous showed it was not sterile, and it was discarded. Unfortunately, no note was made of the organism, for the subsequent histological examination showed that the small nodules were early abscesses. Dr. J. C. Kaufmann of the South African Institute for Medical Research reported as follows:

'Sections from representative nodules show small localized acute abscesses in the choroid (Figs. 1 and 2). In addition to some products of cell destruction, these consist of many polymorphonuclear cells and some other inflammatory cells, chiefly mononuclear cells and histiocytes (Fig. 3). At one level in one of the abscesses just beneath Bruch's membrane there is a rounded mass of micro-organisms (Fig. 4). These are rounded in shape, vary a little in size, are very much smaller than 2 μ, and stain blue-red by Wright and Craighead's method. They thus appear to be cocci and not toxoplasmata. Adjacent vessels are partly blocked by, and their walls are infiltrated with, polymorphonuclear cells, but no septic emboli are visible. In one part inflammatory cells extend deep into the retina as far as the ganglion-cell layer. Choroidal vessels show some hyaline arteriosclerosis and there is also some cystoid degeneration of the retina (Fig. 5).'

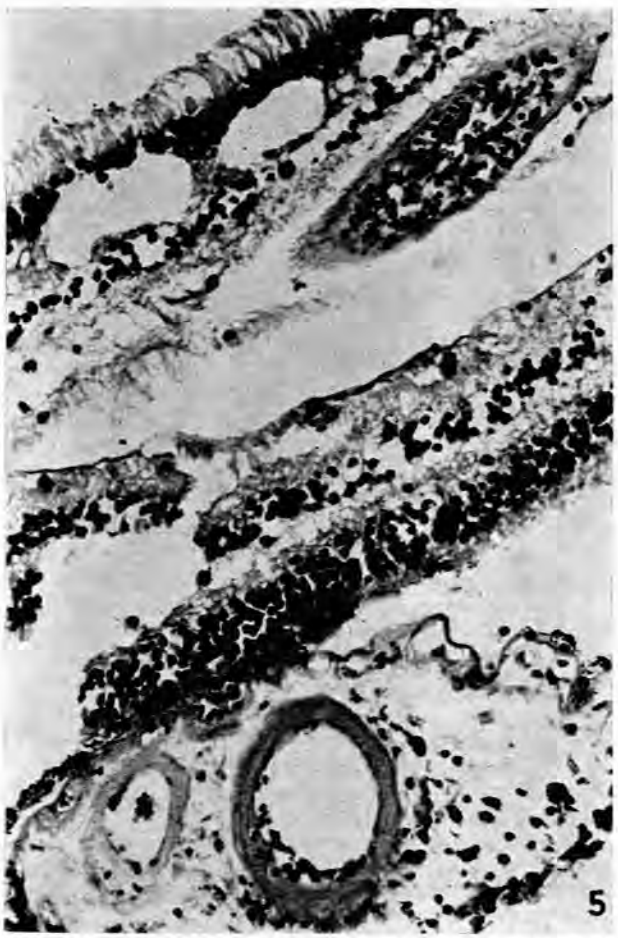


Fig. 5. Choroid and retina. Note the retinal vessel containing polymorphonuclear cells, hyaline arteriosclerosis of the choroidal vessels, and cystoid degeneration of the retina (haematoxylin and eosin × 240).

These incipient abscesses are therefore most probably a result of a slow dying process, with a bacterial invasion of the blood stream. The method of vitreous collection as described by Moffat[2] and Shapland[3] can therefore be a hazardous procedure.

COMMENT

The vitreous-implant operation has usually been a last resort. Shafer pleads that it should be used earlier than at a third or fourth operation. The simplicity of the method of injection described above would allow this to be almost a routine procedure at the first operation (if available) whenever ophthalmoscopic examination shows the retina has not flattened out completely. This problem of availability should stimulate research into the feasibility of using animal vitreous in human beings.*

There can be no doubt that a vitreous implant at the first operation accounts for the successful outcome in the following case:

The patient was a World War I casualty. One eye had been enucleated. An intra-ocular foreign body and several others had been removed from the other eye. A traumatic cataract subsequently progressed, and in 1950 an extra-capsular cataract extraction was done. A dense membrane remained, but there was a small clear gap that enabled the patient to get about and read. Nearly 10 years later his vision suddenly failed. A retinal detachment was suspected, but since it was impossible to see any details, a capsulectomy was done which made it possible to confirm that the retina was severely ballooned and completely detached, at which stage the patient was referred to me.

A mesh of holes was found in the peripheral retina between 5 and 7 o'clock. Two small holes were also noted between 12 and 1 o'clock. At operation, the area of the retinal scars could not be coagulated with the diathermy, since the ballooning was too high. Thermo-couple electrodes of Cuepper were used and a scleral temperature of even 90°C. was tried. Small holes exposing the choroid were then cut in the sclera at about the equator in the 2 lower and upper temporal quadrants. The exposed uvea was touched with a heated Wadsworth cautery and the coagulated tissue then perforated. The lower quadrants only were perforated, the eye becoming so soft it was felt that to perforate the upper temporal quadrant might result in additional damage to the retina. The Tolia needle was then introduced extremely obliquely in the right nasal quadrant 3 mm. from the limbus. (In patients who have a lens the point of entry is 5 mm. from the limbus.) As the vitreous was implanted the retina was observed to flatten out. The advisability of applying diathermy now was considered, but in view of the amount already applied to the sclera it was decided not to manipulate the eye further.

The following day the patient reported his vision had returned. Some days later light coagulation was used to seal the area of the tears, and 2 weeks later still a small scleral buckling operation was done in the lower outer quadrant where retinal and sub-retinal striae were visible, apparently related to the course of the intra-ocular foreign body of World War I. Follow-up shows that the cure has been maintained.

SUMMARY

A technique of collecting vitreous and a simplified method of implantation is described. The advantage over other methods is discussed. A preterminal bacteraemia might produce incipient inflammatory foci within the eye and infect the vitreous. One cured case with an extremely poor pre-operative prognosis is described.

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* Preliminary animal experiments suggest that animal vitreous contains too much protein and may be antigenic. A search of the literature has revealed that it has been tried in humans, but the results were not conclusive.