

# Searching for heavier-than-water tamponades

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in Nürnberg

PROLIFERATIVE vitreoretinopathy has a propensity for the inferior fundus and vitreoretinal investigators are therefore searching for more effective 'sinking' agents to help seal retinal breaks in the lower fundus.

The use of a model eye chamber to study the behaviour of tamponade agents seems to indicate that heavier liquids such as F6H8-silicone oil solutions make good contact with the inferior fundus and may be better at excluding aqueous from inferior retinal breaks. Because the vitreous cavity is nearly spherical, it is difficult to totally fill the eye with any tamponade agent. Therefore, while conventional silicone oil is effective for retinal breaks situated at the superior fundus, heavy silicone oil (such as F6H8-silicone oil solutions) is more effective for inferior retinal breaks, said David Wong. Consultant vitreoretinal surgeon at Royal Liverpool Hospital.

"It may be serendipity that standard silicone oil is just a little lighter than water. Nonetheless, it has served us well for 40 years. It is for this reason that we recommend silicone oil solutions that are just a bit heavier than water. Winter et al suggested that Perfluorocarbon liquids may be toxic because they are too efficient at excluding water from the retinal surface, thereby causing histological damage to the retina," he said.

Dr Wong spoke at a retina seminar at the annual Congress of the German Ophthalmic Surgeons (DOC). He commented that no tamponade agent could be completely effective, as none can achieve and sustain a 100% tamponade effect.

Break closure is best achieved by excluding access of water to retinal breaks thereby stopping or reducing bulk flow of aqueous through the retinal breaks.

Tamponade agents form bubbles that make contact with the retina and keep water away, he said.

The shape of the bubbles, primarily determined by the specific gravity of the substance, plays a deciding role in the ability of a tamponade agent to make contact with the retina. Additionally, tamponade agents that float are more useful for breaks in the superior fundus. Dr Wong has been working with his colleagues Theodor Stappler and Dr Rachel Williams of the Clinical Engineering Department in Liverpool. He reported that using two agents (conventional followed by heavy silicone oil) in two successive operations, one for the upper and then one for the lower fundus, might be a new strategy for treating proliferative retinopathy (PVR).

He said that tamponades only apply a little mechanical force on the retina, and that the word 'tamponade' (suggesting packing or completely filling) was, in a way, a misnomer. Because the vitreous cavity was nearly spherical, it can be impossible to completely fill it to achieve a 'total tamponade'. Earlier attempts at double filling the vitreous cavity with a combination of agents that float and sink did not achieve overall success, as a slight under-fill can leave a large area of the retina without contact with the tamponade agent.

"Break closure is a nebulous concept. It has the connotation of pushing against, as in closing a door. In reality there is very little mechanical force acting on the retina," Dr Wong commented.

He explained that the buoyancy pressure of an air bubble is the product of water density, gravity acceleration, and the height of the bubble. Even for large bubbles or Perfluorocarbon liquids or gas, the buoyancy pressure would still be low.

He said that surgeons were concerned that heavy liquids needed to be 'heavy enough' to be effective. However, even the heavi-

est fluid, perfluorophenanthrene, exerts a maximum downward pressure of only 3.4 mmHg in a normal size globe, he said.

"It is highly doubtful whether such small pressures play an important part in break closure. It is even more controversial to attribute the trophic changes of the retina to the specific gravity of heavy liquids," Dr Wong commented.

He maintained that the ability of a tamponade agent to make contact with the retina and exclude bulk flow of aqueous through retinal breaks was the one crucial factor that determines the efficacy of the agent to close retinal breaks. Contact depends on the buoyancy of the agent and on the interfacial tension.

As the retinal surface is hydrophilic, it determines the shape of bubbles coming into contact with it. Air bubbles become flat bottomed and sili-

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cone bubbles assume a near spherical shape. Even though air has a higher interfacial tension against water than silicone, bubbles of air assume a much more 'useful' shape than silicone.

Since tamponade agents seal retinal breaks through contact with the retina, agents that float should be more effective in closing superior fundus breaks and agents that sink should be more effective for inferior fundus retinal breaks.

He noted that, overall, liquids with higher specific gravities are more effective in making contact with the retina and therefore more effective at closing retinal breaks. Semifluorinated alkanes and other fluorocarbons that are miscible with silicone allow surgeons now to use homogeneous solutions of two or more liquids

as a single tamponade agent.

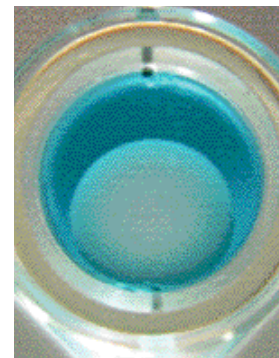
Dr Wong pointed out that intraocular gases were satisfactory in making close to maximum contact with the retina. He would like to identify agents that were specifically more effective in the inferior fundus.

He said that his clinical experience with over 70 cases with Densiron (Fluoron GmbH, Neu-Ulm, Germany) was very positive. The use of this agent focused on cases of retinal detachment complicated by PRV and in which initial surgery with gas or silicone oil had failed. The re-detachment invariably involved inferior pathology either in the form of epiretinal membrane formation or unclosed retinal breaks.

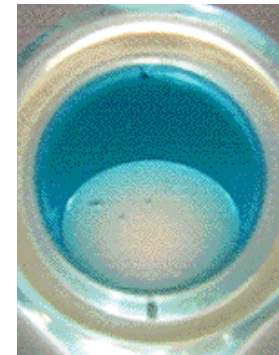
Nevertheless, Dr Wong stressed that patients with retinal detachments complicated by PVR profited from inferior fundus agents that are heavier than water. He stated that this asser-

tion needed to be verified in controlled trials. One such international trial led by Profs Kirshhof and Joussem of Cologne is underway.

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Model eye chamber filled with F6H8-silicone oil solutions a specific gravity of 1.01 g/cm<sup>3</sup>



Model eye chamber filled with F6H8-silicone oil solutions a specific gravity of 1.06 g/cm<sup>3</sup>. Note that the bubble of the lighter silicone oil is more rounded, taller and makes less contact with the chamber.