The Basics of OVDs

An understanding of properties and characteristics of OVDs is key to optimizing their use.

BY NIC J. REUS, MD, PhD

Ophthalmic viscosurgical devices (OVDs), informally known as viscoelastics, function as a cataract surgeon’s third hand. They can be used to maintain intraocular space during the creation of the capsulorrhexis, protect the endothelium against mechanical forces, maintain space during IOL implantation, and provide a barrier against vitreous prolapse in the case of a posterior capsule tear.

OVDs can be constructed out of a number of molecules, including sodium hyaluronate, chondroitin sulfate, and hydroxypropyl methylcellulose. Sodium hyaluronate, previously derived from rooster combs, is now produced by bacterial fermentation. Chondroitin sulfate is derived from shark fin cartilage, and hydroxypropyl methylcellulose is derived from wood pulp. The physical properties of an OVD depend on the concentration, molecular weight, molecular length, and chain interactions of these molecules.

TERMINOLOGY OF OVDs

OVDs can be described in terms of their rheologic properties, including (visco)elasticity, viscosity, pseudoplasticity, and surface tension.

Elasticity and viscoelasticity. These terms refer to the ability of a material to return to its original shape after being pressed. An example of an elastic item is a rubber squash ball because it can be deformed under pressure and return to its original shape when the pressure is released.

Viscosity. This term refers to a solution’s resistance to flow. For example, solutions that have a viscosity of less than 10,000 centistoke (cSt) behave like liquids; solutions with a viscosity greater than 100,000 cSt behave like gels.

Pseudoplasticity. This term refers to a solution’s ability to transform from a gel-like substance to a more liquid substance when under pressure. Pseudoplastic solutions, therefore, have a low viscosity at high shear rates, meaning they behave like a liquid when they pass through a cannula, and a high viscosity at low shear rates, meaning they behave like a gel when at rest in the eye. The surface tension of a substance affects its ability...
It is advantageous to understand the characteristics of each type of OVD, as this will inform the surgeon’s decision of which is best for each surgical scenario.

to coat a surface; solutions with a low surface tension have a better ability to coat a surface.

CLINICAL CHARACTERISTICS AND USES

Based on these characteristics, OVDs can be further clinically categorized as cohesive, dispersive, and visco-adaptive.

Cohesive OVDs. Healon GV (Abbott Medical Optics Inc.; Figure 1) is one example of a cohesive OVD. This and other cohesive OVDs have a high molecular weight, a high degree of pseudoplasticity, and a high surface tension. Thus, they maintain space very well. A cohesive OVD is useful in protecting against a tear-out of the capsulorrhexis, especially in intumescent white cataracts, because it maintains space in the anterior chamber and flattens the anterior lenticular surface, thereby reducing the centrifugal force on the capsulorrhexis. This type of OVD is also useful when creating the capsulorrhexis with forceps, as it maintains a stable anterior chamber while the forceps may keep the primary incision wide open. Furthermore, a cohesive OVD can be easily and completely removed from the anterior chamber.

Dispersive OVDs. Dispersive OVDs including Viscoat (Alcon; Figure 2) have a lower molecular weight, a lower degree of pseudoplasticity, and a lower surface tension. A dispersive OVD is useful in protecting the endothelium from mechanical trauma during phacoemulsification, as it coats the endothelium very well. It is also advantageous in the presence of a posterior capsule tear. While vitreous wants to enter the anterior chamber and lens parts want to leave the anterior chamber through the tear, a dispersive OVD can act as a barrier between these two compartments. Thus, the vitreous remains in the back of the eye and the lens in the front. If the surgeon accidentally aspirates the OVD, only some of it will be removed because the OVD adheres better to its surroundings than to itself, leaving the barrier intact.

Viscoadaptive OVDs. As the name implies, viscoadaptive OVDs offer a combination of both: At low shear rates, they exhibit more cohesive behavior, but at higher shear rates, they have a more dispersive behavior. One example of a viscoadaptive OVD is Healon 5 (Abbott Medical Optics Inc.).

SUMMARY

As the cataract surgeon’s third hand, OVDs are essential tools in cataract surgery. Each agent has its own properties that determine its behavior and function in the eye. It is advantageous to understand the characteristics of the three types of OVDs—cohesive, dispersive, and viscoadaptive—as this will inform the surgeon’s decision of which is best for each surgical scenario.