Experience With Modern Vitrectomy Machines

New technology helps retina surgeons in an ophthalmology referral center in Mexico.

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A retina specialist's surgical outcomes depend mainly on his or her experience, knowledge, and ability. However, results can also be affected by the performance of his or her vitrectomy machine. Additionally, if one has an academic position in a teaching hospital, extra care must be taken with every patient when helping a fellow in his or her surgery (especially at the beginning of the academic year). Therefore, knowing how to control the fluidics of his or her preferred vitrectomy system must be a priority for every posterior segment surgeon.

At the Association to Prevent Blindness (Asociación Para Evitar la Ceguera en México [APEC]), an ophthalmology referral center in Mexico City, the Accurus Surgical System (Alcon Laboratories Inc.) was the leading vitrectomy machine for at least 6 years. Therefore, most vitreoretinal surgical guidelines at the center had been dictated by venturi-controlled vitrectomy systems.

However, vitreoretinal surgery has evolved greatly over the past 4 decades, not only with improvements in vitrectomy machines and fluidics, but also with new and safer endoilluminators, better visualization and optics from the microscopes, and adjuvants such as heavy liquids and stains. Over the years, a decreasing rate of transsurgical iatrogenic complications has been observed in our department, most likely due to these improvements.

It is important to keep in mind that, in Mexico, the main indications for vitrectomy are diabetes-related complications. Of these, tractional retinal detachments can be particularly complex, so the attending (and often the fellow) should be proficient in avoiding excessive traction that could lead to additional complications.

Now there are new options for vitreoretinal surgery. Vitrectomy machines such as the Constellation Vision System (Alcon Laboratories Inc.) and the OS3 (Oertli Instrumente AG) provide different capabilities that allow faster and better cutting and fluidic action during surgery (and hopefully yield fewer iatrogenic retinal tears). This article explores some of the advantages and disadvantages of each system.

PUMPS AND FLUIDICS

Two types of pumps are available—peristaltic and venturi. Peristaltic pumps are positive displacement machines. The fluid contained within a tube is forced to move within the system by rollers that compress it. Venturi pumps operate based on the principle of the same name, in which pressure is reduced when fluid flows through a constricted section of a pipe, thereby providing instant negative pressure.[1]

Fluidic control in the Constellation Vision System works by means of a venturi pump that can control the aspiration rate, with a maximum vacuum of 650 mm Hg. This works in a similar manner as a peristaltic pump. Hence the surgeon has control over the aspiration and the vacuum force induced on the vitreous humor. One key advantage of the Constellation system is the IOP control; even if high aspiration/vacuum is required, the system automatically compensates the infusion pressure. Therefore, one is expected to experience fewer hypotony-related complications.

Duty cycle is the percentage of time that the port probe is open divided by the duration of the entire cycle.[2] Duty cycle modification, available with the Constellation system, helps the surgeon achieve a more efficient performance when shaving or performing core vitrectomy. However, it is rarely necessary to modify this parameter because the presets work perfectly.

The OS3 offers different capabilities. This vitrectomy machine has both venturi and peristaltic pumps that can achieve a maximum vacuum of 600 mm Hg and a maximum aspiration of 50 mL/minute. The surgeon can choose between the 2 pump systems by simply pressing a button; therefore; it is up to the retina specialist to define which pump and parameters he or she will use depending on whether core vitrectomy or vitreous-base shaving is being performed. In our department, the tendency is to use the peristaltic pump for the whole case. The surgeon usually experiences a perfectly controlled vitrectomy with no excessive traction. Also, our anterior segment colleague has no need to be afraid to perform phacoemulsification with a venturi-based pump; so hopefully, fewer posterior capsular ruptures can be expected.

CUT RATES

With a higher cut rate, vitrectomy will be smoother and more predictable, with less flow obstruction and less vitreous surge.[3,4] It is for this reason that the Constellation Vision System and the OS3 have high cut rates of 5000 cpm and 3000 cpm, respectively. Both systems achieve these rates efficiently with the use of a dual pneumatic system, unlike the Accurus, with which, at 2500 cpm, the port was rarely open. The high cut rate has allowed our surgeons to perform any case safely, regardless of its complexity. As of now, no differences have been observed between the 2 systems.

INSTRUMENTATION

With both systems, the surgeon can choose among 20-, 23-, or 25-gauge instruments. So far, an advantage of the OS3 is the valved trocars for 23 gauge, which help control the IOP and reduce unnecessary saline fluid waste and vitreous incarceration. On the other hand, the valve can be problematic, especially when inserting a 23-gauge silicon-tip cannula, as the tip usually breaks off. To avoid this, one can simply insert a 25-gauge cannula without expecting problems.

ENDOILLUMINATION

The light sources for the OS3 and Constellation Vision System differ as well. The OS3's metal halide source offers a less intense illumination and supposedly has less toxicity. This endoillumination has been considered to be a disadvantage by some surgeons who are used to the brightness of the xenon source. Depending on the video recording system, this type of illumination may produce a dim result.

On the other hand, the Constellation Vision System has a xenon source, which can sometimes produce extra bright images on the video; however, this can be improved by lowering the luminosity (to about 40, again, depending on the video camera).

SIZE

Although size is not an important issue when discussing a machine's performance, it should be considered when purchasing a new vitrectomy system. Depending whether the machine will be used in a hospital or an ambulatory surgery center, the amount of space that it occupies is an important factor. Many surgeons feel that the Constellation system is too big, even though it includes the Purepoint Laser system and intraocular gases. The OS3 has been configured to be smaller and, if needed, portable (Figure 1).

PRICE

The price difference between systems can be important. Health-related expenses will definitely be higher with the Constellation Vision System when its retail price and every consumable are included. The OS3 not only has a lower price, but the consumables can be reused many times, making this an advantage over the nonsterilizable materials of the Constellation.

Figure 1. A size comparison of the Constellation Vision System (right) and the OS3 vitrectomy machines.

CONCLUSION

There is no perfect machine. Modern technology has provided the vitreoretinal community with great advances in vitrectomy instrumentation, fluidics, visualization, and illumination choices. Today, we are able to select from a variety of vitrectomy machines that offer different advantages. The OS3 and the Constellation Vision System are 2 modern machines that we consider to be the most significant regarding fluidics. We cannot conclude which one is better. Both are excellent machines that offer the surgeon new options in modern vitrectomy. A retina specialist must remember that perfection depends mostly on his or her experience and objectivity. ■

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