Take the Next Step: Convert to Venturi

In one surgeon's experience, making the transition from peristaltic to venturi vacuum enhances the safety and efficiency of phacoemulsification.

BY PABLO M. ARREGUI, MD

With continuing innovation in phacoemulsification, modern cataract surgeons have been able to improve safety, results, and patients' satisfaction due in part to recent advances in phaco system fluidics and vacuum. For many surgeons, the next step in optimizing their efficiency during surgery is to convert from a peristaltic pump to a venturi pump.

I made the transition to a venturi pump about a year ago. I use a phaco system (WhiteStar Signature System, Abbott Medical Optics Inc.) that allows me to switch from peristaltic to venturi and back, on the fly, throughout a case. I have become so comfortable with the improved safety, efficiency, and flexibility of the venturi pump, however, that I rarely use a peristaltic pump.

UNDERSTANDING PUMP STYLES

As with any phaco machine, the vacuum needs to be variable and highly responsive, as vacuum requirements vary by surgical technique and the stage of surgery. Lower vacuum levels, for example, are typically preferred for sculpting and I/A maneuvers, while higher vacuum is better for chopping and quadrant removal.

There are differences in how vacuum is created by the two pump styles. Peristaltic or flow-based pumps create flow and vacuum by "milking" fluid along compressible tubing with a series of rollers. This type of pump directly controls the level of flow, but vacuum is only achieved secondarily when the phaco tip is occluded. Flow rates are relatively constant until occlusion.

Venturi or vacuum-based pumps create vacuum by adjusting the rate of air (or other fluid) flow over an opening. This allows vacuum levels to be maximized without the need for the phaco tip's occlusion. As a result, flow varies with vacuum levels, leading to more effective flow rates within the eye.

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Venturi pumps have long been considered more efficient[1] than peristaltic pumps, but cataract surgeons have typically avoided them for fear that the rapid generation of vacuum could create too much instability in the anterior chamber. With recent improvements in fluidics and anterior chamber stability, however, modern venturi pumps are now just as safe as peristaltic systems for cataract surgery.

IMPROVED SAFETY

I believe that venturi pumps are actually safer than peristaltic pumps, because the phaco times are shorter, and less ultrasound energy and balanced salt solution (BSS; Alcon Laboratories, Inc.) are used, reducing trauma to the corneal endothelium. Another important safety feature is that the phaco tip can be kept in the center of the eye during segment removal, with the vacuum drawing nuclear fragments to it and holding them until they are completely emulsified.

For me, the defining moment in my decision to switch 100% to a venturi pump came on a day when I was performing surgery on several diabetic patients who did not dilate well and a patient with a small pupil and unstable iris due to tamsulosin use. With a venturi pump, I could

keep the phaco tip in the middle of the eye and draw the fragments to it without too many maneuvers near the iris, which was beneficial in these cases.

Surgeons will immediately appreciate this enhanced followability and the added safety of not having to chase fragments around the anterior chamber, where there is greater risk of contact with the iris or capsule. Upon reviewing my own surgical video, I see dramatically less movement of the phaco tip during segment removal and irrigation/aspiration with a venturi pump than I did previously with a peristaltic pump.

Finally, if the anterior capsule is inadvertently grasped, the venturi pump is so responsive that the surgeon can decrease vacuum and flow rates very quickly; unlike a peristaltic pump, a venturi system does not need to reflux to release the capsule.

At the conclusion of a case, a venturi system provides ideal fluidics for irrigation/aspiration, because complete occlusion is not necessary to capture and remove cortical or viscoelastic material. Vacuum can be greatly reduced and still effectively remove the viscoelastic.

UNDERSTANDING PUMP RAMPS

The WhiteStar Signature System allows for five different preset venturi pump ramp speeds, from slowest (1) to fastest (5), providing a mechanism for surgeons to control the speed of nuclear particle acquisition according to personal preference. Nuclear particles are drawn to the phaco tip by flow; a faster flow (a higher pump ramp) makes this acquisition occur more quickly, while a lower pump ramp setting is a softer initiation of flow that brings the particle to the tip at a slower, more controlled speed.

Changing the ramp settings results in very small changes in acquisition that are measured in fractions of a second but are nevertheless perceivable to the surgeon. For example, surgeons may find a ramp setting of 5 to be very "grabby." Particles fly to the tip, and vacuum builds quickly. At the opposite extreme, a ramp setting of 1 may be slow enough to allow the surgeon to reposition the tip or second instrument before the particle is fully occluded in the tip.

There is no correct pump ramp setting. I began using venturi at a pump ramp setting of 2 and, with more experience, increased to 4, which I find to be fast but predictable. Other surgeons at our center use different settings. It is also possible to downshift to a slower pump ramp setting during surgery if the surgeon encounters a weak capsule or loose zonules. It is important to note that, in my experience, even at lower pump ramp speeds, the venturi pump is still more efficient than a peristaltic pump.

With my system, I have all of the advantages of venturi and transversal with a straight-tip needle, rather than having to use an angled tip, which I find awkward for chopping.

COMPLEMENTING CURRENT TRENDS

Changing trends in cataract surgery are likely to make venturi vacuum an increasingly important part of our phaco techniques. For example, the move from 19- to 20-gauge—and possibly soon to 21-gauge—phaco needle tips makes the efficiencies of venturi even more noticeable. The smaller apertures of the newer needles make vacuum buildup with a peristaltic pump more challenging, so the differences with these tips are noticeable when one transitions to a venturi pump.

I also believe that maximizing efficiency and safety will continue to be a priority for premium IOL surgery, particularly as we enter the era of laser cataract surgery. If this modality lives up to its promise of being safer and more efficient than manual cataract surgery, it does not make sense to ignore potential gains with other technologies involved in the cataract surgical procedure. The phaco pump should complement the other technology being used to create a premium experience and improve outcomes.

TIPS FOR TRANSITIONING TO VENTURI

Surgeons who use a peristaltic pump can transition to venturi with the WhiteStar by taking advantage of the ability to switch back and forth between pump styles. During the initial transition period, I recommend the surgeon perform most of the case with the peristaltic pump and use the venturi pump for viscoelastic removal by placing the irrigation/aspiration tip directly over the middle of the IOL, turning on the pump, and quickly removing all the viscoelastic without reaching behind the IOL. Next, add cortex removal with the venturi pump. Surgeons will quickly appreciate how easy it is to grasp a tiny bit of cortex and then simply pull tangentially to remove all of the cortical material from the capsule without occlusion. The next step would be to begin chopping or making the initial grooves with the venturi pump, and it then becomes intuitive to continue with the same technology for the rest of the case. ■

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