UCLA residents review “Intraocular pressure study using Centurion phacoemulsification technology”

by Mitra Nejad, MD, Jenny Chen, MD, and Wonchon Lin, MD

May 2016

Intraocular pressure study using Centurion phacoemulsification technology

Jason Jensen, BS, Tyler Boulter, BS, Nathan Lambert, BS, Brian Zaugg, MD, Brian Stogg, MD, Jeff Petley, MD, Randall Olson, MD

J Cataract Refract Surg (May) 2016;42. Article in press

Purpose: To optimize phacoemulsification efficiency by varying the intraocular pressure (IOP), using the Centurion Vision System.

Setting: John A. Moran Eye Center Laboratories, University of Utah, Salt Lake City.

Design: In vitro laboratory study.

Methods: Porcine lenses were soaked in formalin and divided into 2 mm cubes. 0.9 mm, balanced tips were used. Intraocular pressure levels were tested from 30 to 110 mm Hg at 10 mm Hg intervals. Vacuum was set to 500 mm Hg, aspiration to 35 mL/min, and torsional power to 60%. Efficiency (time to lens removal) and chatter (number of lens fragment repulsions from the tip) were measured.

Results: Results of the trials showed a linear relationship between efficiency and IOP. Increasing IOP led to an increase in efficiency (i.e., to a decrease in time necessary to remove the lens fragment; R²=0.5769, P=0.0176). Chatter correlated with IOP in the range of 30-50 mm Hg (R²=0.4506, P=0.0448) and was minimal at higher IOPs.

Conclusions: Increasing IOP in the Centurion system improved efficiency. Chatter was also decreased or eliminated with increasing IOP. Additional studies will be required to understand the reasons for these findings.

Background

As UCLA residents, we have the privilege of operating at 4 separate hospitals, each of them with a different phacoemulsification platform. Understanding the various phaco settings and occlusion surge minimizing features of each platform helps us maintain safety and efficiency as we rotate through our multiple hospitals. Currently, the Centurion system (Alcon, Fort Worth, Texas) is being used at 2 of our hospitals. Unlike other phaco systems that use gravity-based fluidics, the Centurion system incorporates Active Fluidics technology, which adjusts the IOP by applying pressure to an irrigation bag housed inside the machine. The bag is connected to a balanced dual-segment peristaltic pump, allowing constant monitoring and controlling of IOP.

As residents, our utmost priority in learning cataract surgery is to maintain patient safety and to ensure good outcomes. Minimizing IOP fluctuations has been shown to reduce post-occlusion surge, which in turn provides for a safer operation.1 Minimizing IOP fluctuations may also have the benefit of not only reducing post-occlusion surge, but also increasing efficiency (time to lens removal). In a previous laboratory study, Dr. Olson’s group examined efficiency and chatter and its relationship to vacuum and flow rate and found a stronger correlation with flow rate than vacuum.2 In this study, Jensen and colleagues looked at the impact of set intraocular pressure settings with Active Fluidics (vacuum, flow rate and power) on efficiency and chatter.

Study summary

The study was done on porcine lenses that were prepared in a similar fashion to previous published studies.3 The Centurion system was used with a balanced phaco tip with vacuum at 500 mm Hg, aspiration at 35 mL/min, and torsional power at 60%. IOP was tested at 10 mm Hg intervals from 30-110 mm Hg. A lens cube was brought to the phaco tip using vacuum, and then the phaco pedal was fully depressed while an observer recorded efficiency only when the lens was in contact with the phaco tip. The number of chatter events was also recorded. Twenty lens cubes were tested at each interval. After the means and standard deviations were calculated for the trials, outliers (more than 2 standard deviations [SDs] from the mean) were removed, and new means and SDs were calculated. Linear regression was used to compare the times for the different groups tested. The authors found a linear relationship between efficiency and IOP among the 9 trials. In other words, increasing the IOP led to increased efficiency, and increasing the IOP led to increased chatter up to an IOP of 50 mm Hg, above which chatter was almost non-existent.

Comments

Dr. Olson’s group has previously published on the validation of the porcine lens preparation used in this study.3 They found that after their rigorous preparation technique, there was a statistically insignificant difference compared to human lens nuclei in regard to efficiency and chatter. While the authors of this study report that they prepared the porcine lenses similarly to the previous methods, it would be impossible to maintain consistent lens quality, introducing a confounding factor. However, as the authors suggest, it would also be very difficult to create a clinical setting where testing could be limited to 1 variable only. This study provides a unique laboratory method to objectively test various fluidic variables.

The density of the human cataract provides its own variable during surgery, which often leads to surgeons adjusting their settings appropriately. The original study on the porcine model used here described that these porcine lenses were similar to a dense human cataract; in fact, the human lenses being tested were obtained via extracapsular lens extraction cases—a procedure, in current times, reserved for the densest of cataracts. For these denser lenses, many surgeons may add longitudinal power that could contribute to more chatter, even at higher IOP settings. Also, the technique of nucleus disassembly can be very different among surgeons, which may make more of a difference than variations in settings or even require different settings for maximum efficiency. Further studies on different cataract gradations, disassembly methods, and varying power settings would be more informative and applicable to clinical practice.

Another variable not discussed in this in-vitro study is other forms of outflow other than aspiration flow rate, such as wound leaks. In gravity-based systems, the surgeon may increase the bottle height to compensate for the fluid egress and maintain the chamber, but this would in turn cause increased turbulence in the anterior chamber. Maintaining a set IOP with the Active Fluidics system prevents fluctuations in the anterior chamber and decreases turbulence, which can enhance followability.

How will this study be used in clinical practice? Even if the assumptions were made that the laboratory settings translated perfectly to the operating room surgical setting, it is

continued on page 72
unclear to what degree this would influence our phaco setting choices. This study demonstrated increased efficiency at higher IOP settings, but in our experience, we adjust the IOP more due to intraoperative safety and comfort issues rather than efficiency issues. Most of our cases, as with the rest of the community, are done under topical anesthesia, and many of our patients would feel some discomfort at IOPs of 80–110 mm Hg. Operating at our affiliate facilities where many of our patients have poor access to care and as a result present with very advanced diseases, we are often operating on advanced glaucoma patients where such high IOPs can be dangerous. Finally, this setting was introduced to “maintain the anterior chamber,” and as such, we are often adjusting the IOP in coordination with the size of our anterior chamber—for example, lowering it for highly myopic patients. From our experience, the IOP is likely the last setting to be changed to achieve efficiency or decrease chatter.

On the other hand, it is possible that in a patient with no history of glaucoma and relatively uncomplicated cataracts, increasing the IOP could improve clinical outcomes. If this laboratory finding did in fact translate clinically, increasing the IOP could potentially reduce the amount of phaco energy needed in a case, and thus decrease the likelihood and amount of postoperative corneal edema and endothelial compromise. Additionally, reducing chatter by increasing the IOP could help the surgeon maintain control, which may be important for novice resident surgeons and also be beneficial for patient safety. Thus, in patients who have otherwise normal baseline IOPs and no other concerning comorbidities, increasing the IOP may have some potential clinical benefits.

While Active Fluidics was introduced with the Centurion as a means to further minimize post-occlusion surge, this study suggests that by increasing the IOP, efficiency can also be enhanced. Rotating from 1 hospital to the next, we as residents often use the settings of our attendings or residents that precede us. With the number of phacoemulsification systems and their respective increase in options in controlling fluidic parameters, it becomes more difficult to learn how to personalize our settings. Objective studies such as this one are important and helpful for a novice surgeon to understand the newest technology that contributes to fluidics in order to better optimize our settings.

References

Contact information
Devgan: devgan@ucla.edu