

Dimensional and Flow Properties of the EX-PRESS Glaucoma Drainage Device

We read with interest the article by Sheybani et al.¹ demonstrating the assessment of fluid dynamics and flow control between the XEN 45 microfistula implant (AqueSys, Aliso Viejo, CA, USA), EX-PRESS implant (Alcon Laboratories, Inc., Fort Worth, TX, USA), and silicone tubing from a Baerveldt implant (Abbott Medical Optics, Abbott Park, IL, USA). The authors demonstrated that the Hagen-Poiseuille equation can be used to calculate the required dimensions of a tube that would prevent hypotony at average aqueous humour production and that the EX-PRESS device, when placed without a sclera flap, results in hypotony.

The article describes the EX-PRESS device to have an opening of 200 µm in inner diameter that tapers to a 50-µm inner lumen. Our group has previously reported our evaluation of the EX-PRESS device.² Two device models are available, the P50 and P200, with advertised 50- and 200-µm luminal internal diameters (ID), respectively. Esterman et al.³ previously reported that the resistance to the flow with the EX-PRESS device would decrease by 256 times if the luminal diameter were increased by 4 times, as expected from the Hagen-Poiseuille equation. However, they only observed a resistance value obtained with the P200 device in the order of 6 to 7 times lower than the P50 device, a finding we previously corroborated in our own study.²

The reduction in resistance with increased lumen ID cannot be explained with the Hagen-Poiseuille equation on the basis of the lumen ID criteria alone. On scanning electron microscopy, we observed that the internal diameters of the lumen of the P50 and P200 were in the region of 200 µm at the subconjunctival space and anterior chamber end. We confirmed with Alcon, Inc. that the P50 differs from the P200 only in having a 150-µm diameter bar lying across its lumen in the middle of the device. The P50 and P200 devices also have a side orifice at the anterior chamber end of their bodies, which means they do not have a constant circular cross section. This, together with the presence of the bar lying across the lumen of the P50 device, means that Poiseuille's Law is not applicable.

Sheybani et al.¹ also state that the EX-PRESS does not provide significant outflow resistance. We too observed that there were minimal differences in pressures between the EX-PRESS device and a typical trabeculectomy. However, we observed that device implantation resulted in less variability in pressure readings. This may be due to more consistent lumen sizes with small tolerances, compared to making a sclerostomy with a punching device or knife. We also observed that more manipulation was required subjectively with a smaller 27-gauge (G) versus 25-G needle stab on device insertion. This may result in a poorer fit around the body of the device, resulting in leakage.

We agree with Sheybani et al.¹ that use of the EX-PRESS device without a scleral flap carries significant risk of hypotony and has similar equilibrium pressures as the trabeculectomy procedure. We would highlight that the effective luminal diameter of the P50 is much larger than 50 µm and that intraoperative surgical technique may reduce tissue manipulation and, therefore, reduce postoperative pressure fluctuations.

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