Glaucoma Surgery in Children - Choices and Considerations

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Page 2

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[Editor's note: also see our webpage www.pgcfa.org to view previous newsletter issues that contain articles about different forms of glaucoma surgery]

What types of glaucoma surgery are there?

There are several types of glaucoma surgery, which all share the common goal of trying to reduce the eye pressure to help prevent damage to the structures of the eye and vision from the glaucoma. To help remember them better, they can be categorised as

1. Angle surgery - this type of surgery helps to open the eye's own drainage system (also called the "angle" or the "trabecular meshwork") so that the fluid of the eye (the aqueous humor) can get from the inside to the outside of the eye through the natural drainage route);
2. Filtration or Drainage surgery - this type of surgery helps the aqueous humor within the front part of the eye to get out through new passageways, but does not use the eye's own drainage system;
3. Cycloablation or Cyclodestruction surgery - this type of surgery works to decrease the amount of aqueous humor that the eye makes, by treating the part of the eye (the ciliary processes) which make the fluid.

It is very important to understand that the best surgery for one child's eye at any given time, may be very different from the best surgery for another child's eye, or even the same child's eye at a later time. The choice of surgery is influenced by the type and severity of the glaucoma, any prior surgeries which the eye has had and how they worked, the age of the child, the personal experience and expertise of the surgeon, and sometimes also by how healthy the child is and how easily the child can be followed up by the surgeon or another pediatric eye specialist.

Angle Surgery: for which cases does it work, and how well?

Both goniotomy and trabeculotomy are surgeries designed to open the existing drainage structures. These surgeries are most successful in children with congenital or infantile glaucoma (glaucoma presenting very

as a result of uveitis (inflammation in the front part of the eye) in association with juvenile rheumatoid arthritis, and sometimes in other forms of glaucoma as well. There are surgeons who have reported excellent success using goniotomy surgery also to help prevent glaucoma associated with aniridia in very selected patients, and some surgeons also favor goniotomy as their initial surgery in juvenile open angle glaucoma (but this is not universal).

The success of angle surgery to control glaucoma depends upon the type and severity and age of onset of the glaucoma: success rates as high as 80% or even higher have been reported for infantile glaucoma presenting between the ages of 3 and 9- 12 months, although conservative estimates probably would place the likelihood of successful control of glaucoma (with or without the additional use of medications) at about 70%. As a treatment for glaucoma in the setting of uveitis (iritis) with or without juvenile arthritis, success of goniotomy is about 60 - 75%, again often requiring medications to continue. Often more than one goniotomy or trabeculotomy is needed to control glaucoma, since these surgeries (except one specific modification of trabeculotomy) usually open only a portion (rather than the entire circumference) of the drainage system each time.

Filtration surgery: for which cases does it work and how does the surgeon choose which type of filtration surgery?

Filtration surgery comes in two basic types: trabeculectomy (and modifications) and glaucoma tube implant surgery. In trabeculectomy, the surgeon creates an opening in the outer coating of the white of the eye (the sclera), just near the limbus (the place where the clear cornea meets the white sclera), usually in the upper portion of the eye which is normally covered by the eyelid. The aqueous fluid then flows through this hole to form a small raised area (the bleb) under the outer overlying covering of the eye (the conjunctiva). Sometimes the surgeon modifies this surgery to include the use of medications to help prevent scarring, such as mitomycin c, and 5-fluorouracil. This surgery can work very well to reduce eye pressure. The two major problems with trabeculectomy surgery include thickening or scarring of the bleb area over time so that the fluid can no longer drain and eye pressure rises again, and the possibility that the bleb tissue might get very thin over time and leak or become infected. If leakage of the bleb persists, and especially if infection occurs, there is a serious risk of damage to the structures of the eye if the problem is not quickly treated. This risk is especially high when mitomycin is used. The bleb may need to be revised or removed if serious infection or persistent leakage occurs, sometimes requiring a different glaucoma procedure to control the eye pressure thereafter.

Trabeculectomy is probably most suited to treat children who are slightly older, because these children seem to have fewer tendencies to scar or thicken their bleb sites, and also seem to be more reliable for examination to detect leaking or infection. Conversely, very young infants and those who have had cataract removal early in life, may be more at risk for scarring or infections and failure of this type of

ranging up to 75% or higher, depending upon the specific published report. The success rate does decline slowly over time, as cases of bleb scarring and infection can continue to occur years after trabeculectomy. This type of surgery can be repeated, and can also be followed by Glaucoma Implant Surgery and/or Cycloablation Surgery (see below). There are also surgeons who prefer to combine trabeculectomy with trabeculotomy for difficult cases of congenital/infantile glaucoma, with some favourable reported success rates in these children.

Glaucoma Implant Surgery was discussed in detail in the Winter 2002 MORINformation newsletter. A glaucoma implant is a tiny tube connected to a round or oval plate (also called the reservoir), which can be used to direct the aqueous humor within the front part of the eye to a space just outside the eye. The fluid drains to the reservoir, which is usually attached to the sclera where the upper eyelid covers it, and under the outer conjunctival layer of the eye. Different types of implants are made with reservoirs of different sizes and shapes, and some also have a "valve", a small flow-regulator, separating the tube from the reservoir plate.

Glaucoma implant surgery is usually reserved for cases of glaucoma that have already been treated with medications and often, in the case of congenital glaucoma, with angle surgery (such as goniotomy or trabeculotomy). Many surgeons prefer to use a glaucoma implant if trabeculectomy surgery (above) has failed to control the glaucoma or before trabeculectomy especially in cases where trabeculectomy is likely to fail (e.g. iritis). Glaucoma implant surgery is also useful for treating glaucoma in eyes that have already had cataracts removed, because these cases sometimes don't do as well with trabeculectomy surgery. Glaucoma implant surgery is sometimes preferred over trabeculectomy in infants, because trabeculectomy has a reduced success rate in infants compared to older children, due to the high rate of bleb scarring that often occurs.

The published success rates of various glaucoma implants used in pediatric cases vary widely, from as low as 50 % to as high as about 90 % over time. It is reasonable to expect about a 60 – 70 % chance that the implant surgery will control the intraocular pressure in an eye, but to realize that additional glaucoma mediations (usually eye drops) will be needed in at least 50 % of eyes that receive a glaucoma implant. The long-term success rate is probably lower in very small children, due to their propensity to form thicker capsules over the implant reservoir, which allows the eye pressure to increase over time. In small children, there is also a substantial risk of needing to do another surgery related to the glaucoma implant, such as repositioning of the tube over time.

Comparing trabeculectomy with glaucoma implant surgery is a little bit like comparing apples and oranges, but we will try anyway! Pros and cons of trabeculectomy include a better chance of getting the eye pressure low enough to not need additional medications, with the disadvantage that this surgery carries a life-long risk of leak and infection, is contraindicated in some surgeons opinions in eyes wearing

scarring. Pros and cons of glaucoma implant surgery include a lower risk of infection over time, and probably an increased success rate vs. trabeculectomy in selected cases such as infants and eyes after cataract removal; with the relative disadvantage of a generally higher eye pressure than after successful trabeculectomy, often requiring continued use of glaucoma medications.

Cycloablation or Cyclodestruction: When should it be considered?

There are three basic ways in which the ciliary processes of the eye can be treated to try to decrease the amount of aqueous humor fluid that the eye makes: 1) cyclocryotherapy; 2) transscleral laser cycloablation; and 3) endoscopic laser cycloablation. These three treatments are usually reserved for use in eyes that either have elevated eye pressure after attempted filtration surgery, or those in which filtration surgery is not possible or advisable due to the shape or other features of the eye. Some surgeons do select endoscopic laser cycloablation as the first surgical choice in children who have had cataracts removed, and in whom the eye pressure is too high despite the use of glaucoma medications.

In cyclocryotherapy, a very cold probe is placed onto the outside of the eye, which, through the sclera and eye, freezes the tissues down into the level of the ciliary processes. This treatment is performed especially in eyes where the anatomy makes it difficult to perform other forms of cycloablation. It causes more inflammation in the eye and is more uncomfortable than the other two types of cycloablation. Transscleral laser cycloablation uses a laser (usually a diode or YAG type of laser) to direct energy directly through the outer sclera of the eye, to reach and destroy portions of the ciliary processes, without causing damage to the overlying tissues. Transscleral laser cycloablation causes less inflammation that cyclocryotherapy, but shares the disadvantage of being unable to always treat the ciliary processes adequately, because the treatment is placed from the outside of the eye without visualizing the target tissue to be treated. Finally, endoscopic diode laser can be used to treat the ciliary processes under direct visualization (see MORINformation January 1999), and may be more effective and with less inflammation than the other two techniques. All cycloablation techniques sometimes require multiple retreatments, and have an overall effectiveness of not more than 50 %. The major risks of the procedures include phthisis (letting the eye pressure go too low from loss of fluid production by the eye), which is rare(especially with the laser techniques), blurred vision from possible edema or swelling in the retina, and rise in eye pressure over time after the treatments, requiring either additional treatment, or another glaucoma surgery to be used. These procedures can be used after almost any other glaucoma procedure described above, and are often reserved to use after other treatments have failed or only partly reduced the eye pressure.

Conclusions

The decision regarding which glaucoma surgery is best for any given child's eye, should be made by the family and the specific surgeon taking care of the child. It is important to know that there may not be just one "right" surgery for a given eye. There are risks and benefits to each type of glaucoma surgery, and it

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