Arch. Soc. Amer. Oftal. Optom. (1981)-15-83

INTRAOCULAR CUTTERS AND ANTERIOR SEGMENT SURGERY

Dr. FRANK W. NEWELL
EE. UU.

In the past 15 years, 2 major surgical techniques have evolved:

1. The traditional limbal incision that may be much smaller than that used earlier, and,

2. The closed surgical techniques in which the intraocular pressure is maintained by infussion and intraocular fragments are removed by suction. The incision may be at the corneal scleral limbus using a conjunction flap, through the peripheral corneal within the corneal scleral limbus, or through the pars plana. The infussion-suction may be combined with a variety of cutters and different types of intraocular lights, mainly using fibre-optics. Additional one may use hooks for stripping membranes and bipolar cautery for closing bload vessels. Intraocular photocoagulation is possible. All of these new instruments permits surgery that was not previously possible. Parenthetically too, there may be complications that were not seen previously. When all goes well however, patients are delighted in having a short post-operative course with early return of function.

Elshnig in 1911 first replaced vitreous with saline. Dor, the same year, used vitreous of other animal species. Subsequently a variety of substances were used: spinal fluid, cadaver vitreous, sodium hyaluronate, and other transparent fluids. Machemer and his cooworkers showed initially that vitreous was best cut from the eye and that simultaneous infussion-suction at a balanced salt solution led to best results. Earlier Kelman demonstrated an ultra sound cutter combined with simultaneous infussion-suction that permitted extracapsular cataract extraction through a small incision.

Not an entirely closed incision but one that is close to it.

I thought it would be of interest to compare the physical charateristics, the advantages and disadvantages and the usefulness of various units used in ophthalmology.

All units share a number of features in common. There is an infussion-suction system. This may be either combined with the cutting system or separate. Generally suction must be combined with the cutter so as to bring material into position for cutting. The suction may be assistant controlled or operator controlled. It may be combined with a method of flushing out particles if it becomes blocked.

There are three basic types of cutting instruments.

a) Ultrasound, b) mechanical: The mechanical may be chopping or rotary, vertical or longitudinal. Rotary cutters are dangerous within the eye for they may not cut and still remove much tissue such as the iris. Please note that the ultrasound fragmenter will not cut membranes - this is a major disadvantage and necessitates the elaborate removal of anterior capsule that we have seen and the discission or removal of the posterior capsule when this is opaque. The carbon dioxide laser is an exciting future possibility. Tissue will be instantly and painlessly carbonized and removed from the eye. The unit is still in the developmental stage and there are major technical problems to be solved.

The cutting may be at the side or at the end. If at the end, may be chopping or scissors. Ultrasound of course must be at the end.

Now I wish to compare various units that are available. I have limited my discussion to units currently in use at the University of Chicago. I have excluded the disposible units of Kaufman and others, and units that we have evaluated and discarded for various technical reasons that include difficulty of maintenance and unreliability. The factors we have considered are illustrated: probe motive power; size of probe; probe aperture size; probe aperture location; size and weight of hand piece; method of infussion; method of suction; light sources; uses.

The prototype unit was the phaco emulsifier. As indicated by Dr. Katzin yesterday, this has increasingly limited use and its large size limits its usefulness. The phaco emulsifier of Sparta (Girard) is an ultrasound unit that delivers 40 thousand Herz with a ceramic transducer with power levels of 2.5 to 15 watts. Probe 18-21 gauge needles. Infussion separate.

(Separate infussion can be useful in maneuvering particles into the cutter). Suction is assistant controlled. Light source is external. By far the heaviest of the units used.

Handle weighs 150 grams.

Two different needle sizes: 18 gauge and 21 gauge.

The assistant controls the suction.

SITE is an acronym for suction-infussion tissue extractor. The motor is contained in the handle and is water sensitive. It, therefore, must be gas sterilized. There are 2 probes: one 1.5 mm in diameter with a 0.5 mm aperture and one 2.1 mm in diameter with a 0.8 mm apperture. A coaxial light pipe is 2.2 mm, in diameter. The handpiece weighs 105 grams. Infussion is coaxial and suction is operator controlled.

THE CONTROL PANEL

The unit is battery operated providing a significant safety factor.

The exploded view of the unassembled unit shows the hand piece; the motor; the suction infussion assembly and the cutter.

The suction-infussion assembly surrounds the cutter that has a 45 degree side aperture that measures either 0.5 or 0.8 mm, in size.

Douvas is a Michigan USA surgeon who provided one of the earliest intraocular cutters, called a roto-extractor. The motor is contained in the handle and is water sensitive. Three probes are provided, one with a 0.4 mm aperture, one with a 0.6 mm side aperture, and one with a trephine end aperture. Infussion is coaxial. Suction is assistant controlled. A coaxial light is available.

In respect to corneal damage the ultrasound is by far the most dangerous with the high frequency sound waves transmitted to the cornea. The various mechanical cutters are dangerous; only if applied directly to the cornea. Conversely the cutters can cut holes in the iris, ciliary body and retina. Ultra sound is of course never used in the vitreous cavity. Some mention should be made of the infussion fluid. In various films we have observed constriction of the pupil as the procedure progresses. If 1 ml 1:1000 epinephrine is added to 500 ml of saline there is no pupillary constriction. The epinephrine however must not contain a preservative and for this reason we use epinephrial prepared for intracardiac injection.

Contamination is a theoretic possibility. In all units with coaxial infussion the fluid is separated from the contaminated motor only by plastic or rubber seals. Theoretically, bacterial matter could be introduced in the eye. For this reason we use gas sterilization frenquently even though it requires 30 hours.

The Douvas unit sheds particles of metal in the eye but these seem to be entirely non-reactive.

Ath the University of Chicago, we prefer the Douvas unit for evacuation of hyphema. The ocutome seems most efficient for soft cataracts and the ultra sound for hard neclei. The ocutome is used most commonly in the vitreous. Any cutter of course may be used for membranes.

The future seems clear. The instruments are simple to construct and any surgeon may construct a suction-infussion device with minimal equipment. There seems likely to be increased reliance on cutters. And cutters will diminish in size. New methods of cutting will evolve particularly using laser energy. The future appears bright and our patients will benefit.