Manual Sutureless Cataract Surgery (MSICS) - a necessity in a cataract surgeon’s armamentarium

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Course Overview

Phacoemulsification is the surgical procedure of choice for cataract management; however MSICS is a good alternative with a flatter learning curve and comparable results. It is economical and is a procedure of choice in large volume centers, as a bail out option in difficult cataract situations. It is safe as it is a closed globe procedure unlike conventional ECCE. Excellent outcomes can be consistently delivered in all situations. This course aims at highlighting the finer nuances of the various steps of this procedure. This is a video based course and the handout will only discuss in brief the principles.

Review of literature

The overall safety profile of MSICS was found to be excellent with intra and postoperative complication rates comparable to phacoemulsification and ECCE. Multiple studies reported the safety and efficacy of MSICS for complicated cases, such as brunescent and white cataract and cataracts associated with phacolytic and phacomorphic glaucoma. Compared to phacoemulsification MSICS was associated with lower and shorter operative times.

* Venkatesh et al randomized 270 consecutive patients with white cataracts to phaco and MSICS and found that uncorrected visual acuity of 6/18 or better was achieved in 87.6% of eyes in the phaco group and 82% of eyes in the MSICS group by 6 weeks postoperatively. The corresponding best corrected visual acuity of 6/18 or better was achieved in 99% from the phaco group and 98.2% from the MSICS group by 6 weeks postoperatively.

* At 6 weeks postoperatively, Gogate et al reported mean astigmatism of 1.1 D for phaco and 1.2 D for MSICS, which was not statistically significant.

* Postoperative endothelial cell loss was reported by George et al to be slightly higher with phaco (5.41%) compared with MSICS (4.21%), but the difference was not statistically significant.

* The cost per case of providing phaco ranges from $25.55 to $70, compared with $15 to $17 for MSICS

ANESTHESIA

Most MSICS are done under peribulbar anesthesia, though surgery under parabulbar and even topical anesthesia is possible in experienced hands. In difficult situations good anesthesia with akinesia is important.
INCISION
Wound construction is one of the most important steps of MSICS. Its size and architecture decides the ease of nucleus delivery, its self-sealing efficacy and induced astigmatism.
A wound with its length and breadth equal (square wound) is ideal though rarely possible, in most circumstances the length is smaller than the width.
The wound has 2 incisions – the external scleral incision and the inner corneal incision.
The external incision can be a straight one, frown shaped, Chevron (inverted V) or a straight with 2 side cuts, the most commonly practiced one is the straight one.

Prerequisites for a good external incision
- Fornix based conjunctival flap – good exposure
- Taut globe – normotensive or hypertensive either by anterior chamber (AC)maintainer or viscoelastic through a side port stab incision
- Good hemostasis – Light wet field cautery, avoid deep or heavy cautery to prevent tissue shrinkage
- Dry surface
- The external incision can be made with a guarded diamond knife or a blade knife or a Bard-Parker blade no.11 /15.
- The tunnel is constructed with a bevel up angled metal or diamond crescent.

Creating the groove
The initial groove should be about half thickness of the sclera.
At the bottom of this groove, dissection is extended anteriorly till it reaches the limbus,
Then, the direction of the crescent is modified to remain along the dome of the cornea
Dissect into 1.5- 2 mm of clear cornea.

The dissection is now carried laterally with sideways sweeping movements of the crescent on either side with great care so as to remain in the plane of dissection. Conscious effort is made to tilt the knife along the contour of the cornea to maintain uniformity of the tunnel roof and avoid buttonholing laterally. (Fig.1a and 1b)
Towards the lateral edge of the tunnel, the knife is swept sideways 45° - 60°, resulting in a funnel shaped tunnel. While the knife is at the lateral edge of the wound, dissection must be
carried obliquely backwards. This creates a lateral pocket on both sides. These pockets serve to accommodate the bulk of the nucleus during its exit.

It is of utmost importance to have good sharp instruments so that the proper plane of dissection is maintained and wound architecture is not destroyed.

Note – Do not hold the anterior lip while creating the groove, it is best to make a small cut in the sclera near the incision and grip that with a toothed forceps to stabilize the globe.

Fixing The Anterior Chamber Maintainer (ACM) – an Optional procedure

Blumenthal and Moisseiev first described the use of an anterior chamber maintainer (ACM) in ECCE along with a reduction in incision size. A lance tip or MVR 20G knife is used to make the side port entry and the ACM bevel incision. Fix the ACM maintainer at this stage as AC is still deep with viscoelastic. MVR entry is made at 6 ‘o clock parallel to limbus, away from the vascular arcade of cornea. The ACM maintainer, a hollow steel tube with 0.9 mm outer and 0.65 mm inner diameter is entered with bevel up and then turned 180 degrees so that the bevel faces the iris. The ACM maintainer is always inserted from the temporal side. The tube of ACM maintainer is attached to BSS/Ringer’s lactate bottle and suspended 60-70 cm above the patient’s eye.

The internal incision

A sharp angled 3.2 mm keratome is used. A slight side to side movement of the blade prevents premature perforation. At the anterior end of the tunnel, it is tilted downwards to create a dimple and enter the anterior chamber.

The internal incision is enlarged by forward and lateral movements of the sharp keratome with viscoelastic in the AC or with the ACM on. The keratome should not be used to cut tissue while withdrawing (laterally and backwards) as opposed to the crescent.

CAPSULAR OPENING

Three types of capsular openings are commonly used – continuous curvilinear capsulorrhexis (CCC), the most ideal as it allows in the bag lens placement, can opener capsulotomy and the envelope capsulotomy.

Capsulorrhexis - should be of a fairly large size (6-6.5 mm) to allow the nucleus to prolapse into the AC.
The CCC should be converted to a can opener capsulotomy if the surgeon feels that the opening may pose a problem to smooth nucleus prolapse.

**Note – CCC is not mandatory to perform a good MSICS**

**HYDROPROCEDURES**

Aim - to separate various layers of the cataractous lens – nucleus, epinucleus and cortex from the capsule.

This facilitates free rotation of the nucleus in the bag and its prolapse into the anterior chamber.

Hydroprocedures are carried out with a 2 cc syringe.

The smaller syringe gives more control over the amount and rate of fluid injected. The cannula may be 27 - 30 G in size, suitably angled and must have a smooth rounded, preferably flattened tip.

**Hydrodissection**

It involves tenting up of the anterior capsule slightly with the cannula and injecting a small amount of fluid with a small but definite force.

Before the hydrodissection, some viscoelastic, which had been introduced earlier for capsulorrhexis, is released, by slight pressure on the posterior lip of the incision. This prevents a sudden rise in pressure on injecting the fluid.

The cannula is introduced preferably from the main incision, except in the technique described by Dr. Blumenthal where it is done through the side port. The tip is guided about 1 mm behind the rhexis margin in the sub-capsular plane and a small amount of fluid injected with a minimal force to produce a fluid wave after slightly tenting the capsule.

The fluid wave is seen to transverse the whole lens as it separates the cortex from the posterior capsule.(Fig.4) In dense cataractous nuclei a slight anterior movement of the nucleus is seen. Fluid injected slowly and smoothly does not produce a wave and returns to the AC. Visual confirmation of the wave and a slight shallowing of the AC indicate the dissection. A gentle tap on the nucleus completes the hydrodissection and deepens the AC. Often the pole opposite to the point of fluid injection rises and if the CCC is adequately large it may partly prolapse out of the bag (Fig.5)

The nucleus is gently rotated with the cannula both clockwise and anti-clockwise. Free rotation signifies successful hydrodissection. **When an intact rhexis is not available, this procedure must be done with great care with minimal amount of fluid to avoid undue forces on the capsulotomy margins and produce extension of a tear.**

**Fig.4**

Hydrodissection

**Fig.5**

Pole prolapses out of the bag following Hydrodissection
NUCLEUS MANAGEMENT

Once the nucleus has been freed and minified in the capsular bag, subsequent maneuvers are undertaken to deliver it out of the eye safely.
This involves 2 important steps –

- **Delivery of the nucleus into the anterior chamber**

  First, the equator of the nucleus is prolapsed out of the capsular bag, and then the whole nucleus is delivered into the anterior chamber. The hydro cannula can be carefully maneuvered under the rhexis margin to go underneath the edge of the nucleus while injecting fluid to dislodge the equator out of the bag.

  In cases where the nucleus is not partially out of the bag, two Sinskey hooks are introduced and the nucleus rotated to confirm successful hydroprocedures. During this bimanual rotation, uneven pressure applied to one hook will cause the nucleus to tilt and gradually dislocate into the AC. Rotate the nucleus if necessary to bring the tip of the tilt up towards the wound (12 o’clock).

  Once the equatorial edge of the nucleus is out of the bag, the whole nucleus is gradually rotated into the AC by *cartwheeling* in a clockwise or anticlockwise fashion.

  When an AC maintainer is not being used, this should be done after injecting viscoelastic both below the prolapsed pole of the nucleus and some amount above it.

  The nucleus floats in a ‘sea of viscoelastic’. Two Sinskey hooks are used for ease. One of these is placed on the lens equator or just under the prolapsed tip of the nucleus and the other is used to rotate the nucleus out of the bag.

  Alternate support with one and rotation with the other hook –‘walking on the equator’ - will lead to the nucleus rotating into the AC. The procedure is similar to a tyre tube being removed.

  With experience only one instrument is required. If a small pupil hinders the above procedure, a different method involving ‘*somersaulting*’ or ‘*tumbling*’ the nucleus end over end may be employed to get the nucleus into the AC.

  Many surgeons prefer to reduce the size of the nucleus further before taking it out, in an attempt to keep the incision size the smallest possible. This involves dividing the nucleus into smaller parts using one of the various instruments available for the purpose today. All these procedures are visco-dependent and demand a high degree of skill.

- **Delivery of the nucleus out of the anterior chamber**

  The entire nucleus must be in the anterior chamber above the iris plane before attempting this procedure. Adequate viscoelastic must be placed below and above the nucleus.

  Most commonly - a *wire Vectis with or without irrigating holes is used for delivering the nucleus out of the anterior chamber*

  Using a *plain wire vectis or an irrigating vectis* - utilizes mechanical and/or hydrostatic force to deliver the nucleus. The irrigating vectis is connected to a syringe filled with BSS or viscoelastic. This is carefully *introduced behind the nucleus and after visually confirming that*
its margins do not engage the iris, it is withdrawn slowly till the superior pole of the nucleus is engaged in the wound. BSS or viscoelastic is not injected till this stage. A counter pressure may be applied by holding the globe or by pulling the superior rectus bridle suture and irrigating fluid is injected to build up pressure. The vectis is now pulled out while injecting and pressing down on the posterior lip of the wound. As the maximal diameter of the nucleus clears the wound, irrigation must be reduced to prevent sudden forceful expression and sudden shallowing of the AC. In dense nuclei a sinskey’s hook may be used with the vectis. The hook is introduced in the AC above the nucleus. The nucleus is sandwiched between the Vectis and the hook and delivered out with similar mechanical pressure as discussed above.

**Bluementhal technique**
Free nucleus in deep AC is ready now to be propelled out of AC by hydropressure generated by ACM. The principle of this technique is to
1. Engage the nucleus into sclera-corneal pocket tunnel with the help of lens glide or McPherson forceps
2. Push the nucleus out by hydropressure.

For engaging the nucleus into the sclerocorneal pocket tunnel a lens glide is passed behind the nucleus 1/3rd or half nucleus width distance in a viscoelastic filled deep AC. The ACM is opened and slight pressure is applied on lens glide on scleral side. Intermittent pressure will engage more and more nucleus bulk into the tunnel. Built up hydropressure will push the nucleus out of tunnel mouth. Subsequently, few more intermittent taps will enable the epinucleus and cortex to flow out of the AC. Lens glide is then pulled out. If lens glide is not available then a thin iris repositor can perform the function of lens glide.

**Other techniques**
Other techniques described in literature involve dividing the nucleus in the AC before delivering it out, this involves using a wire snare or nucleotome to “slice” the nucleus in a visco filled chamber, the fragmented nuclei is then brought out in pieces. This requires more intraocular manipulation and must be done with caution.

**EPINUCLEAR AND CORTICAL REMOVAL**
Epinucleus remaining after the nuclear removal can either be expressed with the same techniques used for nucleus expression (hydro, visco-expression) or it may be aspirated with manual or automated aspiration. The epinucleus in the AC is removed by stroking the scleral lip while the AC maintainer is on. When the visco technique is used, the cannula is taken behind the epinucleus into the bag and viscoelastic is injected with simultaneous pressure on the posterior lip of the wound.
In Bluementhal technique, a single port cannula attached to 5 cc syringe is used to aspirate cortical matter through the stab wound with functioning ACM.
WOUND CLOSURE

No suture is required to close the incision if the tunnel has been well fashioned. The integrity of the inner corneal lips is of paramount importance, all intraocular manipulation must be done without damaging the inner wound. The sideports are hydrosealed. Never attempt to hydroseal the main wound. The conjunctiva is apposed over the wound with a bipolar cautery or by simply drawing it over the wound.

If a suture is required, an infinity ‘∞’ suture can be applied. The first bite is taken from the inner lip of sclera to exit on the outer aspect on the left side. The next bite is taken on the right side of the wound from the corneal to the scleral side. The suture is again crossed over to the left side to take a bite from the corneal side to exit in the wound and the knot is tied in the section. The area is then covered by conjunctiva.

DIFFICULT SITUATIONS

Managing brunescent cataract
Good exposure of the surgical space
Large sclerocorneal tunnel with side pockets after correct estimation of nuclear size and grade
Inner lips should be at least 8 mm, outer lip can be smaller
Large 8mm capsulorrhexis, or can opener capsulotomy
Gentle hydrodissection and prolapse, liberal use of viscoelastics, gentle rotation of nucleus into the AC.
To avoid repeated pupillary margin or iris manipulation thereby maintaining pupillary dilatation.
Reconfirm the inner wound is of adequate opening to engage the nucleus before attempting the nucleus removal from the AC with vectis.
In very dense nuclei after nucleus engages at the inner lips a pie of the nucleus can be cut at the outer lip and the nucleus rotated to deliver the remaining.

Managing mature, intumuscent and hypermature cataract
Rule out lens induced glaucoma, if required IOP lowering medication to be given preoperatively
Ensure corneal clarity especially in phacomorphic glaucoma
Pupillary dilatation to be assessed, micro sphincterotomies may be required if pupillary dilatation is poor and nucleus is large
Liberal use of viscoelastics as anterior chamber may be shallow
These cataracts are associated with a lax capsular bag and or zonules hence hydroprocedures have to be gentle
Capsular staining, lens decompression especially in intumuscent cataract and getting an intact and adequate capsulorrhexis is vital, a 2 stage capsulorrhexis may be required to prevent peripheral run off.
Gentle Nuclear delivery with minimal manipulation especially in hypermature cataracts as the nucleus is small and tends to “tumble within the bag”
Managing the dense cataract in a poorly dilated eye

Ascertain the cause of poor dilatation especially if there is associated pseudoexfoliation. In this situation there may be an added issue of weak zonules hence manipulation must be gentle, definite and minimal. Senile miosis is the commonest cause. Good preoperative assessment is necessary and absence of pupillary ruff is a good sign that dilatation will be inadequate. Use cohesive viscoelastics, if still insufficient Kuglen hooks can be used to stretch the pupils or multiple microphincterotomies can be done. Iris hooks may also be used to dilate the pupils. Remaining steps would be the same, after the nucleus is brought to the AC, hooks may be removed and nucleus delivery out of the AC can be done as described above.

References