1) GENERAL PRINCIPLES

Lasers:

excimer: 193
Argon blue: 488
Argon green: 514 - standard for most laser surgery
Dye yellow: 560
Krypton red: 647
YAG: 1064
Holmium: 1900
CO2: 10000
dye: variable
Xenon: 400-1600

Retina pigment

Xanthophyll: absorbs blue in blue-green
Hemoglobin: absorbs blue, green and yellow; krypton red not absorbed
Melanin: absorbs all lasers
NB: krypton red is only absorbed by melanin

Krypton red is good for

1) juxtafgoveal SRNV
2) SRNV with thin layer of overlying heme (NB: Argon green over blood will be absorbed and cause an inner retinal burn)
3) VH
4) cataract
5) retinal heme

Krypton red can be used for

1) PRP (KARNS showed it to be equivalent)

Krypton red is bad for

1) vascular anomalies
2) pale fundi (not much melanin)

Retrobulbar

1) patients with pain
2) patients with significant eye movement
3) treatment near foveal center

Spot Magnification of retinal lenses

1) Goldman: 1
2) Panfunduscopic: 1.4
3) Volk Quadaspheric: 1.9

Pain on Laser Treatment - to treat:

1) decrease power
2) decrease time
3) increase spot
4) retrobulbar
5) don’t use krypton (red - deeper)

General Complications of laser

A) *Anterior segment*
1) elevated IOP
2) corneal burn
3) iris burns
4) cataract
5) IOL damage
6) internal ophthalmoplegia

B) *Posterior segment*
1) choroidal hemorrhage
2) subretinal hemorrhage
3) vitreous hemorrhage
4) retinal vessel damage
5) preretinal membranes
6) papillitis
7) burn scar enlargement
8) SRNV
9) foveal burn
10) subretinal fibrosis

C) *Other*
1) pain
2) vasovagal
3) seizures

Complications of PRP

A) *Early*
1) constricted VF
2) decreased night vision
3) macular burn
4) vitreous hemorrhage
5) NFB defect
6) decreased acuity
7) decreased contrast sensitivity
8) decreased color vision

B) *Next Day*
1) serous RD
2) choroidal effusion --> angle closure
3) worsened macular edema

C) *Late*
1) SRNV
2) epiretinal membrane

Complications of Macular Laser

1) accidental foveal burn
2) accidental optic nerve burn (mvt)
3) SRNV (late)
4) maculopapular bundle burn
5) vessel occlusion (rare)
6) vessel rupture (hemorrhage)

7) decreased acuity
8) VF scotoma

Compications of SRNV laser
1) RPE tear
2) choroidal ischemia

2) GLAUCOMA

A) iridotomy: PI - YAG and Argon

Technique:

Iridectomy Lenses:

Abraham lens (1973): modified Goldmann lens; has +66D plano convex button

Wise lens: has +103 D button

- location: midperiphery of constricted pupil (2/3 from pupil margin) between 10:30 and 1:30

Preop

1) apraclonidine drops

2)- miotic drops

a) Argon PI

- 50 micron spot size, 0.2 secs, 800 mW
- consider for patients on anti-coagulants (bleeds less)
- usually accomplished in 10 burns
- The easiest irides to penetrate with the argon laser are hazel and light brown.
- The hardest are light blue irides with minimal pigment, and very thick dark brown irides.

b) YAG PI

- 5 mJ shots; 1 pulse per shot

Post op

- measure IOP for 2 hours after treatment (>90% of spikes within 2 hours)
- PF QID x 1 week post laser
- pilo can be continued if on Pilo prelaser
- first postop exam:

i) gonio to evaluate angle and assess for PAS

ii) dilate to ensure plateau iris not present and to examine fundus

- followup for 6 weeks to evaluate patency

Indications for PI

1) acute ACG
2) occludable angle: positive provocative tests, narrow angle
3) phacomorphic glaucoma
4) aphakic
5) pseudophakic (ACIOL)
6) malignant glaucoma
7) silicone oil (6 o'clock)
8) plateau iris (does not work on all)
9) nonperforate surgical iridectomy
10) Fellow eye of a patient with acute angle-closure glaucoma
11) Chronic angle-closure glaucoma
12) Iris bombe from posterior synechiae
13) Prior to ALT to open the angle approach and facilitate treatment

PI complications

1) failure to perforate
2) acute rise in IOP
3) late closure

4) cornea, retinal burns
5) cataract
6) corectopia (especially argon)
7) post. synechia
8) hyphema
9) diplopia

B) pupilloplasty
1) for patients with miotic pupils on pilo
2) in acute ACG, if PI and iridoplasty are not possible due to cloudy cornea, this can break the attack by pulling the pupil away from the lens

C) trabeculoplasty
Indications
- patients with uncontrolled COAG on maximally tolerated medical therapy

Absolute Contraindications
1) juvenile glaucoma
2) glaucoma secondary to uveitis
3) angle recession.

Relative Contraindications
1) patients less than 45 years of age (a filtering procedure is a more appropriate initial choice)
2) If patients have significant compliance problems (filtering surgery is usually recommended)
3) IOPs above 40 mmHg (filtering surgery is usually recommended)

Technique
- Goldman lens or Ritch lens
- 50 µm, 0.1 second, 800 mW
- start with mirror at 12:00 and treat inferiorly (more pigmented, wider angle)
- treat 180 degrees
- treat anterior TM
- 50 burns per 180 degrees
- if the TM cannot be seen easily, the patient *moves his eye in the direction of the gonioscopic mirror* to open the angle and improve visibility.

Preop
1) miotic
2) apraclonidine
lenses:

Postop
1) check IOP for 2 hours
2) PF QID for 5 days

Complications
1) Pressure elevation
2) Corneal epithelial opacities
3) Bleeding
4) Iritis

5) Incorrect part of angle treated
6) Fainting
7) PAS formation

D) gonioplasty/iridoplasty
Indications
1) plateau iris
2) to facilitate PI
3) to facilitate ALT
4) nanophthalmos
Technique
1) topical anesthesia
2) 500 micron spot 0.5 sec burn, 300 mW
3) six applications per quadrant leaving space in between the applications
4) Patients should be told that the treatment might cause slight permanent dilatation of the pupil and that it will cause delayed discoloration of the peripheral iris.

E) peripheral laser synechialysis
- in early synechial closure, to open a synechially closed angle
- should be attempted before surgical goniosynechialysis

F) goniophotocoagulation
- for NVA
- 0.1second, 100-µm, 200 mW to blanch vessels
- vessels treated over scleral spur, not TM

G) argon laser transpupil ciliary process destruction (cyclophotocoagulation)
- was used in aphakic patients
- rarely used today

H) transscleral cyclodestructive procedures (YAG)
Indications
1) glaucoma that is resistant to all medical and surgical therapies
2) neovascular glaucoma with poor visual potential
3) glaucoma advanced to such a restricted VF or poor vision that an intraocular surgical procedure represents an unacceptable risk.
4) patient not a surgical candidate for filtering surgery for general medical

Technique
- Retrobulbar or peribulbar anesthesia
- 32 total burns
i) contact:
ii) noncontact (Lasag): defocused 1.5 mm post. (deep) to sclera; aim 2.5 mm from limbus; 4J

Complications
1) pain
2) inflammation
3) scleral thinning
4) macular edema
5) phthisis

6) cataract
7) hypotony

I) Laser ablation of releasable suture
- cut 1 at a time
- between day 2 and 14
- Use Hoskins lens or edge of Zeiss 4 mirror lens
- Argon green or blue green (not Yag)
- 50 micron spot size, 0.1 sec, 500 mW

J) Holmium sclerostomy: ab interno and ab externo techniques; Holimium, YAG, Argon, CO2

K) YAG Hyaloidotomy
- for aqueous misdirection
- in aphakic or pseudophakic
- 5 mJ

3) RETINA
I) Diabetes
A) PRP for high risk characteristics
HRC
3 out of four
1) vitreous hemorrhage or pre-retinal heme
2) any NV
3) NVD (within 1 DD of disc)
4) size: NVE > ½DD or NVD > ¼to 1/3 DD
or 5) rubeosis
- consider treatment for very severe NPDR (2 of 421) or very severe NPDR (1 of 421)

Procedure:
Settings: 500u, 0.1-0.5 secs, moderately intense (gray-white) burn
- begin 2 DD (3000u) from fovea
- begin 500u from disc
- go until anterior to equator
- don't treat PM bundle
- can consider direct laser to flat NV
- avoid treating over b.v., scars, heme.
- 1500 burns typical; 1 burn width apart up to 3500 burns (Dr. Quigley)

Details
- Treatment should begin at 100 mW with the Goldmann lens or 150 mW with the Rodenstock
- The DRS protocol specified 800 to 1600 spots 500u (Goldman), but typical therapy with a Rodenstock or Volk lens is 600 to 1000 200u spots. The burns should be placed ½1 burn width apart
- Bloom says 1800-2200 burns
- focal confluent bombardment of the NVE
- If possible, the treatment inferiorly should be heavier than the treatment superiorly to preserve downgaze field.
- In treating the temporal raphe, a barrier line should be placed 2.5 DD temporal to the center of the macula, with treatment extending distal to the barrier.
- fewer transient choroidal and exudative retinal detachments in multiple-session treatments over a 3-6 week period
- For NV within 2 DD from fovea, can consider continuing treatment untl 1 DD (1500u) from fovea with 500u spot size, and then treating from 500-1500u with 200 u spot size. (Bloom)

Followup: 4 months

If have CSME and HRC
1) Treat CSME first
2) divide PRP into several sessions
3) treat nasal retina
4) treat anterior retina

To retreat:
1) fill in gaps
2) treat anterior and posterior to PRO
3) can treat over old burbs but this will cause visual loss

B) focal tx for CSME
CSME
1) retinal thickening < 500u from foveola (most urgent)
2) hard exudates < 500u from macula center with adjacent retinal thickening (less urgent)
3) retinal thickening > 1DD within 1 DD from center (least urgent)

Procedure
1) focal leaks (m/a) >greater than 500u and <3000u from the center of the macula thought to be causing CSME
2) focal leaks 300 to 500u from the center of the macula if on follow up vision < 20/40, CSME persits, and there is a good perifoveal capillary network
- FA optional? (thickening is a CL diagnosis)
Settings
1) 50-75u for larger m/a; 50u for smaller m/a after treating base with 100-200u burn
2) 0.1 seconds; burn should kighten or darken the m/a

C) Grid treatment for CSME
1) Areas of diffuse leakage 500-3000u from center of macula causing CSME
2) Avascular zones 500-3000u from center of macula associated with CSME
Procedure
1) spaced 1 burn width apart
2) 100-200u spot size,
3) remain 500u from disc
4) remain 500u from center of fovea

Followup: 3-4 months after treatment

II) Vein Occlusions
A) Grid for BRVO ME
- Eligible eyes: BRVO with a duration of 3 to 18 mo and a visual acuity of 20/40 or worse attributable to macular edema
- don't treat if macular ischemia is cause of vision loss (vs. DM where you can treat macular ischemia)
- follow up Q 4 months
Procedure
- 100u spots, 0.1 secs, mild to moderate burn, one burn width apart
- applied to the area of macular edema
- treatment extends no closer to the fovea than the avascular zone (500u) and no further peripherally than the major vascular arcades

Follow up: 4 months post laser

B) sectoral scatter for BRVO NV
- treat once NVE or NVD develops
- Eyes with BRVO involving at least a 5 DD area of retina
Procedure
- medium-intensity 200 to 500u argon laser burns spaced one burn width apart
- cover the entire area of involved retina, except within 2 DD of center of FAZ
- 24% of the untreated eyes develop neovascularization versus 12% of the treated eyes.

C) PRP for CRVO

- patients should be examined Q1month for 6 months post CRVO (at least) including gonio
- 75-80% of CRVO are non-ischemic
-1/3 of non-ischemic CRVO go on to become ischemic CRVO (within 1 year)
- treat only once NVI develops (2 clock hours) or earlier if close follow up is not possible
- technique is same as DRS 1500-2000 burn PRP)

Risk factors for ischemic CRVO developing NV

1) greater than 10 DD of non-perfusion in the posterior pole - definition (greater risk with greater non-perfusion)
2) RAPD
3) decreased visual acuity
4) blood ++
5) ERG: decreased b:a ratio (normal: 2:1)
6) abnormal EOG
7) elevated central retinal venous pressure
8) duration < 1 month (Bloom
9) male sex (Bloom)

Risk factors for conversion to ischemic CRVO

Risk Factors for CRVO to become ischemic
1) a lot of hemorrhages
2) < 1 month
3) V< 20/200
4) 5-9 disc areas
5) age > 70
6) smoker

III) SRNV

A) MPS - ARMD

- argon green or krypton red

Initial laser burns are along the boundary of the SRNV using a 200-u spot size and 0.2- to 0.5-sec.

- After the boundaries of the lesion have been treated, the area within the boundaries is treated subsequently with burns of the same spot size or larger, using a duration of 0.5 to 1 sec.
- The desired end-point for the intensity of the laser lesion is to create a uniformly white lesion.

Procedure for treating extrafoveal net

1) 100 u spots to outline net
2) 200u spots around foveal edge
3) 200u around rest of net
4) 200-500 spots to fill in net

- Procedure for recurrences: extend 300u into previous treatment scar, 300u past base of recurrent vessel, 100u around vessel

Follow up after Tx.

1) acuity, FA, 2 or 3 wk following treatment.
2) identify the presence of persistent or recurrent CNV
3) acuity, FA, 5-6 weeks following treatment.

4) identify the presence of persistent or recurrent CNV
5) 6 wk following treatment, a patient should be encouraged to use Amsler grid and monitor vision for changes
6) evaluation with FA repeated at 3 and 6 mo
7) evaluations at 9 and 12 mo (FA optional)
8) after 2 yr, recurrences are unusual; follow-up every 6 mo without angiography is sufficient.

IV) Sickle Cell Anemia
A) Seafans
1) Sector scatter for seafans
- for reliable patients
procedure: 500u, 0.1 sec for 1 clock hour around seafan
- don't treat seafan directly
- can treat feeder vessel: 200-500 microns 0.5 sec burns to feeder vessel

B) 360 degree circumferential scatter
- for unless reliable patients
- procedure: 500 micron, 0.1 seconds in area of non-perfused retina

V) Central Serous Retinopathy
a) focal treatment
Procedure: 100u-200u spot directed at site of lesion; light treatment

B) grid treatment
100u-200u directed in region of leakage

Indications to treat CSR
1) need for rapid binocular visual recovery (occupation)
2) persistent serous RD (> 4 months)
3) prior episodes with permanent decrease in visual acuity
4) permanent visual loss in other eye
5) architectural changes (CME)
6) SRNV

VI) Retinal break (hoseshoe tear or other)
Procedure
1) Settings: 200-500u, 0.1 sec; moderated white burn
2) surround lesion (tear) with 2-3 rows of confluent burns
3) laser preferable to cryo (if possible) - scars faster

VII) macroaneurysm
- wait 1-3 months after leak before treating
- treat aneurysm directly (200-500u) as well as area around aneurysm (2 rows 500u)

VIII) Coats
- treat telangiectasias if causing or threatening macula with exudate or RD
settings: 200-500u; 0.2-0.5 seconds
- treat until spasm or whitening of vascular abnormalities

IX) Retinal Cavernous Hemangioma

- treatment usually not necessary

X) Choroidal cavernous hemangioma
- hamartomatous lesion
- treat if associated RD threatens or involves fovea
settings: 200-500u; 0.1-1 second; light to moderate burn

XI) Retinal Capillary hemangioma
- may treat those that are leaking and threatening fovea or conversely treat all because they are much easier to treat when they are smaller and they grow
- much easier to treat if < 2.5 DD
- can treat lesion or feeder vessels
- settings: 0.2-1 second, 200-500u; moderately intense

XII) Optic pit
- 30-50% develop detachments usually age 20-40
- elevation may be schisis
Treatment
- laser burns to temporal 180 degrees pof disk
To flatten RD: (before laser treatment)
1) follow (up to 3 months)
2) bedrest with patches for 2 days
3) laser to detached area
4) intraocular gas bubble
5) PPV with gas injection
- after each step, if retina flattens then laser