Retinal Surgery Complications

Retinal Surgery

OHIO OPHTHALMOLOGIC SOCIETY 2017

JOHNSTONE M. KIM MD
MIDWEST RETINA
JMKIMMD@GMAIL.COM

List of Complications (not complete)

Scleral Buckle

- Complications with scleral buckle suturing
- Vitreoretinal incarceration
- Choroidal detachment, suprachoroidal hemorrhage
- Scleral Rupture/Perforation
- Subretinal fluid drainage complications
- Choroidal hemorrhage
- Subretinal hemorrhage
- Ineffective Drainage
- Vitreomacular incarceration

Air/gas injection complications
- Fish egg formation
- Gas behind lens
- Subretinal air/gas

Buckle Complication
- Buckle away from break
- Scleral Perforation
- Exposure/Infection
- Buckle Migration, extrusion
- Buckle migration, internal
- New Break/missed Break

Pars Plana Vitrectomy (not complete)

- Complication of setting up, maintaining, closing ports
- Subconj hemorrhage/ chemosis
- Enlargement of sclerotomies with thin sclera/prior surgery
- Losing tunnels in trocar insertion
- Vitreoscleral incarceration/subretinal infusion
- Accidental removal of infusion
- Vitreoretinal incarceration at sclerotomies
- Leaking entry sites
- Complications related to crystalline lens
- Cataract development/late touch
- Lens subluxation/luxation
- Phaco/vitrectomy complications
- Anterior chamber flattening
- Posterior capsule/endoirregularity
- PVD induction complications

Common Retinal Surgery Procedures

- Surgical Procedures
- Pars Plana Vitrectomy
- Scleral buckling

- In office Procedures
- Pneumatic Retinopexy
- Scleral buckling
- Retinal Laser
- Cryopexy
- Intravitreal injections/Taps
- Fluorescein and ICG Angiography
- PDT Laser/Visudyne

Complications Encountered in the Office

- Retrobulbar Anesthesia Complications
- Globe Perforation
- Retrobulbar hemorrhage
- Intraocular Gas and Pressure Problems (vitrectomy/pneumatic)
- Post op hypotony, intraocular hypertension
- Endophthalmitis
- Wrong site surgery, consents, contraindications
- Common issues with intravitreal injections
- Post operative pain
- Anaphylaxis/ Allergic reactions (FA/ICG/PDT)

Retrobulbar Anesthesia Complications
PATIENTS AND METHODS: Twenty-five ocular perforations between 1976 and 1993 occurred after 13 retrobulbar and 12 peribulbar injections. Eighteen patients (72%) were women. Eighteen eyes were myopic (72%). Risk factors included high myopia in 11 cases (44%), use of Atkinson gaze in 21 cases (84%) and a sharp injection needle.

RESULTS: Deep position of the posterior pole was common. Perforation signs comprised vitreous hemorrhage in 25 eyes (100%), subretinal hemorrhage in 19 eyes (76%), retinal breaks along the inferior vascular arcade in 19 eyes (76%) and retinal detachment in 14 eyes (56%). Proliferative vitreoretinopathy developed in 11 eyes (44%).

CONCLUSION: Retinal detachment strongly correlated to poor visual outcome.

Retrobulbar Hemorrhage

Gases are colorless, odorless, heavier than air, and non-toxic to the eye.

3 phases:

- Expansion – based on net uptake of nitrogen, oxygen, CO2, and H2O into bubble
- Equilibrium – loss of gas balanced by uptake of nitrogen
- Dissolution – net exit of all gas components

<table>
<thead>
<tr>
<th>Gas</th>
<th>Molecular Weight</th>
<th>Expansion Coefficient</th>
<th>Equilibrium Coefficient</th>
<th>Dissolution Rate</th>
<th>Non-extravasable Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF6</td>
<td>0.034</td>
<td>8.0</td>
<td>24-30</td>
<td>1-2 weeks</td>
<td>20</td>
</tr>
<tr>
<td>C2F6</td>
<td>0.048</td>
<td>1.9</td>
<td>1-2 weeks</td>
<td>4-6 weeks</td>
<td>16</td>
</tr>
<tr>
<td>C3F8</td>
<td>0.058</td>
<td>3.3</td>
<td>4-6 weeks</td>
<td>6-8 weeks</td>
<td>12</td>
</tr>
</tbody>
</table>
**Table 1. Physical Properties and Bubble Dynamics of Gases Used in Vitreoretinal Surgery**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Molecular Weight</th>
<th>Expansion</th>
<th>Specific Gravity</th>
<th>Time to Dissolve</th>
<th>Mass expiration based on 1 g of gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>28.00</td>
<td>0</td>
<td>0.78</td>
<td>0.8 g</td>
<td>0.78 g</td>
</tr>
<tr>
<td>SF6</td>
<td>146.00</td>
<td>2.0</td>
<td>1.2 g</td>
<td>1.2 g</td>
<td>1.2 g</td>
</tr>
<tr>
<td>C3F8</td>
<td>138.00</td>
<td>3.5</td>
<td>4.6 g</td>
<td>4.6 g</td>
<td>4.6 g</td>
</tr>
<tr>
<td>C2F6</td>
<td>188.00</td>
<td>4</td>
<td>6.1 g</td>
<td>6.1 g</td>
<td>6.1 g</td>
</tr>
</tbody>
</table>

- **Pneumatic retinopexy** – involves injection of 0.4-0.6 mL of pure SF6 or 0.3 mL of pure C3F8
- **Pneumatic buckle** – involves gas injection with a buckle
- **Vitrectomy** –
  - Involves use of nonexpansile gas SF6 or C3F8
  - Involves use of silicone oil, 3000 CS or 1000 CS

**Intraocular hypertension**

- Most common post-op complication after fluid/gas exchange is elevated IOP (60%)
- Hypertension related to Gas
  - Intraocular IOP lowering drops/medication
  - Tap gas – 27 or 30 G needle into pars plana (typical intravitreal injection setup)
- Hypertension related to Oil
  - Due to oil overfill,
  - Inherent glaucoma risk factors
  - Pupillary block (inferior PI)
  - TX – medical treatment vs. removal of oil

**Intraocular hypotony**

- **Wound type**:
  - Angled (bevel) sclerotomy preferred over straight incision.
- **Wound creation**
  a) Displace the conjunctiva over the wound entry site
  b) Flatten the sclera during wound creation to provide the longest wound possible, which should help provide best wound apposition
- **End of surgery**
  a) Perform partial air-fluid exchange
  b) Remove cannula with a hard/solid instrument (e.g., light pipe) to prevent wick
  c) Massage wound with a cotton tipped swab
  d) Allow time for leakage to stop, if any
  e) If severe aqueous leak, place a suture
  f) Straight incision requires a suture

**Complications Related to Hypotony**

- Choroidal Detachment
- Suprachoroidal hemorrhage
- Choroidal retinal folds
- Cystoid macular edema
- Optic disc edema
- Persistent fluid
- Retinal detachment
- Endophthalmitis
- Phthisis
Solutions

- Increase steroids when wound leak is ruled out
- Decrease steroids when wound leak is suspected
- Consider large diameter contact lens if wound is anteriorly located
- Use medium lasting cycloplegics – cyclopentolate to stabilize iris/lens diaphragm and ciliary body
- Intracameral administration of viscoelastic, gas injection
- Repeat vitrectomy/closure of wound/removal of tractional membranes

Endophthalmitis after Vitrectomy

- Endophthalmitis rate (1995 - 2001 at BPEI) – 2 in 7429 (0.03%)
  - Lower than cataracts (0.04%)
  - Lower than glaucoma (0.2%)
  - Lower than PKP (0.08%)
- Endophthalmitis rate with Triamcinolone assisted PPV (0.05%)
- Rate of Endophthalmitis higher in Small Gauge Vitrectomy vs. 20G vitrectomy.
  - “LESS” – unsutured sclerotomy and Vitreous Wick
  - Early postoperative hypotony facilitate ingress/ conduit of bacterial entry
- Species
  - Staph Aureus, Proteus Mirabilis, Pseudomonas Aeruginosa, S. Epidermidis

Table 2. Potential Predisposing Factors for Endophthalmitis Following Small-gauge Pars Plana Vitrectomy

- Leaking sclerotomies causing early postoperative hypotony
- Vitreous wick in sclerotomies
- Any bacterial inoculum into the vitreous cavity in patients with relative immune compromise (e.g., patients with diabetes mellitus and the elderly)
- Non-use of subconjunctival antibiotics
- Increasing use of intravitreal adjuvants such as triamcinolone acetate

Table 3. Treatment Options for Endophthalmitis Following Pars Plana Vitrectomy

- Intravitreal antibiotics in all cases (optional intravitreal dexamethasone)
- Consider repeat pars plana vitrectomy (in most severe cases)
- In cases with concurrent retinal detachment and gas-filled eye:
  - Consider antibiotics in the infusion fluid
  - Consider 50% gas fill and lower or standard dosages of intravitreal antibiotics
  - Consider use of systemic antibiotics

Treatment

- Retrobulbar block – pt eye is inflamed
- Vitreous tap with 25 or 27 gauge needle
  - If no fluid then take AC sample
- Intravitreal injection of 0.1 cc
  - 2.25 mg Ceftazidime
  - 1 mg Vancomycin
  - +/- 4 mg of Dexamethasone

Wrong Site Surgery/ Consents/ Contraindications

- Wrong Side Surgery/ Wrong Eye surgery
- Wrong side injection/laser
- Wrong patient injection/laser
- Wrong medication injection
- Absolute contraindications for treatment:
  - Known anaphylaxis/known allergy – i.e. penicillin/cephalosporin
  - Oral medication – aspirin/ibuprofen
  - Intraocular viscoelastic administration – Fluorescein/ICG/Vitadayne
- Known/Unknown Contraindications
  - Pregnancy
  - Sickle Cell
Universal Protocol for Wrong Events

- Complete a pre-operative verification process
- Mark the operative site
- Take a time-out immediately before starting the procedure
- Adapt these requirements to non-operating room settings

Joint Commission Zero Tolerance

- Florida is the only state to strictly penalize wrong site cases
- 33 cases 2000-2006 in Florida
  - 9% of cases were wrong IOL
- JAMA 2007
- 155 cases, including 41 from the Ophthalmic Mutual Insurance Company
  and 64 from the New York State Health Department (1982-2005)
  - 8% were wrong IOL
  - 15 cases were wrong eye
  - 14 cases wrong eye block
  - 8 cases wrong patient or procedure
  - 2 cases wrong corneal transplant
- Universal protocol could have prevented 80% of cases (90 cases)


Intravitreal Injection Complications/Risks (not comprehensive)

- Post injection Pain
- Bleeding
- Retinal Tear/ Retinal Detachment
- Cataracts
- Infection
- Elevated IOP, optic nerve damage
- Stroke/Heart Attack (controversial)

Intravitreal Injections Complications

- Endophthalmitis risk ~0.02% (1/5,000 injections)
  - Evidence suggests due to respiratory flora from patient/medical assistant/physician
  - NO TALK POLICY (or facemask)
- Retinal Tears/ Detachments/Vitreous Hemorrhage – due to vitreous traction from injection
- Systemic Safety
  - Report of elevated systemic arterial hypertension
  - Systemic delivery of VEGF – promotes development of thromboembolic events
  - No statistical evidence for intravitreal injections (but statistics were not sufficiently powered to answer question)
Intravitreal Injection

Contraindications

- Active infection – conjunctivitis, blepharoconjunctivitis, infection
- Pregnancy – no studies were done on pregnant women
- Lucentis
- Cynomolgus Monkey – 13x dose – skeletal abnormalities, no known placental toxicity noted
- Based on VEGF mechanism of action, it may pose risk to embryo-fetal development
- Breastfeeding – unknown but max dose measured at 90,000 fold lower than vitreal concentration. NOT RECOMMENDED.

Intravitreal bevacizumab during pregnancy.

RESULTS:

- Four pregnant women were treated with intravitreal bevacizumab for choroidal neovascularization (CNV) because of presumed ocular histoplasmosis syndrome punctate inner choroidopathy, or similar retinopathy. Patients received a mean of 2.6 ± 2.3 injections (range, 1–6 injections) while pregnant. One patient was treated with bevacizumab at the time of delivery, and the injection was performed at 24.5 weeks gestation. The mean follow-up was 14.2 ± 2.7 months (range, 11–19 months). Slitlamp visual acuities improved in all patients, with a mean gain of 5.6 ± 4.4 Snellen ETDRS lines. All patients had normal prenatal courses and delivered healthy full-term infants. All children have remained healthy, exhibiting normal development and growth during infancy.

CONCLUSION:

- Offering pregnant patients intravitreal bevacizumab therapy during pregnancy for off-label ocular indications can result in significant visual improvement. No adverse events related to treatment occurred in any patient included in this study. Additional studies with more patients and longer follow-up duration are required to identify any risks associated with treatment.

Best Practice Guidelines Panel Recommendation

- Providone-Iodine (5-10%) should be the last agent applied to the intended injection site before injection
- If gel anesthetic is used, providone-iodine should be applied both before and after application because retained gel may prevent providone from contacting the conjunctival surface of injection site
- Topical Antibiotics pre-, peri-, or post injection are unnecessary
- No evidence support use of sterile drape
- Avoid contamination of needle and site by lashes or lid margins
- Avoid extensive massage of lids pre- or post injection
- Use adequate anesthetic for given patient (topical, gel, subconj)
- Use sterile or nonsterile gloves as consistent with modern office practice, combined with strong agreement regarding need for handwashing before and after patient contact

Guidelines with no clear consensus among committee members

- Need for providone-Iodine to the eyelids, including the lashes and margins
- Use of speculum
- Need for pupillary dilation and post-injection dilated exam of the posterior segment
- Use of providone – Iodine flush

Early loss of pregnancy after intravitreal bevacizumab injection

- Systemic bevacizumab is teratogenic in rabbits at doses twice the recommended i.v. human dose (US Food and Drug Administration 2005) and although systemic absorption (when administered intravitreally) is believed to be minimal, recent research has demonstrated that intravitreal 1.25 mg bevacizumab may reach the systemic circulation in plasma concentrations of 100 ng/ml (Csaky 2007).
- Rosen et al. (2009) reported the absence of fetal side-effects after exposure to intravitreal bevacizumab during the second trimester. Although the latter represents an important observation, the effect of bevacizumab exposure during the first trimester is unknown. Moreover, a case of metrorrhagia 2 weeks after intravitreal Avastin injection has been reported (Rodrigues et al. 2007).
Sequence
1. Minimize speaking
2. Take a 30 second time out to verify patient, agent, laterality
3. Apply liquid anesthetic to ocular surface
4. Apply providone – iodine
5. Apply anesthetic gel or subconj injection
6. Retract lids
7. Apply providone – iodine to canji surface to intended site of injection
8. Injection perpendicular to scleral 4 mm to limbus
9. Wash eye liberally

Tips to reduce pain after injection
- Avoid Povidone – Iodine over the Cornea
- Avoid a large bleb for subcon injections
- Keep eye closed after subcon injection and before medication injection
- Wash eye multiple times after injection with eyewash
- Artificial tears every hour while awake for 1 day
- Keep eye closed as much as possible after injection
- Avoid eye rubbing at home/ consider eye patch for 1 hour
- Remind patients to limit Computer time, reading, TV time the day of injection

What to do if pain is already present.
- Consider pressure patch with erythromycin ointment for 1 hour
- Treat like corneal abrasion, follow daily, ointments
- Worst case scenario – block the eye and pressure patch and recheck the next day.

Infectious vs. Noninfectious Endophthalmitis

<table>
<thead>
<tr>
<th>More Common Features</th>
<th>Infectious</th>
<th>Noninfectious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Moderate to severe pain</td>
<td>Usually mild pain</td>
</tr>
<tr>
<td>Vision loss</td>
<td>Severe</td>
<td>Mild to moderate</td>
</tr>
<tr>
<td>Pupillae</td>
<td>Always present</td>
<td>Rare</td>
</tr>
<tr>
<td>Hypospasm</td>
<td>Very common</td>
<td>Usually absent</td>
</tr>
<tr>
<td>Vitreous opacity</td>
<td>Usually prominent</td>
<td>Usually mild</td>
</tr>
<tr>
<td>Conjunctival/vase congestion</td>
<td>Very common</td>
<td>Often absent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Less Common Features</th>
<th>Infectious</th>
<th>Noninfectious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retinal infiltrates</td>
<td>Occasionally present</td>
<td>Absent</td>
</tr>
<tr>
<td>Intraretinal hemorrhages</td>
<td>Common</td>
<td>Rare</td>
</tr>
<tr>
<td>Whitening of retinal vessels</td>
<td>May be present</td>
<td>Absent</td>
</tr>
</tbody>
</table>

Clinical Course
- Rapidly progressive
- Slow improvement

Complications/Side effects related to Fluorescein Angiography/ ICG Angiography
- Skin color changes
- Steve disconnection
- Nausea (0-5%) – occur 30 sec post injection or 1-3 minutes
- Extravasation/Abrasion
- Blepharospasm
- Iatrogenic Edema
- Sympysis
- Anaphylaxis
- MI/ Cardiac Arrest
- Cardiac Arrhythmia
- Death (1/250,000)

Journal of Eye Science July 2016: Risk Factors for adverse reactions of fundus fluorescein angiography
Contraindications

- Most if not all Retinal Specialists do not perform FA/ICG study in pregnant or lactating patients.
- There are no known risks or adverse reactions associated with pregnancy, but most practitioners avoid performing fluorescein angiography in pregnant women, especially in their first trimester.
- Use of FA dye (Non-Iodinated Contrast Media) has not been shown to affect GFR significantly following FA study in diabetics with compromised renal function.
- It is a NON-issue for Dialysis patients.
- It MAY be an issue for near end-stage patients.
- ICG Angiography
  - Contraindicated for Iodine Allergy patients.
  - Contraindicated for patients on Metformin with renal compromise.
  - Contraindicated for patients with known liver failure (exclusive liver excretion).

FA/ICG side effects management

Skin Extravasation
- Avoid – high PH can lead to severe tissue damage.
- Very rare – idiosyncratic reaction (Retina 1987).
- Use Cold compresses, ice pack.

Fainting/Syncope
- If pt has not yet fainted, have pt sit and lower head between knees or place pt in lying down position.
- If pt has fainted – lower pt to ground in cradle position, elevate legs.
- Loosen tight clothing.
- Make sure pt is breathing – establish airway, administer oxygen.
- Check vital signs – HR, BP, O2 sat, BG.
- Place steaming/warming bags under nose + cold compress to forehead and back of neck.
- Place ammonia/smelling salts under nose + cold compress to forehead and back of neck.
- EKG recommended – hip to hospital.

Fainting protocol – lie pt down, raise legs, lose clothing.
- ABCs – establish airway and start IV line.
- O2 – bag mask, etc.
- Bolus 0.9% NS.
- Epinephrine: 0.3 to 0.5 mg IM – repeat injections every 15-20 minutes (not more than 3 doses).
- Other steps – wait for EMS.

Management of allergic reaction during IV FA

- Mild urticaria/hot = 25 to 50 mg oral anti-histamine (diphenhydramine).
- Hypoglycemia –
  - Glucose tabs/soda.
  - If pt is unconscious – consider IM or SC 0.1-0.2 mg of glucagon in the anterior thigh.
- Bronchospasm – follow fainting protocol.
- Administer O2 – high flow vs. manual ventilation with bag.

MI/Cardiac Arrest

- Chest Pain
  - Begin O2 therapy.
  - Monitor VS.
  - Sublingual nitroglycerin (0.2 to 0.6 mg).
- Arrest
  - Maintain airway.
  - BLS.

Anaphylaxis

- Fainting protocol – lie pt down, raise legs, lose clothing.
- ABCs – establish airway and start IV line.
- O2 – bag mask, etc.
- Bolus 0.9% NS.
- Epinephrine: 0.3 to 0.5 mg IM – repeat injections every 15-20 minutes (not more than 3 doses).
- Other steps – wait for EMS.

Table 3: Frequency of various reaction related to age (n=435)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>&lt;20</th>
<th>20-30</th>
<th>30-50</th>
<th>&gt;50</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>28</td>
<td>130</td>
<td>318</td>
<td>377</td>
<td>-</td>
</tr>
<tr>
<td>Painless</td>
<td>8 (29)</td>
<td>28 (21)</td>
<td>91 (29)</td>
<td>36 (9)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>CI</td>
<td>12.53-18.91</td>
<td>18-13.3-60</td>
<td>7.6-0.05-0.59</td>
<td>6.06-12.02</td>
<td>-</td>
</tr>
</tbody>
</table>