2.4 Tissue Prolapse

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2.4.1 Introduction

Extrusion of intraocular contents[1] commonly occurs when an eye injury is full thickness; Table 2.4.1 shows selected incidence figures with different types of trauma. The tissue extrusion typically occurs at the time of injury as the IOP rises during impact;[2] escape of aqueous and tissues through the wound follows a pressure gradient until the IOP is normalized[3].

Unless an ECH occurs (see Chaps. 1.10, 2.8), the surgeon should deal with the prolapsed tissue before closing the wound.

The incidence and consequences of tissue prolapse with different types of trauma, as recorded in the USEIR database, are given in Table 2.4.2.

2.4.2 Evaluation

If uvea has prolapsed, it is usually easily recognizable; vitreous may be more difficult to identify, especially if there is lens disruption or the wound is

1 In this chapter we do not discuss internal tissue prolapse (i.e., lens in the vitreous cavity/AC, vitreous in the AC), which are described in their respective chapters.

2 Factors that may exacerbate tissue extrusion include, among others, intraorbital and intraocular hemorrhage, contraction of the lid and extraocular muscles, and pressure on the eye by the ophthalmologist during examination or surgery.

3 The IOP and the atmospheric pressure rapidly equalize (i.e., the IOP approaches the atmospheric pressure) unless wound closure halts the process.

Table 2.4.1 The incidence (%) and consequences of tissue prolapse with different types of trauma in the USEIR database

Injury type	Prolapsed tissue		Retinal detachment rate	
	Iris/uvea	Vitreous	With tissue prolapse	Without tissue prolapse
Rupture (2117)	54	5	21	10
Penetrating (4220)	38	2	15	4
IOFB (1235)	24	1	31	11
Perforating (464)	41	3	27	19

Based on 9036 cases

Table 2.4.2 Tissue prolapse: summary of management preferences

Tissue	Excise	Reposit	Comment
Iris	+	+++	As much of the iris as possible should be preserved; if excision cannot be avoided, concurrent or subsequent iridoplasty should be considered (see Chap. 2.6)
Ciliary body and choroid	(+)	+++	Because of the risk of hemorrhage, phthisis, and inflammation, excision is reserved for those rare cases where reposition is impossible
Lens	+++	–	Even a partially retained lens capsule can cause inflammation and contribute to destruction of the ciliary processes
Vitreous	+++	–	Vitreous removal should be complete and atraumatic
Retina	(+)	+++	Excision is permissible only in those very rare cases where reposition is physically impossible, but either way the retina must be carefully inspected ab interno, and any pathology properly addressed (see Chap. 2.14)

scleral and posterior, and there is subconjunctival hemorrhage. If presence of a non-self-sealing wound is confirmed at the slit lamp, there is no need to have a definite answer as to whether a tissue prolapse is also present; this should be determined intraoperatively.

2.4.3 Specific Conditions

2.4.3.1 Iris

The iris is the most mobile tissue after the vitreous; therefore, it is easily externalized along with the escaping aqueous. If the wound is corneal, the prolapsed iris is easy to visualize (Fig. 2.4.1); if the wound is scleral, the diagnosis may be more difficult since chemosis, blood, or an intact and congested conjunctiva can hide it. The irregular shape of the pupil ("peaking" toward the wound) should raise suspicion.

2.4.3.1.1 Management

Occasionally, a small prolapse through a small wound may be eliminated by using miotic drugs if the prolapse is peripheral and by mydriatic drugs if the prolapse is more central. It is usually safer, however, to deal with the problem surgically. The surgeon has two options: reposition or excision.

2.4.3.1.1.1 Reposition

This is the primary choice: unless the iris is contaminated and cannot be cleaned, the surgeon should try to save the iris so that it can continue to compartmentalize the eye and regulate the size of the pupil. The iris must first be cleaned of *organisms* that may cause infection, *foreign material*, especially if the injury was caused by explosion, and *epithelial cells*, which could possibly lead to epithelial downgrowth (see Chap. 2.18) [5].

Cleaning of a contaminated iris can be achieved via:

- Removing particles with a Wechsler sponge or forceps

- Directing a strong jet stream onto the iris from a 10-cc syringe, using an irrigation fluid that contains antibiotics.[4] A combination of the two techniques is often necessary.

The iris may also be *macerated*, especially if its prolapse is not fresh. It is a judgment call in such cases whether to reposit or excise it. An iris that is "barely hanging on" to its root is not worth repositing.

The *technique* of iris reposition is simple: if the prolapse is through the cornea or at the limbus, the surgeon should pull, rather than push, the tissue. This is not only more gentle but much more effective than pushing the iris back.[5] A paracentesis needs to be made at a convenient location (90–180° from the wound), and, using a properly long spatula, the iris is swept out of the wound. Once the iris is repositioned, viscoelastics or air can be injected to prevent a recurrence of the extrusion.[6] This is especially important if additional surgical maneuvers are planned.

Pearl

The closer the wound is to the limbus, the higher the risk of iris (re)prolapse and anterior synechia formation.

If the prolapse is through a scleral wound, reposition is done via gentle pushing. If the IOP is high, the prolapse may recur; the assistant should in such cases hold the iris back with a spatula while the surgeon introduces the sutures (see Chap. 2.3). Injecting a strong miotic agent into the anterior chamber (AC) can also help keeping the iris from reprolapsing.

Time was once considered essential in determining whether the iris should be reposited or excised ("excision if extruded for over 24 h"). We now consider the iris' condition (see above) the decisive factor.

4 The same concentration should be used as for intravitreal injections (see Chap. 2.17).
5 Pushing is recommended only if the prolapse is very small.
6 Viscoelastics are used to keep the iris from reprolapsing, *not* to push the iris back into the AC.

2.4.3.1.1.2 Excision

Excision is recommended if the iris is impossible to clean or if it is very necrotic, but the area of excision should be kept to the minimum, and reconstruction of the diaphragm should always be on the surgeon's mind (see Chap. 2.6). Diathermizing the iris before cutting is advisable if the iris is non-necrotic to prevent a major bleeding.

If a significant hemorrhage occurs during excision or reposition, it must be stopped using the endodiathermy probe to prevent blood accumulation in the AC or in the vitreous.

2.4.3.2 Ciliary Body and Choroid

Their prolapse is much less common than that of the iris. Recognition is straightforward once the scleral wound has been identified.

2.4.3.2.1 Management

A prolapsed *choroid* should be reposited since the risk of intraoperative hemorrhage and postoperative inflammation is significant if excision is performed. Gentle diathermy of the choroid makes it shrink, easing reposition.

If the *ciliary body* is extruded, its reposition is especially crucial. The goal is not only to avoid complications such as hemorrhage and inflammation, but to minimize the risk of phthisis (see Chap. 2.8). Special attention must be paid to avoid incarcerating the ciliary body in the wound. Ciliary body trauma is presumed to play a role in the development of sympathetic ophthalmia (see Chap. 1.8).

2.4.3.3 Lens

Both the *diagnosis* and *management* are straightforward: the extruded lens (or IOL), whether it is intact or fragmented, must be removed with forceps or a Wechsler sponge. Occasionally, parts of the capsule may remain attached to the zonules [1]. If the capsule is partially extruded in a young person, removal of the capsule must be very carefully done since the capsule is strongly adherent to the zonules; enzymatic zonulolysis[7] is advised first to

7 Alpha-chymotrypsin in a 1 to 5,000/10,000 dilution

avoid a major hemorrhage. Extreme caution in young people is also necessary because the posterior lens capsule is adhering to the anterior hyaloid as well. Use of the vitrectomy probe, rather than a forceps, allows prevention of vitreous-related complications.

2.4.3.4 Vitreous

Vitreous is the most mobile intraocular tissue.[8] Recognition of vitreous prolapse is also influenced by the condition of the tissue: a formed vitreous is easily visualized in the wound, while a less formed one may be difficult to visualize. TA is very helpful: its adherence to the vitreous fibrils is much stronger than to smooth tissues such as the sclera or choroid. If the wound is in the anterior sclera, and the AC and lens are clear, strands in the anterior vitreous are usually visible at the slit lamp visible as lines converging toward the wound (Fig. 2.4.1).

2.4.3.4.1 Management

All vitreous must be thoroughly excised. If the prolapse is through a corneal wound, the surgeon is advised to also remove the vitreous from the AC (see Chap. 2.5).

Cave

Although it is technically possible to thoroughly remove the prolapsed vitrectomy at the wound using Wechsler sponges[9] and scissors, this is not without risk. The vitreous first needs to adhere to the sponge and then be lifted from the eye before it is cut. The traction exerted on the extruded vitreous is unavoidably transmitted to the peripheral retina and may cause a break.

8 A healthy vitreous requires more force to extrude than one that has lost most of its gel properties.

9 The surgeon should avoid touching the corneal endothelium with the sponge.

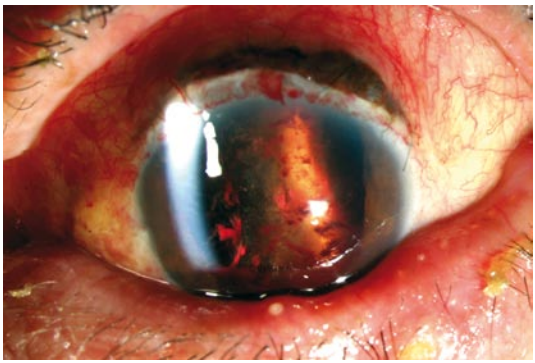

Fig. 2.4.1 Rupture of a cataract wound with iris prolapse and vitreous "streaks". The iris has prolapsed into the limbal wound and tamponaded it. The running suture has been severed. It is not possible to determine whether there is extraocular vitreous prolapse, but the vitreous has prolapsed into the AC and has a few dots of blood on its anterior surface. The vitreous configuration is such that it points the examiner toward the wound (Courtesy of V. Mester, Abu Dhabi, U.A.E.)

The vitrectomy probe is the preferred instrument for removing vitreous from the wound, irrespective of whether the wound is corneal[10] or scleral. It is possible that the higher incidence in the USEIR of retinal detachment associated with scleral compared with corneal wounds (23 vs 11%, respectively; see Tables 2.2.1, 2.3.1) is due not only to the injury itself but also to inappropriate management of vitreous prolapse. This assumption is supported by the finding that the retinal detachment rate is 78% if the scleral wound is at the ora serrata but only 16% the wound is posterior [4] as well as by the clinical experience that the breaks causing the retinal detachment are typically found either at the wound or a 180° away. Failure to fully excise the prolapsed vitreous greatly increases the risk of retinal detachment [2].

10 Unlike the sponge–scissors combination, the vitrectomy probe also allows removing the vitreous from the internal aspect of the wound (see Chap. 2.5).

If vitreous is found to have extruded through a wound posterior to the ora serrata, the retina must also have been injured,[11] and this must be taken into consideration when the management plan is designed. If the scleral wound is very posterior, it may be impossible to remove the vitreous prolapse completely, and management of the condition must be addressed ab interno (see Chap. 2.14).

2.4.3.5 Retina

If retina has prolapsed through the wound, this is easily recognized (Fig. 2.4.2), unless it is completely necrotic and/or blood covers it.

2.4.3.5.1 Management

As a general rule, the retina should not be excised but reposited. Even if it appears that the eye's condition is hopeless, successful retinal reposition may be accompanied by functional improvement.

- A *small* prolapse[12] is dealt with by first removing any vitreous from the retinal surface, then gently introducing the suture into one of the edges of the scleral wound, having the assistant hold/push the retina back with a spatula, putting the needle through the opposing edge of the wound, and tying the suture while the spatula is still underneath the suture, preventing a retinal reprolapse.
- If the prolapse is *large*, its underlying cause must be addressed first: the IOP is high, presumably due to a hemorrhage, which is pushing the retina forward. Patience is needed – waiting for tens of minutes if necessary. The intraocular bleeding must stop first,[13] and the IOP may have to be lowered.[14] Once the IOP is low, the material behind the

11 This statement is another example reflecting a proactive, rather than reactive, treatment philosophy (see Chap 1.8).

12 Small implies small area *and* small elevation.

13 The anesthesiologist should be asked to lower the patient's systemic blood pressure as much as possible.

14 This contradicts what is said about ECH in Chap. 2.8; however, a retinal prolapse requires special treatment. Usually, it is retinal prolapse that needs to be prevented if an intraocular hemorrhage occurs; once a retinal prolapse has occurred, the situation changes dramatically, and a different logic takes over.

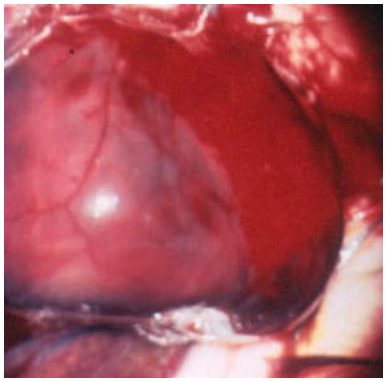

Fig. 2.4.2 Retinal prolapse in a ruptured eye. The retinal extrusion is caused by an ECH. Fresh blood is visible on the right side of the image. Although the prognosis is poor, the eye is not necessarily unsalvageable; primary enucleation is not justified (see the text for management details)

retina (may be vitreous or blood) can be slowly removed, through a retinotomy if necessary. The wound is then gradually closed, using the technique described above.

- If the retina cannot be completely pushed back, it should be cauterized in as small an area as possible, sacrificed, and the scleral wound closed, saving most of the retina.

Pearl

Incarcerating a prolapsed retina in the scleral wound is the lesser of "two evils." Retinal incarceration can be addressed in subsequent surgeries; only enucleation takes away the anatomical and functional hopes (see Chap. 1.8).

- The retina may be incarcerated despite the best efforts by surgeon and assistant [3]. The incarceration may be caused by the retina (a) being caught by the needle/suture, (b) prolapsing into the wound while the wound is being closed, and (c) subsequently being captured by the developing scar.

Regardless of the mechanism of incarceration, the choroid and retina must soon be liberated (i.e., excised) in this area (see Chap. 2.14).

DO:

- try to salvage as much of the uvea and retina as possible
- try to remove as much of the prolapsed vitreous as possible

DON'T:

- enucleate an eye just because there is retinal prolapse; in most cases, the retina can be reposited and the retinal incarceration dealt with later

Summary

Tissue prolapse is a common consequence of open globe injury. Knowledge of a few simple rules of how to deal with the prolapsed tissue greatly increases the eye's chances of anatomical and thus functional recovery.

References

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