



# Intracameral Phenylephrine to Arrest Intraoperative Intraocular Bleeding: A New Technique

Mukhtar Bizrah · Melanie C. Corbett

Received: December 28, 2018 / Published online: February 15, 2019  
© The Author(s) 2019

## ABSTRACT

Intraoperative intraocular bleeding can present a major challenge during anterior segment operations, such as cataract and glaucoma surgery. In the presence of significant intraocular bleeding, the surgeon may be unable to proceed if the bleeding cannot be controlled. Uncontrolled bleeding may also result in intraoperative or postoperative complications. Intracameral injection of phenylephrine was used in three consecutive cases of intraoperative anterior chamber bleeding during cataract surgery, one of which was combined with CyPass<sup>®</sup> Micro-Stent insertion. This resulted in complete cessation of bleeding within a minute of the injection. No further intraoperative or postoperative hemorrhage was seen. As far as we know, this is the first report of intracameral phenylephrine use intraoperatively to successfully stop

anterior chamber bleeding, enabling safe completion of surgery.

**Keywords:** Anterior chamber bleeding; Cypass; Intracameral phenylephrine; Intraocular bleeding; Intraoperative bleeding; Intraoperative hemorrhage; Minimally invasive glaucoma surgery (MIGS)

## INTRODUCTION

Intraoperative intraocular bleeding can present a major challenge during anterior segment operations, such as cataract surgery. In the presence of significant uncontrollable intraocular bleeding, the surgeon may be unable to proceed if the bleeding cannot be controlled. Furthermore, it can result in post-operative hyphema, which can in turn lead to raised intraocular pressure (IOP) and corneal staining.

Intraoperative anterior chamber bleeding can have various causes, such as iatrogenic iris trauma, abnormal blood vessels or be seemingly spontaneous. A number of intraoperative techniques can be utilised to control intraocular bleeding. A watch and wait approach may lead to spontaneous cessation of bleeding. In cases of significant bleeding or impaired clotting, this may be ineffective. Moreover, if the bleeding does stop naturally, it may restart spontaneously or with further intraocular maneuvers.

---

**Enhanced digital features** To view enhanced digital features for this article, including a video, go to <https://doi.org/10.6084/m9.figshare.7623983>.

---

**Electronic supplementary material** The online version of this article (<https://doi.org/10.1007/s40123-019-0165-y>) contains supplementary material, which is available to authorized users.

---

M. Bizrah (✉) · M. C. Corbett  
The Western Eye Hospital, Imperial College NHS  
Trust, London, UK  
e-mail: mbizrah@gmail.com

The anterior segment can be tamponaded with viscoelastic, air or saline solution. During significant active bleeding, this may be ineffective. Raising the IOP through tamponading can be painful under topical anesthesia (now used in > 90% of cataract surgery) [1], and is a risk factor for optic disc damage in patients with advanced glaucoma.

Phenylephrine is an  $\alpha$ -1 adrenergic receptor agonist which is used in ophthalmology to achieve and maintain pupillary dilation [2]. It is used for pre-operative dilation either in the form of eye drops or a pellet inserted into the inferior fornix. It can also be injected intracamerally to induce or improve pupillary dilatation [2, 3].

In 2016, the first author used intracameral phenylephrine 2.5% to halt the significant iris bleeding during cataract surgery. This manoeuvre succeeded in complete cessation of the bleeding within one minute. Based on this experience, intracameral injection of 0.3 ml phenylephrine 2.5% (undiluted) was used in three consecutive cases of intraocular bleeding during cataract surgery, one of which was combined with CyPass<sup>®</sup> Micro-Stent insertion. As far as we know, this is the first report of intracameral phenylephrine use intraoperatively to successfully stop intraocular bleeding, enabling safe completion of surgery. We propose that intracameral phenylephrine can be valuable in controlling intraocular bleeding, by causing vasoconstriction until coagulation of the bleeding vessel occurs.

## CASE PRESENTATIONS

### Compliance with Ethics Guidelines

Informed consent was obtained from all individual participants for being included in the study.

#### Case 1

A 76-year-old woman presented with reduced vision due to cataract formation in her only eye with useful vision. Relevant examination

findings of the operated eye are in Table 1. She therefore underwent cataract surgery [phacoemulsification with intraocular lens (IOL) insertion].

Intraoperatively, during the irrigation and aspiration of the lens cortex, significant intraocular bleeding started. The cause of this is not certain, but probably due to iris or ciliary body trauma. For five minutes, continued irrigation and aspiration was very challenging due to the continued significant bleeding which appeared to originate behind the iris. Video recording of the case was therefore started (see Video) <https://doi.org/10.6084/m9.figshare.7623983>. Due to the magnitude of bleeding, it was felt that tamponade would not work. Then 0.3 ml phenylephrine 2.5% (undiluted) was therefore injected intracamerally. As shown in the video recording, further irrigation and aspiration of the anterior chamber revealed that bleeding completely stopped. No further intraoperative bleeding was observed thereafter, and the case was finished successfully.

#### Case 2

A 78-year-old man on systemic warfarin and tamsulosin tablets had phacoemulsification with IOL insertion. Pre-operative findings are shown in Table 1. Intracameral phenylephrine was used initially to improve pupil dilation. Despite this, iris bleeding occurred at the end of surgery. Intracameral phenylephrine (same concentration as initial injection) was used to control the bleeding. The bleeding point on the iris was seen to stop bleeding about one minute post injection. No further intraoperative bleeding was observed, and the surgery was completed uneventfully.

#### Case 3

An 82-year-old man on aspirin had left phacoemulsification with IOL and Cypass<sup>®</sup> Micro-Stent insertion, having had the same procedure (uncomplicated) to his right eye 2 months prior to this. Ab-interno insertion of the Cypass<sup>®</sup> Micro-Stent into the supraciliary space (second attempt) resulted in significant intraocular

**Table 1** Demographics, pre-operative and post-operative findings

	Case 1	Case 2	Case 3
Demographics			
Age (years)	76	78	82
Gender	Female	Male	Male
Pre-operative findings			
Visual acuity (operated eye)	6/36 with spectacles, improving to 6/18 with pinhole	6/12 with spectacles and pinhole	6/9 unaided and pinhole
Risk factors for bleeding	High myopia (Refraction: – 19.0 dioptres, axial length: 31.38 mm) Deep peripheral cornea stromal vessels	Oral medications: Warfarin and Tamsulosin (floppy iris syndrome present)	CyPass® Micro-Stent insertion Oral aspirin
Pre-operative dilation	3 applications of phenylephrine 2.5% and cyclopentolate 1% drops	Mydriaserit® ophthalmic insert	Mydriaserit® ophthalmic insert
Post-operative findings			
Post-operative review days	3, 13, 17 days	3 and 17 days	6 days
Best corrected visual acuity (operated eye)	6/18	6/9	6/6
Intraocular pressure	2 mmHg (day 3), 5 mmHg (days 13), 11 mmHg (day 17)	7 mmHg (8 mmHg in other eye)	7 mmHg (9 mmHg in other eye)
Hyphema	Absent	Absent	Absent
Other findings			CyPass correctly positioned

bleeding obscuring view of the anterior segment. The bleeding continued despite irrigation and aspiration of the anterior segment. Intracameral phenylephrine was therefore injected, and the bleeding completely stopped within one minute of this injection. Further irrigation/aspiration did not result in more bleeding, and the operation was successfully completed.

### Post-operative Findings

In all three cases, hyphema was not detected at any of the post-operative visits. Post-operative findings are summarized in Table 1. Case 1 had

low IOP the first two post-operative visits, which returned to normal levels at clinic review day 17 post-operatively (11 mmHg). On examination, no cause for this was found, and there was no evidence of a link to use of intracameral phenylephrine. None of the three patients developed post-operative cystoid macular oedema at up to 2 months follow-up.

### DISCUSSION

This appears to be the first report of the use of intracameral phenylephrine for controlling intraocular bleeding during cataract surgery.

Physiologically, the observed cessation of bleeding makes sense in light of the known potent vasoconstrictive properties of phenylephrine. Phenylephrine injected intravitreally in rabbits has been shown to result in iris-ciliary vessel vasoconstriction [4].

Topical phenylephrine or Mydriaser<sup>®</sup> ophthalmic insert was used pre-operatively in all three cases. The latter is removed from the conjunctival fornix a few minutes before the surgery. Animal models have shown that phenylephrine is present in the aqueous humor for at least 2 h following topical drops instillation [5]. Despite this, intraocular bleeding occurred, and was only stopped when phenylephrine was injected intracamerally. There are several explanations for this. Firstly, irrigation and aspiration of anterior chamber fluid may have washed out residual pre-operative phenylephrine. The duration of vasoconstriction has not been studied as far as we know after phenylephrine washout. However, further irrigation and aspiration after intracameral phenylephrine injection (to stop bleeding), did not result in re-bleeding. The efficacy of intracameral phenylephrine may therefore be due to the higher concentration achieved in the aqueous as compared to pre-operative topical application. It is interesting that case 2 had intracameral phenylephrine at the start of surgery yet developed iris bleeding towards the end of surgery. The operation was not prolonged (20 min), suggesting that short duration of action of the first intracameral phenylephrine injection is less likely to explain the bleeding occurring towards the end of surgery. One hypothesis is therefore that the efficacy of phenylephrine is due to the direct vasoconstrictive effect on the exposed bleeding vessel.

There are theoretical concerns regarding vasodilation of the vessel after initial vasoconstriction leading to further intraocular bleeding. This was not observed intraoperatively in these cases, and no hyphema was seen in any of the post-operative visits.

Intraocular adrenaline 0.1% is known to have a vasoconstrictive effect on iris vessels in rat eyes [6]. All three surgical cases had 0.5 ml of adrenaline 1:1000 infused into 500 ml of

balanced saline solution (BSS) irrigation solution (i.e., adrenaline 0.1%). Irrigation and aspiration of the anterior segment with this solution did not succeed in halting the bleeding. This case series suggests that intracameral phenylephrine is much more effective in controlling significant intraoperative intraocular bleeding.

Albeit a few sporadic case reports, no significantly increased risk of systemic or post-operative ophthalmological complications have been reported with intracameral phenylephrine 2.5% use [2, 3, 7]. A concentration of 2.5% has been recommended for operating room use [8].

In our case series, 0.3 ml injection of 2.5% phenylephrine was used. A retrospective study found that a 0.6 ml intracameral injection of diluted phenylephrine (0.3 ml phenylephrine 2.5% mixed with 0.3 ml BSS) was not found to be associated with complications in the short- and medium term [7]. Phenylephrine is a vasoconstrictor, however, and there are case reports of cardiovascular complications [9]. Circulatory monitoring of patients for increased blood pressure and heart rate/rhythm changes is therefore advisable.

Although intracameral phenylephrine was not found to be associated with post-operative complications, no corneal endothelial cell counts nor corneal thickness measurements were performed to assess for endothelial toxicity. Also, as this is not a controlled study, it is not possible to state how much faster the bleeding is controlled with phenylephrine as compared with observation.

## CONCLUSION

Intracameral phenylephrine has a potential application for the cessation of anterior chamber bleeding during intraocular surgery. This technique may be particularly helpful in light of the rising trend of combined cataract surgery with minimally invasive glaucoma shunts, in which the risk of intraocular bleeding intraoperatively can be substantially higher.

## ACKNOWLEDGEMENTS

We would like to thank Dr. Sally Ameen for sharing her clinical experience in implementing this technique. We thank the participants of the study for consenting to share their clinical information.

**Funding.** No funding or sponsorship was received for this study or publication of this article. The article processing charges were funded by the authors.

**Authorship.** All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

**Disclosures.** Mukhtar Bizrah and Melanie C. Corbett have nothing to disclose.

**Compliance with Ethics Guidelines.** Informed consent was obtained from all individual participants for being included in the study.

**Data Availability.** The datasets generated during and/or analyzed during the current study are not publicly available due patient confidentiality reasons, but are available from the corresponding author on reasonable request.

**Open Access.** This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

## REFERENCES

1. Thevi T, Godinho MA trends and complications of local anaesthesia in cataract surgery: an 8-year analysis of 12992 patients. *Br J Ophthalmol*. 2016;100:1708–13.
2. Hovanesian JA, Sheppard JD, Trattler WB, Gayton JL, Malhotra RP, Schaaf DT, Ng E, Dunn SH. Intracameral phenylephrine and ketorolac during cataract surgery to maintain intraoperative mydriasis and reduce postoperative ocular pain: integrated results from 2 pivotal phase 3 studies. *J Cataract Refract Surg*. 2015;41(10):2060–8.
3. Vazquez-Ferreiro P, Carrera-Hueso FJ, Barreiro-Rodríguez L, Diaz-Rey M, Poquet-Jornet JE, Ramón-Barrios MA, Sanjuan-Cerveró R. Effectiveness of intracameral phenylephrine in achieving mydriasis and reducing complications during phacoemulsification: a systematic review and meta-analysis. *J Ocul Pharmacol Ther*. 2017;33(10):735–42.
4. Sugiyama K, Haque MS, Onda E, Taniguchi T, Kitazawa Y. The effects of intravitreally injected endothelin-1 on the iris-ciliary body microvasculature in rabbits. *Curr Eye Res*. 1996;15(6):633–7.
5. Schoenwald RD, Chien DS. Ocular absorption and disposition of phenylephrine and phenylephrine oxazolidine. *Biopharm Drug Dispos*. 1988;9(6):527–38.
6. Coman OA, Tăranu B, Ghiță Cristescu I, Fulga I. Particularities of vascular reactivity of the conjunctiva and iris in rats. *Rom J Morphol Embryol*. 2008;49(1):53–6.
7. Williams GS, Radwan M, Kadare S, Williams CPR. The short to medium-term risks of intracameral phenylephrine. *Middle East Afr J Ophthalmol*. 2012;19(4):357–60.
8. Groudine SB, Hollinger I, Jones J, et al. New York State guidelines on the topical use of phenylephrine in the operating room. The Phenylephrine Advisory Committee. *Anesthesiology*. 2000;92:859–64.
9. Shams F, Jafari AA, Mansfield D. Cardiovascular hazard of intracameral phenylephrine. *J Cataract Refract Surg*. 2015;41(9):2021–2.