Original Article

A Delphi method based consensus statement for surgical management of proliferative diabetic retinopathy in India

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Purpose: To derive consensus statements for surgical management of proliferative diabetic retinopathy (PDR) for vitreoretinal (VR) surgeons. **Methods:** Thirteen prolific VR surgeons representing all regions of India were invited to participate in a 42-point questionnaire based on the Delphi methodology describing various surgical scenarios commonly encountered in PDR. Consensus was derived using predefined robust analytics. Scenarios that returned a moderate consensus in round 1 were taken to round 2 as per the Delphi methodology. After considering all inputs, the final consensus criteria were developed. **Results:** A strong consensus was derived about waiting for 4 weeks before considering vitrectomy. In treatment-naïve eyes with fresh vitreous hemorrhage (VH), the wait time was slightly shorter for extramacular tractional retinal detachment (2–4 weeks) and longer (4–6 weeks) for eyes treated previously with laser or anti-VEGF agents. The expert panel recommended using preoperative anti-VEGF only in eyes with large membranes requiring extensive dissection. For post vitrectomy VH, while a conservative approach was recommended for the first episode of VH, experts recommended immediate vitreous lavage for recurrent episodes of VH. In eyes with iris neovascularization, the panel recommended immediate anti-VEGF injection followed by early vitreous lavage in nonresponsive eyes. A strong consensus was derived for stopping antiplatelet agents before surgery, while there was only a moderate consensus for performing vitrectomy for recalcitrant macular edema unresponsive to anti-VEGF injections in the absence of traction. **Conclusion:** This study provides valuable consensus on managing the different scenarios encountered during surgical management of PDR and should help guide the VR surgeons in clinical decision-making.

Key words: Anti VEGF, diabetic retinopathy, pars plana vitrectomy, tractional retinal detachment, vitreous hemorrhage

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Diabetic retinopathy (DR) is a leading cause of legal blindness among the working-age group.[1] Vision loss can be secondary to diabetic macular edema (DME) or complications of proliferative diabetic retinopathy (PDR) such as vitreous hemorrhage (VH) and tractional retinal detachments (TRD). Optimum management requires a critical interplay of systemic and ocular management.[2] Surgical strategies for DR management have a lot of scenarios ranging from, but not limited to, dense fresh vitreous hemorrhage with no view of the retina to no vitreous hemorrhage but tractional retinal detachment suggestive of burnt-out disease. These cases can present in treatment-naïve or pretreated eyes. The entire spectrum requires different surgical approaches ranging from vitrectomy to membrane dissection and internal limiting membrane (ILM) peeling. Other factors such as prior pan-retinal photocoagulation (PRP) and the use of anti-vascular endothelial growth factor (VEGF) agents also influence decision making.

Approach to surgical management of these cases is varied[3] and requires consideration of many factors. Surgical strategies have also evolved over time with relatively early

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surgery recommended for fresh VH currently.[4-7] Despite evolving literature, controversies and knowledge gaps still exist in many scenarios involving surgical management of DR. Additionally, there are significant variations used by different surgeons to achieve the best outcomes for their patients.[3] To address these lacunae, we present consensus criteria generated from leading vitreoretinal (VR) surgeons of India addressing the management of DR, with an emphasis on surgical decision-making.

Methods

The Delphi method was used to arrive at consensus criteria using previously described robust methodologies.[8,9] A group of 13 fellowship-trained, experienced, and prolific vitreoretinal surgeons were identified from different geographical locations in India and invited to participate in the formulation of the consensus criteria. These participants were identified from the vitreoretinal society of India (VRSI) database based on their experience, clinical acumen, and prior publication history. Various scenarios encountered in DR were discussed by the lead authors (MDS and SS) and pilot-tested with two members of the expert panel (DR and ASK) before finalizing the questions and their options. The scenarios were then presented in the form of a questionnaire with multiple choice answers [Fig. 1] along with a series of relevant full-text articles from the literature using a Google drive link. The questionnaire was shared via Google Forms and adhered to the CHERRIES guidelines for online surveys. The inputs from this Delphi round 1 were analyzed to identify consensus in various scenarios. For questions with more than two available answers, responses for each question were categorized in the ascending order of either time (i.e., timing of vitrectomy-related questions) or complexity of the intervention (e.g., PRP, anti-VEGF, and vitrectomy, in that order). A previously used strategy was employed to determine the level of consensus for each scenario.[8] In summary, the overall likelihood and the agreement to select a particular response to a given PDR scenario among experts was quantified in terms of median score and interquartile range (IQR), respectively. The median score indicates the central tendency of experts to choose a particular treatment. An IQR of 0 indicates absolute consensus among experts, whereas IQRs of 1 and 2 were considered as moderate and no consensus indicators, respectively. In addition to the median and IQR method, we looked at the percentage of each response to each scenario. In general, a strong consensus corresponded to more than 70% of experts recommending the same treatment option for the scenario. Similarly, a moderate consensus corresponded to between 54% and 69% of experts, that is, 7–9 experts recommending the same treatment option for the scenario, and "no consensus" was derived when ≤ 6 experts (<46%) recommended the same option for the scenario.

Those scenarios that returned an IQR of 1, that is, moderate consensus, were represented as a second questionnaire and sent to the same expert panel (Delphi 2). The responses were suitably modified based on inputs from round 1 and data available in the literature. In round 2, in addition to the questions, a short summary of existing literature was also presented with each question instead of the full-text articles as done in round 1, with the aim of improving the consensus related to the particular scenario. After considering these inputs, the final consensus criteria were developed.

Results

All 13 invited VR surgeons agreed to participate in the study and completed all questions in both Delphi rounds. The median experience of the participants was 17 years (interquartile range: 16–24 years) and ranged from 7 to 29 years. A summary of all the questions asked, the most common responses to each scenario by the expert panel, the median (IQR) scores for Delphi rounds 1 and 2, and the level of consensus achieved for each scenario are shown in Table 1. An algorithmic approach to surgically manage cases of PDR is also presented in Fig. 2.

I. Consensus regarding management of PDR in a treatment-naïve eye

A. Treatment-naive PDR with VH and no view of fundus

In eyes with fresh VH and no view of the fundus without any TRD on ultrasound, there was a strong consensus about opting for vitrectomy only after 4 weeks if the VH did not clear enough to initiate pan-retinal photocoagulation (PRP) (n = 11, 85%; median: 3 (IQR: 0)). However, if there was extramacular TRD, there was moderate consensus to intervene earlier, either immediately or within 2 weeks, if VH did not clear enough to visualize membranes and initiate PRP (n = 8, 61%; median: 3 (IQR: 1)). There was also a strong consensus about not employing intravitreal anti-VEGF therapy before vitrectomy in these scenarios in the absence of TRD (n = 12, 92%; median: 0 (IQR: 0)). For VH with macular TRD, there was a unanimous consensus to intervene immediately (n = 13, 100%; median: 0 (IQR: 0)) and there was a moderately strong consensus to employ preoperative anti-VEGF if extensive membrane dissection was anticipated during surgery (n = 9, 69%; median: 1 (IQR: 1)). However, preoperative anti-VEGF was recommended for all cases of macular TRD by 15% of respondents, while the other 15% did not recommend its use.

B. Treatment-naive PDR with VH and partial view of fundus in treatment-naive eyes

In this scenario, there was a strong consensus with (n = 11, 85%; median: 1 (IQR: 0)) experts recommending immediate PRP without any additional anti-VEGF, with only one expert recommending anti-VEGF monotherapy.

C. Treatment-naive PDR and no vitreous hemorrhage

In the scenario with no DME and no TRD, there was a strong consensus about treating with pan-retinal photocoagulation (PRP) alone (n = 12, 92%; median: 1 (IQR: 0)), while in cases with coexistent PDR and center-involving DME, there was a strong consensus about treating with a combination of PRP and anti-VEGF injections (n = 12, 92%; median: 3 (IQR: 0)). In eyes with extramacular TRD, the consensus was strong for Immediate PRP followed by vitrectomy if TRD involves or threatens the macula (n = 12, 92%; median: 1 (IQR: 0)). In treatment-naïve eyes without VH and with a macular TRD, though the recommendation was to operate immediately, the consensus on the use of preoperative anti-VEGF was only moderately strong, with the majority favoring its use only when there were large membranes requiring extensive dissection (n = 8, 62%; median: 3 (IQR: 1)).

II. Consensus regarding management of PDR in eyes previously treated with anti-VEGF and/or PRP

A. PDR with VH and no view of fundus in pretreated eyes

There was no consensus about the timing for vitrectomy in the cohort of eyes without TRD on ultrasound and with opinion varying in favor of waiting for 4–6 weeks for the VH to clear spontaneously before intervening (n = 5, 39% for both 4 weeks and 6 weeks; median: 3 (IQR: 1)). In similar circumstances with extramacular traction, there was moderately strong consensus

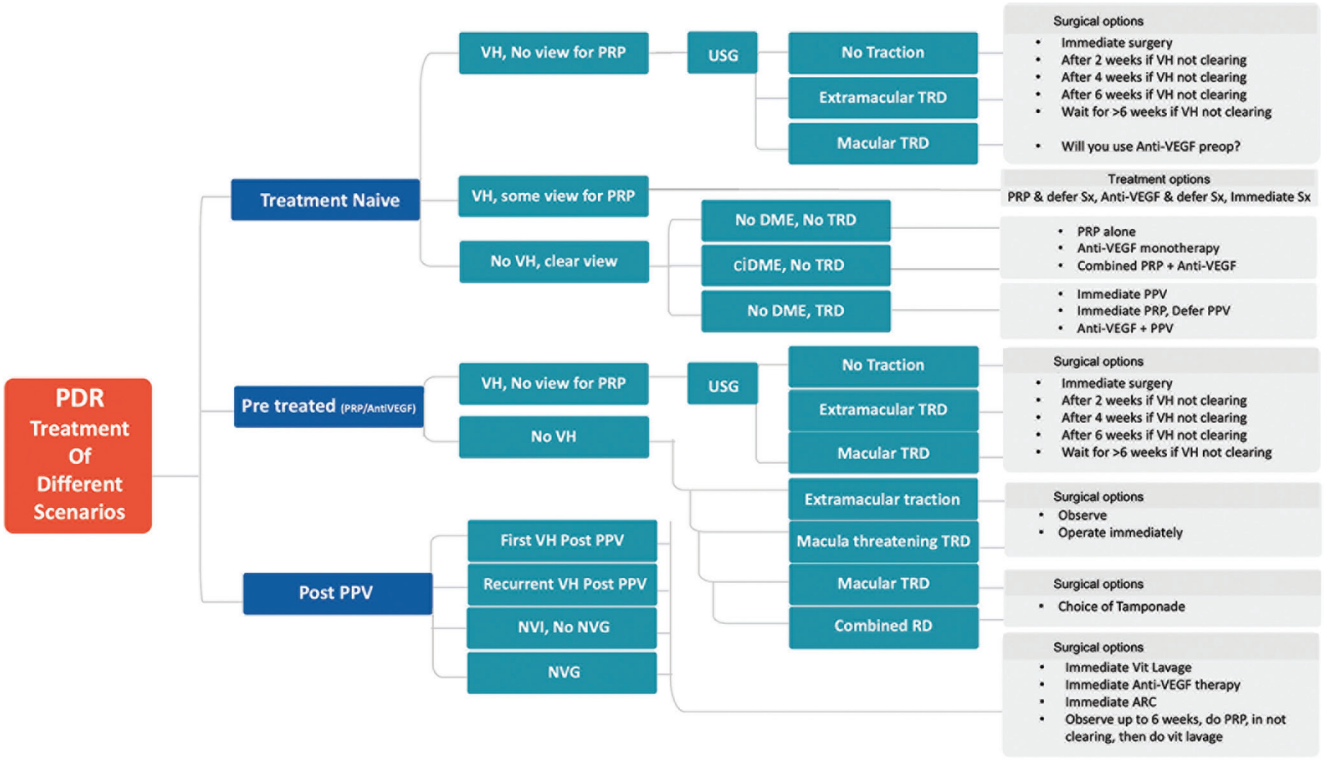

Figure 1: All the scenarios considered for questionnaire development along with treatment options for all scenarios. PPV = pars plana vitrectomy, Sx = surgery, VH = vitreous hemorrhage, PDR = proliferative diabetic retinopathy, PRP = pan-retinal photocoagulation, ci = center-involving, TRD = tractional retinal detachment, vit = vitreous, USG = ultrasound, NVI = neovascularization of the iris, NVA = neovascularization of the angles, NVG = neovascular glaucoma, DME = diabetic macular edema

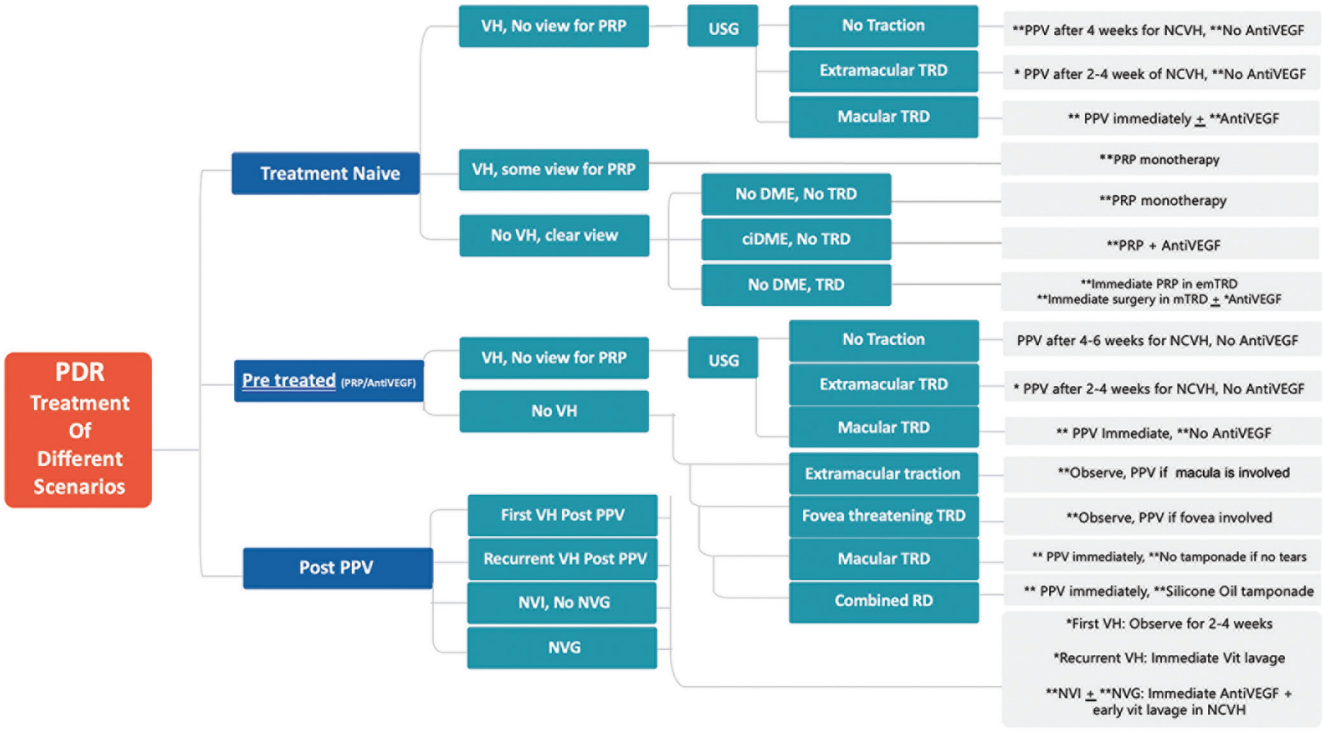

Figure 2: Recommended treatment for each scenario with ** showing strong consensus and * showing moderate consensus. PPV = pars plana vitrectomy, Sx = surgery, VH = vitreous hemorrhage, PDR = proliferative diabetic retinopathy, PRP = pan-retinal photocoagulation, ci = center-involving, TRD = tractional retinal detachment, vit = vitreous, USG = ultrasound, NVI = neovascularization of the iris, NVA = neovascularization of the angles, NVG = neovascular glaucoma, DME = diabetic macular edema, em = extramacular

Table 1: PDR - Consensus statements for surgical management in India

Question	Commonest response	2nd commonest response	Median (IQR) After Delphi 1	Median (IQR) After Delphi 2	Final Consensus	Comment
Subsection 1.1 Treatment-naive PDR with vitreous hemorrhage and NO view of fundus						
**Q1: In treatment-naive PDR with vitreous hemorrhage (VH), No view of fundus and no traction on USG, when do you decide on surgery	After 4 weeks if VH not clearing (*n*=11, 85%)	After 2 weeks if VH not clearing (*n*=2, 214%)	3 (1)	3 (0)	Strong	Wait for 4 weeks and consider PPV if vitreous VH is not clearing to initiate PRP at all
Q2: In this scenario (VH, No TRD), when deciding on vitrectomy, do you recommend using anti-VEGF before surgery?	No (*n*=12, 92%)	Yes (*n*=1, 8%)	0 (0)	0 (0)	Strong	Anti-VEGF not recommended
**Q3: In a case of treatment naive PDR with vitreous hemorrhage (VH) with no view of the fundus, with extra macular traction on USG, when would you opt for vitrectomy?	Immediate or After 2 weeks if VH not clearing (*n*=8, 61%)	After 4 weeks if VH not clearing (*n*=5, 39%)	3 (1)	3 (1)	Moderate	Intervene either immediately or within 2 weeks (based on USG) if VH is not clearing to initiate PRP
Q4: In this scenario (VH with extramacular TRD), when deciding on vitrectomy, do you recommend using anti-VEGF before surgery?	No (*n*=13, 100%)	--	0 (0)	0 (0)	Strong	Anti-VEGF not recommended
Q5: In a case of treatment-naive PDR with vitreous hemorrhage (VH) with no view of the fundus, and macular TRD on USG, when would you opt for vitrectomy?	Immediately (*n*=13, 100%)	--	0 (0)	0 (0)	Strong	Immediate vitrectomy recommended by the group
**Q6: In this scenario (VH with macular TRD), when deciding on vitrectomy, do you recommend using anti-VEGF before surgery?	Yes, but only when I anticipate extensive dissection (*n*=9, 69%)	Yes in all cases of macular TRD (*n*=2, 15%), No, I don't recommend at all (*n*=2, 15%)	0 (1)	1 (1)	Moderate	Preop anti-VEGF is recommended in macular TRD when extensive membrane dissection is expected.
Section 1.2: Treatment naive PDR with Vitreous hemorrhage and partial view of fundus in treatment-naive eyes						
Q7: In treatment-naive PDR with Vitreous hemorrhage, and partial view of the retina (potentially possible PRP), with no macular TRD, which of the following do you recommend?	Immediate PRP and defer vitrectomy (*n*=11, 85%)	Immediate anti-VEGF and defer vitrectomy (*n*=1)	1 (0)	1 (0)	Strong	In the Indian scenario, PRP alone is still the consensus. Anti-VEGF monotherapy not recommended as yet
Section 1.3: Treatment-naive PDR and No vitreous hemorrhage						
Q8: In treatment-naive PDR with No Vitreous hemorrhage, No DME, and No TRD, what is the most recommended treatment	Treat with Immediate PRP alone (*n*=12, 92%)	Treat with anti-VEGF monotherapy and rescue PRP if needed (*n*=1)	1 (0)	1 (0)	Strong	In the Indian scenario, PRP alone is still the consensus. Anti-VEGF monotherapy not recommended as yet
Q9: In treatment-naive PDR with No Vitreous hemorrhage, but with center-involving DME and No TRD, what is the most recommended treatment	Combined PRP and anti-VEGF therapy from the beginning (*n*=12, 92%)	Treat with anti-VEGF monotherapy and rescue PRP if needed (*n*=1)	3 (0)	3 (0)	Strong	In the Indian scenario, PRP+anti-VEGF is the consensus. Anti-VEGF monotherapy not recommended as yet

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Table 1: Contd...

Question	Commonest response	2nd commonest response	Median (IQR) After Delphi 1	Median (IQR) After Delphi 2	Final Consensus	Comment
Section 1.3: Treatment-naive PDR and No vitreous hemorrhage						
Q10: In treatment-naive PDR with No Vitreous hemorrhage, but with extramacular TRD, what is the most recommended treatment	Immediate PRP followed by vitrectomy if TRD involves or threatens the macula (*n*=12, 92%)	Combined PRP and anti-VEGF therapy with vitrectomy if TRD involves or threatens the macula (*n*=1, 8%)	1 (0)	1 (0)	Strong	Early vitrectomy not recommended in this scenario; surgery indicated only if TRD threatens the macula
**Q11: In treatment-naive PDR with No Vitreous hemorrhage, but with macular TRD, what is the most recommended treatment	Immediate vitrectomy with preop anti-VEGF injection in cases with large membranes where I expect extensive dissection (*n*=8, 62%)	Immediate vitrectomy with preop anti-VEGF injection in all cases (*n*=2, 15%). Immediate vitrectomy alone (*n*=2, 15%)	1 (1)	3 (1)	Moderate	Immediate vitrectomy recommended with preop anti-VEGF only in cases where extensive membrane dissection is expected.
Subsection 2.1: PDR with Vitreous hemorrhage and NO view of fundus in pretreated eyes						
**Q12: In a case of pretreated eye with PDR and vitreous hemorrhage (VH) with no view of the fundus, with No traction on USG, when would you opt for vitrectomy?	After 4 weeks if VH not clearing (*n*=5, 39%)	After 6 weeks if VH not clearing (*n*=5, 39%)	3 (2)	3 (1)	No consensus	Though there is only a weak consensus yet, waiting for 4-6 weeks is recommended if VH does not clear to initiate PRP
**Q13: In a case of pretreated eye with PDR and vitreous hemorrhage (VH) with no view of the fundus, with extramacular traction on USG, when would you opt for vitrectomy?	After 4 weeks if VH not clearing (*n*=7, 54%)	After 2 weeks if VH not clearing (*n*=3, 23%)	3 (1)	3 (1)	Moderate	It is recommended to wait for 2-4 weeks and plan vitrectomy if VH does not clear to initiate PRP.
Q14: In a case of pretreated eye with PDR and vitreous hemorrhage (VH) with no view of the fundus, with macular TRD on USG, when would you opt for vitrectomy?	Immediately (*n*=13, 100%)	-	1 (0)	1 (0)	Strong	Immediate vitrectomy indicated with macular TRD
Q14.1: Do you recommend using preoperative anti-VEGF if deciding for vitrectomy in pretreated eyes?	No (*n*=11, 85%)	Yes (*n*=2, 15%)	0 (0)	0 (0)	Strong	Anti-VEGF not recommended in pretreated eyes
Section 2.2: PDR with no vitreous hemorrhage in pretreated eyes						
Q15: In a case of pretreated eye with PDR, no vitreous hemorrhage, with extramacular TRD, what is your primary recommendation?	Observe and plan vitrectomy if TRD threatens or involves the macula (*n*=12, 92%)	Immediate vitrectomy (*n*=1, 8%)	1 (0)	1 (0)	Strong	Early surgery not recommended in extramacular TRD when PDR is stable post PRP

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Table 1: Contd...

Question	Commonest response	2nd commonest response	Median (IQR) After Delphi 1	Median (IQR) After Delphi 2	Final Consensus	Comment
Section 2.2: PDR with no vitreous hemorrhage in pretreated eyes						
**Q16: In a case of pretreated eye with PDR, no vitreous hemorrhage, with fovea threatening TRD and relatively good vision, what is your primary recommendation?	Observe and plan vitrectomy if TRD involves the fovea (*n*=13, 100%)	--	1 (1)	1 (0)	Strong	It is recommended to closely observe and plan vitrectomy if TRD involves the fovea
**Q17: In a case of pretreated eye with PDR, no vitreous hemorrhage, with fovea involving TRD, assuming you will consider surgery, what is your primary tamponading agent of choice (if there are no iatrogenic tears)?	I don't use tamponade in such cases when all traction is released (*n*=10, 77%)	Gas tamponade - non expansile concentration (*n*=3, 23%)	1 (1)	1 (0)	Strong	A tamponade is not recommended in this scenario.
Q18: In the same scenario as Q17, if you experience iatrogenic retinal tears, what is your tamponade of choice?	Gas tamponade - non expansile concentration (*n*=6, 46%)	Oil tamponade (*n*=4, 31%)	3 (2)	3 (2)	No consensus	As there is no consensus, this will depend on the surgeon's choice
Q19: In a case of combined retinal detachment in PDR, what is your tamponade of choice?	Oil tamponade (*n*=10, 77%)	Gas tamponade - non expansile concentration (*n*=2, 15%)	4 (0)	4 (0)	Strong	Oil tamponade is recommended in this scenario
Q20: In the above scenarios involving some form of retinal detachment, in addition to the nature of RD and its configuration, does your tamponade depend on phakic status?	No, my tamponade depends on nature of RD alone (*n*=13, 100%)	-	1 (0)	1 (0)	Strong	Choice of tamponade should be based on the nature of the RD and not the phakic status
Section 3: Eyes with previous vitrectomy						
**Q21: In eyes with previous vitrectomy, with first episode of vitreous hemorrhage, what is your first recommended treatment?	Observe for 2 weeks and do PRP or consider lavage if not clearing (*n*=5, 39%)	Observe for 4 weeks and do PRP or consider lavage if not clearing (*n*=4, 31%)	4 (1)	4 (3)	No consensus	Though there is only a weak consensus yet, waiting for 2-4 weeks is advised if VH does not clear to initiate conservative treatment
**Q22: In eyes with previous vitrectomy, with recurrent episodes of vitreous hemorrhage, what is your first recommended treatment?	Immediate vitreous lavage (*n*=9, 70%)	Immediate anti-VEGF therapy (*n*=2, 15%)	1 (1)	1 (1)	Moderate	It is recommended to undertake immediate vitreous lavage
**Q23: In eyes with previous vitrectomy, with iris neovascularization with VH without raised IOP, what is your recommended treatment?	Immediate anti-VEGF therapy and early vit lavage and add PRP/ cryo (*n*=12, 92%)	Immediate Anterior retinal cryo (*n*=1, 8%)	2 (0)	2 (0)	Strong	Strong consensus to treat NVI with anti-VEGF monotherapy as first line and undertake early vitreous lavage in VH not clearing with anti-VEGF alone.

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Table 1: Contd...

Question	Commonest response	2nd commonest response	Median (IQR) After Delphi 1	Median (IQR) After Delphi 2	Final Consensus	Comment
Section 3: Eyes with previous vitrectomy						
Q24: In eyes with previous vitrectomy, with neovascular glaucoma with VH, what is your recommended treatment?	Immediate anti-VEGF therapy and early vit lavage and add PRP/ cryo (*n*=11, 85%)	Immediate vitreous lavage and add PRP/ cryo (*n*=2, 15%)	2 (0)	2 (0)	Strong	Immediate anti-VEGF followed by early vit lavage strongly recommended in this scenario
Q25: In eyes with previous vitrectomy, with NVI or NVG without VH (unlikely scenario), what is your recommended treatment?	Combined PRP with anti-VEGF (*n*=11, 85%)	Immediate Add PRP till Ora Serrata (*n*=2, 15%)	3 (0)	3 (0)	Strong	Combined treatment recommended strongly in this scenario
**Q26: In eyes with neovascular glaucoma, with controlled retinal status, salvageable visual potential, but uncontrolled NVG due to closed angles, what surgical treatment do you recommend?	I prefer tube directly (*n*=11, 85%)	Prefer Trab first (*n*=1, 8%). Prefer Diode CPC (*n*=1. 8%)	1 (1)	2 (0)	Moderate	Delphi 2 will reassess this with modified options.
Section 4: Miscellaneous section about surgery						
Q27: What gauge of vitrectomy do you prefer for most diabetic vitrectomies	25G (*n*=10, 77%)	23G (*n*=3, 23%)	2 (0)	2 (0)	Strong	25G surgery preferred by majority in the group
Q28: Do you stop antiplatelets (Aspirin or Clopidogrel) before diabetic vitrectomy?	I stop only clopidogrel (*n*=6, 46%)	I stop both (*n*=5, 31%)	2 (1)	2 (1)	Moderate	Though the consensus is moderate, most (*n*=10, 77% recommend stopping antiplatelet agents
Q29: In case of extensive membranes, do you prefer or tend to do bimanual surgery more often?	Yes (*n*=7, 54%)	No (*n*=6, 46%)	--	--	No consensus	There is no consensus on this and depends on surgeons' comfort
Q30: When doing membrane dissections, what is your preferred instrument to segment and delaminate?	Cutter (*n*=6, 46%)	Combination of cutter and scissor (*n*=6, 46%)	2 (2)	2 (2)	No consensus	There is no consensus on this and depends on surgeons' comfort and type of membrane to be dissected
Q31: Do you start membrane dissection from the ONH in any case?	Yes (*n*=8, 62%)	No (*n*=5, 38%)	--	--	Most believe that this is warranted when there is very adherent PVD and no cleavage plane can be obtained in the mid periphery	
Q32. Q32: If you do start membrane dissection from the ONH, please mention the surgical scenario succinctly						
Q33: Do you feel intraoperative OCT is an indispensable tool and surgical results improve with its utilization?	No - I feel an experienced surgeon can peel most membranes without this aid (*n*=9, 69%)	I have not experienced (*n*=3, 23%)	2 (0)	2 (0)	Strong	Intraop OCT not yet recommended by the group

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Table 1: Contd...

Question	Commonest response	2nd commonest response	Median (IQR) After Delphi 1	Median (IQR) After Delphi 2	Final Consensus	Comment
Q34: Do you think heads-up 3D VR surgery is more beneficial for diabetic vitrectomies over conventional BIOM based surgery?	No - I don't think 3D heads-up systems improve diabetic vitrectomies other than ergonomic support (*n*=9, 69%)	I have not experienced (*n*=3, 23%)	2 (0)	2 (0)	Strong	3D heads-up visualization systems, though help in ergonomics, most believe that BIOM use is enough to accomplish a diabetic vitrectomy.
Q35: Do you recommend ILM peeling for all cases undergoing diabetic vitrectomy, even when there is no ERM or pucker?	No (*n*=13, 100%)	--	--	--	Strong	Routine ILM peel not recommended
Q36: Do you recommend vitrectomy for tractional diabetic papillopathy, in the absence of macular traction	I defer surgery and consider it if there is documented vision loss attributable to tractional papillopathy (*n*=10, 77%))	I don't operate as I don't believe that tractional papillopathy is a cause of progressive visual loss (*n*=2, 15%)	2 (0)	2 (0)	Strong	Recommendation is to wait for vision attributable to papillopathy before surgical intervention.
Q37: Do you inject anti-VEGF at the end of all diabetic vitrectomies with the aim of reducing postop bleeding?	No - I don't find it helpful (*n*=12, 92%)	Yes - I use it as it minimizes postop bleeding from residual stumps of fibrovascular proliferations (*n*=1, 8%)	1 (0)	1 (0)	Strong	Postop anti-VEGF at end of routine surgery not recommended by the group
Q38: Do you recommend doing cryo to the sclerotomy ports in 23G, 25G, and 27G surgeries in all cases?	No - I don't think this is essential in the MIVS era (*n*=13, 100%)		--	--	Strong	Routine cryo to sclerotomy sites not indicated at present
Q39: In eyes planned for vitrectomy and having early cataract (<NS2, no PSC, Cortical cataract<5 clock hours) that will not interfere with visualization, do you recommend combining phacoemulsification in view of early cataract developing post PPV and obscuring postop view?	No - I don't combine PPV with Phaco unless there is significant cataract that is likely to interfere with surgery (*n*=11, 85%)	Yes - I recommend doing cataract surgery along with PPV in view of inevitable cataract after PPV and difficulty in IOL power calculations at a later date (*n*=2, 15%)	1 (0)	1 (0)	Strong	Combining cataract surgery in eyes with early cataract that will not interfere with intra-operative visualization not recommended by the group
**Q40: Do you recommend doing PPV for DME not responding to anti-VEGF (without VMT and Taut PHF)	Yes - I think it helps reduce hypoxia and leads to anatomic benefit, and occasionally visual benefit (*n*=9, 69%)	No - I don't believe in PPV for DME (*n*=4, 31%)	--	--	Moderate	If doing vitrectomy, peel ILM where it peels easily, as far as possible, without causing nerve trauma, may not be in all cases.
**Q41: If you do PPV for non-responding DME, do you combine it with ILM peeling?	Yes - only in few cases where ILM peels easily (*n*=5, 39%)	Yes - in all cases (*n*=4, 31%)	4 (3)	4 (3)	No consensus	

Contd...

Table 1: Contd...

Question	Commonest response	2nd commonest response	Median (IQR) After Delphi 1	Median (IQR) After Delphi 2	Final Consensus	Comment
**Q42.1: In cases where surgery is indicated in both eyes, with one eye having VH/No TRD (anatomically simpler involvement and hence potentially better final visual outcome) and other eye has TRD - which will you will first operate?	Eye with VH (*n*=11, 85%)	Eye with TDR (*n*=2, 15%)	1 (1)	1 (0)	Strong	Operate the better eye first i.e., the eye with VH first.
**Q42.2: In eyes with complex TRDs bilaterally, one eye with atrophic thin retina and poorer vision, other eye with better vision and healthier retina - which eye will you operate first?	Eye with healthier retina and better vision (*n*=13, 100%)	-		1 (0)	Strong	Operate the better eye with better visual potential first

**Consensus derived from the second round of questions. The commonest and second commonest responses are after the second round of Delphi. The final consensus is what was arrived upon after two rounds.

on waiting for a slightly longer duration than in treatment-naïve eyes (4 weeks) before considering vitrectomy (*n* = 7, 54%; median: 3 (IQR: 1)). There was a total consensus for operating immediately in eyes with macular TRD in this scenario (*n* = 13, 100%; median: 1 (IQR: 0)), with a vast majority not preferring the use of preoperative anti0VEGF in pretreated eyes (*n* = 11, 85%; median: 0 (IQR: 0)).

B. PDR with no vitreous hemorrhage in pretreated eyes

In pretreated eyes with no new or active neovascularization and extramacular TRD, there was a strong consensus to observe and plan vitrectomy if TRD threatened or involved the macula (*n* = 12, 92%; median: 1 (IQR: 0)). In the same scenario with fovea-threatening TRD and relatively good vision, there was complete consensus on observation and vitrectomy was recommended only if the TRD involves the fovea and there was a drop in vision (*n* = 13, 100%; median: 1 (IQR: 0)). In the same situation but with macular TRD, immediate surgery was recommended, with a strong consensus for not using any tamponade other than air when all traction was released and there were no iatrogenic breaks (*n* = 10, 77%; median: 1 (IQR: 0)). In eyes with TRD and iatrogenic retinal tears, there was no consensus about tamponade use, with some experts preferring gas (*n* = 6, 46%), while others preferring silicone oil (*n* = 4, 31%) (median: 3 (IQR: 2)). However, when there was combined retinal detachment (RD), there was a strong consensus about the use of silicone oil (*n* = 10, 77%; median: 4 (IQR: 0)). Additionally, all the experts recommended choice of tamponade based on the configuration of the RD and not on factors such as phakic status of the eye (*n* = 13, 100%; median: 1 (IQR: 0)).

III. Management of eyes with previous vitrectomy

In eyes with the first episode of VH after vitrectomy, most experts recommended waiting for spontaneous clearance of VH as the first step, but there was no consensus about the observation period, varying between 2 and 4 weeks, before considering vitreous lavage (for 2 weeks: *n* = 5, 39%; for 4 weeks: *n* = 4, 31%; median: 4 (IQR: 3)). In eyes with recurrent episodes of VH, where the first one was managed conservatively, there was a moderate consensus on immediate vitreous lavage (*n* = 9, 70%; median: 1 (IQR: 1)). In vitrectomized eyes with VH and iris neovascularization with or without neovascular glaucoma, there was a strong consensus on immediate anti-VEGF therapy and early vitreous lavage with additional PRP or anterior retinal cryotherapy as needed (*n* = 12, 92%; median: 2 (IQR: 0)). For management of neovascular glaucoma, though most experts preferred to refer patients to their glaucoma colleagues, their preferred practice obtained during round 2 of Delphi revealed that the majority preferred tube shunts for control of intraocular pressure (*n* = 11, 85%; median: 2 (IQR: 0)).

IV. Recommendations about preoperative preferences, steps of surgery, and miscellaneous considerations in diabetic vitrectomies

There was a strong consensus on using 25-G vitrectomy systems for diabetic vitrectomies (*n* = 10, 77%; median: 2 (IQR: 0)). In patients on anti-platelet drugs, such as low-dose aspirin and clopidogrel, though a majority recommended temporary discontinuation of these before surgery, there was a moderate consensus on stopping only clopidogrel (*n* = 6, 46%) or both aspirin and clopidogrel (*n* = 5, 31%) (median: 2 (IQR: 1)). We found that bimanual surgery was preferred by 50% of the participants (no consensus to recommend its routine use). There was also no consensus about the instrumentation to be used for segmentation and delamination, with 50% preferring the cutter alone while the rest preferred a combination of intravitreal scissors and the cutter. In the exceedingly rare situation (<5% cases) where posterior hyaloid is found to be densely adherent with no cleavage plane in mid periphery, the members opined that membrane dissection can be started from the optic nerve head. Most felt strongly about being able to manage dissections without intraoperative OCT during surgery and did not feel the need to switch to 3D heads-up VR surgery even when available, with ergonomics the only perceived benefit. All participating experts recommended against routine ILM peeling in diabetic vitrectomies without ERM or macular pucker (*n* = 13, 100%). Similarly, the majority preferred to defer vitrectomy for tractional diabetic papillopathy and considered it if there was documented vision loss attributable to tractional papillopathy (*n* = 10, 77%; median: 2 (IQR: 0)). With the exception of one expert, none of the experts recommended routine use of anti-VEGF at the end of vitrectomy to minimize

postoperative bleeding (n = 12, 92%; median: 1 (IQR: 0)). In addition, there was a strong consensus on not combining vitrectomy with phacoemulsification in eyes with early cataract that does not hamper intraoperative visualization (n = 11, 85%; median: 1 (IQR: 0)). There was only a moderate consensus for performing vitrectomy with ILM peeling for eyes with DME nonresponsive to anti-VEGF injections (n = 9, 69%). When performing this procedure, half of the experts recommended ILM peeling limited to eyes where the ILM peels relatively easily without trauma to the neurosensory retina while others recommended peeling ILM in all cases. In patients requiring bilateral surgery, most preferred to operate the eye with better visual potential first. On inquiring about not taking eyes up for surgery, most mentioned that they would not recommend surgery in eyes with atrophic retina, sclerosed vessels, and a pale optic disc, or eyes with long-standing macular TRD.

Discussion

In this study, we sought to build a consensus for varied scenarios involving the surgical management of PDR in India with the help of 13 prolific vitreoretinal surgeons representing all regions of India. After two rounds of questions using the Delphi system, we were able to establish a strong consensus for 62% of the scenarios while moderate consensus was obtained in 14% scenarios and no consensus for the rest.

In terms of timing of vitrectomy, experts strongly recommended waiting for 4 weeks for spontaneous clearance of VH in treatment-naïve eyes while the recommended waiting period was slightly longer (4–6 weeks) in pretreated eyes. Experts preferred to intervene earlier in eyes with extramacular TRD and nonresolving VH, though the consensus for this was only moderate. When there was a macular TRD, immediate surgery was recommended in all scenarios. As per the literature, the timing of surgery is debatable, with no meaningful evidence favoring early over delayed surgery in recent times.[4,5,7] The DRVS showed the benefit of early surgery in eyes with nonclearing VH but defined early surgery as before 3 months.[10] However, this study was done more than two decades ago. With recent improvements in VR surgical armamentarium including high-speed cutters and better visualization systems, most VR surgeons would consider surgery before the recommended 3 months. The AAO-preferred practice pattern also recommends early surgery but does not specify a cut-off time period for this.[4] More recent studies show a trend toward better outcomes with early surgery (≤4 weeks),[5,7] though most have small sample sizes and significant methodological challenges to make robust recommendations. Based on our results, it is reasonable to consider 4 weeks as the pivotal time point when a decision to undertake vitrectomy should be made, with slightly earlier intervention when there are tractional elements at play as evidenced by ultrasound and slightly delayed surgery in pretreated eyes. In future studies, incorporation of vision criteria in this decision-making algorithm may improve its applicability.

The use of preoperative anti-VEGF injections has also been long debated with unclear guidelines for their use. Most papers recommending this approach point toward only modest benefits such as lower incidence of intraoperative bleeding, iatrogenic tears, and lower postoperative bleeding as well as lower incidence of macular edema after surgery.[11-13] Our expert panel recommends using preoperative anti-VEGF only when dealing with large vascular membranes requiring extensive dissection only in treatment-naïve eyes. Given that anti-VEGF use adds to the cost of treatment, additional hospital visits, and potential worsening of the tractional component of PDR post anti-VEGF if patients do not turn up for planned surgery after receiving the injection, this appears to be a reasonable recommendation for resource-limited settings. Surprisingly, despite relatively good evidence of reduced postoperative bleeding with intraoperative use of anti-VEGF at the end of the surgery,[11,13,14] all experts except one did not recommend this. Our study also shows that PRP, when possible, is the mainstay of treatment of PDR in our settings. Despite many studies,[15] including Protocol S from the DRCR network showing benefits of anti-VEGF monotherapy in eyes with PDR, the added burden of repeated injections and fear of loss to follow-up governs these decisions.[16]

In eyes with extramacular TRD, the expert panel recommended a conservative approach without an early surgery because despite the advances in instrumentation, success of diabetic vitrectomy is largely dependent on the degree of PVD present and the ease with which it can be separated during surgery. This depends on the time of intervention, duration of the traction, age of the patient, type of diabetes, etc., and hence cannot be safely predicted. Stewart *et al*.[17] in a review article recommend surgical intervention for macula-involved TRD, with observation and additional laser for extramacular detachments.[18] Our expert panel did not recommend using long-acting tamponading agents after vitrectomy in eyes without iatrogenic tears when all tractional components were removed. Though there was no consensus on the use of long-acting gas vs. silicone oil in cases with iatrogenic tears, there was a strong consensus, with the panel recommending silicone oil in eyes being operated for combined mechanism RD. A recent randomized clinical trial found better visual outcomes in eyes that received gas as tamponade post vitrectomy for TRD as compared to 1000 cs silicone oil. Eyes with gas also had more subjects with 20/50 visual recovery but had a slightly higher incidence of the need for repeat vitrectomy, which was not statistically significant.[19] Experts also recommended against selecting tamponade based on the lenticular status of the patient and agent selection should be based on the configuration of the RD alone. In eyes that had undergone vitrectomy in the past, a more conservative approach was recommended for the first episode of VH after surgery while immediate vitreous lavage was recommended for repeat episodes. This may also vary depending upon the time since previous vitrectomy, amount of residual traction after the first surgery, occurrence of neovascular fonds at the previous sclerotomy sites, and the lenticular status of the patient.[20,21] Though this consensus survey did not qualify the time since vitrectomy for recurrent vitreous hemorrhage, any hemorrhage occurring 4–6 weeks after uneventful surgery may be due to sclerotomy site neovascular proliferation, which may need ultrasound biomicroscopy evaluation and earlier intervention. However, it is difficult to record every aspect of the decision-making process and hence, it is a reasonable approach to be conservative during the first episode and aggressive with recurrent episodes.[20,21] In vitrectomized eyes with iris neovascularization, with or without raised intraocular pressure, intravitreal anti-VEGF was the first line of treatment followed by early vitreous lavage if the hemorrhage did not clear, similar to the findings presented in the literature.

Most experts in the panel felt the need to stop antiplatelet agents before surgery to minimize intraoperative bleeding, despite recent papers showing no association between antiplatelet agents and VR surgery.[22] We recommend that if stopping these agents, it should be done in consultation with the patient's treating physician.

The type of surgical instrumentation and use of bimanual techniques are extremely surgeon-dependent and hence

no consensus was reached on these aspects. Despite recent evidence suggesting ILM peeling to be beneficial for all diabetic vitrectomies,[23] our expert panel did not recommend it in the absence of epiretinal membranes or taut posterior hyaloid face. This may be because the ILM in diabetic eyes appears more friable, is more ischemic, difficult to grasp, is therefore technically more challenging to peel, and is often removed piecemeal. It can also be associated with significant neurosensory damage in diabetic eyes and rarely may precipitate full-thickness macular holes, and hence extreme caution should be exercised while attempting ILM peeling in all cases. In recalcitrant DME unresponsive to anti-VEGF injections, despite evidence in the literature favoring vitrectomy with ILM peeling,[24] our panel could arrive at this recommendation with only a moderate consensus, with 30% not favoring this approach, suggesting that surgery should be undertaken with extreme caution in these eyes after explaining the possibility of visual loss due to the surgery itself, a point of view supported by previous studies.[25,26] Lastly, a strong agreement for not requiring 3D heads-up surgery and intraoperative OCT to guide surgical maneuvers is a welcome conclusion from this study given the prohibitive cost of these added instrumentations with incremental benefits at best.

Conclusion

In conclusion, this expert panel recommends early vitrectomy at around 4 weeks for nonclearing VH in eyes with PDR, titrating waiting times to slightly shorter with more tractional elements and longer for pretreated eyes. Immediate surgery is recommended for eyes with macular TRD irrespective of other circumstances at play, though the use of preoperative anti-VEGF is recommended only in cases with large membranes requiring extensive dissection. The recommendation for extramacular TRDs is to wait and watch till there is vision drop and surgery becomes mandatory. In vitrectomized eyes, the first episode of VH should be managed conservatively while recurrent VH may require immediate resurgery. In presence of iris neovascularization, immediate anti-VEGF followed by early vitreous lavage is recommended. Surgeons should operate on the eye with better visual potential first in cases requiring bilateral surgery.

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Conflicts of interest

There are no conflicts of interest.

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