Special Focus, Retina, Original Article

Retinal detachment in eyes treated with Aurolab aqueous drainage implant for refractory glaucoma - Incidence and outcomes

Naresh Babu, Girish Baliga, George Varghese Puthuran[1], Kim Ramasamy

Purpose: To analyze the incidence of rhegmatogenous retinal detachment (RRD) in patients who have undergone prior Aurolab aqueous drainage implant (AADI) surgery and report outcomes in terms of anatomic, visual acuity, and intraocular pressure (IOP) findings. **Methods:** Case records of all patients who underwent RRD repair after AADI surgery from 2013 to 2019 were retrospectively analyzed. Data collected included patient demographics, ocular examination findings at all visits including IOP and best-corrected visual acuity (BCVA) and clinical findings related to RRD both at baseline and postoperatively. **Results:** Ten eyes of nine patients were included in study. The mean age of patients was 28.2 years (median: 15 years, range: 6–83 years). Mean duration between AADI and RRD was 14 months (median 2.5 months; range 2 days-72 months). All eyes underwent pars plana vitrectomy with silicon oil injection. The preoperative LogMAR BCVA (logarithm of the minimum angle of resolution) was 2.52 ± 0.15 which improved to 2.29 ± 0.58 at final follow-up; however, only one eye had vision ≥ 20/400 largely due to recurrent RRD and advanced glaucomatous disc damage. Postoperatively retina was attached in 6 eyes (60%) and IOP was ≤ 21 mmHg in 5 out of 6 eyes with anatomic success. **Conclusion:** The incidence of RRD following AADI was found to be 0.86% in our study. Pars plana vitrectomy (PPV) with silicon oil tamponade was the preferred approach in the management of these eyes with IOP being well controlled post PPV. However, visual acuity outcomes were largely unsatisfactory due to recurrent RRD and preexisting advanced glaucoma.

Access this article online

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_1546_21

Quick Response Code:

Key words: Aurolab aqueous drainage implant (AADI), pars plana vitrectomy, retinal detachment

Glaucoma drainage devices (GDDs), first described by Molteno in 1969, are fast becoming an effective surgical option in the management of complex glaucoma.[1] GDDs have been evaluated for decades and have been classified into two types: nonvalvular [Molteno, Baerveldt Glaucoma Implant (BGI)] and valvular [Ahmed Glaucoma Valve (AGV)], both of which share a common design of a tube that shunts aqueous humor from the anterior chamber to an endplate located at the equatorial region of the globe thereby reducing intraocular pressure (IOP).[2] The Aurolab aqueous drainage implant (AADI; Aurolab, Madurai, India) is a nonvalved, low-cost GDD, similar in design and available at a fraction of the cost of the BGI, and is the latest addition in the armamentarium for the management of refractory glaucomas.[2]

As GDD placement becomes more frequent, the significance of postoperative complications and their long-term outcomes increases. The number of patients presenting with posterior segment complications is also expected to increase. Retinal complications have been described in 14%–50% of eyes with GDD implantation and the majority occurs within 35 days post GDD implantation.[3] Rhegmatogenous retinal detachment (RRD) has been noted in 5% (16/350) eyes following Molteno valve implantation.[4] The safety and efficacy of the AADI in controlling refractory glaucoma has been described previously; however, the incidence of RRD and its outcomes have not been elucidated in detail.[2,5-9] This article reports the anatomic, visual acuity, and intraocular pressure (IOP) outcomes among patients with a preexisting AADI device who underwent RRD repair.

Methods

This was a retrospective study done from 2013 to 2019 in which medical records of patients who underwent RRD surgery following AADI at a tertiary eye care center in South India were reviewed. The study was conducted with the approval of the institutional review board and adhered to the tenets of the declaration of Helsinki. Prior to AADI procedure, informed consent was taken from all patients after explaining the risks and benefits and possible complications arising from the

Departments of Vitreo-retinal Services, [1]Glaucoma, Aravind Eye Hospital and Post Graduate Institute of Ophthalmology, Madurai, Tamil Nadu, India

Institution at which work was done: Department of Vitreo-retinal Services, Aravind Eye Hospital and Post Graduate Institute of Ophthalmology, Madurai, Tamil Nadu, India

Correspondence to: Dr. Girish Baliga, Department of Vitreo-retinal Services, Aravind Eye Hospital and Post Graduate Institute of Ophthalmology, Madurai, Tamil Nadu, India. E-mail: irish192@gmail.com

Received: 03-Jun-2021 Revision: 13-Aug-2021
Accepted: 19-Nov-2021 Published: 22-Mar-2022

Cite this article as: Babu N, Baliga G, Puthuran GV, Ramasamy K. Retinal detachment in eyes treated with Aurolab aqueous drainage implant for refractory glaucoma - Incidence and outcomes. Indian J Ophthalmol 2022;70:1287-93.

procedure. Data collected included demographic information, baseline and postoperative best-corrected visual acuity (BCVA) and IOP, interval between AADI implantation and RRD, details of RRD extent with break localization, and surgical technique. The technique of AADI surgery has been already described in previous reports from our institution.[7]

The technique of RRD repair included 23G vitrectomy in all the cases using the Alcon Constellation vitrectomy machine (Alcon Laboratories, Fort Worth, TX) with a noncontact viewing system RESIGHT 700 (Carl Zeiss Meditec AG, Oberkochen, Germany). In all cases with choroidal detachment (CD), 6 mm infusion cannula was used. In cases where the cannula could not be visualized in the vitreous cavity due to high CD or edematous choroid, an AC maintainer after clear corneal paracentesis was used to build the IOP necessary for drainage. Suprachoroidal fluid was drained at the port site with the 23G sclerotomy using the nonvalved cannula, which is pulled back into the suprachoroidal space to express the straw colored fluid. A blunt cyclodialysis spatula was used subsequently to enter the suprachoroidal space to drain residual fluid by gently depressing the sclerotomy lips. Injection of BSS simultaneously or raising the bottle height to 60 mmHg also helps in this maneuver. In cases with kissing choroidal detachments or extensive choroidal detachment with suprachoroidal hemorrhage(SCH) posterior to the equator, sclerotomy was made at 8mm from the limbus using 23G trochar cannula system at the maximum height of SCH determined preoperatively by ultrasound to gain access to suprachoroidal space and evacuate the blood clots. Prior to starting vitrectomy, AADI tube was temporarily ligated with a 7-0 polyglactin suture to prevent silicon oil migration under the conjunctiva. After a triamcinolone-assisted core vitrectomy for identifying posterior hyaloid, complete vitrectomy with posterior vitreous detachment (PVD) was done. In cases where break was not made out preoperatively, posterior drainage retinotomy was made in the nasal quadrant [Fig. 1]. After membrane peeling and subretinal band removal, endolaser and intraocular silicon oil tamponade were done. [Fig. 2]. In cases with pars plana tube insertion, intraoperatively AADI tube was repositioned in anterior chamber (AC) to prevent oil drainage and hypotony. Sclerotomy placement and port closure were done meticulously so as not to disturb the AADI site. Scleral buckle (SB) or encircling band was not used in any case. Data regarding BCVA, IOP, and postoperative complications were retrieved for every visit from medical records.

Success of RRD surgery was defined by the following anatomic, functional, and IOP criteria:

1. Type 1 anatomical success was defined as total retinal re-attachment, with no detachment after silicon oil removal; type 2 anatomical success was defined as retinal re-attachment, with silicon oil *in situ* till the conclusion of the study; type 3 anatomic success was defined as attached posterior pole under silicon oil with peripheral detachment not extending beyond equator.

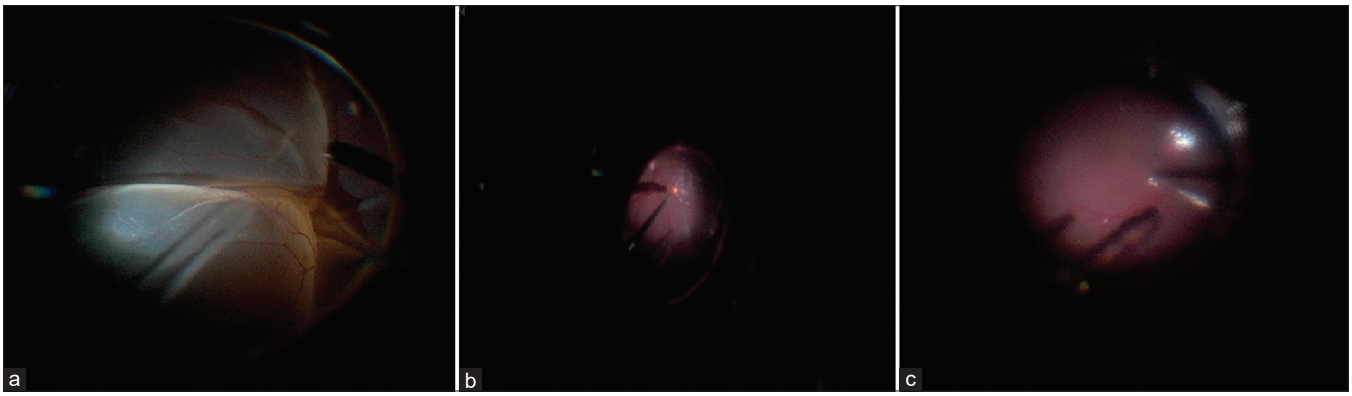

Figure 1: Intraoperative fundus image of patient 4 showing (a) Bullous retinal detachment with AADI tube in the vitreous cavity seen in the foreground in the supero temporal quadrant (b) Endolaser photocoagulation being done to the drainage retinotomy in the nasal quadrant (c) Attached retina at the end of fluid air exchange

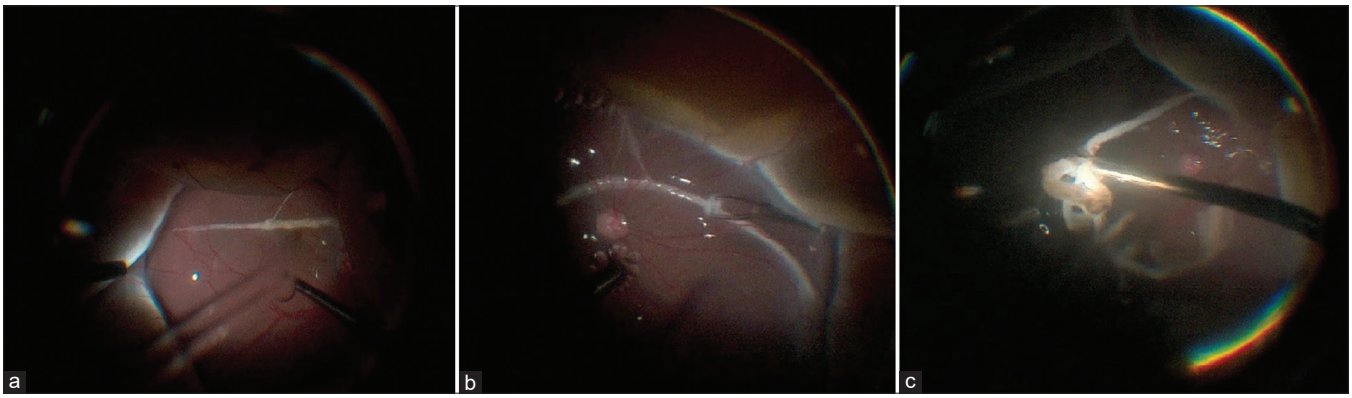

Figure 2: Intraoperative fundus image of patient 4 showing (a)Subretinal band extending below the disc and fovea; (b) After endodiathermy, forceps being used to remove the subretinal band; (c) Subretinal band removed in toto using forceps

Table 1: Preoperative characteristics of patients with AADI and RRD

Age/ Sex	Type of Glaucoma	Lens status	Pre AADI CDR (cup disc ratio)	BCVA in interval between AADI and RRD	Interval between AADI and RRD	Previous surgery/other findings	Tube Location AADI Quadrant	Extent of RRD	Break Location
17/F	Juvenile	Phakic	0.9	HM	2 days	Trabeculectomy, Spherophakia	AC, STQ	Total RRD 360 CD, hgic	Not Localized
62/F	Uveitic	Pseudo phakic	0.7	20/200	3 months	Trabeculectomy PI	AC, STQ	Temporal RRD,360 CD	Not Localized
10/M	Congenital	Phakic	0.8	20/200	72 months	Trabeculectomy, High myopia, Megalocornea	AC, STQ	Total RRD Inf CD	HST, STQ
8/F	Aphakic	Aphakia	0.9	20/200	48 months	ECCE	PC, STQ	Temporal RRD, nasal CD	Not Localized
60/F	POAG	Pseudo phakia	0.8	HM	1 month	Phaco	AC, SNQ	Total RRD 360 CD	Not Localized
6/F	Aphakic	Aphakia	0.7	20/40	4 months	ECCE	PC, INQ	Total RRD 360 CD	Not Localized
14/M	Aphakic	Aphakia	0.8	20/250	2 months	ECCE, Microcornea, Microphthalmos	AC, STQ	Total RRD 360 CD	Not Localized
16/F	Developmental	Pseudo phakia	0.9	PL	2 months	ECCE Microcornea	AC, STQ	Total RRD 360 CD, hgic	Not Localized
83/M	POAG	Pseudo phakia	0.9	20/200	2 months	Phaco	AC, STQ	Total RRD 360 CD	Not Localized
6/F	Aphakic	Aphakia	0.7	20/125	6 months	ECCE	AC, STQ	Inf RRD	Retinal hole ITQ

POAG: Primary open-angle glaucoma, PI: Peripheral iridotomy, ECCE: Extracapsular cataract extraction, Phaco : Phacoemulsification, AC: Anterior chamber, PC: Posterior chamber, RRD: Rhegmatogenous retinal detachment, CD: Choroidal detachment, STQ :Superotemporal quadrant, SNQ: Superonasal quadrant, INQ: Inferonasal quadrant, HST: Horse shoe tear, ITQ: Inferotemporal quadrant, inf: inferior, hgic: hemorrhagic

2. Functional success was defined by attached retina with either improvement or maintenance of BCVA at the time of final follow-up.
3. Successful IOP control was defined as having anatomical attached retina with IOP ≤21 mmHg and ≥5 mmHg with or without antiglaucoma medications (AGMs).

Results

Medical records from 2013 to 2019 were reviewed to identify eyes with RRD post AADI surgery. A total of 1158 AADI implantations were performed during the 7-year study period. A total of 15 eyes developed RRD following AADI out of which 10 eyes of 9 patients were included in this study (0.86%). Four eyes with prior history of RRD surgery and one eye that was deemed inoperable were excluded from final analysis. The mean age was 28.2 years (median: 15 years, range: 6–83 years). Six of the 9 patients were female. Four eyes had aphakic glaucoma, 2 eyes had primary open-angle glaucoma (POAG), one eye each had juvenile glaucoma, uveitic glaucoma, congenital and developmental glaucoma. Four patients had history of prior extracapsular cataract extraction (ECCE) and four patients had a history of prior trabeculectomy. In two patients, the immediate operation preceding RRD was core vitrectomy for post AADI endopthalmitis. Four eyes were aphakic, 4 eyes were pseudophakic, and 2 eyes were phakic of which one eye had spherophakia with subluxated lens. Two eyes had pars plana AADI tube implantation. Preoperative characteristics of patients are depicted in Table 1. Mean duration between insertion of AADI and presentation of RRD was 14 months (median: 2.5 months, range: 2 days–72 months). The mean duration of follow-up was 20 months (median: 10.5 months, range: 6–54 months). Seven eyes presented with total RRD; 7 eyes had 360 degree choroidal detachment (CD) of which 2 eyes had suprachoroidal hemorrhage (SCH). In 8 of the 10 eyes, break could not be identified; the remaining two eyes had break each in superotemporal and inferotemporal quadrant.

All eyes underwent pars plana vitrectomy with silicon oil (SO) tamponade. Scleral buckling procedure or encircling band was not used in any of the eyes. Table 2 summarizes the details of RRD surgery, anatomical, functional, IOP outcome, and additional procedures after surgery. Two eyes with SCH underwent 2 staged vitrectomy procedure where initially CD drainage was done with vitrectomy and perfluorocarbon liquid (PFCL) tamponade followed 5 days later by PFCL removal, fluid air exchange (FAE), and SO tamponade. Postoperatively, 6 eyes had attached retina at final follow-up, 2 eyes had type 1 anatomic success, 3 eyes had type 2 anatomic success, and one eye had type 3 anatomic success. Four eyes had recurrent RD of which 3 eyes developed phthisis bulbi. The preoperative LogMAR BCVA (logarithm of the minimum angle of resolution) was 2.52 ± 0.15, which improved to 2.29 ± 0.58 at final follow-up. Out of 6 patients with the successful anatomical outcome, BCVA was improved in three eyes, while it was stable in three eyes. Mean IOP before RRD surgery was 7.1 ± 3.24 mm of Hg. Postoperatively, raised IOP was found in two patients of which one patient underwent repeat

Table 2: Post operative characteristics, IOP, visual outcome of patients with AADI and RRD

Patient no	Surgery Details	BCVA at time of surgery	IOP at time of surgery (mm Hg)	BCVA at final follow-up	IOP at final follow-up (mm Hg)	AADI status	Retinal attachment	Additional procedures Postoperative events
1	CDD + PPV + PPL + PFCL, PFCLR + SOI (2 stage)	HM	10	HM	8	Undisturbed	Yes under oil	Flat AC post AADI surgery 2 stage RRD surgery
2	PPV+SOI	HM	9	PL	5	Undisturbed	Yes under oil (Peripheral RRD)	SOR + ReSOI done twice for recurrent RRD
3	PPV + PPL + SOI	PL	4	HM	20	Undisturbed	Yes	Repeat inferonasal AADI+diode CPC done for uncontrolled IOP one year after PPV
4	PPV + SOI, AADI repositioned in AC	HM	6	20/200	18	Repositioned in AC	Yes under oil	SOR + ReSOI done for recurrent RRD
5	PPV + SOI	HM	5	20/1000	3	Explanted	No	Tube exposure 3 months after PPV-AADI explantation done
6	PPV + SOI, AADI repositioned in AC	PL	6	20/800	10	Repositioned in AC	Yes under oil	SOR + ReSOI with inf retinectomy done for recurrent RRD
7	PPV+SOI	PL	3	PL	9	Undisturbed	No	Recurrent RRD with anterior PVR changes
8	CDD + PPV + PFCL, PFCLR + SOI (2 stage)	PL	14	PL	3	Undisturbed	No	2 stage RRD surgery recurrent RRD under oil
9	CDD + AC reformation (First stage) PPV + SOI (2nd stage)	HM	8	PL	3	Undisturbed	No	At 1 month Post PPV-raised IOP with shallow AC-underwent AC reformation+PI+partial SOR, decompensated cornea, at final follow-up, inf RRD under oil
10	PPV+SOI	HM	6	20/800	36	Undisturbed	Yes	At 1 month post PPV-AC wash + SOR/ReSOI for hyphaema with raised IOP, endophthalmitis with tunnel and side port infiltrate 8 months after SOI, Gram positive cocci on gram stain, treated with intravitreal clindamycin and ceftazidime, SOR done after 2 years

BCVA: Best-corrected visual acuity, IOP: Intraocular pressure, CDD: Choroidal detachment drainage, PPV: Pars plana vitrectomy, PPL: Pars plana lensectomy, PFCL: Perfluoro carbon liquid, PFCLR: Perfluoro carbon liquid removal, SOI: Silicon oil injection, AADI: Aurolab aqueous drainage implant, HM: Hand movement, PL: Perception of light, AC: Anterior chamber, SOR: Silicon oil removal, PVR: Proliferative vitreoretinopathy, PI: Peripheral iridotomy, CPC: Cyclophotocoagulation, RRD: Rhegmatogenous retinal detachment

inferonasal AADI surgery after one year following PPV along with diode cyclophotocoagulation (CPC) following which IOP was controlled, and second patient was advised diode CPC; however, the patient was subsequently lost to follow-up. One eye developed tube exposure 3 months following RD surgery, and subsequently AADI explantation was done. One eye had late postoperative hypotony (IOP ≤5 mmHg) which could be explained by the peripheral retinal detachment under oil. At the final follow-up, 60% eyes achieved both anatomical and functional success, and 83.3% of eyes with attached retina had successful IOP control.

Discussion

The incidences of RRD attributable to GDD at 1, 5, and 10 years are reported to be 1.25%, 2.02%, and 2.67%, respectively.[10] The present study analyzing the estimated risk of RRD following AADI found an incidence of 0.86 % (10/1158 eyes) which is lower than that reported by other authors.[4,11,12] Table 3 provides a detailed review of all relevant literature regarding the incidence and outcomes of RRD following GDD implantation. All eyes in this study underwent AADI implantation which is a nonvalved device and is a low-cost alternative in our setup as compared to the Ahmed valve. Some of the patients in this

Table 3: Summary of previous literature on outcomes of RRD surgery post GDD implantation

	Waterhouse *et al.* (1994)[4]	Benz *et al.* (2002)[11]	Sharma *et al.* (2018) [12]	Our study (2021)
Number of eyes with RRD post GDD (*n*)	16/350 (5%) (Male 9, female 7)	10 (Male 8, female 2)	10/656 (1.52%) (Male 9, female 3)	10/1158(0.86%) (Male 3, female 6)
Type of glaucoma	4-infantile, 4-post congenital cataract surgery, aphakic-3, traumatic-3, ACG with nanophthalmos-1, uveitic-1, peters anamoly-1	3-CACG, congenital-2, uveitic-2, POAG-2, NVG-1	5-congenital, traumatic glaucoma-3, uveitic-1	4-aphakic 2-POAG 1-Juvenile, uveitic, congenital developmental
GDD used	Molteno implant	350-mm^2 Baerveldt implant-6 Single plate molteno-2	Ahmed-9 AADI-1	AADI
Mean interval between GDD implantation and RRD	9.3±16.2 months (range: 0.5-66)	15 months (range: 1-74 months)	24 months (median 7.5 months; range: 4 days-91 months).	14 months (median 2.5 months; range: 2 days-72 months)
Surgery done	PPV+SB+gas-6 (35%) PPV+gas-5 (29%) PPV+SB+SO-4 (24%) PPV+SOI-1 (6%) SB+gas -1 (6%)	PPV+C3F8-2 PPV+SB+C3F8-1 PPV+SF6-1 PPV+SB+SF6-1 PPV+SOI-1 PPV+SB+SOI-1 SB-1 SB+C3F8-1 PR+SF6+Cryo-1	PPV+SOI -8 PPV+C3F8-1 SB-1	PPV+SOI-all cases
Anatomic attachment	56%	80%	60%	60%
IOP control in attached retina	>5 and <22-8/9 <5-1/9	One eye had IOP >21 at 6 months follow-up	60% had successful IOP control	83.3% (5/6) had successful IOP control
Functional Success (Stable or improved BCVA)	8/9 (88.8%)	70%	50%	60%
GDD status	Molteno tube removed, plate undisturbed- 2 (12%) Molteno implant replaced-3 (18%)	Removal in 3/10 (2-hypotony, 1-Extrusion)	Replacement in 2/10	Removal in 1/10 (tube exposure)
Mean follow-up duration	20.4±15.8 (range: 4-48)	18 months (range: 6-66 months)	24 months (median 24 months; range: 8-42 months).	20 months (median 10.5 months; range: 6-54 months)
Causes of poor visual outcome	Recurrent RRD-7, Phthisis-6, intractable glaucoma-1	Recurrent RRD-3, epiretinal membrane-3, NVG-1	Phthisis-2, Recurrent RRD-2, glaucomatous optic atrophy-1, epiretinal membrane-1, corneal opacity-1	Recurrent RRD-4, Phthisis-2, glaucomatous optic atrophy-3, corneal decompensation-1

RRD: Rhegmatogenous retinal detachment, GDD : Glaucoma drainage device, IOP: Intraocular pressure, ACG : Angle closure glaucoma, PPV: Pars plana vitrectomy, SOI: Silicon oil injection, SB : Scleral buckle, CACG: Chronic angle closure glaucoma, POAG: Primary open angle glaucoma, NVG-Neovascular glaucoma, AADI: Aurolab aqueous drainage implant

study were included in the data from previous reports of AADI surgery from our institution.[2]

Retinal detachment presents a unique set of challenges in the setting of preexisting GDD and outcomes are not often satisfying due to a variety of reasons. Postoperative hypotony after GDD implantation can cause choroidal detachment and suprachoroidal hemorrhage which can make preoperative assessment difficult and complicate RRD surgery. The placement of scleral buckle either alone or in combination with vitrectomy is often hampered by the presence of GDD and can impact its function. In presence of pars plana tube insertion and retinal detachment surgery with silicon oil tamponade, the tube will have to be repositioned in the anterior chamber to prevent silicon oil from blocking the tube. Oil can still come in anterior chamber further compromising trabecular meshwork in long-standing cases, and subconjunctival migration of oil can also be seen.[13] RRD following GDD may not be necessarily related to GDD surgery and may occur in eyes with predisposing factors such as previous history of trauma, uveitis, or in eyes with lattice degeneration.[5] Previous intraocular procedures leading to vitreous syneresis and PVD, aphakic or pseudophakic status as seen in 8/10 eyes in our series are believed to be another factor leading to subsequent RRD.[4] Retinal detachment is a known complication of PPV.[4] Prior vitrectomy probably played a role in the pathogenesis of RRD in two patients, both of whom had core vitrectomy for endopthalmitis as immediate preceding surgery prior

to RRD onset. The risk of RRD following core vitrectomy for endopthalmitis is high due to a multitude of reasons like poor media clarity, difficulty in induction of posterior vitreous detachment (PVD), and the incompleteness of vitreous removal. Undiluted vitreous sampling at the start of PPV for endophthalmitis leads to hypotony, with a potential risk of vitreoretinal traction and subsequent RRD.[14] Banitt *et al*.[15] reported a relatively high rate of 13% incidence of RRD following pars plana Baerveldt implantation for refractory childhood glaucomas and proposed that it may be related to the posterior segment surgery (pars plana vitrectomy and scleral fistulization for tube insertion) performed in all patients. Similar mechanisms could be at play in the two patients in our series who had concurrent vitrectomy during pars plana tube implantation with subsequent development of RRD. Meticulous base dissection during vitrectomy, especially in the quadrant where the AADI tube is planned to be inserted is a prerequisite to reduce the risk of future RRD in such cases.[2] Vitreous incarceration within nonvalved tube like AADI especially in pseudophakic eyes with posterior capsular rupture and aphakic eyes can also result in vitreous traction on the retina causing retinal breaks and subsequent retinal detachment.[4]

Though AADI is available in India, there is limited literature regarding the incidence and outcomes of retinal detachment following AADI surgery. In a previous study by the same authors which described outcomes of pars plana insertion of AADI in 63 eyes, RRD was the most common vision-threatening complication and occurred in 8% (5/63) of eyes that underwent AADI.[2] Puthuran *et al*.[7] in their study of 158 eyes that underwent anterior chamber AADI surgery reported an incidence of 0.6% (1/158) of RRD. Kaushik *et al*.[5] reported one case of retinal detachment in their study of 31 eyes with refractory childhood glaucoma which underwent AADI.

In our study, the interval of RRD from GDD surgery ranged from 2 days to 72 months with 60% of the patients presenting within 3 months of GDD implant surgery. In the study by Waterhouse *et al*.,[4] 70% of patients presented within 4 months. Benz *et al*. reported that the interval between glaucoma surgery and RRD ranged from 1–74 months.[11] Sharma *et al*. reported mean duration between GDD and RRD to be 24 months (4 days-91 months) in their case series of 10 patients.[12]

In our series, all cases were treated with pars plana vitrectomy (PPV) with silicon oil (SO) as endo tamponade in view of complexity of RRD with associated choroidal detachment (CD) in 7/10 cases and unidentified break preoperatively in 8/10 cases. This also minimizes disturbance of functioning AADI plate. SCH was noted in 2/10 cases and both patients underwent two-staged procedure with hemorrhagic CD drainage along with PPV and perfluorocarbon liquid (PFCL) tamponade for 5 days followed by PFCL removal with SO tamponade. Two-staged surgery has been previously reported by the authors to be a good alternative to buckle– vitrectomy for eyes with RRD associated with CD and helps in the complete evacuation of residual blood clots by pushing the blood clots posteroanteriorly.[16] Mechanical stress on posterior ciliary arteries by choroidal effusion is proposed to be a major contributing factor in the development of SCH.[3] Waterhouse *et al*. in their series reported RRD occurring as a consequence of retinal apposition due to hemorrhagic choroidal detachment after releasing the ligature on the Molteno tube.[4] Large serous or hemorrhagic choroidal detachment may result in apposition and adhesion of retina leading to RRD.[3] Choroidal detachment has been noted to be the most common complication between 3 months and 1 year in eyes undergoing AADI surgery.[7] Hypotony is a potential risk factor for exacerbation of vitreous traction. 7/10 cases in our series developed RRD within 3 months of AADI implantation of which all eyes had 360 CD with hypotony suggesting its role in causation of vitreous traction with subsequent breaks and RRD. Verma *et al*.[13] in their review on posterior segment complications following glaucoma surgeries mention that a sudden change in IOP can result in tears leading to rhegmatogenous retinal detachment after glaucoma surgeries. It is tempting to postulate that presumably CD could have been an antecedent event to the occurrence of RRD rather than a consequence of RRD itself.

In our series, 54.5% achieved anatomical attachment of retina which compares favorably with previously reported success rates for anatomic attachment ranged from 56%–60%.[5,10] Visual acuity outcomes in eyes with RRD following GDD surgery have been reported to be poor, largely because of preexisting advanced glaucoma.[10] In our series, out of the 6 eyes with attached retina, although BCVA improved in three eyes, ambulatory vision (BCVA ≥ 20/400) was obtained in only 1/10 (10%) eyes. Causes for poor final visual acuity were recurrent retinal detachment in 4 eyes (40%) of which 3 eyes (30%) developed phthisis bulbi, glaucomatous optic atrophy in 3 eyes, and corneal decompensation in one eye. Waterhouse *et al*. in their series reported recurrent retinal detachment in 44% and pthisis bulbi in 38% of cases.[4] Benz *et al*. in their series reported final visual acuity worse than 2/200 in nine patients (90%) because of recurrent RRD in two patients and preexisting advanced glaucoma in seven patients.[11]

In our study, in eyes with attached retina, 5/6 eyes had IOP ≤21 mmHg at final follow-up. The tube is ligated with a 7-0 polyglactin suture at the time of retinal detachment repair and if present in the posterior chamber, it is brought into the anterior chamber through a peripheral iridectomy at the time of RRD repair. Intraoperative tube manipulation helps in IOP management in spite of possibility of silicone oil tamponade compromising the trabecular meshwork in cases where oil migrates into the anterior chamber.[13] One patient underwent repeat AADI surgery with diode CPC at one year post PPV following which IOP was controlled. Sharma et al. reported raised IOP in 5/6 eyes with attached retina and needed additional anti-glaucoma medications or procedures such as cyclophotocoagulation and GDD replacement.[12] None of the eyes with attached retina had early postoperative hypotony. Late postoperative hypotony due to peripheral retinal detachment under oil was seen in one eye. Benz *et al*. reported valve removal in 2 patients in postoperative period due to hypotony, and in one eye due to valve extrusion.[11] None of our patients needed valve removal due to hypotony in spite of using a nonvalved device. AADI explantation was done in one eye due to tube exposure at 3 months following PPV; this eye eventually developed phthisis bulbi due to infectious endophthalmitis caused by Burkholderia cepacia species.

Strengths of the study include single device, i.e., AADI, being used in all the cases and consistent techniques used by 2 experienced surgeons (NBK and GVP) in the management of RRD following AADI implantation. Limitations of the study include its retrospective design, variable severity of disease, and limited sample size which precludes making any broad recommendations on ideal practices to be followed in the management of RRD following AADI surgery. However considering the limited literature available on this subject, our study is an attempt to shed some light on the pathogenesis and management of this complication.

Conclusion

PPV with silicon oil as tamponade is the preferred approach in the management of RRD following AADI with IOP being usually well-controlled post PPV. Post AADI hypotony leading to large and appositional CD and SCH with subsequent vitreous traction and possible breaks could play a role in the pathogenesis of RRD in cases presenting within 3 months of AADI surgery. Two-staged surgery with short-term PFCL tamponade is a viable option in such eyes. Functional outcomes often lag behind anatomic outcomes due to preexisting advanced glaucomatous damage. Multidisciplinary approach involving retina and glaucoma services is crucial in retinal reattachment and maintaining the function of AADI plate.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Gedde SJ, Schiffman JC, Feuer WJ, Parrish RK, Heuer DK, Brandt JD. The tube versus trabeculectomy study: Design and baseline characteristics of study patients. Am J Ophthalmol 2005;140:275-87.
2. Babu N, Baliga G, Wijesinghe HK, Puthuran GV. Intermediate-term outcomes of pars plana tube insertion of Aurolab aqueous drainage implant for refractory glaucoma. Br J Ophthalmol. 2019; 104:1-5.
3. Law SK, Kalenak JW, Connor TB, Pulido JS, Han DP, Mieler WF. Retinal complications after aqueous shunt surgical procedures for glaucoma. Arch Ophthalmol 1996;114:1473-80.
4. Waterhouse W, Lloyd MAE, Dugel PU, Heuer DK, Baerveldt G, Minckler DS, *et al*. Detachment after molteno glaucoma implant surgery. Ophthalmology 1993;101:665-71.
5. Kaushik S, Kataria P, Raj S, Pandav SS, Ram J. Safety and efficacy of a low-cost glaucoma drainage device for refractory childhood glaucoma. Br J Ophthalmol 2017;101:1623-7.
6. Rao DP, Pathak-Ray V. Combined cataract extraction with a new nonvalved glaucoma drainage device in adult eyes with cataract and refractory glaucoma. Indian J Ophthalmol 2018;661278-83.
7. Puthuran GV, Palmberg P, Wijesinghe HK, Krishnadas SR, Robin A. Intermediate-Term outcomes of an affordable aqueous drainage implant in adults with refractory glaucoma. Ophthalmol Glaucoma 2019;2:258-66.
8. Reji P, Premanand C, Nabeed A, Mrunali D, Ganesh V R. Intermediate term outcome of Aurolab aqueous drainage implant. Indian J Ophthalmol 2019;67:233-8.
9. Maheshwari D, Dabke S, Rajagopal S, Kadar MA, Ramakrishnan R. Clinical outcome of a nonvalved Aurolab aqueous drainage implant in posterior segment versus anterior chamber. Indian J Ophthalmol 2019;67:1303-8.
10. Banitt MR, Feuer WJ, Schiffman JC, Parrish RK. Adverse vitreoretinal outcomes of glaucoma drainage devices based on verified and unverified financial claims data. Ophthalmic Surg Lasers Imaging Retina 2015;46:463-70.
11. Benz MS, Scott IU, Flynn HW Jr, Gedde SJ. Retinal detachment in patients with a pre existing glaucoma drainage device: Anatomic, visual acuity, and intraocular pressure outcomes. Retina 2002;22:283-7.
12. Sharma U, Panda S, Balekudaru S, Lingam V, Bhende P, Sen P. Outcomes of rhegmatogenous retinal detachment surgery in eyes with pre-existing glaucoma drainage devices. Indian J Ophthalmol 2018;66:1820-4.
13. Verma S, Azad SV, Takkar B, Temkar S, Chawla R, Venkatesh P. Posterior segment complications following glaucoma surgeries. Indian J Ophthalmol 2020;68:988-93.
14. Chiquet C, Aptel F, Combey-de Lambert A, Bron AM, Campolmi N, Palombi K, *et al*. Occurrence and risk factors for retinal detachment after pars plana vitrectomy in acute postcataract bacterial endophthalmitis. Br J Ophthalmol 2016;100:1388-92.
15. Banitt MR, Sidoti PA, Gentile RC, Tello C, Liebmann JM, Rodriguez N, *et al*. Pars plana Baerveldt implantation for refractory childhood glaucomas. J Glaucoma 2009;18:412-7.
16. Babu N, Kohli P, Kumar K, Rajan RP, Baliga G, Sen S, *et al*. Two-staged surgery as an alternative to buckle–vitrectomy for rhegmatogenous retinal detachment complicated by choroidal detachment. Int Ophthalmol 2020;41:135-41.