

Aqueous Misdirection Syndrome in Post-trabeculectomy Patients

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Abstract:

Objective: To determine the frequency of aqueous misdirection syndrome and its association with gender and age in post-trabeculectomy patients.

Methods: An observational study was conducted at the Department of Ophthalmology of Hayatabad Medical Complex, Peshawar, from November 2021 to May 2022. The patients who underwent uncomplicated trabeculectomy in the last two months at our department were included in this study. The data were collected for age, gender, best corrected visual acuity, time since surgery, intraocular pressures and presence or absence of aqueous misdirection syndrome. Aqueous misdirection syndrome was diagnosed if there was a shallow anterior chamber with high intraocular pressure in the presence of a patent iridectomy. Association of this complication with age and gender was also determined.

Results: A total 179 participants were recruited with a mean age of 44.30 ± 15.71 years and 103 (57.54%) male participants during the study period. The frequency of aqueous misdirection syndrome was found to be 5 (2.8%) in this study. No statistically significant association was found between development of the complication and age ($p=0.36$) and gender ($p=0.30$) of participants.

Conclusion: Aqueous misdirection syndrome is a rare complication in uncomplicated trabeculectomy surgery. Age and gender have no effect on the occurrence of aqueous misdirection in these patients. *Al-Shifa Journal of Ophthalmology* 2025; 21(2): 89-96. © Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan.

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Introduction:

Globally, glaucoma is the most common cause of irreversible vision loss ¹. It is an optic neuropathy portrayed by degradation of retinal ganglion cells with associated changes in the optic nerve head and corresponding defects in the visual field of the patient ². Raised intraocular pressure (IOP) is a crucial modifiable risk factor that accelerates ganglion cell death. Present guidelines aim to reduce intraocular pressure via pharmacological or surgical means ³. Trabeculectomy provides substantial intraocular pressure reduction and therefore remains the gold standard in glaucoma management ⁴.

Various devastating complications can occur after trabeculectomy. Malignant glaucoma, presently known under the name of aqueous misdirection syndrome (AMS), is a rare cause of secondary angle closure glaucoma ⁵. It can occur as a complication after any intraocular surgery in both open-

angle and narrow-angle patients. Von Graefe, in 1869, described this condition as being characterised by a shallow anterior chamber with raised intraocular pressure in the presence of a patent iridotomy⁶. The same study also reported an AMS prevalence of 0.37% after non-filtering surgery and 2.27% after filtering surgery in angle closure glaucoma patients. The pathogenesis is not well understood but involves anterior rotation of the ciliary body, leading to backwards flow of aqueous humour towards the vitreous, leading to increased vitreous pressure⁷. The incidence of this serious complication has been studied in various populations. According to a study conducted at Al-Shifa Trust Eye Hospital, Rawalpindi, about 1.9% of patients developed this condition after trabeculectomy⁸. However, another study reported that about 3% of their patients developed aqueous misdirection syndrome after trabeculectomy⁹.

Early identification and treatment of this condition are essential to prevent further damage to the eye, such as corneal endothelial decompensation, cataract formation, and further glaucomatous damage to the optic nerve¹⁰. The rationale for our study is that, owing to the rarity of the condition and different reports about the magnitude of this problem, we can't infer from those results. Furthermore, it is a dreadful complication, and timely intervention can save the patients' vision. That is why this study was designed to find the magnitude of this complication in our setup. This will enable us to devise treatment strategies and prevent future damage to vision in these patients.

Methodology:

An observational study was conducted in the ophthalmology department, Hayatabad Medical Complex, Peshawar, from 16th November 2021 to 16th May 2022 after ethical approval from the hospital's ethical committee. The study followed the principles of the Declaration of Helsinki. Participants aged 18-70 years who had

trabeculectomy done within the past 2 months were selected via a consecutive nonprobability sampling technique after taking a detailed informed consent. The indications of trabeculectomy included advanced glaucoma with pressures exceeding target values, progressive glaucomatous changes, uncontrolled IOP despite maximum tolerated medical therapy, and poor compliance with medication. All the trabeculectomy surgeries were performed by a single glaucoma specialist who had specialized training in glaucoma after a fellowship. The technique used in all surgeries was the same. All surgeries performed were fornix-based under local peri-bulbar anaesthesia. A corneal traction suture with 7/0 Vicryl was used to expose the superior surface of the conjunctiva. A 4 mm conjunctival flap measured with callipers was made with Westcott scissors, and wet-field cautery was used to clear the scleral vessels. and 0.4mg/ml Mitomycin-C-soaked cotton sponges were placed on the sclera for 2 min, which was then thoroughly washed with balanced saline solution. A 3x3 mm partial-thickness triangular scleral flap was made, and the trabeculectomy was performed using Kelly's punch, and the iridectomy was performed with scissors. The flap was secured with 3 slip knots using 10/0 nylon thread. A side port was made to check the patency of the bleb, and the anterior chamber was maintained. The conjunctiva was sutured with two 10/0 nylon wing sutures. Subconjunctival dexamethasone 4mg/ml was injected in the inferior fornix at the end of the surgery. Post-operatively, all patients were prescribed topical moxifloxacin eye drops four times a day, topical dexamethasone eye drops two hourly, and topical tobramycin and dexamethasone eye ointment thrice daily. Patients having previous ocular surgeries involving conjunctival manipulation, such as squint or retinal detachment surgeries, were excluded. In addition, patients who had complicated trabeculectomies were also excluded. The uncomplicated

trabeculectomy included trabeculectomy without any complications such as choroidal effusion, suprachoroidal haemorrhage, bleb leaks, or over filtration, as these can also result in shallow AC and confound results. At presentation the following clinical data were extracted from patients: Visual acuity, anterior segment examination using slit lamp biomicroscopy, intraocular pressure (IOP) measurement via Goldman tonometer and fundus examination using a 78D condensing lens. Peripheral anterior chamber depth was measured by the Van Herick method. All the data were recorded on a pre-designed proforma. Aqueous misdirection was diagnosed in post op patients if there was a shallow anterior chamber with high intraocular pressure in the presence of a patent iridectomy. Data were analysed using SPSS version 24. Continuous variables like age, time since surgery, IOP, and VA were analysed for

mean and standard deviation. For the presence or absence of aqueous misdirection syndrome (AMS), frequency and percentages were calculated. The chi-square test was applied to establish an association between the occurrence of AMS with age groups and gender of the participants. A p-value of less than 0.05 was considered significant.

Results:

The total participants recruited during the study period was 179. The mean age of the participants was 44.30 ± 15.71 years, and 103 (57.54%) were males. The baseline profile of the study group is depicted in Table 1. Out of the total, only 5 (2.8%) participants developed AMS in our study. Table 2 shows the association of the AMS with age and gender, but there was no statistically significant association.

Table 1: Demographic profile of study participants.

Characteristics (N=179)	N (%)	Mean \pm SD
Gender, n (%)	Male, 103 (57.54) Female, 76 (42.46)	
AMS, n (%)	5 (2.8)	
Mean Age (years)		44.30 ± 15.71
Mean Time since surgery (in months)		1.95 ± 0.71
Mean IOP (in mmHg)		24.06 ± 3.91
Mean Visual acuity (in LogMAR units)		1.09 ± 0.11

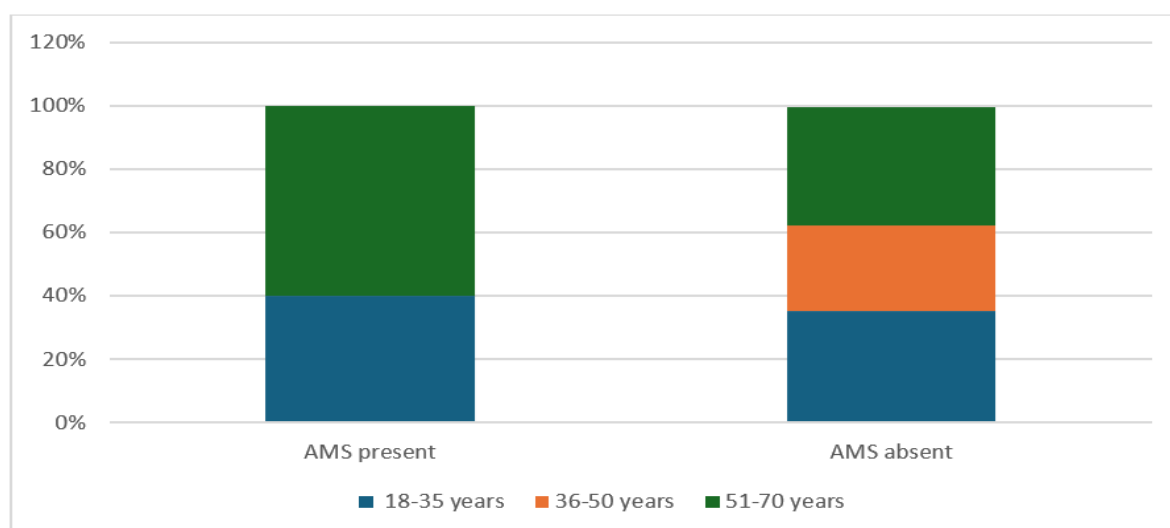


Figure 1: Distribution on aqueous misdirection syndrome (AMS) in our study participants.

Table 2: Association of aqueous misdirection syndrome with age and gender.

Characteristics (N=179)	Age distribution in years, n (%)			P- value*	Gender, n (%)		P- value*
	18 to 35	36 to 50	51 to 70		Male	Female	
AMS present	2 (40)	0 (0)	3 (60)	0.36	4 (80)	1 (20)	0.30
AMS absent	61 (35.1)	47 (27.01)	66 (37.93)		99 (56.9)	75 (43.1)	
Total, n (%)	63 (35.2)	47 (26.25)	69 (38.55)		103 (57.54)	76 (42.46)	

Discussion:

Aqueous misdirection (AMS) is a rare and challenging form of secondary angle closure glaucoma that can occur in the post-operative setting. In this cross-sectional hospital-based study, we described the frequency of Aqueous misdirection syndrome among post-trabeculectomy patients and its association with age and gender. The overall frequency of this complication was found to be 2.8% amongst our patients. This is similar to a study that reported a 3% incidence of this condition after trabeculectomy⁹. Von Graefe in 1869 reported an incidence of this complication to be 2% among post-operative glaucoma patients⁶. Similarly, a study conducted in Al-Shifa Hospital,

Rawalpindi, reported that about 1.9% of their patients developed AMS after trabeculectomy surgery⁸. Likewise, another study reported an incidence of approximately 0.6 to 4%¹¹. Our results are comparable to previous studies with a low frequency of AMS in these patients.

In our study, there was no statistically significant difference between the occurrence of this disease in males and females. This, however, is in contrast to the previous literature which claims that the condition is more common in females¹². At par with this, another study reported that the disease is more common in females with a female-to-male ratio of 7:3. According to them, the explanation for this is the more anterior position of the lens and shallower anterior chambers in the female

population¹². Annes Ahmeidat and Caroline Cobb described 3 case reports of aqueous misdirection syndrome, all occurring in Caucasian females, reiterating the increased incidence of this disease in this gender group¹³. Akin to this a case series of 66 eyes with a diagnosis of malignant glaucoma using data from the Glaucoma Division of the Stein Eye Institute, Los Angeles, from 1997 to 2022 proved that female gender was a predisposing factor for the development of this disease¹⁴. However, isolated case reports of the disease occurring in males have also been reported. Qian Qian Xu et. al reported a rare case of Aqueous misdirection syndrome occurring in a 76-year-old male patient 4 days after trabeculectomy¹⁵. This patient also later developed a ciliary detachment. Also, another case report noted in Taiwan described a 63-year-old male who developed refractory malignant glaucoma two weeks after trabeculectomy in a vasectomized eye¹⁶. On the contrary, our study showed no significant association between gender and the development of this complication. Potential reasons for the lack of gender association in our study included poor follow-up amongst female postoperative patients. Since we live in a primarily male-dominated society with low female literacy rates, females exhibited poor follow-up trends. A good proportion of female patients who visit our tertiary care hospital also come from far-flung areas and depend on menfolk for their commute. Also, there are financial constraints involved in travel to tertiary care centres. These have proved to be hindrances in their admission to our OPD, and hence, poor follow-up and lack of inclusion in our study. Also, there could be unexplored genetic predispositions amongst Pakistani men that could predispose them to the development of AMS. Further studies are needed to unveil such genetic features. The lower female participation in this study has important implications and may have influenced the results. The findings might

underestimate the experience of the female population with the condition or the results of treatment due to the small representation of women. Given possible gender-based variations in ocular anatomy, such as axial length or anterior segment features, which could affect the onset or course of aqueous misdirection syndrome, this is especially pertinent. Furthermore, hormonal variables, like postmenopausal changes, may influence trabeculectomy results or aqueous dynamics; their underrepresentation may result in an inadequate comprehension of these mechanisms. Bias in baseline characteristics may also be introduced by the skewed gender ratio. Men might show up with distinct risk profiles or disease severities, which could skew the results and cause conclusions that are disproportionately impacted by patterns unique to men. Sociocultural elements may also affect results and go unrecognised, such as disparities in access to healthcare, readiness to have surgery, or compliance with follow-up care.

Age is also considered to be an important factor in the development of this complication. A study done in Chinese patients reported an incidence of AMS to be higher among patients < 40 years of age⁶. They identified younger age as a risk factor for the development of aqueous misdirection syndrome after filtering surgery. Likewise, Zhang et al. also reported a higher prevalence of AMS among younger patients compared to older ones⁶. Similarly, another study also showed an incidence of post-operative malignant glaucoma to be about 24.1% in younger patients, which was much higher than the older patients¹⁷. They claimed that shorter axial length and more anteriorly rotated ciliary bodies may be key contributing factors for the development of malignant glaucoma in young patients with PACG after trabeculectomy. This is, in contrast with our results, which showed no statistically significant correlation between the age of patients and the development of this devastating complication. The reasons

may be different among preoperative ocular features, such as axial length, anterior chamber depth, or lens status, or genetic differences in study populations could affect susceptibility to AMS. The other possible explanation may be postoperative management protocols, differences in the aggressiveness of intraocular pressure management, use of cycloplegics, or early detection of anterior chamber shallowing may alter outcomes between studies.

Aqueous misdirection is a rare complication, most reported after trabeculectomy. Several treatment options are available⁵. Due to its rarity, however, rates of treatment success and prognosis in affected eyes are difficult to ascertain¹⁸. The difference between our results and previous literature shows the varied nature of the disease. Our study aimed to determine the frequency of this dreadful complication in our population and ensure early identification and treatment. This will prove vital in saving patients' vision. Delayed presentation has been associated with a greater chance of failure to resolve¹⁹. As a rare and intractable disease, large-scale studies on the disease are lacking. To the best of our knowledge, no such study has been conducted in our region. This study broadens our understanding of the disease in our population and alerts clinicians about its chance of occurrence, and to maintain a high index of suspicion in post op patients with high IOP and shallow anterior chambers.

Our study focuses on the importance of postoperative IOP monitoring for surgeons who have a key interest in trabeculectomy surgery. IOP measurements and looking for signs of AMS in post op patients, even months after surgery, is vital to prevent the development of this complication and enable early recognition and prompt treatment. Therefore, surgeons should formulate accurate early and late follow-up regimens for their post-trabeculectomy patients for better patient care. Nonetheless, our study also has certain limitations. A short follow-up period of only 2 months

was considered, whereas this disease can also occur many months and years postoperatively²⁰. In addition, our study was only done on Pakistani patients, and as a result, these results cannot be extrapolated to other ethnicities. Furthermore, our data lacked crucial objective parameters like refraction and axial length, which are key risk factors involved in the occurrence of this complication. The addition of these would have added more value to our results. We advise further work on the disease, keeping in mind these constraints in our study. It is advised that further work be done on this sight-threatening disease involving multicentric data with larger sample sizes.

Conclusion:

Aqueous misdirection syndrome is a rare complication in uncomplicated trabeculectomy surgery. Age and gender have no effect on the occurrence of aqueous misdirection in these patients. This study expands our knowledge of the disease in our population, cautioning clinicians about its potential occurrence and grave nature. In addition, it emphasizes the need for heightened vigilance in post op patients with elevated intraocular pressure and shallow anterior chamber.

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