***Original Research Article***

Trabeculectomy  : Outcomes , complications and factors of failure in an adult population

**Abstract :**

Glaucoma is the most common irreversible blindness-causing pathology worldwide, and its prevalence continues to increase. This condition accounts for 2% of causes of visual acuity reduction, and 8% of blindness cases worldwide in 2010 were related to glaucoma, a number that raises to 15% in 2020. Glaucoma is often asymptomatic for a long time, which frequently delays diagnosis. Trabeculectomy remains the reference technique for surgical management of glaucoma.
The goal of this study is to describe the characteristics, outcomes, and postoperative complications of trabeculectomy, and to identify the risk factors related to its failure, in order to increase the success rate and its effectiveness in our context.

 This is a retrospective study of eyes that underwent trabeculectomy between 2020 and 2024 at the ophthalmology department. Data were collected using a chart containing preoperative, perioperative, and postoperative parameters. An empirical analysis was conducted, leading to various statistical results. The SPSS software was used to study the prognostic factors for therapeutic failure of trabeculectomy.

A total of 62 eyes from 59 patients (55% women, average age 57.7 years) were identified. The most common etiology was primary open-angle glaucoma (50%). The average number of hypotensive medications used was 3.9, and 64% of patients were on quadruple therapy. The average visual acuity (VA) in logMAR before trabeculectomy was 1.55 (corresponding to 1.6/10), and the preoperative intraocular pressure (IOP) was an average of 30 mmHg ± 1.5. Forty-eight percent of patients underwent combined surgery (phaco-trabeculectomy). Regarding anti-metabolites, 40% had received 5-FU, while only 24% had received MMC.
Postoperatively, VA improved by two lines, from 0.4 log MAR immediately post-surgery to 0.2 log MAR at 10 months. At 10 months postoperative, the filtration bleb (BDF) was formed in 96% of cases, with two blebs remaining encapsulated, and one eye maintaining a flat bleb. The IOP reached an average of 14.8 ± 0.3 mmHg.
Early complications included immediate postoperative hypotony in 10 eyes, managed by reinforcement of the sutures, with recovery in 7 cases; 3 cases complicated with choroidal detachment and hyphema. Immediate postoperative elevated IOP was seen in 9 patients, managed by BDF massage in 5 eyes, and needling in 4, with recovery in follow-up visits.
Late complications were mostly cataract development in 16% of cases (10 eyes), choroidal detachment in 3 eyes (1 recovered, 2 progressed to phthisis), blebitis-related endophthalmitis in 2 eyes (recovered with antibiotic injections), and endophthalmitis from a corneal abscess on a severely altered surface, with no recovery.
Therapeutic success, defined as an IOP ≤18 mmHg, was achieved in 84% of cases (complete success in 44% of eyes, partial success with adjunctive medical treatment in 40% of eyes). Therapeutic failure occurred in 16% of cases. *Discussion* : The risk factors associated with therapeutic failure identified in our study were: younger age (p=0.02), type of glaucoma (secondary glaucoma, p=0.04), preoperative IOP (p=0.001), and non-use of anti-metabolites (p=0.01).
Our results align with several studies in the literature, particularly the large AGIS study and the study by Edmunds et al., which represent national experience with trabeculectomy in England, focusing on complications and risk factors for failure.

Knowledge of these risk factors will help improve the success rate of trabeculectomy and minimize postoperative complications, leading to better overall management of glaucoma.

Key words : Glaucoma , Trabeculectomy , outcomes , failure and success factors

Introduction :

Trabeculectomy, popularized by Cairns in 1968, aimed at lowering intraocular pressure (IOP), remains the first-line filtering surgery of reference in glaucoma because it applies to all types of glaucoma, whether the iridocorneal angle (ICA) is open or closed.

The unparalleled merit of trabeculectomy lies in the deep understanding of the technique, gained through 40 years of clinical experience, which has allowed for a better understanding of its mechanisms of action, long-term efficacy, and the incidence of its complications, some of which are delayed.

The procedure involves, under the protection of a scleral flap, a sclerokeratectomy—ideally including the trabeculum (1)—which allows the aqueous humor (AH) to exit the anterior chamber and flow into the subconjunctival spaces. While there are multiple drainage pathways for the AH (aqueous veins, supraciliary space, trans-scleral and transconjunctival routes), it turns out that the functional prognosis of trabeculectomy is largely determined by the development of a persistent subconjunctival filtration in the form of a filtering bleb.

Although the basic principle of the technique has remained the same since its initial description, surgical variations have been proposed over the years to maintain filtration and reduce the incidence of complications related to prolonged hypotony, the development of fragile, large limbal filtering blebs, or excessive tissue scarring—complications that can jeopardize both the visual and functional outcomes of the surgery (2).

Trabeculectomy is an effective technique for lowering IOP. Complications affect one in two patients but are often minor and can be prevented or limited with careful management before, during, and after surgery (3). Therapeutic failures can occur also , requiring further surgical interventions if conditions allow or reintroduction of hypotensive medical treatments (3).

Postoperative monitoring of trabeculectomy is the most important phase in the management of glaucoma patients, as it is essential for determining total, partial, and failed therapeutic outcomes, as well as for detecting early complications and preventing late complications.

This study aims to evaluate the early and late outcomes of trabeculectomy in all adult patients with primary or secondary glaucoma, and to identify the factors associated with trabeculectomy failure in patients who do not achieve therapeutic success after the procedure.

Materials and Methods

This is a retrospective study of eyes that underwent trabeculectomy between January 2020 and June 2024 in the ophthalmology department at Hassan II University Hospital Centre (CHU) in Fès. Patients with incomplete medical records were excluded from the study. Only cases with a follow-up of ten months or more were included.

The preoperative, perioperative, and postoperative data, including medical history, surgical indication, laterality, visual acuity (VA), slit-lamp examination (corneal status, anterior chamber depth, lens status, gonioscopy findings), and fundus examination (optic disc excavation), intraocular pressure (IOP) measured by Goldman applanation tonometry or non-contact air-puff tonometry, the number and types of hypotensive medications used preoperatively, the type of surgery performed (either trabeculectomy alone or combined surgery: phaco-trabeculectomy) with or without the use of antimetabolites, as well as postoperative data including the status of the filtering bleb, visual acuity, IOP, and optic disc excavation, were all recorded at 1 month, 3 months, 6 months, and 10 months postoperatively. Early and late complications observed during the follow-up were also noted. All of these preoperative, perioperative, and postoperative data were recorded for analysis. The therapeutic success criteria were defined as follows: Total success: IOP ≤ 18 mmHg without the use of adjunctive hypotensive treatment. Relative success: IOP ≤ 18 mmHg with the addition of one or more adjunctive hypotensive treatments. Therapeutic failure: IOP > 18 mmHg. We conducted an empirical analysis that led to several statistical results. We used SPSS software and calculated the p-value to study the prognostic factors for therapeutic failure observed in the study, using two types of variables: Quantitative variables ; we applied the Student's t-test for variables such as age, IOP, and the number of hypotensive medications used and for Qualitative variables , we used the Chi-square test for variables such as diabetes, type of glaucoma, and the use of antimetabolites.

Results:

***Pre operative Data :***

A total of 62 eyes from 59 patients underwent trabeculectomy in our department during the study period . The average age of the subjects was 57.71 ± 4.40 years. A total of 45% were men (28 patients) and nearly 55% were women (34 patients), with a female-to-male sex ratio of 1.21.

The majority of patients in the series were hypertensive (31%, or 37 patients). Diabetes was present in the second most frequent category, affecting 30 patients (25%). 17% of patients (20 patients) had previously undergone ocular surgery. 9% of patients (10 patients) had a history of acute angle-closure glaucoma attacks. 4% (5 patients) had a history of previous ocular trauma. 7% (8 patients) had a history of past uveitis episodes, and 8 patients were monocular (having only one functioning eye). ( Figure 1)

*Figure 1 :* A graph showing the different medical histories of the patients in the series

Among the 62 patients in the series, 31 patients (50%) had Primary Open-Angle Glaucoma (POAG), followed by Chronic Angle-Closure Glaucoma (CACG) in 11 patients (17.74%), then Pseudoexfoliative Glaucoma in 6 patients(10%), Uveitic Glaucoma in 5 patients (8%), and Post-traumatic Glaucoma due to angle recession and Silicone Glaucoma in 3 patients each (5%). Pigmentary Glaucoma was present in 2 patients (3%), and there was 1 case of Neovascular Glaucoma (1.61%) (Figure 2).

*Figure 2 :* Type of Glaucoma found in our series

A total of 40 patients (64.51%) had bilateral glaucoma , while only 22 patients (35.48%) had unilateral one .

The average number of hypotensive treatments used preoperatively was 3.9 (with medications ranging from 3 to 5). 40 patients (64.51%) were on quadruple therapy preoperatively, 10 patients (16.12%) were on topical quadruple therapy plus oral Acetazolamide (250 mg three times a day) with potassium supplementation, 10 patients were on triple topical therapy, and only 2 patients (3.22%) were on dual therapy.

Regarding the topical hypotensive medications used: 61 patients (98%) used Alpha-2 agonists, 60 patients (96.7%) used Beta-blockers and carbonic anhydrase inhibitors, 40 patients (64.5%) used Prostaglandins.

*Figure 3 :* Topical Hypotensive medications used in our series before surgery

The average best corrected visual acuity (BCVA) of the patients in the series preoperatively was 3.5/10 (ranging from finger movements to 8/10), corresponding to 0.5 log MAR ± 0.56. 40.32% (25 patients) were emmetropic, 35.48% (22 patients) had myopia, 6.45% (4 patients) were highly myopic (with a range from -1 to -9 diopters), the remaining 17.74% (11 patients) were hypermetropic (ranging from +1 to +4 diopters).

Evaluated using the Van Herrick (VH) score, the anterior chamber depth was classified as follows ; Grade 4 (deep chamber) in 70.96% of cases (44 eyes), Grade 1 in 17.74% of cases (11 eyes), Grade 2 in 11.29% of cases (7 eyes).

We found that 22 patients in the series were pseudo phakic (35.48%), 10 patients had a clear lens (16.12%), and 30 patients had a cataract. (48.38%)

The average corrected intraocular pressure (IOP) in our series was 30 mmHg ± 1.5, ranging from 27 to 50 mmHg.

44 patients (71%) had an open angle over 360 degrees, Shaffer grade 4. Among these, 10 patients showed the presence of the Sampaolesi line with a highly pigmented trabeculum, 2 had a concave iris, and 3 had an angular recession with irregular widening of the ciliary band and abnormally high visibility of the iris base. 11 patients (17.74%) had a closed angle over 360 degrees, Shaffer grade 0, 6 patients had a narrow angle grade 2 with goniosynechiae at some points, and 1 patient had a neovascular membrane on a closed angle (Shaffer grade 0).

*Figure 4 :* Gonioscopy data

8.38% of eyes underwent combined surgery (phaco-trabeculectomy), while 51.61% underwent trabeculectomy alone. Regarding the use of antimetabolites: 40% (25 eyes) received 5-fluorouracil (5FU) during the surgical procedure, 24% (15 eyes) received Mitomycin C, 36% (22 eyes) underwent trabeculectomy without the use of antimetabolites.

***Post operative Data :***

The immediate postoperative visual acuity at Day 1 (log MAR) was 0.4 ± 0.2 (4/10), which improved to 0.38 ± 0.1 at 1 month post-op, then to 0.35 ± 0.03 at 3 months post-op, and finally reached 0.2 ± 0.1 (6/10) at 10 months post-op.

In the immediate postoperative period, 52 patients (83.8%) had a well-formed filtering bleb (FB) with a negative Seidel test and sealed points. 10 patients had a flatter BDF with a positive Seidel test (these patients either underwent conjunctival reinforcement for very leaking BDFs or received ointment application for BDFs with a mild positive Seidel test).

After 1 month postoperatively, 96% of the FB’s were well-formed (59 eyes), 2 eyes had an encysted FB, and 1 eye had a flat FB.

The mean intraocular pressure (IOP) was 17.1 ± 2 mmHg in the immediate postoperative period, which decreased to 15.38 ± 1.4 mmHg at 1 month post-op, then to 16.56 ± 1.1 mmHg and 15.4 ± 0.5 mmHg at 3 months and 6 months post-op, respectively, finally reaching 14.8 ± 0.3 mmHg at 10 months post-op.

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|  | **BCVA ( log Mar)** | **FILTERING BLEB** | **IOP mmgh** |  |
| **J1** | 0.4 +/- 0.2 ( 4/10) | 84% (formed)  | 17.1 +/- 2 |  |
| **M1** | 0.38 +/- 0.1  | 96% (formed) | 15.38+/-1.4 |  |
| **M3** | 0.37 +/- 0,05  | 96% (formed)  | 16.56+/-1.1 |  |
| **M6** | 0.35 +/- 0,03 | 96% (formed)  | 15.4 +/-0.5 |  |
| **M10** | 0.2 +/- 0,1 ( 6/10) | 96% (formed)  | 14.8 +/-0.3 |  |

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*Table 1 :* Post operative data ( including BCVA , IOP , Filtering Bleb aspect)

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 As far as it concerned the early post operative complications ; the most common early one observed in our series was aqueous humor leakage from the filtering bleb due to sutural relaxation, leading to ocular hypotony . This was seen in 10 patients (16% of eyes), and was managed in the immediate postoperative period by reinforcing the sutures. In 7 cases, intraocular pressure (IOP) improved in subsequent follow-ups. However, 3 patients developed complications, including choroidal detachment, hyphaema , and vitreous hemorrhage, with no recovery. The second early complication was immediate postoperative ocular hypertension, observed in 9 patients (14.5% of eyes). These patients were managed either by massage of the filtering bleb (BDF) and monotherapy (5 eyes), or by needling (4 eyes), with recovery of intraocular pressure in the subsequent follow-up.

The most frequent late complication in the series was cataract development, which occurred in 16.2% of cases (10 eyes), followed by choroidal detachment in 3 patients, which was managed with 1% Atropine, corticotherapy . One eye recovered, while the other two progressed to phthisis. 3 eyes developed endophthalmitis, of which 2 were associated with blebitis, and were treated with systemic and topical antibiotics, along with intravitreal antibiotic injections of glycopeptide-based antibiotics (Vancomycin1mg/0.1ml) and Ceftazidime (Fortum) 2.25mg/0.1ml. Vitreous and local samples were taken, with results in the first case showing Paenibacillus macerans sensitive to the antibiotics, and the second case was negative. Both patients showed favorable outcomes, with visual recovery and IOPs of 16 mmHg and 18 mmHg, respectively. The final patient, a long-standing glaucoma patient with a history of hypotensive treatment (quadruple therapy) and ocular surface disease, developed endophthalmitis following a corneal abscess on a highly damaged ocular surface caused by antiglaucoma eye drops. Despite the administration of local antibiotics, systemic antibiotics, and intravitreal antibiotic therapy (IVT), this patient did not recover.

The intervention is considered as a total therapeutic success if the final IOP is below 18 mmHg, partial success if the IOP is maintained below 18 mmHg with the addition of hypotensive medications. Therapeutic failure is considered if the IOP is greater than or equal to 18 mmHg, with the addition of hypotensive treatment or the occurrence of a severe, non-recoverable complication.

After an average follow-up of 10 months in our patients, the results were as follows ; Complete therapeutic success in 27 eyes (44%). Partial success in 25 eyes (40%) requiring adjunctive medical treatment( Overall success rate: 84%) , Failure in 10 eyes (16%), of which 6 underwent surgical revision.

We studied the prognostic factors that could lead to therapeutic failure, including: Age at the time of surgery , Diabetes , History of previous ocular surgery , Glaucoma Type , Number of hypotensive medications used preoperatively , Preoperative IOP and the Use of antimetabolites and their type. The results are shown in the table below :

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| **Prognostic Factors** | **P value , CI , OR** | **Statistical significance** |
| Age  | 0.02 (CI :-17.95 ; -6)Odds Ratio= 1.037 | Significant  |
| Diabetes | 0.014 ( CI  : 4.8 , 15.9)Odds Ratio = 1.12 |  Significant |
| Previous Surgery  | 0.15 ( CI   : -1.5 ; 12, 1)Odds Ratio = 0.99 | Not significant |
| Glaucoma Type  | 0.04 ( CI  : 1.12 , 15.6) Odds Ratio = 1.01 |  Significant |
| Pre operative IOP  | 0.007 ( CI  : -15.7, -2.8) Odds Ratio = 1.88  | Significant++ |
| Number of hypotensive medications used pre operatively  | 0.5 ( CI  : -1.04 , 0.53)Odds Ratio = 0.96  | Not significant |
| Use of antimetabolites  | 0.016 ( CI   : 1.2 -13.94)Odds Ratio = 1.27 | Significant |

*Table 2 :* **Summary of Risk Factors Correlated with Therapeutic Failure**

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Discussion :

In our study, the mean age of patients who underwent trabeculectomy was 57.71 ± 4.4 years. This is approximately in line with other studies on trabeculectomy. In the AGIS study (4), the average age at the time of surgery was 65.7 years (n=513), in Beth Edmuns et al. (5) it was 69.2 years (n=1450), in A. Ellong et al. (6) it was 42.64 years (n=51), and in Hector et al. (7) it was 66.6 years (n=292). These results are similar and comparable across the different studies, with our study showing a somewhat younger cohort, likely due to the higher frequency and earlier onset of glaucoma in individuals of African descent. Regarding the medical history of the operated patients, the majority of patients in our series were hypertensive (31%); 37 patients. Diabetes was the second most common condition, present in 30 patients (25%). In the AGIS study (4), hypertension was also the most common comorbidity, found in 48.7% of patients, followed by diabetes in 18.3% of patients. The Types of Glaucoma found in our study were dominated by Primary Open-Angle Glaucoma (POAG) in 50% of eyes, followed by Chronic Angle-Closure Glaucoma (CACG) in 18%, then Pseudoexfoliative Glaucoma in 10%, Uveitic Glaucoma in 8%, Post-traumatic Glaucoma with angle recession and Silicone Glaucoma in 5%, Pigmentary Glaucoma in 3%, and finally 1 case of Neovascular Glaucoma (1.61%). In the Beth Edmunds et al. study (24), the majority of the operated patients had POAG (89.2%), followed by Pseudoexfoliative Glaucoma (5.4%), Normal-Tension Glaucoma (3.8%), and Pigmentary Glaucoma (1.6%). In Kathleen et al. study (8), 61 eyes underwent trabeculectomy for Chronic Open-Angle Glaucoma (including POAG, Pseudoexfoliative, and Pigmentary), 4 eyes for Chronic Angle-Closure Glaucoma, and 4 eyes for secondary glaucoma (uveitic and post-traumatic).In summary, POAG remains the most frequent etiology and indication for trabeculectomy in the literature. In our series, the average number of hypotensive treatments used preoperatively was 3.9 (ranging from 3 to 5 medications), with quadruple therapy being the most common (64.5%). In the Beth Edmunds et al. study (5), the average number of hypotensive treatments used was 2, ranging from monotherapy in 38.8% of cases to quadruple therapy in just 0.4%. In the Nouri-Mahdavi study (9), the average was 2.56 ± 0.86. Hector Fontana et al. (7) found an average of 2.7 ± 1, ranging from 1 to 5 treatments, and Shigeeda et al. (10) found an average of 2.67 ± 0.97 (ranging from 1 to 4).

Our result is somewhat higher than in the other series, which may be explained by delayed consultations in our context, leading to a later management of more advanced glaucoma.

The conjunctival incision is performed either using a limbal-based flap or a fornix-based flap. Several studies have compared these two types of incisions without showing significant differences in terms of effectiveness or complications (11, 12). Both Lam (13) and Balo (14) found that trabeculectomy with a limbal-based conjunctival flap yields good mid-term results. In our series, all patients underwent a limbal-based conjunctival incision. The use of combined surgery (phacoemulsification-trabeculectomy) or two-stage surgery remains a highly debated topic. Several studies have demonstrated the efficacy of combined surgery in lowering intraocular pressure both in the medium and long-term, including the study by Mamalis (15). However, compared to filtering surgery, combined surgeries are said to result in less pressure reduction than trabeculectomy alone, according to the studies by Gaskin (16) and Noben (17).

Between 1996 and 2002, the use of antimetabolites in glaucoma surgeries increased, with mitomycin C (MMC) use rising from 45% to 68% and 5-fluorouracil (5-FU) from 29% to 39% during primary trabeculectomies. For combined phaco-trabeculectomy procedures, MMC use increased from 65% to 83%, while 5-FU use decreased slightly from 18% to 15%. (18). In our series , 36% of patients had trabeculectomy without antimetabolites, and 5-FU was used more frequently than mitomycin C (40% vs. 24%). This preference is due to the limited availability of mitomycin C, which is primarily reserved for congenital glaucomas with a worse prognosis.

Concerning post operative data , Our study showed a two-line improvement in visual acuity at 10 months post-surgery, especially in patients undergoing combined phaco-trabeculectomy. n the study by Nouri-Mahdavi et al. (9), the average best-corrected visual acuity (BCVA) improved from 0.67 (±0.27) before surgery to 0.54 (±0.29) at the last follow-up. In Shigeeda et al.'s study (10), 39% of 123 eyes lost 3 lines of visual acuity at the final follow-up, mainly due to cataract progression. In Ibrahima and al.'s series (19), 88% of patients maintained their preoperative visual acuity. The average IOP significantly decreased postoperatively in our study, from 30 mmHg to 14.8 mmHg at 10 months, which is consistent with findings from other studies, further confirming trabeculectomy's effectiveness in lowering intraocular pressure. ( 6, 7, 9)

The complications observed in our study align with those found in other published studies, as detailed in Table 3.

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| **Post operative complications**  |  **AGIS (n= 509)** | **Edmunds and al** **( National survey) n=1240** | **Séries of Lam (n=123)** | **Shigeeda & al( n=123)** | **Nouri & al (n=78)** | **Our series (n=62)** |
| Post operative Hypotony  | 296(23.9%) | 3 (2.5%) | 8.3% |  | 10 (16%) |
| Post operative Hypertony | 30(5.9%) |  |  |  |  | 9(14.5%) |
| Hypheama  | 58(11.4%) | 304(24.6%) | 3(2.5%) |  |  | 3(5%) |
| Leaking of the FB  | 33(6.5%) | 216(17.4%) |  | 6.8 % | 1(1.28%) | 10 (16%) |
| Shallow AC | 79(15.5%) | 296(23.9%) | 3(2.5%) |  | 1(1.28%) | 10 (16%) |
| Cystic FB | 72(14.1%) | 42(3.4%) | 14(11.25%) | 13(16.6%) | 2(3%) |
| Endophtalmitis | 0 | 3(1.5% | 3(2.5%) | 3.5% | 0 | 3(5%) |
| Cataract | 21 (4.1%) | 251(20.2%) | 15(12.5%) | 28% | 18(23%) | 10 (16.2%) |
| Choroidal Detachment 40 ( 7.9%) | 2(1.3%) | 2(1.25%) |  | 1(1.28%) | 3(5%) |
| Hypotonic Maculopathy 0 | 2(1.3%) | 0 | 1% |  | 0 |

*Table 3 :* **Post operative complications in different series**

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Our study found that young age, secondary glaucoma, high preoperative intraocular pressure (IOP), and non-use of antimetabolites were significantly associated with therapeutic failure in trabeculectomy. The correlation between age and type of glaucoma was borderline significant (p < 0.05), while preoperative IOP had a highly significant correlation with failure (p = 0.001). These findings highlight important factors that can predict the outcome of trabeculectomy in glaucoma treatment.

The large multicenter AGIS study (4), which focused on risk factors for trabeculectomy failure, included 779 eyes that underwent the procedure, with a follow-up period of 8 to 13 years. Using the same failure threshold as in our study (18 mmHg), the AGIS study found that Race (specifically African American) increased the risk of failure (HR = 1.6). The risk of failure decreased by 3% for every additional year of age at the time of surgery (HR = 0.97; P = 0.005). The risk increased by 4% for every 1 mmHg increase in preoperative intraocular pressure (IOP) (HR = 1.04; P = 0.002). The risk of failure was almost three times higher in diabetic patients compared to non-diabetic patients (HR = 2.86; P < 0.001). Figure 5 illustrates how the risk of failure increases as preoperative IOP rises and how it is higher in younger patients. 

Fig 5 : Risk of failure increases as preoperative IOP rises

Beth Edmunds and al (5), found in his large observational study , that Diabetes (odds ratio [OR] = 0.485, P = 0.015), Suturing of the superior rectus muscle (OR = 0.580, P = 0.034), Subconjunctival anesthesia (OR = 0.172, P < 0.0001), Non-specialized surgeons (OR = 0.539, P = 0.010), were all significantly associated with less favorable outcomes.

Shigeeda and al.'s study (10) highlighted that lower preoperative IOP and refractive status were significantly associated with surgical success (defined as achieving an IOP < 18 mmHg as in our study or < 16 mmHg postoperatively). However, the number and duration of anti-glaucoma medications did not significantly influence the success or failure of the surgery. No factors were identified as being strongly associated with the third definition of success (30% reduction in IOP and IOP < 21 mmHg). These findings reinforce the importance of preoperative factors in predicting postoperative outcomes in trabeculectomy.

Studies by Talya et al.(20) and Kim et al. ( 21) support the beneficial role of Mitomycin C (MMC) in improving the success rate of trabeculectomy. Specifically, Kim et al. (21) found that a shorter application time of MMC (0.5 to 1 minute) at a concentration of 0.5 mg/ml is optimal for phakic eyes, as opposed to longer applications or no use of MMC, which may lead to less favorable outcomes.

Comparing 5-FU and MMC in trabeculectomy, Uchida et al. (22) reported favorable long-term success rates (57.6% at 6 years, 50.4% at 12 years). While the incidence of bleb leakage and blebitis was somewhat higher with 5-FU in some studies (10), long-term outcomes, including IOP control, seem comparable or slightly better with 5-FU compared to MMC. This suggests that 5-FU could be an effective alternative in some cases of trabeculectomy.

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| **Failure Risk Factors of Trabeculectomy** | **AGIS****(4)** | **Edmunds & al****(5)** | **Shigeeda & al (10)** | **Our series** |
| **Age**  | Significant +( p=0.005) | Not significant (p=0.17) |   | Significant (p=0.02) |
| **Race (melanoderma)** | Significant ( HR=1.6) | Not significant (p=0.2) |   | \_\_ |
| **Diabetes**  | Significant +(p<0.001) | Significant (p=0.01) |   | Not significant (p=0.33) |
| **Type of glaucoma** | \_\_ | Not significant (p=0.49) |   | Significant (p=0.04) |
|  **Pré operative IOP** | Significant+ (p=0.002) | Significant+ (p<0.0001) | Significant +(p=0.009) | Significant (p=0.001) |
| **Number of hypotensive medications**  | \_\_ | Not significant (p=0.87) | Not significant (p=0.82) | Not significant (p=0.1) |
| **Sub conjunctival anesthesia**  | \_\_ | Significant(p=0.001) |   | \_\_ |
| **Surgeon Experience**  | \_\_ | Significant (p=0.02) |   | \_\_ |
| **Use of Antimetabolites**  | \_\_ | Not significant (p=0.39) | Significant ( p=0.03) | Significant (p=0.01) |

*Table 4 :* **Risk Factors of Failure found in different series**

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Conclusion :

Trabeculectomy remains a cornerstone in glaucoma surgery with an 84% success rate in our study, aligning with findings in the literature. We suggest early detection of glaucoma, particularly in individuals over 40, to detect glaucoma early and initiate appropriate treatment, either medical or surgical, particularly in young individuals before irreversible blindness develops. An early surgical intervention, before prolonged medical treatment or polytherapy compromises the conjunctiva and ocular surface, an integrated management of risk factors like diabetes, which has been correlated with therapeutic failure and the occurrence of complications in several studies. And the use of antifibrotic agents (5-FU and MMC) to control the scarring response and improve the success rate of filtration surgery.

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