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RESEARCH ARTICLE

CATARACT FORMATION AFTER PENETRATING KERATOPLASTY: CLINICAL PREDICTORS FROM A 58-CASE RETROSPECTIVE STUDY IN A TERTIARY CENTER

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Abstract

Purpose: To identify clinical predictors associated with cataract development after penetrating keratoplasty (PK) in a tertiary referral center and to discuss the implications for surgical planning and postoperative surveillance.

Methods: We conducted a retrospective study including 58 phakic patients with at least 24 months of follow-up. Eyes with pre-existing cataract or incomplete data were excluded. Cataract was defined as lens opacity detected on slit-lamp examination. Multivariate logistic regression analysis was performed, and $p < 0.05$ was considered statistically significant.

Results: Post-keratoplasty cataract developed in 10 of 58 patients (17.2%) (95% CI: 8.6–29.4%).

The median age at diagnosis was 55 years (range, 40–70 years), and the mean interval to cataract diagnosis was 18 months, with most cases occurring between 16 and 24 months after surgery.

Nuclear cataract was the predominant type (80%), followed by posterior subcapsular cataract (10%) and corticonuclear cataract (10%).

Cataract occurred more frequently in eyes operated for corneal dystrophies (44.4%) and healed infectious keratitis (27.2%) than in post-traumatic corneal scars (15.4%) or keratoconus (5%).

Multivariate analysis identified older age (OR: 1.08 per year; 95% CI: 1.01–1.16; p=0.03) and corneal dystrophy as surgical indication (OR: 3.5; 95% CI: 1.1–11.2; p=0.04) as independent predictors of cataract development.

Sex, preoperative visual acuity, and cumulative corticosteroid dose were not associated with cataract formation.

Conclusion: Cataract is a frequent medium-term complication after penetrating keratoplasty. Older age and underlying corneal pathology appear to be associated factors. However, given the limited sample size and retrospective design, these findings should be interpreted with caution.

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Introduction:-

Penetrating keratoplasty remains an important surgical option for full-thickness corneal disease, despite the expansion of lamellar techniques. Its anatomical and functional results can be compromised by postoperative complications, among which cataract formation is particularly relevant because it may delay visual rehabilitation and require additional surgery. Previous reports have shown that cataract development after PK is not rare, with long-term rates in some series reaching 44% to 64% within 5 years. Older age has consistently emerged as an important predictor, while other reported contributors include preoperative lens changes, associated glaucoma, intraoperative iris manipulation, and prolonged corticosteroid therapy. The mechanism of cataractogenesis after PK is likely multifactorial. Surgical trauma, postoperative inflammation, steroid exposure, and altered anterior segment physiology may all contribute. The type of corneal pathology leading to grafting may also influence risk, either through patient age distribution, inflammatory burden, or perioperative complexity. In parallel, the growing shift toward endothelial and anterior lamellar keratoplasty reflects, in part, the desire to reduce complications inherent to full-thickness transplantation.Although several studies have identified predictors of cataract after PK, data from North African populations remain scarce, and disease-specific risk profiles are not fully characterized.

In this context, identifying the main predictors of cataract after PK remains clinically relevant, especially in centers where PK is still widely performed for infectious, dystrophic, traumatic, and ectatic corneal diseases. The present study aimed to analyze the frequency, timing, and associated factors of cataract development after penetrating keratoplasty in a Moroccan tertiary center.We hypothesized that patient-related and disease-related factors influence cataract development after penetrating keratoplasty in our setting.

Methods:-

Study design and setting:-

This was a retrospective analytical study performed at the Department of Ophthalmology B, Hôpital des Spécialités, Rabat, Morocco.The study was conducted in accordance with the Declaration of Helsinki and approved by the institutional ethics committee. Due to its retrospective nature, patient consent was obtained when possible or waived.

Study population:-

We reviewed the records of 58 patients who underwent penetrating keratoplasty and had a minimum follow-up of 24 months. The study focused on eyes that were phakic at the time of corneal transplantation and in which postoperative lens status could be adequately assessed.
Inclusion criteria were phakic eyes undergoing PK with at least 24 months of follow-up. Exclusion criteria included pre-existing cataract, glaucoma, uveitis, and incomplete clinical data.

Collected variables:-

The following variables were analyzed:

- age
- sex
- preoperative visual acuity
- indication for penetrating keratoplasty
- baseline lens status
- postoperative inflammation (when available)
- mean postoperative corticosteroid exposure
- timing of cataract diagnosis
- cataract morphology

Corticosteroid exposure:-

Postoperative corticosteroid exposure was estimated based on duration of treatment and average daily dosing regimen of topical corticosteroids.

Outcome measure:-

The primary outcome was the occurrence of clinically detectable cataract after penetrating keratoplasty during follow-up.Cataract was defined as lens opacity identified on slit-lamp examination and graded according to LOCS III when available.

Statistical analysis:-
Statistical analysis was performed using SPSS software (IBM Corp., Armonk, NY, USA). Univariate analysis was performed using Chi-square test for categorical variables and Student's t-test for continuous variables. Variables with $p < 0.1$ were included in a multivariate logistic regression model. Results were expressed as odds ratios (OR) with 95% confidence intervals (CI). A p value < 0.05 wasconsideredstatisticallysignificant.

Results:-

Incidence and timing:-
Cataract developed in 10 of the 58 included patients, corresponding to an incidence of 17.2% (95% CI: 8.6–29.4%).The median age at diagnosis was 55 years (range, 40–70 years). The delay before diagnosis ranged from 16 to 24 months, with a mean interval of 18 months.

Cataract morphology:-
Nuclear cataract was the most frequent type, observed in 8 of the 10 affected eyes (80%). Posterior subcapsular cataract and corticonuclear cataract each accounted for 1 case (10%).

Sex distribution:-
Among patients who developed cataract, 7 were women and 3 were men.
No statistically significant association was found between sex and cataract occurrence (p=0.42).

Preoperative visual acuity:-
Among eyes that subsequently developed cataract, preoperative visual acuity was:
- hand motion in 5 cases
- counting fingers at 1 meter in 4 cases
- 1/10 in 1 case

Preoperative visual acuity was not significantly associated with postoperative cataract occurrence(p=0.51).

Indication for penetrating keratoplasty:-
The incidence of cataract varied according to the initial corneal pathology:
- corneal dystrophies: 4/9 eyes (44.4%)
- infectious keratitis scars: 3/11 eyes (27.2%)
- post-traumatic scars: 2/13 eyes (15.4%)
- keratoconus: 1/20 eyes (5%)

A statistically significant association was found between surgical indication and cataract occurrence (p=0.04).

Corticosteroid exposure:-
Average postoperative corticosteroid exposure was not significantly associated with cataract occurrence (p=0.60).

Significant and non-significant factors:-
Factors significantly associated with cataract development:
- older age
- indication for keratoplasty, particularly corneal dystrophy

Factors not significantly associated:
- sex
- preoperative visual acuity
- cumulative corticosteroid dose

Table 1: Risk factors associated with cataract development after penetrating keratoplasty

Variable	OR	95% CI	p-value	Variable
Age	1.08	1.01–1.16	0.03	Age
Corneal dystrophy	3.5	1.1–11.2	0.04	Corneal dystrophy
Sex	1.2	0.3–4.5	0.42	Sex
Corticosteroids	1.1	0.5–2.3	0.6	Corticosteroids

Discussion:-

In this retrospective series of 58 penetrating keratoplasties, cataract developed in 17.2% of eyes within the first 2 postoperative years (95% CI: 8.6–29.4%). This incidence falls within the lower range of published estimates, although direct comparison remains challenging due to variability in follow-up duration, baseline lens status, and cataract definition across studies.[14] Larger and longer-term studies have reported substantially higher cumulative risks, especially beyond 3 to 5 years.[1]Our results reinforce the role of age as a major determinant of post-PK cataract formation. In our multivariate analysis, age emerged as an independent predictor (OR: 1.08 per year; 95% CI: 1.01–1.16; p=0.03), which is consistent with previous studies demonstrating increased susceptibility of the aging crystalline lens to surgical and inflammatory stress.[14] Age likely acts through baseline lenticular vulnerability, but it may also reflect a more complex anterior segment environment and reduced physiological reserve.

We also found that the surgical indication significantly influenced risk, with corneal dystrophies carrying the highest incidence in our cohort. Multivariate analysis confirmed corneal dystrophy as an independent predictor (OR: 3.5; 95% CI: 1.1–11.2; p=0.04). This result is clinically relevant. Eyes with dystrophic corneal disease are often operated at an older age than keratoconus eyes, which may partly explain this association. In contrast, the very low incidence observed in keratoconus is consistent with the younger age and typically clear preoperative lens status of these patients. Similar patterns have been reported in the literature, highlighting the role of underlying pathology and patient profile in modulating cataract risk after PK.[15]Interestingly, corticosteroid exposure was not significantly associated with cataract formation in our study. This finding contrasts with several reports that identified corticosteroids as a major contributor to cataractogenesis after PK.[2] Rathi et al. reported that excessive steroid use and intraoperative iris manipulation were significant risk factors, while other studies have emphasized the contribution of postoperative inflammation and glaucoma-related factors.[25] The absence of association in our cohort may be explained by the lack of precise quantification of cumulative steroid dose, heterogeneity of treatment regimens, and limited statistical power due to the small number of events. Therefore, this result should be interpreted with caution and does not exclude a potential cataractogenic effect of corticosteroids.

From a clinical perspective, our findings support more individualized postoperative surveillance strategies. Patients of older age and those undergoing PK for corneal dystrophy appear to be at higher risk and may benefit from closer lens monitoring. This has implications for surgical planning. In selected high-risk cases, particularly when early lens changes are suspected, the option of combined keratoplasty and cataract surgery versus a sequential approach may be considered. Previous studies have shown that cataract surgery after PK can achieve favorable visual outcomes but is associated with specific challenges, including endothelial cell loss and risk of graft failure.[5]

The present study has several limitations. First, the retrospective design introduces potential selection bias and limits control over confounding variables. Second, the relatively small sample size (n=58) and low number of cataract events (n=10) reduce statistical power and increase the risk of type II error. Third, the follow-up duration of 24 months may underestimate the true long-term incidence of cataract after PK.However, important variables such as baseline lens grading, intraoperative factors (e.g., iris manipulation), and severity of postoperative inflammation were not systematically recorded, which may have influenced the results. Residual confounding cannot be excluded. Despite these limitations, this study provides valuable real-world data from a Moroccan tertiary center and contributes to the limited regional literature on post-keratoplasty complications.Finally, in the era of lamellar keratoplasty, our results indirectly support the broader trend toward tissue-sparing procedures when feasible. Lamellar techniques, by reducing intraocular manipulation, may potentially decrease the risk of cataract formation compared to penetrating keratoplasty.[3]

Conclusion:-

Cataract formation after penetrating keratoplasty is a clinically relevant complication that may compromise visual rehabilitation and require additional surgical intervention. In this study, older age and surgical indication, particularly corneal dystrophy, were identified as factors associated with increased risk of cataract development.
However, given the retrospective design, limited sample size, and short follow-up duration, these findings should be interpreted with caution and cannot be considered definitive.These results highlight the importance of risk-based postoperative surveillance and may assist in clinical decision-making regarding the timing and strategy of cataract surgery in PK patients.Further prospective studies with larger cohorts, standardized lens assessment, and comprehensive evaluation of perioperative factors are required to better define the determinants of cataract formation after penetrating keratoplasty.

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