

Technical Parameters and Patient's Characteristics Influence on the Main Outcomes of Phacoemulsification Cataract Surgery: Results from a Tertiary Healthcare Center

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Rezumat

Influența parametrilor tehnici și a caracteristicilor pacienților asupra principalelor efecte ale operației de cataractă prin facoemulsificare: rezultate obținute într-un singur centru clinic

Obiective: Să evalueze influența parametrilor tehnici (precum timpul faco și energia ultrasunetelor) și a caracteristicilor pacienților (boli asociate, densitatea celulelor endoteliale (CD), tensiunea intraoculară (IOP)) asupra rezultatelor acuității vizuale ale indivizilor supuși unei operații prin facoemulsificare cu implantarea unui cristalin artificial.

Metodologie: Acest studiu transversal retrospectiv a implicat 122 de ochi, împărțiți în 4 grupuri, folosind sistemul de clasificare LOCS III: Gradul 1 (25 de ochi), Gradul 2 (21 de ochi), Gradul 3 (30 de ochi) și Gradul 4 (46 de ochi). Microscopia speculară a fost efectuată atât înainte cât și post operator, iar energia ultrasunetelor și timpul faco efectiv au fost evaluate intraoperator.

Rezultate: A fost observată o scădere progresivă a densității celulare (CD) în toate cele patru grupuri la finalul primei săptămâni postoperatorii, cu o pierdere celulară endotelială medie de aproximativ 700 celule/mm². Tensiunea intraoculară postoperatorie (IOP) a scăzut în mod semnificativ în grupul de cataracta de Gradul 4, de la o valoare medie de 21.3 ± 10.06 la o valoare medie de 17.43 ± 3.81 mmHg, însoțită de un consum mai ridicat de energie a ultrasunetelor. De asemenea, s-a observat o îmbunătățire semnificativă a acuității vizuale din prima zi postoperatorie până la finalul primei săptămâni post-operator, interval în care s-a efectuat monitorizarea în toate cele patru grupuri. Ameliorarea acuității vizuale s-a menținut la un nivel semnificativ doar atunci când au fost comparate grupurile 1 și 4. Analiza regresiei multiple a identificat cataractele de Gradul 3 și 4, împreună cu acuitatea vizuală preoperatorie, ca factori predictivi puternici în ce privește rezultatele acuității vizuale, în timp ce sexul, vârsta, tipul IOL, comorbiditățile, timpul faco (EPT), energia ultrasunetelor (U/S), tensiunea intraoculară

preoperatorie și densitatea celulară nu au fost asociate, în mod independent, cu rezultatele acuității vizuale.

Concluzie: Rezultatele noastre au indicat faptul că 95.9% dintre pacienții evaluați în prima zi postoperator au înregistrat o acuitate vizuală mai mare decât 6/18, în timp ce 4.1% au înregistrat o acuitate vizuală la limită, în intervalul 6/18-6/60, în conformitate cu standardele Organizației Mondiale a Sănătății (WHO) în ce privește rezultatele operației de cataractă.

Cuvinte cheie: facoemulsificare, cataractă, acuitate vizuală, densitate celulară, tensiune intraoculară, grosime corneeană centrală

Abstract

Objectives: To assess the influence of technical parameters (such as phaco time and ultrasound energy) and patient's characteristics (associated diseases, endothelial cell density (CD), intra-ocular pressure (IOP)) on visual acuity outcomes in individuals undergoing phacoemulsification surgery with intraocular lens implantation.

Methodology: This cross-sectional, retrospective study involved 122 eyes divided into 4 groups using the LOCS III system classification: Grade 1 (25 eyes), Grade 2 (21 eyes), Grade 3 (30 eyes) and Grade 4 (46 eyes). Specular microscopy was performed pre- and postoperatively, while the ultrasound energy consumption and the effective phaco time were observed intraoperatively.

Results: A progressive decrease of cell density (CD) was observed in all groups at end of the 1st week postoperatively, with a mean endothelial cell loss of about 700 cell/mm². The postoperative intraocular pressure (IOP) dropped significantly in Grade 4 cataract group from a mean value of 21.3 ± 10.06 to 17.43 ± 3.81 mmHg, accompanied by higher ultrasound energy consumption. A progressive improvement of visual acuity was observed, from the 1st day post-surgical visit to the 1st week follow-up evaluation in all the groups. Visual acuity improvement was maintained significant after 1st week only when comparing groups 1 and 4. The multiple regression analysis identified cataracts Grade 3 and 4 along with the preoperative visual acuity as strong predictors for the final visual acuity outcomes, while gender, age, IOL type, comorbidities, phaco time (EPT), ultrasound energy (U/S), preoperative intraocular pressure and cell density were not independently associated with visual acuity outcomes.

Conclusion: Our results indicated that 95.9% of the patients evaluated 1 day postoperative had visual acuity better than 6/18, while 4.1% had borderline visual acuity in the range of 6/18-6/60, being in line with the World Health Organization (WHO) standards for cataract surgery outcomes.

Keywords: phacoemulsification, cataract, visual acuity outcome, cell density, intraocular pressure, central corneal thickness

Introduction

Cataract represents the cloudiness of the normally clear lens of the eye, that gradually progresses with age, causing visual acuity impairment, interfering with daily routine activities (1,2). Cataract is considered to be the most common cause of reversible blindness all over the world (3), with other known causes of blindness being uncorrected refractive errors, glaucoma, age-related macular degeneration and diabetic retinopathy (4), all together summing a total of about 94 million people worldwide. The most common symptom of cataract is visual acuity loss, both for near and distance, but photophobia, diplopia, change in color vision are also representative for the evolution of cataract (5). The

main cause for cataract development is age, but other factors such as systemic diseases, endocrine disorders, traumatic injuries, retinal de-tachment, uveitis, radiation and chemicals are also involved (6). Regardless of the etiology, cataract treatment is represented by surgical intervention aimed at removing the opacified lens and replacing it with an artificial intraocular lens (IOL) (7,8). During the years, cataract surgery evolved from barbaric techniques to modern surgery. Visual acuity improvement is related to considerable gains in real-life activities, emotional and social life components (9-14). Nowadays, it is not enough to only perform cataract surgeries, but to be done with visual results at highest level possible, as cataract surgery is a sight restoring procedure. The World Health Organization (WHO) has defined standards

for the outcomes of cataract surgery in three categories: good (postoperative visual acuity outcome better than 6/18); borderline (visual acuity outcome in the range 6/18-6/60); and poor (visual acuity less than 6/60) (15-17). The postoperative visual acuity is used as benchmark to determine the quality of cataract surgery. Risk factors for poor visual outcome after cataract surgery are known to be age, ocular comorbidities (such as diabetic retinopathy, dense cataract obscuring fundus view, glaucoma and macular diseases), corneal cell density, intraoperative complications, surgeon experience, types of cataract surgery, surgical wound type and placement, types of intraocular lens. Being aware of these risk factors, prior to surgery, the surgeon must take extra precautions preoperatively and intraoperatively in order to reduce surgical complications. Surgeons must employ detailed preoperative planning, and robust biometry measurements using advanced formulas for IOL calculations such as the SRK/T, Holladay 1 and 2, Barrett, Olsen, Hill-RBF formulas that are constantly being modified for better refractive results. As longevity increases around the world, along with the incidence of ocular diseases such as age-related macular degeneration, glaucoma and diabetic retinopathy rising, more patients who require cataract surgery may have a complex condition that could influence the final visual outcome, despite a perfect surgery. Also, the systemic comorbidities (diabetes, hypertension) affecting the surgical outcome, are also responsible for increased costs, as extra investigations are required. These patients need proper management both pre and intraoperatively, extra precaution for ultrasound energy consumption and limited phaco time usage during lens removal, in order to prevent possible intraoperative complications due to the fragility of ocular structures (18-21). Diabetic patients, even with good glycemic index, are more prone to endothelial damage, such as increased central corneal thickness, increased hexagonality and drastic reduction of endothelial cells after phacoemulsification, as shown in one of our previous studies (22).

In this context, the aim of our study was to investigate the influence of technical parameters (such as phaco time and ultrasound energy) and patient's characteristics (associated diseases, endothelial cell density (CD), intraocular pressure (IOP)) and cataract grade on the main visual outcomes of cataract surgery, performed in a healthcare centre in NV Romania.

Materials and Methods

This cross-sectional, retrospective study was conducted on 122 eyes, respectively 122 patients who underwent phacoemulsification cataract surgery at Emergency County Hospital Oradea, Bihor County, Romania, during the period 28.02.2021-30.02.2023, in order to evaluate the corneal cell density (CD) and visual acuity outcome after phacoemulsification cataract surgery in different grading cataracts.

Inclusion and Exclusion Criteria

The inclusion criteria of the study group consisted of patients aged 40-90 years who underwent phacoemulsification cataract surgery, performed by the same surgeon, during the period 28.02.2021-30.02.2023. A total of 150 patients were initially admitted based on these criteria. Exclusion criteria were: history of ocular disease (7 patients), intraocular surgery, laser treatment and amblyopia (13 patients) and endothelial cell count less than 800 cells/mm² (8 patients). Finally, a total of 122 patients were included for statistical analysis.

Pre- and Post-operative Pphthalmological Examination

Patients underwent meticulous ophthalmological examination, both of the anterior and posterior pole, slit-lamp examination, intraocular pressure using Goldman applanation tonometry, dilated fundus examination using a non-contact lens. The study cohort was divided according to the grading of cataract using the LOCS III system classification, as follows: Grade 1 (25 eyes), grade 2 (21 eyes), grade 3 (30 eyes) and grade 4 (46 eyes), with a mean age (in all groups) of about 70. Visual acuity (VA) was determined prior to surgery and after one day, respectively 1st week post-operative; at all testing sessions, the VA was determined monocularly and noted in logMAR form. For hand movement (HM) visual acuity, the value was expressed as 2.3 logMAR, while for light perception (LP) as 2.7 logMar. One day before cataract surgery, the crystalline lens opacity was categorized and graded in mydriasis at the slit lamp with respect to nuclear opalescence, nuclear color, cortical and posterior subcapsular cataracts, using the Lens Opacities Classification System (LOCS) III. Specular microscopy was performed pre- and 1 week postoperative, using a non-contact Topcon Specular Microscope (Topcon Corporation

Itabashi-ku, Tokyo, Japan 2017) by recording the values of corneal endothelial cell density (CD). The ultrasound energy consumption (U/S) of the phaco machine and the effective phaco time (EPT) were also observed intraoperatively (Stellaris PC, Bausch & Lomb, USA, 2016).

Surgical Procedure

Pupillary dilatation was achieved prior to surgery using tropicamide 1% and phenylephrine 10%. All surgeries were performed under topical and peribulbar anaesthesia by an experienced surgeon using the phacomachine. One main temporal incision of 2.2 mm and two side-port incisions of 1.2 mm were made, followed by application of viscoelastic substances in the anterior chamber for space maintenance and corneal endothelium protection. Using a coaxial capsulorhexis forceps, a curvilinear capsulorhexis was obtained. Hydrodissection and emulsification of the lens using ultrasound energy and removal of the residual cortex with irrigation-aspiration were performed. Intraocular lens (IOL) either monofocal or multifocal were implanted into the capsular bag. The viscoelastic substance was washed out and the corneal incisions were hydro-sealed.

Statistical Analysis

Statistical analyses were performed using GraphPad Prism (version 10.1.2). Numerical variables are presented as the mean \pm standard deviation (SD). Normality was assessed using the Shapiro-Wilk test. For normally distributed parametric data, the paired t-test was employed to compare preoperative and postoperative measurements within each cataract group. ANOVA followed by Tukey's multiple comparisons test was used to evaluate differences among various cataract grading groups. To compare variables at different time points, within each cataract grading group, repeated measures ANOVA followed by Tukey's multiple comparisons test was employed. The Mann-Whitney test was applied to compare visual acuity outcomes between monofocal and multifocal intraocular lenses (IOLs). Correlation analysis assessed the univariate associations between quantitative variables and visual acuity outcomes (LogMAR). Multiple regression analysis was conducted to identify variables that independently contributed to visual acuity outcomes (LogMAR). Statistical significance was set at $p < 0.05$.

Ethical Considerations

The ethical approval for this study was obtained from the Institutional Review Board/Ethical Committee of the Emergency County Hospital Oradea (approval no. 4238/11.02.2021). This study was conducted in compliance with the guidelines of the Declaration of Helsinki. Written informed consent was obtained from the patient for publication.

Results

Socio-demographic and Clinical Characteristics

The socio-demographic characteristics of the included patients are presented in *Fig. 1*. In Grade 4 group, females were predominant (65.22% vs 34.78%), with no statistically significant difference between the rest of the groups in terms of gender. There were slightly more right eyes operated in Grade 1 group. In terms of comorbidities, a total of 47 patients (from all groups) presented no comorbidities, 14 patients had Type 2 diabetes (T2DM) with good glycemic index and no diabetic retinopathy, 42 patients presented high blood pressure (HBP) but well-controlled, and the rest of 19 patients presented both T2DM and HBP (*Fig. 1*).

Intra and Postoperative Complications in Different Cataract Grading

Intra and postoperative complications were more frequent and serious the more advanced the degree of cataract was. We had 25 patients with Grade 1 cataracts and they had no intra, nor post-operative complications. The patients with Grade 4 cataracts showed corneal edema (6 patients), striate kerathopathy (3 patients), iris trauma (3 patients), posterior capsule tear (1 patient) and vitreous loss (1 patient). In Grade 2 and 3 patients presented only corneal edema as complication of cataract surgery (*Table 1*).

Endothelial Cell Density (CD), Intraocular Pressure (IOP), Effective Phaco Time (EPT) and Ultrasound Energy (US)

In all 4 groups, a progressive decrease of the endothelial cells density is observed, from the initial measurements until the 1st postoperative week examination. The mean preoperative cell density was 2200 ± 622.6 cell/mm²; 2132 ± 501.2

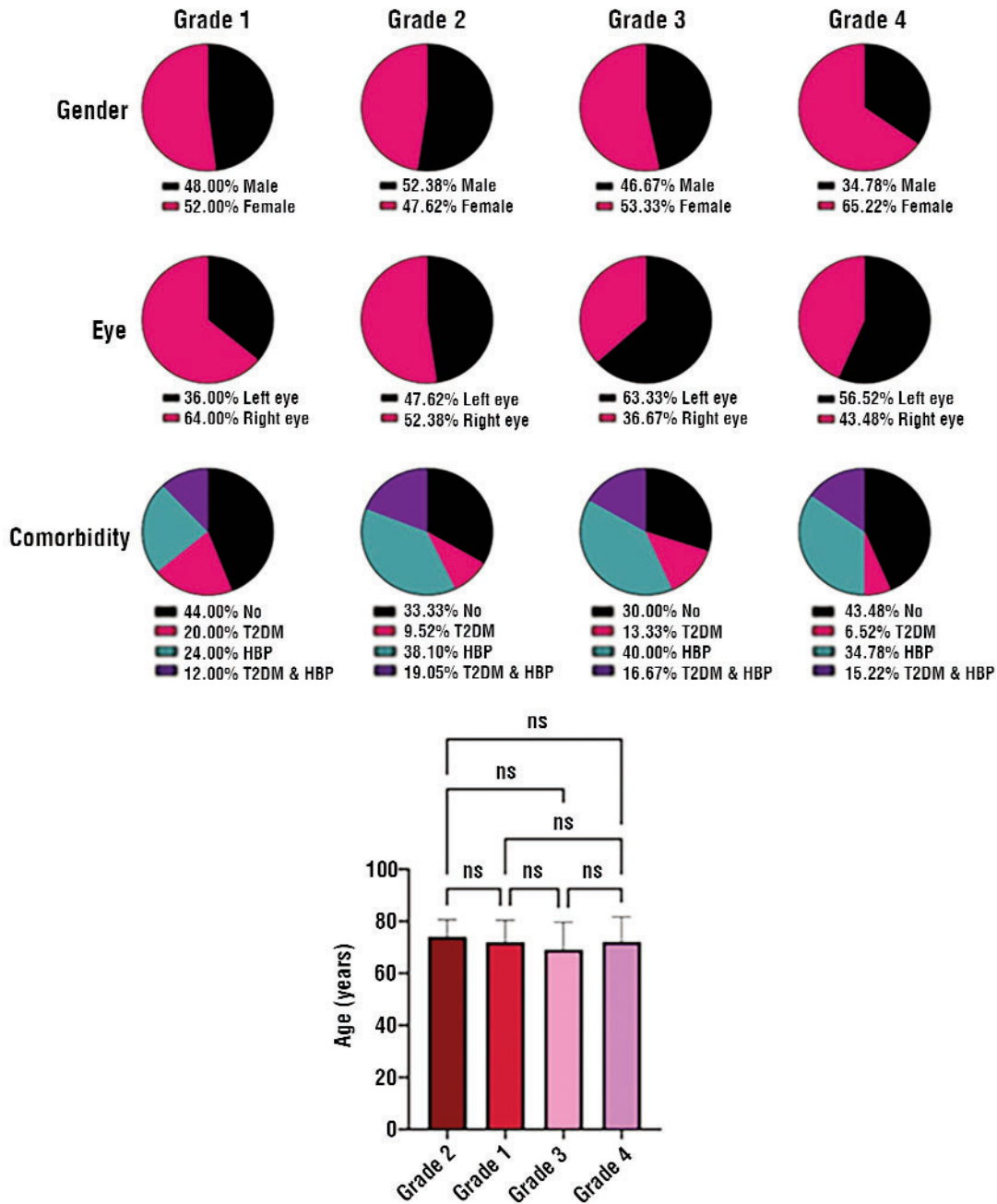


Figure 1. Socio-demographic and clinical characteristics. Legend: T2DM-type 2 diabetes mellitus; HBP-hypertension.

cell/mm², 2244 ± 589 cell/mm² and 2079 ± 637.3 cell/mm² respectively for each Grade group (1 to 4), the mean endothelial cell loss in all groups being about 700 cell/mm², with no statistically significant difference between them (Fig. 2).

The preoperative versus the postoperative IOP values were statistically significant only for Grade 4 group (Table 2).

Intraoperatively, the mean phaco time (EPT) was shorter in Grade 1, 2 and 3 groups, with values ranging from 10.35 ± 3.745 s to 8.94 ± 2.98 s, while a maximum EPT of 17.44 ± 9.63 s was recorded in Grade 4 group (Fig. 3 A). Moreover, the ultrasound energy was also at highest level in Grade 4 group (14.8% ± 4.52), as presented in Fig. 3 B.

Table 1. Intra and postoperative complications in cataract grading

Intra/Post-operative Complications	Grade 1	Grade 2	Grade 3	Grade 4
No	25	20	27	32
Corneal Edema (CE)	0	1	3	6
Striate Kerathopathy (SK)	0	0	0	3
Iris Trauma	0	0	0	3
Posterior Capsule Tear (PCT)	0	0	0	1
Vitreous Loss	0	0	0	1
Total No. of patients	25	21	30	46

Visual Acuity (logMar)

The best post-operative VA was defined as the best visual acuity amongst unaided, best corrected, and pinhole. The visual acuity before and after phacoemulsification, at 1st day respectively 1 week, is shown in Fig. 4. Statistically significant progressive improvement of visual acuity was

Table 2. Pre- and postoperative intraocular pressure (mmHg, mean ± SD)

	Grade 1	Grade 2	Grade 3	Grade 4
Preoperative IOP	16.08±4.932	13.62±2.991	15.87±4.71	21.3±10.06
Postoperative IOP	15.88±3.644	15.76±3.59	15.97±4.46	17.43±3.81

observed from the 1st day post-surgical visit to the 1st week follow-up evaluation in all groups. We noticed a statistically significant improvement of visual acuity in the 1st day post-operative when comparing group 1 to group 4, group 2 to group 4, group 3 to group 4 at p <0.0001, but non-significant differences between group 1 and group 2, nor between group 2 and group 3 (Fig. 4). Moreover, comparing the results at 1st week post-operative, there is no statistically significant improvement in visual acuity between the groups, except between group 1 and group 4 at p <0.05 (Fig. 4).

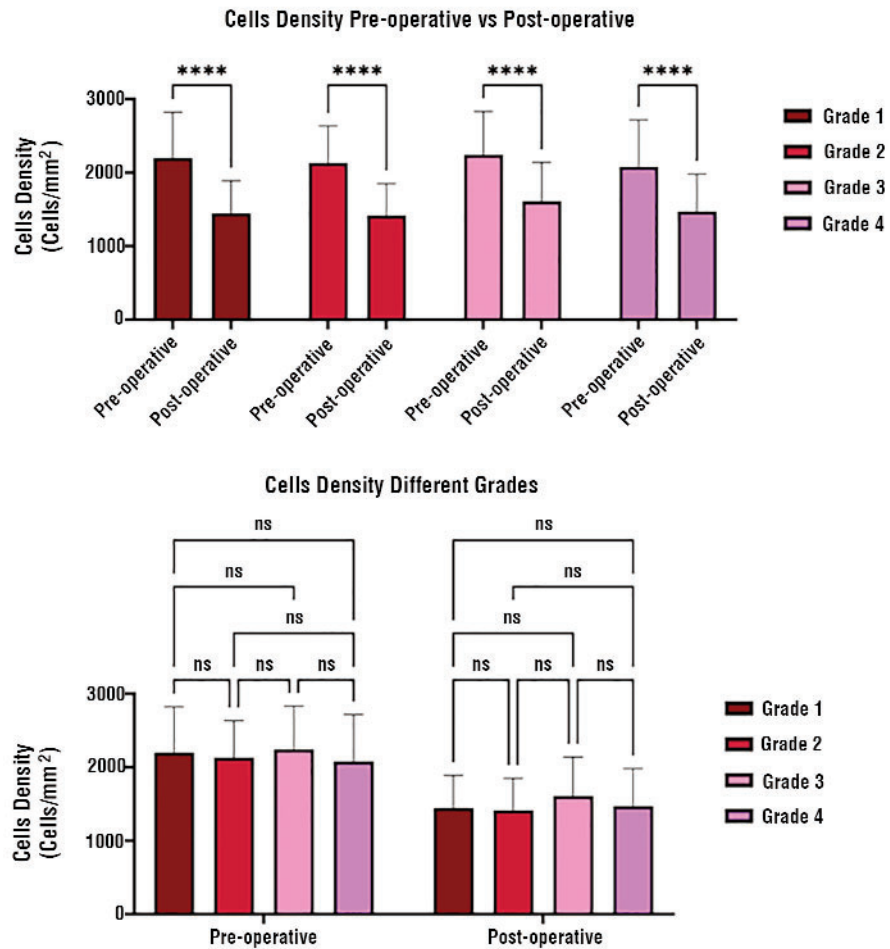


Figure 2. Effect of cataract surgery on cell density (CD)

Figure 3. (A) Phaco time (EPT) in different cataract grades groups; (B) Ultrasound (US) intensity in different cataract grading groups.

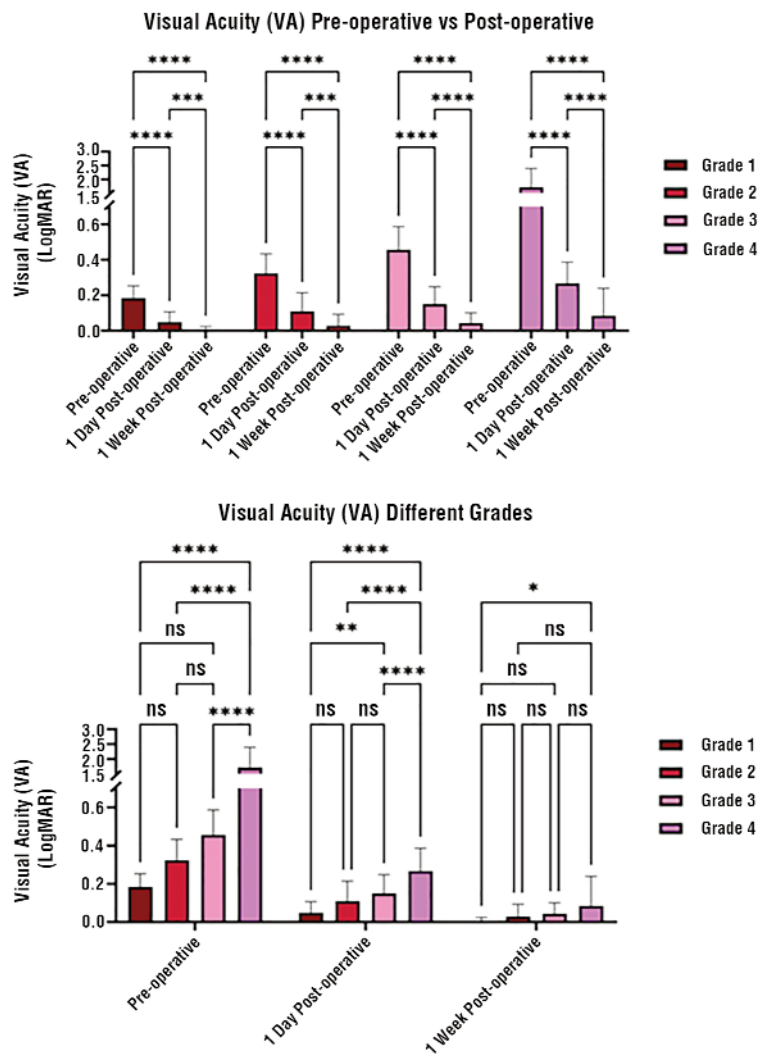
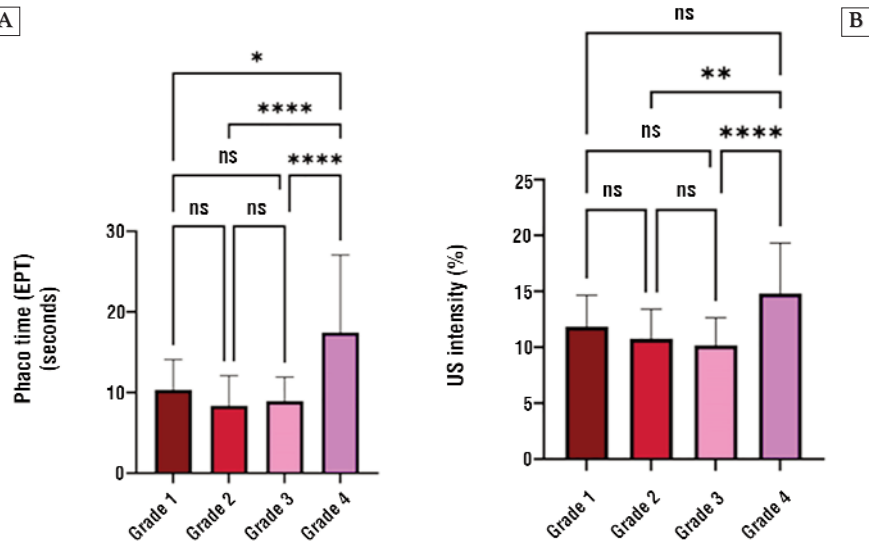


Figure 4. Effect of cataract surgery on visual acuity (VA) (logMar)

In line with the World Health Organisation (WHO) standards of the outcomes of cataract surgery, 117 patients (95.9%) evaluated 1st day postoperative had visual acuity better than 6/18, 5 patients (4.1%) patients presented borderline visual acuity (in the range 6/18–6/60), and no patient was noted with poor visual acuity (VA less than 6/60). We also considered to evaluate the difference between visual acuity outcome after phacoemulsification in patients that were given monofocal versus multifocal IOL, at both 1st day and 1st week postoperative, but no significant difference was observed, as shown in *Table 3*.

Univariate Analysis

By applying the univariate analysis, it was observed that the preoperative visual acuity, phaco time, ultrasound energy consumption, as well as the preoperative intraocular pressure were significantly associated with the visual acuity outcomes of the cataract surgery. Neither the patients age, nor their preoperative cell density had any influence on the visual outcomes (*Table 4*).

Multiple Regression Analysis

The multiple regression analysis was applied in order to find the best predictors for visual acuity outcomes after phacoemulsification cataract surgery. The final model identified that cataracts Grade 3 and 4 along with the preoperative visual acuity are strong variables for final visual acuity outcomes, while gender, age, IOL type, comorbidities, phaco time (EPT), ultrasound energy (U/S), preoperative intraocular pressure and cell density were not independently associated with visual acuity outcomes (*Table 5*).

Discussion

The current study investigated the visual outcomes in phacoemulsification cataract surgery and associated risk factors in terms of patients' comorbidities (T2DM, HBP), age, gender, intraocular pressure, different cataract grades, also taking into account the technical parameters involved in surgical procedure. The mean age of the patients selected in our study was 71.71 years, comparable to Sharifi et al (23). Women were found to be predominantly affected by Grade 4 cataract (65.2%), although in rest of the groups (grade 1, 2 and 3) there was no difference in terms of gender. Previous studies showed

Table 3. Visual acuity outcome (LogMAR) monofocal vs. multifocal IOL

Follow up	Monofocal (mean±SD)	Multifocal (mean±SD)	P value
1st day post-operative	0.18 ± 0.14	0.15 ± 0.12	0.3935
1st week postoperative	0.05 ± 0.06	0.04± 0.13	0.0418

Table 4. Univariate association between the measured variables and visual acuity outcomes (LogMAR).

	Correlation Coefficient (r)	P value
Age	-0.1115	0.2214 ns
Preoperative Visual Acuity	0.6525	<0.0001 ****
Preoperative Cells Density	0.1061	0.245 ns
Intra Ocular Pressure Pre-operative	0.2549	0.0046 **
Phaco Time (EPT)	0.3539	<0.0001 ****
US %	0.266	0.0031 **

that women have a more age-adjusted risk of developing cataract than men, probably due to longer average lifespan (24-25). Our results revealed that HBP and T2DM were present in patients undergoing cataract surgery, but not directly correlated with poor visual outcomes, although previous studies revealed that diabetic patients undergoing phacoemulsification presented greater loss of cell density, increased central corneal thickness and a reduction of hexagonality compared to their non-diabetic's counterparts (22). Liyan et al. reported an average of 4 lines of visual acuity improvement, in both diabetic and non-diabetic group (26). Lindsey et al. concluded

Table 5. Multiple regression model of the measured variables with visual acuity outcomes (LogMAR).

Factor	Estimate	Standard error	P value
Gender(F)	-0.01352	0.01898	0.4776
Age	-0.0008240	0.001287	0.5233
IOL Type (Multifocal)	-0.02176	0.01842	0.2402
Cataract Grading			
Grade 2	0.05092	0.02968	0.0892
Grade 3	0.06985	0.02808	0.0144 *
Grade 4	0.1014	0.04173	0.0168 *
Preoperative Visual Acuity (LogMAR)	0.06191	0.02160	0.0050 **
Preoperative Cells Density (/mm ²)	0.00003591	0.0000197	0.0711
Preoperative Intra Ocular Pressure (mmHg)	0.0006159	0.001333	0.6451
Eye (Left eye)	0.02983	0.01885	0.1165
Comorbidities			
High Blood Pressure	0.02442	0.02162	0.2613
Type 2 Diabetes	-0.02128	0.03039	0.4854
Type 2 Diabetes&High Blood Pressure	-0.01476	0.02737	0.5908
Technical parameters			
Phaco Time (EPT) (Sec-onds)	0.002532	0.002174	0.2466
US Intensity %	-0.001945	0.003806	0.6105
r ² = 0.5339			

that insulin dependent diabetic patients had worse visual outcome when compared to non-insulin dependent or non-diabetic patients (27). Evaluation of visual outcomes should be an essential component of any hospital quality audit. In our study group, 4.1% of the patients had borderline visual acuity outcome after cataract surgery with IOL implantation. The borderline outcome was associated with a pro-longed phaco time and a greater amount of ultrasound energy consumption intraoperatively that are responsible for postoperative corneal edema and endothelial dysfunction. Preoperative visual acuity and preoperative intraocular pressure had been also associated with poorer post-operative visual outcomes.

In the present study, decreased intraocular pressure after phacoemulsification was noted in all grade groups, but significantly in Grade 4, from a mean value of 21.3 ± 10.06 mmHg to 17.43 ± 3.81 mmHg. According to Poley et al, the reduction degree is proportional to the presurgical IOP (28,29). Other studies comparing the visual outcomes of cataract surgery between the monofocal and multifocal groups found that the patients receiving multifocal IOLs attained better uncorrected visual acuity at a range of distances and higher spectacle independence (30,31), whereas patients in the monofocal group had better contrast sensitivity and higher scores for night-time driving (31). In terms of distance visual acuity, our study demonstrated no difference in terms of IOL types, monofocal versus multifocal lens. Unfortunately, we found no data recorded in the patients' files about the contrast sensitivity, night-time driving, near vision score or intermediate visual acuity, and hence, further studies are necessary to assess the superiority of different IOL's type used in our hospital.

According to the WHO standard, less than 5% of cases should have a poor visual outcome (6/60) in post-cataract surgery. Our study met these criteria, as no patient with visual outcome less than 6/60 was recorded. WHO also recommends that after surgery, at least 80% of the operated eyes should have a presenting visual acuity of 6/6 – 6/18, which is referred to as a good visual outcome. After best correction, at least 90% of the eyes should achieve this level of vision (32). The results of our study showed that 95.9% of the patients meet these criteria. By comparing with previous results in the literature, Suresh et al. showed that 38% of their patients had near normal presenting vision of 6/6-6/9, on the 1st day postoperative (33). Khandekar

et al reported that one day after cataract surgery, 46% of patients had good vision, 43.2% borderline vision and 10.7% had poor vision outcome (34). Ahsan et al. achieved WHO recommended criteria of good visual outcome in 81.83% of cases and severe visual impairment in 4.26% (35). Unlike our results, Ukponmwan et al. reported that on the first day, only 8.1% of the patients had visual acuity outcome in the range of 6/6-6/18 (36).

Based on the literature, possible factors that might cause a suboptimal result after cataract surgery are related to eye pathologies, intra-operative and postoperative complications and uncorrected refractory error (37). The complications recorded in our study were as follows: corneal edema - 10 cases, striate kerathopathy - 3 cases, iris trauma - 3 cases, posterior capsule tear - 1 case and vitreous loss - 1 case. Hennig et al reported posterior capsular rent in 0.2% cases (38), Khan et al reported 3.33% (39) and Hosamani et al. reported posterior capsule rupture with vitreous leak in 1.21% cases (40). Posterior capsule rupture alone, when using automated vitrectomy, is not associated with worse postoperative visual acuity, which underlines the importance or proper management of this complication intraoperatively, so that chances of vitreous loss are minimized (41). Iris trauma was found to be associated with worse outcome, being related to an increased risk of postoperative inflammation and higher incidence of postoperative macular edema (42). The results of Kausar study showed that higher cataract density was significantly associated with striate keratopathy and increased phaco time (43).

We noticed that all the complications appeared in cataract Grade 4 (14 cases), followed by Grade 3 (3 cases), while only one complication occurred in Grade 2, which confirm that the higher the cataract grading, the higher chances of intra and postoperative complications and poorer VA. Finally, the multiple regression model employed in our study indicated that cataract Grade 3 and Grade 4 along with the preoperative visual acuity are strong predictors for visual acuity outcomes. Shandiz et al. concluded that increased cataract severity, as determined by LOCS III grading, is strongly associated with a decrease in VA outcomes (44). The International Cataract Surgery Outcomes stated that suboptimal postoperative visual outcome is due to increased age, female gender and lower preoperative visual acuity (45). Similar to our findings, reduced pre-operative VA was shown to reflect a denser cataract, which increases the

risk for intraoperative and postoperative complications, such as capsular rupture or macular edema and poorer postoperative VA (46). Chen et al. also showed that poor outcomes were correlated with the low baseline VA and LOCS III cataract grading (47). On the contrary, in a meta-analysis performed by Kessel et al. it was highlighted that the outcome of cataract surgery did not correlate with preoperative visual acuity values (48).

To the best of our knowledge, this study is the first one performed in Romania so far, evaluating the influence of technical parameters correlated to patient's characteristics and ocular biometrics on the main visual outcomes of cataract surgery. The strengths of our study lay in using a standardized examination process and the LOCS III system to grade lens opacities, employed by an experienced ophthalmologist to measure lens opacities and fundus changes, based on WHO visual criteria.

This study investigated the risk factors associated with postoperative visual acuity recovery in cataract during a short-term phase and gives an overview of the results and associations. Long-term results of visual acuity after cataract surgery may be influenced by the appearance of macular lesions or other fundus lesions, as well as the appearance of posterior capsule opacification, whilst a short-term follow-up can get a clearer satisfaction of patients. Usually, the day 1 visual acuity is available, while the final visual acuity after several weeks may not always be available, as the majority of patients may not return to the hospital for review, especially in middle and low-income countries (49) and even more so during the COVID-19 pandemic and post-pandemic (our study was conducted on patients presented to a public hospital between 2021-2023).

The limitations of the study were: small sample size (patients selected from a single center), short-term follow-up and the retrospective character, where data were dependent on complete medical records, and not randomized, which could have a selection bias. A prospective case-control study will be suggested in the future.

Conclusions

Our study shows postoperative visual outcome results that fall within the WHO standards and recommendations. Despite the intraoperative complications that were successfully managed by the surgeon, no cases with visual acuity less than 6/60 in the 1st postoperative day were recorded. Visual acuity outcomes were independent on the

patient's systemic comorbidities or their age, which shows that a good preparation of the patient in correlation with specific ocular characteristics, preoperative measurements, intraoperative parameters and surgeon's experienced, makes phacoemulsification cataract surgery not only a safe procedure, but also brings satisfaction for both patient and surgeon.

Author's Contributions

Conceptualization: S.C.; A.L.C.; G.R.; methodology: A.M.A.; S.S.; C.F.C.; G.R.; software: A.M.A.; S.S.; investigations: A.L.C., C.F.C. and G.R.; data curation: S.C.; A.L.C. and G.R.; writing - original draft preparation: A.L.C., G.R. and S.C.; writing - review and editing, S.C.; C.F.C.; A.M.A.; S.S.; A.L.C. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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