Open Access

Original Article

Detection of Bacterial Growth in Peroperative Aqueous Humour Samples in Phacoemulsification Surgery with Reusable Versus Disposable Irrigation Aspiration Tubing System

Irshad Hussain, Shahid Hamid Mahmud, Mariam Sarwar*, Muhammad Aamir Arain, Taimoor Ashraf Khan, Rabbia Qammer

Department of Ophthalmology, Combined Military Hospital, Peshawar/National University of Medical Sciences (NUMS) Pakistan,
*Department of Microbiology, Combined Military Hospital, Peshawar/National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To detect the bacterial growth in per-operative aqueous samples during phacoemulsification surgery with reusable versus disposable irrigation aspiration tubing system.
Study Design: Quasi-experimental study.
Place and Duration of study: Eye Department, Combined Military Hospital, Peshawar Pakistan, from Jan 2023-Apr 2024.
Methodology: It was a prospective quasi-experimental study. Total of 274 patients fulfilling the inclusion and exclusion criteria were selected and divided into two groups, 137 in disposable group and 137 in autoclavable group. Pre-operative conjunctival sac sampling via a swab was done in all the patients and was sent for culture for bacterial growth. All patients underwent uneventful phacoemulsification surgery with standard preoperative cleaning and preparation of eye with 5% pyodine solution. Aqueous humor samples were taken for culture and sensitivity before intracameral injection of antibiotics.
Results: Initially 300 patients were selected and 26 were excluded based on strict inclusion & exclusion criteria. Out of 274 included patients, none of the aqueous humor samples in both groups showed any bacterial growth after the specified time. One (0.70%) patient in group A yielded bacterial growth on pre-operative conjunctival sac sampling while 3 (2.10%) patients in group B yielded growth on pre-operative conjunctival sac sampling.
Conclusion: Both reusable and disposable irrigation aspiration systems are equally effective in terms of their safety for bacterial growth.

Keywords: Aqueous humor, Bacterial culture, Culture and Sensitivity, Disposable, Infection, Irrigation aspiration tubing, Phacoemulsification.

How to Cite This Article: *Hussain I, Mahmud SH, Sarwar M, Arain MA, Khan TA, Qammer R. Detection of Bacterial Growth in Peroperative Aqueous Humour Samples in Phacoemulsification Surgery with Reusable Versus Disposable Irrigation Aspiration Tubing System. Pak Armed Forces Med J 2025; 75(Suppl-4): S601-S605. DOI: https://doi.org/10.51253/pafmj.v75iSUPPL-4.12375*

INTRODUCTION

Phacoemulsification surgery is the most popular and commonly performed modern day surgery. The recent advances have led to an excellent refractive outcome and a speedy post operative recovery time, making phacoemulsification procedure a refractive surgery improving the patient's quality of life many folds.[1] However, despite advancements in surgical techniques and sterilization protocols, bacterial contamination remains a persistent concern, potentially leading to most dreaded postoperative complication; endophthalmitis.[2] Irrigation aspiration (IA) tubing system of phaco-machine is of particular interest as it's a crucial and somewhat expensive component.[3]

Recent debates have emerged regarding the comparative safety and efficacy of reusable versus disposable IA tubing systems in phacoemulsification surgeries. The crux of this debate lies in the potential for microbial colonization and biofilm formation within the tubing systems, which could serve as reservoirs for bacterial growth and subsequent contamination of the intraocular niche.[4] While reusable tubing systems offer cost-effectiveness and environmental sustainability, concerns have been raised regarding their ability to withstand rigorous sterilization processes and prevent potentially sight threatening bacterial transmission effectively.[5]

The aqueous humour, serves as a critical site for detecting microbial contamination during surgery. Peroperative sampling of aqueous humour allows for real-time assessment of bacterial growth and provides invaluable insights into the efficacy of intraocular sterilization measures.[6]

Several recent studies have delved into this contentious issue, employing both in vitro models and clinical trials to assess the relative safety profiles of reusable and disposable IA tubing systems. Notably, a

Correspondence: Dr Taimoor Ashraf Khan, Department of Ophthalmology, Combined Military Hospital, Peshawar Pakistan
Received: 20 Jun 2024; revision received: 01 Nov 2024; accepted: 14 Nov 2024

study by Smith *et al*., demonstrated significantly higher rates of bacterial colonization in reusable tubing systems compared to their disposable counterparts.[7] Conversely, a randomized controlled trial by Chen *et al*., found no significant difference in the incidence of endophthalmitis between surgeries utilizing reusable and disposable IA tubing systems, challenging prevailing notions regarding the superiority of disposable systems.[8]

The objective of our study was to detect the bacterial growth in per-operative aqueous samples during phacoemulsification surgery with reusable versus disposable irrigation aspiration tubing system.

METHODOLOGY

It was a quasi-experimental study carried out at eye department Combined Military Hospital Peshawar from January 2023 to April 2024. A sample size of 31 was calculated in each group using OpenEpi online software, keeping odds ratio of 9.56% for developing acute post-op endophthalmitis in cases with per-op posterior capsular rupture. We included all the patients fulfilling the inclusion exclusion criteria i.e. 137 patients in each group after randomization.

Patients were divided in two groups; group A and group B. Group A patients were operated upon using an autoclaved (reusable) irrigation aspiration tubing while group B patients were operated upon using disposable tubing.

Inclusion Criteria: Adult patients of both genders ranging from age 18-90 years planned for routine cataract surgery by phacoemulsification technique and posterior chamber intraocular lens implantation under topical anesthesia with proparacaine 0.5% were included in the study.

Exclusion Criteria: Patients having any preexisting lid infection, chronic blepharitis or dacryocystitis, history or signs of prior intraocular surgery, penetrating or perforating eye injury were excluded from the study. Patients who had intraoperative complications of phacoemulsification surgery like the need to perform pars plana vitrectomy, suturing the corneal wound, conversion to extra capsular cataract surgery were also excluded from the study.

Written informed consent was taken from all the participants and their confidentiality was maintained at all tiers. Approval of hospital ethical review committee was granted vide letter no 00255/24.

Meticulous sterilization of reusable irrigation and aspiration tubing system was performed by thoroughly cleansing any visible debris, especially ophthalmic viscosurgical devices (OVD), and rinsing tube lumen with sterile treated water. The data of tubes are then entered in the autoclave record-keeping register and tubes are then put in autoclave-resistant bags with autoclave tapes mentioned on it. The bag containers are autoclaved for 60 minutes at a temperature of 121 degrees Celsius at a pressure of 15 psi. The tubes containers are then removed and left to cool down at least for 1 hour before the use. The tubing system once removed from container are thoroughly inspected before the use in phacoemulsification machine.

In all patients, cataract surgery was performed on Oertli CataRhex easy phacoemulsification system (Switzerland) as per the standard protocols. Preop preparation of skin and lid with 5% povidone iodine solution with instillation of two drops of the solution into conjunctival sac for minimum of 90 seconds. After draping the eye with single use disposable drape sheet and introducing the lid speculum 1 ml of freshly prepared 5% povidone iodine solution was introduced into conjunctival sac and after two minutes thoroughly washed with phaco irrigating solution. Pre-operative conjunctival sac sampling via a swab was done in all the patients and was sent for culture for bacterial growth to the hospital's laboratory in a sealed and labeled container after the above-mentioned asepsis procedure to check for the efficacy of aseptic measures. Phacoemulsification was performed through a 2.75 mm phaco incision at the steepest meridian. Preloaded foldable acrylic intraocular lens implantation was done. After surgery 0.1-0.2 cc of aqueous samples were taken in the disposable syringe followed by intracameral injection of 1mg/0.1 ml cefuroxime. Corneal sections were sealed with stromal hydration using the irrigating solution. The aqueous samples were sent immediately for gram staining and inoculation of suitable culture media in microbiology lab of the Combined Military Hospital Peshawar Pathology department in a sealed and labeled container. The culture report was collected from the lab after a period of 5 days. Patients were further followed up for 2 weeks at 1-day, 3-day, 1-week and 2-week intervals with complete ocular exams to rule out acute postoperative endophthalmitis. Data was collected on proforma containing patients' demographic details including age and gender, patients' systemic co-morbid including Diabetes and

Hypertension, ocular morbidity; glaucoma, type of irrigation tubing used (disposable vs reusable), pre-operative conjunctival swab results and per-operative aqueous sampling results. The results were compiled and analyzed by Statistical Package for Social Sciences (SPSS) version 27. Chi-square test was applied for associations and a *p*-value of less than 0.05 was considered statistically significant.

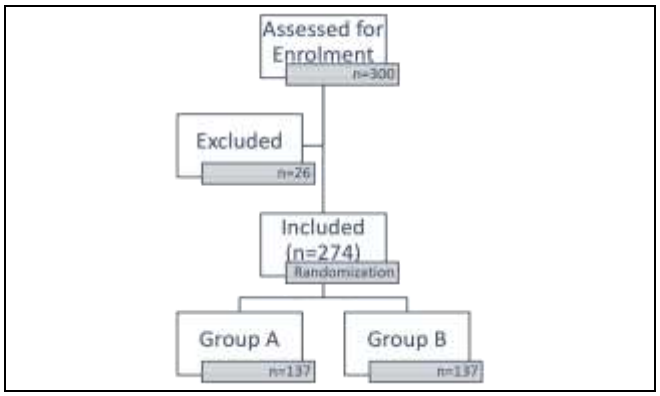

Figure-1: Sample Collection Flow Diagram

RESULTS

Initially 300 patients were selected and 26 were excluded based on strict inclusion & exclusion criteria. A total of 274 patients participated in the study. The mean age of the participants in group A was 65.34±9.24 years while mean age in group B was 63.54±9.29 years which was comparable. There was male preponderance in both groups as shown in Table-I.

Table-I: Gender Wise Distribution Amongst Both Groups

Gender	Group A	Group B
Male	76 (55.50%)	72 (52.60%)
Female	61 (44.50%)	65 (47.40%)

Only 1 (0.70%) patient in group A and 3(2.20%) patients in group B had positive bacterial growth on pre-operative conjunctival sac sampling as shown in Table-II.

Table-II: Bacterial Growth on Pre-operative Conjunctival sac Sampling Amongst Patients of Both Groups.

Bacterial Growth on pre-operative conjunctival sac sampling	Group A	Group B	*p*-value
Yes	1(0.70%)	3(2.20%)	0.31
No	136 (99.30%)	134(97.80%)	

Three out of 4 patients with positive pre-operative sampling had Diabetes. Similarly 3 out of 4 patients with positive pre-operative sampling had Glaucoma and these patients were on topical anti-glaucoma medications. Association of co-morbidities with positive pre-operative conjunctival sac sampling is shown in Table-III.

Table-III: Associated Co-morbidities with Positive Pre-operative Conjunctival sac Sampling.

Gender		Negative Pre-op Bacterial Culture	Positive Pre-Op Bacterial Culture	*p*-value
Diabetes Melitus	Yes	32(11.50%)	3(75%)	<0.01
	No	247(88.50%)	1(25%)	
Glaucoma	Yes	11(3.90%)	3(75%)	<0.01
	No	268(96.10%)	1(25%)	

The bacterial culture of per-operative aqueous humor sampling yielded no bacterial growth in any case of both groups. Post-operative follow-up of the patients on 1*st*, 3rd, 7th and 14th day revealed no patient developed signs and symptoms of acute postoperative endophthalmitis.

DISCUSSION

Endophthalmitis remains a dreaded complication of intraocular surgery, including phacoemulsification, with potentially devastating consequences.[10] Strategies for preventing endophthalmitis include meticulous preoperative preparation, proper disinfection of the ocular surface and periocular skin, the use of sterile equipment operatively, and the use of intracameral antibiotics.[11]

Our study aimed to compare bacterial growth in per-operative aqueous samples during phacoemulsification surgery using reusable versus disposable irrigation aspiration (IA) tubing systems. Contrary to previous findings, we observed no bacterial growth in per-operative aqueous samples from either group which proclaims the efficacy of our pre-operative aseptic measures including the draping and sterilization techniques.[1,2] This also suggests that reusable and disposable IA tubing systems effectively minimize intraocular microbial contamination during phacoemulsification surgery.[12] However, it's essential to note that a small percentage of patients exhibited positive preoperative conjunctival sac cultures, indicating the potential for extrinsic sources of contamination.

Furthermore, we found a higher frequency of positive conjunctival sac cultures in patients with comorbidities such as glaucoma (*p*-value<0.01) and diabetes (*p*-value<0.01). Three out of four positive

culture in ocular adnexa sample growth group were glaucoma patients and were on antiglaucoma eye drops which may suggest possible contamination contributed by the topical medications.[13]

Three out of four positive culture in ocular adnexa sample growth group were diabetic patients and hence may have lesser immunity resulting in growth of the conjunctival growth specimen.[14,15] This further advocates the increased risk of acute post-operative endophthalmitis in patients with Diabetes.[16] The present study showed 0% AC contamination by both reusable vs disposable irrigation/aspiration tubing system for phacoemulsification. The results are comparable to other studies. Cornut et al and Ta *et al.*, reported 0% frequency of per-operative aqueous sampling similar to our study.[17,18] Other studies by Bucci *et al.*, and Bykara *et al.*, also reported less than 3% of per-operative AC contamination in their non-interventional studies.[19-21]

LIMITATIONS OF STUDY

There have been reports of increased incidence of endophthalmitis with polymethylmethacrylate (PMMA) intraocular lenses (IOL). Limitation of the study was lack of evaluation of the type of IOL, the types of viscoelastic used but this limitation was in part neutralized by the fact that the culture of aqueous humor yielded growth in no patient. Further studies which focus on factors like host immune status, concurrent use of any topical treatment, that may be associated with bacterial contamination and postoperative endophthalmitis are required to have a more detailed understanding of this dreadful postoperative complication. Additionally, the virulence of the microorganism grown from the ocular adnexa like the number of colonies were not considered which could influence their ability to be grown from aqueous culture.

CONCLUSION

The results of the study strongly advocate the comparable safety of disposable versus reusable phaco irrigation aspiration tubing systems provided standard sterilization protocols are maintained. This has important implications for developing countries since reusable IA tubing is cost-effective and may reduce the monetary burden on already crunched healthcare facilities.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

IH & SHM: Data acquisition, data analysis, critical review, approval of the final version to be published.

MS & MAA: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

TAK & RQ: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Leong JK, Shah R, McCluskey PJ, Benn RA, Taylor RF. Bacterial contamination of the anterior chamber during phacoemulsification cataract surgery. J Cataract Refract Surg 2002; 28(5): 826-833. https://doi.org/10.1016/s0886-3350(01)01160-9
2. Shi SL, Yu XN, Cui YL, Zheng SF, Shentu XC. Incidence of endophthalmitis after phacoemulsification cataract surgery: a Meta-analysis. Int J Ophthalmol 2022; 15(2): 327-335. https://doi.org/10.18240/ijo.2022.02.20
3. Bartek B, Winkler T, Garbe A, Schelberger T, Perka C, Jung T. Bacterial contamination of irrigation fluid and suture material during ACL reconstruction and meniscus surgery : Low infection rate despite increasing contamination over surgery time. Knee Surg Sports Traumatol Arthrosc 2022; 30(1): 246-252. https://doi.org/10.1007/s00167-021-06481-3
4. Wass S, Albrektsen G, Ødegard MT, Sand M, Austeng D. Antiseptic effect of low-concentration povidone-iodine applied with a depot device in the conjunctiva before cataract surgery. Eye (Lond) 2018; 32(12): 1900-1907. https://doi.org/10.1038/s41433-018-0198-9
5. Safneck JR. Endophthalmitis: A review of recent trends. Saudi J Ophthalmol. 2012; 26(2): 181-189. https://doi.org/10.1016/j.sjopt.2012.02.011
6. Chiang B, Valerio GS, Manche EE. Prospective, Randomized Contralateral Eye Comparison of Wavefront-Guided Laser In Situ Keratomileusis and Small Incision Lenticule Extraction Refractive Surgeries. Am J Ophthalmol 2022; 237: 211-220. https://doi.org/10.1016/j.ajo.2021.11.013
7. Okonkwo ON, Lewis K, Hassan AO, et al. Indications and outcomes of vitrectomy surgery in a series of 1000 black African eyes. BMJ Open Ophthalmol 2019; 4(1): e000083. https://doi.org/10.1136/bmjophth-2017-000083
8. Boyd S, Murphy CJ, Snyman L. Single-use vs. reusable flexible bronchoscopes for airway management and in critical care: a narrative review. Anaesthesia 2025; 80(2): 197-204. https://doi.org/10.1111/anae.16430
9. Hatch WV, Cernat G, Wong D, Devenyi R, Bell CM. Risk factors for acute endophthalmitis after cataract surgery: a population-based study. Ophthalmology 2009; 116(3): 425-30. https://doi.org/10.1016/j.ophtha.2008.09.039.
10. Das T, Sharma S; Hyderabad Endophthalmitis Research Group. Current management strategies of acute post-operative endophthalmitis. Semin Ophthalmol. 2003; 18(3): 109-115. https://doi.org/10.1076/soph.18.3.109.29804
11. Patel SN, Storey PP, Levin H, et al. Endophthalmitis after Cataract Surgery: Changes in Management Based on Microbiologic Cultures. Ophthalmol Retina. 2021; 5(1): 16-22. https://doi.org/10.1016/j.oret.2020.06.028

12. Ndlovu LT. A microscopic analysis of single-use versus multi-use phacoemulsification tubing in maintaining sterility and patient safety. Afr Vision Eye Health. 2019; 78(1), a510. https://doi.org/10.4102/aveh.v78i1.510
13. Chang CJ, Somohano K, Zemsky C, et al. Topical Glaucoma Therapy Is Associated With Alterations of the Ocular Surface Microbiome. Invest Ophthalmol Vis Sci 2022; 63(9): 32. https://doi.org/10.1167/iovs.63.9.32
14. Karimsab D, Razak SK. Study of aerobic bacterial conjunctival flora in patients with diabetes mellitus. Nepal J Ophthalmol 2013; 5(1): 28-32. https://doi.org/doi: 10.3126/nepjoph.v5i1.7818
15. Adam M, Balcı M, Bayhan HA, İnkaya AÇ, Uyar M, Gürdal C. Conjunctival Flora in Diabetic and Nondiabetic Individuals. Turk J Ophthalmol. 2015; 45(5): 193-196. https://doi.org/10.4274/tjo.33230
16. Silpa-Archa S, Papirachnart A, Singhanetr P, Preble JM. Risk factors for endophthalmitis after cataract surgery in diabetic patients: a case control study. Int J Ophthalmol 2019; 12(3): 417-423. https://doi.org/10.18240/ijo.2019.03.11
17. Cornut PL, Vandenesch F, Lina G, et al. Bacterial contamination rate of the anterior chamber during cataract surgery using conventional culture and eubacterial PCR. Eur J Ophthalmol 2010 ; 20(2): 365-9. https://doi.org/10.1177/112067211002000216
18. Ta CN, Lin RC, Singh G, Miño de Kaspar H. Prospective study demonstrating the efficacy of combined preoperative three-day application of antibiotics and povidone-iodine irrigation. Ann Ophthalmol (Skokie) 2007; 39(4): 313-7. https://doi.org/10.1007/s12009-007-9007-y
19. Bucci FA Jr, Amico LM, Evans RE. Antimicrobial efficacy of prophylactic gatifloxacin 0.3% and moxifloxacin 0.5% in patients undergoing phacoemulsification surgery. Eye Contact Lens 2008; 34(1): 39-42. https://doi.org/10.1097/ICL.0b013e3180645d01
20. Kumar MA, Kurien SS, Selvaraj S, Devi U, Selvasundari S. Comparison of different techniques of cataract surgery in bacterial contamination of the anterior chamber in diabetic and non-diabetic population. Indian J Ophthalmol 2012; 60(1): 41-44. https://doi.org/10.4103/0301-4738.90486
21. Baykara M, Ozakin C, Doğru M, Ertürk H, Heper Y, Ozçetin H. The effect of anterior chamber maintainer on anterior chamber contamination. Eur J Ophthalmol 2003; 13(9-10): 770-772. https://doi.org/10.1177/1120672103013009-1006