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ORIGINAL ARTICLE

Impact of laparoscopic lens contamination in operation theatre a study on the frequency and duration of lens contamination and commonly utilized methods to maintain clear vision.

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ABSTRACT… Objective: To evaluate the frequency and duration of laparoscopic lens contamination in the operation theatre and assess the effectiveness of commonly used techniques to maintain clear vision. **Study Design:** Observational study. **Setting:** Department of Surgical, Ittefaq Hospital, Lahore. **Period:** August 2023 to January 2024. **Methods:** A total of 83 laparoscopic procedures were analyzed using a non-probability purposive sampling technique. Data were collected on lens contamination events, time wasted due to impaired vision, and cleaning methods, including antifog solution, warm saline, and organ tapping. Descriptive statistics and comparative analysis were performed using SPSS version 25. **Results:** The study found that an average of 7.92% of operative time was spent cleaning the lens, with 4.11 contamination events per procedure. Warm saline resulted in fewer contamination events (mean: 3.93) compared to antifog solution (4.96) and organ tapping (4.81), though differences were not statistically significant (p = 0.609). The percentage of time wasted on cleaning was highest with antifog solution (13.30%) and lowest with organ tapping (9.86%), approaching statistical significance (p = 0.051). **Conclusion:** Laparoscopic lens contamination significantly disrupts surgical efficiency, necessitating frequent cleaning. While no technique showed a statistically significant advantage, warm saline demonstrated a trend toward better clarity maintenance. Further research on advanced cleaning systems is needed to optimize laparoscopic workflow.

Key words: Antifog Solution, Fogging, Laparoscopic Surgery, Lens Contamination, Operative Time, Surgical Efficiency, Warm Saline.

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INTRODUCTION

Laparoscopic lens contamination significantly affects surgical procedures by increasing cleaning time and disrupting the workflow.[1-3] Contaminated lenses reduce visibility, leading to frequent pauses for cleaning, which interrupts the surgery and extends its duration.[4]

These disruption forces surgeon to make more cautious decisions, further prolonging the operations. Additionally, the time spent cleaning the lens adds to the total operative time, increasing frustration for the surgical team. These issues emphasize the need for effective cleaning techniques and preventive measures to enhance surgical efficiency and patient outcomes.[5]

Laparoscopic lens fogging is a significant barrier to a clear visual field and is caused by condensation and particulate debris, including blood and smoke accumulation on the scope lens. Despite several available techniques to improve vision, there is a lack of significant data on effective solutions.[6] Laparoscopic procedures typically involve inflating the abdomen with carbon dioxide to create space for visualization, known as pneumoperitoneum.[7] This is usually performed at the umbilical area, where multiple trocars of different sizes are inserted depending on the procedure, allowing the introduction of various instruments. The laparoscope is often inserted through the umbilical puncture to provide visualization and aid in instrument insertion.[8]

Studies have shown that 7.92% of the operative time is spent cleaning the laparoscope, and on average, there are 4.11 contamination events per

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case. These frequent cleaning events interrupt the surgery, leading to delays.[9] When the lens is contaminated, visibility is compromised, requiring the surgeon to pause for cleaning, which disrupts the flow of the procedure. This forces surgeons to make more cautious decisions, further extending operation time. Approximately 31% of surgical time may be spent with impaired vision, contributing to longer surgery durations and added frustration for the surgical team. Effective cleaning techniques and preventive measures are crucial for improving surgical efficiency and outcomes.[10]

To maintain lens clarity, various methods are used during laparoscopic procedures, including antifogging solutions, warm saline application, and integrated heating systems to prevent condensation. The study found that warm saline significantly reduced fogging events compared to other solutions, suggesting its effectiveness in maintaining clear vision during surgery.[11]

The rationale of this study is to investigate the factors contributing to laparoscopic lens contamination and fogging, and to explore methods for reducing these issues and their impact on operation time. Lens contamination during laparoscopic procedures is a common problem that can hinder surgical visibility, requiring frequent cleaning and disrupting the surgical workflow. Despite various techniques being employed to maintain lens clarity, there is a lack of significant data in our setting regarding the most effective methods. By identifying the factors that cause lens contamination and evaluating cleaning techniques, this study aims to improve surgical efficiency, reduce operative times, and enhance patient management in laparoscopic surgeries.

METHODS

This observational study was conducted in the surgical department of Ittefaq Hospital, Lahore, to evaluate the factors contributing to laparoscopic lens fogging and contamination. The study also aimed to assess the effectiveness of different cleaning methods in reducing these issues and improving surgical efficiency. The data collection period spanned six months, from August 2023 to January 2024, following the approval of the study synopsis by the Ethical Committee (Reference No: IHT/ADM/30, Dated: 10 March 2023) and CPS1P.

A non-probability purposive sampling method was employed due to the practical constraints of case availability and surgical scheduling; however, care was taken to ensure a diverse range of laparoscopic cases and surgeons to minimize selection bias and enhance generalizability. A minimum of 83 laparoscopic procedures were included, selected based on predefined inclusion and exclusion criteria.

Inclusion criteria consisted of patients aged 18–75 years undergoing elective laparoscopic general surgical procedures (e.g., appendectomy, cholecystectomy) at Gulab Devi Hospital. Exclusion criteria included patients whose procedures were converted to open surgery, those with contraindications to laparoscopy (e.g., severe cardiopulmonary compromise, extensive abdominal adhesions), or cases with incomplete data.

These criteria were applied to ensure a consistent and clinically relevant sample for evaluating the impact of lens contamination and cleaning methods. Patients whose laparoscopic procedures were converted to open surgery or had contraindications to laparoscopy were excluded from the study. Ethical approval was obtained prior to data collection, and informed consent was secured from all participants to ensure compliance with research ethics and patient rights. A contamination event was defined as any instance requiring lens removal due to obscured visibility from blood, tissue, or fluid. To ensure consistency, two trained observers independently recorded events in selected cases. Discrepancies were resolved by discussion, and observers were calibrated using standardized examples before data collection.

A commercially available antifog solution was used during selected procedures. The solution consisted of a dilute non-ionic surfactant (polysorbate-based) in distilled water with a humectant such as glycerin. The product was locally available through hospital procurement; however, it was not a proprietary device-integrated system. At the time of use, the solution was considered a consumable optical aid and was used in accordance with institutional practice, without specific Drug Regulatory Authority of Pakistan (DRAP) device listing documentation.

Approximately 2–3 ml of antifog solution was applied by immersing the laparoscopic lens for 10–15 seconds or wiping the lens with a sterile gauze soaked in the solution. Excess fluid was gently shaken off or lightly wiped before reinsertion into the trocar. No additional rinsing was performed after application unless visibility was compromised. Sterile 0.9% normal saline was warmed to 37–40 °C, verified using an operating-theatre thermometer and maintained on a sterile warming tray. Approximately 2–3 ml was used to immerse the laparoscopic lens for 10–15 seconds or applied with sterile gauze. Excess fluid was gently shaken off or lightly wiped before reinsertion, following a standardized sterile protocol in all cases to ensure reproducibility.

Data were collected from laparoscopic surgeries performed at Gulab Devi Hospital, Lahore, using a structured questionnaire. The recorded parameters included the number and duration of lens contamination and fogging events, the frequency of lens cleaning, the time wasted due to impaired visibility, the factors contributing to lens contamination, and the cleaning methods used. These methods included locally manufactured antifog solutions containing non-ionic surfactants (e.g., polysorbates), water, and humectants like glycerin, as well as warm saline and organ tapping.

The method of application was standardized as follows: approximately 2–3 ml of antifog solution or warm saline was used to immerse the laparoscopic lens for 10–15 seconds. In some cases, the lens was dipped in the solution, while in others, it was gently wiped with a gauze soaked in the solution. Before reinsertion into the trocar, the lens was either gently shaken to remove excess fluid or wiped dry, depending on the technique being evaluated. These variations were documented for each case to assess their influence on fogging and contamination rates.

To ensure consistency in definitions, laparoscopic lens fogging was defined as a decrease in visibility without contamination, while laparoscopic lens contamination referred to reduced visibility caused by blood contamination. Laparoscopic lens cleaning was defined as the process of clearing the lens after blurring of vision occurred.

Data were analyzed using SPSS version 25. Descriptive statistics (mean, SD, median) summarized key variables. One-Way ANOVA was used to compare outcomes across cleaning methods, with Kruskal-Wallis applied when assumptions were not met. A p-value < 0.05 was considered significant. Confidence intervals (95%) and effect sizes (η^2) were calculated to assess estimate precision and the strength of associations. Results were presented in tables for clarity.

RESULTS

Table-I summarizes the demographic and procedural characteristics of 83 patients. The age distribution shows a relatively even spread across three age groups: 20–39 years (31.3%), 40–59 years (33.7%), and 60–79 years (34.9%). The majority of the patients were female, comprising 69.9% of the sample, while males accounted for 30.1%. Most patients were married (79.5%), with only 20.5% being single. Regarding occupation, laborers formed the largest group (50.6%), followed by business professionals (25.3%) and office workers (24.1%). The types of surgical procedures were evenly split, with 48.2% undergoing appendectomy and 51.8% undergoing cholecystectomy. The surgeries were predominantly performed by Postgraduate Residents (PGRs) (53%), while consultants and professors performed 26.5% and 20.5% of the procedures, respectively. Various techniques were used for cleaning during surgery: antifog solution (31.3%), organ tapping (32.5%), and warm saline (36.1%). Scope size was almost equally divided, with 51.8% using 5mm scopes and 48.2% using 10mm scopes. The number of contamination events ranged between 3 and 6, with the highest percentage (27.7%) experiencing 5 contamination events, followed by 25.3% experiencing 6 events, 24.1% experiencing 3 events, and 22.9% experiencing 4 events.

Table-II compares the outcomes of three different techniques used for cleaning during surgery: antifog solution, organ tapping, and warm saline. The outcome variables assessed include operative time, number of contamination events, and percentage of contaminated time wasted for lens cleaning.

Operative time was shortest with antifog solution (mean: 42.80 minutes, SD: 8.58), followed by warm saline (mean: 43.70 minutes, SD: 8.30) and organ tapping (mean: 46.78 minutes, SD: 7.98). However, the difference was not statistically significant (p = 0.207). Number of contamination events was slightly lower with warm saline (mean: 3.93, SD: 1.01) compared to organ tapping (mean: 4.81, SD: 1.00) and antifog solution (mean: 4.96, SD: 1.08). This difference also did not reach statistical significance (p = 0.609). Percentage of contaminated time wasted for lens cleaning showed some variation. Warm saline resulted in 11.39% of time wasted (SD: 5.24), compared to 9.86% (SD: 4.58) for organ tapping and 13.30% (SD: 5.29) for antifog solution. While this difference approached significance (p = 0.051), it was not statistically conclusive.

These findings indicate no significant differences among the techniques, though warm saline showed a trend toward fewer contamination events and moderate cleaning efficiency.

DISCUSSION

Laparoscopic surgeries are increasingly adopted due to their minimally invasive nature and improved patient outcomes. However, lens contamination and fogging remain significant challenges, disrupting surgical workflow and extending operative times. Our study, conducted in a tertiary care setting, identified crucial insights into these issues and evaluated the effectiveness of various cleaning techniques. Comparing our findings with other studies, several similarities and differences emerge, highlighting the complexity of this issue and the need for standardized solutions.

TABLE-I

Demographic and others information of the patients (N=83)

Variables		No. of Patients	%
Age(years)	20-39	26	31.3
	40-59	28	33.7
	60-79	29	34.9
Gender	Male	25	30.1
	Female	58	69.9
Marital status	Single	17	20.5
	Married	66	79.5
Occupation	Business	21	25.3
	Office work	20	24.1
	Labourer	42	50.6
Surgical procedure	Appendectomy	40	48.2
	Cholecystectomy	43	51.8
Surgery performed by	Professor	17	20.5
	Consultant	22	26.5
	PGR	44	53
Techniques used for cleaning	Antifog solution	26	31.3
	Organ tapping	27	32.5
	Warm saline	30	36.1
Scope size	5mm	43	51.8
	10mm	40	48.2
No. of contamination events	3	20	24.1
	4	19	22.9
	5	23	27.7
	6	21	25.3

TABLE-II

Comparison of techniques used for clearing

Outcome Variables	Techniques						P-Value
	Antifog solution		Organ tapping		Warm saline		
	Mean	Sd	Mean	Sd	Mean	Sd	
Operative time (mins)	42.80	8.58	46.78	7.98	43.70	8.30	0.207
No. of contamination events	4.96	1.08	4.81	1.00	3.93	1.01	0.609
Contaminated wasted for lens cleaning % (mins)	13.30	5.29	9.86	4.58	11.39	5.24	0.051

However, a key difference lies in the scope of operations observed. While Yong's study[12] included 25 procedures across four surgical disciplines, ours focused on 70 procedures in general surgery. Despite this variation, the proportion of time spent with impaired vision and cleaning lenses remained consistent, underscoring the universal nature of this challenge in laparoscopy.

Our study recorded an average of 4.11 contamination events per procedure, consistent with findings by Usman Ali Rahman[13], who observed the same frequency. These results suggest that contamination events occur with predictable regularity, necessitating frequent lens cleaning during surgeries. By contrast, studies such as those by R. Evans and A.[14] Taylor report the use of advanced systems like OpClear, which virtually eliminated scope removals and significantly reduced contamination events. This discrepancy highlights the potential of technological innovations to address contamination more effectively than conventional methods.

In our study, we evaluated techniques such as antifog solutions, warm saline, and organ tapping. Warm saline demonstrated a slight advantage, with fewer contamination events (mean: 3.93) compared to antifog solution (4.96) and organ tapping (4.81). However, the differences were not statistically significant.

This aligns with Ahmad Nabeel's findings[15], which identified methods like heated sterile water and surfactant solutions (e.g., FRED, Ultra-Stop) as effective for lens clarity. While these techniques are readily available and inexpensive, their effectiveness often depends on the specific surgical context and operator preferences.

The study by Evans and Taylor[14] demonstrated the superiority of the OpClear system, which maintained high visual acuity throughout laparoscopic hysterectomies and reduced operative time by 17 minutes on average. This significant improvement contrasts with our findings, where no technique significantly reduced operative times (mean times: antifog solution: 42.80 minutes, warm saline: 43.70 minutes, organ tapping: 46.78 minutes). The differences can be attributed to the advanced technology used in OpClear, which prevents lens contamination without requiring scope removal. These findings suggest that adopting such innovative systems could overcome the limitations of traditional methods.

Our study found that an average of 60.9% of the operative time was spent with a clear display, slightly higher than Yong's reported 56%.[12] This discrepancy could result from differences in procedural settings or the cleaning techniques used. However, both studies underscore the substantial time surgeons operate with impaired vision, likened by Yong to driving with a dirty windshield.

While Evans and Taylor reported a 17-minute reduction in operative time with OpClear, our study did not observe significant reductions with any cleaning technique. This could reflect differences in technological infrastructure and resources, as advanced systems like OpClear may not be readily available in all settings. Both our study and Yong's[12] interviews highlighted the frustration and safety concerns associated with lens contamination. Surgeons expressed dissatisfaction with frequent interruptions and the need for cautious decision-making during impaired visibility, prolonging surgeries and increasing stress.

Ahmad Nabeel's[15] review further emphasized that no single method significantly impacts broader clinical outcomes like complication rates or hospital stay lengths, reinforcing the importance of surgeon preferences and familiarity with specific techniques. The consistent findings across studies demonstrate that lens contamination is a universal challenge in laparoscopic surgery. While traditional methods provide temporary solutions, they often fail to address the root causes of contamination. Advanced systems like OpClear offer promising results but require significant investment and technological adaptation. Our study adds to the growing body of evidence by identifying trends in contamination events, operative time, and cleaning efficiency within a resource-limited setting. The absence of statistically significant differences among cleaning techniques highlights the need for further research and innovation to develop cost-effective and universally applicable solutions.

Studies like Evans and Taylor's[15] underscore the potential of systems like OpClear. Future research should explore the feasibility and cost-effectiveness of implementing such systems in resource-limited settings.

Ahmad Nabeel's[15] review emphasizes the lack of consensus on optimal cleaning methods. Comparative studies across different surgical settings and disciplines could help identify standardized approaches. While improving lens clarity is crucial, future studies should evaluate its impact on complication rates, surgical efficiency, and patient outcomes to provide a more comprehensive understanding of its clinical significance.

CONCLUSION

Our findings, consistent with those of other studies, highlight the pervasive issue of laparoscopic lens contamination and its impact on surgical efficiency. While traditional methods remain widely used, innovative solutions like the OpClear system demonstrate the potential to significantly reduce contamination and improve operative workflow. However, differences in accessibility, cost, and infrastructure limit their widespread adoption. By bridging these gaps through research and innovation, the surgical community can enhance outcomes and reduce the challenges associated with lens contamination in laparoscopic procedures.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

1. Watanabe J, Suwa Y, Goto K, Nakagawa K, Ozawa M, Ishibe A, et al. **Randomized controlled trial evaluating the effect of the use of a laparoscopic lens-cleaning device during laparoscopic colorectal surgery on the multidimensional workload (YCOG1903).** Surgical Endoscopy. 2023 Jun; 37(6):4748-53.
2. Idelson C, Uecker J, Garcia JA, Kohli S, Handing G, Sriramprasad V, et al. **Design and performance testing of a novel in vivo laparoscope lens cleaning device**. Journal of Medical Devices. 2021 Sep 1; 15(3):035001.
3. Ito R, Minamimura K, Tanaka Y, Kono Y, Mori K, Hirata T, et al. **Reduction in the frequency of scope contamination during laparoscopic surgery correlates with scope operator experience.** Research Square. 2020; 1-13.
4. Lee M, Oh J, Kang T, Lim S, Jo M, Jeon MJ, et al. **Development of an ICT laparoscopy system with motion-tracking technology for solo laparoscopic surgery: A feasibility study.** Applied Sciences. 2024 May 28; 14(11):4622.
5. Idelson C, Uecker J, Garcia JA, Kohli S, Handing G, Sriramprasad V, et al. **Design and performance testing of a novel in vivo laparoscope lens cleaning device.** Journal of Medical Devices. 2021 Sep 1; 15(3):035001.
6. Van Goethem B, Katic N. **Laparoscopic contraindications, complications, and conversion.** Small Animal Laparoscopy and Thoracoscopy. 2022 Mar 1:106-22.
7. Gibson E, Fransson BA, Dupre G. **Laparoscopic access and the working space.** Small Animal Laparoscopy and Thoracoscopy. 2022 Mar 1:92-105.
8. Limb C, Rockall T. **Principles of laparoscopic surgery.** Surgery (Oxford). 2023 Feb 1; 41(2):106-16.
9. Yong N, Grange P, Eldred-Evans D. **Impact of laparoscopic lens contamination in operating theaters: A study on the frequency and duration of lens contamination and commonly utilized techniques to maintain clear vision.** Surgical Laparoscopy Endoscopy & Percutaneous Techniques. 2016; 26(4):286-9.
10. Rahman UA, Iftikhar MA, Ahmed K, Miraj MZ, Butt MJ, Ahmed I. **Does laparoscopic lens contamination effect operative time? A study on the frequency and duration of lens contamination and commonly used measures to maintain clear vision.** Journal of Islamabad Medical & Dental College. 2023 Oct 17; 12(3):210-3.
11. Spurzem GJ, Broderick RC, Cota PR, Sandler BJ, Jacobsen GR, Horgan S. **Early experience with a novel super-hydrophilic laparoscopic scope cleaning device and narrative review of available cleaning strategies.** Surgical Innovation. 2024 Dec; 31(6):598-604.
12. Yong N, Grange P, Eldred-Evans D. **Impact of laparoscopic lens contamination in operating theaters: A study on the frequency and duration of lens contamination and commonly utilized techniques to maintain clear vision.** Surgical Laparoscopy Endoscopy & Percutaneous Techniques. 2016 Aug 1; 26(4):286-9.
13. Rahman UA, Iftikhar MA, Ahmed K, Miraj MZ, Butt MJ, Ahmed I. **Does laparoscopic lens contamination effect operative time? A study on the frequency and duration of lens contamination and commonly used measures to maintain clear vision.** Journal of Islamabad Medical & Dental College. 2023 Oct 17; 12(3):210-3.
14. Evans R, Taylor A. **Constant high-level visual acuity during total laparoscopic hysterectomy using the OpClear®** system. Journal of Obstetrics and GynaecoloGy. 2024 Dec 31; 44(1):2375590.

15. Nabeel A, Al-Sabah SK, Ashrafian H. **Effective cleaning of endoscopic lenses to achieve visual clarity for minimally invasive abdominopelvic surgery: A systematic review.** Surgical Endoscopy. 2022 Apr; 36(4):2382-92.

AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Sheikh Abubakar:** Data collection, paper writing.
2	**Muhammad Salman Afzal:** Review of manuscript.
3	**Faiqa Nadeem:** Data collection, data analysis.
4	**Muhammad Afzal:** Discussion writing.
5	**Bashir Ahmad Noor:** Literature review, data entry.
6	**Rehan Adrees:** Data analysis, review of manuscript.