

Effect of complicated ocular surgery in stress-related parameters: A novel outlook into surgeon's health

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Purpose: To assess the stress-related physiological parameters of ophthalmic surgeons during complicated cataract surgery and compare them with uncomplicated routine cataract surgery. **Methods:** In this cross-sectional observational study, 110 patients of various types of cataract were divided into two groups: Group 1 included 55 patients with simple cataract (Grade ≤ 3) with no ocular or systemic comorbidities, whereas Group 2 included 55 patients with complicated cataracts (Grade >3) and ocular/systemic comorbidities. All patients underwent phacoemulsification with intraocular lens implantation in the right eye only. The outcome measures were systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR), and saturation of peripheral oxygen (SpO₂). **Results:** The average SBP, DBP, MAP, and HR were significantly higher in the surgeon operating Group 2 (complicated cataract) compared with Group 1 (uncomplicated cataract; $P < 0.05$). The average SBP of the surgeon while operating Group 1 patients preoperatively and postoperatively was 125.42 ± 2.49 mmHg and 122.45 ± 2.10 mmHg, respectively, whereas in Group 2, the average SBP of the surgeon taken preoperatively and postoperatively was 145.98 ± 3.80 mmHg and 137.44 ± 3.45 mmHg, respectively ($P < 0.05$). The surgeon's SpO₂ showed no significant difference between the two groups. **Conclusion:** There is a significant level of increase in stress-related parameters of operating surgeons while doing complicated cataract surgery.

Key words: Cataract, complicated phaco, surgeon, heart rate, stress, systolic blood pressure

Successful surgery requires possession of not only superior surgical skills but also the astuteness to make important decisions while remaining calm in the face of challenging circumstances.^[1] In the modern era of surgical advancements, favorable outcome is expected by the patient even when the case is determined to be intricate since its commencement or when an unexpected complication occurs during the surgery.^[2] The ever-increasing demands and expectations are likely to exert pressure on the surgeon, and the same may manifest in the form of fluctuations in their physiological parameters. Even while performing the same surgical procedure every day, surgeons have been reported to experience a variation in their physiological parameters.^[3] The magnitude of these variations can be greater when the surgeon is aware of the complicated nature of a particular case.

These alterations of the parameters are known to be a physical manifestation of the perceived psychological stress by the surgeon. Ophthalmic surgery is unique in certain ways such as entailment of microscopic procedures, the steep learning curve with high dependence on advanced engineering technology, patient awareness due to the majority of surgeries

being done under local anesthesia, and the tremendously increasing demands and expectations of the patients.

Various factors, including the patient, external environment of the operating room, and equipment, have been reported to play vital roles in inducing stress to the surgeon.^[4] Although there have been studies elucidating this aspect of surgical specialties, variations in physiological parameters in ophthalmic surgeons have not been studied in India. In this study, we will be focusing on the impact of stress and anxiety on physiological parameters of the ophthalmic surgeon while operating complicated cases compared with normal cases. The results might help in framing useful guidelines to monitor the stress levels and control them in order to prevent their adverse consequences on the surgeon's health.

Methods

Study design and subjects

This cross-sectional observational study included 110 eyes of 110 consecutive patients with cataracts owing to different

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etiologies who presented to the Department of Ophthalmology at a tertiary hospital between January 2019 and February 2020. The study adhered to the tenets of the Declaration of Helsinki and was approved by the institutional review board (Ethics committee clearance was obtained from our Institute bearing number IEC/2020/335). Written informed consent was taken from all patients involved in this study, who were planned for phacoemulsification with intraocular lens (IOL) implantation after thorough preoperative evaluation.

Patients were divided into two groups: those with complicated cataracts and those with uncomplicated cataracts. All patients were operated by the same experienced surgeon, whose baseline physiological parameters, namely, blood pressure, pulse rate, and oxygen saturations were monitored for 7 days. The surgical experience of the surgeon was 14 years in cataract surgery and anterior segment microsurgery.

Inclusion criteria: The patients included in this study ranged between 45 and 80 years of age. Group 1 included patients having nuclear sclerosis \leq Grade 3, posterior subcapsular cataract, and cortical cataract with good pupillary dilatation (>7 mm) and no other ocular comorbidities.

Group 2 included patients with nuclear sclerosis $>$ Grade 3, mature and hypermature cataract, posterior polar cataract, traumatic cataract ($<120^\circ$ of zonular dialysis), cataract with poor pupillary dilatation (<5 mm), one-eyed patients, pseudo-exfoliative syndrome, patients with chronic or recurrent uveitis, floppy iris syndrome, and systemic comorbidities (cognitive disorder, Parkinson's disease, Alzheimer's disease, patients on tamsulosin and anxiety disorder).

Exclusion criteria: Patients less than 45 years of age and those with unexpected intraoperative complications were excluded.

The following parameters of all the patients were documented: best-corrected visual acuity (BCVA), grade and type of cataract as per LOC III (Lens Opacities Classification System III) grading, associated ocular and systemic comorbidities, and pupillary dilatation. The surgeon's parameters, namely, blood pressure (systolic and diastolic), pulse rate, and oxygen saturation levels were recorded at the beginning (30 min prior) and at the end of the procedure. Consequently, the percentage changes in the measured parameters were also noted and analyzed. The blood pressure was measured using an automated blood pressure monitor. The mean arterial pressure (MAP) was taken as diastolic pressure $+1/3$ pulse pressure. The person measuring blood pressure, pulse rate, and oxygen saturation was unaware of the groups.

Questionnaire: A questionnaire to assess the personal causes that can affect physiological parameters was filled by the surgeon 30 minutes prior to the first surgery of the day. It included five questions: (1) disturbed sleep or less sleep (<5 hours) prior to the surgery; (2) any personal conflicts at home; (3) whether had breakfast on the day of the surgery; (4) ongoing menstrual cycle; and (5) any excessive workload pre- or postsurgery. All questions were scored as 0 or 1, and a score of ≥ 3 was taken as significant. The menstrual cycle was included in the questionnaire as it might affect the blood pressure.^[5]

All surgeries were performed on the Infiniti Vision System platform (Alcon Laboratories, Inc., Fort Worth, TX, USA) under peribulbar anesthesia. A break of 20-minute duration was taken after every two consecutive cases in both the groups. Two cases from each group were done in a single day.

Statistical analysis

Data analysis was performed using SPSS (Statistical Package for Social sciences) software Version 25.0. Qualitative data variables were expressed as frequency and percentage and numerical data values were expressed as mean and standard deviation. Unpaired *t* test was used to compare the surgeon's physiological parameters while operating Group 1 and Group 2 cases. Chi-square test was used to find the difference between the gender distribution in the two groups. A *P* value of <0.05 was considered statistically significant.

Results

A total of 110 participants (70 men and 40 women) were included in this study. They were divided into two groups of 55 each. Group 1 had 32 men and 23 women, and Group 2 had 38 men and 17 women. Their ages ranged between 45 and 80 years (with a mean of 61.07 ± 7.57 years in Group 1 and 62.35 ± 7.36 years in Group 2). We found no differences in age and gender between the two groups ($P = 0.373$ and 0.234 , respectively) [Table 1].

The average systolic blood pressure (SBP) of the surgeon taken preoperatively was found to be 125.42 ± 2.49 mmHg in Group 1 and 145.98 ± 3.80 mmHg in Group 2. The average SBP taken postoperatively was found to be 122.45 ± 2.10 mmHg in Group 1 and 137.44 ± 3.45 mmHg in Group 2. SBP showed statistically significant variation between the two groups ($P < 0.05$) [Table 2]. The average diastolic blood pressure (DBP) taken preoperatively was found to be 84.85 ± 3.07 mmHg in Group 1 and 87.73 ± 2.51 mmHg in Group 2. The average DBP taken postoperatively was found to be 81.98 ± 2.31 mmHg in Group 1 and 86.02 ± 2.26 mmHg in Group 2. DBP also showed statistically significant variation between the two groups ($P < 0.05$) [Table 2].

The average MAP taken preoperatively was found to be 98.38 ± 2.67 mmHg in Group 1 and 107.15 ± 2.59 mmHg in Group 2. The average MAP taken postoperatively was found to be 95.47 ± 2.07 mmHg in Group 1 and 103.16 ± 2.29 mmHg in Group 2. MAP also showed statistically significant variation between the two groups ($P < 0.05$) [Table 2].

Table 1: Distribution of demographic features in the study population in the two groups

Groups	Number of patients	Age (years)		P
		Mean	SD	
Uncomplicated (Group 1)	55	61.07	7.57	0.373
Complicated (Group 2)	55	62.35	7.36	
Groups	Number of patients	Gender		P
		Male	Female	
Uncomplicated (Group 1)	55	32	23	0.234
Complicated (Group 2)	55	38	17	

P > 0.05 (Not significant). Chi-square test used

The average heart rate (HR) taken preoperatively was found to be 75.47 ± 2.57 /min in Group 1 and 94.93 ± 3.79 /min in Group 2. The average HR taken postoperatively was found to be 74.04 ± 2.57 /min in Group 1 and 91.58 ± 3.88 /min in Group 2. HR also showed statistically significant variation between the two groups ($P < 0.05$) [Table 2].

Intraoperative reading of mean oxygen saturation levels (SpO_2) was $97.51 \pm 1.03\%$ in Group 1 and $97.24 \pm 0.98\%$ in Group 2. In both the groups, SpO_2 was maintained and did not show any significant variation [Fig. 1].

Questionnaire score varied from 0 to 3 in both the groups, and a significant questionnaire score (≥ 3) was seen only in two cases per group [Fig. 2]. Both these confounding factors were comparable among the groups.

Mean and standard deviations of the recorded physiological parameters with respect to specific peculiarities associated in Group 2 patients are shown in Table 3.

Table 2: Distribution of physiological parameters in two groups during preop and postop periods

Parameter	Group 1	Group 2	P
Systolic Blood Pressure (mmHg)			
Pre	125.42 ± 2.49	145.98 ± 3.80	$<0.001^*$
Post	122.45 ± 2.10	137.44 ± 3.45	$<0.001^*$
Diastolic Blood Pressure (mmHg)			
Pre	84.85 ± 3.07	81.98 ± 2.31	$<0.001^*$
Post	87.73 ± 2.51	86.02 ± 2.26	$<0.001^*$
Mean Arterial Pressure (mmHg)			
Pre	98.38 ± 2.67	107.15 ± 2.59	$<0.001^*$
Post	95.47 ± 2.07	103.16 ± 2.29	$<0.001^*$
Heart Rate (per min)			
Pre	75.47 ± 2.68	94.93 ± 3.79	$<0.001^*$
Post	74.04 ± 2.57	91.58 ± 3.88	$<0.001^*$

$P < 0.05$ (Significant); *Unpaired t-test

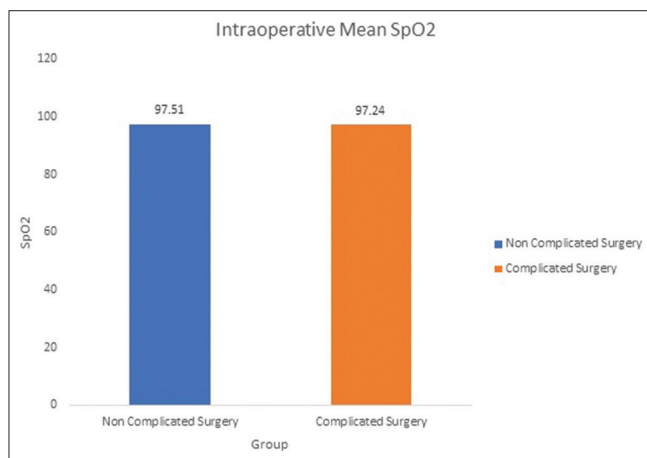


Figure 1: Bar diagram showing comparable saturation of peripheral oxygen (SpO_2) in surgeon while performing cataract surgery in both the groups (uncomplicated and complicated)

Poor dilatation was the most common complication in Group 2 with an incidence of 14 (25.45%) patients.

Discussion

Occupational stress is now known to be a major health hazard typically stemming from high demands of the profession, among other things. Doctors, especially surgeons, are particularly vulnerable to the adverse impact of stress because of various peculiarities entailed in the job.^[6] This stress if unrestrained may expose surgeons to long-term physiological consequences such as hypertension and cardiovascular disease or psychological outcomes such as depression and other mental disorders.^[7,8] The way in which doctors experience stress has not yet been elucidated, and this gap in knowledge serves as an obstacle to implement effective measures to improve resilience among doctors. Understanding this aspect is crucial with the increase in the rate of burnouts among doctors, especially surgeons.^[9]

Surgeons work in an environment of uncertainty with a range of challenges, including unforeseen complications, technical issues, lapses in teamwork, and time constraints.^[3] Some of these hurdles have a greater bearing on the work of an ophthalmic surgeon because of certain dispositions of being a highly equipment-intensive microsurgical specialty.

According to cognitive-behavioral theorists, anxiety comprises of three interrelated components: cognitive, physiological, and behavioral.^[10] Physiological effect of anxiety results from activity in the amygdala and the connected subcortical neural structures. These interactions result in stimulation of the autonomic nervous system,^[11] which results in increased HR, raised blood pressure, nausea, and sweating.

Although earlier studies have demonstrated increased stress-related parameters in various surgical paradigms, this is the first study to report the findings in the context of ophthalmic surgery.

We studied the physiological parameters of an experienced ophthalmologist while operating on simple and complicated cataract cases. SBP and DBP showed a significant difference between the two groups in both preoperative and postoperative periods ($P < 0.05$). DBP represents resting blood pressure

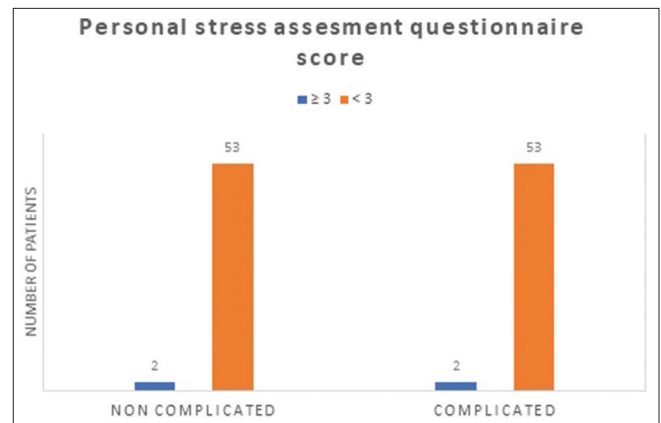


Figure 2: Bar diagram showing comparable scores of personal stress assessment questionnaire in surgeon while doing cataract surgery in the two groups (uncomplicated and complicated)

Table 3: Association of surgeon's physiological parameters with patient's clinical diagnosis among Group 2

Complicated Surgeries	Number of cases	Mean±SD			
		Systolic blood pressure	Diastolic blood pressure	Mean arterial pressure	Heart rate
Single eye	4	153.25±2.36	90.00±0.00	111.08±0.79	94.75±2.99
Glaucoma	7	145.57±3.91	86.00±3.46	105.86±3.37	96.71±3.09
Poor Dilatation	14	145.14±2.85	87.86±2.41	106.95±2.06	95.36±3.52
Mature cataract	7	146.29±2.14	88.86±1.57	108.00±1.09	93.86±4.26
Hyperature Cataract	4	147.25±0.50	89.00±1.15	108.42±0.69	97.50±3.00
Postpolar Cataract	4	145.75±1.5	87.50±1.00	106.92±0.95	94.50±4.12
Zonular dialysis	3	144.67±1.15	86.00±0.00	105.56±0.38	97.67±3.21
Postuveitis	5	141.00±3.74	86.20±3.03	104.47±2.66	94.40±4.83
Traumatic Cataract	4	149.00±1.15	89.50±1.00	109.33±0.94	89.50±0.58
Pseudo-exfoliative syndrome	2	148.00±0.00	88.00±2.83	108.00±1.89	92.00±0.00
Floppy iris syndrome	1	138.00±0.00	82.00±0.00	100.67±0.00	98.00±0.00

in blood vessels and is less affected by stress compared with SBP. MAP in Group 1 varied from 94.33 mmHg to 103.33 mmHg in preoperative and 92 mmHg to 100.66 mmHg in postoperative period. An increase in these parameters in Group 2 can be attributed to the stimulation of the hypothalamic-pituitary-adrenal axis, triggering the release of stress-related hormones, most notably cortisol.^[12] MAP in Group 2 varied from 102.66 to 111.66 mmHg in preoperative and 98 to 106.66 mmHg in postoperative period.

MAP and HR also showed statistically significant difference between the two groups ($P < 0.05$). HR is the most sensitive physiological parameter to be affected by any stress and has been used as a cardiovascular marker in earlier studies.^[13] Variations of physiological parameters seen in our study are consistent with the findings of earlier studies.^[14,15] A study by Alobid *et al.*^[16] has shown that stress causes variations in cardiovascular parameters while operating in the operation theater even when endocrine markers of stress are normal, emphasizing the importance of physiological parameters in acute stress.

The difference in operation room temperature between the two groups was statistically insignificant thereby excluding the confounding effect of this environmental factor, which also contributes to the variation in physiological parameters.

The questionnaire was filled every day before beginning the surgeries, and an equal number of cases from both groups were operated on in a day. This was done to reduce the confounding factor of personal stress because it can also affect the physiological parameters of the surgeon as reported by Bromberger and Matthews^[17] and Veasey *et al.*^[18]

The most frequently encountered stressors in the descending order are external distractions, patient factors, and equipment-related problems.^[4] The contribution of patient factors is well demonstrated by intragroup variation of physiological parameters in Group 2 with single-eyed patients being associated with maximum variation. The explanation for this intragroup variation might be that the hypothalamus-pituitary-adrenocortical axis and sympathetic adrenomedullary system not only respond to the stress but also replicate the intensity of the stressful conditions. The subtlety of variations of physiological parameters found in our study

might be due to the expertise of the surgeon.^[19,20] A study by Elkahlout and Ahmad^[21] has demonstrated that experience does help in controlling anxiety and hence the result shows less variation in physiological parameters.

The limitation of this study was that the complicated cases were taken up after the simple cases. There is a possibility of increasing stress levels while operating later in the day. But the complicated surgeries were done after taking at least 20 minutes of rest. This might nullify the possible stress levels before operating the complicated cases.

Conclusion

Our study acknowledges that surgeons, who form the nucleus of clinical health care system, can be a vulnerable population toward whom support services should be directed. The work stress has led to many cases of burnout among doctors affecting their well-being as well as their patients'. With an increase in the incidence of burnouts among surgeons, this study augments the existing wisdom regarding the vulnerability of surgeons to stress and indicates the need for further controlled studies on a larger scale, specifically focused on interventions to reduce modifiable workplace stressors.

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Conflicts of interest

There are no conflicts of interest.

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