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Preoperative Electrocardiographic Findings and Their Impact on Clinical Decision-Making Among Patients Undergoing Cataract Surgery: A Retrospective Audit

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ABSTRACT

Background: During preoperative evaluation, electrocardiograms (ECGs) are commonly used to detect cardiovascular abnormalities that could affect perioperative care. In many outpatient settings, however, the clinical importance of ECG abnormalities and their influence on patient trajectories are still not well understood. In patients undergoing cataract surgery, this audit assessed the frequency of aberrant ECG results and their impact on clinical decision-making.

Aim: To evaluate ECG findings in patients undergoing preoperative assessment and determine their impact on clinical decision-making and patient flow.

Methods: Anonymized patient data from those who underwent outpatient preoperative evaluation for unilateral cataract surgery with intraocular lens (IOL) insertion between May 7 & July 23, 2024, were used in a retrospective observational clinical audit. The ECG results and patient characteristics were summarized using descriptive statistics. Kruskal-Wallis & Fisher's exact tests were utilised to evaluate correlations between clinical factors and ECG outcomes. To find independent predictors of aberrant ECG readings, multivariable logistic regression was used.

Results: There were 247 patients in all. 55% of the population was female & the median age was 76 years (IQR 70-81). ECG results were categorized as normal in 21% (n = 51), borderline in 31% (n = 76), and abnormal in 49% (n = 120). Conduction abnormalities were the most common abnormal ECG subtype (53%, n = 64), followed by arrhythmias (32%, n = 39), left ventricular hypertrophy (7%, n = 8), and ischaemic changes (2%, n = 3). Age (OR 1.04; 95% CI 1.00-1.07; p = 0.034), diabetes (OR 2.63; 95% CI 1.32-5.41; p = 0.007) & prior cardiac history (OR 3.16; 95% CI 1.62-6.39; p < 0.001) were independently linked with aberrant ECG readings. In 89% of cases, patients were referred for additional anaesthesia review. Despite the high prevalence of ECG abnormalities, procedure delays (2.4%), cancellations (1.6%), and overall route interruption (2.8%) were rare.

Conclusion: Abnormal ECG findings are common among patients undergoing preoperative assessment for cataract surgery, particularly in older individuals and those with diabetes mellitus or established cardiac disease. However, these abnormalities rarely resulted in procedural delays or cancellations. These findings support the need for evidence-based ECG utilisation strategies that optimise patient flow while maintaining patient safety.

Keywords: *Preoperative assessment; electrocardiography; ECG; cataract surgery; clinical audit; patient flow; cardiovascular risk assessment; ophthalmic surgery; perioperative care*

INTRODUCTION

Preoperative assessment is a fundamental component of modern perioperative care and serves as a critical opportunity to identify patient-specific factors that may influence surgical, anaesthetic, and postoperative outcomes. The primary objectives of preoperative evaluation are to optimise patients for surgery, minimize perioperative risk, facilitate appropriate planning of anaesthetic care, and reduce avoidable delays or cancellations. Effective preoperative assessment has been associated with improved patient safety, enhanced perioperative efficiency, reduced healthcare costs, and better utilization of clinical resources (NICE, 2016).

Cardiovascular disease is one of the top causes of perioperative morbidity and mortality around the world. As a result, cardiovascular assessment is an important part of normal preoperative evaluation, especially in older adults & patients with established comorbidities. Electrocardiography (ECG) is one of the most used investigations in this context because it is non-invasive, inexpensive, widely available, and capable of detecting a wide range of cardiac abnormalities, including arrhythmias, myocardial ischemia, conduction disturbances, chamber enlargement, and evidence of previous myocardial infarction (Fleisher et al., 2024).

Historically, ECGs were frequently requested as part of standard preoperative assessment protocols irrespective of patient risk profile or procedural complexity. This practice was largely driven by concerns regarding occult cardiovascular disease and the desire to minimize unexpected perioperative complications. However, over recent decades, increasing attention has been directed towards the clinical utility, cost-effectiveness, and downstream consequences of routine preoperative investigations. Several studies have questioned whether widespread ECG testing in low-risk surgical populations provides meaningful clinical benefit, particularly when findings do not alter perioperative management or improve patient outcomes (NICE, 2016; Fleisher et al., 2024).

Many abnormalities found on standard screening may be accidental or clinically inconsequential, which further complicates the efficacy of preoperative ECG testing. Many ECG abnormalities do not lead to clinically significant interventions, while some findings, such as atrial fibrillation, high-grade conduction abnormalities, or indications of active myocardial ischaemia, may correctly elicit additional assessment or adjustment of perioperative preparations. Therefore, without comparable gains in patient safety or surgical outcomes, frequent ECG screening may result in needless investigations, specialist referrals, procedural delays, increased healthcare spending, and patient anxiety (Ganguli et al., 2019).

Determining which patients benefit from preoperative ECG testing and how ECG results affect clinical decision-making within modern surgical pathways is becoming increasingly important as healthcare systems adopt value-based care models and work to cut down on pointless investigations. Therefore, it is crucial to comprehend the frequency and importance of ECG anomalies within patient categories to optimize resource use and influence evidence-based preoperative assessment techniques.

BACKGROUND

A selective rather than standard approach to preoperative ECG testing is becoming more and more supported by international recommendations. Instead of being routinely carried out for all elective surgical patients, the National Institute for Health and Care Excellence (NICE) recommends that preoperative examinations be guided by patient characteristics, existing comorbidities, and the intricacy of the anticipated therapy (NICE, 2016). Similar to this, current perioperative cardiovascular regulations from the American Heart Association (AHA) and American College of Cardiology (ACC) discourage needless testing in patients undergoing low-risk procedures where the results are unlikely to affect management and encourage risk-based assessment strategies (Fleisher et al., 2024).

Cataract surgery provides an important context for examining the utility of preoperative ECG testing. Cataract extraction with intraocular lens (IOL) implantation is among the most commonly performed elective surgical procedures worldwide and is generally regarded as a low-risk intervention. Most procedures are undertaken under local or regional anaesthesia, are completed on a day-case basis, and are associated with extremely low rates of major perioperative cardiovascular complications. Given these characteristics, cataract surgery has frequently been used as a model procedure in studies evaluating the necessity and impact of routine preoperative testing (Lira et al., 2016).

Previous research indicates that standard preoperative evaluation, including ECG monitoring, may have a minimal impact on clinically meaningful outcomes in groups undergoing cataract surgery. In a retrospective cohort analysis with 968 patients undergoing cataract surgery, Lira et al. (2016) identified no significant perioperative cardiovascular events and discovered that, despite longer wait times for surgery, outpatient preoperative screening did not significantly reduce unfavorable outcomes. Perioperative hypertension episodes decreased in examined patients, but these decreases did not result in appreciable improvements in surgical or medical outcomes. The clinical utility of routine investigations in low-risk surgical groups is called into question by these findings.

In addition to concerns regarding clinical effectiveness, growing attention has been directed towards the concept of low-value care and the unintended consequences of routine testing. Preoperative ECG use among Medicare beneficiaries undergoing cataract surgery was studied by Ganguli et al. (2019), who showed that ECG results frequently led to downstream healthcare utilization, such as additional cardiac investigations, specialist consultations, and additional treatment. At least one cascade event occurred in about 16% of patients who had preoperative ECG testing, with further cardiac testing being the most frequent outcome. According to Ganguli et al. (2019), these cascades have the potential to raise healthcare expenses, deplete scarce resources, and subject patients to more operations in the absence of conclusive proof of better results.

Despite these concerns, abnormal ECG findings remain relatively common within surgical populations, particularly among older adults and individuals with chronic medical conditions. Previous studies have reported associations between abnormal ECG findings and increasing age, hypertension, diabetes mellitus, cardiovascular disease, and other chronic comorbidities (Prakash et al., 2019). Consequently, ECG testing may continue to have an important role in identifying patients requiring additional perioperative evaluation or optimization, particularly when applied selectively according to clinical risk factors.

Nonetheless, there is still a great deal of variation in ECG usage procedures, interpretation of results, specialist referral levels, and subsequent clinical decision-making. Additionally, there is still no local data on the frequency of aberrant ECG findings found during outpatient preoperative evaluation and the degree to which these findings affect patient trajectories. In order to assess existing practice, find areas for quality improvement, and make sure that preoperative investigations significantly improve patient care, it is critical to comprehend these relationships.

Thus, a retrospective clinical audit of patients undergoing unilateral cataract surgery with intraocular lens implantation was conducted as part of the PRE-ECG Study (Preoperative ECG Evaluation and Clinical Guidance). This study aims to give information that can guide more effective, evidence-based, and patient-centred preoperative evaluation pathways by analysing the frequency and types of ECG abnormalities, the therapeutic actions generated by these findings, and their impact on patient flow.

Study Aim

To evaluate ECG findings in patients undergoing preoperative assessment and determine their impact on clinical decision-making and patient flow.

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Study Objectives

1. To describe preoperative ECG findings among patients undergoing cataract surgery.
2. To identify the frequency and types of abnormal ECG findings.
3. To assess clinical actions taken following abnormal ECG findings.
4. To evaluate the impact of ECG findings on patient pathways, including:
   - Further investigations
   - Referrals
   - Procedural delays
   - Procedure cancellations or rescheduling
5. To assess the relationship between patient characteristics and abnormal ECG findings.
6. To explore the implications of current ECG utilisation in relation to contemporary perioperative assessment practice.

Study Rationale

Preoperative investigations must be clinically justified and provide a significant contribution to patient management as healthcare systems continue to prioritize efficiency, value-based treatment, and waiting-list reduction tactics. Knowing the frequency and importance of ECG anomalies in a real-world population undergoing cataract surgery may assist in finding strategies to simplify evaluation procedures, cut down on pointless investigations, maximize resource use, and preserve patient safety. The results of this audit may also influence the creation of local policies pertaining to the use of preoperative ECGs and aid in future quality improvement projects.

METHODOLOGY

Study Design

In this study, patients who attended an outpatient preoperative evaluation service were the subject of a retrospective observational clinical audit. The audit assessed electrocardiographic (ECG) results found during regular preoperative evaluation and looked at how they affected patient paths and clinical decision-making. The audit was conducted within a public outpatient preoperative assessment service in Ireland that provides assessment and optimisation of patients scheduled for elective ophthalmic surgery.

Since all of the data had previously been gathered as part of standard clinical care before the audit started, the study used a retrospective design. Patient management was not altered, nor were any interventions implemented. The audit was conducted in compliance with service evaluation criteria and institutional clinical audit procedures.

Study Setting

The audit was carried out in an outpatient preoperative evaluation service that assesses patients before elective eye surgery. The program conducts routine preoperative evaluations to find variables that could affect surgical planning and perioperative safety.

Every patient in this audit was scheduled for unilateral cataract surgery with intraocular lens (IOL) implantation, a treatment that is often regarded as low risk from a cardiovascular standpoint. For most patients in the local preoperative pathway, anesthetic review was a routine examination that was not only based on ECG results.

Study Population

Patients who attended outpatient preoperative evaluation between May 7, 2024 & July 23, 2024, made up the research population.

The audit covered 247 consecutive patients who satisfied the eligibility requirements.

Inclusion Criteria

Patients qualified for inclusion if they:

- Attended outpatient preoperative assessment during the study period.
- Were scheduled for unilateral cataract surgery with intraocular lens implantation.
- Had an ECG performed as part of their preoperative assessment.
- Had complete clinical records available for review.

Exclusion Criteria

Patients were excluded if they:

- Had incomplete or missing clinical records.
- Had ECGs performed for reasons unrelated to preoperative assessment.
- Had insufficient documentation to determine ECG findings or subsequent clinical actions.

Sample Size

The sample size was determined pragmatically based on all eligible patients who underwent preoperative assessment during the audit period. A total of 247 anonymised patient records were included.

A formal sample size estimate was not necessary because this study was not intended to be a hypothesis-driven interventional trial but rather a retrospective clinical audit. The sample was deemed sufficient to characterize the use of ECGs, the frequency of aberrant ECG results, and their influence on patient paths and clinical decision-making in the service.

Data Source and Data Collection

Preoperative evaluation records and related clinical paperwork were used to retrospectively extract data.
To reduce selection bias, all eligible consecutive patients reviewed during the audit period were included. A structured data gathering tool created especially for the audit was used to extract data.
Prior to analysis, all patient identities were eliminated to guarantee confidentiality and adherence to data protection laws. A distinct research identification number (ECG001-ECG247) was given to each patient.

Quality assurance checks were performed to confirm data accuracy after transcription. Transcription errors were identified in the original source materials & corrected as needed. To protect source data integrity and uphold openness, one discordant ECG entry was kept in the clinical record exactly as it was initially recorded.

Variables Collected

Demographic Variables

The following demographic variables were collected:

- Study identification number
- Age (years)
- Sex (male/female)

Clinical Variables

Clinical characteristics included:

- History of cardiovascular disease
- Hypertension
- Diabetes mellitus

Cardiac history was defined as documented cardiovascular disease including, but not limited to:

- Atrial fibrillation

- Coronary heart disease
- Cardiomyopathy
- Other established cardiac diagnoses

ECG Variables

ECG-related variables included:

ECG Result

Overall ECG interpretation was categorised as:

- Normal
- Borderline
- Abnormal

For multivariable modelling, ECG outcomes were subsequently dichotomised into:

- Normal/Borderline
- Abnormal

This approach was pre-specified within the audit protocol and reflected local clinical practice, where borderline ECG findings without defined pathology were managed similarly to normal ECG findings.

ECG Finding Category

Abnormal ECG findings were classified into the following categories:

- Arrhythmia
- Ischaemic changes
- Conduction abnormalities
- Left ventricular hypertrophy (LVH)
- Other abnormalities

Clinical Outcome Variables

Clinical outcomes following ECG review included:

Clinical Action Taken

- No action required
- Further investigation
- Referral for anaesthetic review

Patient Pathway Outcomes

- Procedure delay
- Procedure cancellation or rescheduling
- Composite pathway disruption outcome (delay and/or cancellation)

Definitions

Abnormal ECG: An abnormal ECG was defined as any documented pathological finding requiring consideration during perioperative assessment, including arrhythmias, ischaemic changes, conduction abnormalities, or evidence of structural cardiac disease.

Normal ECG: A normal ECG was defined as sinus rhythm or a borderline ECG without clinically significant pathology.

Procedural Disruption: Procedural disruption was defined as any delay, cancellation, or rescheduling of the planned surgical procedure attributable to findings identified during the preoperative assessment process.

Statistical Analysis

R version 4.x.x was used to perform statistical studies within the RStudio framework (R Core Team, 2024). While percentages and frequencies have been used to characterize categorical data, interquartile ranges (IQRs) and medians have been used to summarize continuous variables.

The primary outcome was preoperative ECG abnormality. For descriptive and bivariate analyses, ECG findings were reported across three categories:

- Normal
- Borderline
- Abnormal

For multivariable logistic regression analysis, ECG findings were dichotomised into:

- Normal/Borderline
- Abnormal

Secondary outcomes included:

- Clinical actions following ECG review
- Procedure delay
- Procedure cancellation/rescheduling
- Composite pathway disruption

Associations between patient characteristics and ECG findings were assessed using:

- Kruskal-Wallis rank-sum tests for continuous variables
- Fisher's exact tests for categorical variables

Where sparse cell counts limited exact computation, Monte Carlo simulation methods were applied.
Multivariable logistic regression analysis was performed to identify independent predictors of abnormal ECG findings. Variables entered into the model included:

- Age
- Sex
- Hypertension
- Diabetes mellitus
- Cardiac history

Based on clinical significance and previously published data, these factors were chosen beforehand.
95% confidence intervals (CIs) and adjusted odds ratios (ORs) were shown. Variance inflation factors (VIFs) were used to evaluate multicollinearity. Statistical significance was defined as a two-sided p-value of less than 0.05.

Governance and Ethical Considerations

The PRE-ECG Study was classified as a clinical audit in accordance with institutional policy.
Formal research ethics committee approval was therefore not required. Relevant audit and service evaluation approvals were obtained as required by the institution.

The audit utilised fully anonymised retrospective data collected during routine clinical care. No direct patient involvement occurred, and no identifiable patient information was retained.
The General Data Protection Regulation (GDPR) & other relevant data protection laws, as well as institutional confidentiality standards, were adhered to by all data handling practices.

RESULTS

Study Population and Patient Characteristics

This audit included 247 patients who attended outpatient preoperative evaluation for unilateral cataract surgery with intraocular lens (IOL) implantation between May 7, 2024, and July 23, 2024. As part of their preoperative evaluation, every patient had an ECG.

The study population ranged in age from 43 to 95 years, with a median age of 76 (IQR: 70-81 years). Of the patients in the cohort, 55% (n = 136) were female & 45% (n = 111) were male. The most common comorbidity was hypertension, which affected 58% of patients (n = 143), followed by diabetes mellitus in 19% of patients (n = 48) and documented cardiac disease in 23% of patients (n = 57) (Table 1).

Table 1. Baseline Characteristics of the Study Population

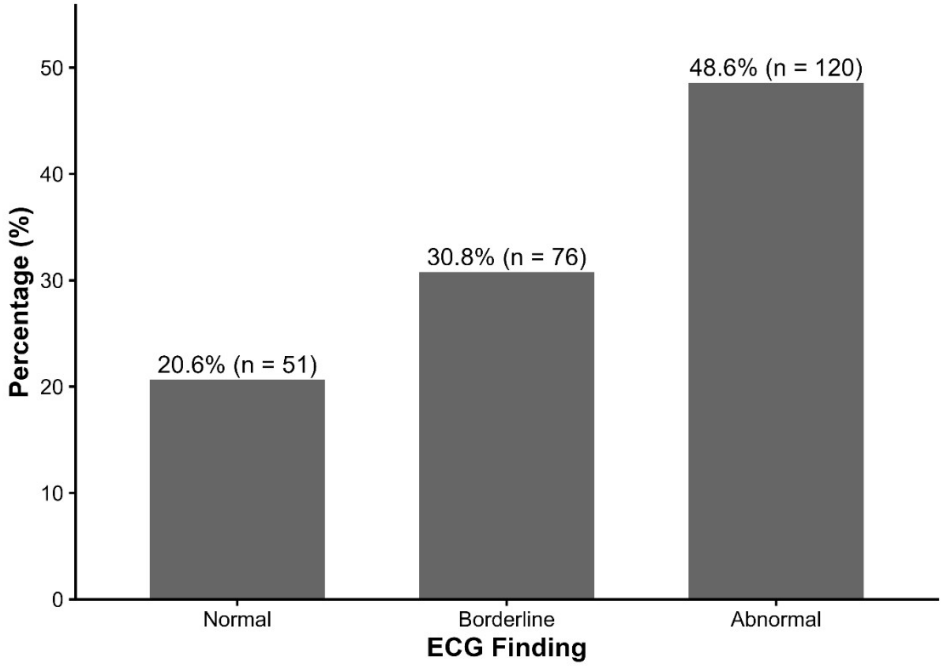
Characteristic	Overall (N = 247)[1]
Age (years)	76 (70, 81)
Sex	
Male	111 (45%)
Female	136 (55%)
Hypertension	143 (58%)
Diabetes mellitus	48 (19%)
Cardiac history	57 (23%)

[1]*Median (Q1, Q3); n (%)*

ECG Findings

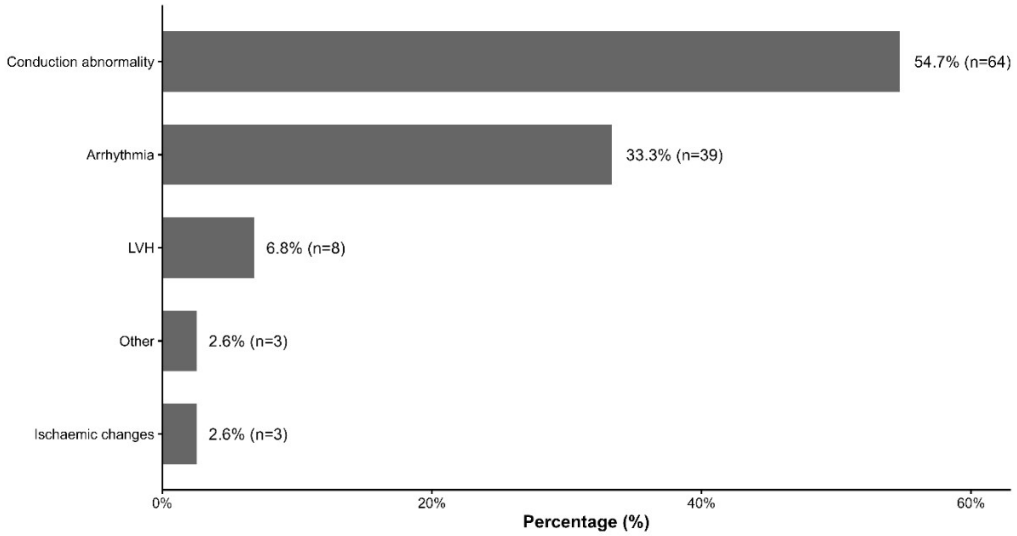
120 (49%) of the 247 ECGs that were examined were categorized as abnormal, 76 (31%) as borderline, and 51 (21%) as normal (Figures 1 and 2).

Figure 1. Overall ECG Interpretation



Conduction abnormalities were the most common ECG abnormality among patients with abnormal ECG findings (n = 120), making up 53% (n = 64) of aberrant tracings. 32% (n = 39) had arrhythmias, and 7% (n = 8) had left ventricular hypertrophy (LVH). In 2% (n = 3) of aberrant ECGs, ischemic alterations were found. The remaining findings included further ECG abnormalities.

Figure 2. Specific ECG Findings



Association Between Patient Characteristics and ECG Findings

Patient characteristics were subsequently analysed according to ECG classification (normal, borderline, and abnormal). Patients with normal ECG findings had a median age of 74 years (IQR: 66-77), those with borderline ECGs had a median age of 75 years (IQR: 70-81), and those with abnormal ECGs had a median age of 77 years (IQR: 72-83). There was a statistically significant difference (p = 0.001).

A documented cardiac history demonstrated a strong association with ECG abnormality. Cardiac disease was present in 34% (n = 41) of patients with abnormal ECGs compared with 13% (n = 10) of patients with borderline ECGs and 12% (n = 6) of those with normal ECG findings (p < 0.001).

Similarly, 27% (n = 32) of patients with aberrant ECG findings had diabetes mellitus, compared to 14% (n = 11) and 10% (n = 5) in the borderline and normal ECG groups, respectively (p = 0.017). No statistically significant associations were identified between ECG findings and sex (p = 0.508) or hypertension status (p = 0.928).

Table 2. Patient Characteristics Stratified by Preoperative ECG Findings

Characteristic	Overall N = 247[1]	Normal N = 51[1]	Borderline N = 76[1]	Abnormal N = 120[1]	p-value[2]
Age (years)	76 (70, 81)	74 (66, 77)	75 (70, 81)	77 (72, 83)	**0.001**
Sex					0.508
Male	111 (45%)	24 (47%)	30 (39%)	57 (48%)	
Female	136 (55%)	27 (53%)	46 (61%)	63 (53%)	
Hypertension	143 (58%)	29 (57%)	43 (57%)	71 (59%)	0.928
Diabetes mellitus	48 (19%)	5 (9.8%)	11 (14%)	32 (27%)	**0.017**

Characteristic	Overall N = 247[1]	Normal N = 51[1]	Borderline N = 76[1]	Abnormal N = 120[1]	p-value[2]
Cardiac history	57 (23%)	6 (12%)	10 (13%)	41 (34%)	**<0.001**

[1]*Median (Q1, Q3); n (%)*
[2]*Kruskal-Wallis rank sum test; Fisher's exact test*
Bold values indicate statistically significant results (P < .05)

Clinical Actions Following ECG Review

Following ECG assessment, clinical actions differed significantly by ECG classification (p < 0.001).
Referral for anaesthetic review was the most common action overall and was recorded in 219 patients (88.7%). Referral rates were highest among patients with abnormal ECG findings, occurring in 99.2% (n = 119) of cases. Corresponding referral rates among patients with borderline and normal ECG findings were 84.2% (n = 64) and 70.6% (n = 36), respectively.

In 27 individuals (10.9%), no clinical intervention was necessary. There were no untreated individuals among those with aberrant ECG findings, and these cases only happened in the normal and borderline ECG categories.
Only one patient (0.4%) underwent additional investigation following ECG review.

Table 3. Actions Taken and Impact by ECG Outcome

Downstream Actions & Impact	Overall N = 247[1]	Normal N = 51[1]	Borderline N = 76[1]	Abnormal N = 120[1]	p-value[2]
Clinical Action Taken					**<0.001**
None	27 (10.9%)	15 (29.4%)	12 (15.8%)	0 (0.0%)	
Further investigation	1 (0.4%)	0 (0.0%)	0 (0.0%)	1 (0.8%)	
Referral	219 (88.7%)	36 (70.6%)	64 (84.2%)	119 (99.2%)	
Procedure Delay	6 (2.4%)	0 (0.0%)	1 (1.3%)	5 (4.2%)	0.354
Procedure Cancellation	4 (1.6%)	0 (0.0%)	1 (1.3%)	3 (2.5%)	0.817
Composite Negative Pathway Impact	7 (2.8%)	0 (0.0%)	1 (1.3%)	6 (5.0%)	0.191

[1]*n (%)*
[2]*Fisher's exact test*
Bold values indicate statistically significant results (P < .05)

Impact on Patient Pathways

Despite the relatively high prevalence of abnormal ECG findings, disruption to planned surgical pathways was uncommon. Six patients (2.4%) experienced delays in their procedures. individuals with abnormal ECG results experienced five delays, whereas individuals with borderline ECG results experienced one delay. The group with a normal ECG showed no delays. There was no statistically significant correlation (p = 0.354) between ECG categorization and procedural delay.
Four patients (1.6%) had their procedures cancelled or rescheduled. There were one case in the borderline ECG group and three in the abnormal ECG group. Once more, there was no statistically significant correlation found (p = 0.817).

A composite measure of pathway disruption, defined as either delay or cancellation/rescheduling, was observed in seven patients (2.8%). Rates were highest among patients with abnormal ECG findings (5.0%; n = 6) compared with borderline

ECG findings (1.3%; n = 1). No pathway disruptions occurred among patients with normal ECG findings. This association did not reach statistical significance (p = 0.191).

Predictors of Abnormal ECG Findings

Multivariable logistic regression analysis was performed to identify independent predictors of abnormal preoperative ECG findings. Increasing age was independently associated with ECG abnormality. For every one-year increase in age, the odds of having an abnormal ECG increased by approximately 4% (OR 1.04; 95% CI 1.00-1.07; p = 0.034).

Diabetes mellitus was also identified as a significant independent predictor. Patients with diabetes had more than twice the odds of exhibiting abnormal ECG findings compared with non-diabetic patients (OR 2.63; 95% CI 1.32-5.41; p = 0.007). The strongest predictor of ECG abnormality was a documented cardiac history. Patients with pre-existing cardiac disease had more than three times the odds of demonstrating abnormal ECG findings compared with patients without cardiac disease (OR 3.16; 95% CI 1.62-6.39; p < 0.001).

Abnormal ECG results were not independently correlated with either sex (p = 0.954) or hypertension (p = 0.609). There was no evidence of significant collinearity in the regression model, according to the multicollinearity assessment, which showed low variance inflation factors for all variables (VIF < 2) (Table 4).

Table 4. Multivariable Logistic Regression for Predictors of Abnormal ECG

Predictors	OR[1]	95% CI[1]	p-value
Age (years)	1.04	1.00, 1.07	**0.034**
Sex			0.954
Male	—	—	
Female	1.02	0.59, 1.76	
Hypertension			0.609
No	—	—	
Yes	0.87	0.50, 1.50	
Diabetes mellitus			**0.007**
No	—	—	
Yes	2.63	1.32, 5.41	
Cardiac history			**<0.001**
No	—	—	
Yes	3.16	1.62, 6.39	

[1]*OR = Odds Ratio, CI = Confidence Interval*

Bold values indicate statistically significant results (P < .05)

DISCUSSION

The preoperative ECG results of patients undergoing unilateral cataract surgery were examined in this retrospective clinical audit, and their influence on clinical decision-making and patient paths was reviewed. The audit showed that nearly half of the study population (49%) had aberrant ECG findings, and another 31% had borderline ECG findings. The most common ECG abnormality was conduction abnormalities, which were followed by arrhythmias. A documented cardiac history, diabetes mellitus, and getting older were all independently linked to aberrant ECG results.

ECG anomalies were very common, but they had little effect on the course of surgery. Procedural delays, cancellations, and general pathway disruption were rare, even though aberrant ECG readings sometimes led to referral for additional anesthetic assessment. These results imply that although ECG anomalies are frequently found during preoperative evaluation for cataract surgery, many of them do not eventually lead to patient pathways that are clinically meaningful.

Comparison with Existing Literature

The audit's conclusions are mostly in line with other research on the function of ECG testing in low-risk surgical groups. With a very low frequency of serious perioperative cardiovascular problems, cataract surgery is generally acknowledged as a low-risk technique. As a result, there has been much discussion over the usefulness of routine preoperative investigations in this context (National Institute for Health and Care Excellence (NICE), 2016; Fleisher et al., 2024).

Comprehensive preoperative review did not significantly improve perioperative or postoperative unfavourable outcomes despite lengthening waiting periods for surgery, according to Lira et al. (2016), who assessed the effect of outpatient preoperative evaluation among cataract surgery patients. In a similar vein, while aberrant ECG results were prevalent in the current audit, their impact on the course of surgery was minimal, with relatively few patients incurring delays or cancellations. All of these results point to the possibility that systematic detection of ECG abnormalities may not always result in significant improvements in perioperative outcomes for patients having low-risk ocular procedures.

Previous research also supports the prevalence of ECG abnormalities found in this audit. According to Prakash et al. (2019), aberrant ECG results are common during regular preoperative evaluation, especially in individuals with chronic medical problems and older adults. Age-related circulatory alterations and the rising burden of chronic disease within aging surgical populations are probably responsible for the prevalence of conduction abnormalities and arrhythmias seen in this study.

The audit's findings of an independent association between increasing age and abnormal ECG findings are consistent with research showing that conduction system disease, atrial arrhythmias, and structural cardiac abnormalities are becoming more common in older adults (Fleisher et al., 2024). Similarly, considering the established link between diabetes and accelerated atherosclerosis, autonomic dysfunction, myocardial fibrosis, & increased cardiovascular morbidity, the linkage between diabetes mellitus and ECG abnormalities is medically reasonable.

The best independent predictor of abnormal ECG results was a recorded cardiac history. This finding supports the importance of focused cardiovascular evaluation in individuals with established heart disease receiving preoperative evaluation & is consistent with previous research (Fleisher et al., 2024).

Clinical Actions Following ECG Findings

One of the most notable findings of this audit was the high frequency of referral for further anaesthetic review. Almost 89% of patients underwent referral following ECG assessment, and referral rates approached 100% among patients with abnormal ECG findings.

This result emphasizes how ECG results have a major impact on perioperative choices made throughout the preoperative evaluation process. Nevertheless, relatively few patients reported procedural interruption, and just one patient needed further evaluation despite the large number of referrals made. This implies that many findings may ultimately have limited clinical implications in the setting of low-risk ocular surgery, even if ECG abnormalities often prompt additional investigation.

These findings raise important questions about striking a balance between patient safety and healthcare efficiency. Excessive reliance on ECG abnormalities alone may raise clinician workload and healthcare utilization, even though referral mechanisms are crucial for identifying patients who need optimization or specialist assessment. Similar issues

have been brought to light in studies looking at low-value preoperative testing, where abnormal results often led to further investigations without appreciable benefits in patient outcomes (Ganguli et al., 2019).

Therefore, rather than relying solely on ECG abnormalities as referral triggers, future pathway refinement may benefit from risk-stratified approaches that account for patient comorbidities, functional status & overall perioperative risk, in addition to ECG findings.

Impact on Patient Pathways

Evaluating the impact of ECG results on patient flow & surgical progression was one of the audit's main goals. While abnormal ECG results often led to referrals, planned care was rarely disrupted.

Less than 3% of the sample population, or just seven patients, had any kind of route disturbance. Additionally, there was no statistically significant correlation seen between the aggregate route disruption outcome, procedural delay, or cancellation and ECG classification.

These results imply that many ECG abnormalities found during preoperative evaluation might not be clinically severe enough to change the planned course of surgery. In cataract surgery, when operational and anesthetic risks are often minimal, this fact is especially pertinent (Lira et al., 2016).

The results also support mounting worries over low-value preoperative testing. ECG testing prior to cataract surgery often results in downstream healthcare utilization, such as further cardiac investigations and specialist consultations, without clear evidence of improved outcomes, as Ganguli et al. (2019) showed. The low percentage of pathway interruption found indicates that more investigation into the clinical utility and cost-effectiveness of routine ECG testing in low-risk ocular surgery is necessary, even if the current audit did not explicitly assess economic consequences.

CLINICAL IMPLICATIONS

The audit's conclusions have a number of significant ramifications for clinical practice and service provision.
First, patients receiving preoperative evaluation for cataract surgery frequently had aberrant ECG results, especially older adults and those with diabetes mellitus or established cardiovascular disease. These patient populations might require closer cardiovascular assessment and risk stratification during preoperative evaluation.

Second, despite the high frequency of ECG abnormalities, clinically notable outcomes were unusual. This result corresponds with current guidelines that recommend selective ECG testing rather than regular screening in low-risk surgical groups (NICE, 2016; Fleisher et al., 2024).

Third, the audit identifies a need to improve preoperative assessment routes by strengthening risk-based decision-making and providing more precise referral criteria. Without jeopardizing patient safety, more judicious use of ECG testing may minimize healthcare utilization, increase efficiency, cut down on needless referrals, and promote waiting-list reduction programs.

Lastly, the results highlight how crucial it is to match local practice with evidence-based guidelines in order to guarantee that preoperative investigations offer significant therapeutic value while preventing needless strain on patients and healthcare systems (NICE, 2016).

STRENGTHS AND LIMITATIONS

Strengths

This study has several significant advantages. To minimize selection bias and provide a representative representation of standard clinical practice, the audit included all eligible consecutive patients undergoing preoperative assessment during the research period. Internal consistency was improved and procedural heterogeneity was decreased by using a homogeneous patient population for unilateral cataract surgery.

To provide a thorough evaluation of the practical impact of ECG findings within a real-world preoperative screening service, the study assessed the entire pathway from ECG detection through following clinical actions and patient pathway outcomes.

Additionally, the use of multivariable logistic regression analysis allowed for the accounting of potential confounding variables while identifying independent predictors of aberrant ECG findings.

Limitations

There are a few restrictions to be aware of. First, the audit's retrospective design makes it more difficult to determine the causal connections between ECG results and clinical outcomes. The correctness and completeness of the current documentation were crucial because the study depended on clinical data that was routinely obtained.

Second, this audit was carried out at a single site with a particular set of ophthalmic surgeons. As a result, conclusions could not apply to higher-risk surgical specialties, other companies, or healthcare systems.

Third, postoperative results outside of the direct preoperative pathway were not assessed. As a result, it was unable to ascertain if aberrant ECG results were linked to later perioperative or postoperative problems.

Lastly, statistical power for analyses incorporating pathway disruption outcomes was constrained by the comparatively modest number of delays and cancellations.

FUTURE RESEARCH AND SERVICE IMPROVEMENT

Future studies should use prospective multicenter designs to investigate the clinical value and cost-effectiveness of ECG testing in low-risk surgical groups. The evidence foundation in favor of preoperative ECG use might be strengthened by more research looking at postoperative outcomes linked to particular ECG abnormalities.

The results of this audit could help the local service reassess its existing ECG utilization patterns, improve referral pipelines, and create risk-based evaluation protocols. These programs might increase productivity while upholding strict perioperative safety regulations.

CONCLUSION

This retrospective clinical audit showed that nearly half of the study population had aberrant ECG results during preoperative evaluation for unilateral cataract surgery. The most common ECG abnormalities were conduction abnormalities and arrhythmias; pre-existing cardiac illness, diabetes mellitus, and advanced age were all independently linked to an increased risk of abnormal ECG findings.

ECG anomalies were relatively common, although they had little effect on patient trajectories. Procedural delays, cancellations, and general route interruption were rare, even though aberrant ECG readings commonly led to referral for

additional anesthetic assessment. These results imply that in low-risk ocular surgery, many ECG abnormalities found during preoperative evaluation would not be clinically important enough to change the intended surgical pathway.

The results corroborate current research that favours the use of selective, risk-based ECGs over routine monitoring for all patients having low-risk operations. Optimizing the use of ECG in preoperative assessment services may increase productivity, cut down on pointless tests and referrals, promote evidence-based clinical decision-making, and help make better use of healthcare resources while preserving patient safety.

To assess the clinical value and cost-effectiveness of ECG testing in low-risk surgical populations and to guide the creation of future guidelines, further prospective and multicentre studies are advised.

Study Running Title
PRE-ECG: Preoperative ECG Findings in Cataract Surgery

Conflict of Interest
The authors declare that they have no competing interests, financial or non-financial, related to this study.

Ethical Statement
The PRE-ECG Study was conducted as a retrospective clinical audit in accordance with institutional clinical audit and service evaluation procedures.

The project was classified as a clinical audit rather than a human subjects study; hence formal research ethics committee approval was not required. Before the study began, all relevant institutional audit and governance norms were met.

Before analysis, all data were anonymised, and no personally identifiable patient information was collected, saved, or shared. Data handling techniques followed local confidentiality standards and applicable data protection legislation, such as the General Data Protection Regulation (GDPR).

Authors' Contributions
Prof. Adebusola Adenike Owokole
- Conceived and designed the audit.
- Led project development, oversight and manuscript preparation.
- Coordinated data collection, review, and final manuscript approval.

Dr. Alazar Menbere Haile
- Developed the statistical analysis plan.
- Performed data analysis and interpretation.
- Contributed to methodological development and critical review of the manuscript.

Dr. Joshua Olaopin
- Supported data transcription and dataset development.
- Assisted with data verification and quality assurance processes.
- Contributed to manuscript review and approval.

All authors reviewed, revised, and approved the final manuscript prior to submission.

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Data Availability Statement
The datasets generated and analysed during the current study are not publicly available due to institutional data protection and confidentiality requirements but may be available upon reasonable request from the corresponding author, subject to institutional governance approval.

Use of Artificial Intelligence
Artificial intelligence-assisted tools were used to support manuscript drafting, language refinement, and formatting. All content was reviewed, verified, and approved by the authors, who accept full responsibility for the accuracy and integrity of the manuscript.

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