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Association Between Preoperative Anxiety and Perioperative Haemodynamic Changes in Patients Undergoing Elective Surgery: A Prospective Observational Study

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Abstract

Background: Preoperative anxiety is common in patients awaiting surgery and can activate sympathetic responses that alter heart rate and arterial blood pressure during anaesthetic induction.

Objectives: To evaluate the association between preoperative anxiety and perioperative haemodynamic changes in adults undergoing elective surgery.

Methods: This prospective observational study was conducted among patients undergoing elective surgery to evaluate the association between preoperative anxiety and perioperative haemodynamic changes. Preoperative anxiety was assessed before surgery, and haemodynamic parameters were monitored at predefined perioperative intervals to examine their relationship with anxiety levels.

Results: The mean age was 44.7 ± 13.1 years; 56% were male. The mean APAIS anxiety score was 10.3 ± 3.9, and 42% had higher anxiety. Compared with lower-anxiety patients, the higher-anxiety group had greater pre-induction heart rate (89.6 ± 11.8 vs 80.7 ± 10.3 beats/min), systolic blood pressure (137.8 ± 15.6 vs 128.9 ± 14.7 mmHg), and mean arterial pressure (101.6 ± 11.2 vs 95.4 ± 10.1 mmHg). Maximum heart-rate and mean arterial pressure increases were also greater. Anxiety scores correlated with maximum changes in heart rate (r = 0.46) and mean arterial pressure (r = 0.42). These associations remained significant after adjustment for clinical covariates.

Conclusion: Greater preoperative anxiety was associated with more pronounced haemodynamic responses during induction and tracheal intubation.

Recommendations: Routine preoperative anxiety screening and targeted non-pharmacological or pharmacological anxiolytic strategies should be considered in perioperative assessment, particularly for patients at risk of exaggerated cardiovascular responses.

Keywords: Amsterdam Preoperative Anxiety and Information Scale; preoperative anxiety; haemodynamics; heart rate; blood pressure; elective surgery; general anaesthesia.
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Introduction

Preoperative anxiety is a frequent psychological response among patients awaiting surgery and anaesthesia. It can arise from uncertainty regarding the procedure, fear of pain, concern about anaesthetic complications, loss of control, unfamiliar hospital surroundings, or apprehension about postoperative recovery[1-2]. Reported prevalence varies substantially because patient populations, surgical settings, timing of assessment, and anxiety instruments differ. In low- and middle-income countries, pooled evidence suggests that preoperative anxiety affects a substantial proportion of surgical patients, reinforcing the need for simple screening approaches in routine perioperative practice [3-4].

Anxiety before surgery is clinically relevant because its effects extend beyond subjective distress. Activation of the hypothalamic-pituitary-adrenal axis and sympathetic nervous system can increase circulating stress mediators, producing tachycardia, elevated arterial pressure, altered vascular tone, and greater cardiovascular reactivity. These responses can become particularly evident during transfer to the operating room, anaesthetic induction, laryngoscopy, and tracheal intubation, when psychological stress is superimposed on potent procedural stimulation. Earlier clinical studies have linked higher preoperative anxiety with greater haemodynamic variability during induction, although the magnitude and consistency of this association have differed across populations [5-8]. Anxiety has also been examined in relation to anaesthetic requirements, postoperative pain, analgesic consumption, recovery, and patient satisfaction [9-11].

Reliable identification of anxiety is therefore important. The Amsterdam Preoperative Anxiety and Information Scale (APAIS) is a brief six-item instrument designed specifically for the perioperative setting. Four items assess anxiety related to anaesthesia and surgery, while two assess the desire for information. The original validation demonstrated good correlation with established state-anxiety measures, and subsequent studies have supported its practical validity

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across diverse surgical populations [1,2,12]. A score of 11 or greater on the four-item anxiety component was proposed in the original work as a clinically useful threshold, although optimal cut-offs vary between settings and populations [1,12].

Despite increasing recognition of preoperative anxiety, routine assessment remains inconsistent, and locally generated data linking anxiety scores with objective perioperative cardiovascular responses are limited in many Indian government-hospital settings. Demonstrating such an association can support risk recognition and encourage proportionate preoperative counselling or anxiolytic interventions without treating anxiety as an isolated psychological variable.

The present prospective observational study was therefore undertaken at Government Medical College, Nirmal, Telangana, India, to determine the association between preoperative anxiety and perioperative haemodynamic changes in adults undergoing elective surgery. The objectives were to quantify preoperative anxiety using the APAIS, compare heart rate and arterial pressure responses between patients with higher and lower anxiety, evaluate correlations between anxiety scores and maximum haemodynamic changes, and determine whether anxiety remained independently associated with haemodynamic variation after adjustment for selected clinical characteristics.

Methodology

Study design and setting: This prospective observational study was conducted in the Department of Anaesthesiology at Government Medical College, Nirmal, Telangana, India, from August 2025 to March 2026. Adults scheduled for elective surgery under general anaesthesia with tracheal intubation were screened consecutively. Anaesthetic management and clinical decisions remained under the treating anaesthesia team.

Participants: Patients aged 18 years or older with American Society of Anesthesiologists (ASA) physical status I or II were eligible when they could understand and complete the anxiety questionnaire. Patients were excluded when surgery was performed on an emergency basis, perioperative observations were incomplete, or a clinical condition, treatment, or airway event was likely to substantially confound haemodynamic interpretation. Screening continued until 100 participants had complete data. A minimum of 85 participants was estimated to detect a correlation coefficient of 0.30 with 80% power and a two-sided alpha of 0.05; allowing about 15% for exclusions or incomplete observations produced a target of 100 completed participants.

Preoperative anxiety assessment: Anxiety was assessed before transfer for surgery using the Amsterdam Preoperative Anxiety and Information Scale (APAIS), a validated six-item perioperative instrument [1,2]. Four items assess anxiety related to anaesthesia and surgery, yielding an anxiety subscale score of 4-20, while two items assess information requirement. An anxiety score of ≥11 was prespecified to classify higher preoperative anxiety in keeping with the original clinical interpretation [1]. The anxiety score was also analysed as a continuous variable.

Haemodynamic assessment and outcomes: Heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were recorded using standard perioperative monitoring. Measurements for analysis included baseline values, pre-induction values, and values 1 minute after tracheal intubation. Primary outcomes were maximum increases in heart rate and mean arterial pressure from baseline during the induction-intubation period. Secondary outcomes included maximum systolic blood pressure change and a haemodynamic response of at least 20% above baseline in either heart rate or mean arterial pressure, consistent with earlier induction-focused research [5].

Bias control: Anxiety assessment preceded induction, predefined measurement time points were applied to all participants, and consecutive recruitment was used to reduce selective enrolment.

Statistical analysis: Continuous variables were summarized as mean ± standard deviation and categorical variables as frequency and percentage. Between-group comparisons used independent-samples t tests for continuous variables and chi-square or Fisher exact tests for categorical variables, as appropriate. Pearson correlation coefficients quantified associations between APAIS scores and haemodynamic changes. Multivariable linear regression evaluated associations after adjustment for age, sex, body mass index, ASA physical status, and duration of surgery. Regression coefficients were reported with 95% confidence intervals. A two-sided P value <0.05 was considered statistically significant.

Ethical considerations: Institutional ethical committee approval was obtained from Government Medical College, Nirmal, Telangana, India. The study followed institutional ethical requirements and the principles of the Declaration of Helsinki.

Results

A total of 106 patients scheduled for elective surgery were assessed for eligibility. Six patients were excluded because they did not meet the predefined eligibility criteria or had incomplete perioperative observations. Therefore, 100 patients were included in the final analysis. The mean age was 44.7 ± 13.1 years, 56 (56.0%) participants were male, and the mean body mass index was 25.8 ± 3.6 kg/m². Fifty-seven patients (57.0%) were ASA physical status I and 43 (43.0%) were ASA physical status II. The mean duration of surgery was 108.6 ± 36.4 minutes. The mean APAIS anxiety score was 10.3 ± 3.9; 42 patients (42.0%) had higher preoperative anxiety (APAIS ≥11), while 58 (58.0%) had lower anxiety (Table 1).

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Table 1

Baseline characteristics of the study participants (n = 100)

Characteristic	Value
Age, years	44.7 ± 13.1
Male sex	56 (56.0)
Female sex	44 (44.0)
BMI, kg/m²	25.8 ± 3.6
ASA physical status I	57 (57.0)
ASA physical status II	43 (43.0)
Duration of surgery, min	108.6 ± 36.4
APAIS anxiety score	10.3 ± 3.9
Higher preoperative anxiety	42 (42.0)
Lower preoperative anxiety	58 (58.0)

Note. Data are presented as mean ± standard deviation or n (%), as appropriate. APAIS = Amsterdam Preoperative Anxiety and Information Scale; ASA = American Society of Anesthesiologists; BMI = body mass index.

Perioperative haemodynamic changes: Heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure increased during the pre-induction and post-intubation periods, with larger increases among patients with higher preoperative anxiety. At pre-induction, the higher-anxiety group had a significantly higher heart rate (89.6 ± 11.8 vs 80.7 ± 10.3 beats/min; P <0.001), systolic blood pressure (137.8 ± 15.6 vs 128.9 ± 14.7 mmHg; P = 0.004), diastolic blood pressure (83.8 ± 10.4 vs 79.1 ± 9.6 mmHg; P = 0.021), and mean arterial pressure (101.6 ± 11.2 vs 95.4 ± 10.1 mmHg; P = 0.005). The largest between-group differences were observed 1 minute after tracheal intubation (Table 2).

Table 2

Comparison of perioperative haemodynamic parameters according to preoperative anxiety status

Parameter	Higher anxiety (n = 42)	Lower anxiety (n = 58)	P value
Baseline heart rate, beats/min	78.8 ± 10.2	75.6 ± 9.4	0.109
Pre-induction heart rate, beats/min	89.6 ± 11.8	80.7 ± 10.3	<0.001
Heart rate 1 min after intubation, beats/min	97.2 ± 13.1	86.4 ± 11.7	<0.001
Baseline SBP, mmHg	128.7 ± 14.9	126.2 ± 13.8	0.387
Pre-induction SBP, mmHg	137.8 ± 15.6	128.9 ± 14.7	0.004
SBP 1 min after intubation, mmHg	148.6 ± 17.2	137.1 ± 16.1	0.001
Baseline DBP, mmHg	77.4 ± 9.8	75.9 ± 9.1	0.433
Pre-induction DBP, mmHg	83.8 ± 10.4	79.1 ± 9.6	0.021
DBP 1 min after intubation, mmHg	89.4 ± 10.7	83.0 ± 10.2	0.003
Baseline MAP, mmHg	94.5 ± 10.6	92.7 ± 9.8	0.381
Pre-induction MAP, mmHg	101.6 ± 11.2	95.4 ± 10.1	0.005
MAP 1 min after intubation, mmHg	109.1 ± 11.8	101.3 ± 11.0	0.001

Note. Data are presented as mean ± standard deviation. DBP = diastolic blood pressure; MAP = mean arterial pressure; SBP = systolic blood pressure.

Magnitude of haemodynamic response: Patients with higher preoperative anxiety demonstrated a greater maximum increase in heart rate from baseline than those with lower anxiety (18.4 ± 9.6 vs 10.8 ± 7.9 beats/min; P <0.001). Maximum systolic blood pressure and mean arterial pressure increases were also significantly greater in

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the higher-anxiety group. A haemodynamic response of ≥20% above baseline in heart rate or mean arterial pressure occurred in 24 of 42 patients (57.1%) with higher anxiety compared with 15 of 58 patients (25.9%) with lower anxiety (P = 0.002) (Table 3).

Table 3

Magnitude of perioperative haemodynamic changes according to anxiety status

Outcome	Higher anxiety (n = 42)	Lower anxiety (n = 58)	P value
Maximum increase in heart rate, beats/min	18.4 ± 9.6	10.8 ± 7.9	<0.001
Maximum increase in SBP, mmHg	20.3 ± 11.8	12.6 ± 10.2	0.001
Maximum increase in MAP, mmHg	18.2 ± 10.1	10.4 ± 8.5	<0.001
≥20% haemodynamic increase from baseline	24 (57.1)	15 (25.9)	0.002

Note. Data are presented as mean ± standard deviation or n (%), as appropriate. MAP = mean arterial pressure; SBP = systolic blood pressure.

Correlation between anxiety and haemodynamic changes: Preoperative APAIS anxiety scores showed a moderate positive correlation with the maximum increase in heart rate (r = 0.46, P <0.001). Positive correlations were also observed with the maximum increase in systolic blood pressure (r = 0.38, P <0.001), diastolic blood pressure (r = 0.31, P = 0.002), and mean arterial pressure (r = 0.42, P <0.001) (Table 4).

Table 4

Correlation between preoperative anxiety score and haemodynamic changes

Haemodynamic variable	Correlation coefficient (r)	P value
Maximum change in heart rate	0.46	<0.001
Maximum change in systolic blood pressure	0.38	<0.001
Maximum change in diastolic blood pressure	0.31	0.002
Maximum change in mean arterial pressure	0.42	<0.001

Note. Pearson correlation coefficients are shown.

Multivariable analysis: After adjustment for age, sex, BMI, ASA physical status, and duration of surgery, the preoperative anxiety score remained independently associated with greater perioperative haemodynamic variation. Each one-point increase in the APAIS anxiety score was associated with an estimated 1.02 beats/min greater maximum increase in heart rate (β = 1.02; 95% CI: 0.61-1.43; P <0.001) and a 0.81 mmHg greater maximum increase in mean arterial pressure (β = 0.81; 95% CI: 0.39-1.23; P <0.001).

Discussion

The present study demonstrated a clear association between greater preoperative anxiety and amplified perioperative haemodynamic responses. Although baseline heart rate and blood pressure were broadly comparable between anxiety groups, differences became evident in the operating-room period and were most pronounced immediately after tracheal intubation. Patients with higher APAIS anxiety scores showed greater increases in heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure. The continuous anxiety score also correlated positively with maximum heart-rate and arterial-pressure changes, and these relationships persisted after adjustment for age, sex, body mass index, ASA physical status, and duration of surgery.

The prevalence of higher anxiety in the present cohort was 42%. This lies within the wide range reported across surgical populations and is broadly compatible with studies showing clinically relevant anxiety in a substantial proportion of elective surgical patients [3,4]. An Indian day-care surgery study reported an even higher prevalence using a different APAIS threshold and assessment schedule, illustrating how prevalence depends on case mix, setting, and operational definition [4]. Differences across studies therefore should not be interpreted as direct prevalence contrasts without considering the anxiety instrument and cut-off used.

The observed haemodynamic pattern is biologically plausible. Anxiety can increase sympathetic activity and cardiovascular responsiveness before any airway stimulus occurs. Laryngoscopy and tracheal intubation independently provoke sympathetic activation; when this procedural stimulus occurs in an already anxious patient, a larger pressor and chronotropic response can result. Kim et al.

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reported that preoperative state anxiety was associated with changes in mean blood pressure and heart rate during induction in selected patient subgroups [5]. Bayrak et al. similarly found less stable intraoperative haemodynamic parameters among patients with higher preoperative anxiety [6]. The current findings extend this relationship using the APAIS and demonstrate both categorical group differences and correlations with continuous anxiety scores.

Not all published findings are uniform. Ahmetovic-Djug et al. observed preoperative anxiety in elective surgical patients but did not identify a significant association between anxiety score and blood-pressure differences during induction [7]. Likewise, studies evaluating anaesthetic requirements have produced mixed results: Maranets and Kain identified greater propofol requirements with higher trait anxiety, whereas Morley et al. did not find an independent effect of anxiety on propofol induction characteristics [9,10]. These discrepancies probably reflect differences in anxiety constructs, timing of measurement, anaesthetic technique, patient age, surgery type, and statistical adjustment. Intervention studies showing attenuation of haemodynamic responses when anxiolysis is improved support the clinical relevance of controlling excessive perioperative stress [8,13]. Broader evidence syntheses also associate preoperative anxiety with increased anaesthetic or analgesic requirements and other adverse perioperative outcomes, while emphasizing substantial heterogeneity across studies [11,14].

Generalizability: The findings are most applicable to adult ASA I-II patients undergoing elective surgery under general anaesthesia with tracheal intubation in a government medical-college setting. They should be extrapolated cautiously to emergency surgery, patients with major cardiovascular disease, regional anaesthesia, paediatric or very elderly populations, and settings using substantially different anaesthetic protocols. Multicentre studies with standardized induction regimens and broader risk profiles would clarify how consistently the observed anxiety-haemodynamic relationship applies across perioperative practice.

Conclusion

Preoperative anxiety was common among adults undergoing elective surgery and was associated with greater cardiovascular reactivity during the peri-induction period. Patients with higher APAIS anxiety scores demonstrated larger increases in heart rate and arterial blood pressure, particularly before induction and immediately after tracheal intubation. The positive correlations between anxiety scores and maximum haemodynamic changes, together with persistence of the associations after multivariable adjustment, indicate that preoperative anxiety is clinically relevant to perioperative haemodynamic stability. Incorporating a brief anxiety assessment into routine pre-anaesthetic evaluation can help identify patients who require additional counselling, reassurance, or individualized anxiolytic measures before surgery. Prospective multicentre research should determine whether targeted anxiety reduction translates into improved haemodynamic and broader perioperative outcomes.

Limitations

This study was conducted at a single centre and included only ASA physical status I-II adults, limiting applicability to higher-risk surgical populations. The observational design does not establish causality. Anxiety was measured at one preoperative time point, and unmeasured psychological or procedural factors could influence haemodynamic responses. Variations in surgical procedures and routine anaesthetic management also introduce residual confounding despite multivariable adjustment.

Recommendations

Routine assessment of preoperative anxiety should be incorporated into pre-anaesthetic evaluation using a brief validated instrument such as the APAIS. Patients with elevated anxiety scores should receive structured counselling, clear procedural information, and individualized reassurance before transfer to the operating room. Where clinically appropriate, pharmacological anxiolysis can be considered alongside non-pharmacological strategies. Anaesthesia teams should anticipate greater haemodynamic variability in highly anxious patients, particularly during induction and tracheal intubation, and ensure vigilant cardiovascular monitoring. Future multicentre studies should evaluate standardized anxiety-reduction pathways and determine whether lowering preoperative anxiety improves haemodynamic stability, anaesthetic requirements, postoperative pain, recovery quality, and patient satisfaction.

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Abbreviations

APAIS: Amsterdam Preoperative Anxiety and Information Scale; ASA: American Society of Anesthesiologists; BMI: Body mass index; CI: Confidence interval; DBP: Diastolic blood pressure; MAP: Mean arterial pressure; SBP: Systolic blood pressure.

Conflict of interest

The authors declare that they have no conflict of interest

Data availability

The data supporting the findings of this study are available

Author Contributions

Dr. K. Prathyusha: Conceptualization, study design, methodology, data collection, literature review, interpretation of findings, manuscript drafting, and critical revision of the manuscript.
Dr. Arun Kumar Atakola: Methodological support, clinical input related to psychiatry, data interpretation, literature review, critical intellectual review of the manuscript, and final approval of the manuscript.
Dr. R. Ramya: Study methodology, data acquisition, data analysis and interpretation, manuscript preparation, critical revision, coordination of the study, correspondence with the journal, and final approval of the version to be published.

Author Biographies

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