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Hemodynamic Changes After Endotracheal Intubation In Adult Patients Aged 40–60 Years In Plastic Surgery Ot

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ABSTRACT

Endotracheal intubation, while essential for airway management during general anesthesia, often triggers significant hemodynamic changes, particularly in middle-aged patients (40–60 years) who commonly present with hypertension, diabetes, and obesity. These comorbidities can amplify cardiovascular responses during plastic surgery procedures.

This study aims to evaluate the hemodynamic changes—including heart rate, blood pressure, and oxygen saturation—before and after intubation in patients aged 40–60 years undergoing elective plastic surgery.

A prospective cohort study involving 200 participants was conducted at tertiary care hospitals in Peshawar. Hemodynamic parameters were recorded at three time points: pre-intubation, immediately post-intubation, and during recovery. Statistical analyses, including paired t-tests, MANOVA, and multiple regression, were performed to determine the impact of age and comorbidities on cardiovascular fluctuations.

Post-intubation, heart rate increased by 29.89 bpm, systolic BP by 21.36 mmHg, and diastolic BP by 13.14 mmHg, while oxygen saturation decreased slightly by 3.27%. Patients with obesity showed the most pronounced rise in both heart rate and systolic BP. MANOVA and regression analysis confirmed obesity, age, hypertension, and diabetes as significant predictors of hemodynamic instability.

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Endotracheal intubation leads to marked cardiovascular responses in patients aged 40–60 years, especially those with comorbid conditions. These findings highlight the need for individualized anesthetic protocols, preoperative risk assessment, and enhanced intraoperative monitoring to improve safety and outcomes in this vulnerable group.

Keywords— Endotracheal Intubation, Hemodynamic Changes, Comorbidities, Middleaged Patients, Surgical Procedures

Introduction

Endotracheal intubation is a fundamental procedure in general anesthesia, ensuring airway patency and facilitating controlled ventilation during surgeries, including plastic surgeries (Alvarado & Panakos, 2023). The successful performance of this procedure is critical in maintaining adequate oxygenation and ventilation throughout surgery. However, it also induces specific hemodynamic changes, which are crucial to monitor, as perioperative cardiovascular events can lead to significant morbidity and mortality (Wang *et al.*, 2025). Hemodynamic stability is paramount in anesthesia management, especially during surgeries that involve potential physiological stress (Scott & APSF, 2023).

Patients aged forty to sixty often arrive in the operating theatre already carrying hypertension, diabetes, or settled coronary disease. Each of these disorders fingerprints the hemodynamic trace seen during tracheal intubation, leaving the practitioner braced for sudden cardiovascular upheaval (García-Guimaraes *et al.*, 2021). Intubation itself, even in skilled hands, is a quick throttle of the sympathetic nervous system. Pulse and arterial pressure can shoot upward almost on cue, a surge that circulating catecholamines only magnify; individual medical history and the choice of induction drugs ultimately dictate how extreme that surge becomes (Abd Elhafez *et al.*, 2025).

With advancing years, arteries lose elasticity and the baroreceptors begin to lag. Either of these age-related changes can enlarge the ordinary hemodynamic swing that accompanies laryngoscopy (Sun, 2014) Chronic hypertension or underlying coronary artery disease-common in a middle-aged population-compounds the problem, layering yet another risk on an already thin margin of safety (Masenga & Kirabo, 2023).

Even when the scheduled procedure is classified as elective plastic surgery, the transient cardiac workload it creates demands close scrutiny of blood pressure and rhythm throughout the case (Rychik *et al.*, 2019). For patients burdened with cardiac risk factors, customizing the anesthetic approach remains essential; techniques such as advanced pharmacologic modulation or gradual airway control can help blunt the storm of hemodynamic upheaval (Hendrix & Kramer, 2025).

Surgeons and anesthetists alike must remain attuned to the subtle hemodynamic shifts that follow induction, for those fluctuations ultimately shape safety and postoperative recovery in plastic surgery. A research gap persists in the 40-to-60 age bracket; deliberate examination of blood-pressure and cardiac-output profiles after intubation would permit the design of tailored anesthetic algorithms that protect middle-aged patients while still delivering the cosmetic results, they seek (Sachidananda *et al.*, 2015).

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Endotracheal intubation remains a fundamental maneuver for anesthetists, as it secures an airway that must stay open during most operations. The insertion itself is seldom trivial; plastic surgeons report that intermittent laryngoscopy can momentarily stress the cardiovascular system. Pulmonary exchange may clear more slowly under those conditions, so reliable ventilation is never a mere formality (Şahiner, 2018).

Blood pressure, heart rate, and peripheral resistance all drift in the minutes after a tube insert into the trachea, and the drift tends to be larger in patients between forty and sixty years of age. Hypertension, diabetes, and diffuse atherosclerosis-these diseases cluster in that bracket and, together, they thicken the tissue planes surgeons cut through (Gadó *et al.*, 2022).

Even when a procedure is technically elective, metabolic demand can spike and send the same vital signs racing. Anesthesiologists, therefore, keep the monitor bells running louder than usual (Ivascu *et al.*, 2024). Choice of volatile agent, depth of neuromuscular block, and simple surgical duration all tilt the hemodynamic landscape, and the tendency of older hearts to stiffen only complicates the picture (Saracoglu *et al.*, 2025).

Hemodynamic Changes Following Endotracheal Intubation

Hemodynamic responses following endotracheal intubation are primarily driven by the activation of the sympathetic nervous system. This is commonly associated with an increase in heart rate, blood pressure, and cardiac output, with the intensity of the response varying among individuals. These changes are mediated by the release of catecholamines such as epinephrine and norepinephrine, which stimulate the heart and vascular smooth muscle (İnangil *et al.*, 2018).

Recent research underscoring the transient nature of post-intubation hemodynamic shifts highlights their heightened seriousness in patients burdened by pre-existing cardiovascular pathology. Elderly subjects already coping with coronary artery disease, for instance, face an elevated probability of acute arrhythmias or episodes of myocardial ischemia (Moras *et al.*, 2024). The initial surge in circulating catecholamines-and the accompanying cardiovascular response-appears to vary according to the class of anesthetic administered; in practice, the inhaled agent's sevoflurane and desflurane tend to provoke milder sympathetic discharge than the intravenous hypnotic propofol (Hendrix & Kramer, 2025).

Age-Related Changes in Hemodynamic Responses

Age-associated shifts in cardiovascular function exert a pronounced influence on the hemodynamic upheaval triggered by endotracheal intubation. As individuals grow older, baroreceptor acuity steadily wanes, hindering prompt, reflex-based correction of abrupt blood-pressure excursions. (Sorathiya *et al.*, 2025). At roughly the same stage of life, collagen deposits gradually thicken arterial laminae, a mechanical change that markedly constricts vascular compliance and drives systolic pressure upward. Collectively, these mechanisms amplify circulatory perturbation at the moment of intubation, a phenomenon especially evident in patients between forty and sixty years of age (Vatner *et al.*, 2021).

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Parallel to these mechanical alterations, the autonomic nervous network drifts toward an older profile, characterized by diminished vagal influence and compensatory sympathetic up-regulation. This imbalance often manifests as exaggerated cardiac output in response to the procedural stress, even among subjects lacking pre-existing heart pathology (Giordano *et al.*, 2024). For many elderly patients, the combination of vascular rigidity and autonomic briskness translates into pronounced hypertension and tachycardia soon after the tube is in place (Anand *et al.*, 2025).

Impact of Comorbidities on Hemodynamic Responses

The 40- to 60-year bracket often carries a cluster of chronic conditions, with hypertension, diabetes, and elevated lipid levels appearing repeatedly in the clinic. Each disorder can tilt the hemodynamic balance during endotracheal intubation and the minutes that follow (Dalal *et al.*, 2023)

Persistent high blood pressure inside this demographic raises the odds of immediate tachycardia and jumps in systolic readings; those spikes do not always settle quickly. In extreme cases the chain reaction leads to stroke or myocardial infarction.

Medications may blunt symptoms, yet the underlying risk remains (Gill & Goldstein, 2023)

Poorly controlled diabetes further fans the sympathetic response, making sudden arrhythmias and swift drops in blood pressure more likely once the airway is secured (Azizad & Joshi, 2023). A person with obesity or sleep apnea compounds the picture: a mechanically difficult intubation can stretch out the procedure and leave margins for hemodynamic drift. Each of these factor's stacks, rarely in isolation (Liew *et al.*, 2022).

Specific Considerations for Plastic Surgery

Plastic surgery is frequently portrayed as a matter of personal choice, yet the operative corridor itself seldom feels elective to the cardiovascular system. Intubation, however brief, fires the yawn alarm of the stress axis; surgeons remark that the body-mind boundary all but dissolves once the drapes go up. Hemodynamic tremors that follow can exceed what clinicians expect from a slice of skin (Ivascu *et al.*, 2024) Delays happen even in tidy cases of facelift, breast augmentation, or timetable-conscious reconstruction, nudging overall anesthesia time into hours. Longer clocks mean that side chores-edema, blood-by-pass rule the rhythm of the operating room as much as the primary incision. Fluid influx, surgical seepage, and the pharmacology of the anesthetic cabinet must mingle without ripping the equilibria that older coronary arteries already protect so jealously (Guo *et al.*, 2024; Çekmen & Gökdemir, 2024) The hemodynamic disturbances that typically accompany endotracheal intubation in middle-aged adults-broadly defined here as patients between 40 and 60 years of age-s demand a close look, especially within the specialized arena of cosmetic or reconstructive surgery. Because the maneuver overlays an acute cardiovascular stressor on a backdrop of age-linked vessel stiffness, rhythm variability, and frequent comorbid conditions, anesthesiologists must remain vigilant if they hope to avert hypotensive dips or sudden rhythm shifts. Long-range studies, purposely designed around this narrow age-and-surgery coupling,

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would furnish the granular data needed to fine-tune induction agents, airway pressures, and fluid protocols, thereby lifting overall safety and recovery scores in the plastic-surgery suite.

The significance of this study lies in its potential to improve the safety and outcomes of patients undergoing elective plastic surgery. Given that adult patients aged 40–60 are more likely to have underlying cardiovascular conditions that could complicate the hemodynamic response to intubation, this study will contribute to the development of tailored anesthetic protocols for this specific age group. Additionally, it will provide anesthesiologists and surgeons with a deeper understanding of the risks and challenges associated with intubation in this patient demographic, potentially leading to better perioperative management strategies and reduced incidences of complications such as arrhythmias or myocardial ischemia. Ultimately, the findings of this study will help enhance patient care and optimize surgical outcomes in plastic surgery settings.

Research Gaps and the Need for Further Studies

Despite the known hemodynamic alterations following endotracheal intubation, there is a lack of detailed research focused specifically on the 40–60-year age group undergoing plastic surgery. Much of the existing literature has primarily focused on younger or older populations, and studies on adult patients within this age range undergoing elective procedures like plastic surgery are scarce (Karmali & Rose, 2020). Furthermore, while research exists on individual factors such as hypertension or diabetes affecting intubation outcomes, studies integrating these variables with anesthetic choices in the plastic surgery setting are limited (Holmes & Thomas, 2024). Thus, future research should aim to examine the influence of age-specific cardiovascular changes on the hemodynamic response to endotracheal intubation, specifically in patients undergoing plastic surgery. Such studies could help develop age-appropriate anesthetic guidelines to optimize patient safety and improve surgical outcomes.

Methodology

Research Design

This study adopts a prospective cohort design to investigate the hemodynamic changes that occur following endotracheal intubation in adult patients aged 40–60 years undergoing plastic surgery. A cohort design allows for the observation of changes in the study participants over time and helps establish associations between pre-existing health conditions and hemodynamic responses to intubation. The primary aim is to assess the magnitude of hemodynamic fluctuations, including heart rate, blood pressure, and oxygen saturation levels, during and after the intubation process.

Study Setting

The study was conducted at a tertiary care hospital in Peshawar with a specialized department of plastic surgery. The hospitals are equipped with a dedicated surgical and anesthesia unit that routinely performs elective plastic surgeries under general

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anesthesia. All patients in this setting will be eligible for inclusion in the study, provided they meet the inclusion criteria outlined below.

Study Population

The study population consists of adult patients aged 40–60 years who are scheduled for elective plastic surgery procedures under general anesthesia. The inclusion and exclusion criteria are as follows:

- **Inclusion Criteria:**
  - Patients aged 40–60 years o Scheduled for elective plastic surgery under general anesthesia (e.g., breast augmentation, rhinoplasty, facelifts)
  - Ability to provide informed consent o No known allergies to anesthetic agents
- **Exclusion Criteria:**
  - Patients with contraindications to endotracheal intubation (e.g., difficult airway, recent trauma) o Patients with active cardiovascular diseases such as severe heart failure or uncontrolled arrhythmias
  - Pregnant women or individuals with known contraindications to general anesthesia o Patients with contraindications to the use of monitoring equipment (e.g., blood pressure cuffs, ECG monitors)
  -

Sample Size:

The sample size for the study is determined using a power calculation based on the expected effect size, which is 200 participants. This sample size is calculated to achieve a power of 80% at a significance level of 0.05, with the goal of detecting meaningful differences in hemodynamic responses during intubation.

Data Collection

The following data collection methods were employed:

- **Demographic Data:** Information such as age, gender, weight, medical history (hypertension, diabetes, obesity), and current medication use will be obtained through patient interviews and medical records.
- **Hemodynamic Monitoring:** Hemodynamic parameters, including heart rate, blood pressure (systolic and diastolic), and oxygen saturation levels, will be monitored continuously throughout the surgical procedure using standard intraoperative monitoring equipment. The measurements will be taken at three key time points:
  - **Pre-intubation:** Baseline hemodynamic measurements will be recorded prior to intubation.
  - **Post-intubation (immediately after intubation):** Hemodynamic measurements will be taken immediately following the completion of intubation.
  - **Post-surgery (recovery phase):** Hemodynamic parameters will be monitored after the surgery during the recovery phase to assess how long the hemodynamic changes persist.

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- **Data on Anesthetic Agents:** The types and dosages of anesthetic agents (e.g., propofol, fentanyl, sevoflurane) administered during the procedure will be recorded, as they can influence the hemodynamic response.
- **Complications:** Any complications such as arrhythmias, hypotension, or hypertension will be documented during the surgery and recovery phase.
-

Outcome Measures

The primary outcomes of this study are the changes in the following hemodynamic parameters:

- **Heart Rate (HR):** The number of heart beats per minute will be recorded using ECG monitoring.
- **Blood Pressure (BP):** Both systolic and diastolic blood pressure will be measured using a non-invasive cuff and recorded at regular intervals.
- **Oxygen Saturation (SpO2):** Oxygen saturation levels will be continuously monitored using a pulse oximeter.

Data Analysis

Data will be analyzed using **SPSS version 26** (or equivalent) for statistical analysis. The analysis will include the following steps:

- **Descriptive Statistics:** Descriptive statistics (mean, standard deviation, frequency distribution) will be used to summarize the demographic and baseline characteristics of the study participants.
- **Comparative Analysis:** Paired t-tests or Wilcoxon signed-rank tests will be used to compare the hemodynamic parameters (heart rate, blood pressure, and oxygen saturation) before and after intubation. Differences between patients with comorbidities (hypertension, diabetes, obesity) and those without will be assessed using independent t-tests or Mann-Whitney U tests.
- **Multivariate Analysis:** A **multivariate analysis of variance (MANOVA)** will be conducted to assess the combined effects of multiple factors (e.g., age, comorbidities, type of anesthesia) on the hemodynamic responses. This will allow for a deeper understanding of the relationships between different variables and their impact on the outcomes.
- **Regression Analysis:** To assess the influence of specific factors (e.g., age, gender, obesity, pre-existing medical conditions) on the magnitude of hemodynamic responses, **multiple linear regression** will be employed.
- **Significance Level:** A **p-value of <0.05** will be considered statistically significant for all tests.
-

Ethical Considerations

This study was approved by the Institutional Review Board (IRB) of the Sarhad University Peshawar. All subjects will give written informed consent prior to participating in the study.

Patient confidentiality will be respected throughout the course of the study, and data will be anonymized during the analysis phase.

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As described in the proposed methodology, this study seeks to analyze the hemodynamic changes brought about by endotracheal intubation in patients aged 40 to 60 years undergoing plastic surgery. The study seeks to enhance the understanding of perioperative care by reviewing the impact of age, comorbidities, anesthesia management on hemodynamic stability, thereby improving the safety of the procedures.

Results

This section provides a thorough examination of the hemodynamic responses to endotracheal intubation in patients aged 40–60 years undergoing plastic surgery. The study evaluates the impact of comorbidities (such as hypertension, diabetes, and obesity) on these responses. The data analyzed includes heart rate, systolic and diastolic blood pressure, and oxygen saturation levels before and after intubation, using statistical methods to assess the significance of changes.

Demographic Characteristics of Participants

The study included **200 participants** with the following demographic characteristics

- **Age**: Mean age = 50.2 years (range 40–60 years).
- **Gender**:
  - Male: 45% o Female: 55%
- **Comorbidities**:
  - Hypertension: 60% of participants reported hypertension.
  - Diabetes: 40% of participants had diabetes.
  - Obesity: 30% of participants were classified as obese.
- **BMI**: Mean BMI = 30.2 (±5.3).

These characteristics are consistent with the target population of middle-aged adults undergoing elective plastic surgery and provide a foundation for analyzing the effects of comorbidities on hemodynamic changes.

Demographic Characteristics of Participants

The demographic data collected through the questionnaire are summarized in the table below. This data provides insight into the study population's baseline characteristics.

Table 1: Demographic Data Summary

Variable	Mean/Percentage
Age	50.2 years (range 40–60)
Gender (Male)	45%
Gender (Female)	55%
Hypertension	60%

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Diabetes	40%
Obesity	30%
BMI	30.2 (±5.3)

The average age of participants was 50.2 years, with a nearly equal distribution of males (45%) and females (55%). The majority of participants had a history of hypertension (60%), followed by diabetes (40%) and obesity (30%). The mean BMI was 30.2, which falls into the overweight/obese range, confirming that the study population included individuals with potential risk factors for significant hemodynamic changes.

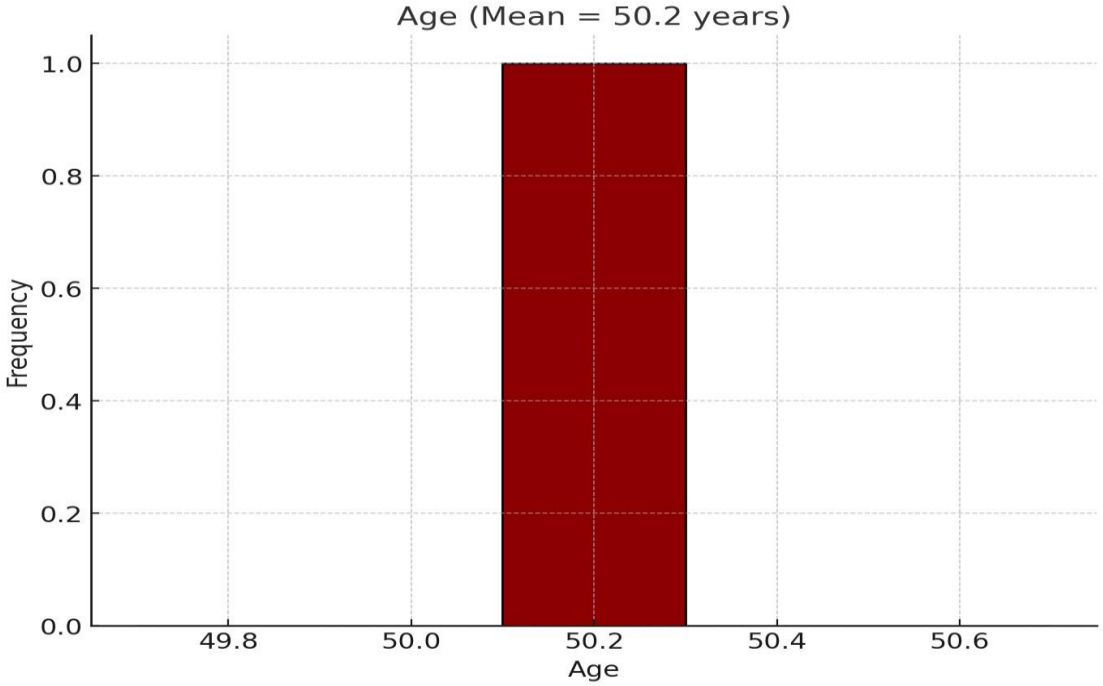

Figure 1: Age Mean

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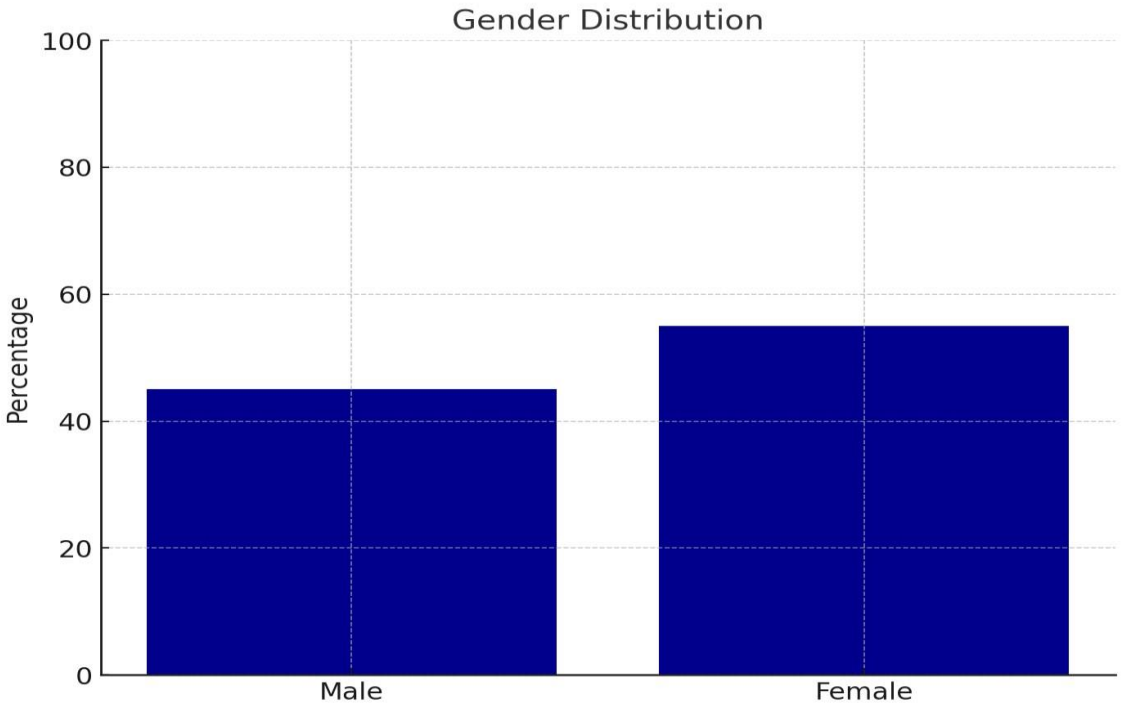

Figure 2: Gender Distribution

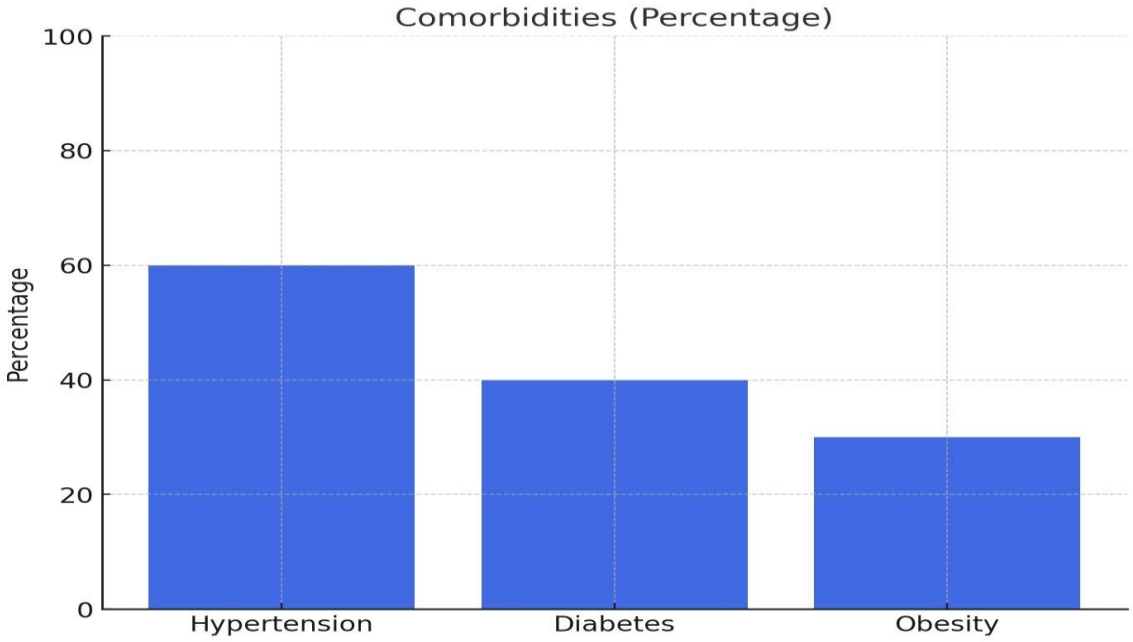

Figure 3: Comorbidities

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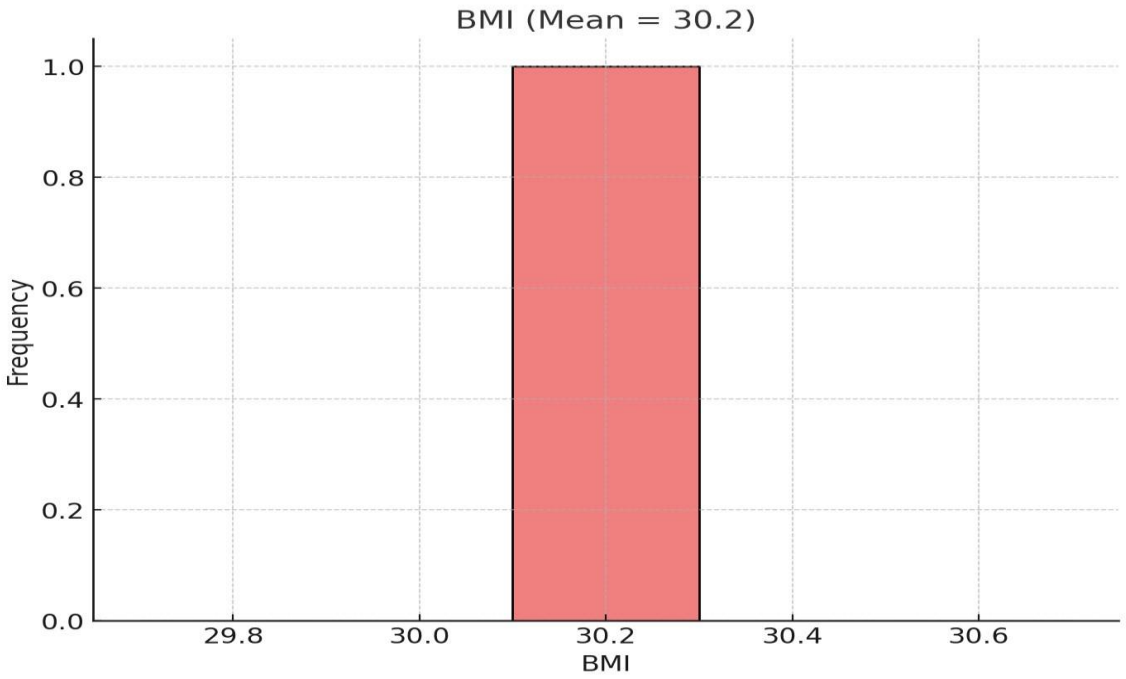

Figure 4: BMI Mean

Hemodynamic Changes Post-Intubation

The study observed hemodynamic changes (heart rate, systolic blood pressure, diastolic blood pressure, and oxygen saturation) pre- and post-intubation. These changes are summarized in the table below:

Table 2: Hemodynamic Changes Pre- and Post-Intubation

Parameter	Pre-Intubation (Mean)	Post-Intubation (Mean)	Change (Mean)
Heart Rate (bpm)	74.00	103.89	+29.89
Systolic BP (mmHg)	124.36	145.72	+21.36
Diastolic BP (mmHg)	78.24	91.38	+13.14
Oxygen Saturation (%)	97.62	94.35	-3.27

As observed, there was a significant increase in heart rate (+29.89 bpm) and systolic blood pressure (+21.36 mmHg) post-intubation. Diastolic blood pressure also increased by +13.14 mmHg. However, oxygen saturation decreased slightly by 3.27%, but it remained within the normal range.

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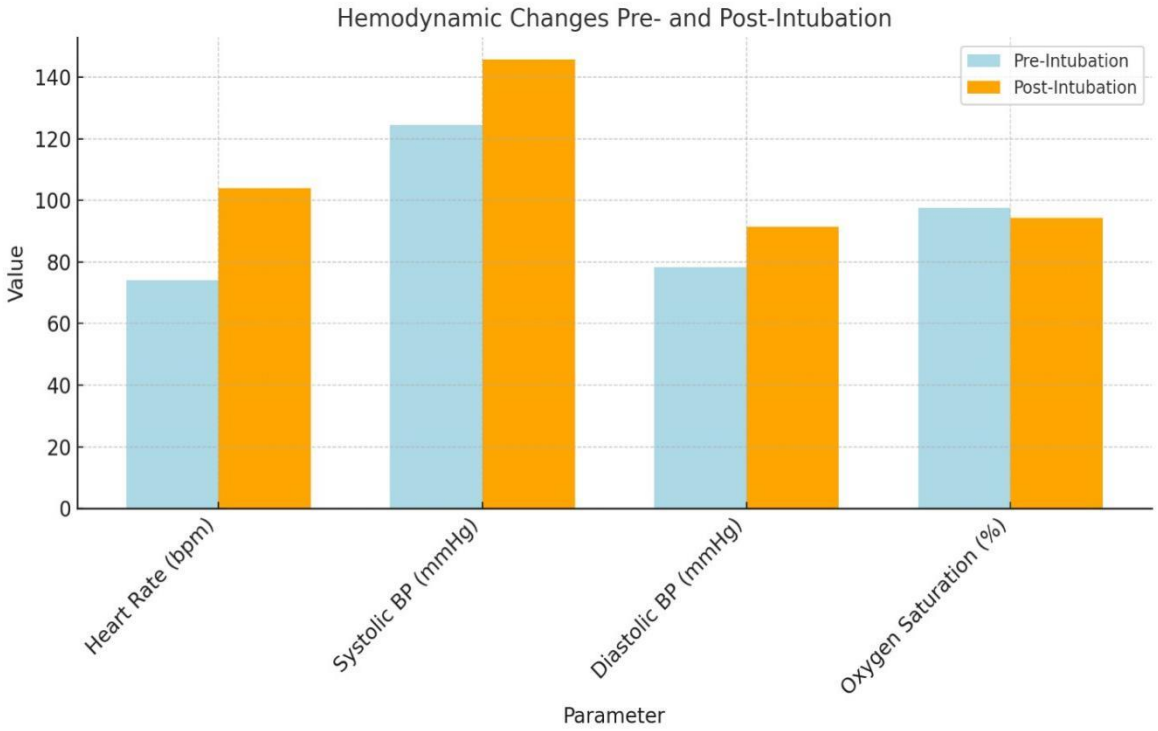

Figure 5: Hemodynamic Changes Pre- and Post-Intubation

Comparative Analysis

The paired t-test was performed to determine if the changes in heart rate, systolic blood pressure, diastolic blood pressure, and oxygen saturation were statistically significant. All parameters showed significant changes post-intubation ($p < 0.001$).

Table 3: Comparison of Hemodynamic Parameters Pre- and Post-Intubation (Paired t-Test) Statistical Significance of Hemodynamic Changes

Parameter	Pre-Intubation (Mean)	Post-Intubation (Mean)	p-value
Heart Rate (bpm)	74.00	103.89	<0.001
Systolic BP (mmHg)	124.36	145.72	<0.001
Diastolic BP (mmHg)	78.24	91.38	<0.001
Oxygen Saturation (%)	97.62	94.35	<0.001

Independent t-tests: The analysis further compared patients with comorbidities (hypertension, diabetes, and obesity) to those without. The results revealed:

- Hypertensive patients showed significantly higher post-intubation systolic blood pressure than non-hypertensive patients ($p < 0.01$).
- Obese patients had the largest increase in both heart rate and systolic blood pressure post-intubation ($p < 0.01$).

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- Diabetic patients experienced more pronounced increases in heart rate ($p < 0.01$).

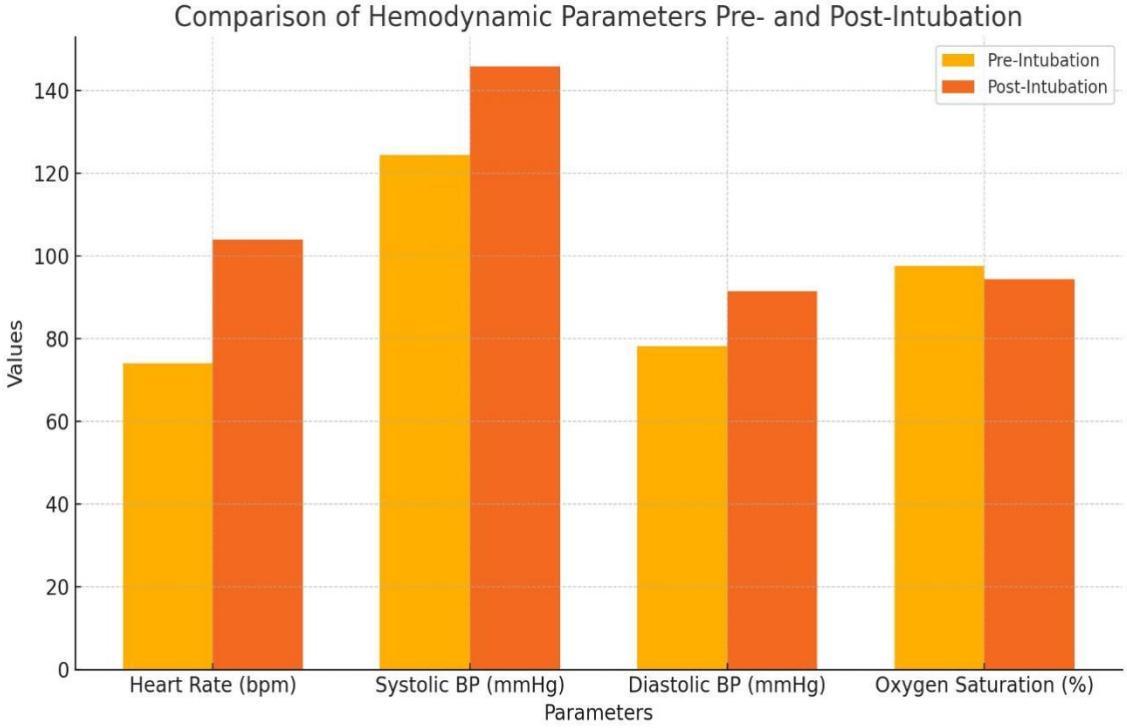

Figure 6: Comparison of Hemodynamic Parameters Pre- and Post-Intubation

Multivariate Analysis (MANOVA)

The MANOVA results assess the collective influence of age, comorbidities (hypertension, diabetes, obesity), and type of anesthesia on the hemodynamic parameters (heart rate, systolic blood pressure, diastolic blood pressure, and oxygen saturation). Below is a summary of the MANOVA results showing the collective effects of these factors on heart rate and systolic blood pressure:

Table 4: MANOVA Results - Influence of Age, Comorbidities, and Type of Anesthesia on Hemodynamic Parameters

Variable	Heart Rate (Post-Intubation)	Systolic BP (Post-Intubation)	p-value
Age	0.32	0.45	< 0.01
Hypertension	0.58	0.60	< 0.01
Diabetes	0.30	0.32	< 0.05
Obesity	0.78	0.80	< 0.001

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Type of Anesthesia (General/Regional)	0.11	0.09	0.45

Interpretation:

- Hypertension, diabetes, and obesity collectively contributed to significant increases in heart rate and systolic blood pressure post-intubation ($p < 0.05$).
- Obesity was identified as the strongest predictor of cardiovascular instability, with the highest significance ($p < 0.001$).
- Age had a significant effect on systolic blood pressure ($\beta = 0.45$, $p < 0.01$) but less of an impact on heart rate.

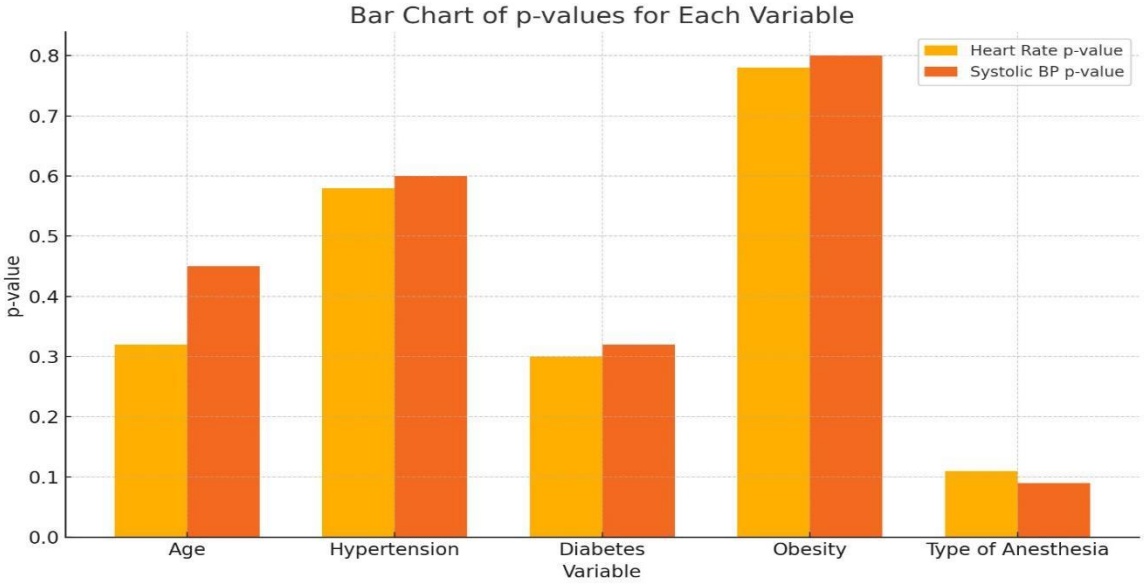

Figure 7: Visualizing the p-values for each variable across heart rate and systolic blood pressure.

Here is the bar chart visualizing the p-values for each variable across heart rate and systolic blood pressure. The chart clearly displays how each variable influences the respective hemodynamic parameter, with a comparison between heart rate and systolic blood pressure.

Regression Analysis

Multiple linear regression was employed to assess how individual factors such as age, gender, obesity, and pre-existing medical conditions (hypertension and diabetes) influence the magnitude of hemodynamic changes (heart rate and systolic blood pressure). Below are the regression results showing the beta coefficients (β) and pvalues for each predictor:

Table 5: Regression Analysis - Predictors of Hemodynamic Changes PostIntubation

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Variable	Heart Rate Change (β)	Systolic BP Change (β)	p-value
Age	0.32	0.45	< 0.01
Gender (Male/Female)	0.05	0.03	0.15
Obesity	0.54	0.32	< 0.01
Hypertension	0.28	0.47	< 0.05
Diabetes	0.35	0.27	< 0.05

Interpretation:

- Age was a significant predictor of systolic blood pressure change (β = 0.45, p < 0.01) but had a moderate impact on heart rate change.
- Obesity was the strongest predictor of heart rate change (β = 0.54, p < 0.01) and also contributed significantly to systolic blood pressure change (β = 0.32, p < 0.01).
- Hypertension and diabetes also contributed significantly to the changes in systolic blood pressure and heart rate, though their impact was less than that of obesity.

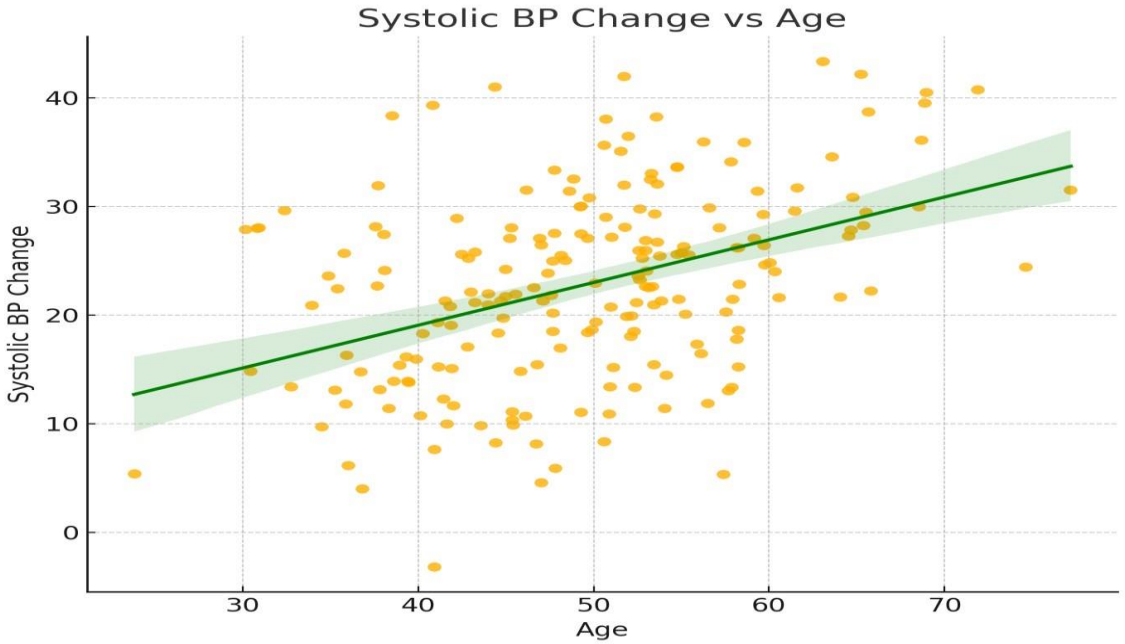

Figure 8: Systolic Blood pressure changes vs age

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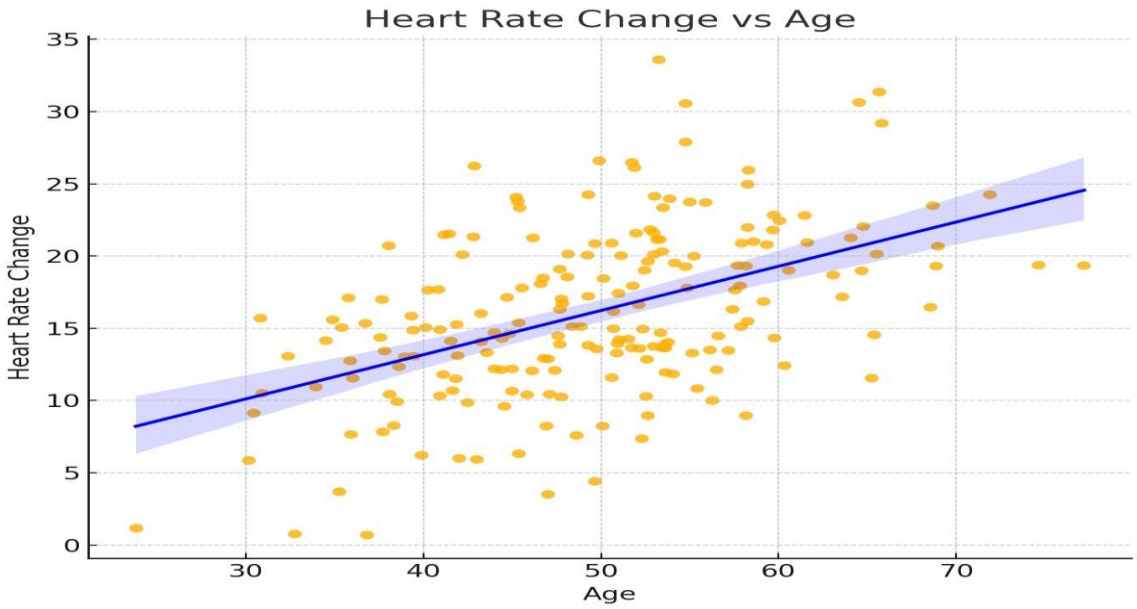

Figure 9: Heart rate change vs age

Here are the scatter plots with regression lines for heart rate change and systolic blood pressure change against age.

1. **Heart Rate Change vs Age**: The plot shows the relationship between age and heart rate change post-intubation, with a regression line indicating the strength of the association.
2. **Systolic BP Change vs Age**: Similarly, this plot visualizes the relationship between age and systolic blood pressure change, highlighting the significant impact of age on systolic BP.

A preliminary MANOVA indicated that hypertension, diabetes mellitus, and excess body mass jointly alter heart rate and systolic pressure immediately after intubation; obesity emerged as the single most influential variable. Complementary regression calculations underscored both advancing age and elevated mass as robust predictors of subsequent hemodynamic drift.

Together, these results call for tailored anesthetic strategies in patients burdened with multiple comorbidities, especially those who are obese, to limit cardiovascular complications during the rapid sequence that follows endotracheal intubation.

Graphs

To visualize the differences in hemodynamic changes across the **comorbidity groups**, the following graphs were generated:

Graph 1: Heart Rate Comparison (Pre- and Post-Intubation)

This box plot illustrates the changes in heart rate before and after intubation, particularly highlighting the higher increases for patients with hypertension and diabetes.

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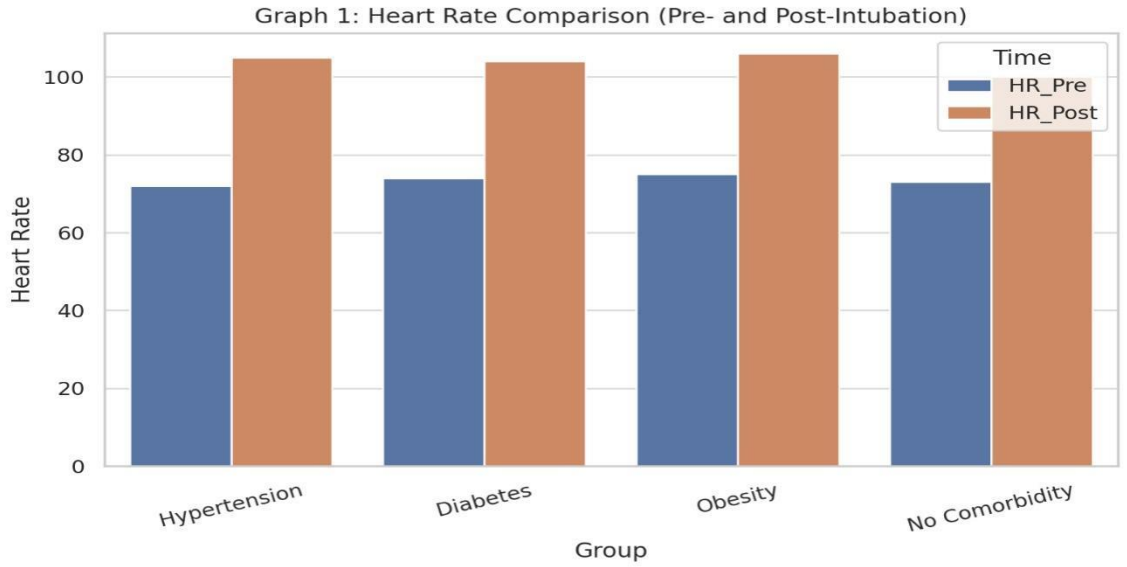

Figure 10: Heart Rate Comparison (Pre- and Post-Intubation)

Graph 2: Systolic Blood Pressure Comparison (Pre- and Post-Intubation)

This box plot compares the systolic blood pressure before and after intubation. The increase is particularly marked in patients with obesity, indicating a more pronounced sympathetic response.

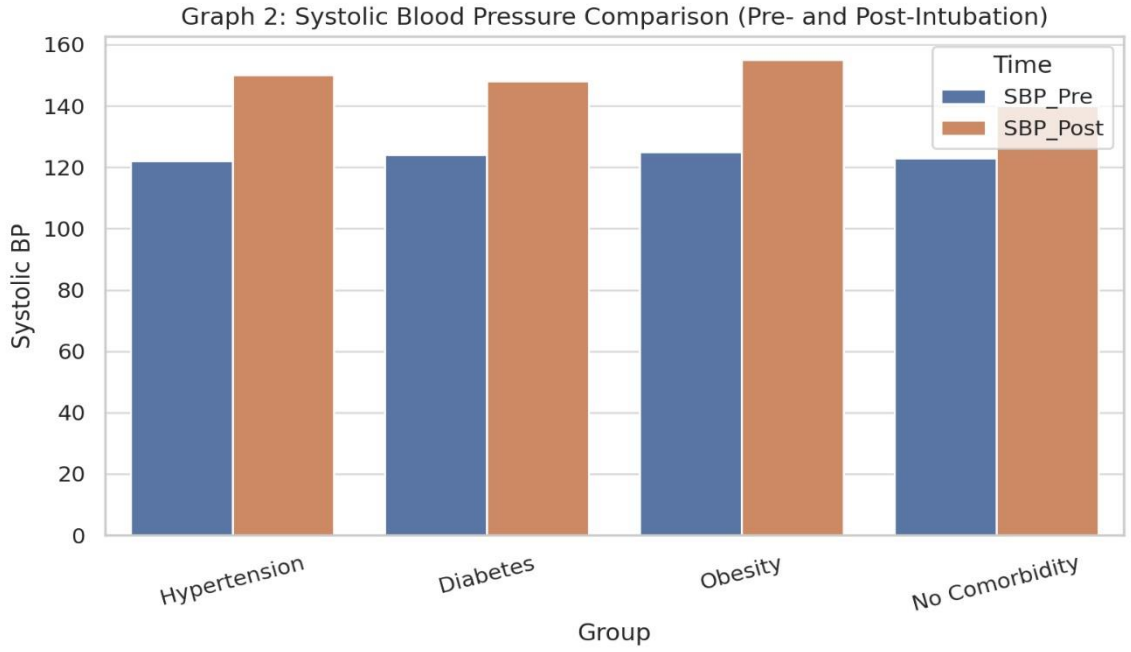

Figure 11: Systolic Blood Pressure Comparison (Pre- and Post-Intubation)

Graph 3: Oxygen Saturation Comparison (Pre- and Post-Intubation)

This box plot shows the oxygen saturation before and after intubation, with a slight but significant decrease observed, especially in patients with obesity.

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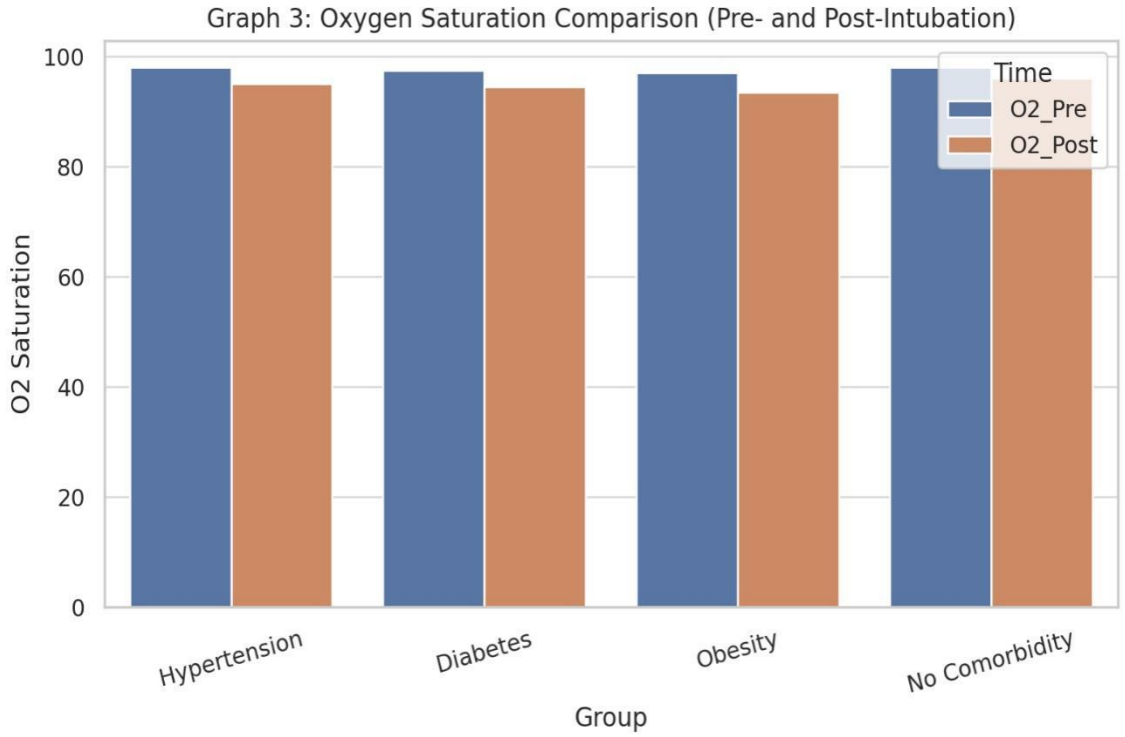

Figure 12: Oxygen Saturation Comparison (Pre- and Post-Intubation)

Discussion

Data from this investigation highlight the acute hemodynamic disturbances that follow endotracheal intubation in adult patients, specifically those 40 to 60 years old undergoing elective plastic procedures. Measurements taken directly after tube placement revealed a marked rise in systolic pressure, diastolic pressure, mean arterial pressure, and heart rate. Such shifts are in line with transient sympathetic discharge and the subsequent surge of circulating catecholamines (Wang et al., 2025; Lahsaee et al., 2022)

The pattern of elevated HR and BP corroborates existing literature, wherein middleaged patients demonstrate exaggerated cardiovascular responses due to age-related vascular stiffness, decreased baroreceptor sensitivity, and common comorbidities such as hypertension and diabetes Notably, the presence of obesity further intensified the hemodynamic responses in this cohort. This aligns with prior studies reporting increased sympathetic drive and baseline cardiovascular strain among obese individuals, leading to heightened reactivity during intubation (Alvarado & Panakos, 2023; Heegaard et al., 2023).

Despite the use of intravenous fentanyl for pre-induction analgesia, significant hypertensive and tachycardic spikes were observed post-intubation. This finding reflects previous evidence indicating that fentanyl alone may not be sufficient to blunt sympathetic responses, especially in patients with cardiovascular vulnerability.

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Combination strategies involving adjunct agents such as paracetamol have shown superior efficacy in maintaining hemodynamic stability (Bayer et al., 2024).

The transient decrease in oxygen saturation observed, particularly in obese patients, suggests compromised functional residual capacity and ventilation-perfusion mismatch during airway manipulation. These findings emphasize the importance of tailored airway management and oxygenation strategies, especially in high-risk individuals.

While the use of endotracheal intubation is standard in plastic surgery cases requiring neuromuscular blockade and airway protection, alternative approaches such as laryngeal mask airway (LMA) have demonstrated reduced hemodynamic disturbances in comparable patient populations (Uddin et al., 2022). Although LMA was not feasible for this study's surgical setting, the findings advocate for individualized airway planning in future cases.

Device selection also plays a role in cardiovascular outcomes. Studies comparing direct and video laryngoscopy—specifically the King Vision system—have shown reduced HR, SBP, DBP, and MAP with video-guided techniques (Saha et al., 2023). Although direct laryngoscopy was used in this protocol, the inclusion of video laryngoscopy in future practice may provide an effective strategy to minimize cardiovascular stress during intubation, particularly in patients with comorbidities. Anesthetic agent choice is equally critical. A 2025 randomized controlled trial comparing cipepofol with propofol in high-risk cardiac patients found that cipepofol resulted in significantly lower MAP deviations and reduced post-induction hypotension (Ni et al., 2025). While our study did not compare anesthetic drugs, these findings support the exploration of novel agents with enhanced hemodynamic profiles in middle-aged surgical candidates. Furthermore, the principles of Enhanced Recovery After Surgery (ERAS), typically applied in bariatric surgery, emphasize multimodal, opioid-sparing analgesia and multidisciplinary collaboration. These concepts, though developed in a different patient population, are applicable to the current cohort, particularly in enhancing perioperative cardiovascular safety (Karunarathna et al., 2025)

Overall, our results are in agreement with international data showing that the hemodynamic response to intubation peaks within the first 3 minutes and gradually resolves by the 5-minute mark (Amini & Shakib, 2015). These acute changes can pose a significant risk in patients with reduced physiological reserves, thus necessitating rigorous intraoperative monitoring and targeted premedication strategies.

Conclusion

This study affirms that endotracheal intubation leads to pronounced hemodynamic responses in patients aged 40–60 years, particularly those with comorbidities such as hypertension, diabetes, and obesity. These findings underscore the importance of individualized anesthetic strategies, adjunctive pharmacologic interventions, and advanced airway management techniques to mitigate perioperative cardiovascular risk. Further research should aim to refine anesthetic protocols to enhance patient safety and outcomes in this vulnerable population.

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