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Frequency And Riskfactors Of Intraoperative Hypertension In Adult Population Under General Anesthesia At Govt: Naseerullah Khan Babar Memorial Hospital Peshawar

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Abstract

Background- Intraoperative hypertension is a common problem during intraoperative field under GA. Elevated Blood Pressure leads to major cardiovascular complications and end organ damage. The Incidence of Intraoperative Hypertension is 20% to 40% varies on type of surgery, history of hypertension, age, obesity and different other factors. This study aims to find frequency and risk factors of Intraoperative Hypertension, So that the perioperative management of Hypertension can be improved.

Objectives-

a) To find frequency of intraoperative hypertension.

b) To identify risk factors that contribute to intraoperative hypertension.

Method- Study design for this study was descriptive cross sectional study. A special questionnaire was used to conduct data from patients. Time period for the study was from August 2024 to November 2024.Throughout the given time period we collected the data of 384 patients undergoing surgery under general anesthesia.

Introduction

Intraoperative hypertension (IOH) is a problematic intra operative complication described by an acute elevation of blood pressure (BP) during surgery under GA. Hypertension is defined as systolic blood pressure (SBP) more than 140 mmHg or a mean arterial pressure (MAP) more than 105 mmHg, IOH has important clinical implications for the safety of the and surgical outcomes. The prevalence of IOH depends on a number of factors, and is reported to range between 5% and 51% during different type of surgeries, these factors are patient characteristics, co-existing diseases, and the type of surgical procedure [**Error! Reference source not found.**]. As a result negative surgical outcomes, for instance myocardial ischemia, stroke, and increased perioperative morbidity and other complications may arise, understanding the frequency and risk factors of IOH is important to counter these complications.

Classification of hypertension

Hypertension is classified as follows [**Error! Reference source not found.**]:

Normotensive: Systolic blood pressure less than 140mmHg and diastolic blood pressure less than 90mmHg.

Stage 1 hypertension: Systolic blood pressure less than 160mmHg and diastolic blood pressure less than 90mmHg.

Stage 2 hypertension: Systolic blood pressure less than 180mmHg and diastolic blood pressure less than 90mmHg.

Severe hypertension: Systolic blood pressure more than 180mmHg and diastolic blood pressure more than 110mmHg.

Background and Significance

During intra operative surgical field patient is prone to variance in different physiologic systems of the body causing hemodynamic instability. Factors for example surgical stress, anesthetic agents, and co-existing diseases play major role in creating a dynamic body environment where BP alters are common [**Error! Reference source not found.**]. Additionally, Intra operative hypertension may develop challenges because of its rapid onset and its potential for rapid but persistent consequences.

Intraoperative hypertension may not be recognized timely, bacause it may be transient or underrated by other perioperative priorities. But, its clinical significance cannot be underestimated. Intra operative hypertension during surgery may worsen myocardial oxygen demand, reduces coronary perfusion, and increases ICP that may result in intracranial bleeding in neurosurgical procedures [**Error! Reference source not found.**]. Moreover, Intraoperative hypertension may also lead to development of a number of postoperative complications, as a result more hospital stays and increased healthcare costs are there [**Error! Reference source not found.**].

Epidemiology and Prevalence

As there are different definitions of hypertension so the frequency of IOH varies across studies, It is also depended on measurement techniques. According to a meta-analysis there is higher prevalence of intra operative hypertension in patients undergoing cardiovascular and neurosurgical in comparison to those undergoing minor surgeries [**Error! Reference source not found.**]. In addition, demographic characteristics for example age, sex, and race helps in differences in prevalence of intra operative hypertension, and there is disproportionality in older adults than

younger ones, and males than females. Regardless of advancements in anesthetic techniques and monitoring, the stress of IOH remains significant, pointing out the requirement for continued research in this area [**Error! Reference source not found.**].

Pathophysiology

A number of pathophysiological factors influence intraoperative hypertension ranging from Patient related factors to surgical factors and anesthetic techniques and agents used. Main contributors, that leads to development of intra operative hypertension includes:

Sympathetic Activation: Surgical stimulation, especially during intubation, incision, and manipulation of visceral organs, can stimulate sympathetic nervous system, leading to acute elevations in BP [**Error! Reference source not found.**].

Vascular Reactivity: Patients with history of hypertension most of the time produce heightened vascular sensitivity to catecholamines, increasing development of intra operative hypertension [**Error! Reference source not found.**].

Pharmacologic Factors: Anesthetic agents are used in different dosages depending on patient condition. Inhalational anesthetic agent have blood pressure lowering effects while some intravenous agents increases blood pressure. In addition, insufficient depth of anesthesia or the use of vasopressors can help in development of intraoperative hypertension [**Error! Reference source not found.**].

Coexisting diseases: Patients with history of hypertension, obesity, and diabetes mellitus are susceptible to hemodynamic alterations, that may also increase the likelihood of development of intraoperative hypertension [**Error! Reference source not found.**].

Risk Factors

Timely understanding of risk factors for development of intra operative hypertension is needed for risk categorization and required interventions. These factors include patient-related, surgery-related, and anesthesia-related variables:

Risk Factors related to Patients:

History of Hypertension: History of hypertension is on of the most significant predictor of development of intraoperative hypertension, patients with poorly controlled hypertension are vulnerable to development of intraoperative hypertension [**Error! Reference source not found.**].

Obesity: In obese patients there is increased sympathetic tone. Moreover, the pharmacokinetics of anesthetic agents in these patients are also altered because of altered metabolic rates [**Error! Reference source not found.**]

Elderly Population: Patients in their advanced age are presented with vascular changes, for example reduced arterial compliance, make older patients to face BP instability [**Error! Reference source not found.**].

Pre-existing disease: Patients who are presented with diseases like diabetes mellitus, chronic kidney disease, and obstructive sleep apnea faces greater number of perioperative BP alterations [**Error! Reference source not found.**].

Risk Factors related to Surgery:

Type of Surgery: Patients undergoing cardiovascular, neurosurgical, and laparoscopic procedures are vulnerable to develop higher rates of intraoperative hypertension [**Error! Reference source not found.**].

Duration of Surgery: Surgeries with prolonged operative durations increase the likelihood of hemodynamic fluctuations, leading to higher rates of intraoperative hypertension [**Error! Reference source not found.**].

Surgical Positioning: Surgical position play vital role in venous return and BP Trendelenburg or prone position might decrease or may increase venous return and BP [**Error! Reference source not found.**].

Risk Factors Related to Anesthesia:
Anesthesia depth: Patients with insufficient anesthesia are more likely to develop hypertension in responses to surgical stimuli [**Error! Reference source not found.**].

Pharmacologic Agents: A number of anesthetic agents are used during general anesthesia, the use of agents like adrenergic agonists, vasopressors, or certain neuromuscular blockers may help in development of intraoperative hypertension [**Error! Reference source not found.**].

Anesthetic Technique: Certain inhalational anesthetic agents have BP lowering impact, while on the other hand intravenous agents for example ketamine increases blood pressure, and this choice between inhalational versus intravenous anesthesia impacts BP dynamics [**Error! Reference source not found.**]

Impacts of Intraoperative Hypertension

Intraoperative hypertension may lead to a number of clinical consequences that extend even after intraoperative period, these consequences may appear immediately during postoperative stay. These adverse effects include:

Cardiovascular Complications: Myocardial tissues consume more oxygen during intra operative hypertension and can lead irregular cardiac rythemes, myocardial infarction, or heart failure in such individuals [**Error! Reference source not found.**].

Neurological Consequences: Development of hypertension is more in patients undergoing neurosurgery, and they are specifically more susceptible to develop hypertensive crises, that may result in cerebral edema, hemorrhage, or ischemia [**Error! Reference source not found.**].

Renal Impairment: Intra operative hypertension effects renal perfusion causing renal hypo perfusion, as a result contributing to acute kidney injury in vulnerable patients[**Error! Reference source not found.**].

Increased Mortality: Intraoperative hypertension can also lead to higher perioperative mortality rates depending on severity and sustainability(duration) of intraoperative hypertension [**Error! Reference source not found.**]

Current Gaps in Knowledge

Regardless of its clinical significance, several gaps remain in the understanding of Intraoperative. Key areas that require further investigation include:

More Standardized Definitions: Variance in the cutoffs used to define intraoperative hypertension complicates comparisons across studies and restricts the applicability of results [**Error! Reference source not found.**].

Forecasting Models: Strong forecasting tools including patient characteristics, type of surgery, and anesthetic components are needed to timely recognize identify vulnerable individuals [**Error! Reference source not found.**].

Extended consequences: Intraoperative hypertension has impact cardiovascular and renal health for long term and is poorly understood [**Error! Reference source not found.**].

Ideal Approaches: Evidence-based guidelines to prevent and to treat of intraoperative hypertension are lacking, demanding more research [**Error! Reference source not found.**].

Objectives of the Study

Objectives for this study include following:

To Measure the prevalence of intraoperative hypertension in different surgical population.

To Identify patient, surgical, and anesthetic components that predispose the risk of developing intraoperative hypertension.

In conclusion, intraoperative hypertension under general anesthesia is one of the most significant complication yet requires more exploration. In this study we tried to investigate risk factors for intraoperative hypertension comprehensively, to advance our understanding of intraoperative hypertension, and as a result to improve patient care and outcomes.

LITERATURE REVIEW

Systolic Blood Pressure more than 140mmHg intraoperatively is known as Intraoperative hypertension (IOH) or other elevated values from baseline like diastolic blood pressure intraoperatively. Intraoperative hypertension is one of the most common hemodynamic alterations during the course of the surgery, seen in approximately 5% to 40% in patients undergoing surgeries, depending on factors like procedure type and disease that patient has. IOH results in many complications, these are myocardial ischemia, stroke and more events of surgical bleeding, based on these factors there is need of proper understanding of intraoperative monitoring and management of these complications (Wax et al., 2010 [17]. Prolonged rise in blood pressure during surgery effects heart and vascular system, specifically in high-risk persons, and results in increased number of perioperative morbidity and mortality.

Prevalence of Intraoperative Hypertension

Factors like type of surgical procedure and patient population effect the prevalence of intraoperative hypertension among others. According to Bijker et al. (2009) [1] events of intraoperative blood pressure alterations, including elevated blood pressure, is seen in 5% to 25% of patients having general surgeries. There are more events in other procedures like in procedures that involve major sympathetic stimulation procedures such as cardiac surgeries and neurosurgeries, where the rates are 30% to 40%. As like above results a local and or regional study by Sohail et al. (2019) [18] found 20% to 40% of patients undergoing surgery had intraoperative hypertension in a leading tertiary care hospital in Karachi, which shows that intraoperative hypertension is one of the frequent complications during surgery. Based on these findings, that emphasizes, that alterations in blood pressure during surgery is a major complication in different healthcare settings.

Risk Factors for Intraoperative Hypertension

There are a number of factors that brings events of intraoperative hypertension. Some noticable risk factors are as following:

Patient-Related Factors

Patients having hypertension before surgery are at higher risks of developing intraoperative hypertension, and even if they have controlled blood pressure pre operatively there is still risks of having intraoperative hypertension. Aronson et al. (2006) [15] reported that individuals having history of systemic hypertension are more susceptible of intraoperative hemodynamic alterations, including episodes of elevated blood pressure. In patient related factors age is also a key factor; Domi et al. (2013) [16] found that patients in advanced age showed more vascular stiffness and impaired autonomic regulation, making them susceptible of having altered blood pressure as a result of surgical stress. In addition to these factors another factor is comorbidities for example diabetes mellitus, End stage renal disorders like CKD, and respiratory problems like obstructive sleep apnea (OSA) have impact on endothelial dysfunction and autonomic response of the body, both of which results in poor intraoperative blood pressure control.

Surgical Factors

Frequency of developing intraoperative hypertension depends on the type surgery and invasiveness of that surgery, it plays a crucial role in determining the likelihood of

intraoperative hypertension. Patient undergoing major vascular and neurosurgical surgeries are specifically at high risk, and are reported with incidence rates of 20%–40% due to aggressive sympathetic activation during different surgical stages (Bijker et al., 2009 [1]). Furthermore, insufficient pain management in patients results in catecholamine release, further elevating systemic blood pressure (Sohail et al., 2019 [18]). These findings suggest that the surgical stress response and perioperative nociception are major contributors to IOH.

Anesthetic Factors

The adequacy of anesthetic depth is another important determinant of intraoperative blood pressure stability. Wax et al. (2010) [17] emphasized that inadequate anesthetic depth fails to suppress sympathetic activation due to surgical stress, leading to hypertensive episodes. This shows the importance of continuous depth-of-anesthesia monitoring and proper titration of anesthetic agents to minimize hemodynamic changes. The interplay between anesthetic management, surgical stimulation, and patient comorbidities therefore demands individualized anesthetic planning and proper hemodynamic monitoring to prevent hypertensive surges.

CHAPTER 02
MATERIALS AND METHODS:

Study setting:

This study was conducted in the orthopedic, neurosurgery, general surgery and ENT departments of Govt: Naseerullah Khan Babar Memorial Hospital, Peshawar.

Study population:

The population for this study was Patients with surgeries under general anaesthesia in orthopedic, neurosurgery, general surgery and ENT departments of Govt: Naseerullah Khan Babar Memorial Hospital, Peshawar.

Study Duration:

The total duration of this study was 4 months (August to November 2024).

Study design:

The design of this study was descriptive cross-sectional.

Sample Size:

A total of 384 adult patients under general anesthesia were studied.

Sample size calculation:

Cochrane formula

n= sample size

Z= CI 95%= 1.96

p= Prevalence (P)= 0.5

E= Margin error (E) 5%= 0.05

$$n = \frac{z^2 p(1-p)}{E^2}$$

$$n = (1.96)^2 * 0.5(1 - 0.5)/0.05^2$$

$$n = 384$$

Sampling technique:

Non probability /convenient sampling technique was used for this study.

Sample selection:

Inclusion Criteria:

Participants who were willing, were involved in this study.
Data of ASA class I and II patients.
Data of patients aged 18 years to 45 years patients.
Data of all the patients undergoing elective surgeries under General Anesthesia.
Gender: Both Male and Female.

Exclusion Criteria:

Any sort of refusal by the participants.
ASA class >II patients.
Data of <18 years and >45 years.
Pregnant woman.
Patients undergoing cardiac surgeries.

Data Collection Procedure:

A proposal was presented to Internal Graduate Studies Committee of Ahmad Medical Institute, Peshawar, who approved the proposal and then a letter of approval was received. Approval letter was then presented to the ethical committee of Govt: Naseerullah Khan Babar Memorial hospital, Peshawar with clearly defined aims of the study and an attached questionnaire. The Govt: Naseerullah Khan Babar Memorial hospital, Peshawar gave a written approval letter. After that, data was collected from different operations theaters, The patient involved were fully informed about the aims of the study, informed consent was taken from all participants and from concerned departments. The questionnaire formulated to collect the required details was specified in the hospital record. And the pertinent information is entered into the data collection sheet, including gender, designation and departments concerned. Standard protocol of Govt: Naseerullah khan babar memorial hospital, Peshawar were followed in collecting required data.

Ethical Consideration:

Patient autonomy and informed consent: All participants were fully informed about purpose, risk and benefits of the study and then informed consent was taken from willing participants furnished informed consent, detailing the objectives, methodologies, potential risks, and advantages of the research

Confidentiality and Data Protection: All the identifiable data was removed while collecting data and data were presented in collective form to prevent the identification of individual participants. Participant confidentiality was diligently safeguarded. Confidentiality measures were outlined in the informed consent process.

Justice: All the participants were selected fairly without any bias.

Transparency: The findings are reported accurately with transparency.

Voluntary Participation: No participant was selected without informed consent and involvement in the research was entirely optional.

Privacy: During data collection, analysis, and reporting we took all measures to ensure privacy of participants. All the potential points were encountered to keep the electronic data safe.

Beneficence and Non-Maleficence: The study aimed to contribute valuable insights to the field of anesthesia, with the potential to improve patient care. Precautions were taken to minimize any potential harm to participants, both physically and psychologically.

Approval from Ethics Committee: The research proposal was presented to the ethical committee of Govt: Naseerullah khan babar memorial hospital, Peshawar and approval was granted. This ensured that the study adhered to ethical norms and was

ensured to be aligned with established guidelines.

Data Analysis

Percentages and frequencies were used to determine the various association. Data were presented in the form of graphs, including bar chart, pie chart,and tables. The data were examined utilizing the Statistical Package for Social Sciences [SPSS version 22]

RESULT

In our study we collect data from 384 participants. Who had a surgery under General Anesthesia. The data was collected from 215 males (55.98%) and 169 females (44.01%) in this study. Table [3.1]

We collected data from participants undergoing surgeries in various departments i.e general surgery, orthopedic surgery, Neurosurgery and ENT surgery, shown accordingly in table[3.2] and figure 3.2. As of the departments, there were a total of 384 participants of which 154 participates (40.10%) in general surgery, 70 participants (18.22%) in orthopedic sugery, 39 participants (10.15%) in Neurosurgery ,121 (31.51%) participants in ENT surgery Table [3.2].

In our study we found most of the participants within normal range of BMI. 52 Participants were underweight, 230 were normal, 74 were overweight and 28 were obese Table 3.3 and figure 3.3.

83 Participants were hypertensive preoperatively, out of which 61 were taking antihypertensive medications. 45 patients were presented with hypertension along with other co morbidities for example CVS conditions, Diabetes, Kidney failure and others Table 3.4 and figure 3.4.

Out of 384 participants 23 were hypertensive in their preoperative period and 74 patients faced hypertension in their previous surgeries Table 3.5 and figure 3.5.

In our study 15 patients faced hypertension and 86 didn't of age ranging 18 years to 24 years,37 patients were hypertensive while 111 were normotensive intra operatively of age ranging from 25 to 31 years, 53 patients faced hypertension and 49 patients didn't of age ranging from 32 to 38 years, and patients in advanced age (39 to 45 years old) 13 patients faced intraoperative hypertension and 20 didn't Table 3.6 and figure 3.6.

On the basis of BMI, out of 52 underweight patients 11 were hypertensive, out of 230 normal patients 47 were hypertensive, out of 74 overweight patients 45 were hypertensive and out of 28 obese patients 15 faced intraoperative hypertension Table 3.7 and figure 3.7.

During induction 95 patients faced high blood pressure, While 102 patients faced MAP above 105mmHg. And during incision 79 patients faced hypertension and 83 patients faced MAP above 105mmHg Table 3.8 and figure 3.8.

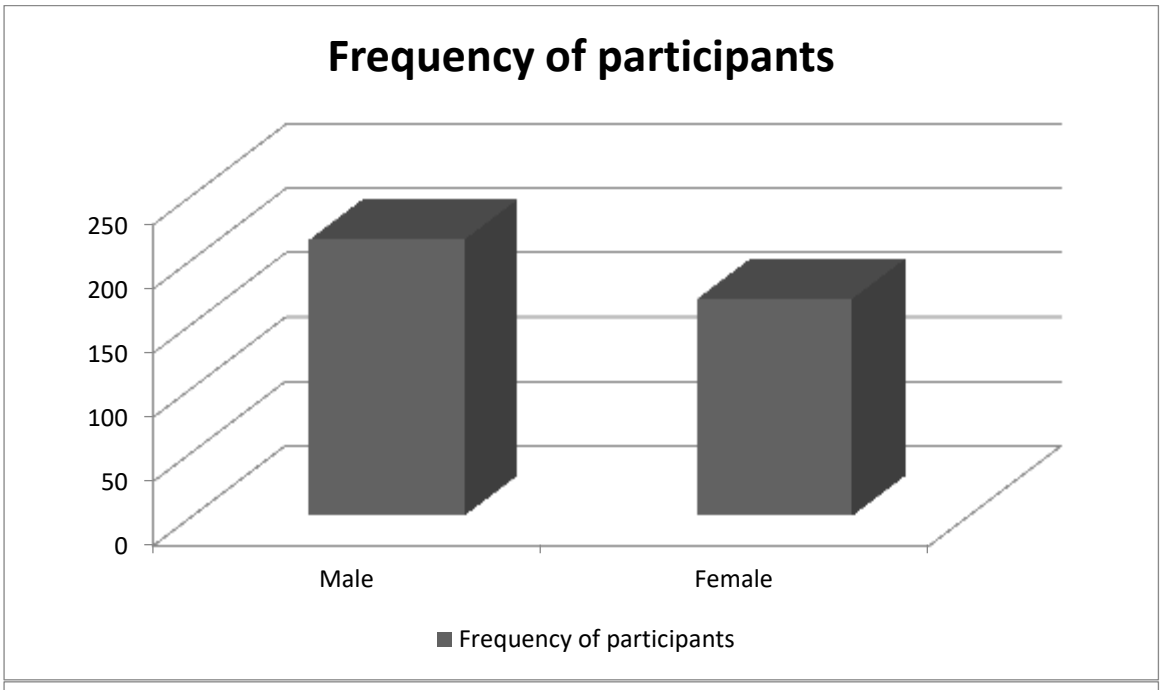
In our study we found that out of 118 hypertensive patients 9 patients faced hypertension due to insufficient depth of anesthesia,69 faced hypertension in response to surgical stimuli,23 were hypertensive due to pain,5 were hypertensive because of fluid overload and 12 patients faced intraoperative hypertension due to use of certain medication Table 3.9 and figure 3.9.

Gender of participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	215	55.9	55.9	55.9
	Female	169	44.01	44.01	100.0

Total	384	100.0	100.0	

Table 3.1: Gender of the participants.



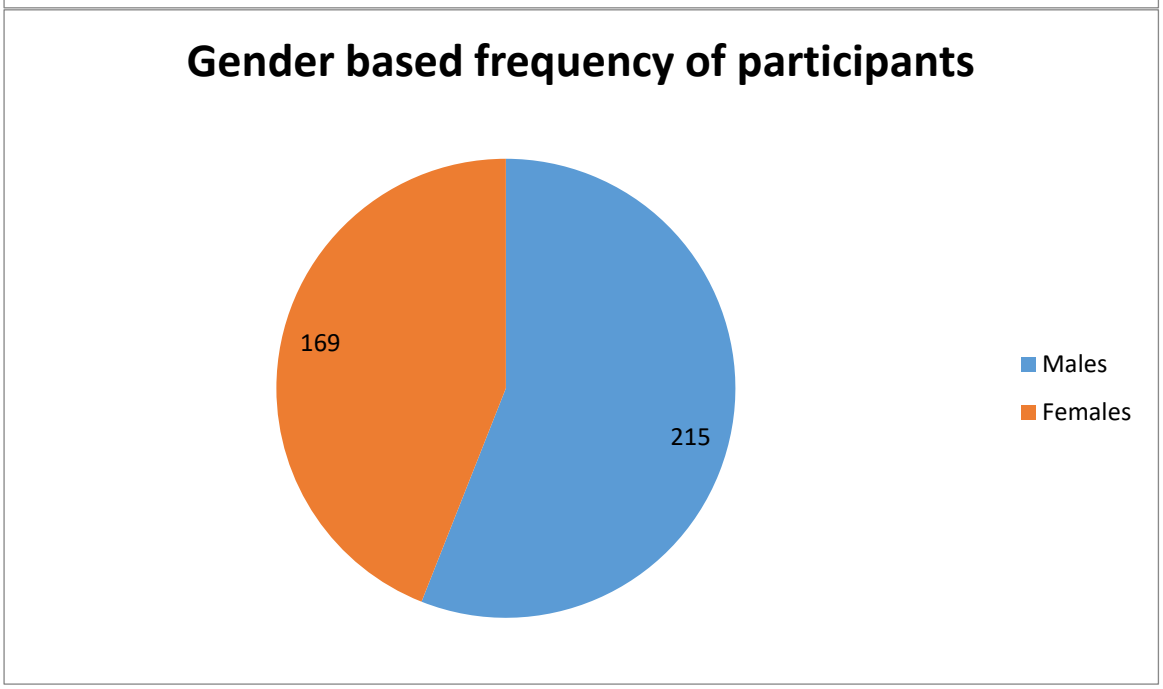


Figure 3.1

Table 3.1 and Figure 3.1 are statistical analysis of frequency of male and female participants of the 384 participants, of which 215 (55.98%) were males and 169 (44.01%) were females, and are shown on both bar chart and pie chart

Departmental Distribution:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	General Surgery	154	40.10	40.10	40.10
	Orthopedic Surgery	70	18.22	18.22	58.32
	Neurosurgery	39	10.15	10.15	68.47
	ENT surgery	121	31.51	31.51	100
	Total	384	100	100	

Table 3.2: Department of the participants.

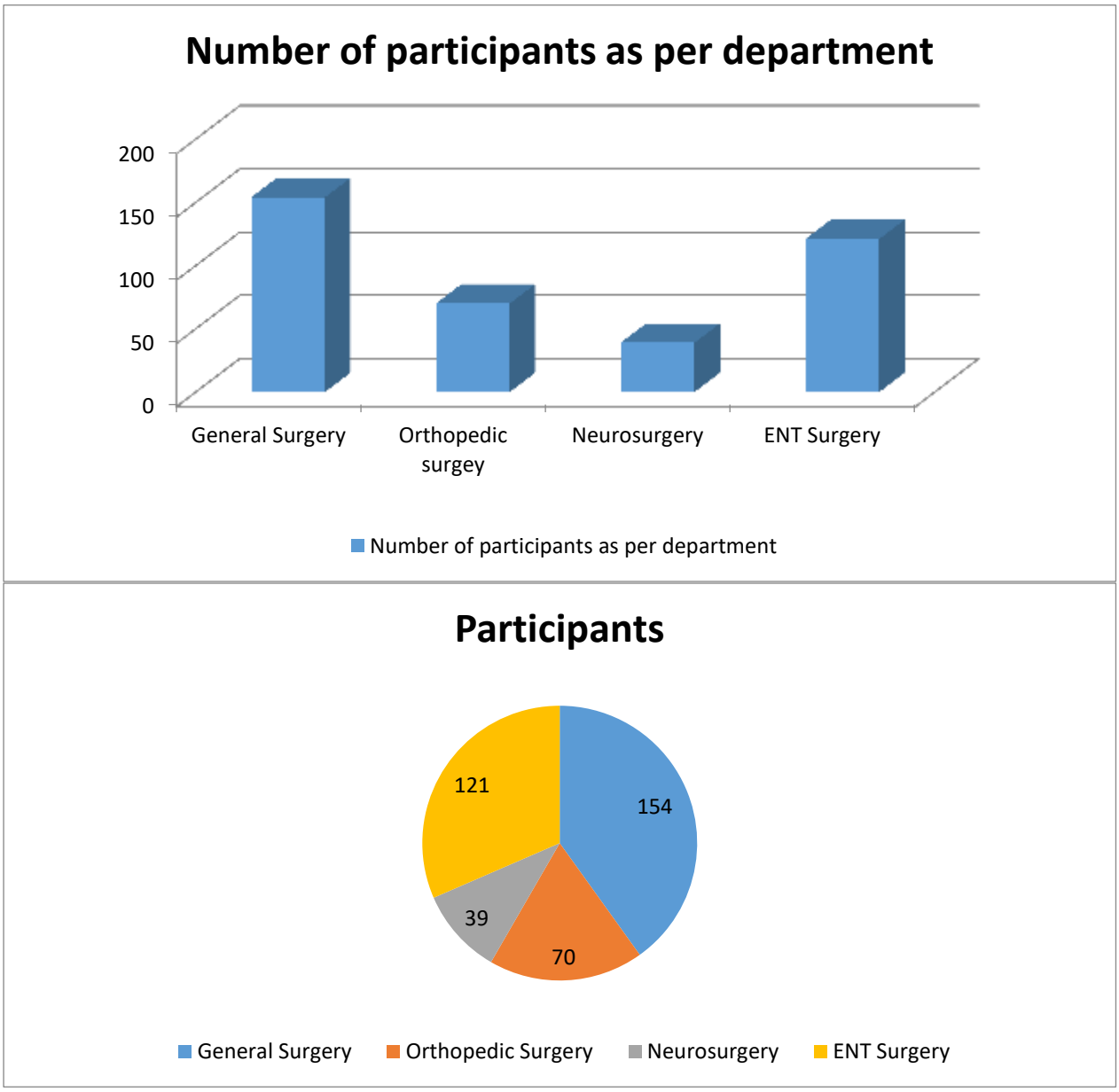


Figure 3.2
Number of participants as per department

BMI Range	Frequency
Underweight	52
Normal	230
Overweight	74
Obese	28

Table 3.3 Frequency of participants according to BMI

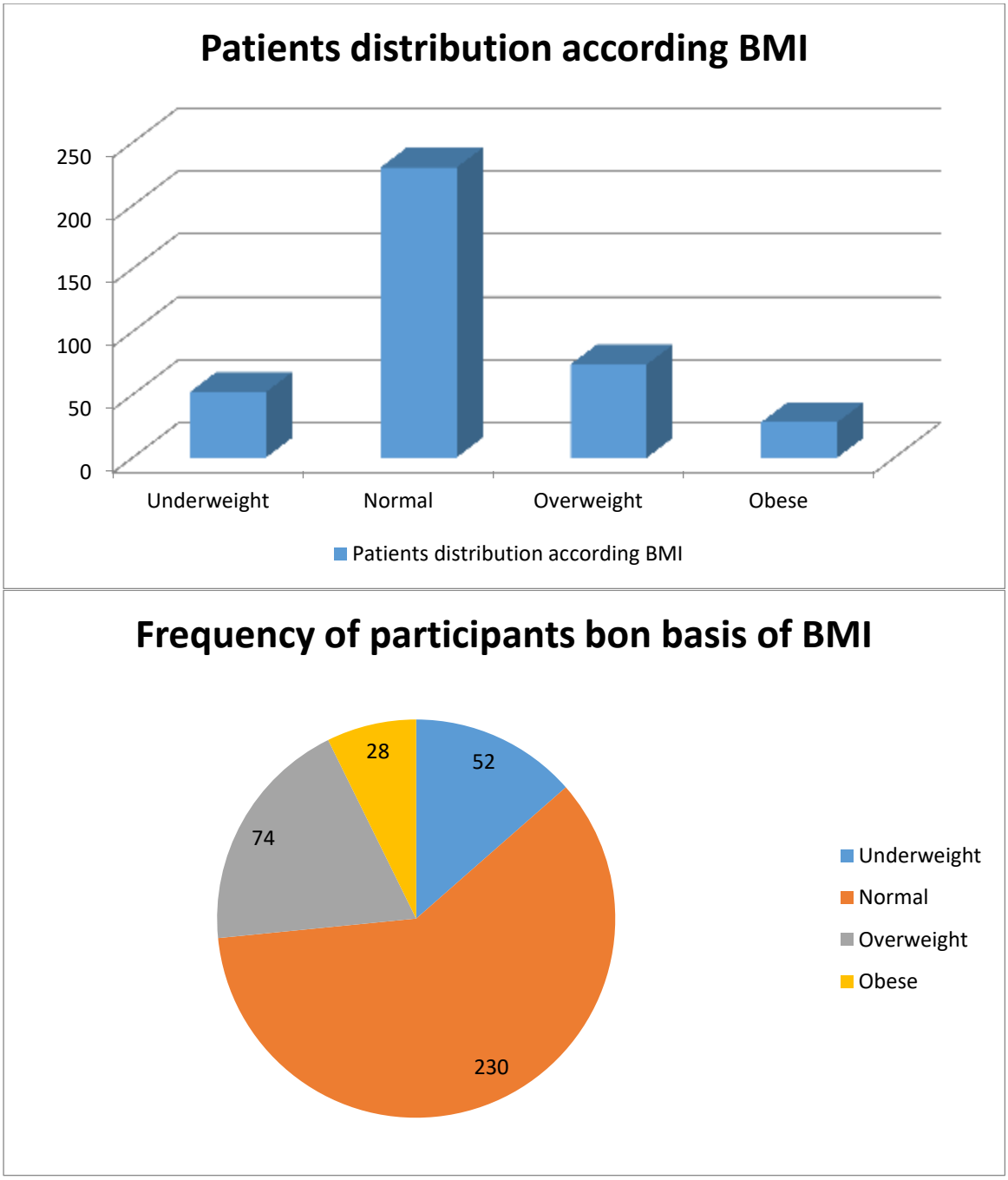
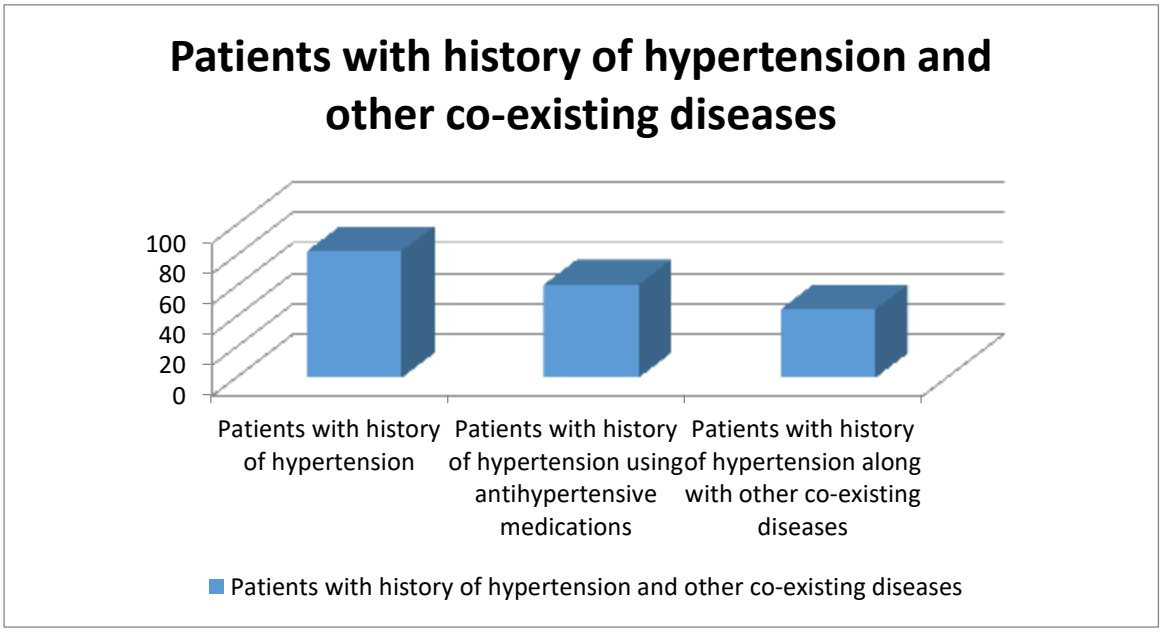


Figure 3.3: Frequency of participants on basis of BMI

History of comorbidities	Frequency
Patients with history of hypertension	**83**
Patients with history of hypertension using antihypertensive medication	**61**
Patients with history of hypertension along with other co-existing diseases	**45**

Table 3.4: Patients presented with history of hypertension and other co-existing diseases



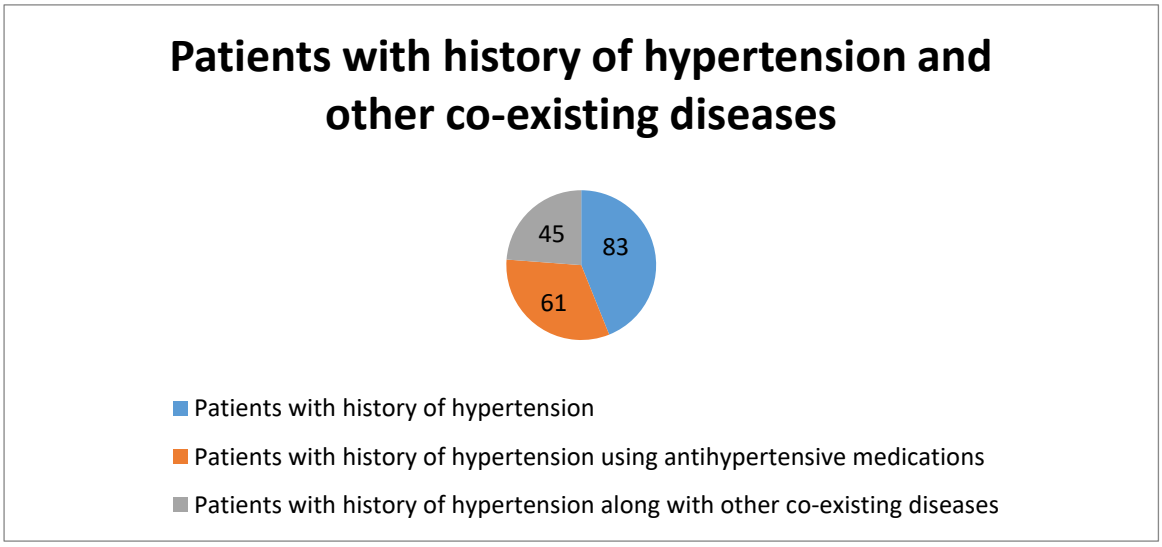
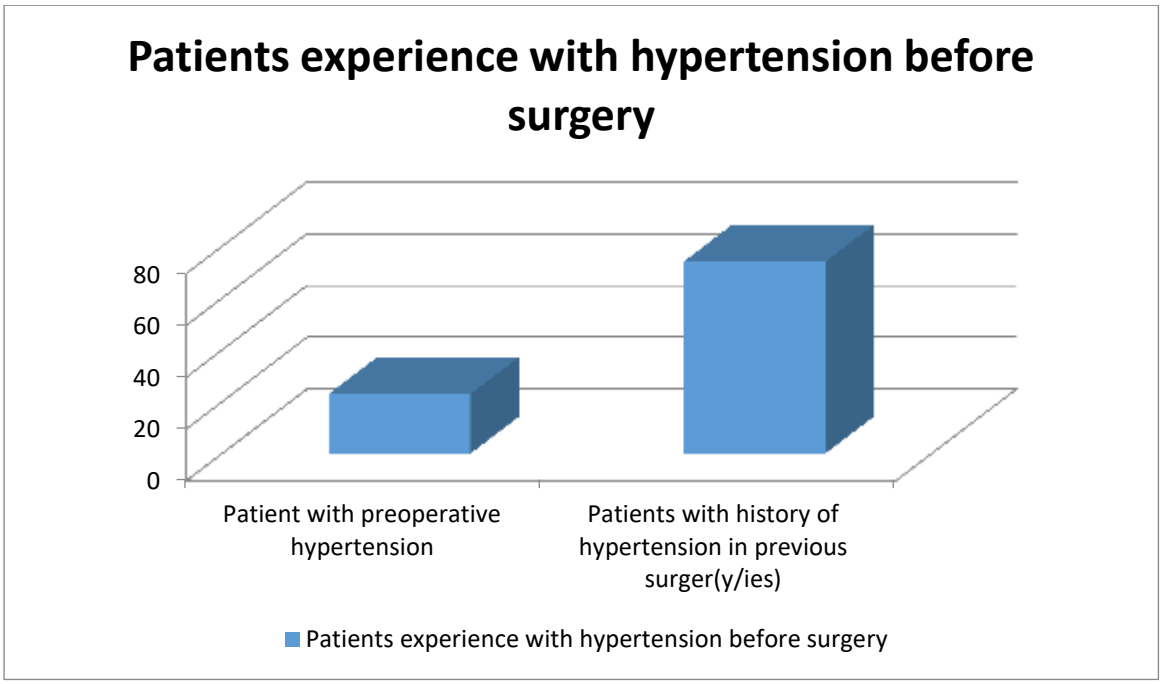


Figure 3.4: Patients with history of hypertension and other co-existing diseases

Patients experience with hypertension before surgery	
Patient with preoperative hypertension	23
Patients with history of hypertension in previous surger(y/ies)	74

Table 3.5: Patients experience with hypertension before surgery



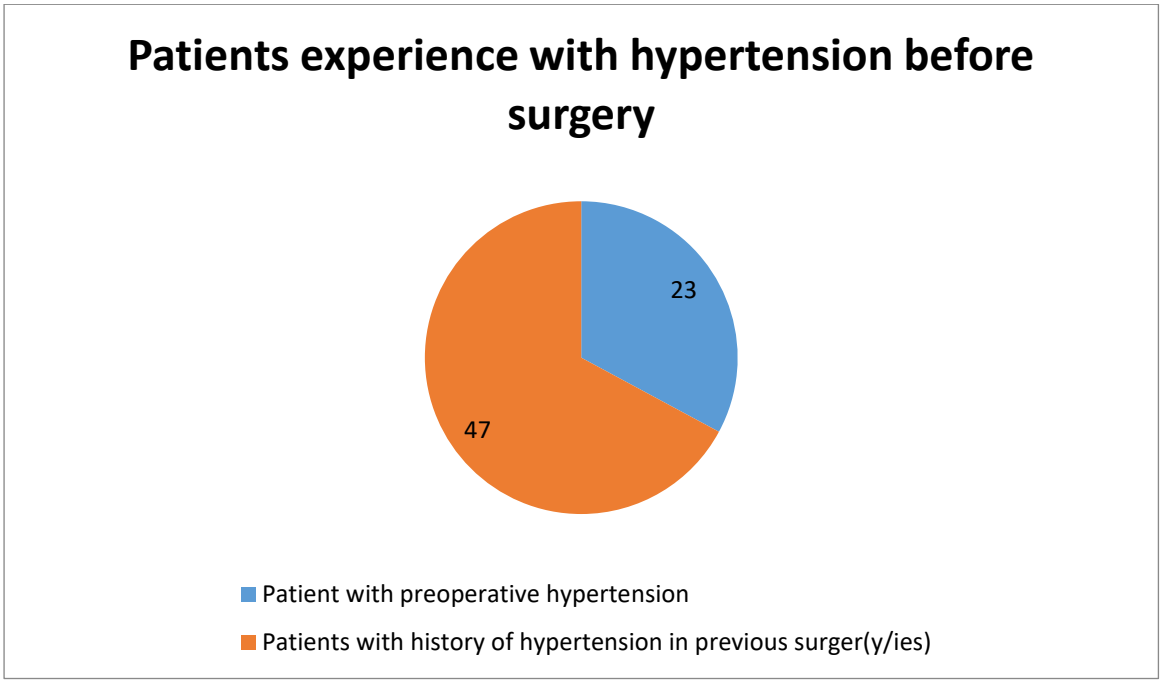
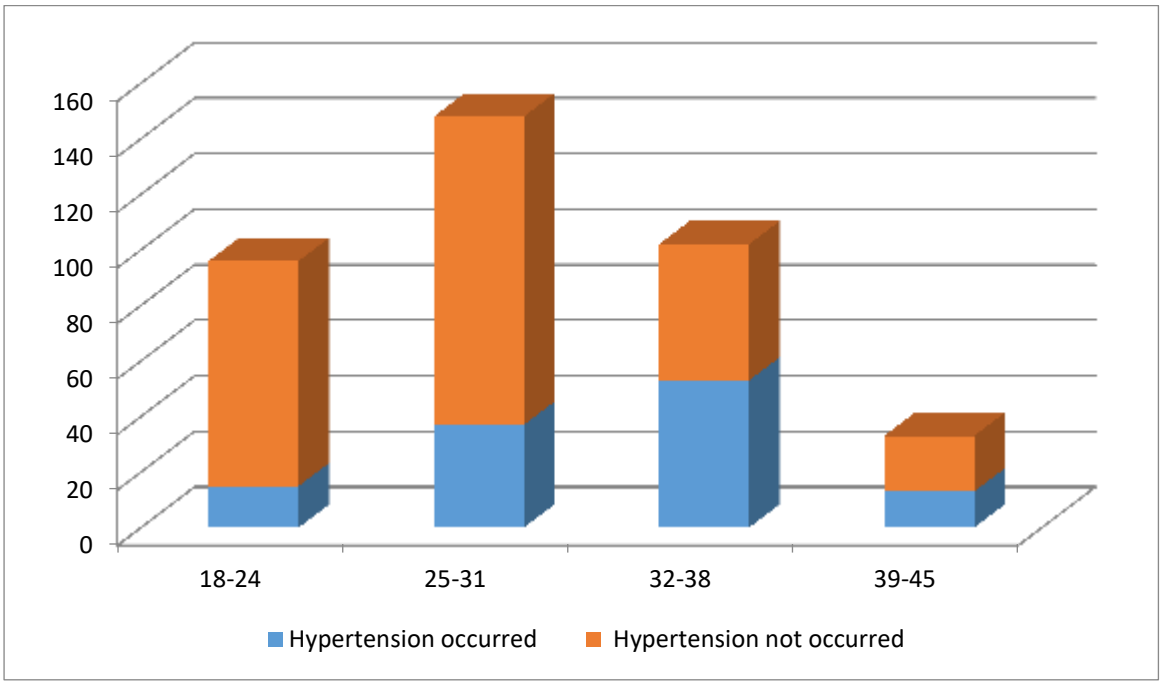


Figure 3.5: Patients experience with hypertension before surgery

Age range	Hypertension occurred	Hypertension not occurred
18-24	15	86
25-31	37	111
32-38	53	49
39-45	13	20

Table 3.6: Occurrence of hypertension in different age groups



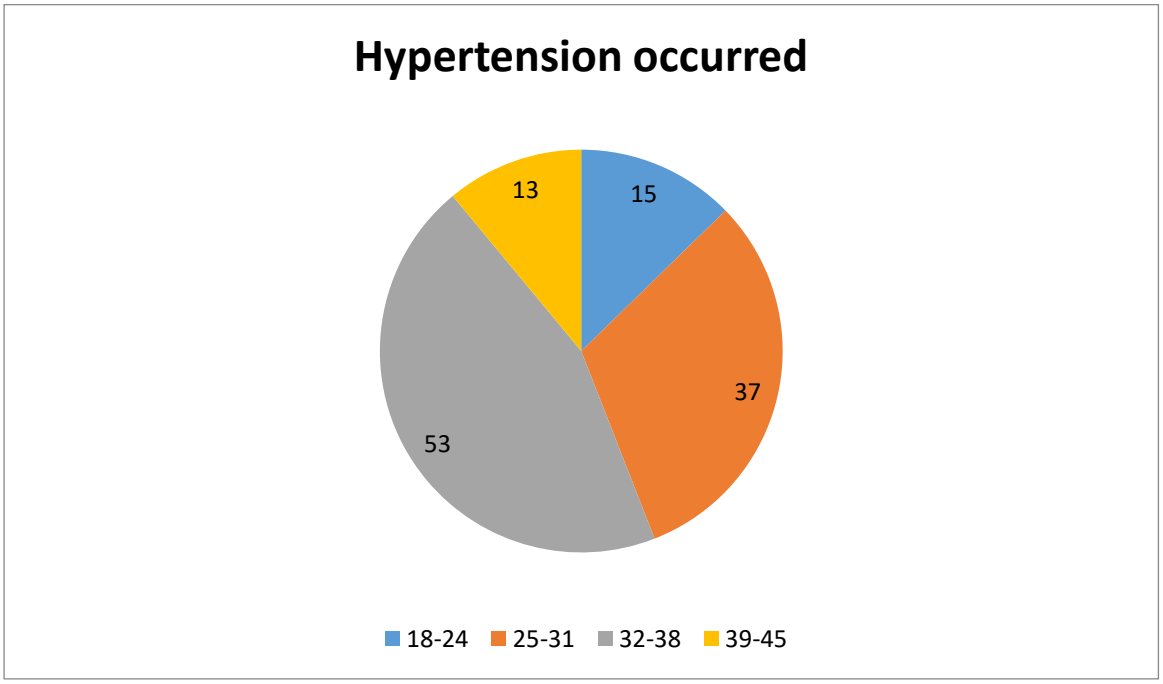
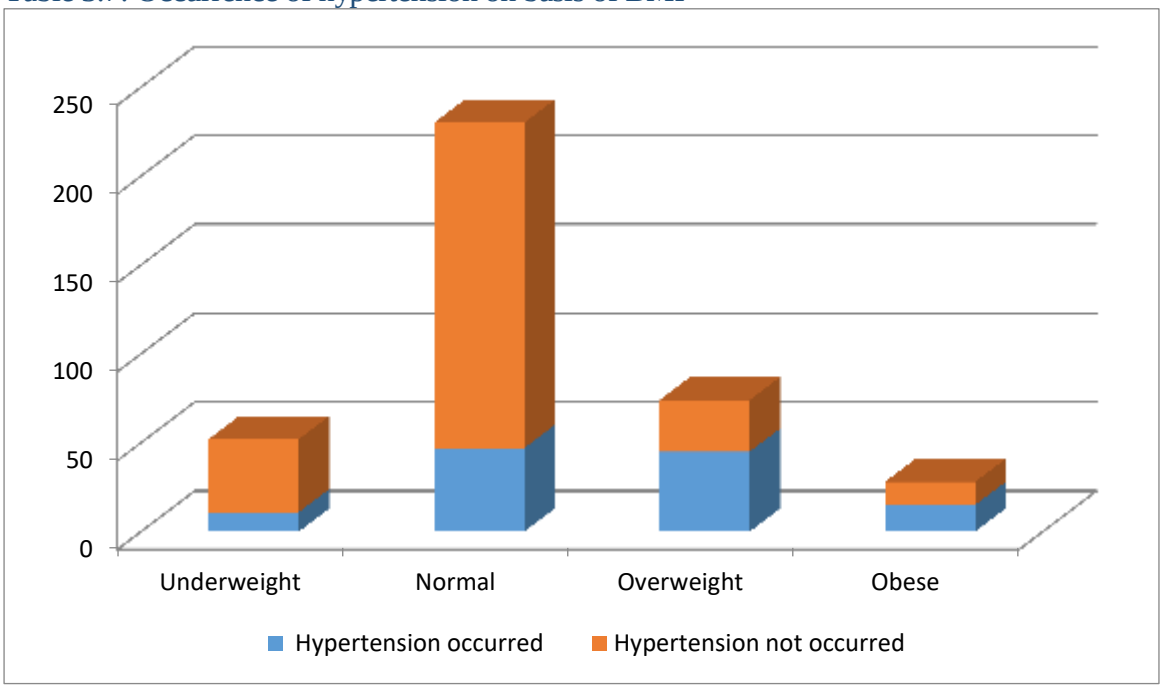


Figure 3.6: Occurrence of hypertension in different age groups

BMI	Hypertension occurred	Hypertension not occurred
Underweight	11	41
Normal	47	183
Overweight	45	29
Obese	15	13

Table 3.7: Occurrence of hypertension on basis of BMI



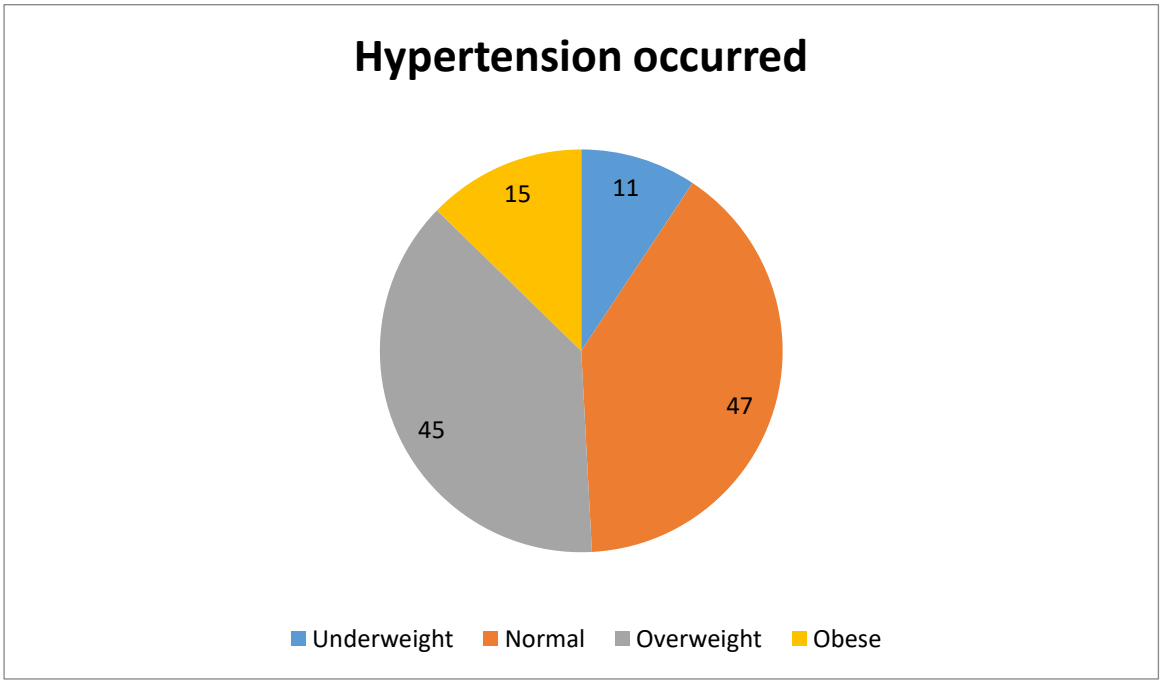


Figure 3.7:Occurrence of hypertension on basis of BMI

	Hypertension occurred	MAP >105mmHg
Induction	95	102
Incision	79	83

Table 3.8:Hypertension at Induction and Incision

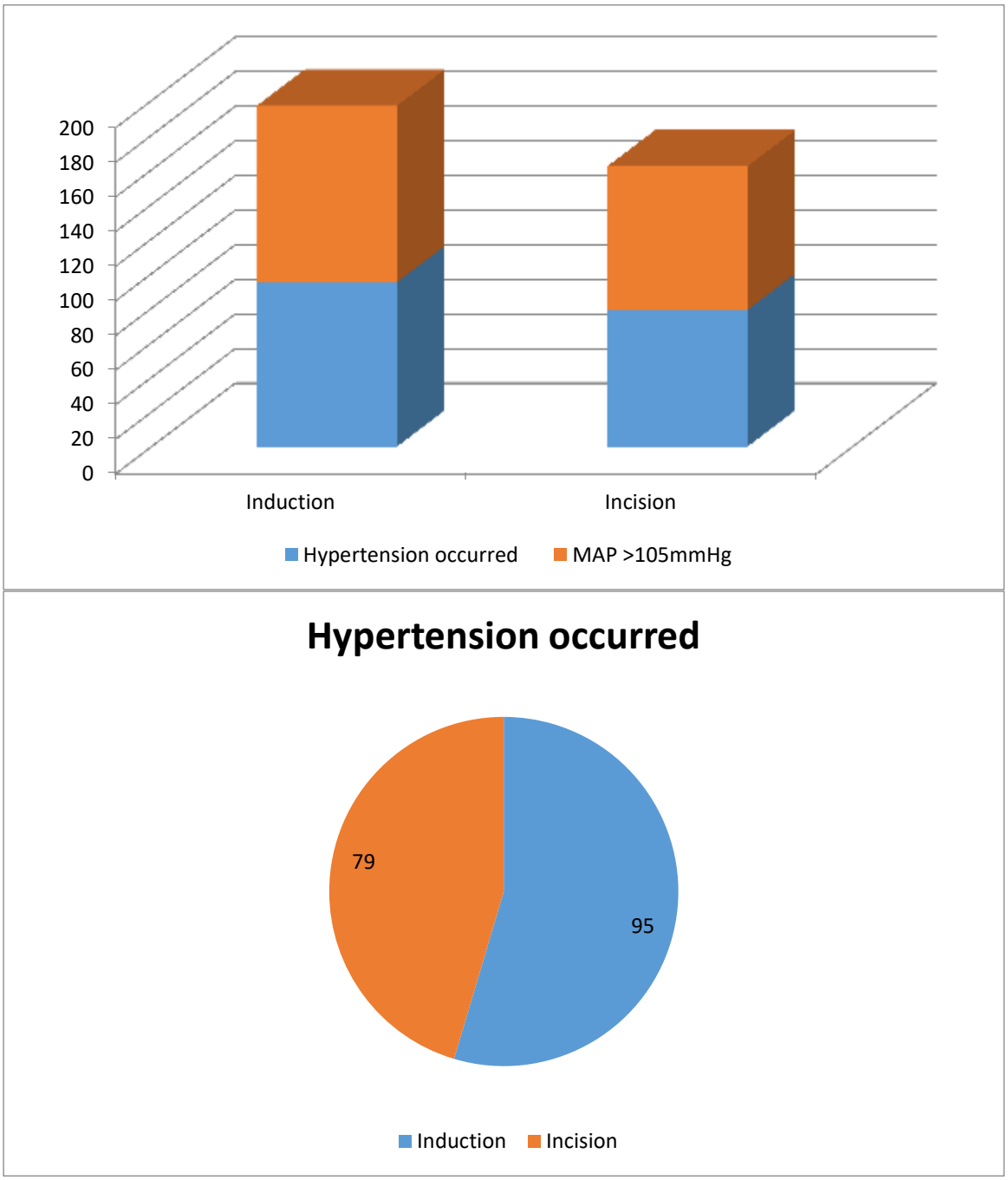
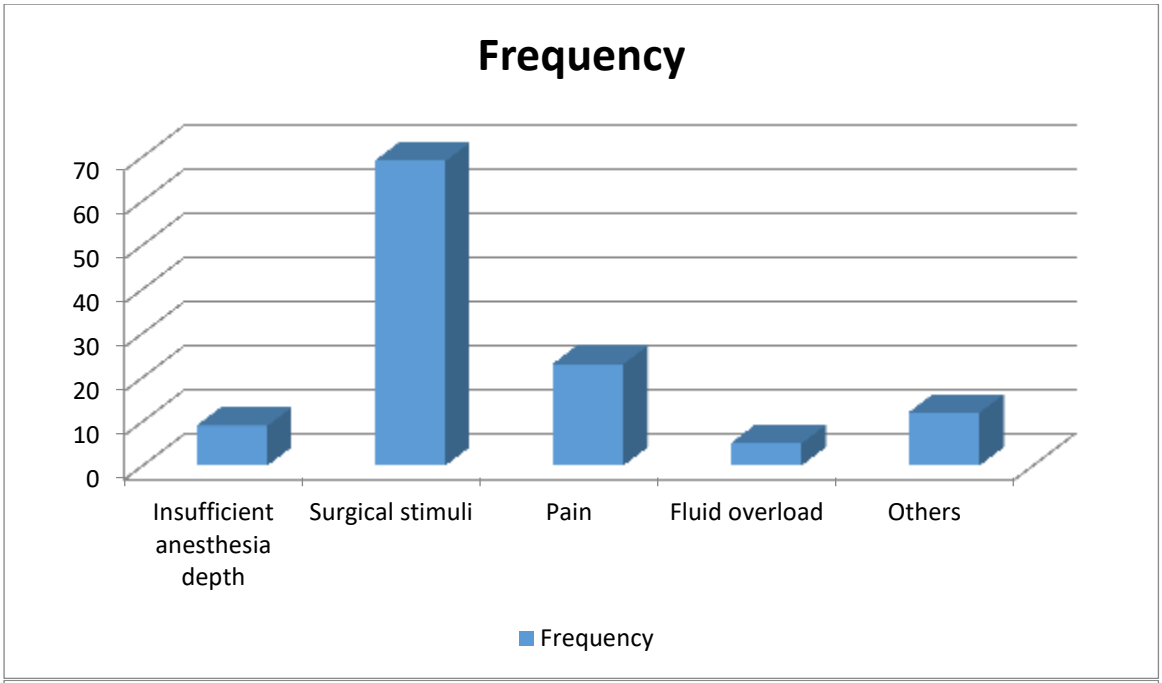


Figure 3.8:Hypertension at Induction and Incision

Cause	Frequency
Insufficient anesthesia depth	9
Surgical stimuli	69
Pain	23
Fluid overload	5
Others	12
Total	118

Table 3.9: Causes of intraoperative hypertension



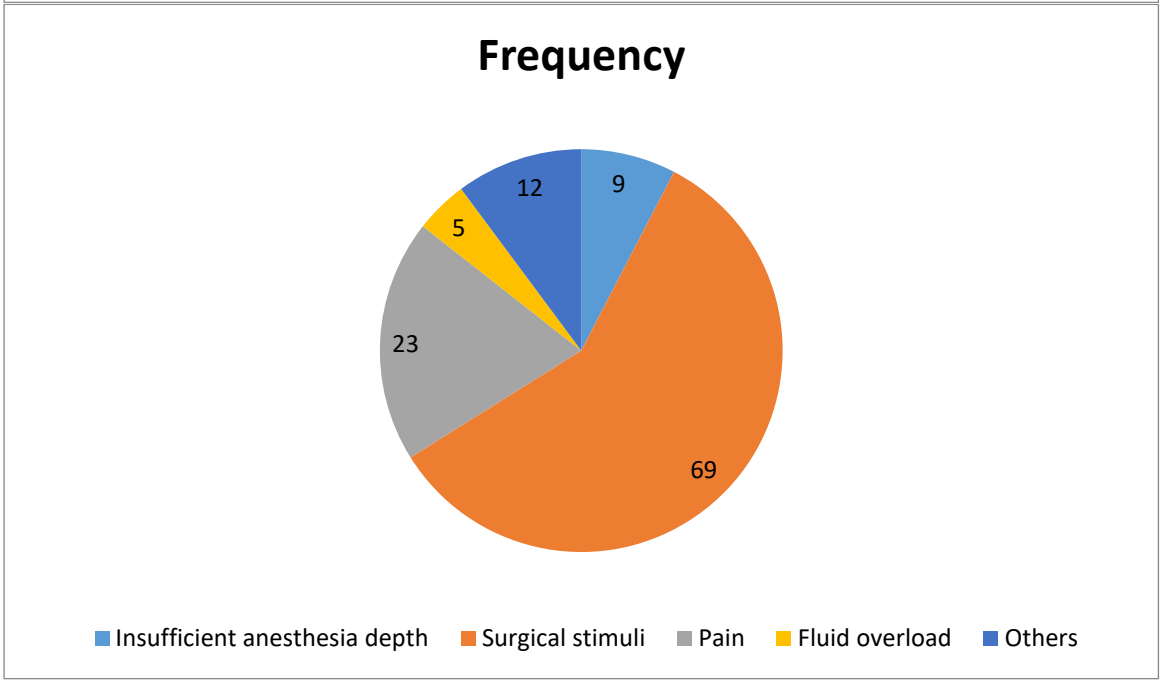


Table 3.9: Causes of intraoperative hypertension

CHAPTER 04

DISCUSSION

This study highlights the frequency and risk factors related to intraoperative hypertension (IOH) in adults undergoing surgery under general anesthesia. A number of participants faced IOH, forcing its relevance as a perioperative problem. Our findings show that age, BMI, preoperative hypertension, and the type of the surgical stimulus are important determinants of IOH.

Patients aged 32–38 years showed the highest frequency of intraoperative hypertension, because of age related components such as vascular variations and co-existing diseases increase vulnerability. Also, the association between BMI and IOH was considerable, and higher rates observed in overweight and obese participants.

Preoperative hypertension and comorbid conditions such as diabetes, cardiovascular disease, and kidney dysfunction were notable indicators of IOH. In 118 hypertensive participants, surgical stress is also one of predominant trigger, affecting 66.9%

participants. This shows the significant role of proper anesthetic depth and analgesia in countering hemodynamic variations.

However, insufficient depth of anesthesia was responsible for hypertension in 7.6% of cases, showing room for improvement in intraoperative monitoring and management. The incidence of IOH because of fluid overload was 5% highlighting the importance of accurate fluid management to avoid volume-induced hypertension.

During phases of induction and incision, considerable alterations in MAP above 105 mmHg were observed in 102 and 83 patients, respectively. These results show the requirement for proactive measures during these phases of surgery.

In conclusion,

Overall, this study shows the multi-causal nature of IOH. Future research should focus on developing standardized protocols for vulnerable groups.CHAPTER 05

CONCLUSION

This study highlights that intraoperative hypertension (IOH) is common in adults under general anesthesia, greatly influenced by patient characteristics such as age, BMI, preoperative hypertension, and co-existing diseases. Patients with age ranging from 32 years to 38 years and patients with higher BMI were vulnerable to development of IOH, also surgical stimuli was the primary trigger. Surgery phases, such as induction and incision, there were MAP spikes. Proper management and monitoring are essential elements to reduce frequency of IOH.

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