“Evaluation of gastric residual volume using ultrasound in fasting diabetic patients and non diabetic patients scheduled for elective surgeries; A Comparative study”

By

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Under the guidance of

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DR. T.JYOTHI SWAROOP

ABBREVIATIONS

AP	ANTERO-POSTERIOR
ASA	AMERICAN SOCIETY OF ANESTHESIOLOGISTS
CC	CRANIO-CAUDAL
CSA	CROSS SECTIONAL AREA
DM	DIABETES MELLITUS
ESA	EUROPEAN SOCIETY OF ANAESTHESIOLOGY
GDA	GASTRODUODENAL ARTERY
GDM	GESTATIONAL DIABETES MELLITUS
GV	GASTRIC VOLUME
HCL	HYDROCHLORIC ACID
IFG	IMPAIRED FASTING GLUCOSE
LGA	LEFT GASTRIC ARTERY
LGEA	LEFT GASTROEPIPLOIC (GASTROOMENTAL) ARTERY
OGTT	ORAL GLUCOSE TOLERANCE TEST
RLD	RIGHT LATERAL DECUBITUS
USG	ULTRASONOGRAPHY
NG	NASOGASTRIC

ABSTRACT

INTRODUCTION

Gastric residual volume is vital for assessing gastric emptying and gastrointestinal function. Traditional method of measuring gastric residual volume (GRV) like aspiration through nasogastric (NG) tube are invasive and uncomfortable. Ultrasonography (USG) emerged as non-invasive , reliable alternative , hence the present study is used for evaluation of gastric volume among the diabetic and non-diabetic population to minimize the intraoperative and post operative complications like pulmonary aspiration. This study considered factors such as diabetes duration, blood sugar levels, HbA1c, and fasting duration in evaluation of gastric residual volume.

MATERIALS AND METHODS:

It is a comparative study , conducted on 104 patients undergoing for elective surgeries at BLDE Hospital and research center, Vijayapura during the academic year 2022-2024,we divided in tot 2 groups after taking informed consent and fulfilling the inclusion criteria, group D is having 52 patients who were having history of diabetes mellitus and group ND who were non diabetic patients ,patients was then explained about the procedure and were scanned in supine position and then scanned in right lateral decubitus position ,then the ultrasonography images of both were measured with following diameters, craniocaudal(CC), anteroposterior(AP), cross sectional area (CSA) and

gastric volume is measured using CC&AP diameters. All the data were collected on ms excel sheet and statistical analysis was performed. A p value of < 0.001 was considered statistically significant

RESULTS :

The mean age of the participants was found to be 40.62 ± 9.16yrs with 72.11% were male patients and 27.88% were female patient. Among the patients there is significant higher mean level of CC diameter, AP diameter and CSA in supine position in cases compared to controls. ($p<0.05$) Similarly, there is significant higher mean level of CC diameter, AP diameter and CSA in RLD position in cases compared to controls. ($p<0.05$) The gastric volume was significantly higher in Diabetics (39.07± 8.39)compared to the Normal individuals(9.28± 4.11) in the study. ($p<0.05$)

CONCLUSION :

Diabetic patients have significantly higher fasting gastric volumes as measured using point of care ultrasonography, in comparison to non diabetic patients.

Keywords: Gastric emptying; pyloric antrum; Gastric residual volume; ultrasonography.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF GRAPHS

INTRODUCTION

Gastric emptying is the process by which the stomach contents are moved into the duodenum. Liquids will ordinarily empty faster than solids and smaller objects faster than larger ones. Gastric emptying may be affected during generalized ileus due to surgery, severe infection, metabolic derangement, e.g., Diabetes mellites.

Gastric residual volume (GRV) measures liquid and undigested food in the stomach, measurement of GRV commonly used in critically ill patients on enteral feeding. It's essential for pre-operative patient evaluation. The traditional method involves invasive techniques like nasogastric aspiration, which can cause patient discomfort and complications despite being effective.

Both humoral and neural factors influence gastric emptying. One important factor influencing the rate of gastric emptying is the amount and composition of the food in the stomach. The application of fasting guidelines provided by the American Society of anesthesiologists (ASA) ensures that the stomach is emptied before anesthesia induction, which is the primary measure to prevent aspiration.[1]

Standardized guidelines may not consider individual factors like diabetes and its complications. Tailored preoperative fasting protocols accounting for diabetes and gastroparesis are necessary to decrease aspiration risk.

It is also unknown whether compliance with fasting guidelines ensures that gastric residual volume is safe in patients with known risk factors like diabetes mellitus e.g.; factors known to delay gastric emptying or to increase gastric residual volume.[2]

Diabetes Mellitus (DM) presents acute and chronic disease manifestations, increasing the likelihood of surgical procedures for affected individuals. The complications that most diabetics develop in multiple organ systems need to be identified before surgery. It is affecting about 25% of surgical patients, has attracted considerable attention concerning residual gastric volumes after sufficient pre-anesthesia fasting. Individuals with DM, especially those with gastropathy associated with autonomic dysfunction, are prone to delayed gastric emptying, making them more susceptible to a higher risk of aspiration compared to non-diabetic individuals. [3,4]

Diabetic autonomic neuropathy (DAN) is a frequent type of nerve damage seen in individuals with diabetes. Autonomic neuropathy in diabetic patients can lead to hemodynamic instability during anesthesia and increase the risk of pulmonary aspiration due to gastroparesis.

Pulmonary aspiration of gastric content is a severe perioperative complication that occurs in patients who are undergoing general anaesthesia. Gastroparesis despite standard fasting in diabetic patients may increase the aspiration risk. Pneumonitis has been reported in up to 47% of patients who suffer pulmonary aspiration[5].

Gastroparesis incidences vary among diabetes types and non-diabetic individuals, with diabetics being more prone to delayed gastric emptying and aspiration risks. Incidence of gastroparesis ;4.8% in type 1 DM,1% in type 2 DM, 0.1% in non diabetic people[6].

The longer a person has diabetes, the higher the prevalence of diabetic autonomic neuropathy (DAN). It can be detected in individuals when they are first diagnosed with diabetes in as many as 7 percent of cases [7], but this number can increase to 50 percent after 15 years [8]. DAN is present in individuals with either type 1 or type 2 diabetes mellitus [9].

Approximately 30-50% of chronic diabetic patients exhibit prolonged gastric emptying times, posing challenges in preoperative management, especially concerning gastric contents and aspiration risks. Hyperglycemia and autonomic neuropathy play key roles in causing gastroparesis in diabetics, emphasizing the need for specialized perioperative care for this population. Comparative data on gastric residual volumes between diabetic and non-diabetic patients using modern ultrasound techniques are lacking, highlighting the importance of tailored management strategies for diabetic individuals undergoing surgery.[10,11]

Diabetes has always been seen as a condition with a high level of risk, presenting numerous challenging scenarios for anesthesiologists. Pulmonary aspiration is a highly alarming consequence of diabetes that occurs when a patient with autonomic gastropathy has a full stomach.[12,13]

Ultrasonography allows high-resolution imaging of anatomical structures during the perioperative period, particularly in patients with unknown gastric content. This assessment can help tailor anesthesia to individual aspiration risk and improve perioperative safety.

Ultrasonography provides advantages over traditional methods, being non-invasive and repeatable with no risk to the patient. It offers real-time imaging and quantitative assessment of GRV, aiding in identifying patients at risk of aspiration.

Hence in this study we Evaluated the gastric residual volume using ultrasound in fasting diabetic patients and fasting non diabetic patients scheduled for elective surgeries relative to the duration of diabetes, blood sugar levels, HbA1c, and fasting duration.

AIM AND OBJECTIVES

AIM

Evaluation of gastric residual volume in fasting diabetic and nondiabetic patients scheduled for elective surgeries relative to HbA1c, fasting duration, blood sugar level, and duration of diabetes.

OBJECTIVES

PRIMARY OBJECTIVES :

- Measuring and calculating the gastric volume in the supine position.
- Measuring and calculating the gastric volume in right lateral decubitus position.

SECONDARY OBJECTIVES :

Measuring GRV with respect to

- Duration of diabetes
- Blood sugar level
- HbA1c
- Fasting duration

ANATOMY OF STOMACH

STRUCTURE AND FUNCTION[14]

The two main functions of the stomach are partial digestion and short-term food storage. The upper portions of the stomach expand to accommodate more food as it enters, enabling the stomach to hold more food. In order to aid in the breakdown of food particles and combine them with stomach fluids, the bottom region contracts rhythmically. This mixture, known as chyme, is produced for accelerated digestion. Twenty-second intervals are used to create mixing waves, which intensify until they reach the stomach's bottom.

A sufficient amount of chyme is discharged into the small intestine for the duodenum to regulate and control with every wave that passes past the pyloric sphincter. For chemical digestion, the fundus region of the stomach produces gastric juices, which are liquids that contain the enzymes pepsin and hydrochloric acid (HCL). Moreover, the parietal cells in the stomach also produce intrinsic factor (IF). The intrinsic factor (IF) aids in the subsequent absorption of vitamin B12 in the small intestine. The production of the intrinsic factor is crucial as vitamin B12 is necessary for the growth of the brain and red blood cells.

Typically, food breaks down in the stomach and travels to the duodenum in two to four hours. However, the kind of food consumed has a big impact on this rate since, whereas fats like triglycerides take longer to breakdown in the stomach, proteins and carbohydrates do so very quickly. The stomach can absorb some chemicals, but it is not the primary place for doing so when it comes to nutrition. Drugs such as ethanol, aspirin, caffeine, amino acids, and several water-soluble vitamins, as well as water in case of dehydration

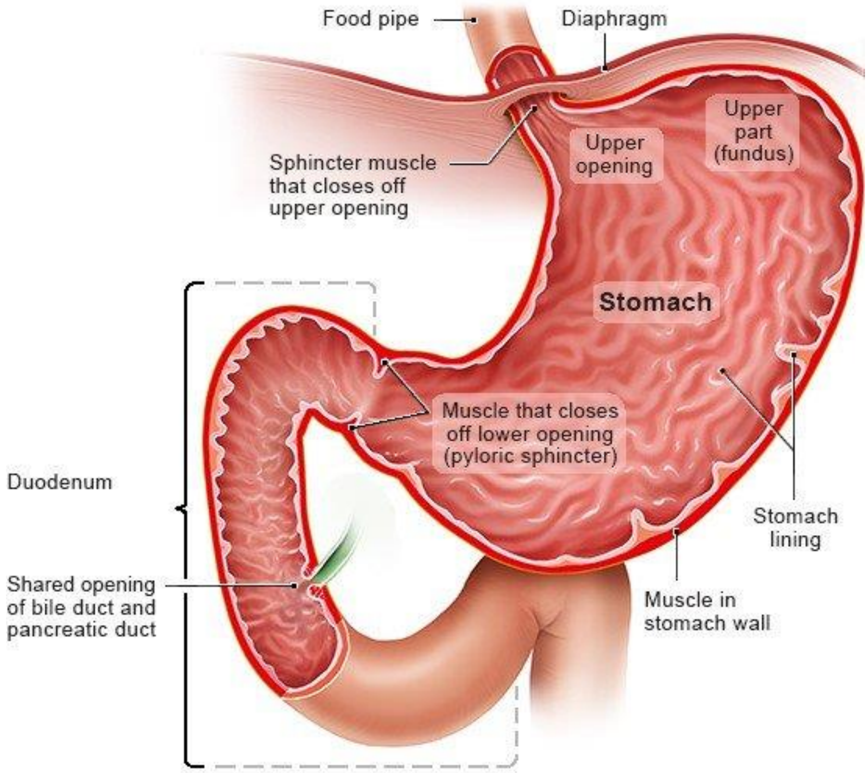


Figure.01 Function of Stomach

LAYERS OF STOMACH[14]

The gut wall consists of four primary layers:
a) The mucosa is the innermost layer of the stomach that contains gastric glands responsible for secreting enzymes and gastric fluids.
b) The submucosa is composed of blood arteries, lymphatics, nerves, and dense connective tissue that forms the rugae. It provides support to the mucosal layer and enables it to stretch as food enters the stomach.

c) The muscularis externa consists of three distinct sublayers.

The outer longitudinal layer

The middle circular layer

The inner oblique layer

The Auerbach's plexus, which is also called the myenteric plexus, is situated between the circular and longitudinal muscle layers. It provides nerve signals to these two layers that are next to each other. The upper longitudinal layer contracts the muscles to make it easier for food to move into the pylorus.

d) The serosa, which is the final layer, consists of multiple layers of connective tissue that are permanently attached to the peritoneum.

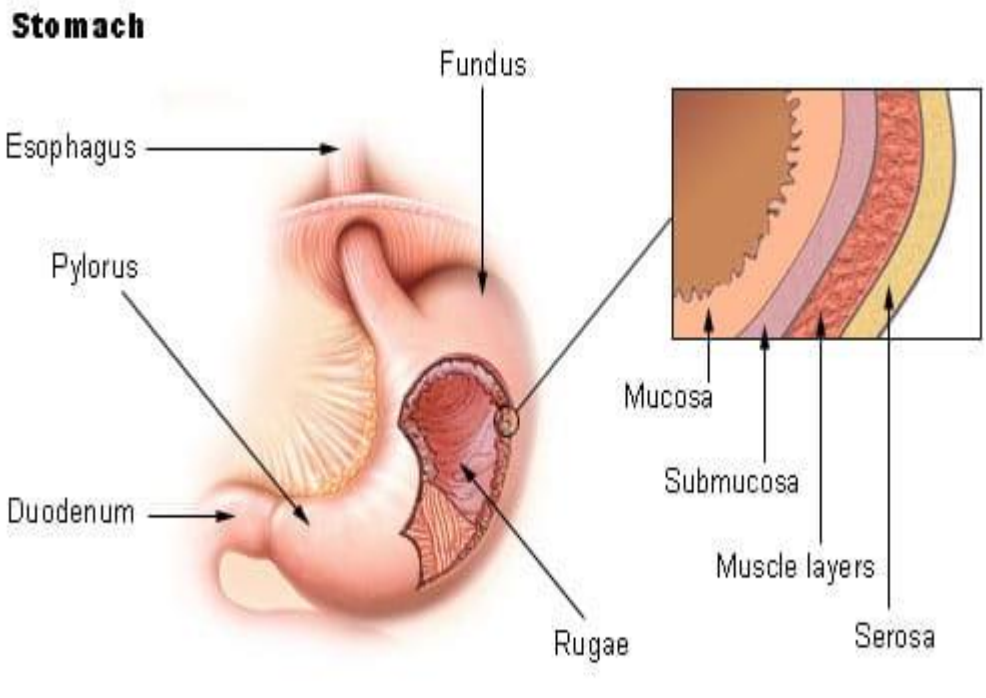


Figure:02 Layers of Stomach

FUNCTION OF STOMACH AT CELLULAR LEVEL[14]

The stomach wall is meant to create a temporary acidic environment for food digestion into chyme. The fundus, cardia, body, and pylorus comprise the stomach. When food is consumed, the stomach's rugated inner surface expands the gastric mucosa. Mucosal, submucosa, muscularis externa, and adventitia/serosa make up the stomach wall. 3 layers make up the gastric mucosal layer: surface epithelium, lamina propria, and muscularis mucosa. Gastric epithelial layer invades lamina propria to create pits and glands. In these stomach glands, surface mucous cells (foveolar cells), parietal cells, chief cells, and neuroendocrine cells (G-cells or ECL-like cells) perform different activities.[15,16]

Gastric mucosa-lining surface mucus cells (foveolar cells) produce mucus. Mucus protects against stomach acid. The stomach glands' deep pits contain the remaining specialized cells.

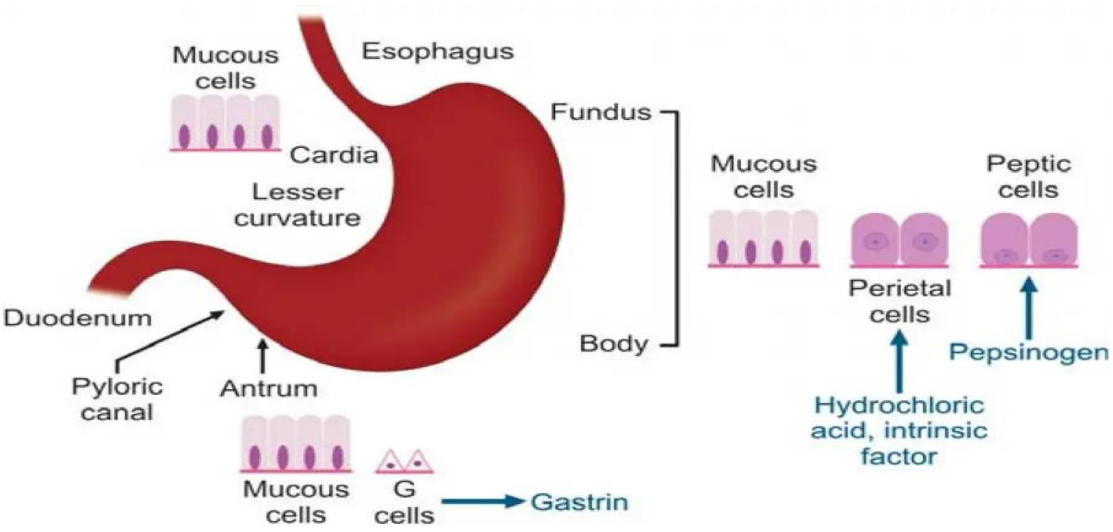


Figure : 03 Types of Cells In Stomach

Parietal cells

In the fundus, parietal cells secrete gastric acid (HCL) into the stomach lumen. The protein intrinsic factor is also released. Vitamin B12 absorption in the terminal ileum requires IF. Gastrin, histamines, and acetylcholine regulate these cells. All receptors control luminal H+/K+ ATPase protein channel. One proton enters the lumen when this protein absorbs one k+ ion. Chloride ions produce HCl by following the proton gradient through the stomach lumen via the K+/Cl- channel. [15]

Chief cells

Chief cells release pepsinogen in the stomach fundus. Degrading proteins into polypeptides requires the proteolytic enzyme pepsin, which is inactive. Only parietal cell-produced stomach acid activates it. This avoids inappropriate digestion of proteins found outside the lumen of stomach.[15]

Neuroendocrine cells

There are also neuroendocrine cells, also known as enterochromaffin-like cells or G-cells, on the gastric mucosa that help make stomach acid. These cells are found in the gastric glands. When the ECL-like cells are triggered by a hormone called gastrin, they make and release histamine. This directly affects the parietal cells and raises the production of HCl. Cells that look like ECL are mostly found in the stomach's fundus.

G-cells

There are G-cells in the pylorus area of the stomach, and they make gastrin, a neuroendocrine hormone. Gastrin can increase the production of HCl in two ways: directly and indirectly. The first method involves driving histamine-releasing ECL-like cells, which strengthens parietal cells. Direct stimulation of the parietal cells is the second method. The H+/K+ ATPase activity goes up through both of these ways.

D-cells

D-cells are found in the pylorus of the gut and release somatostatin, a chemical that stops cell growth. When the stomach lumen hits a certain acidity level, D cells start to work. Somatostatin then stops gastrin from being released, which lowers the amount of gastric acid made total.[17]

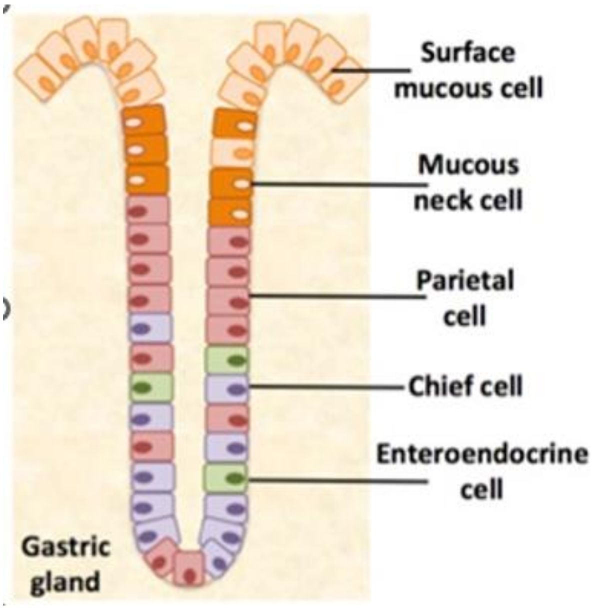


Figure : 04 Cells In The Stomach

BLOOD SUPPLY TO STOMACH[14]

Most of the arterial blood flow originates from the celiac trunk, which branches off from the aorta.The ascending branch of the Left gastric artery (LGA) provides blood to a portion of the oesophagus, whereas its descending branch nourishes the less curved side of the stomach. The right gastric artery (RGA) is a hepatic artery branch that provides blood supply to the smaller curvature of the stomach. The gastroduodenal artery (GDA) gives rise to a right gastroepiploic artery (RGEA) that enhances the elastic nature of the stomach. The left gastroepiploic artery (LGEA) is a subsidiary of the splenic artery that provides blood to the greater curvature of the stomach.

The left and right stomach veins, as well as the right gastro-omental veins, drain into the portal vein. The splenic vein collects blood from the vasa brevia and left gastro-omental vein, which are the veins that drain the short stomach.

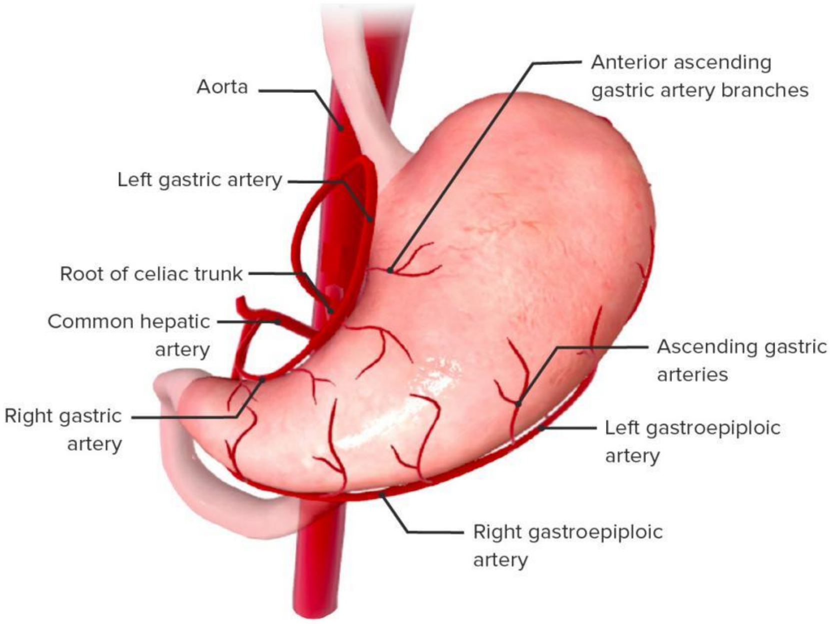


Figure : 05 Blood supply of Stomach

NERVE SUPPLY[14]

The stomach receives its nerve supply from both parasympathetic and sympathetic fibers. The peripheral nervous system (PNS) receives nerve supply from the vagus nerve via the right posterior and left vagal trunks. The criminal nerve of Grassi responsible for innervating the cardia and fundus, receives a branch from the right vagus nerve. The trunks also give rise to the Latarjet posterior and anterior gastric nerves, which provide innervation to the body, antrum, and pylorus. The spinal cord segments

T6-T9 contain sympathetic nerves that innervate the celiac plexus, including some fibers that provide pain signals.

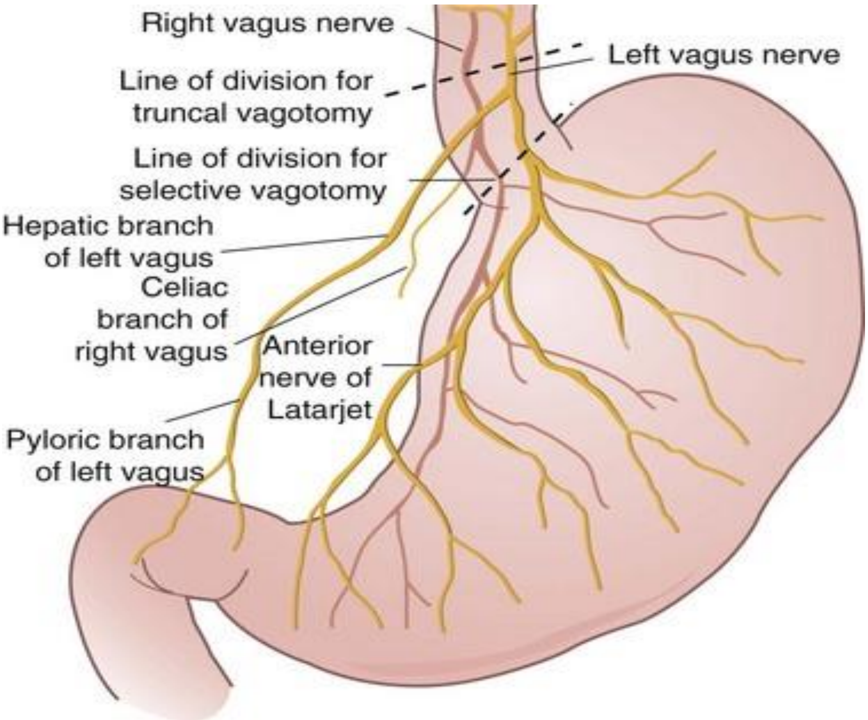


Figure 06 : Nerve supply of Stomach

PHYSIOLOGY OF STOMACH

GASTRIC MOTOR FUNCTION

The gastric motor function is controlled by 3 main levels

-Parasympathetic and sympathetic nervous system

-Smooth muscle cells

-Enteric neurons and interstitial cell of cajal

AUTONOMIC NERVOUS SYSTEM

Vagus nerves control the stomach and upper intestine from parasympathetic circuits. The dorsal motor nucleus of the vagus nerve produces vagal efferent. They generate stomach myenteric plexus terminals that resemble bead chains but do not directly innervate muscle from T5-T10, the celiac ganglia receives stomach sympathetics from the intermediolateral spinal cord. The celiac ganglia supplies the myenteric ganglia and the pyloric sphincter with splanchnic efferents.[18,19,20]

ENTERIC NERVOUS SYSTEM

The ganglionated plexi form a large network that serves as a circuit connecting the regulation of gastrointestinal motility from external sources and the sensory afferents in the stomach wall. The neuronal networks in the gut wall are organized into five distinct layers, including the myenteric, deep muscular, and submucosal plexi. The ICC, functioning as pacemakers for the muscle layers in the gastrointestinal wall, are part of the deep muscular plexus.

SMOOTH MUSCLES

Gastrointestinal motility is controlled by smooth muscle cells' excitable membrane at the third level. Certain receptors in the cell membrane bind to peptides, amines, and other transmitters that travel through the neurocrine, paracrine, or endocrine pathways to reach the smooth muscle membrane. The resting membrane potential of pacemaker cells spontaneously depolarizes, indicating the presence of action potentials that cause the cell to contract.

The stomach muscle is made up of three layers, with fibers distributed along three different axes: circular, oblique, and longitudinal. It was previously thought that the fundus and antrum were the two functional portions of the stomach. In the middle of the stomach's larger curvature, the gastric electrical pacemaker is in full swing. The stomach acts as a "housekeeper," guiding undigested solid matter towards the colon as part of the continuous movement that occurs in the digestive system during periods of fasting. It seems that the stomach component of the migrating motor complex is triggered by hormone motilin, which is produced from the duodenum in dogs.[21]

PATHOGENESIS OF DELAYED GASTRIC EMPTYING:

There are many conditions that can affect the muscles in the stomach, which can lead to delayed gastric emptying. Each part of the stomach can be affected by a different disease.

FUNDUS ABNORMALITIES: Several diseases are associated with disrupted proximal gastric motor function. The accommodation response has been found to significantly impact the rate of gastric emptying, particularly in the proximal stomach.

POST-VAGOTOMY DYSFUNCTION:

The response of the stomach's accommodation and phasic contractility to distention is completely abolished after vagotomy and minor gastric resection.[22]

The solid components of food require more time to be digested and cleared from the digestive system compared to liquids, which are processed more quickly.[23] Fundoplication is the primary cause of diminished fundal accommodation, which is further worsened by concurrent vagal injury.[24]

GASTRIC ULTRASOUND

Point of care Gastric ultrasonography has become increasingly popular in recent years and has been gradually included into the area of Anesthesiology. Its purpose is to aid in making clinical decisions prior to administering anesthesia, particularly in cases when the fasting status of patients is uncertain or in emergency situations where surgery is necessary.

Placing the curvilinear probe between the xiphoid process and umbilicus in the sagittal axis allows for easy visualization of the gastric antrum through the hepatic lobe window. The thickness of the gastric wall in adults is typically around 4-6 millimeters, encompassing all five layers. The Muscularis Propria is easily identifiable and serves as a reliable marker for locating the antrum in ultrasound imaging. Content observed within the antrum.[25]

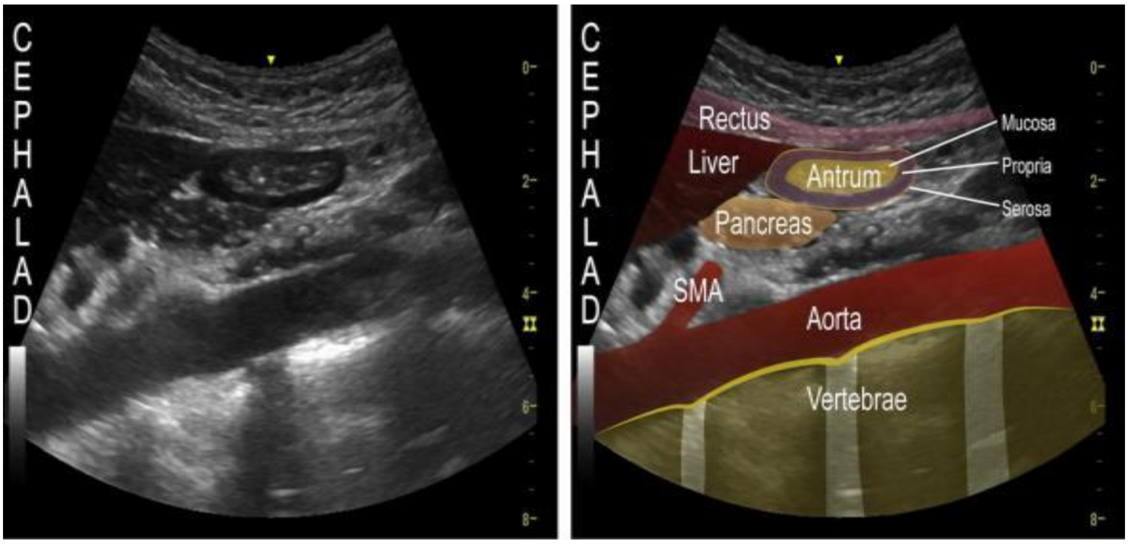


Figure 07 : Stomach Under Ultrasonography

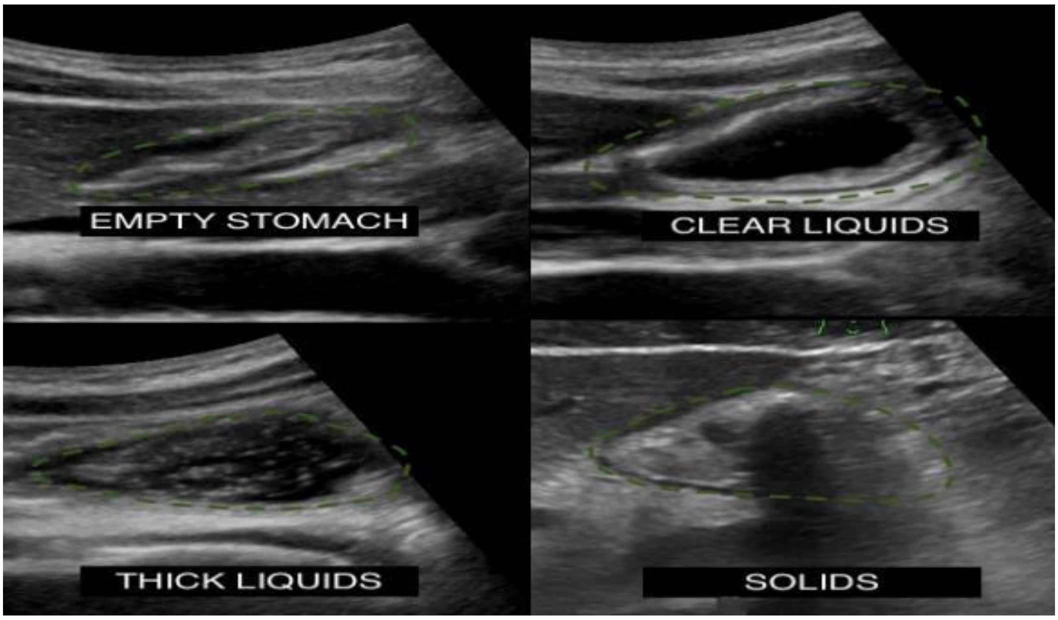


Figure 08 :Contents of Stomach Contents

DIABETES MELLITUS

DEFINITION

"Diabetes Mellitus is defined as a group f metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The American Diabetes Association Expert Panel recommends a diagnosis of diabetes mellitus when one of the three criteria is met"[26]

CLASSIFICATION

Diabetes Mellitus is classified into 4 types:

1. Type 1/Insulin dependent DM
2. Type 2/Non-insulin dependent DM
3. MODY or Maturity onset Diabetes Mellitus
4. Gestational diabetes mellitus (GDM)

Pathophysiology

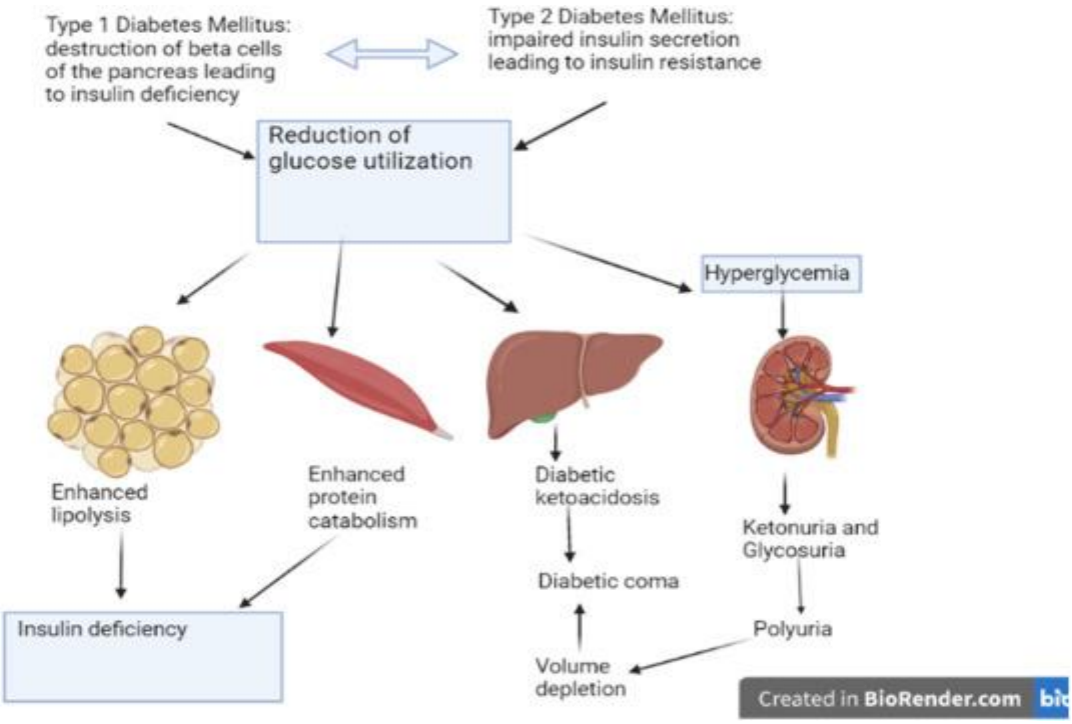


Figure 09 :Pathophysiology of Diabetes Mellitus

Differences in gastric emptying between diabetic and non-diabetic patients.

Gastric emptying differs significantly between diabetic and non-diabetic patients due to various physiological and pathological factors. Here are the key differences:

Differences	Diabetic	Non-Diabetic
Prevalence of Gastroparesis	A higher prevalence of gastroparesis is observed in diabetic patients, particularly those with long-standing diabetes or poor glycemic control. Gastroparesis is characterized by delayed gastric emptying without mechanical obstruction, leading to symptoms such as nausea, vomiting, bloating, and early satiety.	Gastroparesis is less common in non-diabetic patients and usually occurs due to other conditions such as post-viral syndromes, medications, or idiopathic causes.
Gastric Motility	Diabetes can cause autonomic neuropathy, which affects the vagus nerve responsible for regulating gastric motility. This leads to impaired coordination of gastric contractions, resulting in	Non-diabetic individuals typically have normal gastric motility unless affected by other gastrointestinal disorders. Gastric emptying is

	delayed gastric emptying.	generally more coordinated and efficient.
Impact of Hyperglycemia:	Acute hyperglycemia can further delay gastric emptying in diabetic patients. Elevated blood glucose levels slow down gastric motility and increase the risk of gastroparesis.	Non-diabetic individuals do not experience hyperglycemia-induced delays in gastric emptying. Their gastric emptying rates are more stable and less affected by blood glucose fluctuations.
Symptomatology:	Symptoms of delayed gastric emptying in diabetic patients include nausea, vomiting, early satiety, bloating, and abdominal pain. These symptoms can significantly impact nutritional intake and glycemic control.	Non-diabetic individuals with delayed gastric emptying may experience similar symptoms, but these are usually less frequent and severe compared to diabetic patients.
Glycemic Control and Gastric Emptying	Poor glycemic control is both a cause and consequence of delayed gastric emptying.	Non-diabetic individuals do not face this cyclical relationship between

	Fluctuating blood glucose levels can worsen gastroparesis, creating a cycle that complicates diabetes management.	glycemic control and gastric emptying.

REVIEW OF LITERATURE

Darwiche G et,al[1999] used ultrasound to measure stomach emptying rates (GER) in 33 diabetics and non-diabetics following semi-solid meals. Measurements of the gastric antrum. Diabetes patients had considerably greater postprandial antral medians after 90 minutes. Diabetics had a median GER of 29%, while healthy controls had 63%. Their study showed GER differences between healthy and diabetic persons.[27]

Sharma G et al.[2018] conducted an observational study in adult patients to examine the preoperative assessment of stomach content and volume using bedside ultrasonography. Out of the 100 participants, 6 had solid contents and 16 had clear liquids that exceeded 1.5 milliliters per kilogram, even though they had fasted for 10 to 15 hours. Diabetes and chronic renal illnesses were linked to significant increases in CSA in both the supine and RLD postures in patients, according to statistical analysis. The patients' stomach capacity increased in proportion to their BMI. According to study, fasting for more than 6 to 10 hours does not guarantee that the Stomach is empty . Individuals with diabetes, obesity, or chronic kidney disease (CKD) are more susceptible to having hazardous stomach contents.[28]

Y.Ohashi et al[2018] measured gastric volumes in fasted patients using bedside gastric ultrasound. 222 successful scans were performed; of these 110 patients had an empty stomach, 9 patients had a GRV >100 ml, and a further 6 patients had a GRV >1.5 ml/kg. There was no significant relationship between ‘at risk’ GRV and obesity, diabetes mellitus, despite compliance with fasting guidelines, a small percentage of patients still had GRVs that pose a pulmonary aspiration risk.[29]

Sabry R et al.[2019] measured gastric residual volume in fasting diabetics using gastric ultrasonographyThe diabetes group had a larger median (quartiles) antral CSA and a larger estimated stomach residual volume in comparison to the control group.

Also, there is more NG tube aspirate in the diabetic group than in the control group. There was a very strong link between the estimated residual stomach capacity and the amount of NG tube aspirate. People with long-term diabetes had more stomach capacity left after an 8-hour fast before planned surgery than healthy controls.[30]

Zhou et al.[2020] Examined the frequency of individuals with type 2 diabetes who have a full stomach before elective surgery and identified the elements that contribute to this condition. A gastric ultrasound was conducted either 2 hours after consuming a clear fluid or 6 hours after having a small meal. The term "full stomach" was defined as the presence of gastric content in both semi-recumbent and right lateral decubitus positions. Analysed were a total of fifty-two participants with type 2 diabetes and fifty people without diabetes. Approximately 50% of individuals with type 2 diabetes experience postprandial satiety in accordance with the existing preoperative fasting protocol. It is recommended to use preoperative ultrasound to evaluate the contents of the stomach in patients with type 2 diabetes, particularly those who have ocular diseases associated to diabetes. **[31]**

Khan *et al.* [2020] This study examined the gastric contents and volume in fasting diabetic and non-diabetic individuals who were scheduled for elective surgery under general anaesthesia, using USG-guided techniques. 50 patients were categorized into two groups, namely group A (consisting of 25 patients with diabetes mellitus for more than 5 years) and group B (consisting of 25 patients without diabetes mellitus). Following a usual fasting period of 8 hours, a bedside ultrasonography was performed to evaluate the gastric antral cross-sectional area, gastric volume, and contents. The average stomach antral cross-sectional area and the average gastric volume per kilogram of body weight after an 8-hour fasting period were greater in individuals with diabetes compared to those without diabetes, but the differences were not statistically significant. A study found that diabetic patients had a slower rate of stomach emptying, resulting in larger mean gastric volume and gastric volume per kilogram of body weight after a fixed period of fasting. Nevertheless, none of the patients exhibited a stomach volume per kilogram of body weight greater than 1.5 ml/kg, nor was any solid food observed in any of the groups. [32]

Reshma Ambulkar et al [2021] It was investigated if patients who followed both ASA fasting rules and the ERAS protocol were more likely to have a full stomach. A total of 102 patients were recruited and analyzed. A total of 4 patients had gastric volume > 1.5 ml/kg; out of these 4 patients, 3 were female and one was male. Study didnt observe any case of pulmonary aspiration in any of our patients. And study concluded that, even though for elective surgeries, the current fasting guidelines are adequate, these findings cannot be extrapolated to patients with risk factors for high gastric residual volume where further studies need to be performed. [33]

Cunha DD et al.[2022] conducted study to assess the use of gastric ultrasonography to measure the amount of stomach contents in fasting individuals from both diabetes and non-diabetic groups. Irrespective of their fasting status, 75% of the participants had Grade stomach contents on USG. The statistical significance of the data was assessed using a significance level of $P<0.05$. There was no statistically significant correlation between age and ultrasound results. Nevertheless, there was a notable correlation between the patient's BMI and stomach content and volume ($P<0.01$). Currently, the determination of NPO status relies on patient history, which might be unreliable. This poses a higher risk of aspiration in persons who are at a greater risk of delayed stomach emptying. Prior to planning the anesthesia induction and surgery, utilizing stomach ultrasonography as a screening approach before anesthesia induction and operation can aid in mitigating preventable perioperative complications.[34]

Demirel et al[2023] This study uses ultrasonography to measure the antral cross-sectional area (CSA) and gastric volume, and it looks at the relationship between these parameters and the onset and management of type 2 diabetic mellitus (DM). Measuring the antral CSA in supine and right lateral decubitus (RLD) positions on 80 subjects allowed for the estimation of gastric volume. Age, BMI, solid, supine position, and RLD CSA had a significant association with full stomach in this group of 12 patients who had grade 2 stomach .One risk factor for a full stomach was found to be a history of peripheral neuropathy ($p = 0.005$) and diabetes ($p < 0.001$). It is advised to perform a preoperative ultrasound examination of the stomach contents in individuals with type 2 diabetes, particularly if they have peripheral neuropathy and have had the disease for more than eight years. The results of this study require more research in order to facilitate the development of tailored diabetes guidelines that reduce the risk of pulmonary aspiration.[35]

Kenchey et al[2023] This study compares Gastric volumes in diabetes and non-diabetic individuals using point-of-care ultrasound and correlates with them with HbA1c levels in diabetic patients. 180 patients, 90 diabetic (>5 years) and 90 nondiabetic, over 40 years old, with American Society of Anaesthesiologists physical status I-II, fasted for 8 hours. Diabetics had significantly more GV compared to non-diabetics ($p < 0.0001$). In diabetics, stomach volumes correlated significantly with HbA1c. Diabetic patients have a greater residual stomach volume than non-diabetic patients, which indicates gastroparesis. Gastric volumes are further expanded in people with poorly managed illness and high HbA1C levels. Ultrasound is a useful technique for determining the risk of aspiration and adjusting anaesthetic care accordingly.[36]

Rajeswari L et al.[2023] used ultrasonography to quantify the residual volume of the stomach in patients undergoing elective surgery, both in the diabetic and non-diabetic groups, who were fasting. Diabetics had significantly larger mean antral CSA and estimated mean GRV in both the right lateral and semi-sitting positions,. A significantly higher number of those without diabetes, as compared to those with diabetes, had an empty stomach antrum in both groups. Diabetics had a significantly greater average amount of stomach aspirate compared to non-diabetics. The existing guidelines on preoperative fasting in individuals with chronic diabetes are ambiguous. Therefore, we strongly recommend the utilization of point-of-care ultrasonography as a highly effective screening method for evaluating the likelihood of aspiration and customizing the dose of anesthesia.[37]

Materials and Method

Study Design :

An observational comparative study

Source of data:

This study was carried out in the Department of Anaesthesiology: B.LD.E's (Deemed to be University) Shri B.M.Patil Medical College, Hospital and Research Centre, Vijayapur.

Study Duration and Place of Study :

The study was conducted from Dec 2022 to june 2024.

Study Population

This study was done on inpatients undergoing various elective surgical procedures (ASAI, II, and III).

Inclusion Criteria

- Patients aged between 20-80 years.
- Patients admitted for elective surgeries with ASA Grade I , II &III.

Exclusion Criteria

- pregnant women.
- Obese patients.
- Co-existing autoimmune diseases
- Patients with H/o gastric surgeries.
- Patients unable to position in right lateral decubitus position.

Ethical Committee Approval:

The present study was approved by institutional ethics committee of our tertiary care centre (B.L.D.E.U.'s) committee.

METHODOLOGY

- **Pre anaesthetic evaluation:**

The Pre anaesthetic evaluation included the following:

- **History:**

History of underlying medical illness, previous history of surgery, anaesthetic exposure, andhospitalization will be elicited.

Physical Examination

- The general condition of the patient.
- Vital signs -heart rate, blood pressure, respiratory rate.
- Height and weight.
- Examination of the respiratory system, cardiovascular system, central nervous system, and vertebral system.
- Airway assessment by Mallampati grading.
- The procedure was explained to the patient and patient attenders.

Investigation

Routine investigations include CBC, FBS, ECG, Chest X-ray, HIV, HbsAg, Urineroutine,HbA1c,UKB.

Procedure

- Pre anesthetic evaluation was done in the ward.
- Patients were kept nill by mouth for more than 8hrs overnight fasting.
- Patients were selected for the study based on the inclusion and exclusion criteria.
- The procedure was explained to the patient, and informed consent was taken.
- Sonosite M Turbo portable ultrasound machine was used.
- An abdominal pre-set portable curve array low-frequency abdominal probe (2–5 MHz) was utilized.

- Optimal visualization of the antrum is typically achieved in a parasagittal plane, where the left lobe of the liver is positioned anteriorly and the head or body of the pancreas is positioned posteriorly, serving as a point of reference.
- The examination was conducted as follows: for maximum sensitivity, the patient was first scanned while supine with the head of the bed raised to 45° (semi-recumbent position, or SRD-). Next, the patient was placed in a right lateral decubitus (RLD) with the head of the bed lifted to 45 (RLD).
- The transducer was positioned in the epigastric region in a sagittal plane. The antrum is distinguished by its multilayered structure. Measurements were conducted when the plane was scanned above the major abdominal vessels (aorta or inferior vena cava) in accordance with the consensus.
- In order to determine the cross-sectional area (CSA) using the two-diameter method, three static pictures of the antrum will be captured during periods of rest (between peristaltic contractions) in both the supine and right lateral decubitus (RLD) positions.
- Using two perpendicular antrum diameters from serosa to serosa—the craniocaudal (CC) and anteroposterior (AP) diameters—the cross-sectional area (CSA) of the antrum in the RLD is calculated using the formula for an ellipse: The three measures' numerical average was noted. Using a previously published mathematical model created by Perlas et al., the total stomach fluid volume was estimated for each patient based on antral CSA (where right-lateral CSA is the antral CSA observed in the RLD).
- Volume = 27.0 + 14.6 x right lateral CSA - 1.28 x age.

- The anesthesiologists who performed the scanning technique was not blinded regarding the diabetic status of the patient.

Figure 10: Assessment of GRV at supine position

Figure 11: Assessment of GRV at Right Lateral Decubitus position

Sample Size Caluculation :

Using G*Power ver. 3.1.9.4 software for sample size calculation, The CSA supine position (mm 2) for Nondiabetic patients (Mean=8.8, SD=3.7037) and Diabetic patients (Mean=13.8, SD=7.407), this study requires a total sample size of 104 (for each group 52, assuming equal Group sizes). So to achieve a power of 99% for detecting a difference means(t-tests - Means: Difference between two independent means (two groups)) with a 5% level of significance.

Statistical Analysis

Collected data were entered in the Microsoft Excel for further statistical analysis, Categorical data were expressed interms of frequency and proportion, while quantitative data were expressed interms of mean and standard deviation. t-test of independence was used to find mean difference between diabetic and non-diabetic patients, while distribution of various parameters were assessed with the help of chi-square test. P-value less than 0.05 were considered as statistically significant. SPSS version 25 were used for further statistical analysis.

OBSERVATION AND RESULTS

The total of 104 patients were divided into two groups 52 diabetic patients and 52 non diabetic patients

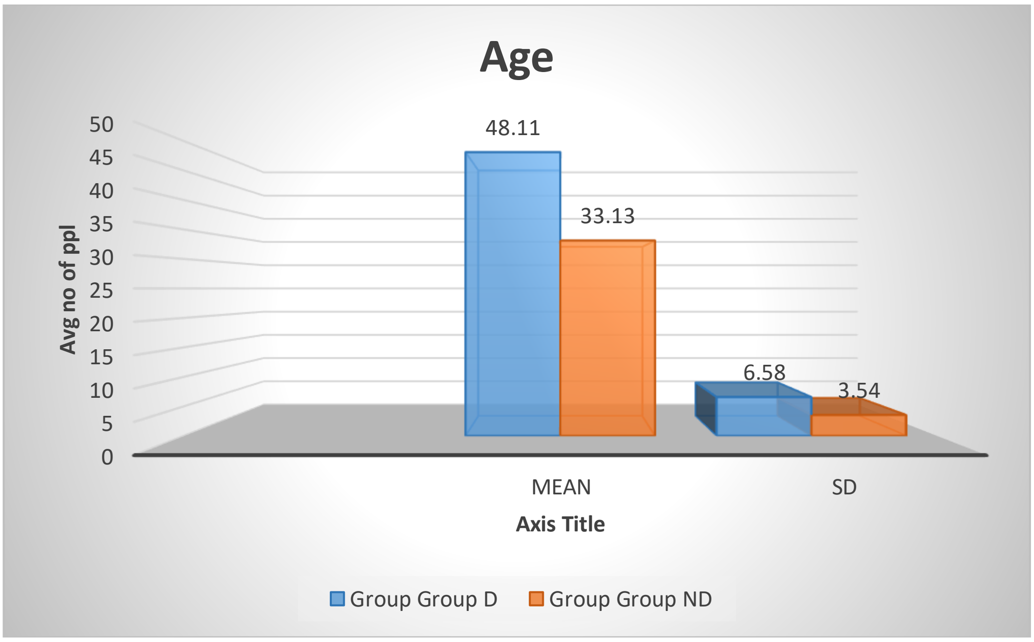
Group D -Diabetic patients (52 patients)

Group ND – Non Diabetic patients(52 patients)

Table 1 : Age distribution among study population

Age	Group		t-test	P-value
	Group D	Group ND		
Mean	48.11	33.13	14.3	<0.001
SD	6.58	3.54		
Statistically significant as p value less than 0.05				

The mean age in group D (48.11±6.58) and in group ND was (33.13±3.54), The results were statistically significant within the groups.

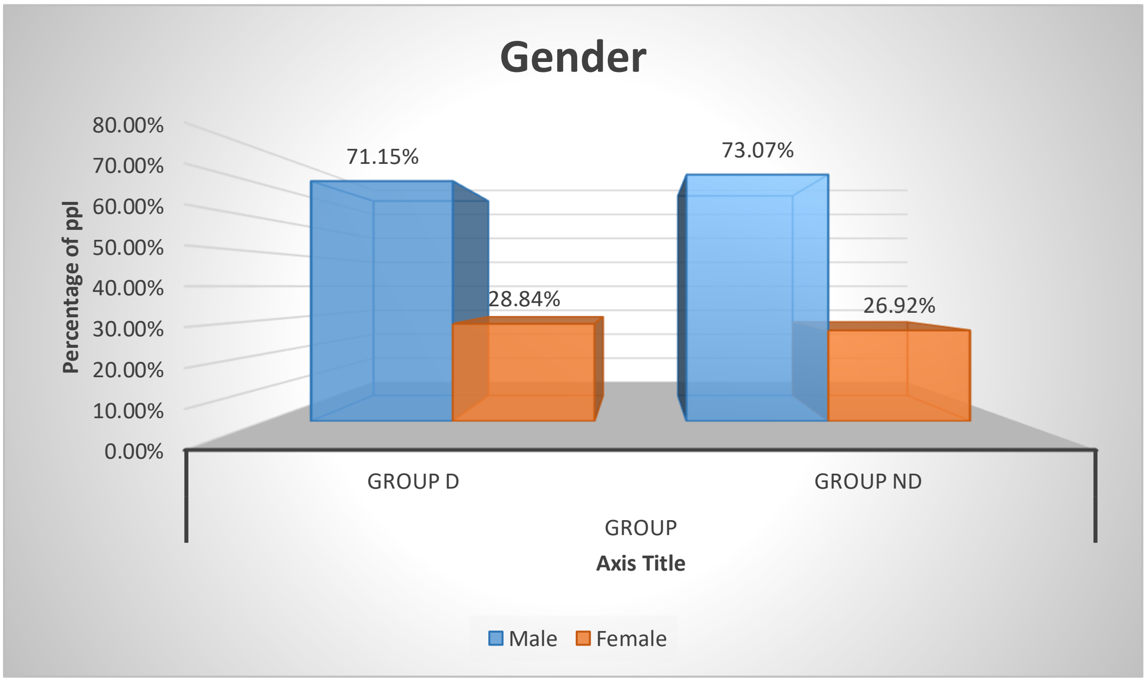


Graph 1: Comparision of age among study population

Table 2 : Mean Gender distribution among study population

Gender	Group		Chi^2 test	P-value
	Group D	Group ND		
Male	37(71.15%)	38(73.07%)	0.047	0.8269
Female	15(28.84%)	14(26.92%)		
Statistically insignificant as p value more than 0.05				

The gender distribution in group D 15(28.84%) were females and 37(71.15%) were males whereas in group ND 14(26.92%) were females and 38(73.07%) were males, there is no significant difference noted between the groups.(p>0.05)

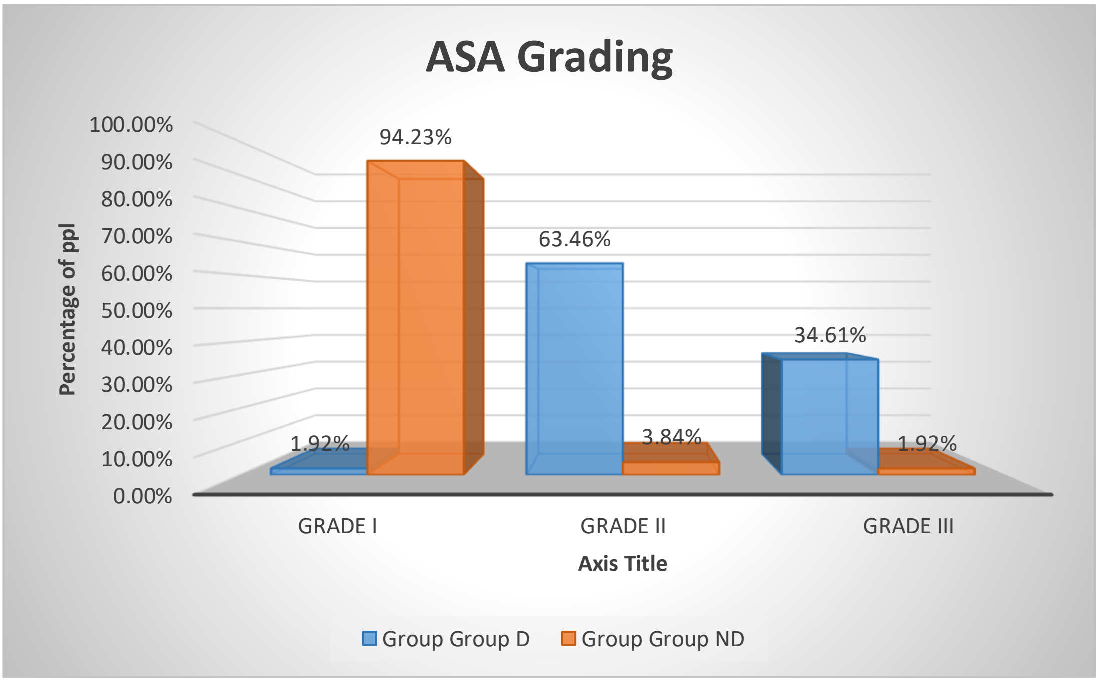


Graph 2:Gender distribution among study population

Table 3 : ASA distribution among study population

ASA	Group		Chi-square test	P-value
	Group D	Group ND		
Grade I	1(1.92%)	49(94.23%)	88.74	<0.001
Grade II	33(63.46%)	2(3.84%)		
Grade III	18(34.61%)	1(1.92%)		
Statistically significant as p value less than 0.05				

ASA distribution between the groups were statistically significant, among diabetic patients, majority of the patients were of grade II (63.46%) compared to grade I(1.92%) & III(34.61%) and majority of the patients were of grade I(94.23%) compared to grade II(3.84%) & III(1.92%) in non-diabetic group

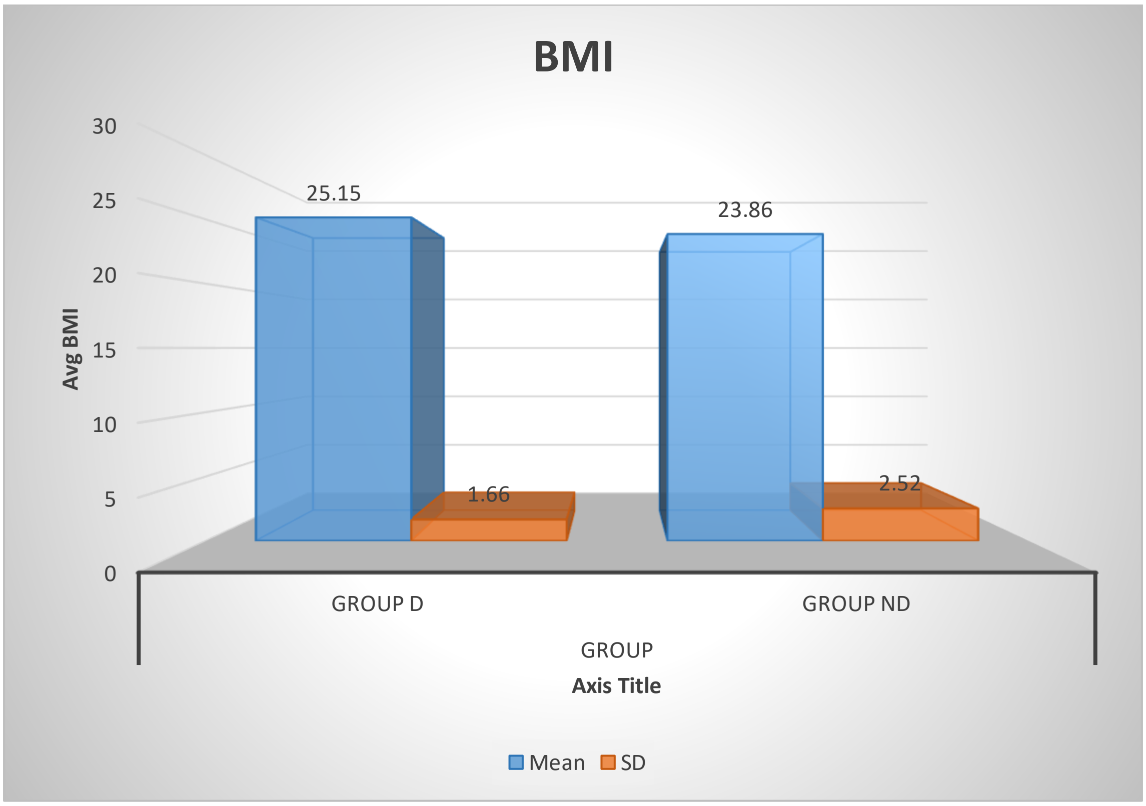


Graph 3: ASA distribution among study population

Table 4 : BMI distribution among study population

BMI	Group		t-test	P-value
	Group D	Group ND		
Mean	25.15	23.86	3.06	0.0013
SD	1.66	2.52		
Statistically significant as p value less than 0.05				

Mean BMI among diabetic patients were more as compared to non diabetic patients, and this difference between the groups were statistically significant as shown in above table.

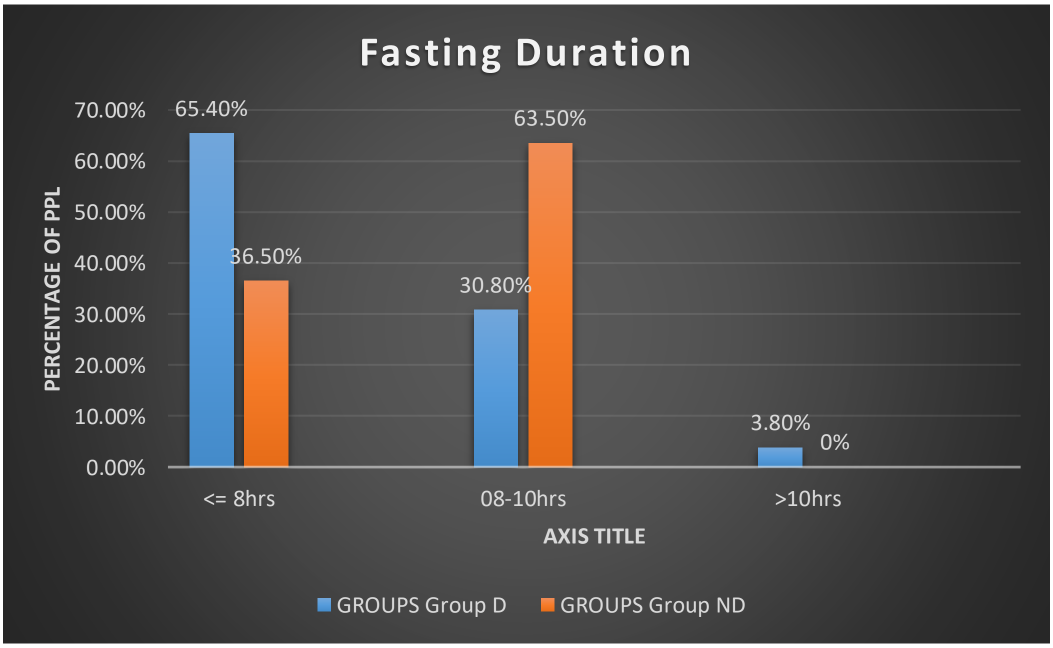


Graph 4: Comparision of BMI among study population

Table 5: Duration of fasting distribution among study population

Fasting Duration(hrs)	GROUPS		Total	Chi2 test	P Value
	Group D	Group ND			
<= 8hrs	34(65.4%)	19(36.5%)	53(51%)	12.143	0.002
08-10hrs	16(30.8%)	33(63.5%)	49(47.1%)		
>10hrs	2(3.8%)	0(0%)	2(1.9%)		
Total	52(100%)	52(100%)	104(100%)		
Statistically insignificant as p value more than 0.05					

The above table shows the study population having fasting duration among the two groups , The statistical difference is insignificant as the p value is more than 0.05

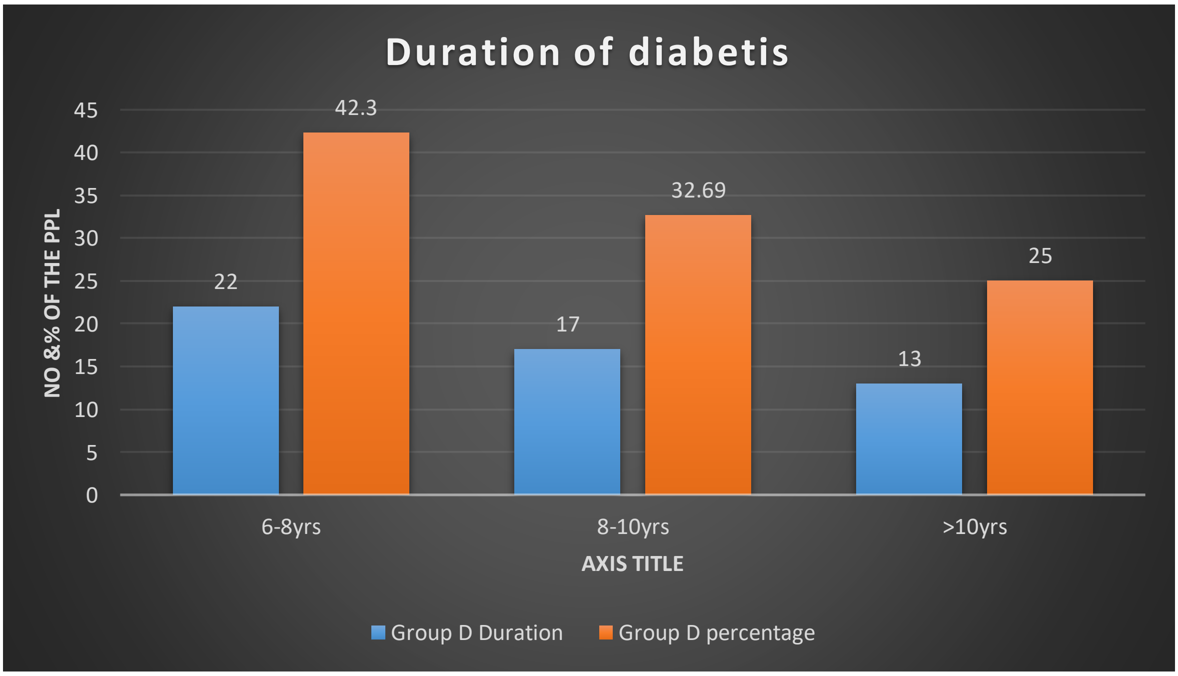


Graph5: Comparison of fasting duration among study population

Table 6 History of Diabetes among the study population

History of diabetes	Group D	
	Duration	percentage
6-8yrs	22	42.3
8-10yrs	17	32.69
>10yrs	13	25

In this study, 43.3% of the diabetic patients have 6-8 yrs of diabetes,32.69% of the diabetic patients have 8-10yrs of diabetes and 25% of the diabetic patients have more than 10 yrs of diabetes.

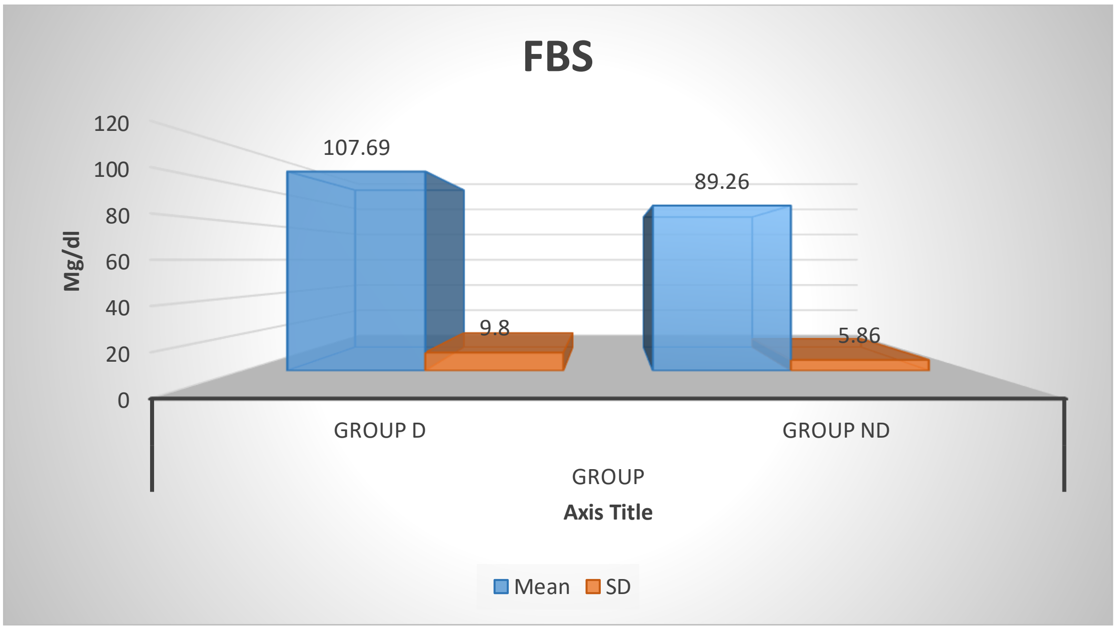


Graph6: Comparision of duration of diabetes among study population

Table 7: FBS distribution among study population

FBS	Group		t-test	P-value
	Group D	Group ND		
Mean	107.69	89.26	-11.51	<0.00001
SD	9.8	5.86		
Statistically significant as p value less than 0.05				

Mean FBS among diabetic patients were more as compared to non diabetic patients, and this difference between the groups were statistically significant as shown in above table.

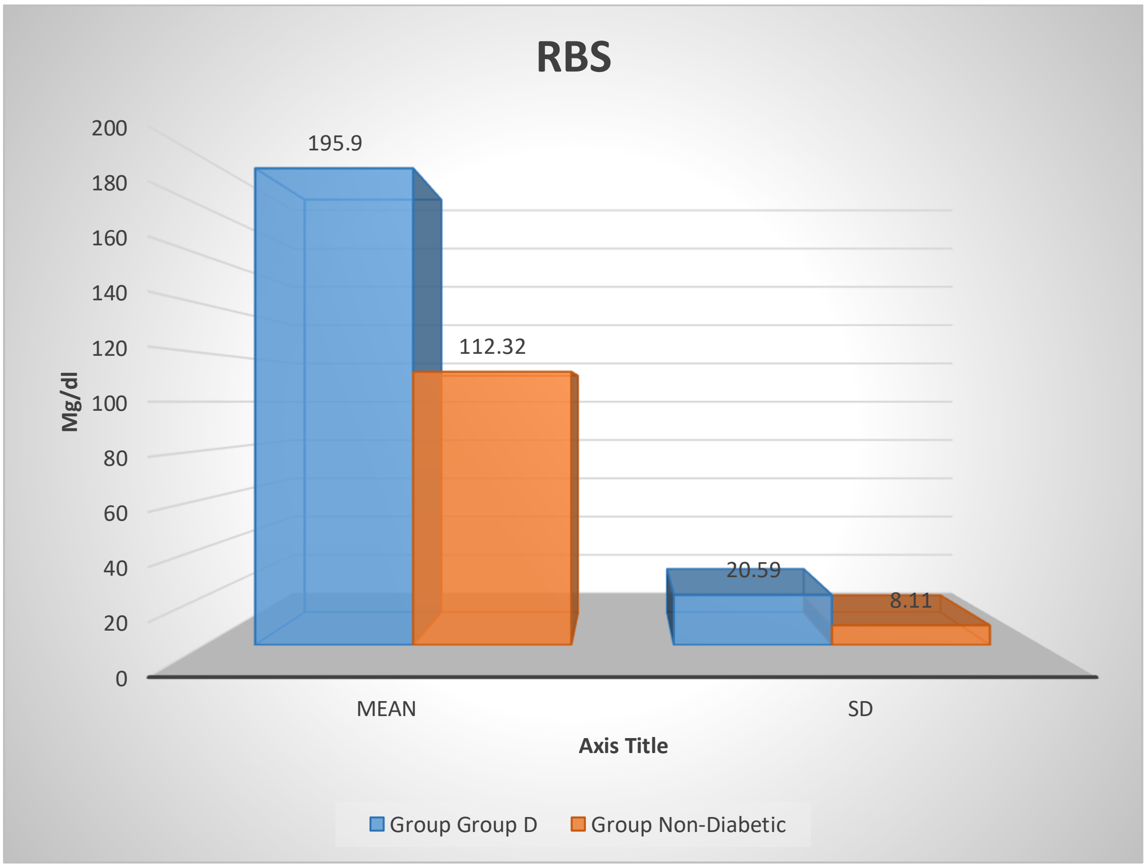


Graph 7: Comparison of FBS among study population

Table 8: RBS distribution among study population

RBS	Group		t-test	P-value
	Group D	Non-Diabetic		
Mean	195.9	112.32	-26.96	<0.00001
SD	20.59	8.11		
Statistically significant as p value less than 0.05				

Mean RBS among diabetic patients were more as compared to non diabetic patients, and this difference between the groups were statistically significant as shown in above table.

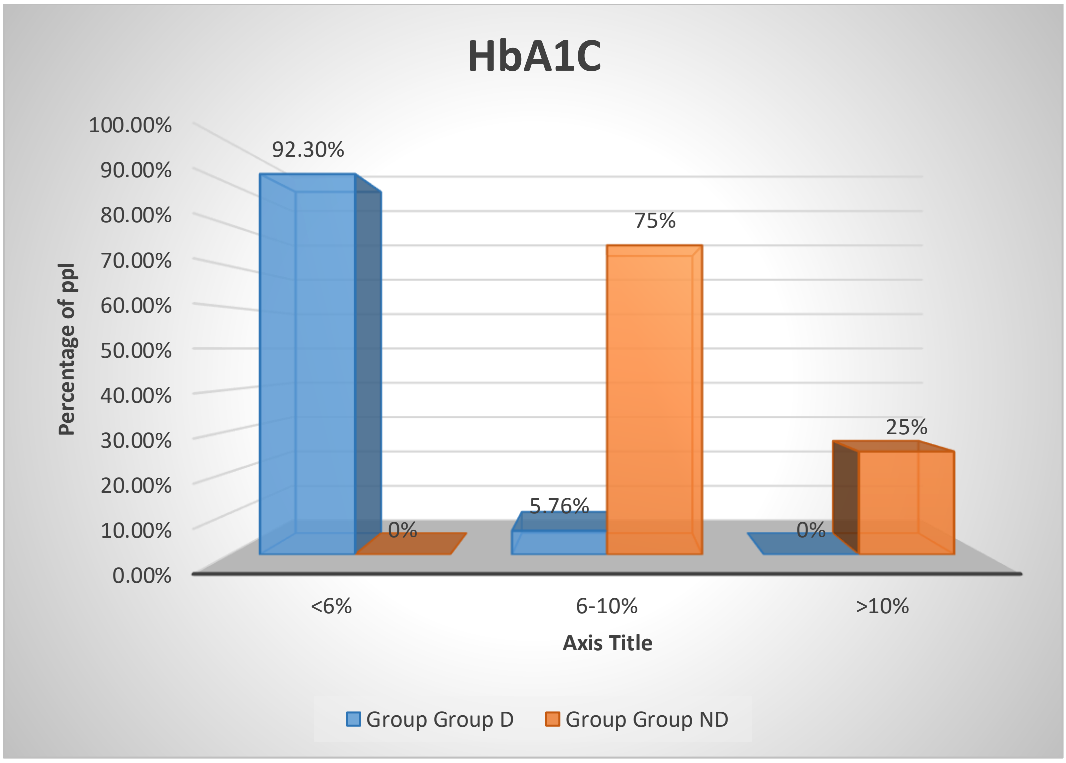


Graph 8: Comparison of RBS among study population

Table 9: HbA1C distribution among study population

HbA1C	Group		Chi-square test	P-value
	Group D	Group ND		
<6(%)	48(92.30%)	0(0%)	88.24	<0.001
6-10%	3(5.76%)	39(75%)		
>10%	0(0%)	13(25%)		
Statistically significant as p value less than 0.05				

HbA1C distribution between the groups were statistically significant, among diabetic patients, majority of the patients were between 6-10% and majority of the patients were <6% non-diabetic group.

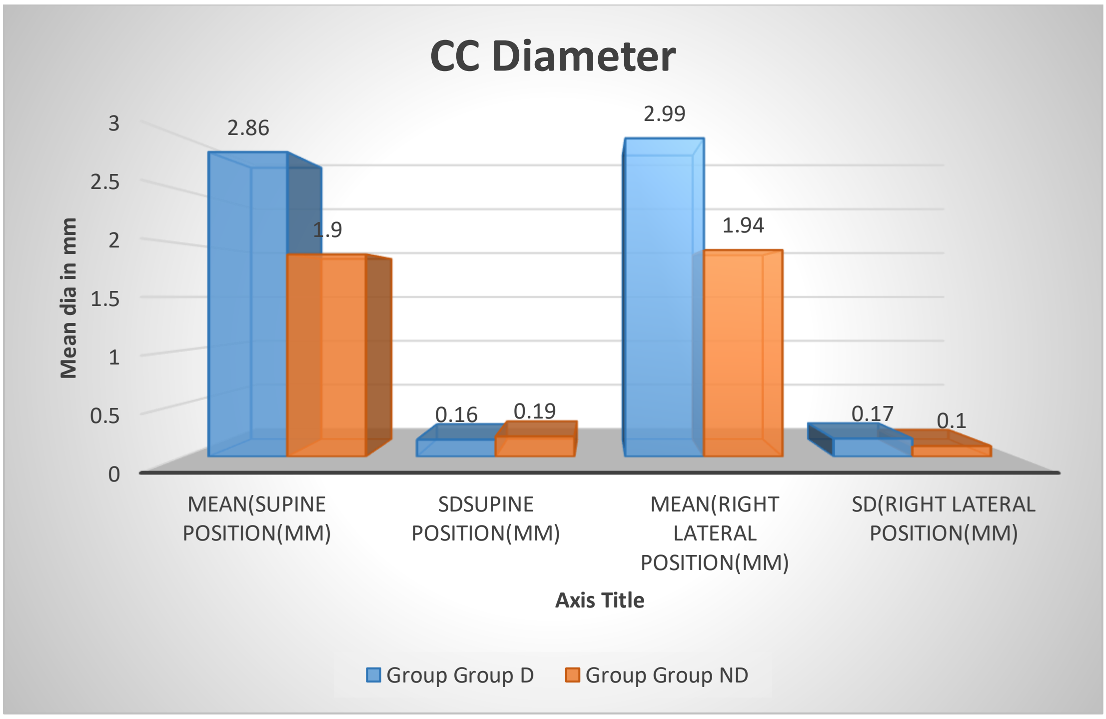


Graph 9: Comparison of HbA1C among study population

Table 10 : Mean CC Diameter of antrum distribution among study population

CC Diameter of Antrum	Group		t-test	P-value
	Group D	Group ND		
CC Diameter In Supine Position(mm)				
Mean	2.86	1.9	26.85	<0.001
SD	0.16	0.19		
CC Diameter In Right Lateral Position(mm)				
Mean	2.99	1.94	37.15	<0.001
SD	0.17	0.1		
Statistically significant as p value less than 0.05				

The cc diameters measured among diabetic are 2.86±1.90 in supine position whereas 2.99±0.17 in right later decubitus position. Mean The cc diameters measured among non diabetic are 1.90±0.19 in supine position whereas 1.94±0.10 in right lateral decubitus position. Mean cc diameter among diabetic patients was more as compared to non-diabetic patients at supine position, and this difference between the group was statistically significant, also at lateral position also it was more among diabetic groups and mean difference between the group was statistically significant.

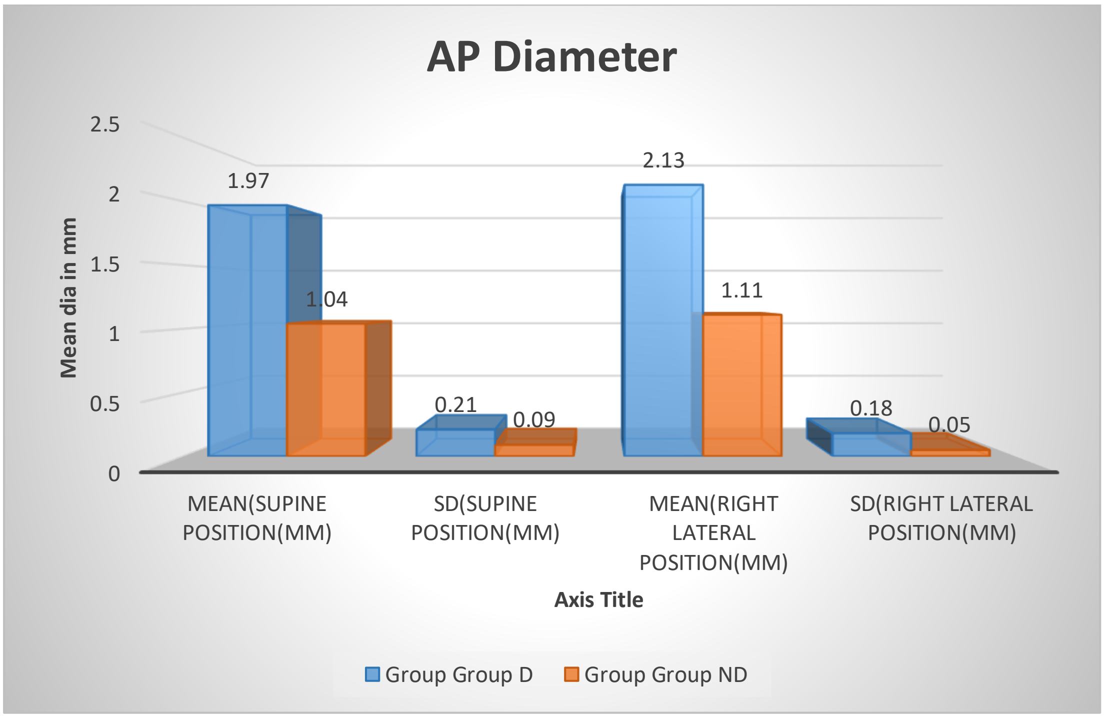


Graph 10: Comparison of CC Diameter of Antrum among study population

Table 11 : Mean AP Diameter of Antrum distribution among study population

AP Diameter of antrum	Group		t-test	P-value
	Group D	Group ND		
AP Diameter In Supine Position(mm)				
Mean	1.97	1.04	27.67	<0.001
SD	0.21	0.09		
AP Diameter In Right Lateral Position(mm)				
Mean	2.13	1.11	38.11	<0.001
SD	0.18	0.05		
Statistically significant as p value less than 0.05				

The ap diameters measured among diabetic are 1.97±0.21 in supine position whereas 2.13±0.18 in right later decubitus position.Mean , The ap diameters measured among non diabetic are 1.04±0.09 in supine position whereas 1.11±0.05 in right later decubitus position.Mean cc diameter among diabetic patients was more as compared to non-diabetic patients at supine position, and this difference between the group was statistically significant, also at lateral position also it was more among diabetic groups and mean difference between the group was statistically significant.

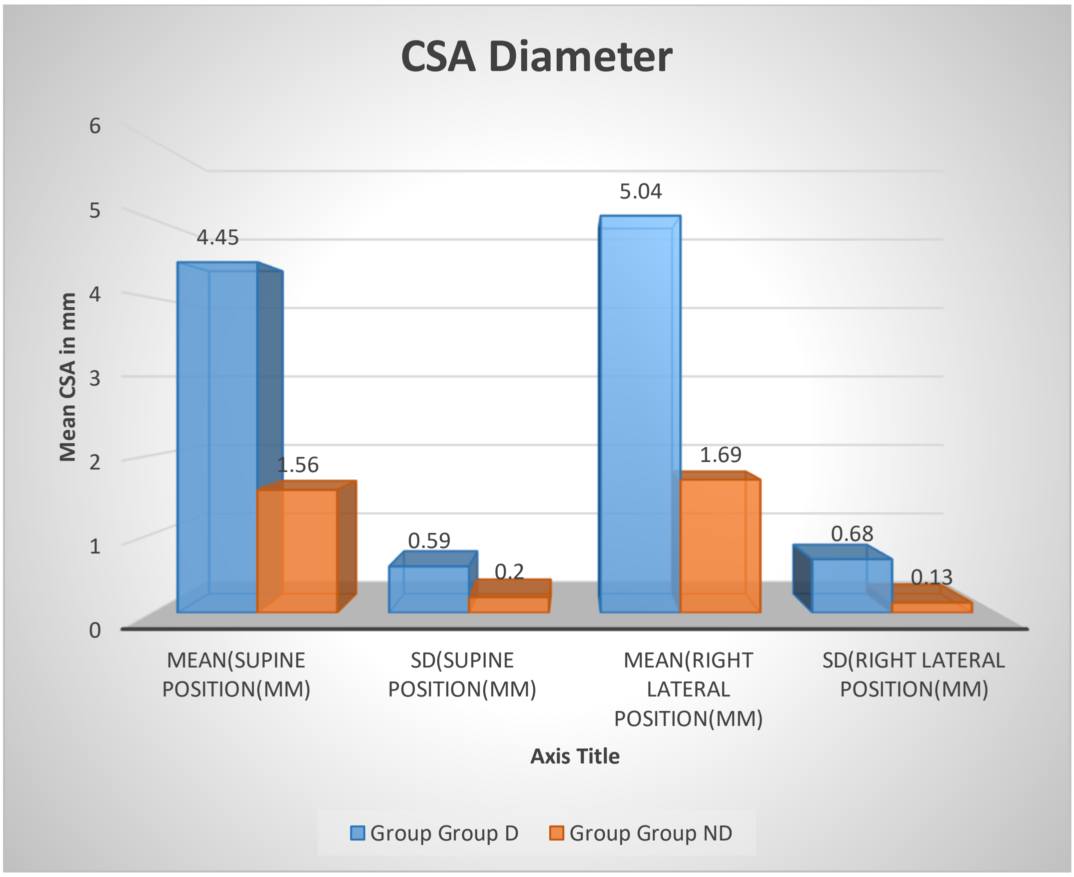


Graph 11: Comparision of AP Diameter of Antrum among study population

Table 12 : Mean cross sectional area of Antrum distribution among study population

Cross Sectional Area	Group		t-test	P-value
	Group D	Group ND		
CSA at Supine Position(Cm2)				
Mean	4.45	1.56	33.002	<0.001
SD	0.59	0.2		
CSA at Right Lateral Position(cm2)				
Mean	5.04	1.69	34.57	<0.001
SD	0.68	0.13		
Statistically significant as p value less than 0.05				

The CSA measured among diabetic are 4.45±0.59 in supine position whereas 5.04±0.68 in right later decubitus position.Mean , The CSA measured among non diabetic are 1.56±0.20 in supine position whereas 1.69±0.13 in right later decubitus position.Mean CSA among diabetic patients was more as compared to non-diabetic patients at supine position, and this difference between the group was statistically significant, also at lateral position also it was more among diabetic groups and mean difference between the group was statistically significant.

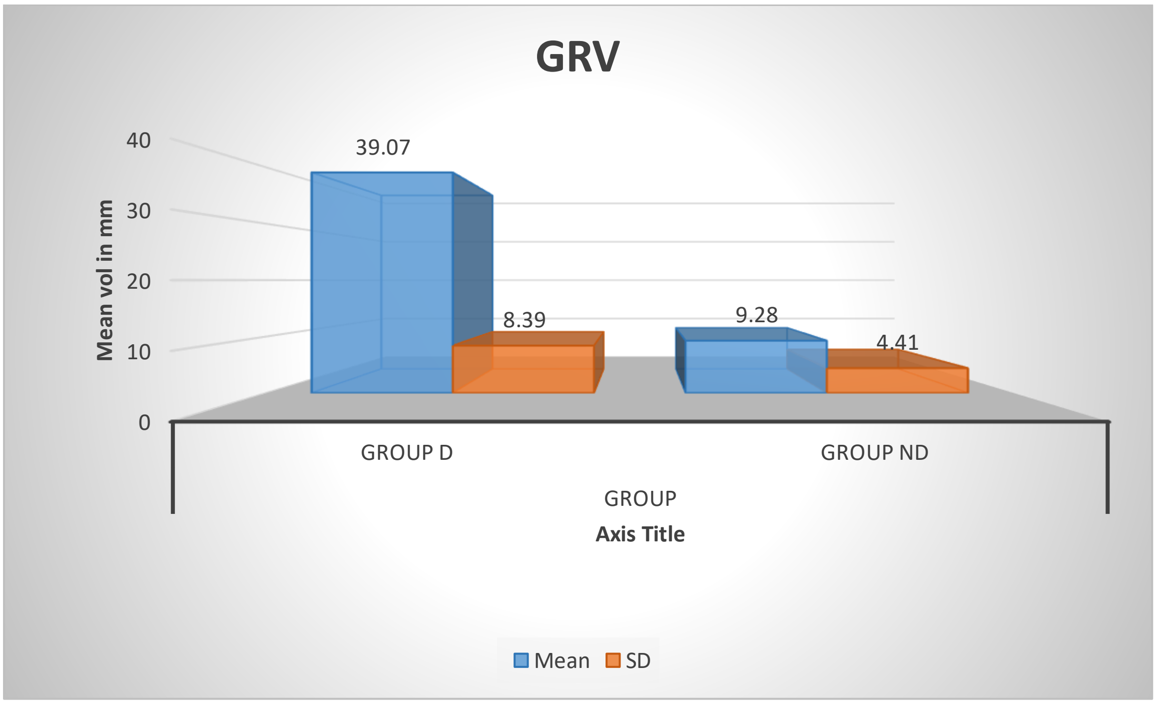


Graph 12: Comparison of CSA among study population

Table 13: GRV distribution among study population

GRV	Group		t-test	P-value
	Group D	Group ND		
Mean	39.07	9.28	22.43	<0.00001
SD	8.39	4.41		
Statistically significant as p value less than 0.05				

The mean gastric residual volume measured among the diabetic patients is 39.07±8.39 whereas 9.28±4.11 in non diabetic patients ,gastric residual volume measured in diabetic patients is more compared with the non diabetic patients.

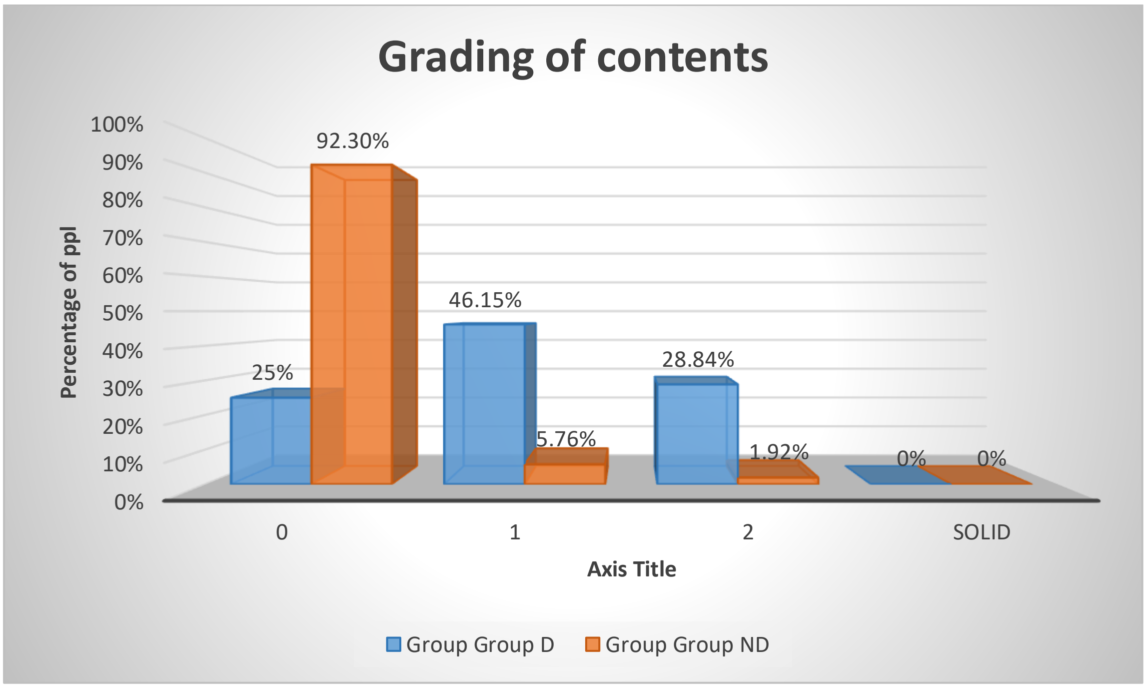


Graph 13: Comparison of GRV among study population

Table 14 : Grading of contents distribution among study population

Grading of Contents	Group		chi-square test	P-value
	Group D	Group ND		
0	13(25%)	48(92.30%)	48.66	<0.001
1	24(46.15%)	3(5.76%)		
2	15(28.84%)	1(1.92%)		
Solid	0(0%)	0(0%)		
Statistically significant as p value less than 0.05				

Distribution of grading of contents between diabetic and non-diabetic patients were statistically significant as shown in above table.

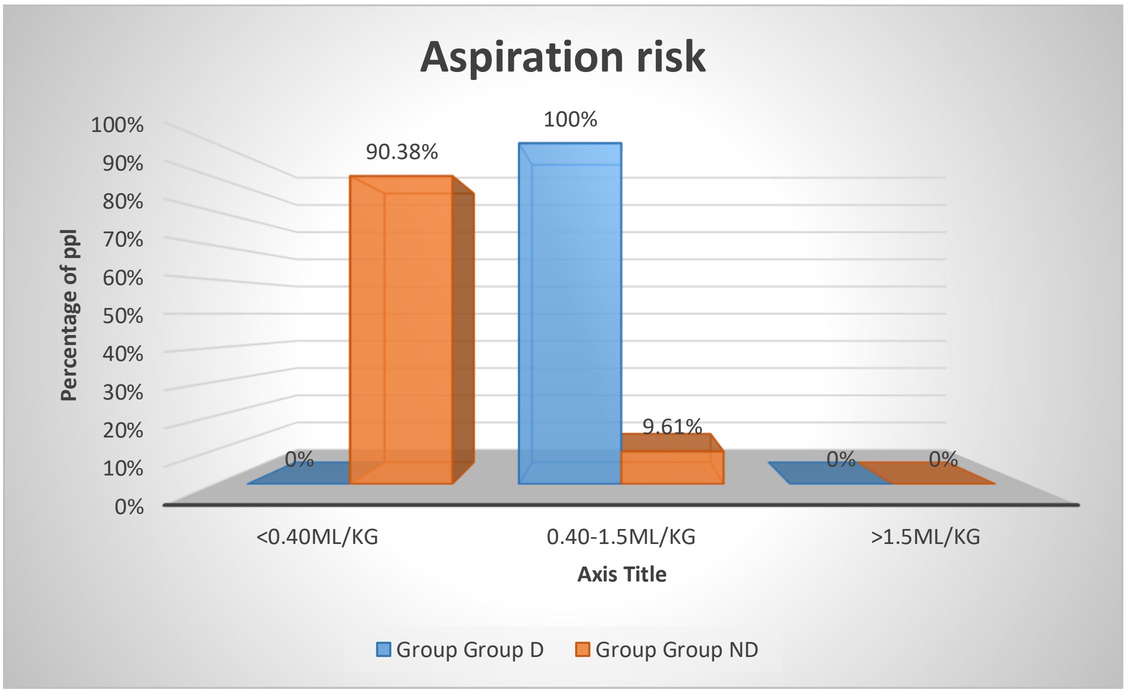


Graph 14: Comparison of Grading of stomach contents among study population

Table 15 : Distribution of Risk of aspiration among study population

Gastric volume	Group	
	Group D	Group ND
<0.40ml/kg	0(0%)	47(90.38%)
0.40-1.5ml/kg	52(100%)	5(9.61%)
>1.5ml/kg	0(0%)	0(0%)

In this study 47(90.38%) non diabetic patients are having GRV less than 0.40ml/kg,5(9.61%) and 5(9.61%) are having 0.40-1.5ml/kg, whereas in the diabetic patients 52(100%) are having GRV between 0.40-1.5ml/kg



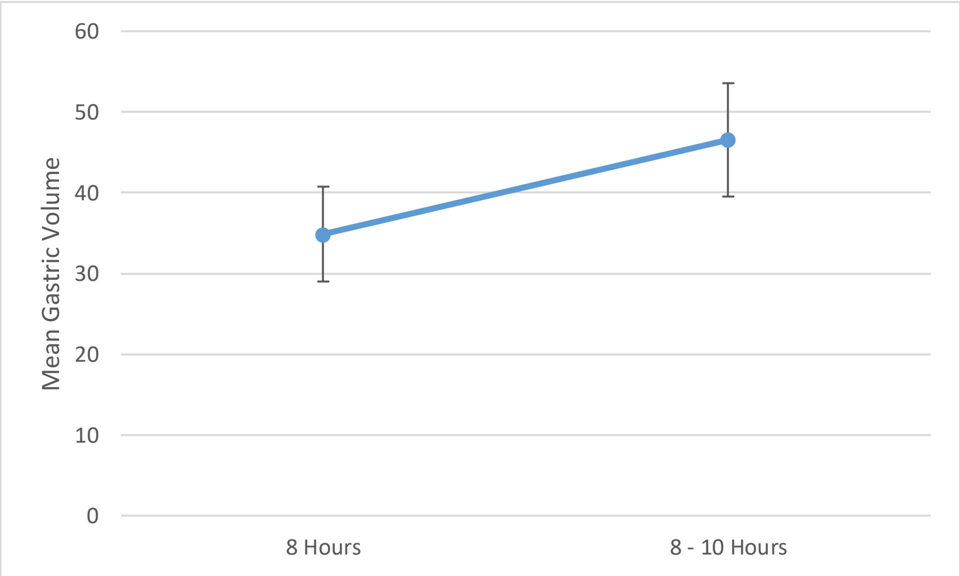
Graph 15: Comparison of risk of aspiration among study population

Table 16 : Correlation between gastric volume and other parameters

Parameters	Gastric Volume	
	R-value	P-value
FBS(mg/dl)	0.731**	<0.001
HbA1C(%)	0.924**	<0.001
Fasting Duration(hrs)	0.706**	<0.001

Table 17 : Mean Distribution of gastric volume in fasting duration

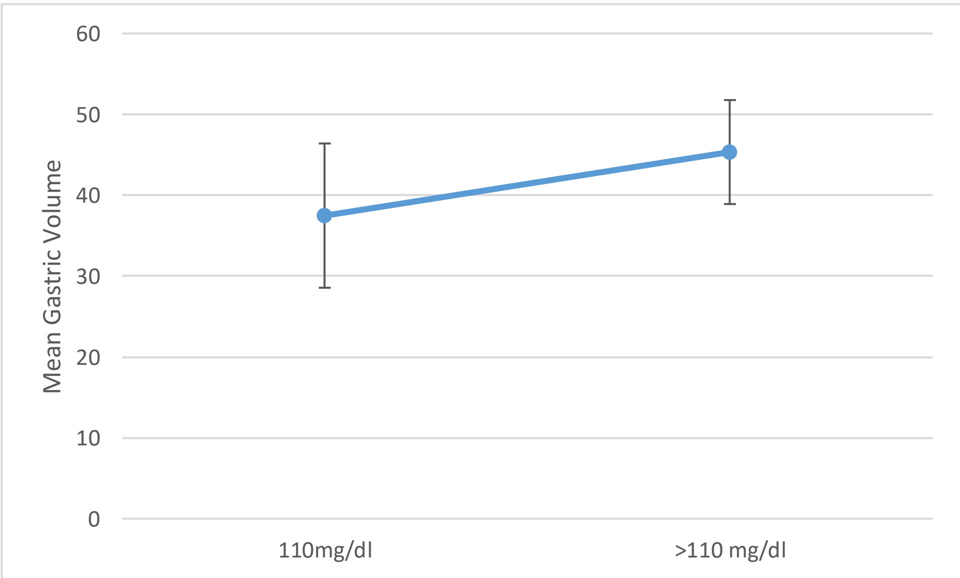
Fasting Duration	Mean	SD	t-test	p-Value
8 Hours	34.8753	5.87531	6.153	<0.001
8 - 10 Hours	46.5456	7.02077		
Statistically significant as p value less than 0.05				



Graph 16: Mean Distribution of gastric volume in fasting duration

Table 18: Mean Distribution of gastric volume in Fasting blood sugar

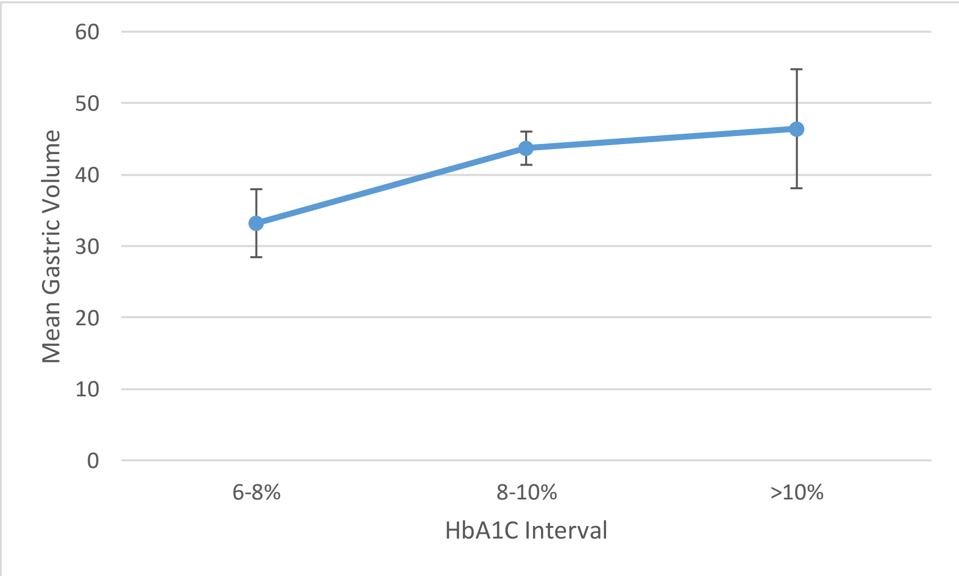
Fasting Blood Sugar	Mean	SD	t-test	p-Value
110mg/dl	37.48	8.92	3.55	0.0008
>110 mg/dl	45.34	6.43		
Statistically significant as p value less than 0.05				



Graph 17: Mean Distribution of gastric volume in Fasting blood sugar

Table 19 : Mean Distribution of gastric volume in HbA1C

HbA1C	Mean	SD	t-test	p-Value
6-8%	33.1915	4.75747	29.12	<0.001
8-10%	43.6911	2.32965		
>10%	46.4144	8.33		
Statistically significant as p value less than 0.05				



Graph 18 : Mean Distribution of gastric volume in HbA1C

DISCUSSION

Numerous scintigraphic studies have shown that approximately 30-50% of patients with long-term diabetes mellitus experience delayed gastric emptying. However, the prevalence of disordered gastric emptying in newly diagnosed Type 2 diabetes mellitus patients remains controversial. Diabetes is often seen as a high-risk condition that poses significant challenges to anesthesiologists in various ways. One major concern is the risk of pulmonary aspiration, as diabetic patients are considered to have a full stomach due to autonomic gastropathy. Camilleri et al. noted that delayed gastric emptying is a prominent feature of diabetes mellitus[39-42]

Putte et al. conducted a retrospective cohort study involving 538 patients and discovered that a standard fasting interval does not guarantee sufficient gastric emptying, even in healthy individuals. In their study, 32 patients had fasting gastric volumes exceeding the safe limit, necessitating a change in the anesthetic induction plan.[41]

Diabetic patients have long been considered high-risk, but no real-time study has accurately stratified their fasting gastric volume status or measured the actual gastric volume using gastric ultrasound'. With the introduction of ERAS protocols and more liberal fasting guidelines, ultrasound may prove beneficial in assessing gastric volume in diabetic patients during perioperative care. This study conducted an ultrasonography of the gastric antrum to assess the fasting stomach volume of diabetes and non-diabetic patients who were scheduled for elective surgery.

Aspiration of gastric contents, though rare, is a significant complication associated with general anesthesia. Diabetes mellitus (DM) presents various challenges to anesthesiologists, as diabetic patients are often considered to have full stomachs and are at increased risk of pulmonary aspiration due to autonomic gastropathy[39]

Van de Putte et al.[2014] [43] conducted a retrospective cohort study on patients scheduled for elective surgery under general anesthesia, using ultrasound to assess gastric content. Their study found that a small percentage (6.2%) of these patients could have a full stomach. Antral ultrasonography could be included into an algorithm to evaluate the risk of pulmonary aspiration in diabetic patients prior to the induction of general anesthesia, thanks to the development of real-time bedside or point-of-care ultrasonography. There have been limited studies comparing preoperative fasting residual gastric volume between diabetic and non-diabetic patients.

Due to the lack of data, it was considered more prudent to assume that patients had a 'full stomach' during emergency scenarios. This led to the cancellation of surgeries, postponing of elective cases, or making changes to treatments in order to prevent aspiration, such as using rapid sequence induction and tracheal intubation. Preoperative fasting recommendations are beneficial in reducing risk for elective cases in patients with few comorbidities. There is a widely held belief that fasting a patient for a duration over 6 hours is considered to be in the 'safe' category in terms of the risk of aspiration. Various techniques have been described to assess stomach contents, including paracetamol absorption, electrical impedance tomography, radio-labelled diet, polyethylene glycol dilution, and gastric content aspiration.[44,45] However, these methods are not suitable for the perioperative period and none have proven to be foolproof or easy to use. With the advent of newer portable ultrasound machines, it is now possible to accurately diagnose the presence of unsafe stomach contents noninvasively. This allows clinicians to individualize aspiration risk at the bedside and guide anesthetic management more appropriately.[44]

Demographic Profile

Demirel et al[2023][35], observed that mean age of the patients between the groups was statistically significant(p-value=0.005) also body mass index was statistically highly significant between the groups(p-value=0.001) which was similar to our study, it means that diabetes is more common among older ages and that also with overweight or obesity. In the same study ultrasound evaluations indicated that thirty one percent were grade 0, fifty three percent were grade 1, and fifteen percent were grade 2 in the antrum.

Kenchey et al[2023][36] observed that, all patients of Group D were ASA II (owing to their diabetic status) while in Group ND, 43 patients were ASA I and 47 were ASA II and this difference in the distribution of patients between the groups was statistically significant(p-value<0.001) Also Mean body mass index (BMI) of patients included in group D was 25.64±3.003 kg/m2 and in Group ND was 23.47±2.908 kg/m2When compared to their non-diabetic counterparts, the diabetic patients' mean weight and BMI were considerably greater (p-value=0.0009). Because we only included patients with long-standing diabetes in the diabetic group, the study found that the average age of patients with diabetes was much greater than that of non-diabetics. Furthermore, because diabetes and obesity are known to be associated, patients with diabetes have greater BMIs than those without the disease. Also previous studies conducted have significant differences in age and weight of patients in diabetic and non-diabetic groups. [46]

In the present study demographic parameters like mean age distribution between diabetic and non-diabetic patients were statistically significant (p-value<0.001). Majority of the patients were males compared to females and this difference between the groups were statistically not significant. ASA distribution between the groups were statistically significant, among diabetic patients, majority of the patients were of grade II compared to grade I and its vice versa in non-diabetic group. Mean BMI among diabetic patients were more as compared to non diabetic patients, and this difference between the groups were statistically not significant (p-value=0.0013) and also distribution of grading of contents between diabetic and non-diabetic patients were statistically significant(p-value<0.001)

One more study by Haramgatti, et al[2022][47] observerd that, the mean age of the study population in group D was 54.68 ± 9.68 and 49.58 ± 11.9 in group ND (*p*-value = 0.039) with a minimum age of 20 years and a maximum of 70 years. The diabetic group had older patients compared to non-diabetic patients. This difference was also statistically significant and a similar age difference was there in studies by Rabab Sabry et al.[2019][30] This age difference was probably due to criteria of a minimum of 8 years from diagnosis in the diabetic group. Though both the groups were similar and comparable regarding gender and no statistically significant difference was found.

In the present study , 43.3% of the diabetic patients have 6-8 yrs of diabetes,32.69% of the diabetic patients have 8-10yrs of diabetes and 25% of the diabetic patients have more than 10 yrs of diabetes. Mean FBS among diabetic patients is 107± 9.80 and 89± 5.86 among non diabetic patients, mean FBS is more among the diabetic patients compared to non diabetic patients and this difference between the groups were statistically significant. Mean RBS among diabetic patients is 195.90 ± 20.59 and 112 ± 8.11 among non diabetic patients, mean RBS is more among the diabetic patients compared to non diabetic patients and this difference between the groups were statistically significant. HbA1C distribution between the groups were statistically significant, among diabetic patients, majority of the patients were between 6-10% and majority of the patients were <6% non-diabetic group. Mean HbA1C among the diabetic is 8.46 ± 1.89, similarly a study by Kenchey et al[2023][36] observed that, Mean HbA1C was 8.93011 ± 2.16424 in the diabetic group, and as per their study, as poor glycemic control in diabetics is positively associated with neuropathic gastrointestinal complications and delay in the emptying stomach.

Cross Sectional Area (CSA) and Gastric Volume

In the present study mean cross sectional area among diabetic patients was more as compared to non-diabetic patients at supine position, and this difference between the group was statistically significant(p-value<0.001), also at lateral position also it was more among diabetic groups and mean difference between the group was statistically significant(p-value<0.001). And Mean gastric volume among diabetic patients were more compared to non-diabetic patients and this difference between the groups were statistically significant.

Study by Demirel et al[2023][35], observed that, approximately 15% of patients with type 2 DM exhibited a full stomach post-adherence to the conventional preoperative fasting guidelines set by the ASA. Significantly, individuals in this study exhibited higher parameters including age, BMI, duration of solid fasting, and CSA values in both supine and RLD positions.

Another study by Anahi Perlas et al[2009] and Schmitz et al[2009] Studies have demonstrated that the antral cross-sectional area (CSA) is greater in the right lateral decubitus (RLD) position compared to the supine position, for a given volume of stomach fluid. This is because the fluid moves towards the antrum as a result of gravity. Measurements taken in the RLD posture are more sensitive in detecting changes in volume, especially in situations where the volume is low. However, in our investigation, we conducted measurements both in the supine position and in the right lateral decubitus (RLD) position. [47,48] Kenchey et al2023],[36] have done the measurement in the RLD position between diabetic and non-diabetic patients and they calculated value of CSA in diabetics was significantly higher than non-diabetics ($p < 0.0001$) which was also similar to our study.

Another study by Khan et al.[2023][32] observed that, After adequate standard fasting period of 8 h, the bedside ultrasound was conducted in study participants to assess the gastric antrum cross sectional area (CSA) and gastric volume. Patients with diabetes had higher mean antral cross-sectional area (CSA) and mean estimated stomach volume (GV) than patients without diabetes, however these differences were not statistically significant. Comparing diabetic individuals to non-diabetics, it was also discovered that the mean stomach volume per kilogram bodyweight was marginally greater in the diabetic group.

X. Xiao et al[2019], in the review study, they identified seven such studies,[30,31,49-53]and the results were mixed, with five studies reporting small negligible gastric content similar to controls [30,49-53] and two studies reporting a higher incidence of 'full stomach' in patients with DM.[30,31] There have been varying opinions on what threshold of GRV increases aspiration risk. In earlier studies, a volume of >0.40 ml kg_1 was arbitrarily defined to be indicative of an increased risk for aspiration.[54] However, that value represented the volume of hydrochloric acid directly injected into the trachea of animals in an experimental setting, and its clinical relevance as a threshold of GRV has been questioned.[54] Recently, the consensus is that a GRV up to 1.5 ml kg is common in healthy, fasted patients and can be considered safe.[55-58].

Though the recent studies suggest that < 1.5ml/kg is having low risk of aspiration , in our study we found that patients with <0.40ml/kg are having no risk of aspiration and patients having 0.40ml – 1.5ml/kg are having low risk of aspiration. similary the above study found that <1.5ml/kg are having low risk of aspiration and patients with >1.5ml/kg are having high risk of aspiration.

Heena Garg *et al[2020].*[49] observed the CSA in RLD was 2.30 ± 1.18 cm2 and 3.73 ± 1.61 cm2 in non-diabetic and diabetic patients, respectively. The mean residual gastric volumes were 4.20 ± 22.26 ml and 9.15 ± 25.70 ml in non-diabetic and diabetic patients, showing statistically significant more fasting residual gastric volume in diabetic patients. which is similar to our study CSA in RLD was 1.69±0.13 cm2 and 5.04±0.68 cm2 in non-diabetic and diabetic patients, respectively. The mean residual gastric volumes were 9.28±4.11 ml and 39.07±8.39 ml in non-diabetic and diabetic patients, showing statistically significant more fasting residual gastric volume in diabetic patients.

Limitations:

The sample size studied was relatively small to draw conclusions. Effect of obesity on fasting gastric volume was not evaluated, as obesity coexists in diabetics and can be a confounding factor. We did not study the effect on gastric volume with use of H2 blockers

CONCLUSION

Based on the observations and results, along with comparisons to other studies, we can conclude that gastric ultrasound is a simple and non-invasive method for assessing stomach content and volume. It is an effective tool for evaluating the risk of aspiration, particularly during anesthesia. However, because of delayed gastric emptying, people with longstanding diabetes remain vulnerable to aspiration even after a sufficient period of fasting. Diabetic patients have increased stomach antral cross-sectional area and gastric volumes as observed using ultrasound, indicating a delay in gastric emptying. While qualitative grading can be used for screening, quantitative assessment offers a more reliable estimate of gastric volume.

SUMMARY

This comparative study titled, "EVALUATION OF GASTRIC RESIDUAL VOLUME USING ULTRASOUND IN FASTING DIABETIC PATIENTS AND NON DIABETIC PATIENTS SHEDULED FOR ELECTIVE SURGERIES" was carried out from April 2022 to June 2024 in the department of anesthesiology at shri BM Patil medical college and hospital, BLDE University , Vijayapura.

This study was designed to compare the gastric residual volume among diabetic and non diabetic patients using ultrasonography in patients undergoing elective surgeries.

The objectives of this study were to measure the gastric residual volume and compare among both the groups with respect to HbA1C,blood sugars , fasting duration.

The study population of 104 patients were selected between the age of more than 20 years and less than 80 years of age under ASA I,II and III. They were divided into two groups i,e. Group D and Group ND with 52 patients in each group.

Mean age distribution between diabetic and non-diabetic patients were statistically significant(p-value<0.001), majority of the patients were males compared to females, ASA distribution between the groups were statistically significant,(p-value<0.001), mean BMI distribution between diabetic and non-diabetic patients were statistically significant, distribution of grading of contents between diabetic and non-diabetic patients were statistically significant, mean cross sectional area among

diabetic patients was more as compared to non-diabetic patients at supine position as well as at lateral position and it was statistically significant.(p-value<0.001), mean Gastric Volume distribution between diabetic and non-diabetic patients were statistically significant(p-value<0.001), 42.3% of the patients had duration of diabetes was 6-8 years followed by 32.69% patients had 8-10 years and 25% of the patients had more than 10 years, difference in the distribution of FBS between diabetic and non-diabetic statistically significant.(p-value<0.001), in this study we found that patients with gastric volume is positively corelated with FBS, Majority of the patients had HbA1c level was between 6-10% among diabetic and is positively correlating with gastric volume, Fasting duration among the study population was statistically in significant, distribution of aspiration between diabetic and non-diabetic was observed statistically significant, in this study we found that low risk of aspiration is observed among the patients having gastric volume between 0.4-1.5ml/kg.

Thus gastric ultrasonography can be used as a safer, reliable ,easy and non-invasive method for measurement of GRV preoperatively in patients posted for elective surgery.

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Patient Information Sheet

Title: "Evaluation of gastric residual volume using ultrasound in fasting diabetic patients and non-diabetic patients scheduled for elective surgeries: A Comparative Study"

Investigators: Dr. T. Jyothi Swaroop

Study Location BLDE (DU) Shri. B. M. PatilMedical College, Hospital and Research Centre Vijayapura.

Details: All patients posted for elective surgeries will be included in this study, both diabetic and non-diabetic. Patients with other co-morbidities will be excluded.

This study aims to reduce the incidence of intraoperative and perioperative aspiration in patients, especially diabetics, undergoing elective surgeries under general anaesthesia. The patient and the attendees will be completely explained about the procedure being done, i.e., peri-operative ultrasound assessment.

Ultrasound assessment will be avoided in patients who are taking medication for upper gastro-intestinal tract, chronic kidney disease, hypothyroidism, connective tissue disorder, On antidepressant medication, previous oesophageal or abdominal surgery obese patients, pregnant patients, and patients with nasogastric tubes in situ

Please read the information and discuss it with your family members. You can ask any question regarding the study. If you agree to participate in the study, we will collect information. Relevant history will be taken. This information collected will be used only for dissertations and publications.

All information collected from you will be kept confidential and will not be disclosed to any outsider. Your identity will not be revealed. There is no compulsion to agree to this study. The care you will get will not change if you don’t wish to participate. You are required to sign or provide a thumb impression only if you voluntarily agree to participate in this study.

Date:

DR. Sridevi Mulimani — DR. T.Jyothi Swarooop

(Guide) — (Investigator)

PROFORMA

STUDY: Evaluation of gastric residual volume using ultrasound in fasting diabetic patients and nondiabetic patients scheduled for elective surgeries.

Patient Details:

Name: Height: Diagnosis:

Age: Weight: Surgical procedure:

Sex: BMI:

Past history:

General physical examination:

Pallor Icterus Cyanosis Clubbing Edema

Lymphadenopathy Mallampatti Grading (I II III IV)

Vital parameters:

Pulse Blood pressure Respiratory rate Temperature

Systemic Examination:

CVS RS CNS PER ABDOMEN

Investigations:

Hb: TLC: Platelet count: UrineRoutine:

HIV: HbsAg: HCV: HbA1c:

FBS: UKB Drug Therapy:(Insulin/Oral):

Parameters:

Measurements	Nondiabetic patients (Group -ND)	Diabetic patients (Group-D)
CSA supine position(mm2)		
CSA right lateral position(mm2)		
Gastric volume(ml)		
Grading of contents		
0		
1		
2		
solid		
Aspiration		

Variables			Group ND	Group D
Duration of diabetes		6-8yrs		
		8-10yrs		
		>10yrs		
Blood sugar levels	**Fasting blood sugar**	110mg/dl		
		>110 mg/dl		
	Random blood sugar	Up to 200 mg/dl		
		>200 mg/dl		
HbA1C		6-8%		
		8-10%		
		>10%		
Fasting duration		8 hrs		
		8-10hrs		
		>10 hrs		

BIO-DATA

Guide Name: Dr. Sridevi Mulimani

Date of Birth: 11/11/1966

Education: MBBS-1990 (KIMS, HUBLI)

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Azadi Ka Amrit Mahotsav

BLDE
(DEEMED TO BE UNIVERSITY)
Declared as Deemed to be University u/s 3 of UGC Act, 1956
Accredited with 'A' Grade by NAAC (Cycle-2)
The Constituent College
SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA

BLDE (DU)/IEC/ 788/2022-23 30/8/2022

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this University met on **Friday, 26th August, 2022 at 3.30 p.m. in the Department of Pharmacology** scrutinizes the Synopsis of Post Graduate Student of BLDE (DU)'s Shri B.M.Patil Medical College Hospital & Research Centre from ethical clearance point of view. After scrutiny, the following original/ corrected and revised version synopsis of the thesis/ research projects has been accorded ethical clearance.

TITLE: "**Evaluation of gastric residual volume using ultrasound in fasting Diabetic patients and non diabetic patients scheduled for elective Surgeries; A Comparative study**".

NAME OF THE STUDENT/PRINCIPAL INVESTIGATOR: Dr.T Jyothi Swaroop

NAME OF THE GUIDE Dr.Sridevi M M, **Dept. of Anaesthesiology**

Dr. Santoshkumar Jeevangi
Chairperson
IEC, BLDE (DU),
VIJAYAPURA

Chairman,
Institutional Ethical Committee,
BLDE (Deemed to be University)
Vijayapura

Dr.Akram A. Naikwadi
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VIJAYAPURA

MEMBER SECRETARY
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Vijayapura-586103. Karnataka

Following documents were placed before Ethical Committee for Scrutinization.

- Copy of Synopsis/Research Projects
- Copy of inform consent form
- Any other relevant document

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Master chart

Sr. No	Group	Name	Age	Gender	ASA	Weight(KG	Height(CM	BMI(Kg/M2	y of Diabet	g Duration	FBS(mg/dl	RBS(mg/dl	HbA1C(%)	ameter[su	ameter[su	(cm2)[sup	Diameter[R	Diameter[R	SA(cm2) RL	stric Volum	ing of con	egurgitatio	piration ris
1	D	rajappa	48	M	1	62	164	23.05	8	8	88	164	7	2.87	1.14	2.56	2.86	2.14	4.8	35.64	1	no	yes
2	D	hanagouda	49	M	2	64	165	23.5	10	8	102	186	7.5	2.94	1.18	2.72	3.02	2.13	5.05	38.01	1	no	yes
3	D	basavaraj	44	M	2	67	167	24.02	9	10	98	217	11	3.02	1.46	3.46	3.12	2.22	5.43	49.95	2	no	yes
4	D	manjappa	45	M	2	68	164	25.28	8	11	112	196	13	3.08	2.11	5.1	3.14	2.34	5.77	53.64	2	no	yes
5	D	yamanavva	41	F	3	69	171	23.59	7	10	106	184	12	3.12	2.06	5.04	3.15	2.12	5.24	51.02	2	no	yes
6	D	shridevi	54	F	3	68	162	25.91	12	9	106	178	7.5	2.96	1.96	4.55	3.17	2.21	5.5	38.18	1	no	yes
7	D	kamala	39	F	2	71	163	26.72	7	10	103	208	11	2.84	1.88	4.19	3.01	2.01	4.75	46.43	2	no	yes
8	D	dhenendra	63	M	3	73	164	27.14	13	8	96	218	10	2.93	1.98	4.55	3.18	2.67	6.66	43.59	2	no	yes
9	D	vittal	58	M	2	72	168	25.51	10	8	115	176	6.5	2.78	1.84	4.01	2.95	2.11	4.88	24	0	no	yes
10	D	perappa	54	M	2	77	163	28.98	9	8	94	168	10	3.02	1.93	4.57	3.24	2.44	6.2	48.4	2	no	yes
11	D	siddappa	48	M	3	73	161	28.16	10	10	108	195	12	3.12	2.12	5.19	3.32	2.47	6.44	59.58	2	no	yes
12	D	shrikanth	49	M	2	69	163	25.97	8	8	94	207	6.8	2.88	1.78	4.02	2.94	1.98	4.57	31	1	no	yes
13	D	basavaraj	48	M	2	64	163	24.08	8	8	112	187	6.8	2.94	2.12	4.89	2.98	2.01	4.7	34.18	1	no	yes
14	D	poornima	39	F	3	68	165	24.97	7	9	114	223	12.5	2.84	1.98	4.41	2.92	2.24	5.13	51.97	2	no	yes
15	D	hedha beg	58	F	2	72	166	26.12	11	9	98	214	11.5	3.12	2.45	6.003	3.44	2.64	7.13	56.85	2	no	yes
16	D	bouravva	56	F	3	73	168	25.86	8	8	106	196	6.5	2.78	1.98	4.32	2.98	2.14	5	28.32	1	no	yes
17	D	laxmi	48	F	3	66	171	22.57	9	8	104	179	7	2.65	2.14	4.45	2.87	2.01	4.53	31.69	0	no	yes
18	D	shankarling	56	M	3	68	159	26.89	10	8	92	184	6.3	2.77	2.16	4.69	2.88	2.11	4.77	24.96	0	no	yes
19	D	basavaraj	54	M	3	70	164	26.02	10	8	117	211	7	2.94	2.12	4.89	3.01	2.14	5.05	31.61	0	no	yes
20	D	mahadev	59	M	2	71	164	26.39	12	8	106	188	7.5	3.01	2.12	5.01	3.12	2.44	5.97	38.64	0	no	yes
21	D	vittal	44	M	2	72	165	26.44	13	9	98	208	9	2.88	2.14	4.84	2.94	2.18	5.03	44.11	1	no	yes
22	D	bdul rehma	39	M	3	69	167	24.74	9	8	114	214	8.5	2.67	2.17	4.55	2.81	2.11	4.65	44.97	1	no	yes
23	D	siddappa	45	M	2	68	168	24.09	7	8	99	203	7.5	2.54	2.12	4.22	2.65	2.12	4.41	33.78	1	no	yes
24	D	shrikanth	39	M	2	65	164	24.16	7	8	100	204	7.5	2.44	1.98	3.79	2.57	2.06	4.15	37.67	1	no	yes
25	D	gopal	46	M	2	67	163	25.21	8	8	113	211	7.5	3.01	1.94	4.58	3.11	2.01	4.9	39.66	1	no	yes
26	D	l ramachar	44	M	3	70	165	25.71	8	8	108	194	7	2.93	1.98	4.55	3.01	1.88	4.44	35.5	0	no	yes
27	D	vittal rao	49	M	2	64	165	23.5	10	8	94	196	7	2.87	2.11	4.75	2.98	2.12	4.96	36.69	0	no	yes
28	D	laxmi	38	F	2	70	164	26.02	8	10	109	212	10	3.01	2.12	5.01	2.94	1.98	4.57	45.08	1	no	yes
29	D	kamalabai	62	F	2	58	158	23.23	12	10	121	216	10	2.98	2.12	4.96	3.23	2.54	6.44	41.66	2	no	yes
30	D	rudramma	42	F	2	55	157	22.31	8	8	104	215	8.5	2.86	1.98	4.44	2.98	2.01	4.7	41.86	1	no	yes
31	D	haranamm	39	F	2	59	164	21.93	7	11	99	221	11	2.76	2.11	4.57	2.86	2.16	4.85	47.89	1	no	yes
32	D	kaveri bai	42	F	2	60	167	21.51	8	9	121	208	7.5	2.64	1.94	4.02	2.84	1.99	4.43	37.91	0	no	yes
33	D	suresh	46	M	3	68	168	24.09	8	8	123	244	6.5	2.66	1.83	3.82	2.76	1.88	4.07	27.54	0	no	yes
34	D	bismilla	57	M	3	67	166	24.31	12	8	106	168	8.5	2.96	2.21	5.13	3.06	2.34	5.62	36.09	0	no	yes
35	D	beemappa	47	M	3	65	165	23.87	9	8	111	221	9	2.89	2.16	4.9	2.98	2.21	5.17	42.32	2	no	yes
36	D	giridhar	43	M	3	67	158	26.83	8	8	109	217	8.5	2.73	1.86	3.98	2.84	1.94	4.32	35.03	1	no	yes
37	D	shivanand	39	M	2	68	159	26.89	7	9	97	174	10	2.88	1.93	4.36	2.92	1.92	4.4	41.32	1	no	yes
38	D	syed	41	M	2	69	163	25.97	8	8	115	192	8.5	2.73	1.84	3.94	2.88	1.92	4.34	37.88	1	no	yes
39	D	mohomadh	39	M	2	70	166	25.4	7	8	125	217	9	2.82	1.82	4.03	2.93	1.92	4.41	41.46	2	no	yes
40	D	eswarappa	48	M	2	72	164	26.76	10	10	111	203	12	3.12	2.21	5.41	3.33	2.38	6.22	56.37	2	no	yes
41	D	hankarapp	54	M	2	69	168	24.44	12	8	103	216	8.5	3.01	2.11	4.98	3.14	2.26	5.57	39.2	1	no	yes
42	D	hivalingapp	57	M	2	71	167	25.45	12	8	98	188	8.5	3.21	2.01	5.06	3.26	2.14	5.47	33.9	1	no	yes
43	D	suresh	47	M	2	77	164	28.62	9	8	99	168	6.5	2.65	1.88	3.91	2.76	1.99	4.31	29.76	0	no	yes
44	D	sunanda	48	F	2	72	170	24.91	8	8	105	144	6.2	2.74	1.92	4.13	2.88	2.01	4.54	31.84	0	no	yes
45	D	laxmi	51	F	2	68	172	22.98	10	8	112	156	6	2.66	1.98	4.13	2.84	2.01	4.48	27.12	0	no	yes
46	D	mahantesh	44	M	2	69	164	25.65	9	9	115	167	7.5	2.72	2.11	4.5	2.88	2.11	4.77	40.32	2	no	yes
47	D	lakkappa	48	M	2	67	163	25.27	9	9	121	159	7.5	2.65	1.98	4.12	3.01	2.12	5.01	38.7	1	no	yes
48	D	bhimappa	56	M	2	64	168	22.67	12	8	127	183	7	3.12	1.98	4.85	3.32	2.06	5.37	33.72	1	no	yes
49	D	ningappa	52	M	3	70	162	26.67	11	8	124	188	6.5	2.76	1.92	4.16	2.93	2.01	4.62	27.89	1	no	yes
50	D	laxman	51	M	3	71	169	24.85	13	8	132	204	7	2.87	2.03	4.57	2.97	2.11	4.92	33.55	1	no	yes
51	D	ramu	51	M	3	69	159	27.29	12	8	112	184	6.5	2.79	1.97	4.31	2.89	2.01	4.56	28.29	1	no	yes
52	D	kasturi bai	44	F	2	68	163	25.59	10	10	104	213	10	2.95	1.94	4.49	3.03	2.15	5.11	45.28	2	no	yes

Sr. No	Group	Name	Age	Gender	ASA	Weight(KG	Height(CM	BMI(Kg/M2	y of Diabet	g Duration	FBS(mg/dl	RBS(mg/dl	HbA1C(%)	ameter[su	ameter[su	(cm2)[sup	Diameter[R	Diameter[R	SA(cm2) RL	stric Volum	ing of con	egurgitatio	piration ris
1	D	rajappa	48	M	1	62	164	23.05	8	8	88	113	7	2.87	1.14	2.56	2.86	2.14	4.8	35.64	1	no	yes
2	D	hanagouda	49	M	2	64	165	23.5	10	8	102	128	7.5	2.94	1.18	2.72	3.02	2.13	5.05	38.01	1	no	yes
3	D	basavaraj	44	M	2	67	167	24.02	9	10	98	132	11	3.02	1.46	3.46	3.12	2.22	5.43	49.95	2	no	yes
4	D	manjappa	45	M	2	68	164	25.28	8	11	112	143	13	3.08	2.11	5.1	3.14	2.34	5.77	53.64	2	no	yes
5	D	yamanavva	41	F	3	69	171	23.59	7	10	106	138	12	3.12	2.06	5.04	3.15	2.12	5.24	51.02	2	no	yes
6	D	shridevi	54	F	3	68	162	25.91	12	9	106	127	7.5	2.96	1.96	4.55	3.17	2.21	5.5	38.18	1	no	yes
7	D	kamala	39	F	2	71	163	26.72	7	10	103	129	11	2.84	1.88	4.19	3.01	2.01	4.75	46.43	2	no	yes
8	D	dhenendra	63	M	3	73	164	27.14	13	8	96	136	10	2.93	1.98	4.55	3.18	2.67	6.66	43.59	2	no	yes
9	D	vittal	58	M	2	72	168	25.51	10	8	115	144	6.5	2.78	1.84	4.01	2.95	2.11	4.88	24	0	no	yes
10	D	perappa	54	M	2	77	163	28.98	9	8	94	121	10	3.02	1.93	4.57	3.24	2.44	6.2	48.4	2	no	yes
11	D	siddappa	48	M	3	73	161	28.16	10	10	108	138	12	3.12	2.12	5.19	3.32	2.47	6.44	59.58	2	no	yes
12	D	shrikanth	49	M	2	69	163	25.97	8	8	94	129	6.8	2.88	1.78	4.02	2.94	1.98	4.57	31	1	no	yes
13	D	basavaraj	48	M	2	64	163	24.08	8	8	112	128	6.8	2.94	2.12	4.89	2.98	2.01	4.7	34.18	1	no	yes
14	D	poornima	39	F	3	68	165	24.97	7	9	114	127	12.5	2.84	1.98	4.41	2.92	2.24	5.13	51.97	2	no	yes
15	D	hedha beg	58	F	2	72	166	26.12	11	9	98	118	11.5	3.12	2.45	6.003	3.44	2.64	7.13	56.85	2	no	yes
16	D	bouravva	56	F	3	73	168	25.86	8	8	106	132	6.5	2.78	1.98	4.32	2.98	2.14	5	28.32	1	no	yes
17	D	laxmi	48	F	3	66	171	22.57	9	8	104	123	7	2.65	2.14	4.45	2.87	2.01	4.53	31.69	0	no	yes
18	D	shankarling	56	M	3	68	159	26.89	10	8	92	128	6.3	2.77	2.16	4.69	2.88	2.11	4.77	24.96	0	no	yes
19	D	basavaraj	54	M	3	70	164	26.02	10	8	117	143	7	2.94	2.12	4.89	3.01	2.14	5.05	31.61	0	no	yes
20	D	mahadev	59	M	2	71	164	26.39	12	8	106	141	7.5	3.01	2.12	5.01	3.12	2.44	5.97	38.64	0	no	yes
21	D	vittal	44	M	2	72	165	26.44	13	9	98	148	9	2.88	2.14	4.84	2.94	2.18	5.03	44.11	1	no	yes
22	D	bdul rehma	39	M	3	69	167	24.74	9	8	114	153	8.5	2.67	2.17	4.55	2.81	2.11	4.65	44.97	1	no	yes
23	D	siddappa	45	M	2	68	168	24.09	7	8	99	124	7.5	2.54	2.12	4.22	2.65	2.12	4.41	33.78	1	no	yes
24	D	shrikanth	39	M	2	65	164	24.16	7	8	100	120	7.5	2.44	1.98	3.79	2.57	2.06	4.15	37.67	1	no	yes
25	D	gopal	46	M	2	67	163	25.21	8	8	113	137	7.5	3.01	1.94	4.58	3.11	2.01	4.9	39.66	1	no	yes
26	D	l ramachar	44	M	3	70	165	25.71	8	8	108	140	7	2.93	1.98	4.55	3.01	1.88	4.44	35.5	0	no	yes
27	D	vittal rao	49	M	2	64	165	23.5	10	8	94	128	7	2.87	2.11	4.75	2.98	2.12	4.96	36.69	0	no	yes
28	D	laxmi	38	F	2	70	164	26.02	8	10	109	130	10	3.01	2.12	5.01	2.94	1.98	4.57	45.08	1	no	yes
29	D	kamalabai	62	F	2	58	158	23.23	12	10	121	147	10	2.98	2.12	4.96	3.23	2.54	6.44	41.66	2	no	yes
30	D	rudramma	42	F	2	55	157	22.31	8	8	104	136	8.5	2.86	1.98	4.44	2.98	2.01	4.7	41.86	1	no	yes
31	D	haranamm	39	F	2	59	164	21.93	7	11	99	126	11	2.76	2.11	4.57	2.86	2.16	4.85	47.89	1	no	yes
32	D	kaveri bai	42	F	2	60	167	21.51	8	9	121	147	7.5	2.64	1.94	4.02	2.84	1.99	4.43	37.91	0	no	yes
33	D	suresh	46	M	3	68	168	24.09	8	8	123	164	6.5	2.66	1.83	3.82	2.76	1.88	4.07	27.54	0	no	yes
34	D	bismilla	57	M	3	67	166	24.31	12	8	106	121	8.5	2.96	2.21	5.13	3.06	2.34	5.62	36.09	0	no	yes
35	D	beemappa	47	M	3	65	165	23.87	9	8	111	139	9	2.89	2.16	4.9	2.98	2.21	5.17	42.32	2	no	yes
36	D	giridhar	43	M	3	67	158	26.83	8	8	109	134	8.5	2.73	1.86	3.98	2.84	1.94	4.32	35.03	1	no	yes
37	D	shivanand	39	M	2	68	159	26.89	7	9	97	126	10	2.88	1.93	4.36	2.92	1.92	4.4	41.32	1	no	yes
38	D	syed	41	M	2	69	163	25.97	8	8	115	138	8.5	2.73	1.84	3.94	2.88	1.92	4.34	37.88	1	no	yes
39	D	mohomadh	39	M	2	70	166	25.4	7	8	125	145	9	2.82	1.82	4.03	2.93	1.92	4.41	41.46	2	no	yes
40	D	eswarappa	48	M	2	72	164	26.76	10	10	111	141	12	3.12	2.21	5.41	3.33	2.38	6.22	56.37	2	no	yes
41	D	hankarapp	54	M	2	69	168	24.44	12	8	103	131	8.5	3.01	2.11	4.98	3.14	2.26	5.57	39.2	1	no	yes
42	D	hivalingapp	57	M	2	71	167	25.45	12	8	98	127	8.5	3.21	2.01	5.06	3.26	2.14	5.47	33.9	1	no	yes
43	D	suresh	47	M	2	77	164	28.62	9	8	99	126	6.5	2.65	1.88	3.91	2.76	1.99	4.31	29.76	0	no	yes
44	D	sunanda	48	F	2	72	170	24.91	8	8	105	132	6.2	2.74	1.92	4.13	2.88	2.01	4.54	31.84	0	no	yes
45	D	laxmi	51	F	2	68	172	22.98	10	8	112	136	6	2.66	1.98	4.13	2.84	2.01	4.48	27.12	0	no	yes
46	D	mahantesh	44	M	2	69	164	25.65	9	9	115	132	7.5	2.72	2.11	4.5	2.88	2.11	4.77	40.32	2	no	yes
47	D	lakkappa	48	M	2	67	163	25.27	9	9	121	147	7.5	2.65	1.98	4.12	3.01	2.12	5.01	38.7	1	no	yes
48	D	bhimappa	56	M	2	64	168	22.67	12	8	127	143	7	3.12	1.98	4.85	3.32	2.06	5.37	33.72	1	no	yes
49	D	ningappa	52	M	3	70	162	26.67	11	8	124	153	6.5	2.76	1.92	4.16	2.93	2.01	4.62	27.89	1	no	yes
50	D	laxman	51	M	3	71	169	24.85	13	8	132	162	7	2.87	2.03	4.57	2.97	2.11	4.92	33.55	1	no	yes
51	D	ramu	51	M	3	69	159	27.29	12	8	112	130	6.5	2.79	1.97	4.31	2.89	2.01	4.56	28.29	1	no	yes
52	D	kasturi bai	44	F	2	68	163	25.59	10	10	104	127	10	2.95	1.94	4.49	3.03	2.15	5.11	45.28	2	no	yes

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