THE JOURNAL OF SURGICAL RADIOLOGY

# Journal of Surgical Radiology

Site: https://journalsurgrad.com/

ISSN Print 2156-213X| ISSN Online: 2156-4566 Volume: 05 Issue: 07 Open Access

Research Article

# "A STUDY TO COMPARE THE FREQUENCY OF GASTRIC INSUFFLATION USING ULTRASOUND DURING MANUAL AND PRESSURE-CONTROLLED MASK VENTILATION DURING INDUCTION OF GENERAL ANESTHESIA IN ADULT PATIENTS."

**Dr. Manasa G.[1], Dr. Sindhu S.[2], Dr. Darshan M. S.[3]**

[1]Assistant Professor, Department of Anaesthesiology, Chamarajnagar Institute of Medical Sciences, Karnataka, India.
[2]Assistant Professor, Department of Anaesthesiology, Chamarajnagar Institute of Medical Sciences, Karnataka, India.
[3]Associate Professor, Department of Anaesthesiology, Chamarajnagar Institute of Medical Sciences, Karnataka, India.

*Corresponding Author
Dr. Manasa G
Email:
manasagopal555@gmail.com

Article History
**Received:** 25-05-2026
**Revised:** 30-05-2026
**Accepted:** 10-06-2026
**Published:** 20-07-2026

**Citations:**
Manasa G, Sindhu S, Darshan MS. A study to compare the frequency of gastric insufflation using ultrasound during manual and pressure-controlled mask ventilation during induction of general anesthesia in adult patients. J Surg Radiol, V5 (7) 225-233

**Abstract**: ***Introduction:*** Gastric insufflation leads to gastric regurgitation and it increases the risk for pulmonary aspiration in patients undergoing surgery under general anesthesia. The pressure controlled mask ventilation is useful for a steady control of airway pressure and also helps in preventing higher peak airway pressures and prevents the gastric insufflation so it reduces the chances of aspiration into the airway. This study was conducted to compare the frequency of gastric insufflation in manual and pressure controlled mask ventilation during induction of general anesthesia **Material and Methods:** It was a prospective observational study conducted in a tertiary care hospital among the 70 patients underwent surgery under general anaesthesia. For selection of patients for the study, purposive sampling method was used. The total 70 patient were randomly allocated in to manual face mask ventilation group (35 patients) and pressure controlled ventilation group (35 patients). Group M was received manual ventilation by bag and mask at peak inspiratory pressure (PIP) of 13 cm of water and Group P was received Pressure controlled mask ventilation at PIP of 13 cm of water. Patients will be ventilated using the C and E technique of mask ventilation to obtain a tight seal around the face. End tidal carbon dioxide (Etco2) will be recorded. Antral area of the stomach was measured by ultrasonography. Data analysis was done using descriptive statistics and chi-square test. **Result:** The means of end tidal carbon dioxide (etCO2) at base line was lower in Face mask ventilation group than that of in the Pressure controlled ventilation group, as time progresses, it becomes same in as in the pressure controlled ventilation group. In pressure controlled ventilation group, the peak airway pressure did not showed noticeable variation and it remains same from base line up to the 120 seconds. The mean tidal volume was higher in face mask ventilation group than in the pressure controlled ventilation group of patients. Ultrasonography of stomach showed that, the mean antral area was more in the manual face mask ventilation group as compared to that of in the Pressure controlled ventilation group of patients. **Conclusion:** Peak airway pressure is not affected in pressure controlled ventilation group. There is no increase in the mean tidal volume in the pressure controlled ventilation group of patients. Ultrasonography of stomach showed that there is no increase in the mean antral area in the Pressure controlled ventilation group as compared to the manual face mask ventilation group of patients. Therefore pressure controlled ventilation is useful for prevention of gastric insufflation.

**Keywords**: Gastric Insufflation, manual face mask ventilation, Pressure controlled mask ventilation, Ultrasonography, General anesthesia

## INTRODUCTION

Ventilation via a face mask is a non invasive method of ventilation which can be used for short procedures as well as for bridging the gap to establishing a definite airway like an endotracheal tube[1]. This helps in achieving a positive airway pressure which aids in ventilation when the patient is paralysed[1, 2]. There are two ways of achieving the positive airway pressure, via bag and mask and the other is through pressure control mode once the adequate pressure for maintaining ventilation is known[3].

Bag and mask ventilation as compared to pressure controlled mode has higher probability of pressure deviations and hence carries a higher risk for gastric insufflation once pressure overshoots the lower esophageal sphincter pressure [3] . A peak inspiratory airway pressure of 13 cm of water is able to achieve adequate tidal volume as well as decreases the chances of inflating the stomach [3, 4].

The use of pressure controlled mode thus offers a steady control of airway pressure and helps in preventing higher peak airway pressures which in turn reduces the chances of aspiration [5, 9]. Gastric regurgitation as a result of gastric insufflation is a primary cause of increased risk for pulmonary aspiration [5].

This study is undertaken to compare the frequency of insufflation of the stomach in manual and pressure controlled mask ventilation during induction of general anesthesia in adult patients by ultrasound of the antrum of stomach and auscultation of the fundus of the stomach [6, 7, 8]. Antrum of the stomach is the most consistently identifiable structure with easily accessible landmarks via ultrasound[6, 7].

Need for the study: To compare the frequency of gastric insufflation in manual and pressure controlled mask ventilation during induction of general anesthesia in adult patients with the help of ultrasound of antrum of stomach.

# MATERIALS AND METHODS

A prospective observational study was conducted among the 70 patients underwent surgery under general anesthesia in a tertiary care hospital. The primary objective of this study was to compare the frequency of gastric insufflation in manual and pressure controlled mask ventilation during induction of general anesthesia in adult patients. The secondary objective of this study was to determine and compare tidal volume, peak inspiratory pressure, end tidal carbon dioxide ($ETCO_2$) during induction of general anaesthesia in manual and pressure controlled mask ventilation. For the selection of the patients for this study, purposive sampling method was used. The total 70 patient were randomly allocated in to manual face mask ventilation group (35 patients) and pressure controlled ventilation group (35 patients).
Inclusion criteria: ASA Class I and II patients posted for elective surgery under general anesthesia, Age group between 18-60 years of both the gender who were willing to participate and has given informed consent and Patients with BMI <30 kg/$m^2$

**Exclusion criteria:** BMI> 30 kg/$m^2$, Patient with anticipated difficult mask ventilation including facial deformities and cleft palate, Patients with risk of aspiration including pyloric stenosis, duodenal atresia, gastric bands etc, Patient with risk of upper airway obstruction Patients with known history of respiratory diseases and cerebrovascular disease

Patients fulfilling inclusion criteria who were willing to give informed consent were included in the study. The total 70 patients were divided to two groups. Pre operative evaluation was done for all patients with routine investigations and examination of cardiovascular, respiratory and central nervous system. On arrival to the operating room, Plethysmograph (SPO2), Non-Invasive Blood Pressure (NIBP) and Electrocardiogram (ECG) was connected and vitals were monitored. Group M (Manual ventilation with bag and mask) was received Manual ventilation by bag and mask at PIP of 13 cm of water and Group P (pressure controlled face mask ventilation) was received Pressure controlled mask ventilation at PIP of 13 cm of water.

Patients were placed in supine position. Patients were administered premedication glycopyrrolate 0.004 mg/ kg and fentanyl 2 mcg/ kg, patients were preoxygenated for 3 minutes with 100% oxygen. Patients were ventilated using the C and E technique of mask ventilation to obtain a tight seal around the face. The thumb and index finger press down the mask whereas the middle finger lifts the chin, the ring finger and the little finger elevate the ramus and angle of mandible respectively. End tidal carbon dioxide (Etco2) was recorded.

Baseline antral area was measured by using the B mode of Sonosite M – Turbo Ultrasound using low frequency transducer of 4-8 MHz using the curvilinear probe. The antrum was identified in Sagittal plane lying between the left lobe of liver and the pancreas with aorta and inferior vena cava posteriorly. Antral area was measured using the formula $\pi * D1 * D2/4$ with D1 and D2 being the longitudinal and anteroposterior diameter of the antrum. Patients were induced using propofol 2 mg/ kg. Atracurium 0.5 mg/ kg was administered for muscle relaxation.

The flow rate was maintained at 10 Litres per minute with 100% Oxygen. The tidal volume was maintained at 6-10 ml / kg and EtCO2 at 30-35 mmHg. Positive end expiratory pressure was kept zero in both groups. The presence or absence of gastric insufflation, gastric volume, tidal volume, peak airway pressure, EtCO2, SpO2, heart rate were recorded every 30 seconds for 180 seconds. Ultrasound of antrum area was done looking for acoustic shadow phenomena and comet tail artefact as signs of gastric insufflation. Antral area of the gastric antrum was measured using the above formula.

Patients in group M were ventilated manually with the help of bag and mask of appropriate size. The adjustable pressure limiting valve was set at 13 cm of water. The peak airway pressure was maintained between 12 to 13 cm of water. The frequency of respiration was maintained at 12 to 16 cycles per minute with I:E ratio of 1:2. Patients in group P were ventilated by pressure controlled mode with maintaining peak inspiratory pressure between 12 to 13 cm of water. Respiratory rate was set at 12 cycles per minute with I: E ratio of 1:2. The APL valve was set at 13 cm of water. Routine intra operative monitoring were continued throughout the surgery.

The parameters were measured during induction in both the groups were, Antral cross sectional area (CSA) by ultrasound, Presence of comet tail and acoustic shadow in gastric antrum by ultrasound, Tidal volume($V_t$), End tidal carbon dioxide(EtCO2), Heart rate (HR), Oxygen saturation (SpO2) and Peak inspiratory pressure (PIP).

**Statistical analysis:** Statistical analysis of the data were performed using SPSS23.0 (IBM SPSS Statistics. Descriptive statistics was presented using frequency, percentage, mean and Standard deviation. Comparison of

Numerical variables between the groups was done and Categorical variables was analysed using Chi square test. A p value <0.05 was considered statistically significant.

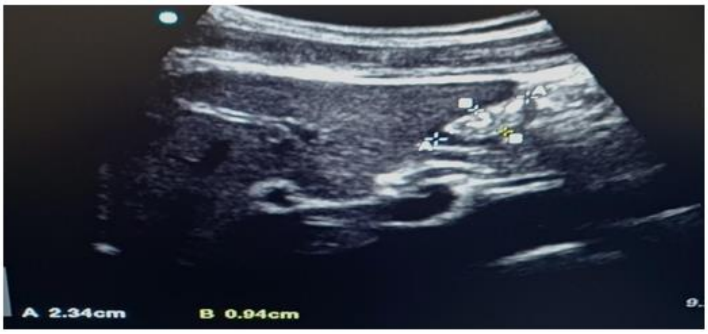


**Photo 1**

# RESULTS

In this study, total 70 patients were included. These 70 patients were randomly allocated in to two groups, Face mask ventilation group (35 patients) and Pressure controlled ventilation group (35 patients). The mean age (mean ± standard deviation) of the total 70 patients was 38.81 ± 10.49. The mean age of Face mask ventilation group and Pressure controlled ventilation group was found to be 39.83 ± 10.89 and 37.80 ± 10.14 respectively. Among total 70 patients, 32 (45.7%) were males and 38 (54.3) were females. Among total 35 patients in Face mask ventilation group, 16 (45.7%) were males and 19 (54.3%) were females. Similarly among total 35 patients in Pressure controlled ventilation group, 16 (45.7%) were males and 19 (54.3%) were females.

**Table 1: Age group wise distribution of patients received face mask ventilation and Pressure controlled ventilation during induction of general anesthesia (N=70)**

| Age group (in years) | Patients under general anesthesia | | Total (%) |
|---|---|---|---|
| | Face mask ventilation group (%) | Pressure controlled ventilation group (%) | |
| 18 to 30 | 8 (47.1) | 9 (52.9) | 17 (24.3) |
| 31 to 40 | 10 (47.6) | 11 (52.4) | 21 (30) |
| 41 to 50 | 9 (45) | 11 (55) | 20 (28.6) |
| 51 to 60 | 8 (66.6) | 4 (33.4) | 12 (17.1) |
| **Total** | **35** | **35** | **70** |

Among total 70 patients, 21 (30%) of the patients belonged to age group 31 to 40 years, among which 10 (47.6%) were in Face mask ventilation group and 11 (52.4%) were in Pressure controlled ventilation group. In this study, 17 (24.3%) patients were from the 18 to 30 years of age group and 12 (17.1%) of the patients were from the 51 to 60 years. [Table 1]

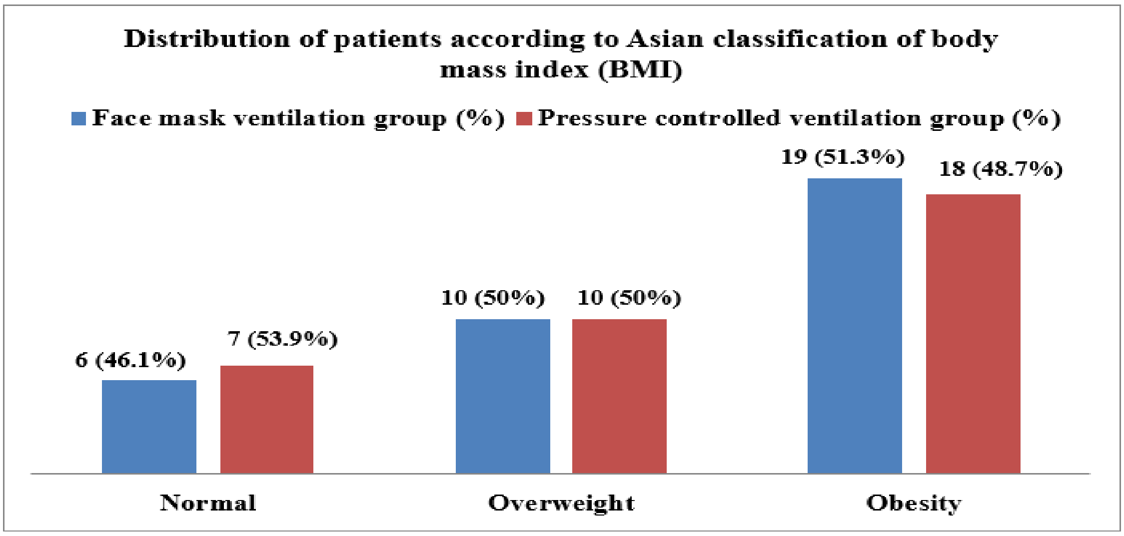


**Figure 1: Distribution of patients according to their body mass index (BMI). (N= 70)**

**Note:** Asian classification of Body mass index (BMI) in kg/m$^2$. Normal: 18.5 to 22.9. Over weight: 23 to 24.9. Obesity: 25 to 29.9.

Among total 70 patients, 13 (18.6%) of them have normal body mass index (BMI), of which 6 (46.1%) were in Face mask ventilation group and 6 (54.6%) in Pressure controlled ventilation group. Among 70 patients, 20 (28.6%) were overweight. Among total 70 patients, 37 (52.8%) were obese, of which 19 (51.3%) were in Face mask ventilation group and 18 (48.7%) in Pressure controlled ventilation group. [Figure 1]

**Table 2: Distribution of patients according to their body mass index (BMI) and gender (N= 70)**

| BMI in Kg/m$^2$ | Sex | | Total (%) |
|---|---|---|---|
| | Male (%) | Female (%) | |
| 18.5 to 22.9 | 4 (30.8) | 9 (69.2) | 13 (18.6) |
| 23 to 24.9 | 9 (45) | 11 (55) | 20 (28.6) |
| 25 to 29.9 | 19 (51.3) | 18 (48.7) | 37 (52.8) |
| **Total** | **32** | **38** | **70** |

**Note:** Asian classification of Body mass index (BMI) in kg/m$^2$. Normal: 18.5 to 22.9. Over weight: 23 to 24.9. Obesity: 25 to 29.9.

Among total 70 patients, 13 (18.6%) of them have normal body mass index (BMI), of which 4 (30.8%) were male patients and 6 (54.6%) were female patients. Among total 70 patients, 37 (52.8%) were obese, of which 19 (51.3%) were male patients and 18 (48.7%) were females patients. [Table 3]

**Table 3: Means of End tidal carbon dioxide (etCO2) of the patients received general anesthesia for surgery (N=70)**

| Time intervals | Means of End tidal carbon dioxide (etCO2) of the patients received general anesthesia for surgery | |
|---|---|---|
| | Face mask ventilation group (mean $\pm$ SD) | Pressure controlled ventilation group (mean $\pm$ SD) |
| **Baseline** | 32.66 $\pm$ 1.87 | 33.40 $\pm$ 1.81 |
| **At 30 seconds** | 33.20 $\pm$ 1.67 | 33.57 $\pm$ 1.63 |
| **At 60 seconds** | 33.46 $\pm$ 1.75 | 33.63 $\pm$ 1.71 |
| **At 90 seconds** | 33.54$\pm$ 1.65 | 33.49 $\pm$ 1.70 |
| **At 120 seconds** | 33.57$\pm$ 1.66 | 33.60 $\pm$ 1.78 |

The Means of End tidal carbon dioxide (etCO2) at baseline were 32.66 $\pm$ 1.87 and 33.40 $\pm$ 1.81 in Face mask ventilation group and Pressure controlled ventilation group respectively. The Means of End tidal carbon dioxide (etCO2) was assessed at different time intervals in the both group of patients, it was fond that there no difference in the Means of End tidal carbon dioxide (etCO2) among the Face mask ventilation group and Pressure controlled ventilation group. [Table 4]

**Table 4: Means of Peak airway pressure of the patients received general anesthesia for surgery (N=70)**

| Time intervals | Means of Peak airway pressure (in cm$H_2O$) of the patients received general anesthesia for surgery | |
|---|---|---|
| | Face mask ventilation group (mean $\pm$ SD) | Pressure controlled ventilation group (mean $\pm$ SD) |
| **Baseline** | 13.03 $\pm$ 0.56 | 13.00 $\pm$ 0.00 |
| **At 30 seconds** | 13.29 $\pm$ 0.62 | 13.00 $\pm$ 0.00 |
| **At 60 seconds** | 13.43 $\pm$ 0.69 | 13.00 $\pm$ 0.00 |
| **At 90 seconds** | 13.57 $\pm$ 0.69 | 13.00 $\pm$ 0.00 |
| **At 120 seconds** | 13.60 $\pm$ 0.91 | 13.00 $\pm$ 0.00 |

The means of peak airway pressure at baseline were 13.03 $\pm$ 0.56 and 13.00 $\pm$ 0.00 cm$H_2O$ in Face mask ventilation group and Pressure controlled ventilation group respectively. The peak airway pressure was measured at regular time intervals, the patients who received the Face mask ventilation during the general anesthesia, showed variation in the Peak airway pressure where as patients who received the Pressure controlled ventilation, did not showed the noticeable variation in the peak airway pressure. [Table 5]

**Table 5: Means of Tidal volume of the patients received general anesthesia for surgery (N=70)**

| Time intervals | Means of Tidal volume of the patients received general anesthesia for surgery | |
|---|---|---|
| | Face mask ventilation group (mean $\pm$ SD) | Pressure controlled ventilation group (mean $\pm$ SD) |
| **Baseline** | 415.43 $\pm$ 39.73 | 377.71 $\pm$ 24.74 |
| **At 30 seconds** | 434.63 $\pm$ 36.17 | 380.43 $\pm$ 24.43 |
| **At 60 seconds** | 442.86 $\pm$ 31.16 | 381.40 $\pm$ 26.33 |
| **At 90 seconds** | 435.11 $\pm$ 32.25 | 384.60 $\pm$ 27.07 |

| | | |
|---|---|---|
| **At 120 seconds** | 439.71 + 38.00 | 383.31 + 25.06 |

The means of Tidal volume at baseline were 415.43 + 39.73 and 377.71 + 24.74 in face mask ventilation group and pressure controlled ventilation group respectively. The tidal volume monitored at different time intervals in the both the groups. It is observed that the tidal volume increased as the time progresses from 30 seconds to 120 seconds. The tidal volume was lower in the patients who received pressure controlled ventilation as compared that of in the patients who received face mask ventilation. [Table 6]

**Table 6: Means of antral area of stomach the patients received general anesthesia for surgery (N=70)**

| Antral area of stomach | Means of antral area of the patients received general anesthesia for surgery | |
|---|---|---|
| | Face mask ventilation group (mean + SD) | Pressure controlled ventilation group (mean + SD) |
| **Before ventilation** | 2.11 + 0.32 | 2.20 + 0.40 |
| **After ventilation** | 4.11 + 0.67 | 2.51 + 0.50 |

Ultrasonography of stomach was done to assess occurrence of gastric insufflation in both groups. It was observed that, among the face mask ventilation group, the mean antral area of stomach before ventilation was 2.11 + 0.32 and increased to 4.11 + 0.67 after ventilation and lead to gastric insufflation, whereas among the Pressure controlled ventilation group of patients, the mean antral area of stomach before ventilation was 2.20 + 0.40 and increased to 2.51 + 0.50 after ventilation. This shows that the risk of occurrence of the gastric insufflation was lower in Pressure controlled ventilation group. [Table 7]

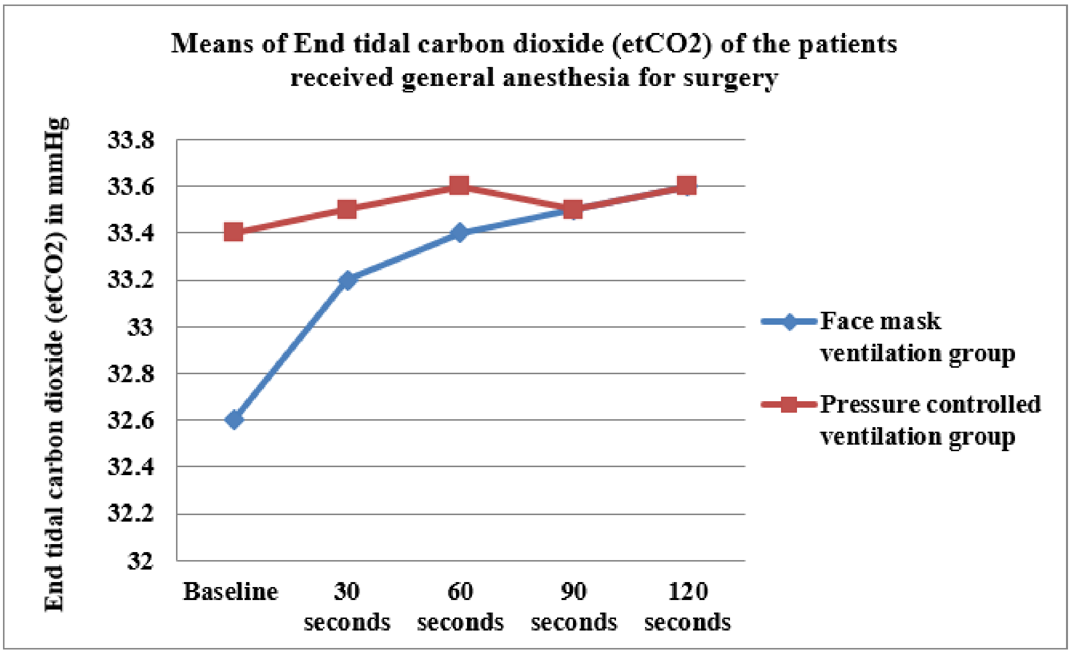


**Figure 2: Multiple line diagram showing the means of End tidal carbon dioxide (etCO2) of the two groups of patients received general anesthesia for surgery (N=70)**

The multiple line diagram is showing the relationship between the means of end tidal carbon dioxide (etCO2) and the time intervals during the induction of anesthesia among the patients of face mask ventilation group and Pressure controlled ventilation group underwent surgery. At the base line the means of end tidal carbon dioxide (etCO2) were 32.66 + 1.87 and 33.40 + 1.81 in Face mask ventilation group and Pressure controlled ventilation group respectively. The diagram shows that the means of end tidal carbon dioxide (etCO2) at base line was lower in Face mask ventilation group than that of in the Pressure controlled ventilation group. It was observed that as time progresses from baseline to 90 seconds, the end tidal carbon dioxide (etCO2) of the Face mask ventilation group becomes same as in the Pressure controlled ventilation group and also at 120 seconds. [Figure 2]

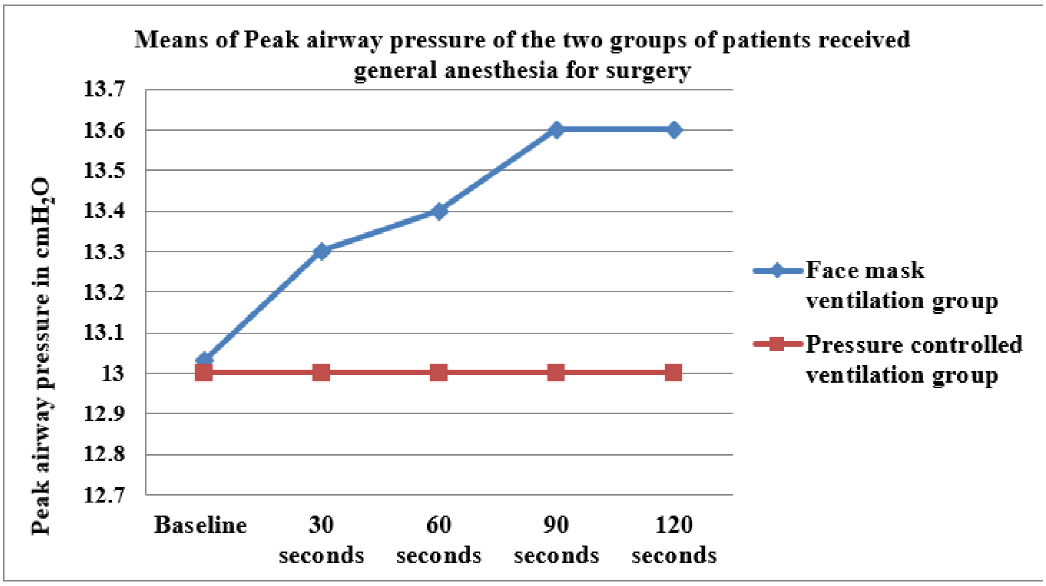


**Figure 3: Multiple line diagram showing the means of Peak airway pressure of the two groups of patients received general anesthesia for surgery (N=70)**

The multiple line diagram is showing the relationship between the means of peak airway pressure and the time intervals during the induction of anesthesia among the patients of face mask ventilation group and Pressure controlled ventilation group underwent surgery. The means of peak airway pressure at baseline were 13.03 $\pm$ 0.56 and 13.00 $\pm$ 0.00 cm$H_2O$ in Face mask ventilation group and Pressure controlled ventilation group respectively. The peak airway pressure was measured at regular time intervals, the patients who received the Face mask ventilation during the general anesthesia, the Peak airway pressure goes on increasing from baseline up to 90 seconds and becomes steady from 90 seconds and 120 seconds, where as patients who received the Pressure controlled ventilation, the peak airway pressure did not showed noticeable variation and it remains same from base line up to the 120 seconds, therefore Pressure controlled ventilation useful for prevention of gastric insufflation. [Figure 3]

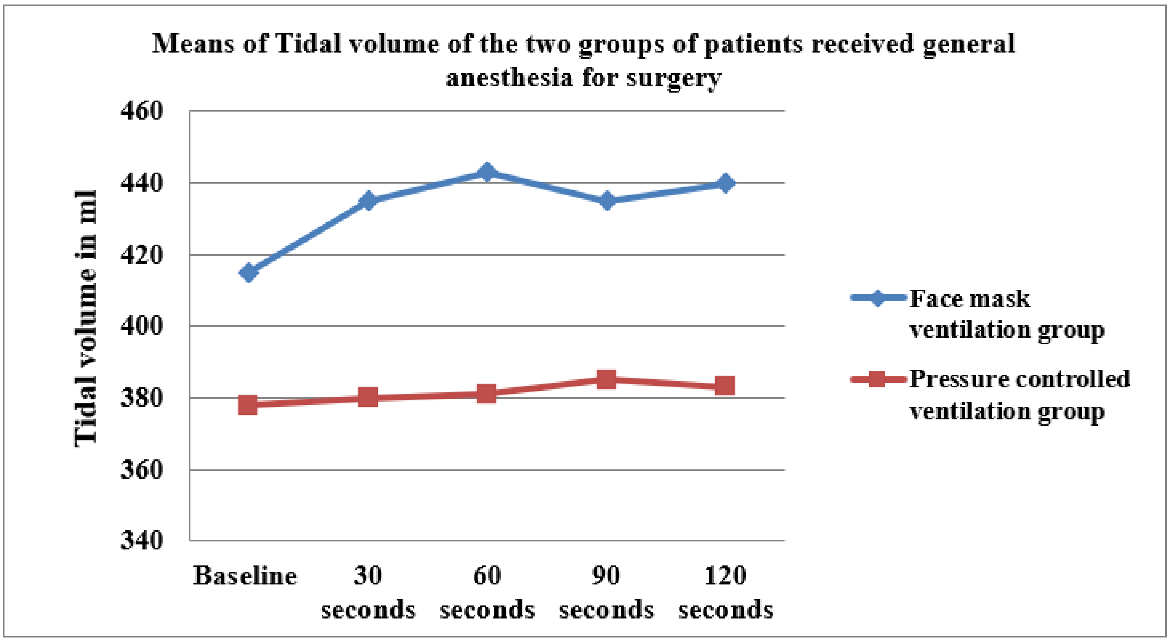


**Figure 4: Multiple line diagram showing the means of Tidal volume of the two groups of patients received general anesthesia for surgery (N=70)**

The multiple line diagram is showing the relationship between the means of tidal volume and the time intervals during the induction of anesthesia among the patients of face mask ventilation group and Pressure controlled ventilation group underwent surgery. The means of tidal volume at baseline were 415.43 $\pm$ 39.73 and 377.71 $\pm$ 24.74 in face mask ventilation group and pressure controlled ventilation group respectively. The tidal volume monitored at different time intervals in the both the groups. It is observed that, the patient who received face mask ventilation showed variation in the increased tidal volume from 415 ml to the 443 ml. whereas the Pressure controlled ventilation group of patients showed variation in the tidal volume from 378 ml to 385 ml only. The mean tidal volume was higher in face mask ventilation group of patients as compared that of in the Pressure controlled ventilation group of patients. [Figure 4]

## DISCUSSION

Total 70 patients undergoing surgery under general anesthesia were included in our study. These 70 patients were randomly allocated in to two groups, Face mask ventilation group (35 patients) and Pressure controlled ventilation group (35 patients). The mean age (mean ± standard deviation) of the total 70 patients was 38.81 ± 10.49. Among total 70 patients, 32 (45.7%) were males and 38 (54.3) were females. The mean age was 46.7(± 12.2) in laryngeal mask airway ProSeal as per the study conducted by Gunasekaran A. at. al.[14] The mean was 49 years in a study done by Chlouchi et al.[17]

Among total 70 patients, 13 (18.6%) of them have normal body mass index (BMI), of which 6 (46.1%) were in Face mask ventilation group and 6 (54.6%) in Pressure controlled ventilation group. Among 70 patients, 20 (28.6%) were overweight. Among total 70 patients, 37 (52.8%) were obese, of which 19 (51.3%) were in Face mask ventilation group and 18 (48.7%) in Pressure controlled ventilation group. According to a study done by Gunasekaran A. at. al.[14], the mean BMI was 22.9 ± 2.2 and 23.1 ± 2.1 in Ambu AuraGain group and laryngeal mask airway ProSeal group respectively. Mean BMI was 23.2 ± 2.7 kg/m$^2$ in a study conducted by Min-Huan Wang et. al.[9]

In our study, The peak airway pressure was measured at regular time intervals, the patients who received the Face mask ventilation during the general anesthesia, showed variation in the Peak airway pressure where as patients who received the Pressure controlled ventilation, did not showed the noticeable variation in the peak airway pressure. it was fond that there no difference in the Means of End tidal carbon dioxide (etCO2) among the Face mask ventilation group and Pressure controlled ventilation group of patients. Lee J et al.[3] conducted randomized controlled trial among children to compare the incidence of stomach insufflation at an inspiratory pressure of 13 cm of water. They found that, pressure controlled mask ventilation as more effective in preventing insufflation of stomach than manual mask ventilation.

Lee J et al.[4] conducted an another prospective randomized non blinded study, they observed that, there was no significant difference among the two groups regarding incidence of stomach insufflation and hence neuromuscular agent (Rocuronium 0.6 mg / kg) to have minimal effect on the measured parameter. Von Goedecke et. al.[13] conducted a study, they found that the apneic patients with an unprotected airway, pressure-controlled ventilation resulted in reduced inspiratory peak flow rates and peak airway pressures when compared with circle system ventilation, thus providing an additional patient safety effect during mask ventilation.

In our study, the tidal volume monitored at different time intervals, it is observed that the tidal volume increased as the time progresses from 30 seconds to 120 seconds. The tidal volume was lower in the patients who received pressure controlled ventilation as compared that in the patients who received face mask ventilation. Lagarde, S et. al.[11] conducted a study to determine the level of inspiratory pressures allowing adequate and safe ventilation without any risk of gastric insufflation (GI) in children according to age and found that, Increasing inspiratory pressure above ≤15 cm $H_2O$ results increased gastric insufflation (GI) and no change in tidal volume.

Zhang et. al.[12] conducted a randomized double-blind study found that, the mean tidal volume was about 7 ml/kg in group P10, and was >11 ml/kg in group P15 in the same period. As indicated by ultrasonography showed antral area in P15 group (Inspiratory pressure of 15 cm $H_2O$) was markedly increased compared with P10 group (Inspiratory pressure of 10 cm $H_2O$). therefore the inspiratory pressure of 10 cm $H_2O$ allowed for reduced occurrence of gastric insufflation with proper lung ventilation during induction of anesthesia with sufentanil and propofol in nonparalyzed and non-obese patients.

In our study, the Ultrasonography of stomach was done to assess occurrence of gastric insufflation in both groups. It was observed that the Pressure controlled ventilation group of patients, the mean antral area of stomach before ventilation was 2.20 $\pm$ 0.40 and increased to 2.51 $\pm$ 0.50 after ventilation. This shows that the risk of occurrence of the gastric insufflation was lower in Pressure controlled ventilation group than in the manual face mask ventilation group.

Adethen Gunasekaran et. al.[14] conducted a study, found that, there was a increased incidence of postoperative complications was observed with LMA ProSeal. Therefore the Ambu AuraGain resulted in a lower gastric insufflation volume than LMA ProSeal with lesser incidence of postoperative complications. Abdellatif Chlouchi et. al.[17] was conducted a randomized prospective study among the patients undergoing laparoscopic cholecystectomy found that, the pressure-controlled ventilation mode causes less gastric insufflation without additional hemodynamic or respiratory cost and gives the surgeon greater comfort without the need for a stomach probe.

Cajender P et al.[5] conducted a randomized controlled trial among adults patients, There was no difference in the upper esophageal sphincter tone but lower esophageal sphincter tone decreased more in the fixed positive end expiratory pressure (PEEP) group. They found that Rocuronium 0.6 mg / kg facilitates gastric insufflation irrespective of the peak airway pressure. In our study, the means of end tidal carbon dioxide (etCO2) at base line was lower in Face mask ventilation group than that of in the Pressure controlled ventilation group. It was observed that as time progresses from baseline to 90 seconds, the tidal carbon dioxide (etCO2) of the Face mask ventilation group becomes same as in the Pressure controlled ventilation group and also at 120 seconds.

In our study, the peak airway pressure was measured at regular time intervals, the patients who received the Face mask ventilation during the general anesthesia, the Peak airway pressure goes on increasing from baseline up to 90 seconds and becomes steady from 90 seconds and 120 seconds, where as patients who received the Pressure controlled ventilation, the peak airway pressure did not showed noticeable variation and it remains same from base line up to the 120 seconds, therefore Pressure controlled ventilation useful for prevention of gastric insufflation. Bouvet L. et al.[10] conducted a randomized prospective double blinded study to study the relation of inspiratory pressure with the incidence of stomach insufflation, found that an inspiratory pressure of 15 cm of water could reduce the chances of stomach insufflation. Ultrasound of the antrum is effective for detecting insufflation of stomach. According to the study conducted by Ji-Hyun Lee et. al.[15] The incidence of gastric insufflation increased with increasing inspiratory pressure. Gastric insufflation was detected by ultrasonography and epigastric auscultation. Neuromuscular blocking agent has minimal effect on the inspiratory pressure that causes gastric insufflation during face mask ventilation in children.

According to our study findings, the tidal volume monitored at different time intervals in the both the groups. The mean tidal volume was higher in face mask ventilation group of patients as compared that of in the Pressure controlled ventilation group of patients. A study done by Xiaowei Qian et. al.[16] showed that, the antral cross sectional area (CSA) after facemask ventilation statistically increased in subgroups in that gastric insufflation was detected by ultrasonography, whereas it did not change statistically in other groups. It was found that an inspiratory pressure of 12 cm H2O is sufficient to provide adequate ventilation with a lower occurrence of gastric insufflation during induction of general anesthesia in paralyzed Chinese children. According a study conducted by Dongare PA et. al.[18], the newer modalities such as gastric ultrasonography (GUS) has been increasingly used to study the gastric volumes and emptying**.**

## CONCLUSION

Peak airway pressure is not affected in pressure controlled ventilation group. There is no increase in the mean tidal volume in the pressure controlled ventilation group of patients. Ultrasonography of stomach showed that there is no increase in the mean antral area in the Pressure controlled ventilation group as compared to the manual face mask ventilation group of patients. Therefore pressure controlled ventilation is useful for prevention of gastric insufflation.

**Financial support and sponsorship:** Nil
**Conflicts of interest:** There are no conflicts of interest.
**Acknowledgements:** I thank our institution for providing opportunities for conducting this research study and also for providing required equipments. I also thank our HOD and staff in our department for their guidance and support. I thank the patients for giving consent and participated in this study.

## REFERENCES

1. Carina H, Carlos A, Airway Management in the Adult. In: Miller, Cohen, Eriksson, Fleisher, Weiner-Kronish, Young, editors. Miller's Anesthesia. 8th edition. Elsevier; 2015. P 1647
2. Baldini G, Butterworth J, Cowles C, Frölich M, Giescecke et al. Airway management. In: Butterworth, Mackey, Wasnick, editors. Morgan and Mikhail's Clinical Anesthesiology. McGraw Hill Lange; P 307
3. Lee, J. H., Jung, H., Jang, Y. E., Kim, E. H., Song, I. K., Kim, H. S., & Kim, J. T. (2019). Manual vs pressure-controlled facemask ventilation during the induction of general anesthesia in children: A prospective randomized controlled study. Paediatric anaesthesia, 29(4), 331–337. Available from: DOI: https://doi.org/10.1111/pan.13594
4. Lee, J. H., Jung, H., Kim, E. H., Song, I. K., Kim, H. S., & Kim, J. T. (2018). Optimal inspiratory pressure for face mask ventilation in paralyzed and unparalyzed children to prevent gastric insufflation: a prospective, randomized, non-blinded study. Canadian Journal of Anesthesia. 65(12), 1288–1295. Available from: DOI: https://doi.org/10.1007/s12630-018-1183-2
5. Cajander, P., Edmark, L., Ahlstrand, R., Magnuson, A., & de Leon, A. (2019). Effect of positive end-expiratory pressure on gastric insufflation during induction of anaesthesia when using pressure-controlled ventilation via a face mask: A randomised controlled trial. European journal of anaesthesiology, 36(9), 625–632. Available from: DOI: https://doi.org/10.1097/EJA.0000000000001016
6. Van de Putte, P., & Perlas, A. (2014). Ultrasound assessment of gastric content and volume. British journal of anaesthesia, 113(1), 12–22. Available from: DOI: https://doi.org/10.1093/bja/aeu151
7. Perlas, A., Davis, L., Khan, M., Mitsakakis, N., & Chan, V. W. (2011). Gastric sonography in the fasted surgical patient: a prospective descriptive study. Anesthesia and analgesia, 113(1), 93–97.

Available from: DOI: https://doi.org/10.1213/ANE.0b013e31821b98c0

8. Brimacomb, J., Keller, C., Kurian, S., & Myles, J. (2002). Reliability of epigastric auscultation to detect gastric insufflation. British journal of anaesthesia, 88(1), 127–129. Available from: DOI: https://doi.org/10.1093/bja/88.1.127
9. Wang MH, Hang LH. Appropriate pressure for facemask ventilation during induction of general anaesthesia in adult patients: measurement of antral cross-sectional area by real-time ultrasonography. International journal of clinical and experimental medicine. 2019 Jan 1;12 (7):8999-9004. /ISSN:1940-5901/IJCEM0087852 Available from: https://e-century.us/files/ijcem/12/7/ijcem0087852.pdf
10. Bouvet, L., Albert, M. L., Augris, C., Boselli, E., Ecochard, R., Rabilloud, M., Chassard, D., & Allaouchiche, B. (2014). Real-time detection of gastric insufflation related to facemask pressure-controlled ventilation using ultrasonography of the antrum and epigastric auscultation in nonparalyzed patients: a prospective, randomized, double-blind study. Anesthesiology, 120(2), 326–334. Available from: DOI: https://doi.org/10.1097/ALN.0000000000000094
11. Lagarde, S., Semjen, F., Nouette-Gaulain, K., Masson, F., Bordes, M., Meymat, Y., & Cros, A. M. (2010). Facemask pressure-controlled ventilation in children: what is the pressure limit?. Anesthesia and analgesia, 110(6), 1676–1679. Available from: DOI: https://doi.org/10.1213/ANE.0b013e3181d8a14c
12. Zhang, Q., Zhou, Q., Zhang, J., & Zhao, D. (2020). Gentle facemask ventilation during induction of anesthesia. The American journal of emergency medicine, 38(6), 1137–1140. Available from: DOI: https://doi.org/10.1016/j.ajem.2019.158399
13. Von Goedecke, A., Voelckel, W. G., Wenzel, V., Hörmann, C., Wagner-Berger, H. G., Dörges, V., Lindner, K. H., & Keller, C. (2004). Mechanical versus manual ventilation via a face mask during the induction of anesthesia: a prospective, randomized, crossover study. Anesthesia and analgesia, 98(1), 260–263. Available from: DOI: https://doi.org/10.1213/01.ANE.0000096190.36875.67
14. Gunasekaran, A., Govindaraj, K., Gupta, S. L., Vinayagam, S., & Mishra, S. K. (2022). Comparison of Gastric Insufflation Volume between Ambu AuraGain and ProSeal Laryngeal Mask Airway Using Ultrasonography in Patients Undergoing General Anesthesia: A Randomized Controlled Trial. Cureus, 14(8), e27888. Available from: DOI: https://doi.org/10.7759/cureus.27888
15. Lee, J. H., Jung, H., Kim, E. H., Song, I. K., Kim, H. S., & Kim, J. T. (2018). Optimal inspiratory pressure for face mask ventilation in paralyzed and unparalyzed children to prevent gastric insufflation: a prospective, randomized, non-blinded study. Canadian journal of anaesthesia, 65(12), 1288–1295. Available from: DOI: https://doi.org/10.1007/s12630-018-1183-2
16. Xiaowei Qian, Qiong Hu, Hang Zhao, Bo Meng, Yang Nan, Hong Cao, Qingquan Lian and Jun Li. Qian et al. Determination of the optimal inspiratory pressure providing adequate ventilation while minimizing gastric insufflation using real-time ultrasonography in Chinese children: a prospective, randomized, double-blind study. BMC Anaesthesiology (2017) 17:126 Available from: DOI: https://doi.org.10.1186/s12871-017-0417-0
17. Abdellatif Chlouchi Aziz Benakrout, Mohamed Rabi Andaloussi, Mustapha Bensghir and Abdelouahed Baite. Gastric Insufflation and Ventilatory Mode during Induction of Anesthesia: A Prospective Randomized Study. Faculty of Medicine and Pharmacy of Rabat, Military Teaching Hospital Mohamed V Rabat, Mohamed V University of Rabat, Morocco. Available from: DOI: https://doi.org.10.9734/JAMMR/2022/v34i234849
18. Dongare, P. A., Bhaskar, S. B., Harsoor, S. S., Garg, R., Kannan, S., Goneppanavar, U. et al. (2020). Perioperative fasting and feeding in adults, obstetric, paediatric and bariatric population: Practice Guidelines from the Indian Society of Anaesthesiologists. Indian journal of anaesthesia, 64(7), 556–584. Available from: DOI: https://doi.org/10.4103/ija.IJA_735_20