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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/17888
DOI URL: http://dx.doi.org/10.21474/IJAR01/17888

ISSN NO. 2320-5407

RESEARCH ARTICLE

A COMPARATIVE STUDY TO ASSESS EFFECTS OF PNEUMOPERITONEUM AND TRENDELENBURG POSITION ON HEMODYNAMICS AND VENTILATORY MECHANICS DURING TOTAL LAPAROSCOPIC HYSTERECTOMY IN OBESE AND NON-OBESE PATIENTS

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Manuscript Info

Manuscript History
Received: 16 September 2023
Final Accepted: 19 October 2023
Published: November 2023

Key words:-
Body Mass Index, General Anesthesia, Laparoscopic Hysterectomy, Lung Compliance, Obesity

Abstract

Background: Hysterectomy is a common gynaecological surgical procedure, with Laparoscopic hysterectomy (LH) emerging as a favorable approach due to its benefits such as shorter recovery periods and reduced complications. However, the creation of pneumoperitoneum and the Trendelenburg position required for total laparoscopic hysterectomy (TLH) can induce significant hemodynamic and ventilatory changes.

Methodology: Our study included 60 patients who were categorized into two groups of 30 each based on their BMI: non-obese (BMI < 30) and obese (BMI ≥ 30). All patients underwent routine pre-anaesthesia check-up followed by general anaesthesia. Diastolic blood pressure (DBP), systolic blood pressure (SBP), peripheral oxygen saturation (SpO_2), heart rate (HR), mean arterial pressure (MAP), plateau pressure (PPLAT), peak pressure (PPEAK), and driving pressure (PDRIVING), end-tidal carbon dioxide ($EtCO_2$) as well as static (CST) and dynamic (CDYN) lung compliance were measured at different time intervals including baseline, following induction of anaesthesia, insufflation, changing to Trendelenburg position, desufflation and after extubation.

Results: The heart rate decreased on induction of anesthesia in both the groups and remained lower throughout the procedure but was statistically non-significant ($p>0.05$). There was a rise in SBP, DBP, and MAP on insufflation and further with head-down positioning in both obese and non-obese patients, however, was statistically non-significant ($p>0.05$). The PPEAK, PPLAT, and PDRIVING were increased on induction, following the creation of pneumoperitoneum as well as Trendelenburg position ($p<0.05$). The values were higher in obese as compared to the non-obese. The static and dynamic compliance were lower at all time intervals in obese patients when compared to the non-obese group.

Conclusion: Obese patients exhibit higher plateau pressure, peak inspiratory pressure, and driving pressure values, indicating increased airway resistance and potential ventilation challenges during surgery. Additionally, the reduced static and dynamic lung compliance values in obese patients suggest decreased lung elasticity and difficult ventilation.

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Introduction:-

Over the last several decades, obesity has become more common in India than it has anywhere else in the globe. For example, among women, the prevalence of overweight people grew from 8.4% to 15.5% between 1998 and 2015, and over the same time, the prevalence of obesity increased from 2.2% to 5.1% [1, 2]. Obese people have a greater incidence of endometrial cancer and an enlarged uterus because of an enhanced unopposed estrogen action in hormone-responsive tissues, according to Modesitt SC et al., therefore, hysterectomy rates are higher in obese individuals [3]. Comorbid conditions such as obstructive sleep apnea, diabetes mellitus, obesity hypoventilation syndrome, and persistently raised intra-abdominal pressure as a result of abdominal fat deposition are linked to obesity [4, 5]. In addition, obese people's accumulated neck fat makes mask ventilation and intubation challenging. They also demand more oxygen and have a faster metabolic rate [6, 7].

Extrinsic Positive End-Expiratory Pressure (PEEP) applications with recruitment processes, increases in respiratory rate, and proper patient position are only few of the methods proposed to improve intraoperative ventilation in obese surgical patients [8]. Mechanical breathing strategies in obese surgery patients: a meta-analysis by Aldenkortt et al., when comparing pressure-controlled ventilation to volume-controlled ventilation, the findings showed no significant difference for these individuals [9].

One of the most common surgical procedures in gynecology is the hysterectomy [10]. In order to treat a number of gynecological disorders, the uterine corpus is removed either completely (total hysterectomy) or partially (subtotal or supracervical hysterectomy) [11]. The incidence of hysterectomy among women in India between the ages of 15 and 49 is 3.2% [12]. Uterine cancer and non-cancerous uterine problems such prolapse, fibroids, endometriosis, and other uterine illnesses are the main reasons for the procedure [12]. There are many options for the surgical approach, including laparotomy, vaginal, minimally invasive (laparoscopy, robotic surgery), or a combination of the latter two [12].

For many kinds of surgical operations, laparoscopic surgery is becoming an increasingly popular alternative to traditional open surgery because to its minimum invasiveness, decreased risk of hemorrhage, decreased postoperative discomfort, and ensuing early release [13, 14]. The use of a CO_2 pneumoperitoneum (PP) and often a concurrent steep head-down posture (up to 45; Trendelenburg position; TP) are necessary for an appropriate surgical exposure. Because of the absorption of CO_2 over the peritoneal surface, pneumoperitoneum and the resulting elevated intraabdominal pressure may have a variety of systemic physiological effects, such as reduced venous return, hypercapnia, and respiratory acidosis [15, 16]. The effects on breathing and hemodynamics are often negligible and well-tolerated [17].

Combining the abdominal and vaginal pathways into one procedure, laparoscopic hysterectomy (LH) is a superior method that offers the patient a faster recovery time, a shorter hospital stay, less scars, less blood loss, less post-operative discomfort, and fewer pulmonary problems [18]. The creation of pneumoperitoneum, which is achieved by insufflating a gas (often CO_2) into the peritoneal cavity, is the distinguishing feature of laparoscopic surgery. Intraabdominal pressure rises as a result (IAP). In order to generate the pneumoperitoneum, 4–6 liters of carbon dioxide per minute are insufflated into the peritoneal cavity, at a pressure of 10–20 mm Hg. Maintaining the pneumoperitoneum requires maintaining a constant gas flow of 200–400 ml/min [19]. Furthermore, in order to have a good surgical view during a total laparoscopic hysterectomy (TLH), patients must assume the Trendelenburg position, which requires them to move their viscera away from the surgical site. This causes the contents of the abdomen to shift, raising the intrathoracic pressure and decreasing lung compliance [20]. The pneumoperitoneum, the patient's posture, and the absorption of CO_2 cause an elevated intraabdominal pressure that affects hemodynamics and triggers stress hormone reactions (cortisol, adrenaline, and nor-epinephrine), which makes laparoscopic surgery difficult for the anesthesiologist.

Because of this, the anesthesia staff has to learn pertinent and sufficient information to treat obese patients undergoing laparoscopic surgery. In order for the surgical team to be ready to handle any complications that may develop during the procedure, it is also crucial that the patients be thoroughly evaluated before to surgery in order to identify any risk factors associated to anesthesia. Therefore, the study's objective is to assess and contrast the impact of the Trendelenburg position and pneumoperitoneum on ventilatory and hemodynamic parameters in patients having complete laparoscopic hysterectomy who are obese and those who are not.

Methodology:-

After obtaining approval from the Institutional Review Board, the study was designed as a prospective, hospital-based, prospective observational comparative study comparative trial in an affiliated in the "Department of Anaesthesiology and Intensive Care, Max Super Speciality Hospital, Mohali" over a duration of 12 months. A total of 60 cases were taken. Consecutively, the cases were chosen in the order of their visual appeal and convenient accessibility. The sampling procedure was concluded upon reaching the total number of cases.Patients undergoing laparoscopic hysterectomy were eligible for the research after written informed permission was obtained from each individual. Participants were patients who had ASA physical status I to III, had a body mass index (BMI) between 30 (not obese) and 40 (obesity), and underwent at least 1 hour of pneumoperitoneum in the Trendelenburg position. The exclusion criteria were possible Conversion of laparoscopic to open surgery, intracranial pathology, and severely obstructive pulmonary disease.

Anaesthesia Technique

The night before surgery, all patients received a regular pre-anesthesia examination and a tablet containing 40 mg of pantoprazole and 0.25 mg of alprazolam. Prior to surgery, it was determined that patients had been maintained off of all oral medications for a sufficient period of time. Patients were informed about the research and asked to sign permission forms indicating that they were willing to participate. Patients were brought to the operating room after a standard pre-operative examination. An infusion of 0.9% saline was begun at patient-appropriate rates after securing a patent IV access. The five-lead ECG, noninvasive blood pressure, heart rate, pulse oximetry, and temperature probe were all ASA standard monitors. To monitor oxygen, capnography, and inhalational anesthetic drugs, a conventional gas monitor was used. Thirty minutes before to incision, prophylactic antibiotics were administered to each patient. After ensuring enough pre-oxygenation with 100% O_2 for three minutes, induction took place. Intravenous midazolam (1 mg), fentanyl (1-2 mcg/kg), propofol (1.5-2.5 mg/kg), and atracurium (0.5 mg/kg) were administered to the patients. An suitably sized cuffed endotracheal tube was used for intubation after the patient's muscles were sufficiently relaxed. Sevoflurane or desflurane (minimum alveolar concentration of 0.8–1), oxygen, nitrous oxide, or medical air were used to maintain anesthesia, coupled with intravenous boluses of fentanyl and atracurium. The patients were made to lie supine during the CO_2 insufflation procedure that created the pneumoperitoneum. Patients were placed in the Trendelenburg position and kept there for the duration of the procedure once the pneumoperitoneum was created. After the procedure was finished, the patients were returned to the supine position after desufflation. Subsequently, the patients were extubated and given intravenous neostigmine (0.04-0.07 mg/kg) to reverse their condition. Following verification that the patients are stable in their vital signs, cognizant, and able to follow verbal instructions, they were moved to the recovery room.

Intra-operative evaluation:

Ventilatory parameters ($EtCO_2$, peak airway pressure, respiratory rate, compliance, plateau pressure, driving force) and hemodynamic parameters (heart rate, diastolic blood pressure, systolic blood pressure, perfusion index, mean arterial pressure, SpO_2) were measured. Recordings were taken at baseline in the supine position, after induction of anaesthesia, immediately after creating pneumoperitoneum (CO_2 insufflation), change to Trendelenburg position, 10 minutes and 30 minutes after insufflation, 1 and 3 minutes after desufflation, back to supine and just after extubation. Intra-operatively, measurements were recorded and calculated as follows:

1. TV, PEEP, PPLAT (Plateau airway pressure) and PPEAK (Peak airway pressure) were recorded which were displayed on the anaesthesia machine ventilator.
2. Driving pressure (PDRIVING) = PPLAT – PEEP [21]
3. Static compliance (CSTAT) = TV/(PPLAT – PEEP) [22, 23]
4. Dynamic compliance (CDYNAMIC) = TV/(PPEAK – PEEP) [24, 25]

Statistical Analysis

A pre-designed research proforma recorded all data. Frequency and proportion reflected qualitative data. The Chi-Square test examined qualitative variables' relationships. Quantitative data was reported as Mean ± SD. If the data passed the "Normality test," an unpaired t-test was used to analyze quantitative data between the two groups. If not, a Mann-Whitney test was used. The threshold of significance was set at p-value < 0.05. Graphics were used where required. SPSS 26.0 was used for most analysis and Excel 2021 for graphics.

Results and Discussion:-

At Max Hospital in Mohali, India, 60 patients tried total laparoscopic hysterectomy (TLH) throughout the research period. Of the study population as a entire, the mean BMI was obese (BMI less then 30 kg/m2), while the non-obesity group had a BMI < 30 kg/m2 (range 18.2 to 56.8 kg/m2). Thirty of the sixty patients were into the non-obesity category (30.11 to 56.8 kg/m2). Thirty of the patients were obese, with a BMI of more than 40 kg/m2.

Table 1:- Anthropometric comparison among study groups.

	Non-Obese	Obese	Sig.
Age	49.87±9.62	53.57±7.41	0.101
Weight (Kg)	65±7.79	78.80±9.28	<0.05
Height (cm)	157.55±6.42	155.08±4.13	0.08
BMI (Kg/m2)	26.23±2.44	32.71±3.23	<0.05

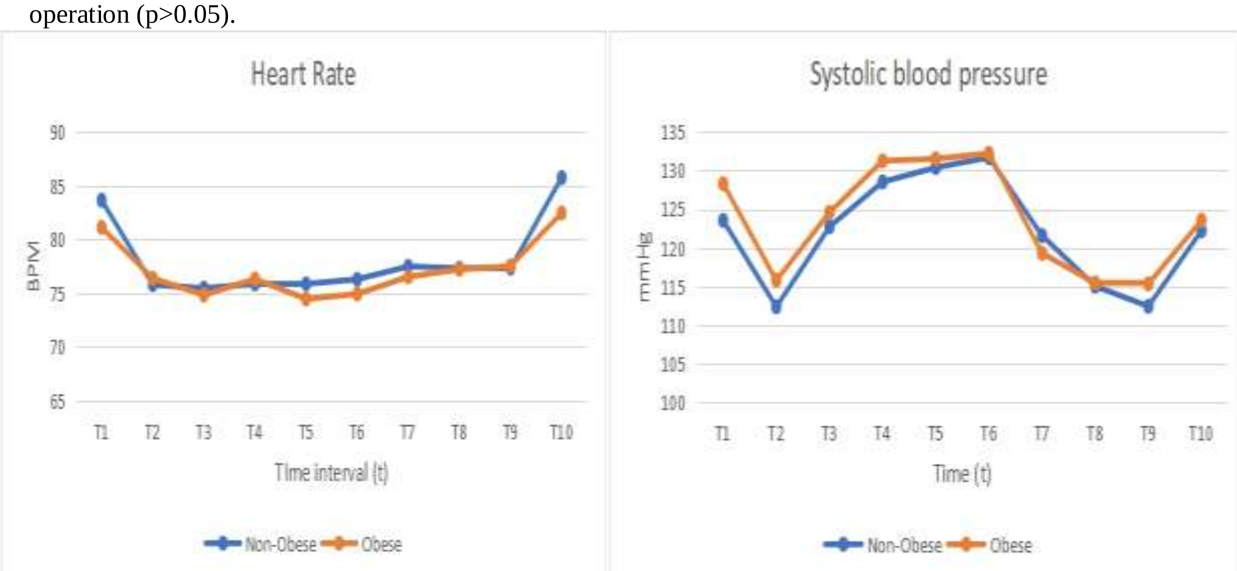
The research found no statistically significant difference (p>0.05) in the mean age of the non-obese and obese groups, which were 53.57 ± 7.41 and 49.87 ± 9.62 years, respectively. The mean weight in the non-obesity group was 65 ± 7.79 kg, but it was statistically significant (p<0.05) at 78.8 ± 9.28 kg in the obese group. In the non-obesity group, the mean height was 157.55 ± 6.42 cm, whereas it was 155.08 ± 4.13 cm and not statistically significant (p>0.05) in the obese group. Table 1 shows that the mean BMI for the non-obese group was 26.23 ±2.44 kg/m2, whereas it was 32.71 ± 3.23 kg/m2 and statistically significant (p<0.05) for the obese group (table 1).

Table 2:- Comparison of study groups as per changes in heart rate, systolic, diastolic pressure,atrial pressure, oxygen saturation (SpO2) and Perfusion index (PI).

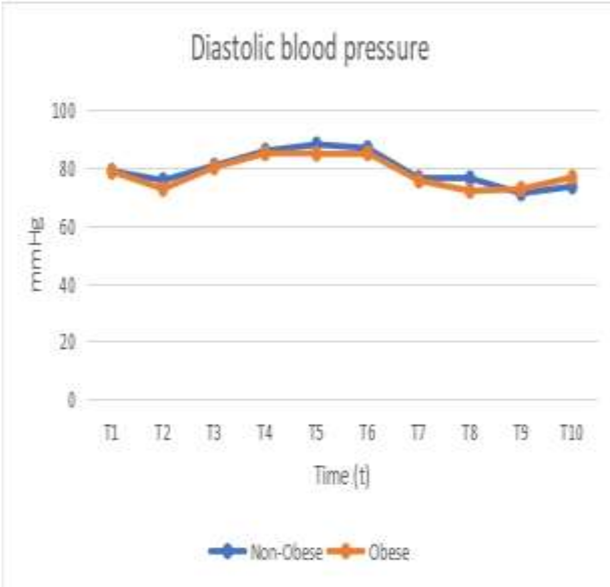
Groups	Time									
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**
Heart Rate										
Non-Obese	83.67±11.94	75.8±9.87	75.47±9.46	75.87±6.94	75.87±6.57	76.3±6.66	77.5±6.09	77.33±5.80	77.33±6.00	85.77±6.38
Obese	81.13±9.32	76.4±7.69	74.83±6.40	76.33±6.45	74.47±6.87	74.93±6.59	76.53±6.61	77.23±6.43	77.53±6.21	82.47±6.56
Sig.	0.36	0.79	0.76	0.79	0.42	0.43	0.56	0.95	0.9	0.05
Systolic blood pressure										
Non-Obese	123.53±11.81	112.33±8.11	122.7±6.24	128.53 6.98	130.45.85	131.7±8.55	121.57±6.32	115±6.31	112.4±5.98	122.2±5.73
Obese	128.3±11.82	115.77±7.20	124.57±5.17	131.27±7.74	131.53±8.15	132.23±7.88	119.27±12.60	115.43±11.02	115.3±9.14	123.57±7.06
Sig.	0.12	0.09	0.21	0.16	0.54	0.8	0.38	0.85	0.15	0.41
Diastolic blood pressure										
Non-Obese	78.9±10.85	75.73±7.52	80.77±6.17	85.93±7.00	88.13±8.29	86.87±7.99	76.5±10.32	76.4±7.33	71.2±6.56	73.57±11.49
Obese	78.73±8.30	72.73±5.39	80.2±5.37	85.07±6.46	84.9±9.26	85.1±10.01	75.63±13.34	72.03±11.46	72.7±8.33	76.7±7.13
Sig.	0.95	0.08	0.71	0.62	0.16	0.45	0.78	0.35	0.44	0.21
Arterial pressure										
Non-Obese	94.7±12.91	87.93±6.60	94.74±5.32	100.13 6.30	101.13 6.36	101.83±7.34	88.9±9.85	86.87±6.95	85.03±5.76	90.9±6.41
Obese	95.3±9.41	86.47±4.31	94.99±4.31	100.47±6.22	99.3±9.59	100.07±8.91	88.61±3.81	84.87±11.66	86.17±7.45	92.32±6.55
Sig.	0.89	0.31	0.85	0.84	0.39	0.41	0.92	0.42	0.51	0.4
Oxygen saturation (SpO2)										
Non-Obese	100±0.00	100±0.00	100±0.00	100±0.00	100±0.00	100±0.00	100±0.00	100±0.00	100±0.00	99.98±0.09
Obese	99.77±0.94	100±0.00	99.97±0.18	99.97±0.18	99.93±0.25	99.93±0.25	99.93±0.25	99.93±0.25	99.97±0.18	99.97±0.18
Sig.	0.18	0.32	0.32	0.16	0.16	0.16	0.16	0.32	0.32	0.61

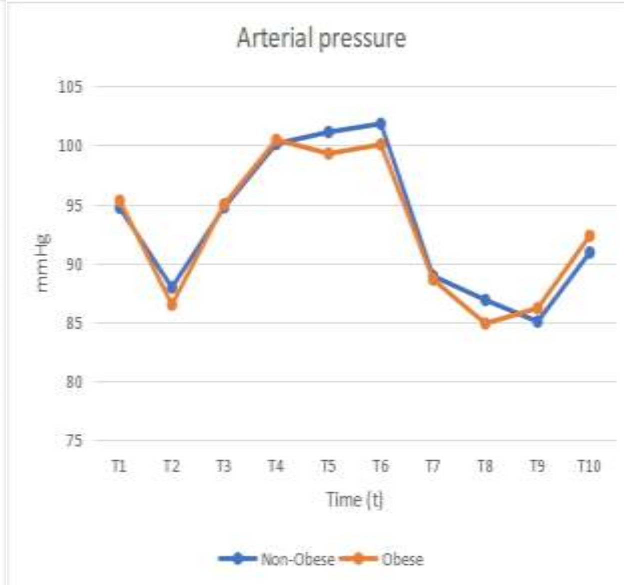
Perfusion index (PI)										
Non-Obese	0.93±0.13	0.86±0.06	0.93±0.05	0.98±0.06	0.99±0.06	1±0.07	0.87±0.10	0.85±0.07	0.83±0.06	0.89±0.06
Obese	0.93±0.09	0.85±0.04	0.93±0.04	0.98±0.06	0.97±0.09	0.98±0.09	0.87±0.14	0.83±0.11	0.84±0.07	0.91±0.06
Sig.	0.87	0.33	0.81	0.85	0.37	0.44	0.91	0.4	0.53	0.41

The table 2 represent mean values of heart rate, systolic, diastolic pressure, atrial pressure, oxygen saturation and perfusion index between obese and non-obese groups. The present study showed the Mean heart rate at baseline is comparable between obese and non-obese groups respectively (p>0.05). Mean heart rate decreased in both groups after induction of anaesthesia and remained lower than baseline till cases were positioned back to supine position. The mean heart rate reached the baseline value after extubation in both groups. The changes were comparable in both groups (p>0.05). At T1, the mean systolic blood pressure in obese cases was observed to be higher, although the difference did not reach statistical significance (p>0.05). At T2, both groups exhibited a decrease in mean SBP, with obese cases showing a slightly greater reduction. Afterwards, SBP increased in both groups at T4 and T3. Nevertheless, until the point of extubation, there were no significant variations in SBP between the two groups (p>0.05). The mean diastolic blood pressure was similar in both groups at baseline (p>0.05). At T2, mean DBP dropped in both groups, although in obese patients it dropped more than in non-obese cases. DBP then rose in both groups at T3 and T4, but until the point of extubation, there were no appreciable differences between the two groups (p>0.05). The mean arterial pressure (MAP) was similar in both groups at baseline (p>0.05). At T2, MAP dropped in all groups, with obese subjects showing a larger drop. Following this, both groups' MAP rose at T3 and T4, but until the moment of extubation, there were no discernible differences between the two groups (p>0.05). Between the two groups, the mean oxygen saturation levels and perfusion index were similar at baseline and after the surgical operation (p>0.05).

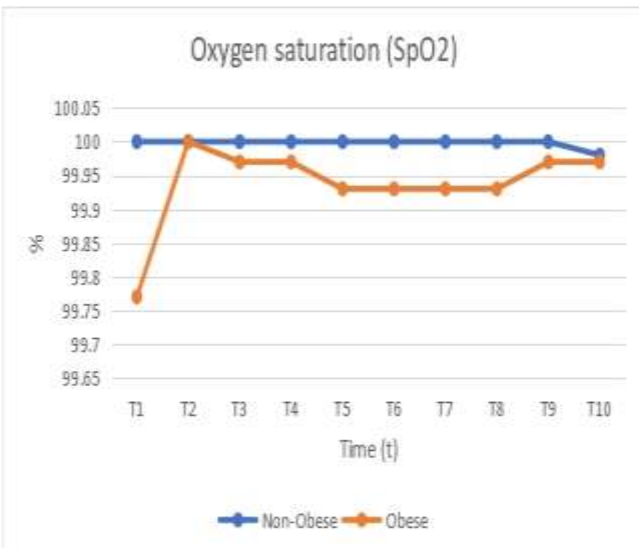


(a) **(b)**





(c) **(d)**



(e) **(f)**

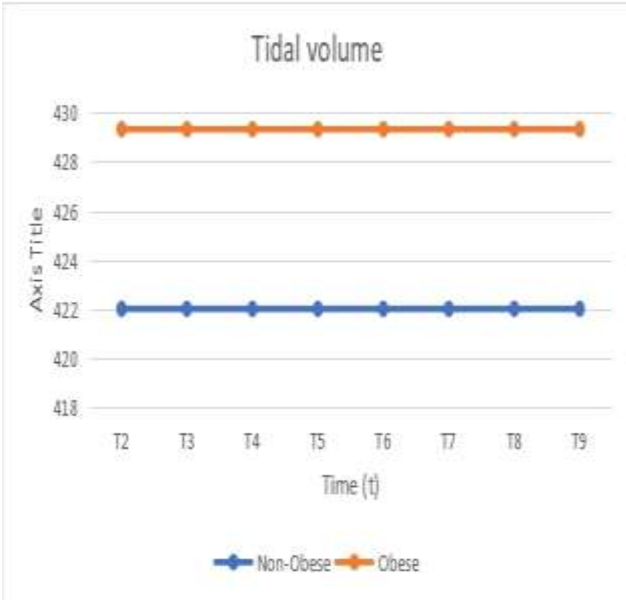
Fig. 1:- Comparison of study groups as per changes various parameters like (a) Heart rate, (b) Systolic pressure, (c) diastolic pressure, (d) atrial pressure, (e) Oxygen saturation (SpO2), (f) Perfusion index (PI).

Table 3:- Comparison of study groups as per changes in tidal volume, peak inspiratory, plateau pressure, End-tidal carbon dioxide level, Driving pressure, Static and Dynamic compliance.

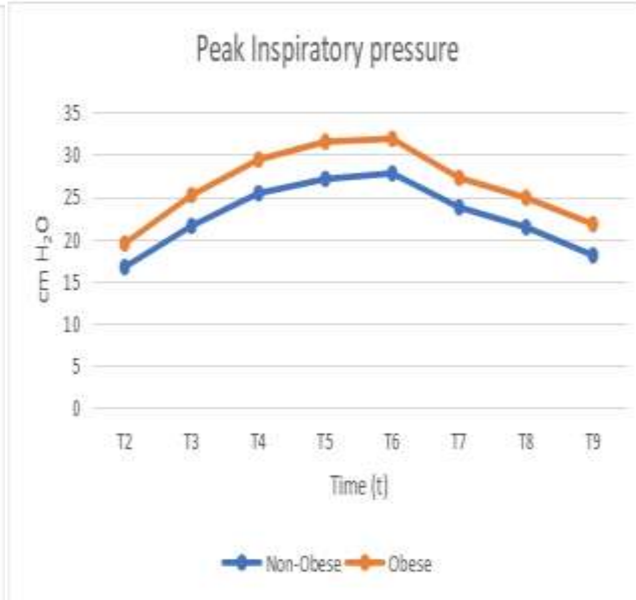
Groups	**Time**							
	T2	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**
Tidal volume								
Non-Obese	422±7.14	422±7.14	422±7.14	422±7.14	422±7.14	422±7.14	422±7.14	422±7.14
Obese	429.33±15.52	429.33±15.52	429.33±15.52	429.33±15.52	429.33±15.52	429.33±15.52	429.33±15.52	429.33±15.52
Sig.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Peak Inspiratory pressure								
Non-	16.63±15.	21.53±3.1	25.4±3.44	27.1±3.25	27.77±2.7	23.73±3.2	21.37±2.7	18.03±2.0

Obese	52	0			6	1	6	4
Obese	19.43±3.08	25.17±4.94	29.4±5.32	28.1±3.52	31.87±3.37	27.23±3.09	24.87±2.22	21.73±2.24
Sig.	0.0001	0.0001	0.0001	29.1	0.0001	0.0001	0.0001	0.0001
Plateau pressure								
Non-Obese	13.8±1.47	18.57±3.46	22.7±3.74	24.37±3.35	25.1±2.81	20.63±3.38	18.43±2.70	15.3±2.22
Obese	16.13±2.89	22.23±5.07	26.53±5.35	28.27±3.05	28.93±2.83	24.53±2.71	22±2.12	18.87±2.37
Sig.	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
End-tidal carbon dioxide level								
Non-Obese	29.8±2.66	31.73±2.33	33.4±2.22	35.07±2.27	36.5±3.35	34.07±3.35	32.33±3.26	31.2±3.15
Obese	31.27±3.04	32.5±2.71	34.1±3.00	35.43±2.96	36.27±3.71	34.63±3.86	33.3±4.18	32.53±4.23
Sig.	0.051	0.245	0.309	0.592	0.799	0.546	0.322	0.171
Driving pressure								
Non-Obese	8.8±1.47	13.57±3.46	17.73.74	19.37±3.35	20.1±2.81	15.63±3.38	13.43±2.70	10.3±2.22
Obese	11.13±2.89	17.23±5.07	21.53±5.35	23.27±3.05	23.93±2.83	19.53±2.71	17±2.12	13.87±2.37
Sig.	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Static compliance								
Non-Obese	49.26±8.32	33.35±9.52	24.94±5.54	22.51±4.49	21.48±3.70	28.31±6.58	32.66±6.62	43.11±0.54
Obese	41.02±10.20	27.28±8.77	21.36±6.29	18.79±2.79	18.16±2.20	22.41±3.50	25.72±4.06	31.89±5.83
Sig.	0.0001	0.01	0.02	0.0001	0.0001	0.0001	0.0001	0.0001
Dynamic compliance								
Non-Obese	36.89±4.69	26.39±4.85	21.25±3.55	19.51±3.03	18.82±2.51	23.18±4.05	26.47±4.28	33.2±5.55
Obese	31±6.39	22.69±6.14	18.55±4.74	16.49±2.49	16.22±2.18	19.67±2.88	21.91±2.93	26.11±3.68
Sig.	0.0001	0.01	0.02	0.0001	0.0001	0.0001	0.0001	0.0001

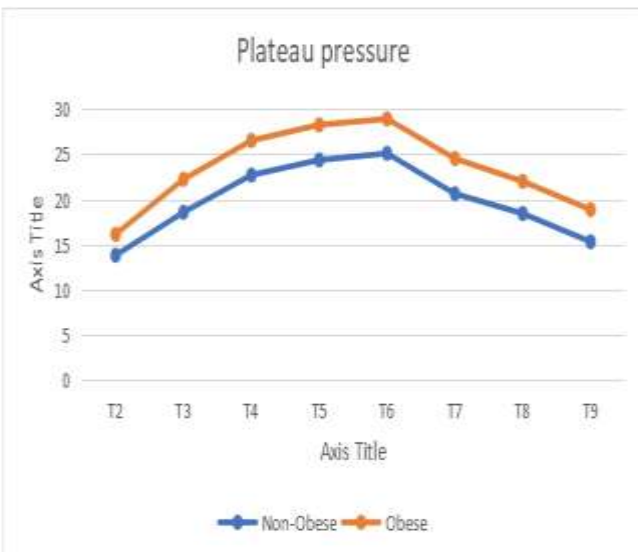
Table 3 depict the mean values of tidal volume, PIP, PP, $EtCO_2$ levels, driving pressure, static compliance and dynamic compliance between obese and non-obese groups. The mean tidal volume (TV) values for the non-obese group and obese group were 422 ± 7.14 ml and 429.33 ± 15.52 respectively and were statistically significant ($p<0.05$). The mean peak inspiratory pressure and plateau pressure values at T2 for the non-obese group and obese group were 16.63 ± 1.63 and 19.43 ± 3.08 and 13.8 ± 1.47 and 16.13 ± 2.89 cm H_2O respectively and were statistically significant ($p<0.05$). It remained significant at all time intervals. The mean end-tidal carbon dioxide levels werecomparable between both groups at baseline and throughout the surgical procedure ($p>0.05$). similarly, the mean driving pressure, static compliance and dynamic compliance values at T2 for the non-obese group and obese group were statistically significant ($p<0.05$). It remained significant at all time intervals.


Tidal volume
430
428
426
424
422
420
418
Axis Title
T2 T3 T4 T5 T6 T7 T8 T9
Time (t)
Non-Obese Obese

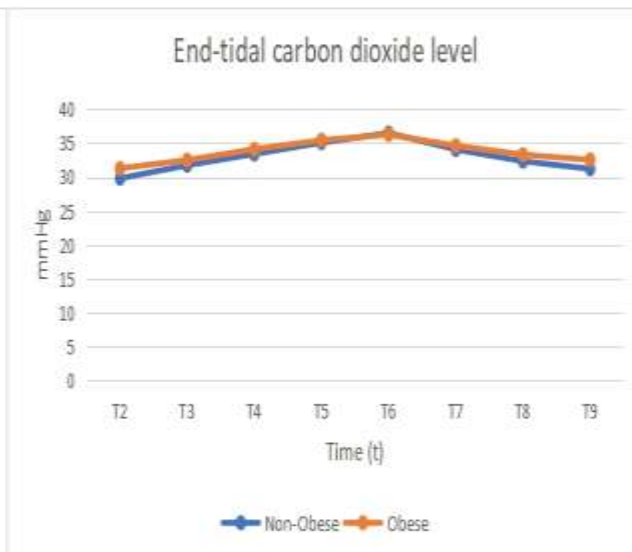
(a)


Peak Inspiratory pressure
35
30
25
20
15
10
5
0
cm H2O
T2 T3 T4 T5 T6 T7 T8 T9
Time (t)
Non-Obese Obese

(b)


Plateau pressure
30
25
20
15
10
5
0
Axis Title
T2 T3 T4 T5 T6 T7 T8 T9
Axis Title
Non-Obese Obese

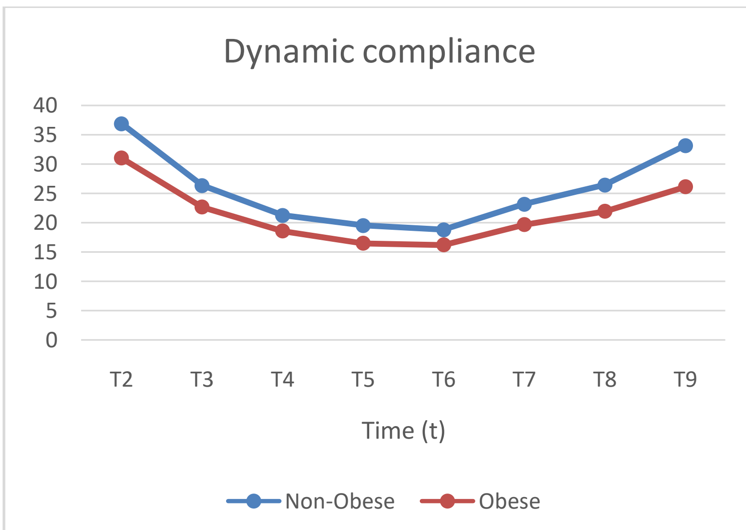
(c)


End-tidal carbon dioxide level
40
35
30
25
20
15
10
5
0
mmHg
T2 T3 T4 T5 T6 T7 T8 T9
Time (t)
Non-Obese Obese

(d)

(e)

(f)



(g)

Fig. 2:-Comparison of study groups as per changes various parameters like (a) Tidal volume, (b) Peak respiratory pressure, (c) Plateau pressure, (d) End-tidal carbon dioxide level, (e) Driving pressure, (f) Static compliance and, (g) Dynamic compliance.

Discussion:-

Pneumoperitoneum is a characteristic of laparoscopic surgery, resulting in a rise in intra-abdominal pressure (IAP). Trendelenburg posture is also necessary for TLH in order to move the viscera away from the surgical site and allow a clear surgical view. This causes the contents of the abdomen to shift cranially, raising the intrathoracic pressure. In this study, we compared the effects of Trendelenburg position (TP) and pneumoperitoneum (PP) on hemodynamic parameters (MAP, SBP, DBP, HR, peripheral oxygen saturation (SpO2), end-tidal carbon dioxide (EtCO2), static (CST) and dynamic (CDYN) lung compliance, and ventilatory parameters (P_{PEAK}, P_{PLAT}, and driving ($P_{DRIVING}$) pressures in obese and non-obese patients undergoing total laparoscopic hysterectomy). 60 patience of total laparoscopic hysterectomy (TLH) at our institution were included in the current research. Of these instances, 30 were classified as obese (O) and the remaining 30 as non-obesity (NO). The groups with and without obesity differed in mean age in a statistically significant way ($p>0.05$). There was a statistically significant difference in mean weight between the O group and NO group ($p<0.05$). There was no statistically significant difference in the mean height between the NO and O groups ($p>0.05$). According to our study's inclusion criteria, the mean BMI difference between the NO group and O group was statistically significant ($p<0.05$). The NO group and O group had similar baseline mean heart rates ($p>0.05$), at 83.67 ± 11.94 bpm and 81.13 ± 9.32 bpm, respectively. Following the induction of anesthesia, the heart rates in both groups fell. They continued to be lower than baseline throughout the pneumoperitoneum and transition to the Trendelenburg position until the patients were returned to the supine position. Gautam et al. conducted comparable investigations that revealed similar outcomes during laparoscopic procedures and came to the conclusion that vagal stimulation caused peritoneal insufflation, which in turn caused a drop in heart rate [25]. Between the two groups, the baseline SBP, DBP, and MAP were similar and did not differ statistically. When pneumoperitoneum and Trendelenburg position were compared for their effects on systolic, diastolic, and mean arterial pressure, the results showed that the creation of pneumoperitoneum increased values, which increased even more after Trendelenburg position was changed. SBP, DBP, and MAP values decreased by 33 after anesthesia was induced. Although higher in the O group than in the NO group, the increases in SBP, DBP, and MAP were statistically not significant ($p>0.05$). Na JH et al. observed similar outcomes when they examined ten patients undergoing different laparoscopic pelvic surgeries. They discovered that arterial blood pressure increased following CO_2 insufflation and that these elevated values continued during the procedure and even ten minutes after desufflation in the supine position [26].

Following the end of the procedure, the patients were returned to a supine posture after desufflation. SBP, DBP, and MAP all showed a reduction upon desufflation, and in both the O and NO groups, these values further declined to almost pre-insufflation levels after supine orientation. Three groups of patients having laparoscopic cholecystectomy (with varied IAP) were evaluated in a prior research by Umar A et al., [27], and comparable outcomes of a rise in SBP, DBP, and MAP after CO_2 insufflation were seen. A continuous pulse oximeter measurement of peripheral perfusion is used to estimate peripheral perfusion non-invasively (PI). Additionally, it might measure the pain experienced under general anesthesia 34 and, as a result, assist in managing the pain experienced during surgery when a patient is unable to express their displeasure [28]. The baseline mean difference PI value for the NO group and O group in the current investigation was statistically non-significant ($p>0.05$). Similar findings were made by Arslantas R et al., who examined 67 patients to determine how patient position and pneumoperitoneum affected the perfusion index during laparoscopic bariatric surgery. They discovered that while pneumoperitoneum decreased HR and increased MAP, it had no effect on the perfusion index values of [29].

In this investigation, the obese group had substantially higher mean peak inspiratory pressure and plateau pressure values from the time of anesthesia induction until the patients were restored in a supine posture ($p<0.05$). Following pneumoperitoneum, both the obese and nonobese groups showed increases in peak inspiratory pressure (5.74 in O and 4.9 cmH_2O in NO), plateau pressure (4.23 in O and 3.87 cmH_2O in NO), and driving pressure (6.1 in O and 4.77 cmH_2O in NO). It was shown that the obese group saw a greater rise.

In a similar vein, the peak airway pressure (4.23 in O and 3.87 cmH_2O in NO) and plateau pressure (4.3 in O and 4.13 cmH_2O in NO) rose after the Trendelenburg position in both the obese and non-obese groups, with the obese patients seeing a greater rise. Ppeak and Pplat levels dropped after desufflation in both groups, and they continued to drop when the patients were returned to the supine position. A S Bhadauria et al., noticed similar outcomes to ours when they evaluated 61 individuals following laparoscopic cholecystectomy and found that 35 peak inspiratory pressure (PIP) and peak plateau pressure (PPP) increased significantly throughout pneumoperitoneum and even after desufflation [30]. Suh MK et al. also noted that dynamic lung compliance dropped by 12 ml/cmH_2O 36 after the formation of pneumoperitoneum, and there was a considerable rise inplateau pressure (7 cmH_2O), peak inspiratory pressure (6 cmH_2O), and end-tidal CO_2 (5 mmHg) [31]. The effects of morbid obesity, pneumoperitoneum, and body posture (30° head down and 30° head up) on ventilatory mechanics during laparoscopy were examined by Sprung J et al., in a prior study. They found similar results, namely that pneumoperitoneum increased Ppeak and Pplat values and that the increase in PPEAK and PPLAT values was greater in obese patients [32]. This could have happened as a consequence of their much lower FRC.

In a prospective analysis of 62 patients undergoing elective abdominal robot-assisted surgery (RAS), Tomescu DR et al., found that obesity is the primary risk factor for decreased lung compliance during RAS, and that the effects of patient positioning during surgery—either in a Trendelenburg or steep Trendelenburg—on respiratory physiology were minimal [33]. $P_{DRIVING}$, or driving Pressure, which is determined by deducting PEEP from P_{PLAT}, is necessary for alveolar opening. It is negatively correlated with the lungs' static compliance. When anesthesia was induced and the patients were placed back in a supine posture, the mean driving pressure in the obese group was substantially greater ($p<0.05$). Both the obese and non-obese groups showed a rise in driving pressure (6.1 in O and 4.77 cmH2O in NO) upon insufflation of CO_2. The group that was fat had a greater rise. Trendelenburg position caused the driving pressure to rise even further (4.3 in O and 4.1 cmH2O in NO). The driving pressure values dropped upon desufflation. Similar findings were made by Casati A et al., [34] in regards to obese individuals having laparoscopies. The authors proposed that while the 36 increase in pulmonary blood volume significantly affects the lung elastance, increasing the requirement of driving pressures in obese patients 56, the increase in IAP due to pneumoperitoneum increases the central venous pressure by forcing blood from the abdominal organs into the central venous reservoir. After induction, the NO group and O group in this research had mean EtCO2 values of 29.8± 2.66 and 31.27± 3.04, respectively, which was similar ($p>0.05$). It was raised after Trendelenburg positioning and after insufflation, and it was raised even more after insufflation for ten and thirty minutes. Even though they were not statistically significant, the values in both groups began to decline following desufflation and switching to a supine posture. Similar increases in EtCO2 levels were seen by Bhadauria A S et al. during the pneumoperitoneum and post-desufflation in obese patients having laparoscopic cholecystectomy [30]. The increase in CO_2 absorption into the systemic circulation via the peritoneal surface and the hypoventilation brought on by a raised diaphragm during pneumoperitoneum 38 were the causes of the rise in EtCO2 readings. From the moment anesthesia was induced throughout the procedure, the obese group's mean static and dynamic compliance in this research was considerably poorer ($p<0.05$). Both groups' dynamic and static compliance values declined after the formation of the pneumoperitoneum and again following the Trendelenburg position.

Similar results were found by Sprung J et al., who compared 9 morbidly obese patients with 8 normal weight patients and found that, as compared to normal-weight individuals [32], morbidly obese supine anesthetized patients had 30% worse static compliance and 68% greater inspiratory resistance. Pneumoperitoneum exacerbated these alterations because it lowered lung compliance due to elevated IAP. During the procedure, the steep Trendelenburg posture exacerbates these pulmonary mechanics. When Araujo O. C. et al. evaluated the impact of pneumoperitoneum on respiratory mechanics in obese vs non-obese individuals, they found similar outcomes [35]. The non-obesity group's baseline pulmonary compliance (47.4 ± 5.7 mL.cm H2O -1) was higher than the obese group's (38.3 ± 8.3 mL.cm H2O -1) ($p = 0.01$). Lung compliance fell during insufflation in both groups, and it was consistently poorer in the obese group throughout the assessment ($p < 0.05$). While variances were comparable at the times of analysis, peak and plateau pressure were greater in the obese. In summary, this research found that obese individuals having complete laparoscopic hysterectomy show higher fluctuations in hemodynamic and respiratory parameters than non-obese patients. Pneumoperitoneum and Trendelenburg positions exacerbated these results, which were statistically significant. Heart rate and systolic/diastolic/mean arterial pressure variations were seen in both groups, but they were not statistically significant.

Conclusion:-

This study concludes that obese patients exhibit more variations in hemodynamic and respiratory parameters as compared to non-obese patients, especially after induction of anesthesia and the creation of pneumoperitoneum. Mean peak airway pressure, plateau pressure, and driving pressure were higher, and static and dynamic lung compliance were lower in obese patients. Variations in hemodynamic parameters (heart rate and systolic/ diastolic/ mean arterial pressure) were more pronounced but non-significant in obese patients. These observations underscore the challenge of anesthesiologists regarding suitable ventilation in this group of patients.

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