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Research Article

# A Technique to Reduce Trendelenburg Degree during Gynaecological Laparoscopic Surgeries

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## Abstract

The trendelenburg position in awake and anaesthetised patient's increases Pulmonary Arterial Pressures (PAP), Central Venous Pressure (CVP) and Pulmonary Capillary Wedge Pressure (PCWP). Trendelenburg position in laparoscopic surgeries generally increases venous return and Cardiac Output. If the patient is placed in extreme trendelenburg, a decrease in venous return from the head may result, thus leading to increased intracranial and intraocular pressures. If this position is maintained for an extended duration, cerebral edema and retinal detachment may occur. Because of venous stagnation, cyanosis and edema in the face and neck may be expected. Hence, our study aims to demonstrate a new technique which can help to reduce the angle degree of trendelenburg position, thereby reducing the adverse effects of prolonged decreased venous return from the head, like increased intracranial and intraocular pressures, cyanosis or oedema of the face.

## Introduction

The trendelenburg position is quite essential during laparoscopic surgeries because it facilitates emptying the pelvis from the bowel, hence the surgeon can perform the surgery more efficiently and safely. In this position the patient is kept supine and the head is tilted down to a degree of 15-20 on average. This position in awake and anaesthetised patients increases the pulmonary arterial pressures, Central Venous Pressure (CVP) and Pulmonary Capillary Wedge Pressure (PCWP). It also increases the venous return and Cardiac Output. If the patient is placed in extreme trendelenburg, a decrease in venous return from the head may result, leading to increased intracranial and intraocular pressures. If this position is maintained for an extended duration, cerebral oedema and retinal detachment may occur. Moreover, as a result of venous stagnation, cyanosis and oedema in the face and neck may be expected.

Different Authors proposed to place an elevation under the patient's buttocks to reduce the angle of trendelenburg, providing good pelvis exposure. However, this technique is not currently routinely or widely used and there is no much published data about its outcomes. Hence, the purpose of this study is to validate the efficacy of this technique. Our study aims to demonstrate a technique to reduce the angle degree of trendelenburg positioning of the patients undergoing gynaecological laparoscopic surgeries at a degree where the pelvis is free from the bowel. This reduction of the angle degree of trendelenburg shall therefore reduce the adverse effects of prolonged decreased venous return from the head, as well as the cardiovascular and respiratory effects.

## Methodology

### Study design

Prospective

### Study population/sample size

50 patient's undergone Gynaecological laparoscopic surgeries in Latifa Hospital were studied. Patients were selected randomly. A covered envelope with 25 cards named 'with pillow' and 25 cards 'without pillow' were given to an uninvolved person to pick a card everyday and accordingly we involve it. Most of the included population were between 20-40 years of age, had a BMI between 25-29.9, and were mostly operated for Infertility, pelvic pain and endometriosis. The cardiovascular and respiratory parameters were in the normal range for most of both the studied groups. Blood Pressure (chi-square=2.286, p=0.319). There was no significant difference for both groups in terms of surgical difficulties, postoperative orientation, face oedema (chi-square=3.030, p=0.189), back pain (chi-square=1.087, p=0.609), shoulder pain (chi-square=0.758, p=0.667) and hospital stay.

25 patients were experimented with the new technique, against a control group of 25. On the operating table, the bottoms of the patients were elevated using one rectangular pillow for all of them, which was around 40cm long x 25cm wide and 25cm thick. The degree of trendelenburg was noted during the procedure. The operators were limited to 2 surgeons. Other parameters like the patient's Age, BMI, type of surgery, previous surgeries, respiratory and cardiovascular

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parameters, surgery difficulties and duration, postoperative shoulder and back pain, face oedema were also studied. The study was conducted during a period of 9months from Dec 2015 till September 2016.

### Technique steps

The technique steps which we performed for all the patients were:

- Setting the patient to a flat angle
- Creating the pneumo at 15 mm of Hg
- Place the ancillary trocars
- Place the patient on high- extreme trendelenburg position
- Recline all bowel from pelvis
- Reduce the trendelenburg degree until the bowel loops start to return down
- Measure the angle using a compass

On the operating table, the bottoms of the patients were elevated using the pillow (Figure 1).

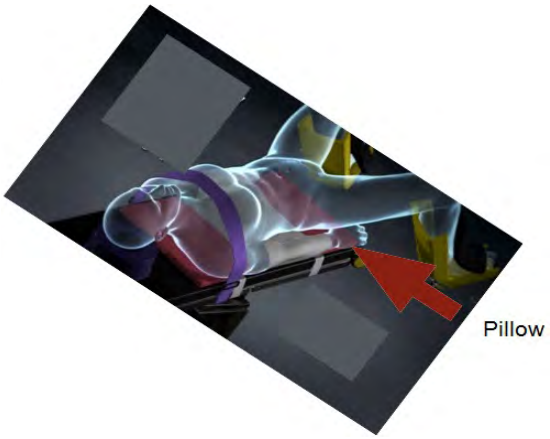


**Figure 1:** Patient positioning and technique of the pillow placement.

### Data analysis

The SPSS Statistics software package was used and statistics significance using the P value tests.

## Results

Among both the studied groups "with and without the pillow", most of the population (68%) and (56%), were between 20-40 years of age and most of them (44%) & (52%) had a BMI between 25-29.9. Among the group with pillow, most of the surgical indications (36%) were for Infertility, Ovarian Cystectomy, Salpingectomies and Ligamentopexy surgeries. While 28% of the cases were operated for pelvic pain and endometriosis. In the other group, without the pillow, most of the surgeries (32%) were for Pelvic Pain/Endometriosis, 24% had TLH and 24% had myomectomies (Figure 2).

In both the studied groups, 52% and 60% of the patients did not have previous pelvic surgeries. Almost all the studied group had a preoperative bowel preparation and were categorized ASA 1-2 (96% and 100%) (Figure 3).

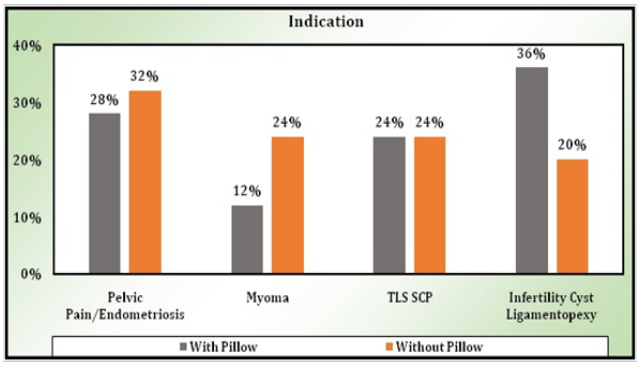


**Figure 2:** This bar chart describes the percentage of the indications of laparoscopic procedures involved, using the pillow and without it.

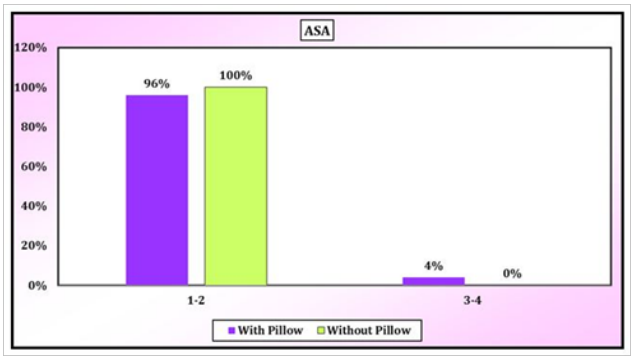


**Figure 3:** This chart represents the relation between the with pillow and without pillow of the ASA.

The MAP was <30 for all the patients population and there were no complications recorded. The Heart rate was within normal (60-99) beat per minute in most (84%) of the population with the pillow and in (92%) of the patients without pillow group, there is no significant difference between the groups (with &without pillow) and Heart Rate (chi-square=3.424, p=0.180), (Figure 4 and Table 1).

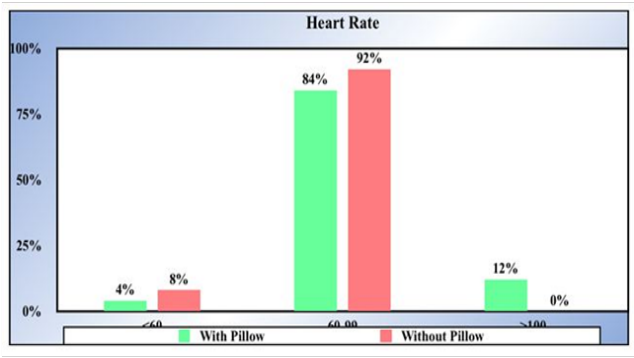


**Figure 4:** The above graph represents the relation between the with pillow and without pillow of the heart rate.

The Blood pressure was in the normal range (100-139/60-89), for most (68%) of both the studied groups. No significant difference between the groups (with &without pillow) and Blood Pressure (chi-square=2.286, p=0.319) (Figures 5 and Table 2).

| Complications | Group | | Total | With pillow | With pillow |
|---|---|---|---|---|---|
| | With pillow | Without pillow | | | |
| Nil | 25 | 25 | 50 | 100% | 100% |
| Total | 25 | 25 | 50 | | |
| **MAP** | **Group** | | **Total** | **With pillow** | **With pillow** |
| | **With pillow** | **Without pillow** | | | |
| 30> | 25 | 25 | 50 | 100% | 100% |
| Total | 25 | 25 | 50 | | |
| **Heart rate** | **Group** | | **Total** | **With pillow** | **With pillow** |
| | **With pillow** | **Without pillow** | | | |
| 60> | 1 | 2 | 3 | 4% | 8% |
| 60-99 | 21 | 23 | 44 | 84% | 92% |
| 100< | 3 | 0 | 3 | 12% | 0% |
| Total | 25 | 25 | 50 | | |

**Table 1:** The above table represents the relation between the with pillow and without pillow of the MAP and heart rate.

| BP | Group | | Total | With pillow | With pillow |
|---|---|---|---|---|---|
| | With pillow | Without pillow | | | |
| 100/60> | 8 | 6 | 14 | 32% | 24% |
| 100-139/60-89 | 17 | 17 | 34 | 68% | 68% |
| 139/89< | 0 | 2 | 2 | 0% | 8% |
| Total | 25 | 25 | 50 | | |

**Table 2:** The above table represents the relation between the with pillow and without pillow of the blood pressure.

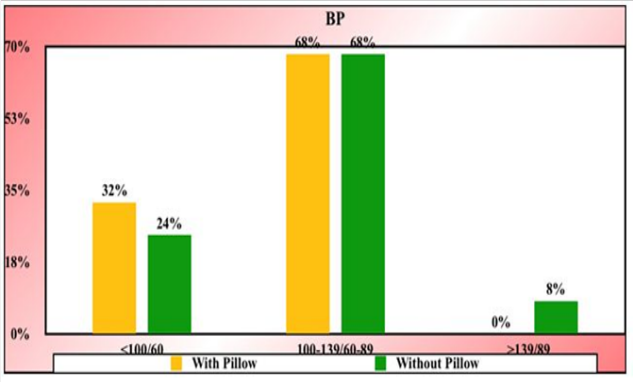


**Figure 5:** The above chart represents the relation between the with pillow and without pillow of the blood pressure.

Ventilation pressure was maintained normal <30/ 5-10 in 84 and 80% of both the groups, with and without. No significant difference between the groups (with &without pillow) and Ventilation Pressure (chi-square=0.136, p=1.000) (Figures 6 and Table 3).

Most (76%) of both the groups maintained a CO2 normal pressure of 30-45mmhg, no significant difference between the groups (with &without pillow) and CO2 (chi-square=1.333, p=0.513) and all of them maintained a normal O2 of 90-100% (Figure 7 and Table 4).

There is no significant difference between the groups- with and without pillow in terms of the surgery duration (chi-square=0.311, p=0.958), most of the surgeries 88 and 76% respectively, had a duration of <= 2hrs (Figure 8 and Table 5).

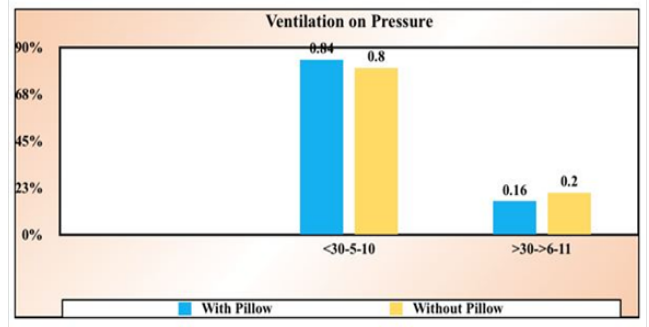


**Figure 6:** The above graph represents the relation between the with pillow and .without pillow of the ventilation on pressure

Postoperatively, there was no significant difference for both groups in terms of orientation, face oedema (chi-square=3.030, p=0.189), back pain (chi-square=1.087, p=0.609), shoulder pain (chi-square=0.758, p=0.667), and hospital stay. All of the with pillow group patients had a pain scale score of <=3, and that was the same for 92% of the patients without the pillow and All of them were oriented postoperatively. Majority (64%) of the patients among the "with pillow" group, required a trendelenburg degree of 0-5, 28% required 6-10 degree, 4% required 16-20 degree and 4% required 21-25 degree.

| Ventilation pressure | Group | | Total | With pillow | With pillow |
|---|---|---|---|---|---|
| | With pillow | Without pillow | | | |
| 30-5-10> | 21 | 20 | 41 | 84% | 80% |
| 6-11<30-< | 4 | 5 | 9 | 16% | 20% |
| Total | 25 | 25 | 50 | | |

**Table 3:** The below table represents the relation between the with pillow and without pillow of the ventilation on pressure.

| $CO_2$ | Group | | Total | With pillow | With pillow |
|---|---|---|---|---|---|
| | With pillow | Without pillow | | | |
| 30> | 4 | 2 | 6 | 100% | 50% |
| 30-45 | 19 | 19 | 38 | 475% | 475% |
| 45< | 2 | 4 | 6 | 50% | 100% |
| Total | 25 | 25 | 50 | | |

**Table 4:** The above table represents the relation between the with pillow and without pillow of the $CO_2$.

| Operation duration | Group | | Total | With pillow | With pillow |
|---|---|---|---|---|---|
| | With pillow | Without pillow | | | |
| .2Hrs => | 22 | 19 | 41 | 88% | 76% |
| .2Hrs => | 3 | 6 | 9 | 12% | 24% |
| Total | 25 | 25 | 50 | | |

**Table 5:** The below table represents the relation between the with pillow and without pillow of the operation duration.

On the other group "without pillow group", 40% required 6-10, 40% required 11-15 degree of trendelenburg, 12% of them required 16-20 degree while only 4% required 0-5 degree and another 4% required 20-25 degree (Figure 9 and Table 6).

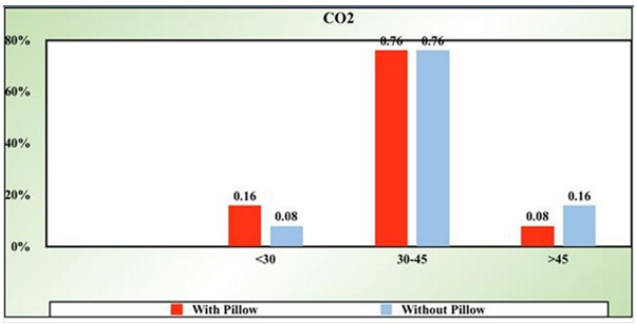


**Figure 7:** The above graph represents the relation between the with pillow and without pillow of the $CO_2$.

Comparing the Angle of trendelenburg and both groups, 34% of the population required a trendelenburg degree of 0-5, and 94% of them were with the pillow (Figure 9 and Table 6). Significant difference between the groups (with &without pillow) and Angle of Trendelenburg (chi-square=24.765, p=0.000).

Comparing the angle of trendelenburg with the patient's BMI, among the group with the pillow, most of the patients (37.5%), who required an angle of 0-5 had a BMI of 18.5-24 and 31.3% of them had a BMI 25-29.9. Among those who required 6-10 degree of trendelenburg, 71.4% had a BMI of 25-29.9. Among the group, one patient required a trendelenburg degree of 21-25 and was with a BMI>30, no significant difference (chi-square=9.320, p=0.408).

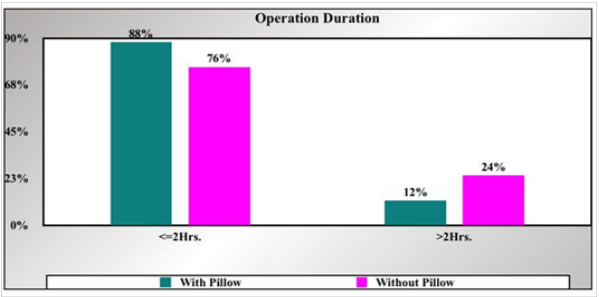


**Figure 8:** The above graph represents the relation between the with pillow and without pillow of the operation duration.

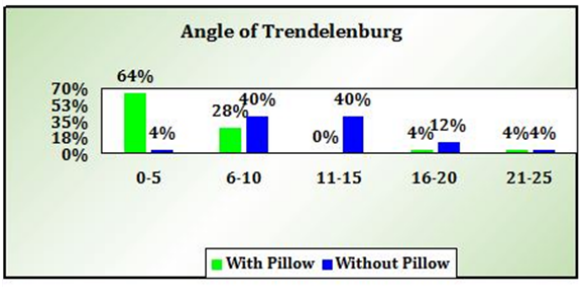


**Figure 9:** The above graph represents the relation between the with pillow and without pillow of the angle of trendelenburg.

| | Value | df | (Asymp. Sig. (2-sided |
|---|---|---|---|
| Pearson Chi-Square | 24.765[a] | 4 | 0.000 |
| Likelihood ratio | 31.402 | 4 | 0.000 |
| Linear-by-Linear association | 13.732 | 1 | 0.000 |
| N of valid cases | 50 | | |

**Table 6:** This table compares the angle of trendelenburg in both groups.

a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is 1.00

Among the group without the pillow, among the 80% who required trendelenburg degree between 6-15, 60% of them had a BMI of 25-29.9 (Figures 10, 11 and Table 7).

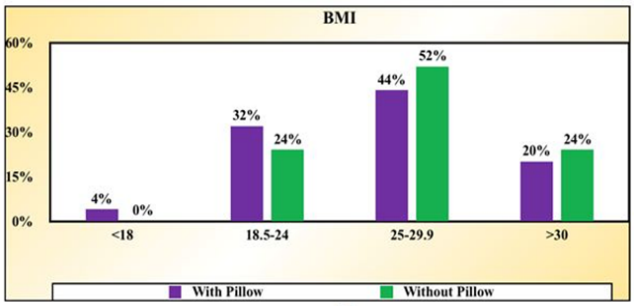


**Figure 10:** The above graph represents the relation between the BMI with pillow and without pillow.

| Crosstab | | | | | | |
|---|---|---|---|---|---|---|
| | Angle of Trendelenburg * BMI | | BMI | | | Total |
| | | | 18.5-24 | 25-29.9 | >30 | |
| Angle of Trendelenburg | 0-5 | Count | 1 | 0 | 0 | 1 |
| | | % within Angle of Trendelenburg | 100.0% | 0.0% | 0.0% | 100.0% |
| | | % within BMI | 16.7% | 0.0% | 0.0% | 4.0% |
| | | % of Total | 4.0% | 0.0% | 0.0% | 4.0% |
| | 6-10 | Count | 4 | 6 | 0 | 10 |
| | | % within Angle of Trendelenburg | 40.0% | 60.0% | 0.0% | 100.0% |
| | | % within BMI | 66.7% | 46.2% | 0.0% | 40.0% |
| | | % of Total | 16.0% | 24.0% | 0.0% | 40.0% |
| | 11-15 | Count | 1 | 6 | 3 | 10 |
| | | % within Angle of Trendelenburg | 10.0% | 60.0% | 30.0% | 100.0% |
| | | % within BMI | 16.7% | 46.2% | 50.0% | 40.0% |
| | | % of Total | 4.0% | 24.0% | 12.0% | 40.0% |
| | 16-20 | Count | 0 | 1 | 2 | 3 |
| | | % within Angle of Trendelenburg | 0.0% | 33.3% | 66.7% | 100.0% |
| | | % within BMI | 0.0% | 7.7% | 33.3% | 12.0% |
| | | % of Total | 0.0% | 4.0% | 8.0% | 12.0% |
| | 21-25 | Count | 0 | 0 | 1 | 1 |
| | | % within Angle of Trendelenburg | 0.0% | 0.0% | 100.0% | 100.0% |
| | | % within BMI | 0.0% | 0.0% | 16.7% | 4.0% |
| | | % of Total | 0.0% | 0.0% | 4.0% | 4.0% |
| | Total | Count | 6 | 13 | 6 | 25 |
| | | % within Angle of Trendelenburg | 24.0% | 52.0% | 24.0% | 100.0% |
| | | % within BMI | 100.0% | 100.0% | 100.0% | 100.0% |
| | | % of Total | 24.0% | 52.0% | 24.0% | 100.0% |

**Figure 11:** The above cross tab is comparing the angle of trendelenburg with the patient's BMI.

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 14.209[a] | 8 | 0.076 |
| Likelihood ratio | 16.015 | 8 | 0.042 |
| Linear-by-Linear association | 10.504 | 1 | 0.001 |
| N of valid cases | 25 | | |

**Table 7:** Comparing the angle of trendelenburg with the duration of surgery there is no significant difference between the groups with and without pillow.

a. 13 cells (86.7%) have expected count less than 5. The minimum expected count is .24

## Discussion

Trendelenburg position is essential during laparoscopic gynaecological procedures in order to operate in the pelvis free from the bowel. The degree ranges from 15-20, and in some studies, a mean trendelenburg angle of 28.0 degrees was adequate to complete most gynecologic robotic surgical procedures when compared with historical control angle of 40 degrees [1]. In our study, most of the patients experimented with the pillow, required a trendelenburg degree of only 0-5, to achieve a pelvis free from the bowel, which is quite less compared to the group without the pillow where only 4% of them required this angle and the majority of them (80%) required

6-15 degree of trendelenburg. Furthermore, when we compared the angle of trendelenburg with both groups, 34% of the population required a trendelenburg degree of 0-5, and 94% of those patients were with the pillow (Statistically Significant difference). These results supports the fact that using this technique we significantly reduce the degree of trendelenburg during gynaecological laparoscopies providing good exposure for the surgeon and also gives an idea about the best angle at which the surgery can be performed while the abdomen is free from the bowel, in relationship to different patient parameters.

There was a linear relationship between angle of trendelenburg and the BMI of the patients. The greater the BMI of the patient, the bigger is the trendelenburg degree required. Among the group with the pillow, most of the patients (37.5%), who required an angle of 0-5 had a BMI of 18.5-24 and 31.3% of them had a BMI 25-29.9, while those who required 6-10 degree of trendelenburg, 71.4% had a BMI of 25-29.9. Only one patient required a trendelenburg degree of 21-25 and was with a BMI>30, no statistical significant difference (chi-square= 9.320, p=0.408). While, among the group without the pillow, among the 80% who required trendelenburg degree between 6-15, most (60%) of them had a BMI of 25-29.9.

Hence, our technique can help in reducing the degree of trendelenburg in obese patients. Reviewing the literature, few data exist regarding weight or timing guidelines for steep trendelenburg positioning in obese patients [2]. Kalmar and colleagues note that patients of normal weight can safely tolerate even prolonged periods (>6 hours) of steep trendelenburg [3]. Due to lack of evidence of the time to incur morbidity and mortality in steep trendelenburg, certain authors advocate for limiting steep Trendelenburg time to less than 5 hours [4]. They concluded that pneumoperitoneum with carbon dioxide leads to elevations in carbon dioxide, which may be difficult to eliminate due to decreased lung and chest wall compliance and elevated airway pressures in obese patients in steep Trendelenburg.

Trendelenburg position, especially when it's prolonged and extreme, is associated with adverse effects on the intracranial, intraocular pressures, cerebral and face oedema, as well as cardiovascular and respiratory effects. Several studies showed significant elevations of IOP during robotic surgery in steep trendelenburg position, in patients with healthy eyes [5]. A significant increase in IOP from baseline was observed after 1 hour and 2 hours of steep Trendelenburg positioning in laparoscopic hysterectomies & remained significantly elevated once the patient was returned to the supine position when compared with the baseline [6]. Furthermore, studies demonstrated blood gas changes and respiratory mechanics were affected by the duration of pneumoperitoneum and patient positioning [7]. The Mean arterial pressure and cerebral perfusion pressure decreased significantly over time after adopting the Trendelenburg position during pneumoperitoneum [8]. It was also demonstrated, that anesthesia and the Trendelenburg position increased the CVP, PCWP and pulmonary arterial pressures and decreased cardiac output [9]. In some studies, with 45° Trendelenburg position, the central venous pressure increased almost 3-fold compared with the initial value, with an associated 2-fold increase in mean pulmonary artery pressure and pulmonary capillary wedge pressure, they concluded that the filling pressures were normalized immediately after surgery, the lung compliance was halved. Gas exchange was unaffected and no perioperative cardiovascular complications occurred [10]. However, in our study there was no significant difference in terms of the ventilation pressure and cardiac parameters for both the groups and that could be explained by the fact that most of our studied cases required a short surgical duration of less than or equal to 2 hours.

There is no doubt that trendelenburg position improves the exposure of the surgical area, using the gravity effects to retract the bowel, hence it helps the surgeon to operate easily and efficiently [11]. The Anaesthesia team is always concerned with the cardiopulmonary effects associated with the trendelenburg position, hence, they are usually resistant to provide the optimal degree. We proved that with this technique we can obtain the same level of adequate surgical exposure, with lower trendelenburg angle.

## Conclusion

This technique demonstrates the possibility to achieve good pelvis exposure during gynaecological laparoscopic surgeries, with less trendelenburg positioning degree for the patients. There was a linear relationship between angle of trendelenburg and the BMI of the patients. The greater the BMI of the patient, the bigger is the trendelenburg degree required.

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Journal of Obesity & Weight Loss

Journal of Orthopedic Research & Physiotherapy

Journal of Otolaryngology, Head & Neck Surgery

Journal of Protein Research & Bioinformatics

Journal of Pathology Clinical & Medical Research

Journal of Pharmacology, Pharmaceutics & Pharmacovigilance

Journal of Physical Medicine, Rehabilitation & Disabilities

Journal of Plant Science: Current Research

Journal of Psychiatry, Depression & Anxiety

Journal of Pulmonary Medicine & Respiratory Research

Journal of Practical & Professional Nursing

Journal of Reproductive Medicine, Gynaecology & Obstetrics

Journal of Stem Cells Research, Development & Therapy

Journal of Surgery: Current Trends & Innovations

Journal of Toxicology: Current Research

Journal of Translational Science and Research

Trends in Anatomy & Physiology

Journal of Vaccines Research & Vaccination

Journal of Virology & Antivirals