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A Comparative Study of Low Versus Standard Intraperitoneal Pressures in Gynaecological Laparoscopic Surgery

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Background: Minimal access surgery in contrast to open surgery has quicker recovery during the postoperative period as well as reduced scores of pain. As a result of increased pressure in the abdominal cavity, laparoscopic surgery has many implications over a range of organ systems as well as their functioning. Laparoscopic surgery due to increased intraabdominal pressure also has many implications on various organ systems and their functioning. To overcome the consequences of increased intrabdominal pressure, a number of trials have been formulated to compare low-versus standard-pressure pneumoperitoneum.
Aim: The aim of this study was to assess the effectivity of low intraperitoneal pressures v/s standard intraperitoneal pressure during laparoscopic hysterectomies.
Study Design: Experimental study
Materials and Methods: 40 cases with uncomplicated symptomatic benign uterine pathologies who were posted for laparoscopic hysterectomy were selected out of which 20-20 cases were

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randomized into low and standard pneumoperitoneum groups.
Results: In patients in whom low pressure pneumoperitoneum is employed are better recovered in terms of pain than standard pressure pneumoperitoneum. This means hospital stay can be shortened in low pressure pneumoperitoneum groups which will be more economical and comfortable for patients.
Conclusion: Laparoscopic hysterectomy can be done at 10 mmhg with the benefits of :

- Optimum visualization with low pressure
- Reduction in post operative pain helping the patient for early ambulation so that patient will get back to routine work and normal life earlier, it is the main purpose of minimal invasive surgery.

Keywords: Laparoscopy; pneumoperitoneum; hysterectomy.

1. INTRODUCTION

For laparoscopic surgery, the most suitable intraperitoneal pressure during laparoscopy is still debatable. There have been a few studies which have emphasized on the convenience of using lower pressures, but the effectivity of performing abdominal surgery with low peritoneal pressures needs further evaluation This study compares low with standard pneumoperitoneum during the process of gynecological laparoscopy.

Intraperitoneal pressures at or above the value of 12 mm Hg are most commonly used while performing laparoscopic procedures of the abdomen [1,2]. Studies done by various authors have concluded that by using low pressures for pnemoperitoneum there could be resultant less pain during the postoperative period and reduced risk of complications which are relared to laparoscopy including pneumothorax, pneumomediastinum, air embolism, arrhythmias and respiratory implications [3–8]. Howsoever, with low pressure pneumoperitoneum improper operative field of vision is a major concern [9] which can result in various complications. Proper visualization may be achieved with optimal pressure of pneumoperitoneum which in turn redcues the complications during post-operative period [1]. The above mentioned findings may vary from one case to another as a result of the differences in positioning provided to the patient (Trendelenburg vs Fowler) as well as the nature of gynecologic laproscopy [10-12].

However, sparsity of data exists about the possibility of endoscopic abdominal surgeries with less than 12 mm of Hg of peritoneal pressures [13,14]. Hence the purpose of this study to compare the gynaecologic laparoscopies done with low and standard Intraperitoneal pressure.

1.1 Objectives

To compare the effectivity of low intraperitoneal pressure with standard intraperitoneal pressure in terms of duration of operating time related to adequate exposure. Intraoperative haemodynamic changes Postoperative pain.

2. METHODS

2.1 Study Type

Experimental study.

2.2 Sample Size

Out of total 40 cases, in which 20 were randomised in to low pneumoperitoneum pressure group and 20 patients were randomized in to standard pressure group.

2.3 Inclusion Criteria

All consecutive patients with uncomplicated symptomatic benign uterine pathologies posted for laparoscopic hysterectomies who gave consent for study

2.4 Exclusion Criteria

- Patients with complicated uterine pathologies, with large size masses (more than 20 weeks size), and with cancer.
- Cases with medical and surgical problems.
- Cases with acute abdomen

- Patients were randomized into two groups. One group with patients undergoing laparoscopic hysterectomy with standard pressure pneumoperitoneum at 14 mm Hg while the other group with patients undergoing laparoscopic hysterectomy with low pressure pneumoperitoneum at 10 mm Hg

- A standard laparoscopic hysterectomy was performed with the insertion of four ports at the start of surgery.
- At admission, the patient's blood pressure and heart rate was noted.
- Intraoperative blood pressure and heart rate was noted. The difference between the readings at admission and those taken intraoperatively was calculated.
- Postoperative analgesia was administered in the form of diclofenac 12 hourly with additional doses where necessary. Postoperative pain was assessed at 6, 12 and 24 hours using a visual analogue scale.
- Need for additional analgesia over and above the 12 hourly diclofenac and incidence of shoulder tip pain was also noted.

3. RESULTS

- Standard pressure pneumoperitoneum took an average of 139.2 ± 6.9 minutes whereas low pressure pneumoperitoneum took an average of 147.3 ± 5.7 minutes for completion of laparoscopic hysterectomy.
- While doing laparoscopic hysterectomies under low pressure pneumoperitoneum,it took on average eight minutes more when compared to the laparoscopic hysterectomy done using standard pressure for pneumoperitoneum. The difference in time duration was not statistically significant (p = 0.1).
- In patients who underwent low pressure laparoscopic hysterectomy ,the average change in systolic BP was an increase of 0.96 + 6.27 mm Hg with a maximum rise of 13 mm Hg and a maximum fall of 10 mm Hg. Whereas, in patients who underwent standard pressure laparoscopic hysterectomy ,there was an increase of 0.8 + 8.9 mm Hg with a maximum rise of 18 mmHg and a maximum fall of 16mm Hg. This difference was not statistically significant.
- In patients who underwent low pressure laparoscopic hysterectomy , the average change in diastolic blood pressure was increase of 1.8 ± 5.2 mm Hg with a maximum rise of 13 mm Hg and a maximum fall of 7 mm Hg. Whereas, the average change in diastolic BP in patients who underwent standard pressure laparoscopic hysterectomy was an increase of 2.8 ± 4.2 mm Hg with a maximum rise of 10 mm Hg and a maximum fall of 7 mm Hg. This difference was not statistically significant.
- The variation of heart rate in patients who underwent low pressure laparoscopic hysterectomy was a decrease of 0.5 ± 5.28 beats per minute, whereas in patients who underwent standard pressure laparoscopic hysterectomy there was an increase of 1.5 ± 6.02 beats per minute.
- The difference in heart rate in both groups of patients was not statistically significant.
- At 6 hours post surgery, the average pain score was 62.2 and 59.1 for patients who underwent low pressure laparoscopic hysterectomy and standard pressure laparoscopic hysterectomy respectively and,the difference was not statistically significant (p = 0.4).
- After 12 hours of the surgery, the average pain score was 54.2 and 62.2 for patients who underwent low pressure laparoscopic hysterectomy and standard pressure laparoscopic hysterectomy respectively respectively and the difference in both the groups was statistically significant.(p = 0.04).
- At completion of 24 hours of the postoperative period the average pain score was 4.6 and 5.2 for patients who underwent low pressure laparoscopic hysterectomy and standard pressure laparoscopic hysterectomy respectively. This difference was not statistically significant.
- One (5.8%) of the 17 patients who underwent low pressure laparoscopic hysterectomy and two (11.11%) of the 18 patients who underwent standard pressure laparoscopic hysterectomy had post operative pain referred to the tip of the right shoulder. This difference was not statistically significant (p = 1.0).

Table 1. Time required while using standard pressure v/s low pressure pneumoperitoneum

	Standard pressure	Low pressure
Average time required	139.2	147.3
Minimum time required	105	120
Maximum time required	195	180

Table 2. Changes in blood pressure while using standard pressure v/s low pressure pneumoperitoneum

Average change in Blood Pressure	Standard pressure	Low pressure
Systolic Bp	0.8 + 8.9 mm Hg	0.96 + 6.27 mm Hg
Diastolic Bp	2.8 ± 4.2 mm Hg	1.8 ± 5.2 mm Hg

Table 3. Changes in heart rate while using standard pressure v/s low pressure pneumoperitoneum

	Standard pressure	Low pressure
Average change in heart rate	1.5 ± 6.02 beats per minute	0.5 ± 5.28 beats per minute

Table 4. Pain Score noted while using standard pressure v/s low pressure pneumoperitoneum

	Standard pressure	Low pressure
Average pain score at time interval		
6 hours	59.1	62.2
12 hours	62.2	54.2
24 hours	5.2	4.6

Table 5. Shoulder tip pain noted while using standard pressure v/s low pressure pneumoperitoneum

	Standard pressure	Low pressure
No. of cases	18	17
Shoulder tip pain present	2(11.1%)	1(5.8%)
Shoulder tip pain absent	16(88.8%)	16(94.2%)

4. DISCUSSION

For laparoscopic surgery CO_2 is the insufflation gas of choice. As air insufflation affects the systemic and peritoneal response more in comparison to CO_2, therefore CO_2 is preferred over air insufflations [15]. The advantages of using CO_2 are: that it is, non-inflammable, dissolvable in the blood as well as transparent. However, the usage of carbon dioxide comes with certain disadvantages as increase in intra-abdominal pressure leads to an increase in the absorption of Carbon dioxide, which results in hypercapnia and acidosis, which has to be countered through carbon dioxide washout in the form of hyperventilation [16]. The use of CO_2 increases the peak airway pressure [17,18] as it pushes the diaphragm upwards and thereby decreasing the pulmonary compliance [16,17].

With creation of pneumoperitoneum there also occurs rise in systemic vascular resistance [18,19] as well as pulmonary vascular resistance [18]. CO_2 insufflation also predisposes the patient to cardiac arrhythmias [20]. Cardiac output decreases during the early phase of pneumoperitoneum [17,18] as there is a reduction in the venous return [21]. Healthy adults with adequate cardiopulmonary reserve may easily tolerate these cardiorespiratory changes ,however people with underlying cardiopulmonary disease may not be able to cope up with these changes. Laparolift [20] or Laparo-tensor [17], is a special device used for abdominal wall lift, is introduced through a port in the abdominal wall and is applied to decrease the cardiopulmonary changes [22].

The data from a few randomized clinical trials shows that by incorporating low pressures for pneumoperitoneum the is lesser degree of changes seen with cardiorespiratory system, [23] patients also have low pain score postoperatively [24] with less no of patients complaining of shoulder tip pain [25] and fewer requiring analgesia [24-27]. When creating pneumoperitoneum with lower pressures of CO2, the risk of mortality because of CO2 embolism is also prevented [28]. In a study done by Schwarte et al. [28], it was also seen that with rise in intra-abdominal pressure there is decreased gastric mucosal oxygen saturation. Use of lowest intra-abdominal pressure instead of routine pressure(14 mmHg) for adequate visualization of the operative field is also recommended by The European Association for Endoscopic Surgery (EAES) and is one of the practice recommendation in their guideline [21].

5. CONCLUSION

Both groups are equally comparable in almost all above parameters. There is no significant differences in both groups, this means low pressure pneumoperitoneum can be used as effectively as standard pressure pneumoperitoneum.

In patients in whom low pressure pneumoperitoneum is employed are better recovered in terms of pain than standard pressure pneumoperitoneum. This means hospital stay can be shortened in low pressure pneumoperitoneum groups which will be more economical and comfortable for patients.

Impact of low pressure pneumoperitoneum on intra-operative hemodynamics is not significant. This needs to be examined through a more complex set up and probably a bigger sample size that includes a larger numbers of patients with cardiovascular comorbid conditions.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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