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Changes in Intraoperative Anaesthetic Parameters During Laparoscopy with Low Pressure Vs Standard Insufflation: A Retrospective Cohort Study

Abstract

Objective: To evaluate the changes in intraoperative anaesthetic parameters during Low-Pressure laparoscopy with Air Seal® versus standard insufflation laparoscopy in gynaecological surgeries.

Materials and methods: 77 patients who had laparoscopic hysterectomy for gynaecological causes were retrospectively identified. Patient demographics, procedure details, the data on intraoperative anaesthetic parameters and duration of recovery from GA after the procedure were collected from patients' electronic and paper notes. No ethical approval was required for this project and the study was registered as a quality improvement project.

Results: 41 patients were operated with 7mmHg Air Seal® system and 36 with 15mmHg standard insufflation. Duration of recovery time from GA was significantly lower in the Air Seal® group. Statistically significant differences were also found in the mid-procedure end tidal CO2 levels and peak airway pressure at the end of the procedure.

Conclusion: In conclusion, our results show that there is no statistically significant difference in anaesthetic parameters between the low-pressure group and standard insufflation group except EtCO2 levels mid-procedure, and that the recovery time after general anaesthesia is significantly lower in the low-pressure group.

Keywords: • Laparoscopy • Pneumoperitoneum • Gynaecology • Low pressure

Research Article

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Introduction

With the recent advances in methods and training in operative gynaecological treatments, laparoscopy has replaced open surgeries in treatment of various gynaecological diseases from endometriosis to endometrial cancer [1, 2].

One of the crucial steps of the laparoscopic surgeries is to create a pneumoperitoneum via CO2 insufflation to achieve direct view of the organs [1, 3]. Despite it being accepted as the most optimal and feasible method to date, several complications have been found to be associated with CO2 insufflation such as shoulder tip pain, subcutaneous emphysema, hypercapnia, and several cardiopulmonary changes [4-6].

Optimising the intra-abdominal pressure to maximise the surgeons' view whilst minimising the haemodynamic and ventilatory complications

and the duration of the post-op hospital admission has remained a challenge. Until recently, an intra-abdominal pressure in the range of 12-15mmHg was the preferred pressure to achieve adequate working space, however, with the introduction of platforms operating through a valveless insufflation trocar such as AirSeal®, it has become possible to perform a laparoscopy with a pneumoperitoneum of 7mmHg [7, 8]. Recent studies have shown that, when lower intra-abdominal pressure was applied during laparoscopic procedures, there was a reduction in the frequency and intensity of postoperative shoulder pain [8, 9, 10, 11], and decrease of End Tidal CO2 (ETCO2) and systolic blood pressure [8]. Furthermore, it was also reported that there was significantly less variability in pressure readings with AirSeal® as compared to the conventional insufflation methods using one-way valve trocar [12].

Although there has been an increased attention on the feasibility of the low-pressure laparoscopy in the academic world recently, there still is a paucity of data on its application in gynaecological procedures. Therefore, our aim is to evaluate and compare the anaesthetic outcomes of gynaecological laparoscopies with low pressure (7mmHg) vs standard insufflation (15mmHg).

Materials and Methods

This two-arm, retrospective, monocentre study has been registered as quality improvement project with the Dudley Group NHS Foundation Trust audit office. No ethical approvals were needed as all the patients were consented pre-operatively. 77 patients who were referred for laparoscopic procedure for treatment of various gynaecological illnesses of benign and low-grade malignant nature were identified retrospectively. Patients were operated on by two surgeons at the Dudley Group NHS Foundation Trust, UK over two years. The patients were grouped based on the pressure used during laparoscopy. First group was the ‘standard pressure’ group with conventional insufflation system at 15mmHg pneumoperitoneum, and the second group was the ‘low pressure’ group with AirSeal® system at 7mmHg pneumoperitoneum. Patient demographics, operation details and Peak Airway Pressure (cmH2O), Systolic Blood Pressure (mmHg) and End Tidal CO2 (kPa) values which were recorded at the beginning, in the middle and at the end of each procedure were collected from patients’ electronic and paper records retrospectively. Data on the duration of recovery for each case was also collected for comparison.

Surgical Procedure: Prior to induction of General Anaesthesia, the patient was attached to full monitoring including ECG, non-invasive blood pressure and pulse oximeter. General anaesthesia was induced in all cases with an intravenous bolus of Propofol 0.5-1 mg/kg and Fentanyl 1-2 microgram/kg. Following this, muscle relaxation was achieved with intravenous Rocuronium 0.5-0.6mg/kg, and endotracheal intubation was performed. General anaesthesia was maintained with the help of inhalational agent Sevoflurane 2-4 % with Oxygen. Analgesia was maintained with intermittent boluses of intravenous Fentanyl. Incidence of postoperative nausea and vomiting was reduced using intravenous Dexamethasone (3.3-6.6mg) and Ondansetron (4-8mg). Trans-umbilical incision was performed, and laparoscopy was proceeded with conventional insufflation in standard pressure group, whereas AirSeal® was used after the insertion of all ports to achieve a lower intra-abdominal pressure in low pressure group. Each procedure was performed with designated pressure. Although the diagnoses were different, the procedures were similar in terms of surgical complexity, procedure time and recovery time.

Statistical analysis: Statistical analysis was performed using GraphPad Prism software (Version 9.0.0). Two-sided alpha level of 0.05 was considered statistically significant. Continuous variables were summarized as the mean ± standard deviation for normally distributed variables, and as median and interquartile range (IQR) if non-normally distributed; and were compared by student’s t-test, or by Mann-Whitney U-test, as appropriate. Categorical variables are summarized as number and percentage, and their distributions among the study groups were compared by Chi-square or Fisher’s exact tests, as appropriate.

Repeated measure data in the two groups were analyzed using a mixed-effects model with Geisser-Greenhouse correction and adjusting for multiple comparisons using Sidak's multiple comparisons test. Effect size of using the low-pressure AirSeal®® was estimated for continuous outcomes by mean difference, or median of differences (calculated using Hodges-Lehmann method) between LP–AirSeal® – Standard insufflation groups, and their 95% confidence interval.

Results: Apart from the higher age range for the AirSeal® group, patient demographics and clinical characteristics were not significantly different (Table 1).

	LP − AirSeal®® Group [n = 41]	**Standard Insufflation Group** [n = 36]	P
Age (yrs)	52.6 ± 16.8	34.9 ± 8.1	**<0.001**
BMI (Kg/m2)	28.3 ± 7.2	28.7 ± 6.2	0.80
ASA score	2 (2 – 2)	2 (1 – 2)	0.05
Medical comorbidities			
Cardiovascular	12 (29.3%)	3 (8.3%)	0.04
Pulmonary	8 (19.5%)	7 (19.4%)	0.78
Indication for surgery			
Endometriosis / DIE	19 (46.3%)	36 (100.0%)	**<0.001**
Abnormal uterine bleeding	4 (9.8%)	0 (0%)	
Endometrial hyperplasia	2 (4.9%)	0 (0%)	
Endometrial cancer	10 (24.4%)	0 (0%)	
CIN II	1 (2.4%)	0 (0%)	
Adnexal mass	4 (9.8%)	0 (0%)	
Others	1 (2.4%)	0 (0%)	

Data presented as mean ± standard deviation, median (interquartile range), or number (percent).

Abbreviations: LP – AirSeal®® low pressure – AirSeal®®, BMI body mass index, ASA American Society of Anesthesiology, DIE deep infiltrating endometriosis, CIN II cervical intraepithelial neoplasia II.

Table 1: Baseline demographic and clinical character istics of the two study groups.

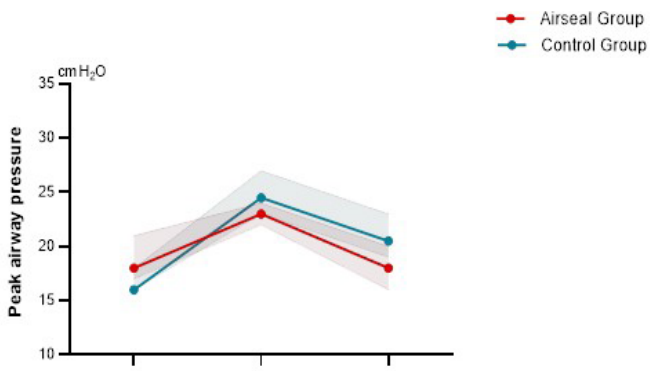
Table 2: Comparison of the anaesthetic parameters in the two study groups.

Discussion

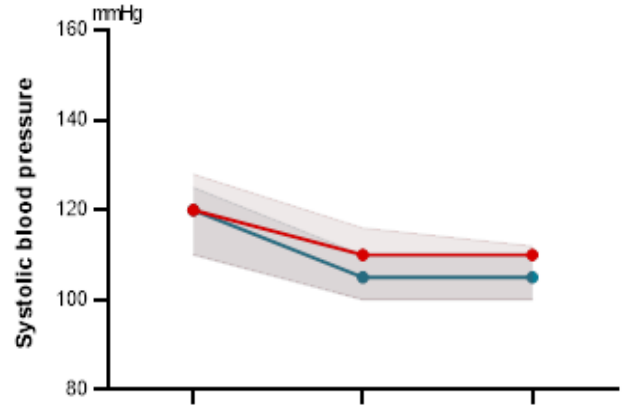
As for the anaesthetic parameters monitored, the peak airway pressure tended to be lower in the the end of the operation by an average of 2.8 cmH2O middle of the operation and was significantly lower at (Graph 1). The same was also observed with the end tidal CO2 (Graph 2), which was significantly lower in the AirSeal® group in the middle of the operation by 0.34 kPa (Table 2). On the other hand, no significant differences were noted in the measured values for the systolic blood pressure in the two

	LP − AirSeal®® Group [n = 41]	**Standard Insuffla-tion Group** [n = 36]	P	**Estimated effect of LP – AirSeal®® (95%CI)**
Peak airway pressure (cm H2O)				
BMI (Kg/m2)	28.3 ± 7.2	28.7 ± 6.2	0.80	
At the beginning of operation	18.0 (16.0 – 23.0)	16.0 (15.0 – 19.75)	0.06	+ 2.5 (-0.1 – 5.1)
In the middle of the operation	23.0 (21.0 – 25.8)	24.5 (22.25 – 28.0)	0.20	– 1.6 (-3.8 – 0.56)
At the end of the operation	18.0 (16.0 – 21.0)	20.5 (18 – 24.75)	**0.02**	– 2.8 (-5.1 – -0.36)
Systolic blood pressure (mmHg)				
At the beginning of operation	120.0 (100.0 – 130.0)	120.0 (101.25 – 128.75)	0.98	+ 1.7 (-11.0 – 14.0)
In the middle of the operation	110.0 (100.0 – 124.0)	105.0 (100.0 – 113.75)	0.21	+ 6.3 (-2.2 – 15.0)
At the end of the operation	110.0 (100.0 – 115.0)	105.0 (100.0 – 110.0)	0.59	+ 3.0 (-3.5 – 9.5)
End tidal CO2 (kPa)				
At the beginning of operation	4.52 ± 0.45	4.58 ± 0.46	**0.91**	**– 0.06 (-0.32 – 0.19)**
In the middle of the operation	4.77 ± 0.37	5.10 ± 0.50	0.004	**– 0.34 (-0.59 – -0.09)**
At the end of the operation	4.84 ± 0.61	5.04 ± 0.63	0.45	**– 0.19 (-0.54 – 0.16)**
Duration of recovery wfrom GA (min)	42.5 (33.5 – 52.5)	50.0 (40.0 – 70.0)	**0.02**	**– 10.0 (-20.0 – 0.0)**

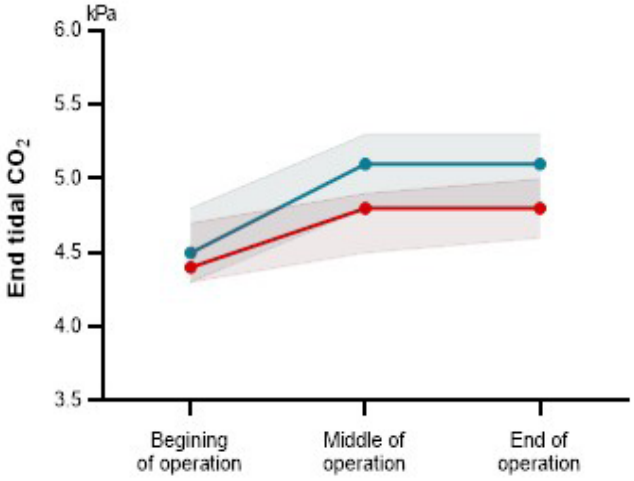
groups (Graph 3). The operating surgeons who performed low pressure laparoscopy did not report any intra-operative difficulties due to lower intraabdominal pressure. According to the Clavien-Dindo classification, there were no complications ≥ Grade II in either patient group. Finally, there was a statistically significant difference ($p<0.05$) between the two groups in duration of recovery from GA. Low pressure group recovered in a median duration of 42.5min, whereas it took standard insufflation group a median of 50min to recover.



Graph 1: Line graph comparing peak airway pressure at the beginning, middle and the end of the operation between the Air seal and the control groups.



Graph 2: Line graph comparing systolic blood pressure at the beginning, middle and the end of the operation between the Air seal and the control groups.



Graph 3: Line graph comparing end tidal CO2 at the beginning, middle and the end of the operation between the Airseal and the control groups.

Low pressure laparoscopy is commonly performed when a high insufflation pressure might be considered harmful such as patients with multiple co-morbidities [13] and in pregnancy [14], but there is not enough evidence to recommend using this low pressure routinely in minimally invasive surgery. One of the well-studied benefits of using low pressure in laparoscopic surgery is that it causes less post-op pain [15-17].

Results of the study of Topcu et.al. demonstrated that the post-operative pain was significantly lower when intraoperative pressure of 8mmHg was preferred [15].

Kyle EB et al. also reported a significant reduction in standardised pain measurement, which was the most significant 24 hours after the surgery [16]. In conjunction with these findings, Bogani et. al reported less shoulder tip pain with lower pressure on the first and third hours following the surgery, and less use of rescue analgesics in their study in 2014 [17].

Another understudied area when it comes to low pressure laparoscopy is whether it causes shortened hospital admission. Our study showed that the low-pressure group recovered from general anaesthesia

about 7 minutes quicker than the standard insufflation group. In their study on cholecystectomy patients, Hua J et.al [18] also demonstrated that the duration of hospital stay was 0.2 days shorter with low pressure, supporting our findings and the theory that the duration of hospital stay could be shortened by lowering intraoperative pressure. It was mentioned at Kyle EB et al's systematic review in 2016 that low pressure laparoscopy might result in poor visibility and that because of this, the surgical technique could be affected [16].

As difficult a parameter as this can be to evaluate, Hua et.al [18] and Gurusamy et.al [19] found in their study on cholecystectomy that the operative times in low pressure and standard pressure were comparable. They reported that there was no difference in the amount of blood loss between the two groups. Surprisingly, the need to increase the pressure during surgery and rate of conversion to laparotomy were also similar in low pressure and standard insufflation groups. Post-op complication rates were comparable in both groups in these studies. In our study, the only significant difference in patient demographics was the mean age which was higher in the low-pressure arm. We do not think that this has affected our main results.

Our study showed that the anaesthetic parameters were overall comparable with both standard and low intraabdominal pressure and the duration of recovery from GA was significantly shorter after low pressure laparoscopy. In the current healthcare climate where enhanced recovery and same day discharges are encouraged due to limited inpatient capacity, low pressure laparoscopy could be a good method to achieve faster patient turnover, and potentially reduce mortality and morbidity due to hospital admission, however, further studies on bigger populations are needed.

In summary, when the benefits of less post-operative pain with low pressure laparoscopy with similar surgical parameters such as estimated blood loss and operating time considered, low pressure laparoscopy could be a method to follow to improve patient flow. However, more data with higher level of evidence is needed before it could be recommended for complex gynaecological cases such as endometriosis excision surgery or low-grade gynaecological malignancies.

Strengths and limitations

One of the weaknesses of our study is our sample size. There is need for further studies on bigger samples. Another weakness of our study is that it is a retrospective study which makes it subject to confounding and some less crucial key statistics could not be measured.

Conclusion

In conclusion, our results show that there is no statistically significant difference in anaesthetic parameters between the low-pressure group and standard insufflation group except EtCO2 levels mid-procedure, and that the recovery time after general anaesthesia is significantly lower in the low-pressure group.

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Authorship Contribution

Farshad Tahmsebi: Conceptualization, Operating Gynaecologist. Mohamed M Hosni: Reviewing and Editing Maher Alazizi: Data curation. Sebnem Selek: Writing, Original draft preparation. Hari Krovvidi: Anaesthetist, Reviewing. Mohamad Ismail: Data curation. Khaled Afifi: Statistical Analysis. Hassan Morsi: Operating Gynaecologist, Reviewing and Editing.

Disclosure of interest

The authors have no conflict of interest to disclose.

References

1. Chapelle, Claire F, Willem A. Bemelman, Bart MP Rademaker and Teus A. Barneveld et al and Dutch Multidisciplinary Guideline Development Group Minimally Invasive Surgery. “A multidisciplinary evidence-based guideline for minimally invasive surgery.” Gynecol Surg. 9 (2012): 271-282.
2. Matsuzaki, Sachiko, Kris Jardon, Elodie Maleysson, Francis D’Arpiany and Michel Canis et al. “Impact of intraperitoneal pressure of a CO2 pneumoperitoneum on the surgical peritoneal environment.” Hum. Reprod. 6 (2012): 1613-1623.
3. Wolf Jr, J. Stuart, and Marshall L. Stoller. “The physiology of laparoscopy: basic principles, complications and other considerations.” J. Urol. 2 (1994): 294-302.
4. Rudston-Brown, Blair CD, David MacLennan, C. Brian Warriner, and P. Terry Phang. “Effect of subcutaneous carbon dioxide insufflation on arterial pCO2.” Am. J. Surg. no. 5 (1996): 460-463.
5. Siu, Wendy, Brian D. Seifman, and J. Stuart Wolf. “Subcutaneous emphysema, pneumomediastinum and bilateral pneumothoraces after laparoscopic pyeloplasty.” J. Urol. no. 5 (2003): 1936-1937.
6. Worrell, Jeffrey B, and Deborah Tarleton Cleary. “Massive subcutaneous emphysema and hypercarbia: complications of carbon dioxide absorption during extraperitoneal and intraperitoneal laparoscopic surgery--case studies.” AANA journal, no. 6 (2002).
7. Horstmann M, Horton K, Kurz M, et al. Prospective comparison between the AirSeal®1 System valveless Trocar and a standard Versaport Plus V2 Trocar in robotic-assisted radical prostatectomy. J Endourol 2013; 27:579–82.
8. Sroussi, J, A. Elies, A. Rigouzzo, N. Louvet, M. Mezzadri and A. Fazel et al. “Low pressure gynecological laparoscopy (7 mmHg) with AirSeal® System versus a standard insufflation (15 mmHg): a pilot study in 60 patients.” J Gynecol Obstet Hum Reprod. no. 2 (2017): 155-158.
9. Sarli, Leopoldo, Renato Costi, G. Sansebastiano, M. Trivelli, and Luigi Roncoroni. “Prospective randomized trial of low-pressure pneumoperitoneum for reduction of shoulder-tip pain following laparoscopy.” J Briti Surg. no. 9 (2000): 1161-1165.
10. Matsuzaki, Sachiko, Kris Jardon, Elodie Maleysson and Francis D’Arpiany et al. “Impact of intraperitoneal pressure of a CO2 pneumoperitoneum on the surgical peritoneal environment.” Hum. Reprod. no. 6 (2012): 1613-1623.
11. Gurusamy, Kurinchi Selvan, Jessica Vaughan, and Brian R. Davidson. “Low pressure versus standard pressure pneumoperitoneum in laparoscopic cholecystectomy.” Cochrane Database Syst Rev 3 (2014).
12. Bucur, Philip, Martin Hofmann, Ashleigh Menhadji and Garen Abedi et al. “Comparison of pneumoperitoneum stability between a valveless trocar system and conventional insufflation: a prospective randomized trial.” Urology (2016): 274-280.

13. Hirvonen, E. A, L. S. Nuutinen, and M1 Kauko. “Hemodynamic changes due to Trendelenburg positioning and pneumoperitoneum during laparoscopic hysterectomy.” Acta Anaesthesiol Scand, no. 7 (1995): 949-955.

14. Ball E, N. Waters, N. Cooper, C. Talati and R. Mallick et al. “Evidence-based guideline on laparoscopy in pregnancy: Commissioned by the British Society for Gynaecological Endoscopy (BSGE) endorsed by the Royal College of Obstetricians & Gynaecologists (RCOG).” Facts Views Vis Obgyn (2019).

15. Topçu, Hasan Onur, S. Cavkaytar, K. Kokanalı and A. I. Guzel et al. “A prospective randomized trial of postoperative pain following different insufflation pressures during gynecologic laparoscopy.” European Journal of Obstetrics & Gynecology and Reproductive Biology (2014): 81-85.

16. Kyle EB, Maheux-Lacroix S, Boutin A, et al. Low vs Standard Pressures in Gynecologic Laparoscopy: a Systematic Review. JSLS. 2016

17. Bogani, Giorgio, Stefano Uccella, Antonella Cromi, Maurizio Serati and Jvan Casarin et al. “Low vs standard pneumoperitoneum pressure during laparoscopic hysterectomy: prospective randomized trial.” J. Minim. Invasive Gynecol, no. 3 (2014): 466-471.

18. Hua, Jie, Jian Gong, Le Yao and Bo Zhou et al. “Low-pressure versus standard-pressure pneumoperitoneum for laparoscopic cholecystectomy: a systematic review and meta-analysis.” Am. J. Surg, no. 1 (2014): 143-150.

19. Gurusamy, Kurinchi Selvan, Jessica Vaughan, and Brian R. Davidson. “Low pressure versus standard pressure pneumoperitoneum in laparoscopic cholecystectomy.” Cochrane Database Syst Rev 3 (2014).

20. Selek, Sebnem, Farshad Tahmasebi, Maher Alazizi and Hari Krovvidi et al. “Changes in Intraoperative Anaesthetic Parameters During Laparoscopy with Low Pressure vs Standard Insufflation: A retrospective cohort study.” Authorea Preprints (2023).

21. Hormones and Histopathological Findings.” Reprod. Biol. 21 (2021):100501.

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