International Journal of Gynecology and Obstetrics Research
Vol. 3(1), pp. 024-030, August, 2017. © www.premierpublishers.org ISSN: 1407-8019

IJGOR

Research Article

Manipulating gas deflation to reduce laparoscopic post-operative pain

Amira Mohammed Badawy

MD, Lecturer of Obstetrics and Gynaecology, Gynae-oncology Unit, Department of Obstetrics and Gynaecology, Faculty of Medicine, Alexandria University, Egypt.
E-mail: dr.amirabadawy@gmail.com ***Telephone(s)***: 00201148087666, 00201000905213, 002035466643
Mailing address: Dr. Amira Badawy Clinic, Cleopatra square, Port Saeed st., Cleopatra Class Building, 3rd floor

Pneumoperitoneum is essential during laparoscopic surgeries. However, residual intra-abdominal gas was proved to be responsible for postoperative upper abdominal and shoulder-tip pain. The current study aimed to assess the safety and efficacy of active gas deflation at the end of gynaecologic laparoscopic surgeries, as a method to reduce post-operative gas-induced pain. The study included 40 cases, planned for operative laparoscopy for benign gynaecologic indications. Cases were randomly allocated to one of the 3 designed groups; Group-A (10 cases), where passive rapid gas deflation was done, group-B (15 cases), where passive slow gas deflation was done, and group-C (15 cases), where gas was rapidly and actively deflated. Postoperative pain was assessed by Visual Analogue Scale (VAS) at 1, 6, 24 hours and 7 days after operation. Postoperative analgesic requirements and frequency of nausea and vomiting were also recorded. The overall results showed that postoperative VAS was significantly less in group C. Total amount of analgesia needed in group C and B was significantly less compared to group A (p=0.0001). We concluded that active aspiration of residual gas at the end of gynaecologic laparoscopy significantly reduces postoperative pain. This simple clinical manoeuvre may also reduce postoperative nausea and vomiting.

KEYWORDS: gynaecologic laparoscopy, shoulder tip pain, gas deflation, gas aspiration, post laparoscopy pain.

INTRODUCTION

Laparoscopic procedures, compared to laparotomies, have many advantages. They are associated with lower morbidity, smaller incisions, shorter hospitalizations, earlier return to normal activity, and less postoperative pain. (Grace et al., 1991, Ortega et al., 2005, Valla et al., 2001)

Postoperative pain management after laparoscopic procedures remains a major challenge. Effective pain control encourages early ambulation, which significantly reduces the risk of deep vein thrombosis and pulmonary embolism. (El-Sherbiny et al.,2009)

Pain after laparoscopic surgery has two components; visceral and somatic. The somatic component is due to the holes made in the abdominal wall for the trocars' entry. The visceral component is due to surgical handling, tissue injury, and stretching of nerve endings. Pneumoperitoneum stretches the peritoneum and the diaphragmatic muscle fibres. (Pasqualucci et al., 1996, Bisgaard et al., 2001).

Dissolved carbon dioxide (CO_2) is another factor for diaphragmatic irritation. In addition, retained CO_2 within the abdomen irritates the phrenic nerve endings; this nerve shares a common route with nerves that innervate the shoulder causing referred pain in the C4 dermatome, resulting in what is known as laparoscopy-induced "shoulder tip pain". Jakson et al., 1996, Shin et al., 2010, Korell et al., 1996) Moreover, CO_2 trapped between the liver and the right diaphragm, irritates the diaphragm, and causes upper abdominal pain. (Phelps et al. 2008). Although it is a soluble gas in comparison to oxygen and nitrogen, CO_2 may take up to two days to be completely absorbed from the peritoneal cavity. Pain due to the residual gas may be of a delayed onset and may be felt after the patient has been discharged from hospital. Hohlrieder et al (2007) have found that the worst pain after gynaecological laparoscopic surgeries was felt in the shoulder in 1% of patients, two hours after surgery. But in 70% of patients, shoulder tip pain was felt 24 hours

after surgery. Similarly, Stanley et al (2012) have reported that the pain attributed to intra-peritoneal gas was as frequent as abdominal wall pain at 24 hours, but declined markedly by 48 hours after laparoscopy, along with a corresponding reduction in the retained gas shown on X-ray.
Because CO2 retention is a key factor in laparoscopy-induced upper abdominal and shoulder tip pain, removing or washing out residual CO2 might reduce the occurrence or severity of this pain in both shoulder and upper abdomen. (Phelps et al., 2008, Sharami et al., 2010, Tsimoyiannis et al., 1998)

The aim of the current study was to assess the safety and efficacy of active gas deflation at the end of gynaecologic laparoscopic surgeries, in order to reduce post-operative gas-induced pain.

PATIENTS AND METHODS

Study Design

This study is a randomized, double-blind clinical trial. It was conducted from the 1st of September 2016, till the 1st of April 2017.
Approval of the local ethics committee and informed consent of Alexandria University Maternity Hospital (El-Shatby Hospital) was obtained before beginning of the study.

Patient Selection

Study cases were selected among those who were admitted to Alexandria University Maternity Hospital (El-Shatby Hospital) and who were scheduled for operative laparoscopy for benign indications (such as adnexal cysts, adhesiolysis and tubal occlusion).
No specific age was selected, but cases known to have chronic pelvic pain, as a result of pelvic endometriosis, pelvic inflammatory disease, or inflammatory bowel disease were excluded. Other exclusion criteria included current pregnancy or malignancy, current or recent opioid use, and those who were unfit for laparoscopic surgery.
After obtaining a detailed informed written consent from each participant, full medical and surgical history was taken; followed by thorough general, abdominal, and local pelvic examination. All cases were then subjected to pre-anaesthetic check-up and routine investigations, such as complete blood count test, random blood sugar level, liver and renal function tests and coagulation profile.
Recruited cases were randomly assigned to one of the following three groups:

- Group A (10 cases), where passive rapid gas deflation was done.
- Group B (15 cases), where passive slow gas deflation was done.
- Group C (15 cases), where gas was rapidly and actively deflated.

Procedures

All laparoscopic procedures were performed under general anaesthesia. On arrival to the operating room, standard anaesthetic, analgesic and antiemetic regimens were conducted similarly for all cases.

For randomization, the number of the group (A, B, or C) was written on a paper and put in similarly shaped envelops, which were sealed and manually shuffled. For each patient, an envelope was chosen randomly and opened by the anaesthesiologist prior the end of operation (when the surgeon stated that the main surgical procedure had finished). In addition, the medical staff who were monitoring the patients during the post-operative periods and were obtaining postoperative pain scores were blinded to the patient`s group allocation, and were not present in the operating room during the intervention.
Laparoscopy was conducted by the same surgeon. Pre-emptive port site analgesia using 2-3 ml local Xylocaine® (Lidocaine 2%, AstraZeneca) infiltration was done prior any incision (to reduce postoperative incision-site pain). (Jiménez Cruz et al., 2014) After placing the Veress needle, pneumo-peritoneum was created by gradual insufflation of CO2 in a rate of 2 Litres/minute and a pressure of 12-14 mmHg.

After placing the main (umbilical) 10 mm trocar, the laparoscope was introduced, and Trendelenberg's position was attained. Two or three 5 mm ancillary trocars were then inserted under direct visualization in either the left/right iliac fossa or the supra-symphyseal midline according to indication.

Throughout the surgery, intra-abdominal pressure was adjusted to sustain a maximum pressure of 14 mmHg, and gas flow rate was maintained not to exceed 2 Litres/minute. After finishing the surgical procedure, all secondary trocars were removed under direct vision (except in group-C where one was left for active gas suction), then CO2 was deflated according to the assigned group. Finally, Trendelenberg's position was corrected after removal of all trocars.

For group-A cases, gas was passively, but rapidly deflated (by external manual compression of the abdominal wall and flanks), in a period of 10-20 seconds. For group-B, gas was allowed to pass out of the abdomen slowly (through the main trocar) in a period of two minutes (120 seconds). For the third group (group-C), the gas was rapidly and actively deflated by placing a multi-port suction tube (through one of the secondary port sites) at the utero-vesical pouch to deflate gas rapidly & actively under vision. By the end of active suction, and to avoid suction or entangling of a bowel loop or mesentery, 10 mm saline were pushed into the suction tube just prior its pulling out of the abdominal port.

Outcomes

Primary outcome was to assess the degree of postoperative pain for each group. This was carried out

Table 1. Characteristic features of the three studied groups.

	Group-A Passive rapid deflation (n=10)	Group-B Passive slow deflation (n=15)	Group-C Active rapid deflation (n=15)	Significance (p value)
Age (in years)				
- Min-Max	19.0-43.0	21.0-46.0	15.0-50.0	0.755 *NS*
- Mean ± S.D.	34.40±7.81	32.07±6.78	32.07±10.28	
Parity				
- Min-Max	0-5	0-5	0-4	0.379 *NS*
- Mean ± S.D.	2.40±1.65	1.87±1.30	1.60±1.30	
BMI				
- Min-Max	22.00-36.00	20.00-35.00	19.00-31.00	0.916 *NS*
- Mean ± S.D.	28.00±4.52	27.33±5.27	27.27±3.88	
BMI: body mass index, ***Min***: Minimum, ***Max***: Maximum		**S.D.:** Standard deviation, ***NS***: not statistically significant (p>0.05)		

by using the Visual Analogue Scale (VAS) and recording degree of pain at 1, 6, 24 hours, and 7 days postoperatively. Patients were instructed how to use the 0-10 VAS; with end-points to be labelled "no pain=0" and "worst possible pain=10". Patients who had VAS > 4, were administered a bolus dose of intravenous analgesia composed of 37.5 mg Diclofenac Sodium (1/2 ampule of Voltaren®, Novartis Pharmaceuticals), in 250 ml normal saline to be given as slow intravenous infusion over a period of 15-30 minutes. Dose was repeated every 6 hours (if indicated), for maximum 4 doses (150 mg) during the first 24 postoperative hours. The number of postoperative analgesic doses was recorded.
Other outcomes included the occurrence of nausea and vomiting during the first 24 hours after operation.

Statistical methodology

The Data were collected and entered to the computer. Statistical analysis was done using Statistical Package for Social Sciences (SPSS/version 20) software.
Arithmetic mean, standard deviation, for categorized parameters chai square test was used while for numerical data for to compare more than two groups ANOVA test was used. The level of significant was 0.05.

RESULTS

52 cases where primarily enrolled in the study, however 12 of them were excluded due to presence of one of the exclusion criteria, one case had border line serous cystadenoma (considered as a low-grade malignancy tumour), 2 cases had tubo-ovarian abscess, and 2 cases had ovarian endometriomata - chocolate cysts - (which were diagnosed pre-operatively as complicated ovarian cysts), and 7 cases had pelvic endometriosis. So, the remaining cases who matched the inclusion criteria were 40 cases.
There were no statistical significant differences between the three studied groups regarding basic characteristics (namely; age, parity and body mass index-BMI). (Table-1).

Operative findings and procedures were adhesiolysis (8 cases), tubal occlusion (4 cases), and cystectomy for simple –functional- cyst (11 cases), haemorrhagic cyst (4cases), mucinous cystadenoma (3 cases), para-ovarian cysts (3 cases) and dermoid cyst (6 cases). There were no statistical significant differences between the three studied groups regarding different indications. (p=0.422). (Table 2)

The size of different types of adnexal cysts was ranging from 4 cm to 11 cms, it was also comparable between the 3 groups, with no statistical difference (p=0.131). The mean operative time (from the beginning of gas inflation, till complete deflation) was 55.50±23.74, 43.33±13.45 and 53.00±21.53 minutes for group A, B and C respectively. The three groups were comparable regarding duration of operation. (Table-3).

After operation, VAS was recorded by each patient at 1, 6, 24 hours, and 7 days after laparoscopy. It was significantly higher among patients of group A (passive rapid deflation) compared to the other two groups at each point of follow up.
The same was noted when group B was compared to group C; where VAS was significantly higher among patients of group B (passive slow deflation) compared to group C (active rapid deflation) at 1, 6, and 24 hours. However, after 7 days of follow-up, there was no significant difference between both groups. (Table 4, figure-1).

Table (5) shows comparison between the three studied groups regarding amount of analgesia needed (in the form of doses, each of 37.5 mg Diclofenac Sodium). It demonstrates that in groups B and C the amount of required analgesia was significantly less compared to group A (0.80±0.56, 1.27±0.59 and 2.80±0.63 doses for group C, B and A respectively, p=0.0001).

Comparison between the three studied groups regarding postoperative nausea and vomiting was recorded in

Table 2. Comparison between the three studied groups regarding the indications of operations.

	Group-A Passive rapid deflation (n=10)		Group-B Passive slow deflation (n=15)		Group-C Active rapid deflation (n=15)	
	No.	**%**	**No.**	**%**	**No.**	**%**
Adhesiolysis	1	10.0	2	13.3	5	33.3
Dermoid cyst	2	20.0	1	6.7	3	20.0
Simple ovarian cyst	3	30.0	5	33.3	3	20.0
haemorrhagic Cyst	1	10.0	3	20.0	1	6.7
Mucinous cystadenoma	2	20.0	0	0.0	1	6.7
Para ovarian cyst	0	0.0	2	13.3	1	6.7
Tubal occlusion	1	10.0	2	13.3	1	6.7
X^2 **Significance (p value)**	14.37 0.422 *NS*					
X^2= Pearson Chi-Square, ***NS***: not statistically significant (p>0.05)						

Table 3. Comparison between the three studied groups regarding cyst size and operative time.

	Group-A Passive rapid deflation (n=10)	Group-B Passive slow deflation (n=15)	Group-C Active rapid deflation (n=15)	Significance (p value)
Cyst size (in cm) - Min-Max - Mean ± S.D.	 5.00-7.00 6.00±0.60	 4.00-11.00 7.54±1.92	 4.50-9.50 6.67±1.86	 0.131 *NS*
Operative duration (min) - Min-Max - Mean ± S.D.	 30.00-100.00 55.50±23.74	 25.00-60.00 43.33±13.45	 30.00-100.00 53.00±21.53	 0.248 *NS*
Min: Minimum, ***Max***: Maximum		**S.D.:** Standard deviation, ***NS***: not statistically significant (p>0.05)		

Table 4. Comparison between the three studied groups regarding VAS at different times of follow up.

VAS	Group-A Passive rapid deflation (n=10)	Group-B Passive slow deflation (n=15)	Group-C Active rapid deflation (n=15)	Significance (p value)	LSD
After 1 hour - Min-Max - Mean ± S.D.	 7.00-10.00 8.70±0.95	 6.00-9.00 7.07±0.88	 5.00-8.00 6.00±0.93	 0.001*	 A# B, C B # C
After 6 hours - Min-Max - Mean ± S.D.	 6.00-9.00 7.60±1.17	 4.00-6.00 5.00±0.76	 2.00-5.00 3.00±1.00	 0.001*	 A# B, C B # C
After 24 hours - Min-Max - Mean ± S.D.	 4.00-9.00 6.10±1.45	 1.00-5.00 2.87±1.19	 1.00-3.00 2.07±0.70	 0.001*	 A# B, C B # C
After 7 days - Min-Max - Mean ± S.D.	 1.00-4.00 2.50±0.97	 1.00-3.00 1.80±0.56	 1.00-2.00 1.40±0.51	 0.013*	 A# B, C
VAS: Visual Analogue scale, ***Min***: Minimum, ***Max:*** Maximum		***S.D.:*** Standard deviation, *****: Statistically significant (p<0.05) ***LSD:*** Least Significant Difference.			

table (6), which shows that patients in group B and C had less nausea and vomiting compared to patients in group A, but differences were not significant (*p*=0.291).

DISCUSSION

The Cochran Database shows that post laparoscopic shoulder pain is preventable by evacuating the residual CO2. (Gurusamy et al., 2007)

Recently, two methods have been proposed to reduce shoulder pain; the pulmonary recruitment manoeuvre and intra-peritoneal normal saline infusion. These two techniques have been thoroughly studied, and were proved to be effective in reducing postoperative pain.

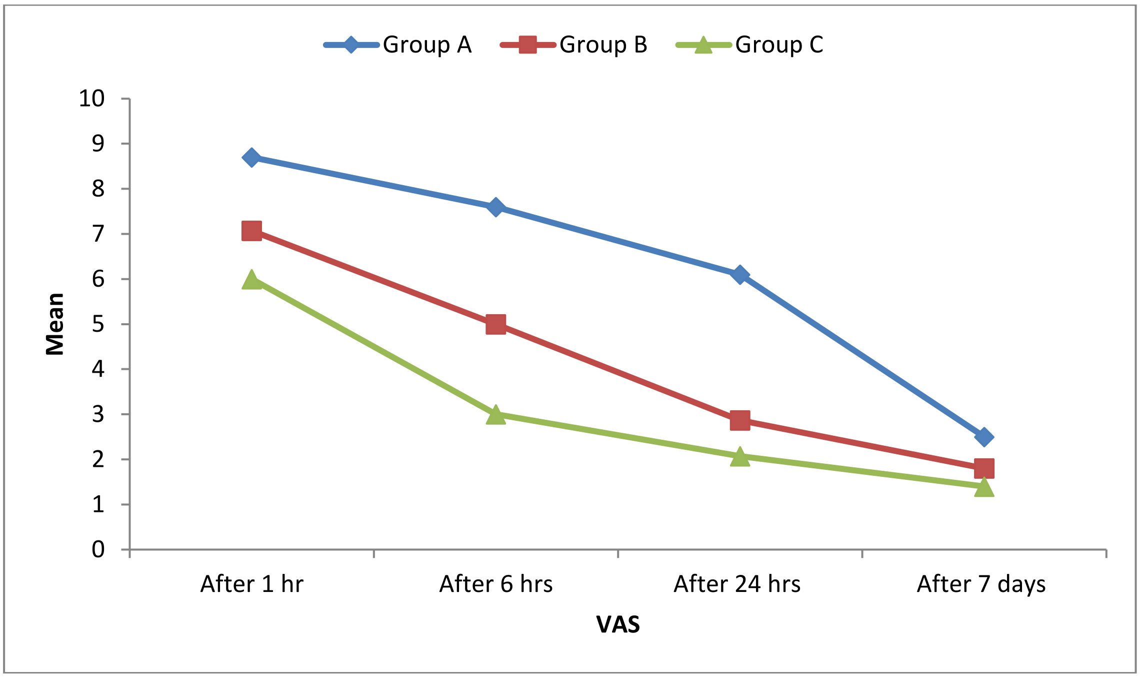

Figure 1: Comparison between the three studied groups regarding visual analogue scale (VAS) at different times of follow up.

Table 5. Comparison between the three studied groups regarding amount of analgesia in doses.

	Group-A Passive rapid deflation (n=10)	**Group-B Passive slow deflation (n=15)**	**Group-C Active rapid deflation (n=15)**
Doses of analgesia needed - Min-Max - Mean ± S.D.	2.00-4.00 2.80±0.63	0.00-2.00 1.27±0.59	0.00-2.00 0.80±0.56
Significance (p value)	0.0001*		
LSD	A# B, C B # C		
Min: Minimum, ***Max:*** Maximum, ***S.D.:*** Standard deviation,	*****: Statistically significant (p<0.05) ***LS D:*** Least Significant Difference.		

Table 6. Comparison between the three studied groups regarding nausea and vomiting.

Nausea and Vomiting	**Group-A Passive rapid deflation (n=10)**		**Group-B Passive slow deflation (n=15)**		**Group-C Active rapid deflation (n=15)**	
	No.	**%**	**No.**	**%**	**No.**	**%**
- **Non**	3	30.0	9	60.0	9	60.0
- **Mild**	2	20.0	3	20.0	5	33.3
- **Moderate**	4	40.0	2	13.3	1	6.7
- **Severe**	1	10.0	1	6.7	0	0.0
X^2 **Significance (p value)**	7.33 0.291 *NS*					
X^2= Pearson Chi-Square, ***NS***: not statistically significant (p>0.05)						

(Phelps et al., 2008, Hohlrieder et al., 2007, Stanley et al., 2012, Tsai et al., 2011).

In the current study, 3 ways of deflating gas at the end of operative gynaecologic laparoscopy were tested for their effect on postoperative pain; rapid passive deflation, slow passive deflation, and active rapid deflation. Results showed that active rapid gas deflation (compared to the other two methods) was significantly associated with less postoperative pain (which was more obvious during the first postoperative 24 hours) and less need for analgesia.

When comparing the three studied groups regarding the postoperative nausea and vomiting; we found that patients in group B and C had less nausea and vomiting compared to patients in group A, however, differences were not significant (*p*=0.291).

In agreement with our study, in 2004, Kafali and colleagues showed that forced aspiration of residual CO2 gas by an aspiration cannula after minor gynaecologic laparoscopic surgery significantly reduced the intensity of pain and analgesic requirements up to 24 hours after surgery.

Previously, Fredman et al (1994) had conducted a study in which residual gas was removed by active aspiration, they reported less morphine use at one hour postoperatively, though VAS scores were similar over the 4-hour postoperative follow up period. Pain scores afterwards and after discharge were not assessed.

In another recent study, Leelasuwattanakul et al (2016) have evaluated the effectiveness of active gas aspiration to reduce postoperative shoulder pain in infertile women undergoing day-case diagnostic laparoscopy. Authors have concluded that active gas aspiration had provided a significantly superior effect on postoperative shoulder pain relief after diagnostic laparoscopy when compared to simple gas evacuation, without any adverse events.

In the current study, slow passive gas deflation was superior to rapid passive deflation in reducing postoperative gas-induced pain (table-4, figure-1). Similarly, Alexander and Hull (1987) had studied the effectiveness of using a gas drain in pain reduction after laparoscopy. A suction catheter with end and side holes was fed through the trocar at the end of the operation. The drain was then removed after 6 hours. The median VAS was reduced up to and including the afternoon of the first postoperative day, and pain frequency was reduced up to and including the second postoperative day.

In another Australian placebo-controlled, randomized trial, Swift et al 92002) used a blocked gas drain as a placebo. It showed that pain scores were significantly reduced for up to 72 hours postoperatively when a patent gas drain was present for four hours postoperatively. There was no associated morbidity in their group of 80 patients.

Conflicts of interest statement*:* There were no conflicts of interest.

CONCLUSIONS

We concluded that active aspiration of residual gas at the end of laparoscopy significantly reduces postoperative pain. This simple clinical manoeuvre may also reduce postoperative nausea and vomiting. It is easy enough to be implemented in all cases of gynaecologic laparoscopic surgeries, and it may have additional benefits as well, such as reducing atelectasis induced by the laparoscopic technique. And if passive gas deflation will be conducted, slow evacuation will give better results regarding postoperative pain and nausea and vomiting.

It was noted also that slow passive gas deflation was superior to rapid passive deflation in getting less pain postoperatively. This may be explained by the fact that slow deflation gives time for more gas to be expelled out of the peritoneal cavity.

As the number of cases in the current study was small, we recommend establishment of more studies with larger number of patients to get more accurate and precise results.

REFERENCES

Alexander JI, Hull MG (1987). Abdominal pain after laparoscopy: The value of a gas drain. Br J Obstet Gynecol. 94: 267–9.

Bisgaard T, Kehlet H, Rosenberg J (2001). Pain and convalescence after laparoscopic cholecystectomy. Eur J Surg. 167: 84–96.

El-Sherbiny W, Saber W, Askalany AN, El-Daly A, Salem AA (2009). Effect of intra-abdominal instillation of lidocaine during minor laparoscopic procedures. Int J Gynaecol Obstet. 106: 213–15.

Fredman B, Jedeikin R, Olsfanger D, Flor P, Gruzman A (1994). Residual pneumoperitoneum: a cause of postoperative pain after laparoscopic cholecystectomy. Anesth Analg. 79: 152–4.

Grace PA, Quereshi A, Coleman J, Keane R, McEntee G, Broe P (1991). Reduced postoperative hospitalization after laparoscopic cholecystectomy. Br J Surg. 78: 160–2.

Gurusamy KS, Samraj K, Mullerat P, Davidson BR (2007). Routine abdominal drainage for uncomplicated laparoscopic cholecystectomy. Cochrane Database Syst Rev. (3): CD006004.

Hohlrieder M, Brimacombe J, Eschertzhuber S, Ulmer H, Keller C (2007). A study of airway management using the ProSeal LMA compared with the tracheal tube on postoperative analgesia requirements following gynecological laparoscopic surgery. Anesthesia. 62: 913–8.

Jackson SA, Laurence AS, Hill JC (1995) Does post-laparoscopy pain relate to residual carbon dioxide? Anaesthesia. 51(5): 485-7.

Jiménez Cruz J, Diebolder H, Dogan A, Mothes A, Rengsberger M, Hartmann M, Meissner W, Runnebaum IB (2014). Combination of pre-emptive port-site and intraoperative intraperitoneal ropivacaine for reduction of postoperative pain: a prospective cohort study. Eur J Obstet Gynecol Reprod Biol. 179: 11-6.

Kafali H, Karaoglanoglu M, Oksuzler C, Bozkurt S. (2004). Active intraperitoneal gas aspiration to reduce postoperative shoulder pain after laparoscopy. Pain

Clin 16: 197–200.
Korell M, Schmaus F, Strowitzki T, Schneeweiss SG, Hepp H (1996). Pain intensity following laparoscopy. Surg Laparosc Endosc. 6(5): 375-9.
Leelasuwattanakul N, Bunyavehchevin S, Sriprachittichai P (2016). Active gas aspiration versus simple gas evacuation to reduce shoulder pain after diagnostic laparoscopy: A randomized controlled trial. J Obstet Gynaecol Res. 42(2): 190-4.
Ortega AE, Hunter JG, Peters JH, Swanstrom LL, Schirmer B (2005). A prospective, randomized comparison of laparoscopic appendectomy with open appendectomy. Laparoscopic Appendectomy Study Group. Am J Surg. 169: 208–12.
Pasqualucci A, de Angelis V, Contardo R, Colò F, Terrosu G, Donini A, Pasetto A, Bresadola F (1996). Preemptive analgesia: Intraperitoneal local anesthetic in laparoscopic cholecystectomy. A randomized, double-blind, placebo-controlled study. Anesthesiology. 85: 11-20.
Phelps P, Cakmakkaya OS, Apfel CC, Radke OC. (2008) A simple clinical maneuver to reduce laparoscopy-induced shoulder pain: a randomized controlled trial. Obstet Gynecol. 111(5): 1155-60.
Sharami SH, Sharami MB, Abdollahzadeh M, Keyvan A (2010). Randomised clinical trial of the influence of pulmonary recruitment manoeuvre on reducing shoulder pain after laparoscopy. J Obstet Gynaecol. 30(5): 505-10.
Shin HY, Kim SH, Lee YJ, Kim DK. (2010). The effect of mechanical ventilation tidal volume during pneumoperitoneum on shoulder pain after a laparoscopic appendectomy. Surg Endosc. 24(8): 2002-7.
Stanley IR, Laurence AS, Hill JC. (2012) Disappearance of intraperitoneal gas following gynecological laparoscopy. Anesthesia. 57: 57–61.
Swift G, Healey M, Varol N, Maher P, Hill D (2002). A prospective randomised double blind placebo controlled trial to assess whether gas drains reduce shoulder pain following gynecological laparoscopy. Aust N Z J Obstet Gynecol Gynec. 42: 267–70.
Tsai HW, Chen YJ, Ho CM, Hseu SS, Chao KC, Tsai SK, Wang PH (2011). Maneuvers to Decrease Laparoscopy-Induce Shoulder and Upper Abdominal Pain. Arch Surg. 146(12): 1360-6.
Tsimoyiannis EC, Siakas P, Tassis A, Lekkas ET, Tzourou H, Kambili M (1998). Intraperitoneal normal saline infusion for postoperative pain after laparoscopic cholecystectomy. World J Surg. 22(8): 824-8.
Valla JS, Limonne B, Valla V, Montupet P, Daoud N, Grinda A, Chavrier Y (2001). Laparoscopic appendectomy in children: report of 465 cases. Surg Laparosc Endosc. 1: 166–72.

Accepted 22 June, 2017

Citation: Badawy AM (2017). Manipulating gas deflation to reduce laparoscopic post-operative pain. International Journal of Gynecology and Obstetrics Research, 3(1): 024-030.