

Effect of Low Pressure Pneumoperitoneum on Shoulder Tip Pain: A Prospective Study

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Abstract: As laparoscopic procedures are done by a small incision made at a site away from the operative field, space is very limited in laparoscopic surgeries. Hence, for adequate exposure and to facilitate the space for proper handling of the instruments required for performing laparoscopic surgery abdominal wall has to be lifted up. This can be achieved by either mechanical abdominal wall elevators or by creating pneumoperitoneum. And this pneumoperitoneum is created by insufflating carbon dioxide in the abdominal cavity using a pressure regulating automatic insufflators. However, this raised intra-abdominal pressure is related with some negative effects on circulatory & respiratory systems, as well as on the kidneys, but many advantages are well established of procedures done laparoscopically. The study presented here shows the effect of raised intra-abdominal pressure on shoulder tip pain particularly in laparoscopic cholecystectomy.

Keywords: Intra-abdominal pressure, laparoscopic surgery, low pressure, pneumoperitoneum, shoulder tip pain

INTRODUCTION

During laparoscopic surgery when gas is insufflated to create pneumoperitoneum, diaphragm raises upward as a repercussion of abdominal wall stretching caused by the gas. Because of it, the compliance of lung decreases and patient's respiration get compromised. Also, the venous blood return from the inferior vena cava to the heart is impaired, which further put down the stroke volume and renal blood flow, this results in shrinkage of visceral vascular bed and increased mean arterial pressure[2,3,4,5].

As a consequence of which blood supply to vital structures along with kidneys get hampered. To curtail these negative impacts, the clinical practices are exercised with low pressure pneumoperitoneum [8 to 10 mm Hg].

The mechanism of pain after pneumoperitoneum is still not known exactly. Though many theories are proposed to explain pain after pneumoperitoneum, some of them are:

Diaphragmatic stretching

When carbon dioxide gas is insufflated in the peritoneal cavity intra-abdominal pressure increases which causes stretching and tearing of diaphragmatic muscle fibers. These results in irritation of phrenic nerve and thus pain in right shoulder supplied by C4 dermatome referred as shoulder tip pain.

Chemical nature of the gas

Carbon dioxide is an acidic gas. It reacts with peritoneal fluid and forms carbonic acid. This intra-

abdominal acidic milieu causes chemical irritation of peritoneum resulting in neuropraxia of phrenic nerve and thus shoulder tip pain.

Sympathetic nervous system activation

Hypercarbia resulting from carbon dioxide gas insufflation leads to sympathetic nervous system activation as well as local tissue inflammatory response resulting in release of inflammatory cytokines and splanchnic mucosal ischemia [6,7]. However, the perfect mechanism in this concern is yet to be questionable.

The aim of the present study is to look for the effect of low pressure pneumoperitoneum in reducing the shoulder tip pain. Also the complications and difficulties surgeon may encounter with while performing laparoscopic surgery under low pressure pneumoperitoneum particularly cholecystectomy. And the after effects post operatively.

METHODS AND MATERIALS

This study was a hospital based randomized comparative intervention study, carried out in department of general surgery of Sawai Man Singh Hospital Jaipur between periods from March'2016 to December'2017. A total of 118 cases were analyzed to carry out the study. All the cases who met the inclusion and exclusion criteria of the study were randomly

allocated in two groups A and B (59 in each group). Allocation of the cases in group A of low pressure group (8 to 10 mm of Hg) or group B of normal pressure group (10 to 12 mm of Hg) is done by simple random technique through chit box method. All the patients consented for the study were educated regarding visual analogue pain scale preoperatively and the same is showing in following figure 1.

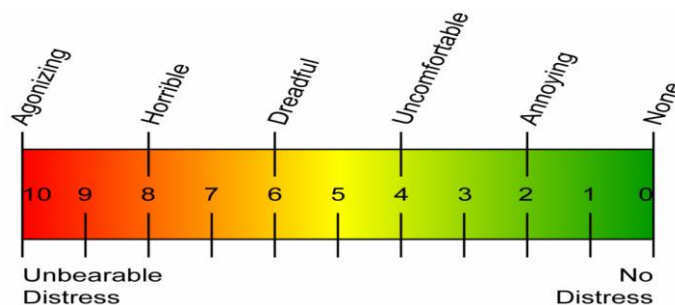


Fig-1: Visual analogue pain scale

Patients those having serious pre-existing cardiovascular, pulmonary or immunological diseases; pregnancy; coagulopathies; complicated gall bladder, such as, dense adhesions at triangle of calot's (frozen calot), contracted and fibrotic gall bladder, gangrenous gall bladder, acutely inflamed gall bladder, empyema of gall bladder; mirrizi's syndrome; cholecysto-gastric or duodenal fistula; and with any previous upper abdominal surgery were not included in the study. In addition, patients with neuralgic pain or any shoulder

pathology causing pain were also not considered for this study. The method of analysing the results is based on chi-square test and unpaired t-test.

OBSERVATIONS

The various parameters as shown in table 1 were considered in this comparative analysis study. The observations corresponding to these parameters were collected during the study period and the same are represented in the table.

Table-1: Study parameters and corresponding observations in both the groups

S. No.	Study parameters	Observations		p value	
		Group A: low pressure group	Group B: normal pressure group		
1	Mean age(in years)	39.75	38.61	0.586	
2	Male and female ratio (M:F)	6:53	7:52	0.769	
3	Duration of surgery(Mean±SD)	26.10±10.42	25.47±9.28	0.485	
4	Intra operative gas consumption(Mean±SD)	51.73±24.78	63.39±26.26	0.000036	
5	Bile spillage (No. of patients)	11	12	0.758	
6	Bleeding (No. of patients)	5	3	0.758	
7	Post-operative shoulder tip pain(No. of patients)	7	22	0.00134	
8	Mean visual analogue scale	1 hr	0.00	0.10	0.159
		6 hr	0.42	1.97	0.00024
		12 hr	0.25	1.25	0.00022
		24 hr	0.14	0.97	0.00004
9	Analgesic requirement(No. of patients)	27	17	0.057	
10	Time of first analgesic dose(Mean±SD)	45±27.88	27.9±25.94	0.042	
11	No. of ampoules of analgesic(Mean±SD)	1.13±0.34	1.69±0.78	0.003	

(SD = Standard deviation)

Thus, it can be inferred from the results shown in the table that laparoscopy is better than open

cholecystectomy but some significant findings also need attention here.

Mean duration of surgery is more in low pressure group (8-10 mm of Hg) as compare to normal pressure group (10-12 mm of Hg) but it does not reach to a significant level. Similarly, no of patients' encountered intra operative complications like bile spillage and bleeding are more in low pressure group i.e. 16 versus 15 in normal pressure group but it did not touch significant level.

Post-operative shoulder tip pain is more and frequent in high pressure group as can be seen by visual analogue score analyzed at 1st, 6th, 12th, 24th post-operative hours. And the results were found to be very significant. Though analgesic requirement and time at which first dose of analgesic is required makes no significant difference among the groups. It may be due to need of analgesics for pain other than shoulder tip pain in the early post-operative period, such as, abdominal (visceral) or incisional site pain and hence further study is needed to improve the quality of the post-operative care of the patients.

DISCUSSION

Post-operative pain whether incisional, visceral or intra-abdominal, shoulder tip pain is very frequent and most troublesome complication for the patients underwent surgery both open and laparoscopic surgery. Incisional and intra-abdominal pain is less after laparoscopic surgery but, shoulder tip pain is more frequent. As present time is the era of laparoscopic surgery and laparoscopic cholecystectomy is performed as a day care surgery. Hence more attention should be given on improving early post-operative pain.

For the treatment of any disease, its pathology should be known. Although, phenomenon of shoulder tip pain after laparoscopic cholecystectomy is not clearly known but to minimize its occurrence and severity, a wide range of studies have been conducted. They propose various perioperative analgesic schemes including subcutaneous and intramuscular anesthetic administration to the shoulder, and intraperitoneal irrigation with bupivacaine to both hemi diaphragms at the end of the surgery [8]. Further, no one route of administration attributed to sufficient positive results to justify routine clinical use [1].

Some studies concluded effect of temperature and humidity of gas used for insufflation. They studied the effect of temperature on post-operative pain after laparoscopic surgery. According to them when gas is insufflated at body temperature versus standard gas insufflation temperature (20°C), pain is significantly reduced when warmed gas was insufflated especially shoulder tip pain.

Another study showed effect of humidity of gas on diaphragmatic and shoulder tip pain. When humidified gas was used instead of standard dry gas,

pain was significantly reduced along with shorter post-operative hospital stay and early return of work.

This prospective trial has confirmed that low pressure pneumoperitoneum significantly decreases post-operative pain as apparent by the noticeable difference in the mean visual analogue pain scale score between the group A and group. The number of patients who did not require any analgesic medication was high in low pressure group. And the total analgesic requirement in terms of the number of ampoules of tramadol was significantly less in the low pressure group than in the normal pressure group. Thus, an involvement of reducing the pressure of carbon dioxide pneumoperitoneum during laparoscopic cholecystectomy has resulted in significant decrease in the occurrence and severity of shoulder tip pain, therefore, reducing need of analgesics in the post-operative period.

CONCLUSION

Low pressure carbon dioxide pneumoperitoneum laparoscopic cholecystectomy is a better procedure as compare to normal pressure pneumoperitoneum laparoscopic cholecystectomy as there is no major difference in intraoperative and post-operative complications between the studied groups. Further, the frequency as well as intensity of post-operative pain and shoulder tip pain is less in low pressure pneumoperitoneum group, thereby, low pressure carbon dioxide pneumoperitoneum laparoscopic cholecystectomy may be accepted as superior than other one.

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