Original Article

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Incidence of Neurological, Ophthalmic and Otological Symptoms in Laparoscopic Surgery in Post Operative Period: An Observational Study

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Abstract

Context: Laparoscopic surgery technique creates certain changes in various systems presenting as post-operative side effects and symptoms.

Aims: To observe incidence of post-operative neurological, ophthalmic and otological symptoms in patients undergoing laparoscopic surgery.

Setting and Design: Institutional setting, retrospective observational study

Material and methods: After ethical committee clearance, 100 patients undergoing laparoscopic surgery, meeting inclusion criteria were included in the study. Patients were monitored intra-operatively for haemodynamic changes;EtCO2, Ppeak. After extubation in post-operative period, patientswere monitored for signs and symptoms in PACU, after 4 hours and 2nd post-operative day and system specific symptoms noted.

Statistical analysis used: Data collection done using SPSS 21.0. Analysis of collected data done using independent t test, paired t test, chi-square test and Fischer's test.

Results: Out of 100 patients,36 patients showed symptoms. 8 patients had BMI >35kg/m2, 7 out of them had neurological (p value=0.14) and all 3 neurological, ophthalmic and otological symptoms. Trendelenburg combined with lithotomy position was used in 7 patients, 6 patients showed symptoms, 5 of them showed neurological symptoms (p value=0.006) and 3 showed ophthalmic symptoms (p value=0.002). Total colorectal surgeries done were 5, out of which 4 showed symptoms. Total gynaecological surgeries done were 10, out of which 7 showed symptoms, neurological=6 and ophthalmic=3. Mean duration of insufflation in neurological symptoms- 4.06hrs (p-value 0.007), for ophthalmicsymptoms-4hrs (p-value 0.334) and otological symptoms-8hrs (p-value 0.002). Certain parameters like EtCO2, Peak airway pressures, increased during insufflation and continued to remain high even after desufflation (P value=0.0001). Age of the patients, Intra-abdominal pressure (IAP) and comorbidities did not show significant impact on incidence of symptoms.

Conclusion: Trendelenburg with lithotomy position, higher BMI, longer duration of insufflation can be major factors contributing to neurological and ophthalmic symptoms in laparoscopic surgeries.

Keywords: Laparoscopic surgery; Neurological symptoms; Pneumoperitoneum; Trendelenburg's position.

Key Message: Laparoscopic surgery involves the risk of rise in ICP and IOP, susceptible patients should be screened and monitored vigilantly.

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Introduction

The use of CO_2 for pneumoperitoneum during laparoscopic surgery, positioning and insufflation for prolonged duration creates changes in various body systems. Cerebral blood flow increases by 1-2 mL per per minute for every 1mm Hg increase in partial pressure of carbon dioxide ($PaCO_2$). Trendelenburg's position can lead to increase in CVP, prolonged duration of this position can also cause cerebral edema and even retinal detachment.[1] These changes can cause post-operative symptoms suggestive of neurological, ophthalmic and otological origin leading further to symptoms. Anticipating these inevitable changes, careful screening and patient selection as well as preventive measures can improve the outcome of surgery and anesthesia.

Material and Methods

Our study was subjected to institutional ethical committee clearance and written informed consent was taken from all the patients. It was a non-interventional and observational study conducted in a multi-specialty tertiary center.100 patients of ASA I, II and III: 18-60 years age of both sexes, undergoing laparoscopic surgery of more than 1 hour duration were included. Patients were screened in preoperative evaluation for pre-existing conditions of raised ICP, IOP or inner ear diseasese.g.: glaucoma, seizure disorders, CSOM etc. During the laparoscopic surgery,hemodynamics parameters, Intra-abdominal pressure IAP, patient positions, surgical duration, Ppeak and $ETCO_2$ were monitored.

Ventilation settings were managed according to lung protection ventilation strategies. After extubation, patient's signs and symptoms were noted in post anesthesia care unit (PACU), followed by 4hours after surgery and 2nd post -operative day. Patients with positive findings were followed up further. Retrospective analysis of patients monitoring record in relation to BMI, positioning, duration of insufflation, intra-abdominal pressure (IAP) was done. Data entry was done in Microsoft excel, analysis on SPSS 21.0. Categorical values were represented as number and percentages, continuous variables as mean ± SD and median values. Quantitative variables were analysed using independent t test and paired t test, qualitative variables were analysed using chi-square/Fischer's test as applicable. P-value of <0.05 was considered significant.

Results

A total of 100 patients were part of the study with mean age of 42 years, consisting of 47 females and 53 males; 33 belonged to ASA I, 60-ASA II and 7-ASA III.

36 patients showed symptoms, out of these neurological symptoms were seen in 34 patients, ophthalmic symptoms were observed in 8 and otological was observed in 1 patient(Figure 1).

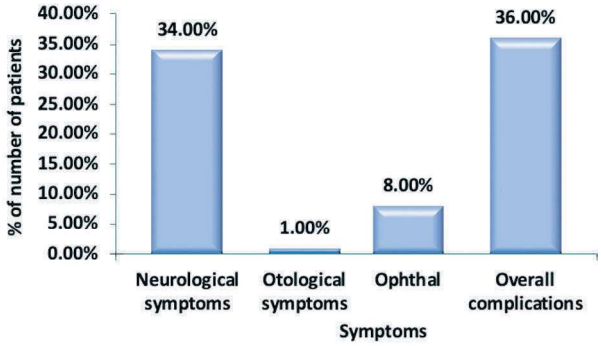

Fig. 1: Symptoms in study subjects.

In patient of age <20 years (n=3),2 patients had neurological, none of the patients had ophthalmic or otological symptoms. In 20-29 years (n=22), 8 patients had symptoms, out of which6 patients had neurological symptoms, 4 patients had ophthalmicsymptoms, none of the patients had otological symptoms; in 30-39 years (n=18), 2 patients had symptoms, both patients had neurological symptoms. In 40-49 years, age group (n=19), 10 patients had symptoms, all 10 patients had neurological, 4 patients had ophthalmicsymptoms and 1 patienthad otological symptoms; in 50-60 years(n=38), 14 patients had symptoms,all 14 patients had neurological, none of the patients had ophthalmic or otological symptoms. The difference in ophthalmic symptoms incidence in various age

Table 1: Distribution of incidence of symptoms according to age (in years).

Symptoms	<20 (n=3)	20-29 (n=22)	30-39 (n=18)	40-49 (n=19)	50-60 (n=38)	p-value
Neurological symptoms	2 (66.67%)	6 (27.27%)	2 (11.11%)	10 (52.63%)	14 (36.84%)	0.057
Ophthalmic Symptoms	0 (0%)	4 (18.18%)	0 (0%)	4 (21.05%)	0 (0%)	0.006
Otological symptoms	0 (0%)	0 (0%)	0 (0%)	1 (5.26%)	0 (0%)	0.4
Overall symptoms	2 (66.67%)	8 (36.36%)	2 (11.11%)	10 (52.63%)	14 (36.84%)	0.079

groups was statistically significant (p value=0.006) (Table 1).

Out of the total patients with symptoms, 22 females, 14 males had symptoms. (total n=36) and the difference was significant (P value=0.034), neurological symptoms were seen in 21 females, 13 males (total n=34) and the difference was statistically significant. (P value=0.034). Ophthalmicsymptoms were seen in 5 females, 3 males (total n=8), otological symptoms were seen in 1 female and none of the males, in both the cases difference was not statistically significant. In patients with <20kg/m2 BMI (n=6), 2 patients showedsymptoms, 1 neurological, 2 ophthalmic. In the BMI range 20-25 kg/m2(n=37), 10 patients had symptoms, 9 patients had neurological symptoms, 2ophthalmicsymptoms. In the range 26-30 kg/m2 (n=43), 15 patients had symptoms, 15 had neurological symptoms, 3 hadophthalmicsymptoms. In 31-35 kg/m2 (n=6) range, 2 patients had symptoms, 2 had neurological and 1 had ophthalmicsymptoms. In patients with BMI > 35 kg/m2 (n=8), 7 patients had symptoms, 7 had neurological and1 had otological symptoms. The difference amongst the different categories was significant for neurological (P value=0.014) and overall symptoms(P value=0.031) (Figure 3).

In the patients operated in lateral position, n=18, 4 patients showed only neurological symptoms. Surgery done in lithotomy position, n=2, 2 had neurological symptoms and 1 had ophthalmicsymptoms. In reverse Trendelenburg's position (n=42),16 patients had symptoms,16 neurological, 2ophthalmic and 1 otological. Patients undergoing surgery in supine position (n=20), 2 patients had onlyneurological symptoms. In Trendelenburg's position (n=11), 6 patients had symptoms, 5patients hadneurological symptoms, 2ophthalmicsymptoms. Surgery done in combined Trendelenburg's and lithotomy position (n=7), 6 patients had symptoms, neurological symptoms were seen in 5, ophthalmicsymptoms in 3. The difference in neurological (P value=0.006), ophthalmic(P value=0.002) and overall symptoms (0.001) was statistically significant (Table 2).

Fig. 2: Distribution of symptoms according to BMI in (kg/m2).

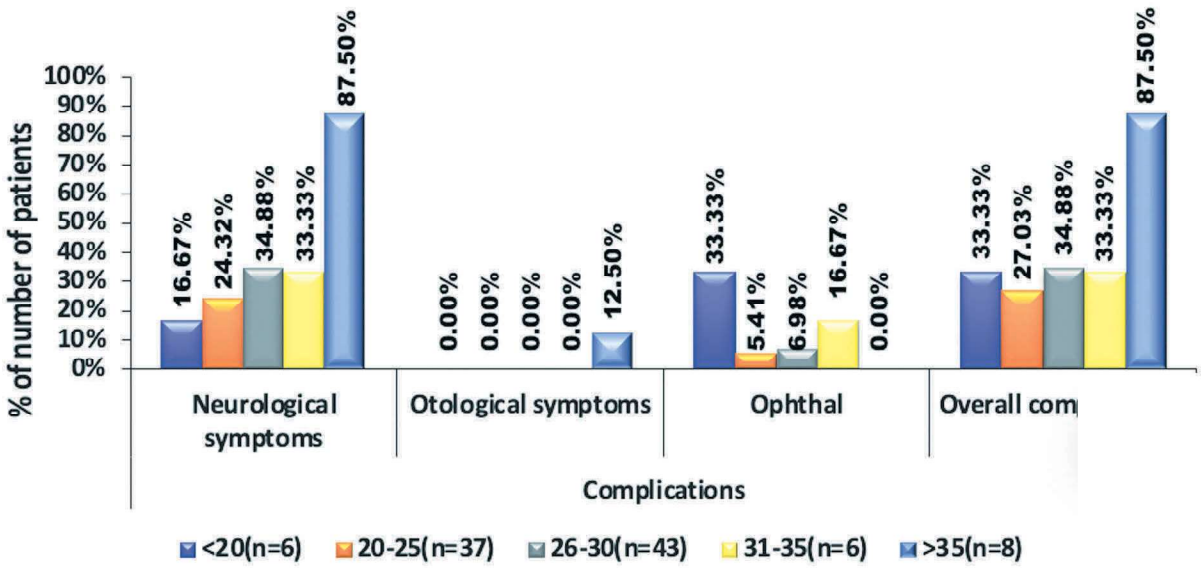

Table 2: Distribution of symptoms with different positions.

Patient position	Neurological symptoms	Ophthalmic symptoms	Otological symptoms	Overall symptoms
Lateral (n=18)	4 (22.22%)	–	–	4 (22.22%)
Lithotomy (n=2)	2 (100%)	1 (50%)	–	2 (100%)
Reverse Trendelenburg's (n=42)	16 (38.10%)	2 (4.76%)	1 (2.38%)	16 (38.10%)
Supine (n=20)	2 (10%)	–	–	2 (10%)
Trendelenburg's (n=11)	5 (45.45%)	2 (18.18%)	–	6 (54.55%)
Trendelenburg's + Lithotomy (n=7)	5 (71.43%)	3 (42.86%)	–	6 (85.61%)
p-value	0.006	0.002	1	0.001

In patients undergoing laparoscopic abdominal surgeries (n=31), 7 had symptoms, 6had neurological symptoms and 1 ophthalmic. Patients undergoing laparoscopic cholecystectomy (n=32), 11 had symptoms, 11 had neurological symptoms, 1 had neurolical and ophthalmicsymptoms. In laparoscopic gynaecological surgery patients (n=10), 7 had symptoms, 6 had neurological symptoms and 3 ophthalmicsymptoms. In laparoscopic urological procedures (n=19), 5 had symptoms, all 5 patients had only neurologicalsymptoms. In patients undergoing laparoscopic colorectal surgery (n=5), 4 had symptoms, 4 patients had neurological and 2 had neurological and ophthalmicsymptoms. In laparoscopic bariatric procedures (n=3),2 had symptoms, 2 patientsneurological and 1 had neurological and otological symptoms. The difference of symptoms in different surgeries was statistically significant (Table 3).

Table 3: Distribution of symptoms in different surgeries.

Type of surgery	Neuro-logical symptoms	Ophthalmic symptoms	Otological symptoms	Overall symptoms
Lap abdominal surgeries (n=31)	6 (19.35%)	2 (6.45%)	0 (0%)	7 (22.58%)
Lap chole-cystectomy (n=32)	11 (34.38%)	1 (3.13%)	0 (0%)	11 (34.38%)
Lap Gynaec surgeries (n=10)	6 (60%)	3 (30%)	0 (0%)	7 (70%)
Lap Urological surgeries (n=19)	5 (26.32%)	0 (0%)	0 (0%)	5 (26.32%)
Lap colorectal surgeries (n=5)	4 (80%)	2 (40%)	0 (0%)	4 (80%)
Lap Bariatric surgeries (n=3)	2 (66.67%)	0 (0%)	1 (33.33%)	2 (66.67%)
p-value (n=31)	0.023	0.011	0.03	0.015

Considering the duration of insufflation,it was found that asymptomatic patients mean duration was 3.21 ± 1.35 hours,in patients having neurological symptoms mean duration of insufflation was 4.06 ± 1.7 hours. (P value=0.007).Only 1 Patient showed otological symptom, had mean duration of insufflation of 8 ± 0 hours (P value=0.002). Patients without these symptomsduration was 3.45 ± 1.46 hours. In patients with ophthalmicsymptoms mean duration was 4 ± 2.07 hours, in patients without symptoms it was 3.45 ± 1.48 hours and in total number of patients it was 3.5 ± 1.53 hours (Table 4).

Table 4: Comparison of duration of insufflation and symptoms.

Duration of insufflation (Hours)	Absent	Present	Total	p-value
Neurological Symptoms				
Mean	3.21 ± 1.35	4.06 ± 1.7		0.007
Ophthalmic Symptoms			3.5 ± 1.53	
Mean	3.45 ± 1.48	4 ± 2.07		0.334
Otological Symptoms				
Mean	3.45 ± 1.46	8 ± 0		0.002

Mean $EtCO_2$ before insufflation was 33.45 ± 3.3 mmHg, during insufflation was 38.74 ± 4.19 mmHg and after desufflation was 35.18 ± 3.03 mmHg. The difference at all stages was statistically significant.

Table 5a: $EtCO_2$ comparison before insufflation, during insufflation and after desufflation.

$EtCO_2$ (mmHg)	Mean ± SD	Before vs During	Before vs After	During vs After
Before Insufflation	33.45 ± 3.3			
During insufflation	38.74 ± 4.19	<0.0001	0.0001	<0.0001
After Desufflation	35.18 ± 3.03			

$EtCO_2$ End-tidal carbon dioxide, SD Standard deviation.

Mean Ppeak before insufflation was 18.7 ± 2.86 cm H_2O, during insufflation was 26.94 ± 2.75 cm H_2O and after desufflation was 19.67 ± 3.06 cm H_2O. The difference at all stages was statistically significant.

Table 5b: Ppeak comparison before insufflation, during insufflation and after desufflation.

Ppeak (cmH_2O)	Mean ± SD	Before vs During	Before vs After	During vs After
Before Insufflation	18.7 ± 2.86			
During insufflation	26.94 ± 2.75	<0.0001	0.024	<0.0001
After Desufflation	19.67 ± 3.06			

Ppeak-peak airway pressure, SD-Standard deviation.

Discussion

The creation of pneumoperitoneum with CO_2, created during laparoscopic surgery and the positioning of the patient has adverse effects on the physiology of the patient. The aim of our

study was to evaluate incidence of neurological, ophthalmic and otological symptoms in patients undergoing laparoscopic surgery. The signs and symptoms suggestive of neurologicalchanges were represented by headache, nausea, vomiting, delirium, ophthalmicidentified by blurring of visionand diplopia and otological symptoms by hearing impairment and ear pain.

Cerebral blood flow (normally~50mL/100g brain tissue per minute) increases by 1- 2mL/100 g per minute for every 1mm Hg increase in partial pressure of carbon dioxide(PaCO2).The impact of $PaCO_2$ on CBF is mediated by variations in the pH of cerebrospinal fluid(CSF) around the walls of arterioles. Decreased CSF pH causes cerebral vasodilatation and increased CSF pH results in vasoconstriction creating changes in Cerebral blood volume(CBV). Autoregulation of cerebral blood flow(CBF) may be lost or impaired after administration of volatile anaesthetics. Trendelenburg is a head down position which creates pressure on the diaphragm leading to considerable reduction in lung volumes and venous stasis even with adequate ventilation. The increase in CVP causes fall in cerebral perfusion particularly if the patient is hypotensive. Prolonged head down tilt can cause cerebral oedema and retinal detachment1.Venous pressure changes are variably transmitted to the brain depending on whether the patient's position is horizontal (maximum cerebral blood volume increases) or head up(minimum CBV decreases)[2]

Mean $EtCO_2$ the difference at every stage was statistically significant with a p-value of <0.0001, which shows that there is a significant increase in CO_2 levels during insufflation and these remain to be at a high level even after desufflation and do not return to the pre-insufflation period. Umar et al3 showed that there was an immediate increase in $EtCO_2$ after insufflation continuing to increase in period of insufflation and this remained higher than baseline even 10 min after desufflation.

The difference between the peak airway pressures at different stages of laparoscopic surgeries was found to be statistically significant with p-value of levels before insufflation and during insufflation, during insufflation and after desufflation being <0.0001 in each case, that of before insufflation and after desufflation was 0.024, showing airway pressures increasing during creation of pneumoperitoneum and continued to remain significantly higher even after the procedure is done. Our study showed that across various age groups undergoing similar laparoscopic procedures, age did not have a statistically significant influence in the incidence of post-operative complications. The only significant difference seen was in the ophthalmological complications (p-value 0.006) with maximum percentage in the age group 40-49 years(52.63%).

A study conducted in 2009 by Tina T. Wong et al named "The Relationship of Intraocular Pressure with Age, Systolic Blood Pressure, and Central Corneal Thickness in an Asian Population", concluded that IOP increases till sixth decade of life after which it shows slight dip with increasing age.[4] Another study in 2016 by Adisa Adewale et al, named "Intraocular Pressure Changes with Positioning During Laparoscopy", showed an increase in IOP after induction of pneumoperitoneum and there was further rise in IOP in Trendelenburg's position.[5] In patients with pre-existing eye conditions like glaucoma, these changes have more clinical significance. Prior screening of patient in pre-operative evaluation and appropriate measures intra-operatively can prevent complications.

Obesity (BMI≥35kg/m^2) showed significantly high incidence of post-operative symptoms. This is due to the fact that normal IAP in non-obese patients is 5mmHg whereas in obese individuals it is elevated at around 9-10mmHg, creation of pneumoperitoneum further accentuates it.[6]

Our study demonstrated that position of the patient during surgery plays a major role in development of neurological, ophthalmological and otological complications in the post-operative period. The incidence of neurological complications occurring in lithotomy was 100% and Trendelenburg position was 45.45% and that of the combined Trendelenburg and Lithotomy was 71.43%, which was higher than other positions with a statistical significance.The p-value for the difference in neurological complications amongst different positions was 0.06. In a study done by Halverson and colleagues[7] where they examined "effects of position during pneumoperitoneum on ICP in an experimental model" they concluded that Trendelenburg position increases ICP in addition to the ICP raised by pneumoperitoneum.

We observed that pelvic procedures like gynaecological and colorectal surgery, had higher complications as compared to other surgeries and the position in these surgeries assumed are either lithotomy or Trendelenburg's or a combination of both. It can be concluded that the neurological, ophthalmicsymptoms in post-operative period are higher in pelvic/gynaecological surgery requiring a

head low or Trendelenburg's position or lithotomy. Chin et al[8] found a significant increase in optic nerve sheath diameter (ONSD), 3 minutes after changing position from supine to steep Trendelenburg's position combined with pneumoperitoneum.

Our study demonstrated that longer surgical duration causes higher post-operative symptoms, the mean duration of surgery was significantly higher (>4hrs) in patients with post-operative symptoms as compared to those without symptoms. Hayden and Cowman[9] showed that longer duration of surgery particularly in Trendelenburg's position of >4hrs can have devastating effects and prescribed normalising position every 2hrs.

Apparently female patients undergoing gynaecological procedures showed significantly higher incidence of symptoms as compared to males. (44.68% vs 34%) with p-value of 0.034. This could be attributed to particular procedures and their position requirements during laparoscopic surgery. There was a statistically significant rise from the baseline of pulse rate (p-value <0.0001), systolic (p-value <0.0001) and diastolic blood pressure (p-value <0.0001) during insufflation which came down to baseline after desufflation (Before vs after p-values 0.301, 0.433 and 0.094 respectively).

Presence of comorbidities and Intra-abdominal pressure (IAP) changes did not show any statistically significant correlation to post-operative symptoms. Knowledge of changes in ICP and CBF during laparoscopic surgeries and their timely identification can improve the management of anaesthesia during laparoscopic surgeries and anaesthesia outcome. Our study was mixed case study including variety of cases. Study in specific laparoscopic procedure in particular age group and specific gender can give us real picture of individual factors creating changes in various systems.

Conclusion

Trendelenburg with lithotomy position, higher BMI, longer duration of insufflation can be major factors contributing to neurological and ophthalmic symptoms in laparoscopic surgeries.

Abbreviations

CO_2- Carbon Dioxide, $PaCO_2$- Partial pressure of CO_2, CVP- Central Venous Pressure, ASA grade- American Society of Anesthesiologists grade, ICP- Intracranial Pressure, IOP- Intra-ophthalmic pressure, CSOM- Chronic Suppurative Otitis Media, IAP- Intra-abdominal pressure, PACU- Post-anesthesia care unit, BMI- Body Mass Index, CBF- Cerebral blood flow, CSF- Cerebro-spinal fluid, CBV- Cerebral blood volume, $EtCO_2$- End-tidal CO_2, Ppeak- Peak airway pressure.

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