Original Article

The Effect of Pneumoperitoneum on the Ankle–brachial Index of the Patients Undergoing Laparoscopic Cholecystectomy: An Observational Study

Abstract

Background: Improvement in the perioperative care has led to increased use of minimally invasive surgeries. Multiple physiological changes during minimally invasive surgeries are attributed to the creation of pneumoperitoneum. **Materials and Methods:** One hundred and nine patients who underwent laparoscopic cholecystectomy at a tertiary care hospital in north India meeting the inclusion and exclusion criteria were enrolled. **Results:** Out of the total 109 patients, 13 were males and 96 females (M:F = 1:7.3), the mean basal metabolic rate was 28.95 kg/m^2. The mean systolic and diastolic blood pressure of the upper limb were 134.33 + 17.545 and 80.69 + 11.59 respectively. The mean systolic and diastolic blood pressure in lower limb (LL) were 142.32 + 21.552 and 79.44 + 11.94, respectively. Significant rise in the SBP was noticed in LL at the time of creation of Pneumoperitoneum and after changing the position for surgery ($P < 0.05$). The diastolic pressure in the LL rises significantly in the LL after creation of pneumoperitoneum, at induction, after reverse Trendelenburg position and extubation ($P < 0.05$). The mean arterial pressure increased significantly in the LL after the creation of pneumoperitoneum and persisted till the extubation ($P < 0.05$). A significant rise of ankle–brachial index (ABI) was observed in the patients after the creation of pneumoperitoneum and it remained significant till 15 min into surgery ($P < 0.05$). There was no correlation of ABI with weight and age of the patients on Pearson correlation. **Conclusion:** There is rise in ABI of the patients undergoing laparoscopic cholecystectomy at the time of creation of pneumoperitoneum, after Trendelenburg position and 15 min into surgery.

Keywords: *Ankle–brachial index, laparoscopic cholecystectomy, pneumoperitoneum*

Ravneet Kaur Gill, Ashish Gupta[1], Prabhjot Kaur[1], Bharti Sidhu, Puja Saxena, Navdeep Singh Saini[2], Money Gupta[1]

Departments of Anesthesia, [1]General Surgery and [2]Surgery, AIMS, Mohali, Punjab, India

Introduction

Minimally invasive surgeries are being increasingly performed nowadays.[1] The use of minimal invasive techniques for advanced surgeries can be attributed to an improvement in the perioperative care. The advent of advanced robotics and endoscopic instruments has helped the surgeons to perform complex and lengthy procedures without increased morbidity and mortality. Robotics and three dimensional endoscopic systems have aided the surgeons, where they get the haptic and the visual perceptions very similar to the open surgery.[2] Laparoscopic cholecystectomy has been established as a gold standard treatment for various benign pathologies affecting the gallbladder.[3] It is being performed worldwide as a day care procedure.

Any minimal invasive procedure mandates the creation of a pneumoperitoneum. Multiple hemodynamic changes that are observed during the laparoscopic surgeries are attributed to the creation of pneumoperitoneum.[4] These changes are due to increased pressure on diaphragm causing reduced vital capacity of the lungs or the decreased venous return causing the cardiac compromise. The changes are more pronounced in patients with cardiopulmonary jeopardy. The changes in the physiology of the cardiac pulmonary and neurological system have been studied in detail.

Ankle–brachial index (ABI) is a traditional ratio which has been used for diagnosing the patients with peripheral vascular diseases.[5] These patients are more commonly encountered in clinical practice in the communities where smoking is rampant. Theoretically, the perfusion to the lower limb (LL) will reduce as the cardiac

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Address for correspondence:
Dr. Ashish Gupta,
Department of General Surgery,
AIMS, Mohali, Punjab, India.
E-mail: drashish0403@gmail.com

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output reduces during surgery. The effect is negligible in upper limbs as the pneumoperitoneum affects the LLs. This study was planned to demonstrate the physiological changes in ABI at various time intervals in the patients who underwent laparoscopic cholecystectomy.

Materials and Methods

It was a prospective cohort study which was planned at the Department of General Surgery of a Tertiary Care Hospital attached to a medical college. The study was approved by the institutional ethical committee vide no AIMS/IEC/2022/16 dated May 20, 2022.

Sample size calculation

The sample size was calculated based on the data from our pilot study of 20 patients, with the incidence of ABI at time of pneumoperitoneum and baseline being 1.061 + 0.213 and 1.18 + 0.113, respectively. On simple interactive statistical analysis, the sample size of minimum 88 was derived using the formula for sample size calculation on Open Epi Version 3 software (Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version. www.OpenEpi.com, updated 2013/04/06, accessed 2024/04/09) based on the assumption of α (type 1 error) =5%, β (type 2 error) =0.1 and power of the study = 90%. The number of patients was increased to 109 to include any dropouts.

Methodology

One hundred and nine patients who met the inclusion and exclusion criteria at our institute were recruited to the study. All the patients underwent laparoscopic cholecystectomy. The inclusion criteria were (1) patients aged 18– 75 years, (2) consent for participation in the study, and (3) patients without known peripheral vascular disease and the patients <18 years and 75 years of age, with known peripheral vascular disease, ABI <0.8, having coronary artery disease and history of stroke and having features of critical limb ischemia such as rest pain, skin change, and digital gangrene were excluded from the study.

After obtaining the consent from the eligible participants, complete demographic profile, personal and past history was taken and recoded. All the patients underwent ultrasonogram for the diagnosis of gall bladder stones. Contrast enhanced computerized tomogram was done to rule out any malignancy wherever the suspicion was so. Magnetic resonance cholangiopancreatography was carried out to rule out choledocholithiasis in case of dilated common bile duct and deranged biochemical tests. Liver Function tests, Renal functions, hematological and coagulation profiles were performed as a part pf pre anaesthetic workup. The patients were subjected to endoscopic retrograde cholangiopancreatography as part of choledocholithiasis management strategy followed by the cholecystectomy. The patients underwent cardiac evaluation and other radiological tests as per the requirement of the anesthesia.

After optimization and obtaining the consent for surgery, the patients were kept nil per oral at least 8 h for solids and 2 h for clear liquids before the surgery. The ABI was measured on the right arm and right ankle as ABI = Systolic pressure at the ankle (San)/Systolic pressure in arm (Sar).

All patients were pre-medicated with injection glycopyrrolate 0.2 mg and midazolam 0.04 mg/kg, 5 min before induction. All patients were administered General anesthesia (GA). Induction was carried in the supine position with the head on a standard pillow of 7 cm in height. After preoxygenation for 3 min, the patient was induced using morphine 0.1 mg/kg and propofol 1.5–2.5 mg/kg. After checking for the ability to achieve adequate mask ventilation, vecuronium 0.1 mg/kg was used to facilitate muscle relaxation. Assisted mask ventilation with 1% isoflurane in oxygen was carried out using circle system (Drager Fabius Plus) for 4 min. The inner diameter of the endotracheal tube used was 7.0–7.5 mm for female patients and 7.5–8.0 mm for male patients. Intubation was performed by direct laryngoscopy. After successful intubation, mechanical ventilation was started, and the end-tidal carbon dioxide pressure was maintained at 35–40 mmHg. GA was maintained with nitrous oxide and oxygen mixture in the ratio of 2:1 and isoflurane (1 MAC) and intravenous muscle relaxants will be given every 30–40 min to maintain the neuromuscular paralysis. At the end surgery, 15 mg/kg paracetamol and ondansetron 0.1 mg/kg intravenous were administered for postoperative pain and emesis respectively. The oropharynx was suctioned, the inhalational agent stopped, and the patient was administered 100% oxygen. After the return of spontaneous respiration, neuromuscular blockade was reversed with 0.05 mg/kg of neostigmine and 0.01 mg/kg of injection glycopyrrolate. Extubation was carried out when the patient demonstrated the ability to follow verbal commands or show purposeful movements in addition to resumption of regular spontaneous respiration.

After prepping and draping the patient in a supine position, pneumoperitoneum was created using veress needle or open Hassan technique as per the surgeon's preference. Carbon dioxide was insufflated in the peritoneal cavity and a pressure of 12 mmHg was maintained. Standard four port technique of cholecystectomy as mentioned in the literature was carried out in all patients. Surgery was performed in reverse Trendelenburg position with a right-up position of 15°–25°. ABI was measured using BP cuff compatible with Philips intellivue MX 500 monitors at baseline, after induction, after the creation of pneumoperitoneum and achieving desired pressure, after reverse Trendelenburg position, after 15 min interval till the completion of surgery, after extubation, and 2 h after surgery.

After completion of surgery, the patient was shifted to postoperative room where the vitals and other parameters were maintained. The patient was allowed orally after 6 h of surgery and they were discharged once the patient had tolerated the feeds well and passed urine.

Statistical analysis

The data were analyzed using the SPSS (Released 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp). The continuous variables were expressed as mean + standard deviation (SD). The means were compared using the Student's-*t*-test. A *P* = 0.05 was considered statistically significant.

Results

The mean time of surgery varied from patients to patients. The number of patients whose readings were recorded at 30 min (T6), 45 min (T7), and 60 min (T8) were 26, 8, and 4 respectively.

Demographic data

A total of 115 patients were enrolled in the study. Out of these 6 patients had to be converted to open surgery due to difficult calot's anatomy. The data were analyzed for 109 patients. The mean age of the patients was 39.4 + 11.57 years. There were a total of 96 females and 13 males (M:F = 1:7.3). Hypertension and diabetes were reported in 13 and 12 patients, respectively. Out of 13 males, 2 were smokers but had normal ABI at initial presentation. The mean Basal Metabolic Index of the patients was 28.95 kg/m^2. The mean values of the liver function tests of the enrolled patients are shown in Table 1.

Table 1: Demographic characteristics and medical characteristics

Parameters	Value
Age (years), mean±SD	39.41±11.57
ASA I	97
ASA II	12
Weight (kg), mean±SD	71.38±12.86
Height (cm), mean±SD	157.41±5.5
Males	13
Females	96
HTN	13
Diabetes mellitus	12
Smoking	2
Total bilirubin	0.86±0.28
AST	30.39±16.41
ALT	33.74±24.61
Alkaline phosphatase	117.14±48.95

SD: Standard deviation; HTN: Hypertension; AST: Aspartate aminotransferase; ALT: Alanine transaminase; ASA: American Society of Anesthesiologists

Systolic blood pressure measurements of upper limb and lower limb

The mean blood pressure of the upper limb and leg at baseline were 134.33 + 17.545 and 142.32 + 21.552. A significant reduction in the systolic blood pressure was observed in upper limb after induction and the same persisted till the end of surgery. The significant rise in blood pressure was noticed at the time of extubation. LL systolic pressure significantly reduced at the time of induction. However, a significant rise in the SBP in LL was noticed at the time of the creation of pneumoperitoneum as well as after changing the position for surgery. There was a significant rise of LL SBP at the time of extubation and it significantly reduced 2 h after the surgery [Table 2].

Changes in the diastolic blood pressures of upper and lower limb

The diastolic pressure in the LL rises significantly in the LL after the creation of pneumoperitoneum, at induction, after reverse Trendelenburg position and after extubation [Table 3].

Effects of pneumoperitoneum on mean arterial blood pressure

The mean arterial pressure increased significantly in the LL after the creation of pneumoperitoneum and it persisted till the extubation. The similar changes were not observed in the upper limb. The significant decrease in mean arterial blood pressure was noticed in both limbs at the time of induction [Table 4].

Table 2: Effect of pneumoperitoneum on the systolic blood pressure of upper limb and lower limbs

Group	Upper limb SBP				LL SBP			
	Mean±SD	Mean difference (with T0)	*P*	95% CI	Mean±SD	Mean difference	*P*	95% CI
T0 (*n*=109)	134.33±17.545				142.32±21.552			
T1 (*n*=109)	117.39±17.038	16.945	<0.001	12.328–21.562	125.94±21.669	16.376	<0.001	10.606–22.146
T2 (*n*=109)	126.26±19.348	8.073	0.001	3.142–13.004	139.97±23.859	2.349	0.447	−3.721–8.418
T3 (*n*=109)	129.33±20.068	5	0.051	−0.032–10.032	151.06±24.231	−8.734	0.005	−14.856–−2.612
T4 (*n*=109)	129.89±15.515	4.44	0.049	0.019–8.862	153.19±20.089	−10.872	<0.001	−16.434–−5.309
T5 (*n*=109)	125.88±17.791	8.45	0.032	0.734–16.166	146.56±25.681	−4.239	0.394	−14.047–5.569
T6 (*n*=26)	108.13±45.300	26.205	<0.001	11.442–40.969	143±19.071	−2.679	0.733	−18.213–12.855
T7 (*n*=8)	81±54.006	53.330	<0.001	33.708–72.952	131.25±20.759	11.071	0.315	−10.649–32.791
T8 (*n*=4)	128.21±16.492	6.119	0.009	1.573–10.665	141.88±21.361	0.440	0.880	−5.288–6.169
T9 (*n*=109)	143.17±17.277	−8.844	<0.001	−13.493–−4.195	151.04±19.986	−8.716	0.002	−14.265–−3.167
T10 (*n*=109)	130.30±13.766	4.028	0.061	−0.183–8.238	135.87±15.537	6.450	0.012	1.434–11.465

SBP: Systolic blood pressure; SD: Standard deviation; CI: Confidence interval; LL: Lower limb

Table 3: Effect of pneumoperitoneum on diastolic blood pressure in upper and lower limbs

Group	Upper limb DBP				LL DBP			
	Mean±SD	Mean difference (with T0)	*P*	95% CI	Mean±SD	Mean difference	*P*	95% CI
T0	80.69±11.59				79.44±11.94			
T1	72.88±13.81	−7.81	<0.0001	−11.21–1.727	75.65±15.34	−3.790	0.04	−7.460–−0.120
T2	83.27±15.99	2.58	0.17	−1.148–6.308	91.58±17.46	12.14	<0.0001	8.147–16.13
T3	87±18.78	6.310	0.0032	2.144–10.48	100.61±16.22	21.17	<0.0001	17.37–24.97
T4	82.7±11.67	2.10	0.20	−1.095–5.115	95.39±14.74	15.95	<0.0001	12.37–19.53
T5	78.69±12.91	−2.0	0.23	−5.275–1.275	87.57±13.89	8.130	<0.0001	4.672–11.59
T6	77.37±7.09	−3.32	0.01	−5.885–−0.755	85.5±10.56	6.060	<0.0001	3.051–9.069
T7	72.25±8.26	−8.440	<0.0001	−11.13–−5.753	84±12.19	4.560	0.005	1.339–7.781
T8	80.47±12.8	−0.22	0.894	−3.480–3.040	84.19±13.4	4.750	0.006	1.362–8.138
T9	88.72±11.31	8.030	<0.0001	4.973–11.09	90.71±14.8	11.27	<0.0001	7.680–14.86
T10	83.35±11.79	2.66	0.09	−0.461–5.781	83.01±11.51	3.5	0.02	0.439–6.701

DBP: Diastolic blood pressure; SD: Standard deviation; CI: Confidence interval; LL: Lower limb

Table 4: Effect of pneumoperitoneum on the mean arterial blood pressure of the upper and lower limbs

Group	Upper limb mean blood pressure				LL mean blood pressure			
	Mean±SD	Mean difference (with T0)	*P*	95% CI	Mean±SD	Mean difference	*P*	95% CI
T0 (*n*=109)	96.44±13.456				96.92±12.360			
T1 (*n*=109)	85.42±14.708	11.018	<0.001	7.255–14.782	90.22±15.823	6.695	<0.001	2.898–10.492
T2 (*n*=109)	95.87±17.146	0.569	0.786	−3.546–4.684	105.69±18.421	−8.777	<0.001	−12.971–−4.583
T3 (*n*=109)	99.20±16.604	−2.761	0.179	−6.796–1.273	114.78±17.952	−17.862	<0.001	−21.977–−13.748
T4 (*n*=109)	96.64±12.358	−0.202	0.908	−3.651–3.247	112.06±14.687	−15.138	<0.001	−18.762–−11.514
T5 (*n*=109)	91.56±13.559	4.880	0.105	−1.030–10.791	104.08±16.618	−7.163	0.016	−12.969–−1.356
T6 (*n*=26)	95.63±9.635	0.815	0.867	−8.802–10.433	102.13±12.495	−5.208	0.253	−14.182–3.767
T7 (*n*=8)	81.00±3.651	15.440	0.02	2.037–28.844	92.25±8.578	4.667	0.457	−7.714–17.049
T8 (*n*=4)	94.81±13.244	1.633	0.368	−1.931–5.197	100.47±14.185	−3.550	0.05	−7.102–0.002
T9 (*n*=109)	105.57±12.196	−9.128	<0.001	−12.557–5.700	107.65±13.689	−10.734	<0.001	−14.216–−7.252
T10 (*n*=109)	96.45±11.196	0	1	−3.305–3.305	98.70±11.563	−1.780	0.274	−4.975–1.416

SD: Standard deviation; CI: Confidence interval; LL: Lower limb

Effects of pneumoperitoneum on ankle–brachial index

A significant rise of ABI was observed in the patients after the creation of pneumoperitoneum and it remained significant till 15 min after surgery. The ABI however stabilized after the 15 min into surgery and it remained stable till the end of surgery [Table 5].

Subgroup analysis and ankle–brachial index

The mean + SD of the ABI and their significance is shown in Tables 6 and 7. A significant change in ABI was noticed in patients up to 50 years of age, female patients, hypertensive, and nondiabetic patients. The change was more pronounced after the creation of pneumoperitoneum till 15 min into the surgery. The change in ABI stabilized after the 15 min and persisted till the completion of surgery. There was no correlation of ABI with weight and age of the patients on Pearson correlation analysis [Table 8].

Table 5: Effect of pneumoperitoneum on ankle–brachial index

Group	Mean±SD	Mean difference	*P*	SEM	95% CI
T0	1.059±0.121			0.0116	
T1	1.079±0.193	−0.020	0.351	0.018	−0.063–0.022
T2	1.110±0.142	−0.051	0.005	0.013	0.086–−0.015
T3	1.166±0.106	−0.106	<0.001	0.010	−0.137–−0.076
T4	1.178±0.103	−0.118	<0.001	0.009	−0.148–−0.088
T5	1.106±0.270	−0.047	0.176	0.053	−0.116–0.021
T6	1.017±0.436	0.041	0.476	0.154	−0.073–0.157
T7	0.865±0.594	0.194	0.015	0.297	0.0384–0.350
T8	1.104±0.107	−0.045	0.004	0.010	−0.075–−0.014
T9	1.057±0.128	0.002	0.901	0.012	−0.031–0.035
T10	1.044±0.106	0.014	0.343	0.010	−0.015–0.045

SD: Standard deviation; CI: Confidence interval; SEM: Standard error of mean

Discussion

The advent of minimally invasive techniques has revolutionized the ways of performing the major surgeries.[6] The laparoscopic surgeries are becoming more popular as these are associated with reduced mortality and morbidity. The laparoscopic surgeries are associated with major changes in the cardiopulmonary

Table 6: Mean values of ankle–brachial index in various subgroups

Characteristic	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
18–30 years (*n*=29)	1.04±0.11	1.01±0.12	1.07±0.13	1.13±0.08	1.15±0.07	1.18±0.05	1.24±0.07	1.25±0.08	1.07±0.07	1.01±0.10	1.02±0.11
31–40 years (*n*=42)	1.05±0.10	1.11±0.18	1.11±0.13	1.17±0.12	1.18±0.10	1.13±0.08	1.11±0.18	1.12±0.23	1.12±0.11	1.07±0.14	1.05±0.09
41–50 years (*n*=18)	1.07±0.14	1.12±0.29	1.12±0.19	1.19±0.10	1.22±0.09	1.22±0.28	1.24	-	1.14±0.11	1.11±0.13	1.05±0.09
51–60 years (*n*=15)	1.06±0.15	1.08±0.18	1.11±0.13	1.15±0.10	1.14±0.14	1.01±0.12	-	-	1.08±0.12	1.01±0.11	1.02±0.12
>60 years (*n*=5)	1.13±0.11	1.04±0.16	1.14±0.10	1.19±0.07	1.19±0.07	1.16±0.09	0.96	-	1.06±0.17	1.05±0.13	1.09±0.15
Males (*n*=13)	1.09±0.11	1.10±0.21	1.14±0.17	1.18±0.08	1.19±0.08	1.20±0.05	1.14±0.16	1.29	1.11±0.08	1.01±0.15	1.07±0.12
Females (*n*=96)	1.05±0.12	1.07±0.19	1.10±0.14	1.16±0.11	1.17±0.10	1.13±0.16	1.19±0.15	1.15±0.17	1.10±0.11	1.06±0.12	1.04±0.10
Hypertensive (*n*=13)	1.07±0.11	1.11±0.18	1.10±0.11	1.15±0.04	1.18±0.12	0.94±0.20			1.10±0.13	1.03±0.12	1.005±0.12
Nonhypertensive (*n*=96)	1.05±0.12	1.07±0.19	1.11±0.14	1.16±0.11	1.17±0.10	1.16±0.13	1.17±0.14	1.18±0.16	1.04±0.10	1.05±0.13	1.04±0.10
Diabetic (*n*=12)	1.06±0.16	0.98±0.13	1.11±0.07	1.18±0.07	1.13±0.08	1.1±0.19			1.06±0.13	1.03±0.13	0.99±0.12
Nondiabetic (*n*=97)	1.05±0.11	1.09±0.19	1.10±0.14	1.16±0.11	1.18±0.10	1.15±0.14	1.17±0.14	1.18±0.16	1.11±0.10	1.05±0.12	1.05±0.10

physiology of the patients undergoing surgery. These changes are attributed to the creation of pneumoperitoneum by insufflating the inert gas in the abdominal cavity. The inert gas under the pressure compresses on the central veins and the diaphragm leading on to the observed changes.[7]

The compression of the veins happens at a lower intra-abdominal pressure as arterial walls are more robust and can withstand high pressures. The compression on the venous walls leads to the venous stasis in the LLs and reduced venous return. The reduced preload on the cardiac muscles causes reduction in the cardiac output. The changes are more pronounced in the LLs as the creation of pneumoperitoneum acts as a transition point between the upper limb and the LLs.

ABI is traditionally being used to establish the critical limb ischemia of the LLs.[8] It is a clinical sign which can be easily measured in the low-resource areas. The advent of angiography and vascular imaging with interventions have reduced it is clinical utility but it is still a good screening tool for the initial assessment of patients with vascular compromise. As the minimally invasive techniques in surgery are advancing the complex procedures are being performed laparoscopically. The article intends to demonstrate the physiological changes in various blood pressure parameters during a standard pressure laparoscopic cholecystectomy.

Majority of the patients enrolled in the study were female signifying the commonality of the gallstones in female patients.[9] The other parameters were normal. The reduction in the systolic blood pressure in upper limb was noticed after induction of the patient till the end of surgery. This is explained physiologically by the reduced cardiac output after the venous stasis in the LLs. The reduction was more pronounced in the upper limbs as compared to the LLs. This might be explained by the fact that the insufflation of the gas in the peritoneal cavity may cause the arterial constriction as well leading to the increased intravascular systolic pressures.

On the contrary, a rise in diastolic BP was observed in patients after the creation of pneumoperitoneum till 15 min into the surgery. This change was more significant in the LL as compared to upper limb. The rise in diastolic blood pressure may be explained by the fact that the pneumoperitoneum causes the pressures on intra-abdominal arteries to rise leading on to decrease capacitance of the vascular channels. The changes are less pronounced in the upper limb arteries. Due to the significant rise in the diastolic pressure in the LL arteries similar effect of pneumoperitoneum was observed in the mean arterial pressures.

A significant rise in ABI was observed at the time of the creation of pneumoperitoneum and the changes persisted

Table 7: Significance values in various subgroups

Group	18–30 years	31–40	41–50	51–60	>60	Male	Females	HTN	Normotensive	Diabetic	Nondiabetic
T0–T1	0.325	0.063	0.514	0.743	0.330	0.880	0.384	0.50	0.38	0.19	0.07
T0–T2	0.325	0.020	0.375	0.338	0.884	0.382	0.009	0.49	0.001	0.33	0.006
T0–T3	<0.001	<0.001	0.006	0.063	0.334	0.025	<0.001	0.02	0.0001	0.02	0.0001
T0–T4	<0.001	<0.001	<0.001	0.142	0.334	014	<0.001	0.02	0.0001	0.18	0.0001
T0–T5	<0.001	<0.001	0.050	0.332	0.650	0.003	<0.001	0.05	0.0001	0.58	0.0001
T0–T6	<0.001	0.063	-	-	-	0.362	<0.001	-	0.0001	-	0.0001
T0–T7	<0.001	0.074	-	-	-	-	<0.001	-	0.0001	-	0.0001
T0–T8	0.220	0.003	0.104	0.690	0.462	0.601	0.003	0.53	0.53	1	0.0001
T0–T9	0.282	0.453	0.381	0.307	0.324	0.134	0.564	0.38	1	0.62	1
T0–T10	0.492	1	0.613	0.427	0.644	0.662	0.531	0.16	0.53	0.23	1

HTN: Hypertension

Table 8: Group wise Pearson correlation

Group	Age			Height			Weight		
	R coefficient	*P*	95% CI	*R* coefficient	*P*	95% CI	*R* coefficient	*P*	95% CI
T0	−0.135	0.161	−0.32–0.054	0.100	0.303	−0.090–0.28	0.069	0.478	−0.12–0.25
T1	−0.051	0.600	−0.24–0.14	0.011	0.910	−0.18–0.20	0.061	0.529	−0.13–0.25
T2	−0.001	0.988	−0.19–0.19	0.031	0.746	−0.16–0.22	0.181	0.059	−0.0069–0.36
T3	0.010	0.921	−0.18–0.20	−0.077	0.426	−0.26–0.11	0.159	0.098	−0.030–0.34
T4	0.015	0.879	−0.17–0.20	−0.017	0.859	−0.20–0.17	0.088	0.365	−0.10–0.27
T5	−0.019	0.928	−0.40–0.37	−0.092	0.654	−0.46–0.31	−0.036	0.861	−0.42–0.36
T6	−0.771	0.025	−0.96–−0.14	0.155	0.713	−0.62–0.78	0.053	0.900	−0.68–0.73
T7	−0.960	0.040	−1–0.010	0.575	0.425	−0.86–0.99	0.593	0.407	−0.86–0.99
T8	−0.067	0.491	−0.25–0.12	−0.067	0.491	−0.25–0.12	0.063	0.517	−0.13–0.25
T9	−0.087	0.369	−0.27–0.12	0.019	0.848	−0.17–0.21	0.091	0.345	−0.099–0.27
T10	−0.092	0.344	−0.27–0.10	0.002	0.987	−0.19–0.19	0.196	0.042	0.0077–0.37

CI: Confidence interval

till 15 min into the surgery. The rise in the ABI during LC may be explained by increased perfusion of the LL arteries after the creation of pneumoperitoneum or the decrease compliance of the vessel walls due to the external pressure of the gases as in calcified vessels.[10] The latter seems to be a reasonable explanation to the observed changes as the reduction in the cardiac output after the creation of pneumoperitoneum would result in decreased LL perfusion.

These findings are more relevant in current scenario, as the advances in the perioperative care have resulted prolonged minimal invasive surgeries being performed in morbid patients.[11] The reduction in the LL perfusion in an already compromised limb might result in a surgical catastrophe. Preoperative documentation of ABI in a smoker and patient with comorbidities might prove a helpful strategy to improve postoperative outcomes.

This is the first study to document the effect of pneumoperitoneum on various blood pressure parameters during cholecystectomy. The limitations of the study are low sample size and unavailability of the control arm. Further studies using high and low-pressure pneumoperitoneum can be used to establish the further physiological changes after pneumoperitoneum.[4]

Conclusion

There is a significant rise of ABI after the creation of pneumoperitoneum. The rise can be attributed to the rise of the external pressure causing decrease in the compliance of the vessels. Further studies are required to establish the changes in the various blood pressure parameters during the minimally invasive surgeries.

Ethical statement

The study was approved by the institutional ethical committee vide no AIMS/IEC/2022/16 dated May 20, 2022.

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Conflicts of interest

There are no conflicts of interest.

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