Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/yq6y4k28

CHANGES IN COAGULATION PROFILE IN PATIENTS UNDERGOING LAPAROSCOPIC CHOLECYSTECTOMY WITH CARBON DIOXIDE PNEUMOPERITONEUM

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ABSTRACT

Introduction: Laparoscopic cholecystectomy is a widely performed surgical procedure. The use of carbon dioxide pneumoperitoneum during this surgery may impact the coagulation profile of patients. This study aims to investigate the effects of carbon dioxide pneumoperitoneum on coagulation parameters and assess the potential risk of thrombosis.

Methodology: A clinical observational study was conducted on 113 patients undergoing laparoscopic cholecystectomy with carbon dioxide pneumoperitoneum. Prothrombin time and D-dimer levels were measured before and after surgery. Data were analyzed using the paired t-test.

Results: The study revealed a post-operative decrease in prothrombin time and an increase in D-dimer levels. Specifically, the mean post-operative prothrombin time was 0.159 seconds shorter than the pre-operative value, while D-dimer levels were three times higher than pre-operative levels. Both results were statistically significant.

Conclusion: Laparoscopic cholecystectomy with carbon dioxide pneumoperitoneum induces a hypercoagulable state. Therefore, rigorous measures should be implemented to provide prophylaxis against deep vein thrombosis to prevent serious complications.

Keywords: Laparoscopic cholecystectomy, Carbon dioxide pneumoperitoneum, Coagulation profile, Prothrombin time, D-dimer, Hypercoagulability, DVT prophylaxis.

INTRODUCTION

Laparoscopy has become a widely utilized tool for both diagnostic and therapeutic purposes in recent years. It offers several benefits, including improved cosmetic outcomes, reduced post-operative pain, shorter hospital stays, and a quicker return to daily activities and work. With advancements in technology and surgical instruments, laparoscopy is now applied across various surgical specialties. A crucial requirement for laparoscopy is the creation of a working cavity, typically achieved through positive pressure pneumoperitoneum using carbon dioxide. In 1924, Richard Zolliker from Switzerland first suggested the use of carbon dioxide for pneumoperitoneum because of its

noncombustible properties, allowing safe use of electrocoagulation during surgery. However, carbon dioxide pneumoperitoneum can impact normal physiological functions. It is rapidly absorbed from the peritoneal cavity into the bloodstream, potentially influencing the cardiovascular, respiratory, and coagulation systems, among others. Laparoscopy is associated with certain complications due to increased intra-abdominal pressure, absorption of carbon dioxide from the peritoneum during insufflation, and the use of the reverse Trendelenburg position during surgery. Prof Dr Med Erich Muhe of Boblingen, Germany, performed the first laparoscopic cholecystectomy on September 12, 1985.[16] Over the past three decades, there have been significant advancements in the technique, leading to shorter surgery durations and fewer complications. Today, laparoscopic cholecystectomy is considered the gold standard procedure. With over 500,000 procedures performed annually, it holds great importance in the field of general surgery.
It is essential to study the effects of carbon dioxide pneumoperitoneum on various physiological systems in detail. This study aims to investigate its impact on the coagulation system in patients undergoing laparoscopic cholecystectomy, highlighting any potential adverse effects to enhance surgical awareness and safety.

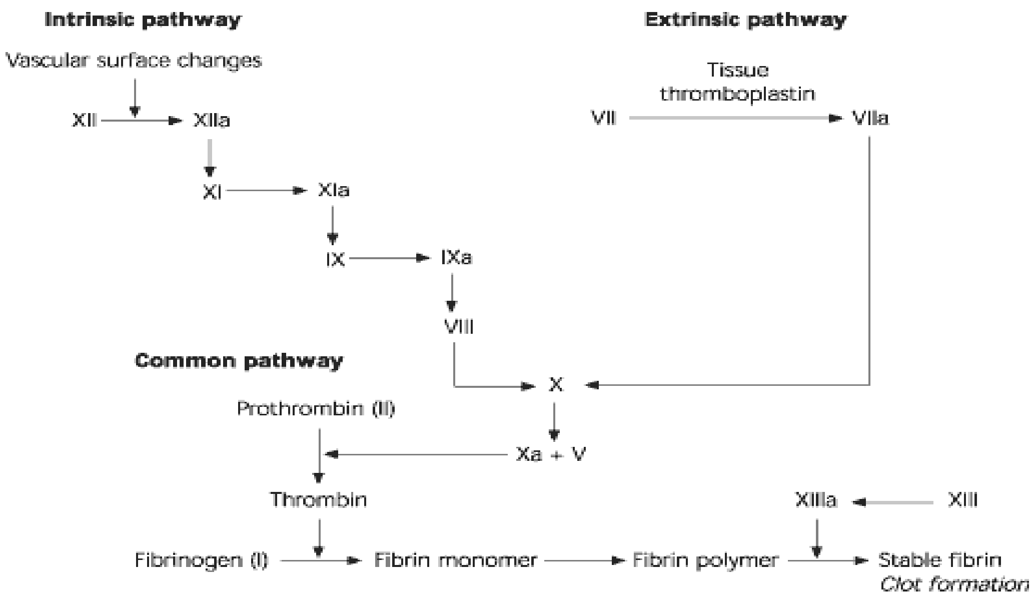
CHOLECYSTECTOMY-Cholecystectomy is the surgical removal of the gallbladder. It is indicated for conditions such as symptomatic gallstones, gallbladder polyps larger than 1 cm, acute and chronic cholecystitis, acalculous cholecystitis, empyema of the gallbladder, mucocele of the gallbladder, typhoid carriers, and gallstone-induced pancreatitis[14]. Prophylactic cholecystectomy is recommended for diabetic patients, immunocompromised individuals, organ transplant recipients, patients with congenital haemolytic anaemia, those undergoing bariatric surgery, and cases of porcelain gallbladder. Absolute contraindications for laparoscopic cholecystectomy include patients who are unfit for general anaesthesia, those with coagulation disorders, suspected gallbladder carcinoma (due to the risk of port site metastasis), and patients who do not consent to the laparoscopic approach. Relative contraindications for laparoscopic cholecystectomy include a history of upper abdominal surgeries due to the presence of dense adhesions, liver cirrhosis where the liver is too fragile for retraction, portal hypertension due to the risk of multiple venous collaterals, patients with cardiac or respiratory issues, and pregnancy. Challenges during cholecystectomy may include difficult dissection of Calot’s triangle, dense adhesions, perioperative bleeding from the pedicle or liver bed, and anatomical variations of the cystic duct and cystic artery. Post-operative complications can include infection, subphrenic abscess, and bleeding from the cystic artery or liver bed. There is also a risk of inadvertent injury to the common bile duct or hepatic duct, which may lead to bile leaks, biliary fistulas, or stricture formation. Rare but serious complications include iatrogenic injury to the colon, duodenum, or mesentery, particularly in cases with dense adhesions. There was a time when the surgical community believed that "larger problems required larger incisions." However, with advancements in anaesthesia, fibre optics, and surgical instruments, the focus has shifted towards minimally invasive surgery, prioritizing minimal or no visible scars. Cosmetic outcomes have become a significant consideration, as smaller scars are associated with less postoperative pain, fewer adhesions, and minimal complications. This pursuit of better outcomes has led to innovations in single-incision laparoscopy, natural orifice laparoscopic surgery, three-dimensional laparoscopic surgery, and robotic surgery. In 1687, Stal Pert discovered gallstones in a patient who underwent laparotomy for peritonitis. Two centuries later, Langenbuch performed the first open cholecystectomy, establishing it as the gold standard for nearly a century. Although newer techniques have largely replaced it, open cholecystectomy is still employed in cases with dense adhesions or when common bile duct exploration is necessary along with cholecystectomy. Single Incision Laparoscopic Surgery (SILS) is a sophisticated minimally invasive technique that also facilitates easy retrieval of surgical specimens through the 2.5 cm umbilical incision. However, the high cost of the R-port significantly increases the overall surgical expense. For some patients, the umbilical scar from SILS is considered cosmetically undesirable, leading to the development of Natural Orifice Transluminal Endoscopic Surgery (NOTES). This approach uses natural body openings for surgical access and has been explored for various procedures, including thyroidectomy via the transoral route. Cholecystectomy has been attempted using multiple natural access routes, including trans gastric, trans anal, transvaginal, and trans colonic approaches. These procedures require specialized equipment such as colonoscopes, vaginal platform instruments, staplers, and flexible endoscopic tools. Despite its potential, NOTES presents several challenges, including high setup costs, a steep learning curve, the need to perforate a healthy organ for peritoneal access, and the risk of infections, surgical site contamination, and complications related to closing the perforation created during surgery. Natural Orifice Transluminal Endoscopic Surgery (NOTES) is rapidly evolving and holds the potential to become a distinct surgical specialty due to its diverse applications. Ongoing animal and human clinical trials are exploring the possibilities of robotic surgeries. With the integration of robotics and robot-assisted techniques into surgical practice, the field is continuously advancing, offering new and exciting possibilities with each passing day.

LAPAROSCOPY:-Laparoscopy is an endoscopic procedure used to visualize the peritoneal cavity. It is typically aided by pneumoperitoneum, which expands the peritoneal cavity and separates the abdominal wall from the internal organs. This expansion enhances the visibility of abdominal structures, provides the necessary working space for diagnostic and therapeutic procedures, minimizes the risk of injury to surrounding organs, and helps maintain the physiological conditions needed for safe and effective surgery.

PNEUMOPERITONEUM:-The choice of gas for creating pneumoperitoneum depends on several factors, including the type of anaesthesia used, the gas delivery method, physiological compatibility, non-combustibility, low or no toxicity, ease of use, safety, cost, harmlessness in case of leakage, and ease of elimination through metabolism. Commonly used gases for pneumoperitoneum include carbon dioxide, nitrous oxide, helium, oxygen, argon, and air. Each gas has its own set of advantages and disadvantages, leading to different medical applications. Pneumoperitoneum can be established using two main methods: the closed technique (Veress method) and the open technique (Hasson's method).**Veress Method:-**This technique utilizes a specialized instrument called the Veress needle, which is typically 12 to 15 cm long and features a spring-loaded blunt tip designed to protect the bowel. To create pneumoperitoneum, the anterior abdominal wall is lifted to provide counterpressure, and the Veress needle is then inserted into the abdominal cavity. Once the needle is inside the peritoneal cavity, gas is insufflated, and the telescope port is inserted blindly. Additional ports are placed under direct visual guidance. Advantage is Faster procedure and Does not require specialized instruments beyond the Veress needle. Disadvantage is Increased risk of injury to the bowel and underlying vascular structures. **Open Method (Hasson's Technique):-**This approach does not require a Veress needle, and every step is performed under direct vision. A small incision (1 to 1.5 cm) is made at the umbilicus and extended down to the rectus muscle. The rectus muscle and peritoneum are then carefully opened under direct visualization. Once entry into the peritoneal cavity is confirmed, the umbilical port is inserted, and gas is insufflated to create pneumoperitoneum. A telescope is then introduced under direct vision for laparoscopy, and additional ports are placed under visual guidance. The primary advantage of the open method (Hasson's technique) is the minimal risk of injury to the bowel or vascular structures since each step is performed under direct vision. However, a drawback is that it generally takes longer to perform compared to the Veress method. The most significant complications in laparoscopy typically occur during the insertion of the umbilical trocar, mainly due to adhesions at the entry site. The Veress technique is used in approximately 62% of cases, while the Hasson's method is used in about 38% of cases. Despite the lower overall usage, the Hasson's method is preferred by most general surgeons because it is considered the safer approach for accessing the peritoneal cavity. The ideal pressure for pneumoperitoneum is 12-15 mm Hg. Higher pressures may be utilized during the initial port entry to reduce the risk of injury. Carbon dioxide (CO_2) is the preferred gas for creating pneumoperitoneum due to its high diffusion coefficient. As a natural end product of metabolism, excess CO_2 is easily tolerated and rapidly cleared from the body.

Its high solubility in blood and tissues minimizes the risk of gas embolism. However, CO_2 has some disadvantages, particularly in cardiac patients and during prolonged surgeries, as it can cause arrhythmias, hypercarbia, tachycardia, and acidosis. Despite these drawbacks, CO_2 is widely used because it is easy to produce, readily available, cost-effective, non-combustible, and poses no risk to medical personnel in case of leakage. It is also non-irritant and nearly odourless. Due to these benefits, carbon dioxide is currently the "gas of choice" for creating pneumoperitoneum.

Coagulation Pathway:
Blood coagulation depends on a balance between two groups of substances: procoagulants and anticoagulants[15]. In response to endothelial damage, prothrombin activators are formed, leading to the conversion of prothrombin into thrombin. Thrombin catalyses the conversion of fibrinogen into fibrin, which results in a stable clot. The conversion of prothrombin to thrombin requires tissue factor or factor III, factor X-A, factor V and calcium.



PROTHROMBIN :-Prothrombin is a plasma protein formed by the liver. It is involved in the process of coagulation. It is Vitamin K dependent. On exposure to prothrombin activators, it is converted into thrombin. Thrombin further helps in conversion of fibrinogen into fibrin and thus forms clots. Prothrombin time is the indicator of concentration of prothrombin in blood. Upon collection, Blood is oxalated to prevent conversion of prothrombin to thrombin. Large amounts of calcium ion and tissue factor is then mixed. This activates the extrinsic pathway for coagulation .The time required for coagulation is denoted as the prothrombin time. Normal time is around 12 seconds.

D-DIMER:-D-dimer is a degradation product of cross-linked fibrin (Factor XII) and serves as an indicator of ongoing activation of the haemostatic system[17]. Its reference value is less than 500 ng/ml or 0.5 µg/ml fibrinogen equivalent units. D-dimer is useful in evaluating thrombus formation, ruling out deep vein thrombosis, monitoring anticoagulant therapy, diagnosing disseminated intravascular coagulation, and detecting snake venom poisoning. It is also a cost-effective and rapid tool for ruling out pulmonary embolism in patients with a low risk of the condition. Elevated D-dimer levels can occur in pregnancy, inflammation, malignancy, heart disease, trauma, liver diseases, and following surgical procedures. In adults with a low pretest probability (based on the Well's score), a negative D-dimer test has a 99% negative predictive value for ruling out thromboembolism in patients under 80 years of age.

Surgical Steps: -

- Procedure was done under general anaesthesia.
- Surgery was done with standard laparoscopic equipment for all patients using carbon dioxide pneumoperitoneum.
- Patients were put in classical supine position with table given 30 degrees head up position and 15 degrees right up position to allow better visualisation of gallbladder and Calot's triangle as it allows the colon and duodenum to fall away from the liver edge.
- Surgeon stands on the left of the patient with monitor placed near the right shoulder.
- A nasogastric tube and Foley's catheter were inserted to deflate the distended stomach and empty the urinary bladder.
- Pneumoperitoneum was created either by open Hasson's method or veress method.
- After confirming entry into the peritoneal cavity, a 10 mm port was inserted, and carbon dioxide was insufflated to a pressure between 12-14 mmHg at a flow rate of around 2 to 3.5 litres per minute.
- A 0-degree or 30-degree 10 mm telescope was attached to light source and endocamera and inserted through the 10 mm port.
- Laparotomy was done to exclude injury to structures during port insertion to exclude other suspected or associated pathologies and assess the feasibility of laparoscopic procedure.
- Rest of the ports were inserted under vision. A 10-mm working port is created in the epigastrium to the right of falciform ligament. Two 5-mm port one each in the midclavicular line and another in the anterior axillary line are created to retract the gallbladder and to visualise the Calot's triangle.
- The cystic pedicle is exposed, and dissection is carried out to create a window all around the cystic duct. Three clips are applied, and cystic duct cut in between. Cystic artery is then isolated, and clips applied and cut.
- The gallbladder is then removed from the liver bed by dissection in the loose fibrous layer, which separates the gallbladder from the fascia covering the bed of the liver.
- The gallbladder was then delivered through the epigastric or the umbilical port.
- Haemostasis was ascertained and ports are removed under vision and pneumoperitoneum was released.
- Wound was closed in layers and patients were given analgesics for pain relief.
- Specimen was sent for histopathological examination and stones if present are sent for biochemical analysis.

Sages (American Gastro and Endoscopic Surgeons Society)1 recommended that "Basic philosophy is that prophylaxis has to be tailored for each patient based on their estimated risk. All laparoscopic procedures carry a risk of hypercoagulability. Short and less complicated or less complex procedures like laparoscopic appendectomy and laparoscopic cholecystectomy carry a low risk of venous thromboembolism." [1] "Patient positioning during surgery may alter the DVT risk. But the evidence is not significant enough to suggest that DVT prophylaxis should be changed based only on body position." "Laparoscopic procedures that extend beyond one hour may need venous thromboembolism prophylaxis. Compression dressing, unfractionated heparin, low molecular weight heparin maybe used to this effect."

MATERIALS AND METHOD

From May,2023 -April,2025, a prospective observational study was conducted at VIMSAR, Burla, to evaluate changes in coagulation profile in patients undergoing laparoscopic cholecystectomy with carbon dioxide pneumoperitoneum . 113 patients were enrolled as per the sampling method . All patients of both the sexes age from 21-60yrs operated for lap cholecystectomy were included in the study with gall stones, chronic cholecystitis or gall bladder polyp

Threshold probability for rejecting the null hypothesis, α (two -tailed) =0.05 Probability of failing to reject the null hypothesis under the alternative hypothesis. Type II error rate β =20%, Effect size 0.5, $S\Delta = 1$, Calculation using the T statistic and non-centrality parameter: A value of N = 112.3082 gives the following calculations: NCP Non-centrality parameter=√N*E/SΔ=2.8260. DF= Degree of freedom=N -1=111.3082 tα Inverse of the two-tailed T distribution given probability of 1 - (α / 2) and DF of 111.3082=1.9815. Beta (t α, DF, NCP) =0.20009. If N was calculated correctly, this should closely approximate your selected value of beta, above. The N thus calculated is rounded up to the next highest integer to give the group size= 113[11,12,13]

RESULT

The paired Student's t-test was used to analyse the values collected before and after the surgery. The software tools used for the purpose were downloaded from the internet. The values obtained were confirmed using another similar software to check the validity.

The mean of the two groups, the standard deviation, standard error of mean and the p-value were calculated. The results were again converted into pie charts, bar diagrams and scatter map for the sake of easy understanding and are presented as follows.

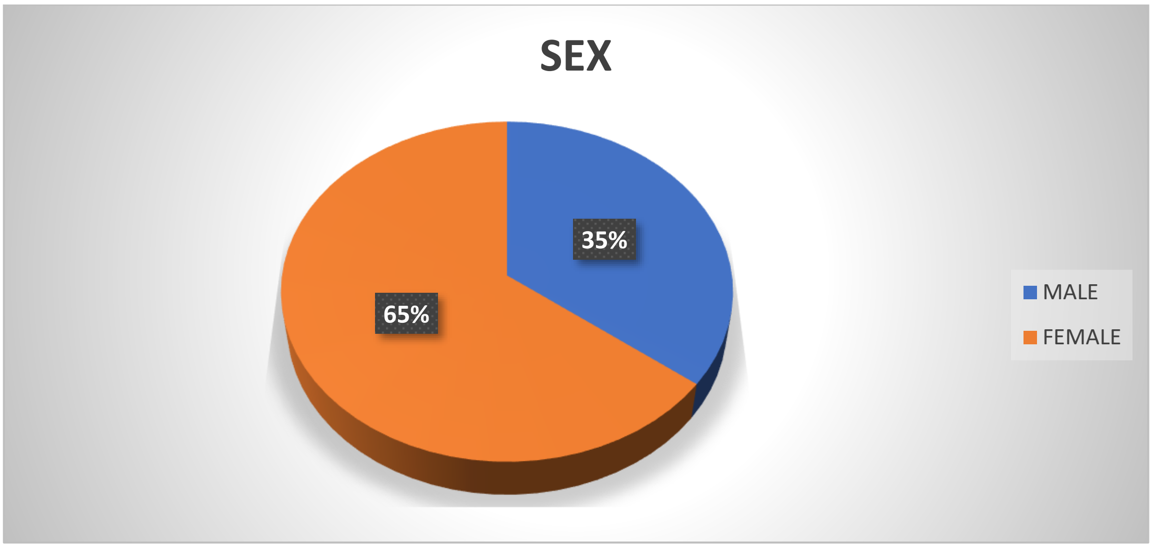


CHART 1.- PIE CHART DEPICTING SEX DISTRIBUTION

Of the 113 patients operated, 73 were females and 40 were male patients. The most common age group was 41-50 years among both female and male groups, followed by the age group of 51-60.

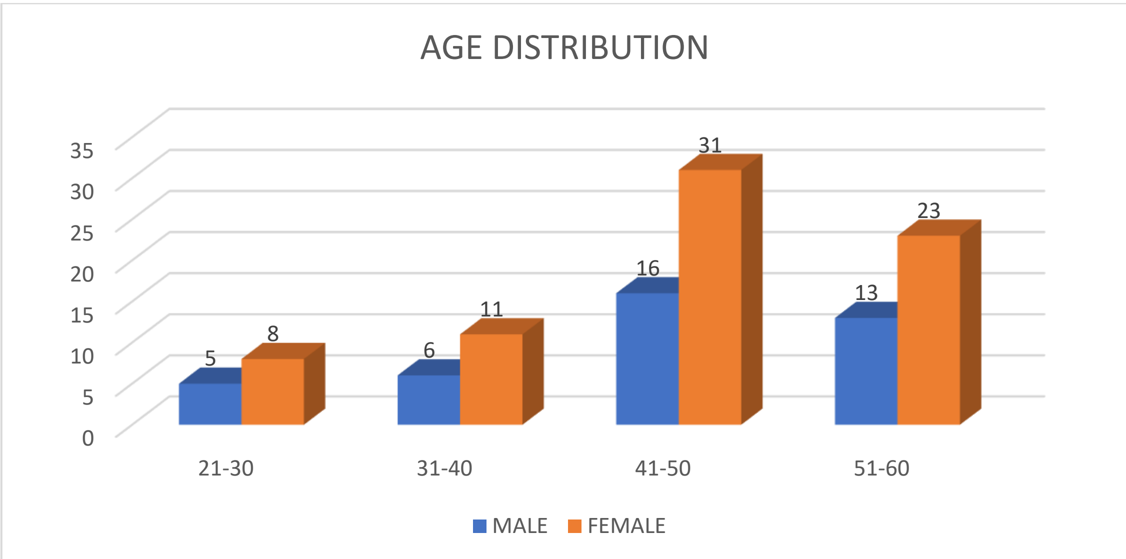


CHART 2.- BAR DIAGRAM DEPICTING AGE DISTRIBUTION

The duration of the surgery ranged from 1 hour 25 minutes to 2 hours 50 minutes. The reasons for prolonged surgical time were dense adhesions in the Calot's triangle and gallbladder adherent to the liver bed.

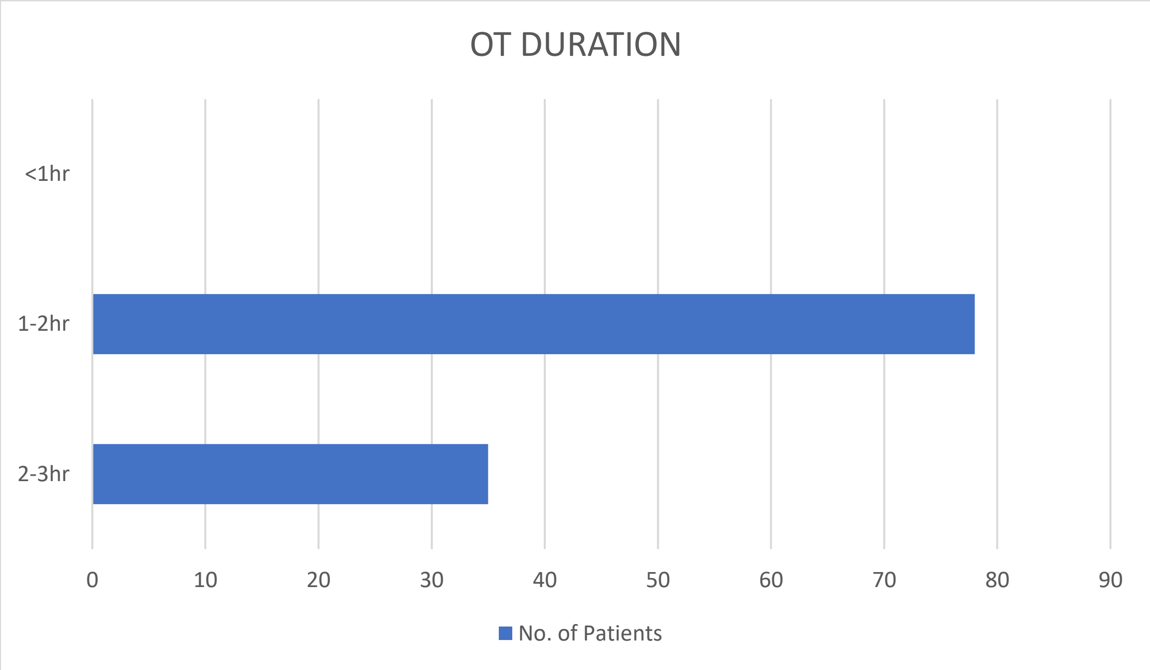


CHART 3.- BAR DIAGRAM DEPICTING DURATION OF SURGERY

There were no major preoperative complications. There was wound infection at the umbilical site in 3 patients, which settled with conservative treatment with a course of antibiotics.
There were no major postoperative complications in the operated patients during hospital stay and during the follow up period. The mean hospital stay was 4 days.

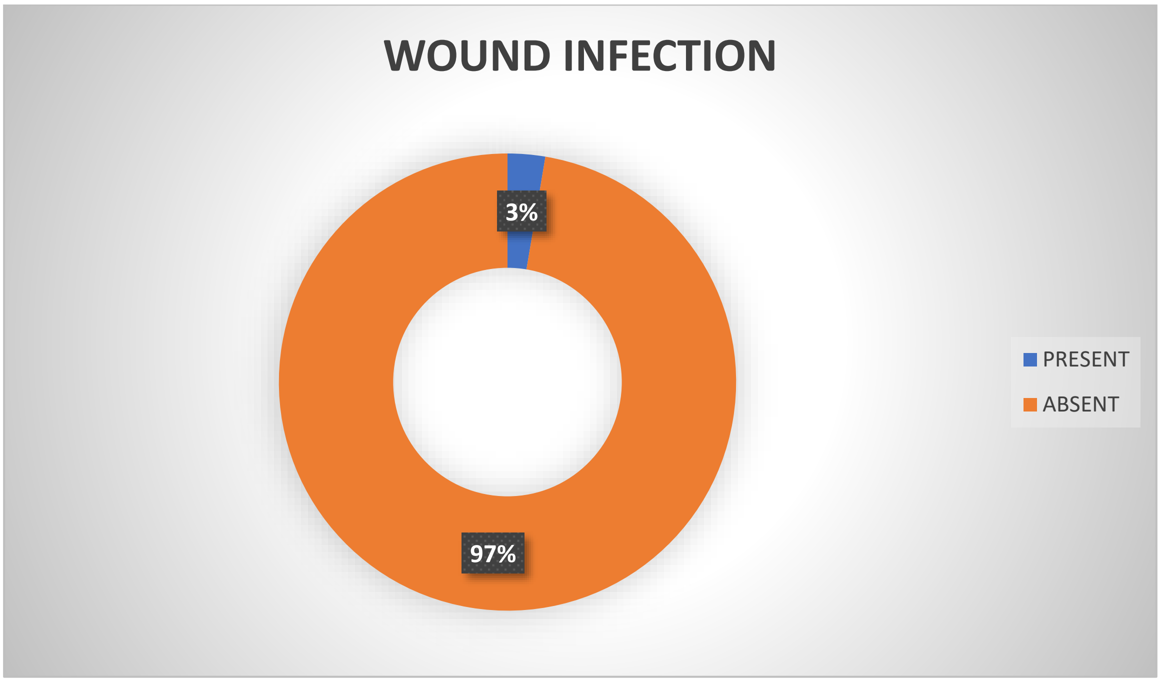


CHART 4.- DOUGHNUT PIE CHART DEPICTING SSI

The prothrombin time of the patients before surgery ranged from 10 to 13.5 seconds with the mean at 11.84 seconds. The standard deviation was 1.207 and standard error of mean was 0.114. The prothrombin time of patients 6 hours after surgery ranged from 10.5 seconds to 13.5 seconds. The mean of prothrombin time after surgery was 11.68 seconds. The standard deviation was 1.071 and the standard error of mean being 0.101. The difference in the mean between the two groups was 0.159. The confidence interval at 95% was between 0.078 to 0.240. The p-value was <0.001. Hence, the value was statistically extremely significant.

TABLE 1.- SHOWING CHANGES IN PROTHOMBIN TIME BEFORE AND AFTER SURGERY

	Before Surgery	After Surgery
Mean	11.84	11.68
Standard Deviation	1.207	1.071
Standard Error of Mean	0.114	0.101

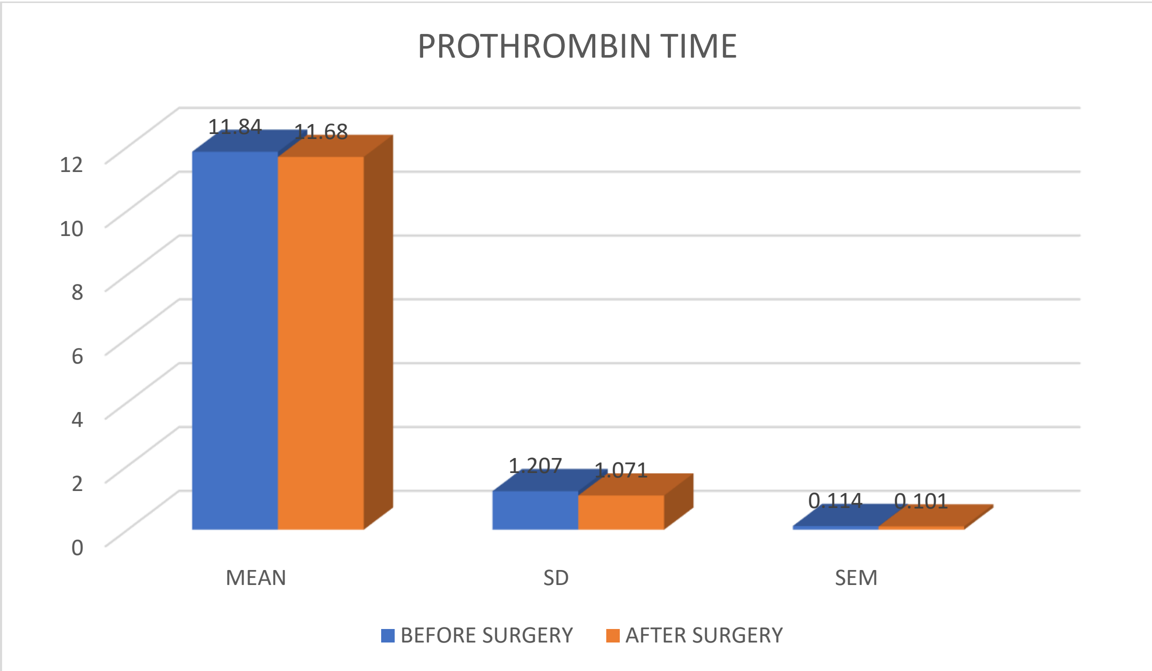


CHART 5.- BAR DIAGRAM DEPICTING CHANGES IN PROTHOMBIN TIME BEFORE AND AFTER SURGERY

The values for D-dimer were analysed. The D-dimer value before surgery for the 113 patients ranged from 91 to 178 with the mean at 129.62. The standard deviation was 21.09 and standard error of mean was at 1.984. The D-dimer values after surgery varied between 199 and 506. The mean was calculated to be 345.24 with the standard deviation at 73.099 and standard error of mean at 6.877. The D-dimer of all the patients showed a drastic increase post-surgery. The difference in mean of the two groups was 215.61 and the confidence interval of 95% lay between 227.49 to 203.74. The p-value of the D-dimer analysis was at <0.001 was meant it was extremely significant statistically.

TABLE 2.- SHOWING CHANGES IN D-DIMER VALUE BEFORE AND AFTER SURGERY

	Before Surgery	After Surgery
Mean	129.62	345.24
Standard Deviation	21.09	73.099
Standard Error of Mean	1.984	6.877

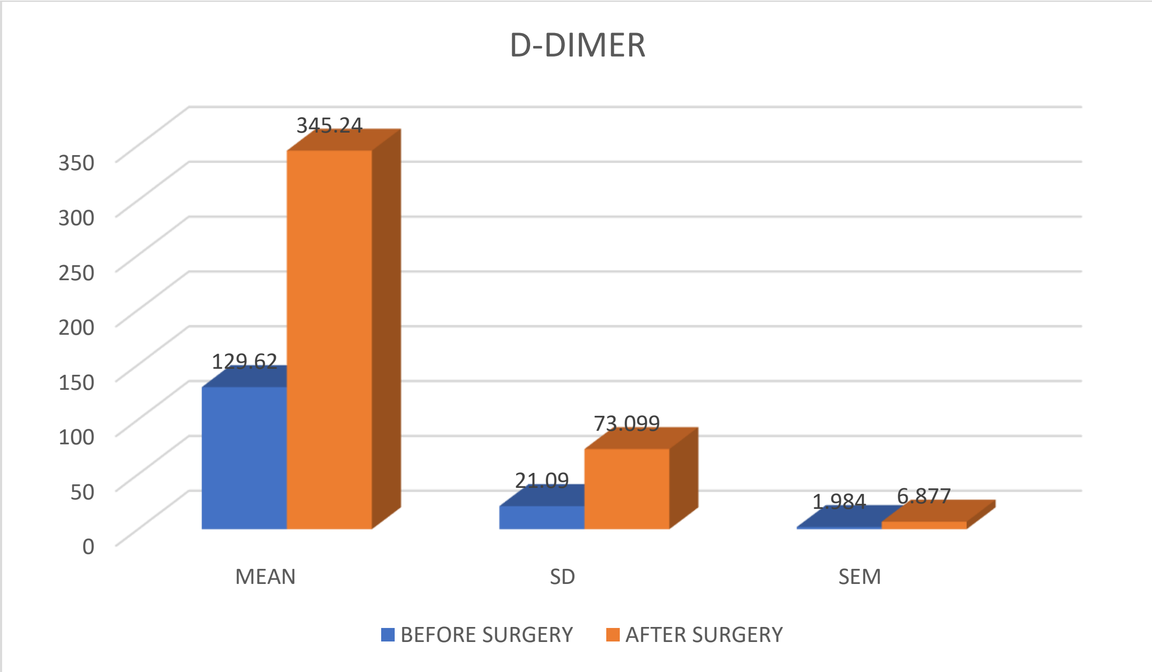


CHART 6.- BAR DIAGRAM DEPICTING CHANGES IN D-DIMER VALUE BEFORE AND AFTER SURGERY

On follow up, none of the patients' developed signs of deep vein thrombosis clinically when they turned up for follow up to 2 weeks post-surgery.

DISCUSSION

The values of prothrombin time and D-dimer of the 113 patients were analysed. The inferences derived from them were compared with other similar studies. There was a higher incidence of female patients undergoing cholecystectomy ,65% compared to males 35%. This matches the global rates and rates in India, which also shows a higher female predisposition towards gallbladder pathologies. Most of the patients who underwent surgery were in the age group of 41-50 years in both the sexes. The second highest was seen in the age group of 51-60 years. These two groups constituted 73% of the cases showing that the disease incidence increased after the age of 40 years. The duration of surgery varied between 1 hour 25 minutes to 2 hours 50 minutes. This shows the unpredictability of the duration of the surgery, the longest taking twice the time for the shortest procedure. The prothrombin times of patients when analysed showed that the results were not uniform for all patients, while some showed an elevation in prothrombin time indicating hypocoagulability. There were a few who had decreased prothrombin time after surgery showing hypercoagulability. The prothrombin time was not altered in most of the patients 62% (70 out of 113). This gave the appearance that there was not much difference in the coagulation profile with respect to prothrombin time. The mean of the prothrombin time before surgery was 11.84 and the one after surgery was 11.68. The standard error of mean was 0.114 and 0.101. This small value showed the accuracy of the mean and that a similar mean would have been obtained with a study with a larger sample. These values when charted showed that the decrease in the mean was statistically significant. Hence, the prothrombin time can be considered to decrease and there is hypercoagulability of blood. The study goes in line with other studies by Hans et al,[2] Garg et al [3] who also support the fact that there is a state of hypercoagulability. When the D-dimer values are analysed, all the patients are seen to have an increase in the D-dimer values with many showing a two-fold increase in the D-dimer values before and after surgery. The mean of the D-dimer before and after surgery were calculated to be 129.62 and 345.24 and the standard error of mean was 1.984 and 6.877. The difference in the mean was 215.619. This increase clearly indicates the undergoing fibrinolytic process. Statistically too, the values were found to be extremely significant with a p value of <0.001. Thus, this increase in D-dimer suggests the high risk of thrombosis leading to activation of fibrinolytic systems. The high values of D-dimer post-surgery were also seen in many studies like the study by Amin Buhe [4] et al where postoperative D-dimer values have been shown to get elevated by close to 5 times the preoperative values. The findings of the study though contradict the studies by Yan MJ [5] et al, Martinez et al [6] who report hypocoagulability of blood postoperatively or no change in coagulation profile. The change in the coagulation profile can be attributed to be due to surgery and is not specific to laparoscopy with carbon dioxide pneumoperitoneum as other studies by Jens Fromholt et al[7] have shown similar rise in values after open surgery and gasless laparoscopic surgeries too. D-dimer is not specific for pulmonary thrombosis or deep vein thrombosis. Values greater than 500 ng/mL are indicative of fibrinolytic activity. These changes in coagulation factors cannot be attributed to the position of patient alone. Not all patients showed a similar change in coagulation profile. The effect of position can only be studies if studies are done comparing laparoscopic procedures that adopt a Trendelenburg position to procedures that employ reverse Trendelenburg position. The effect of increased abdominal pressure may have a role to play in the alteration of coagulation profile. Stasis of blood is a component of Virchow's triad [8] and could trigger the coagulation pathway. Intra-abdominal pressures of 12-14 mmHg are maintained for a period of few hours during laparoscopic surgery. In patients suffering from chronic liver disease with ascites, abdominal pressures ranging from 15 mmHg to as high as 80 mmHg have been recorded.[9] But, these patients are not at increased risk for thrombotic phenomenon. While Custendil et al [10] in their studies found increased incidence of thrombosis on the first- and third days following surgery, no such observations were made during the study. None of the patients in the study were put on prophylaxis of any form because there were no added risk factors that indicated their need. On the contrary to many studies that reported the incidence of thrombosis postoperatively, there were no cases who developed signs of thrombosis though the patients showed increased coagulation profile. This was probably due to the small size of the population under study. The incidence of postoperative thrombosis was placed at 0.02% (1 in 5,000) in the larger studies done elsewhere. The analysis of these factors show that causation of deep vein thrombosis is multifactorial and only carbon dioxide pneumoperitoneum cannot be held responsible in patients undergoing laparoscopic cholecystectomy. But laparoscopic cholecystectomy using carbon dioxide pneumoperitoneum does play a role in altering the coagulation profile of patients and hence may need the use of prophylactic measures for thrombosis in high-risk individuals.

CONCLUSION

The study was done with the objective to find if there was a change in the coagulation profile in laparoscopic cholecystectomy using carbon dioxide pneumoperitoneum and if there is an increased risk of thrombosis. The study shows a marked increase in the D-dimer values and a significant decrease in the prothrombin time. This goes to prove that there is activation of both coagulation and fibrinolytic systems post laparoscopic cholecystectomy. This activation of coagulation system could spell a disaster if the patients were to face a thromboembolic phenomenon post cholecystectomy. But none of the 113 patients operated by us had any thromboembolic problems postoperatively. This could mean that the body has effective counter mechanisms to deal with this change in coagulation profile. When assessed, if there is a need for prophylaxis against thrombosis, the study shows that regular need for thrombosis prophylaxis is questionable despite the gross change in the coagulation profile. A watchful eye and monitoring of the clinical picture could do the trick in most cases who are amenable to follow up. Laparoscopic cholecystectomy is now being considered as an outpatient surgery. This means that the opportunity for postoperative follow up decreases. Hence, it is better that in those patients undergoing laparoscopic cholecystectomy and having lesser follow up opportunities are put on some form of deep vein thrombosis prophylaxis. The choice of which patient must be started on which method of prophylaxis could well be left to the surgeon considering that the risk varies on patient-to-patient basis. The presence of even a single risk factor should necessitate the surgeon to start the patient on prophylaxis to avoid dire consequences. Finally, larger, and detailed studies are required to throw more light on these changes in the coagulation system and quantitatively determine the risk associated for laparoscopic cholecystectomy using carbon dioxide pneumoperitoneum.

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