

A COMPARATIVE STUDY OF OPEN VERSUS LAPAROSCOPIC CHOLECYSTECTOMY IN RELATION TO CHANGES OF LIVER ENZYMES AND DURATION OF HOSPITAL STAY

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Abstract

Background: Laparoscopic cholecystectomy (LC) requires the creation of pneumoperitoneum via insufflations of carbon dioxide; resulting in increased partial pressure of carbon dioxide (Co₂) and intraperitoneal pressure which leads to changes in pulmonary functions and hemodynamic measurements. Liver function indicators were observed to be disrupted after a laparoscopic cholecystectomy (LC) in numerous studies. Pneumoperitoneum induced by carbon dioxide modifies splanchnic microcirculation and can affect lung, liver, kidney and heart physiology. The purpose of the study was to determine how liver function tests in LC were affected by carbon dioxide pneumoperitoneum. The studies objective was to determine the impact of changes to liver function test and the safety of the surgery. **Methods of study:** Pre operative and post operative (day 1 and day 3) serum bilirubin, albumin, AST and ALT will be estimated (Method used for serum Bilirubin and albumin is Colorimetric and for serum AST and ALT is multiple – point rate) followed by Comparison of preoperative and postoperative liver enzymes changes in laparoscopic cholecystectomy with CO₂ as pneumoperitoneum . **Results :** There is statistically insignificant changes of serum bilirubin and albumin on post operative 3 rd day in both open and laparoscopic cholecystectomy but in case of laparoscopic cholecystectomy there is statistically significant change of serum ALT in post operative day 1 and 3 with p value <0.001 and statistically significant elevation of serum AST on post operative day 1 whereas on post operative day 3 it is statistically insignificant with p value <0.001. In terms of duration of hospital stay and duration of surgery longer duration is found in open cholecystectomy as compared to laparoscopic cholecystectomy **Discussion:** Current study shows no change in serum bilirubin and albumin but shows statistically significant increase of serum AST and ALT in post operative status of laparoscopic cholecystectomy.

Key word: Laparoscopic cholecystectomy, Liver enzymes, Pneumoperitoneum

Introduction

Laparoscopic cholecystectomy(LC) has become the standard treatment of symptomatic gall stones and currently it is the “gold standard” procedure of choice for cholecystectomy .

The laparoscopic approach is beneficial to the patients in terms of shorter hospital stay, less post operative pain, an early return to work, and better cosmetic scars. The pneumoperitoneum (PNP) is a crucial element in laparoscopic surgery. Georg Kelling's first in 1901 described the technique of establishing PNP and first did a review of the method of the abdomen, which was then named after him celioscopy, now known as laparoscopy^{1,2}. It is believed that Zollhofer, in 1924, first described the use of CO₂ for establishing PNP. An IAP of 15 mm Hg used in laparoscopic surgery is higher than the normal portal blood pressure (7-10 mm Hg). This PNP could therefore reduce portal flow and cause alteration in liver function and changes the liver enzymes. In healthy patients, increased IAP of 10 mm Hg at 15 mm Hg leads to a significant reduction in blood flow through various abdominal organs: the stomach by 54%, jejunum by 32%, in the colon for 4%, in the liver by 39%, peritoneum by 60 and 11% for duodenum. Splanchnic ischemia time was identical duration increased IAP^{6,7}. The reduction of blood flow in the mesenteric blood vessels can occasionally lead to mesenteric ischemia but in healthy person, no clinical manifestations are seen. Hence we opted this topic to evaluate the safety of the patient due to the effect of carbon dioxide pneumoperitoneum on liver enzymes due to laparoscopic cholecystectomy.

Aim

To study the liver enzyme changes due to use of carbon dioxide as pneumoperitoneum in laparoscopic cholecystectomy.

Objectives

- To evaluate the serum Albumin, serum bilirubin, AST and ALT changes on preoperative and post operative day 1 and day 3 of laparoscopic cholecystectomy.
- To study complications or morbidity due to use of carbon dioxide as Pneumoperitoneum in laparoscopic cholecystectomy.

Material and methods

- *Place of study:* Department of general surgery at Assam Medical College and Hospital, Dibrugarh.
- *Study period:* 1 year i.e., from 1st June 2021 to 31st May 2022.
- *Type of study:* Hospital based prospective and observational study.
- *Source of data:* The patients admitted in our hospitals wards with symptomatic cholelithiasis in 1 year will be taken up for the study.
- *Sample size:* Considering 95% confidence interval with absolute precision of 5% and from baseline S. ALT level increased in 90.5% of the patients during postoperative period, sample size calculated to be 140 for the present study.²³¹

Inclusion criteria

Patients with symptomatic cholelithiasis with age 15 to 80 yrs

Exclusion criteria

1. Any patient with pre-operative abnormality in liver enzymes.
2. Chronic liver diseases.
3. Intra-Operative Complication – CBD injury.

4. Haematological Disorder
5. Common bile duct pathology.
6. Conversion to open cholecystectomy.

Methods of study

Once symptomatic cholelithiasis patients are been admitted following steps were taken : -

1. Pre operative serum bilirubin, albumin, AST and ALT will be estimated.
2. Blood sample to be collected on day 1, day 3 in red vial for serum bilirubin, albumin, ALT and AST.
3. Method of laboratory testing of serum bilirubin, serum albumin, AST and ALT

Enzymes	Methods used	Normal range (mg/ dl)
Serum Bilirubin	Colorimetric	0.20 – 1.30
Serum Albumin	Colorimetric	3.50 – 5.00
AST	Multiple - point rate	17 - 59
ALT	Multiple – point rate	< 50

4. Comparison of preoperative and postoperative liver enzymes changes in laparoscopic cholecystectomy with CO₂ as pneumoperitoneum .

Methodology

Patients with a history of abdominal pain will be examined by the surgeon. For establishing the diagnosis, a careful history will be taken from the patient or the attendant. It will be then followed by a general examination and systemic examination of the patient and finally some routine blood examinations and radiological examinations.

Patients who diagnosed to have cholelithiasis preoperative blood analysis for liver enzymes will be done and then subjected to laparoscopic cholecystectomy after obtaining proper consent from the patient / patient party. The excised gall bladder specimen will then be sent for histopathological examination in the department of pathology of Assam Medical College and Hospital, Dibrugarh to rule out other pathology of gall bladder. Post-operative care will be taken, post-operative blood analysis for liver enzymes will be done on day1 and day 3. Comparison of liver enzyme changes pre operatively and post operatively will be studied.

Instrument used to estimate

- serum liver enzymes – VITROS 5600 INTEGRATED AUTO ANALYSER SYSTEM
- Estimation of serum total bilirubin Method used – colorimetric
- Estimation of serum AST and ALT Method used - Multiple-point rate

Surgical procedure

Laprosopic Cholecystectomy .
Open Cholecystectom

Results and observations

1. Age Distribution

This study excluded patients below 15 years and over 80 years of age. Patients who were deemed fit for surgical interventions were admitted to various units of Department of surgery. A total of 140 patients were enrolled to the study. The mean age was found to be 40.37 ± 12.58 years. The youngest patient in this study was 20 years of age while the oldest one was 72 years of age (Range=20-72yrs). Patients in this study tend to clustered around older age groups. Patients from age groups 20-50 years formed the largest group comprising 81.43% of sample size peak levels belongs to the age group from 31 to 40 years with total of 28.57 % .

2. Gender Distribution

In this study of 140 cholelithiasis cases, Female gender was the largest group forming 71.43% of the sample size with male –female ratio of 1:2.5 ratio .

3. Type of Surgery

In this study, out of 140 cholelithiasis cases 74 cases underwent open cholecystectomy and 66 underwent laparoscopic cholecystectomy which comprises 52.86 % and 47.14% of total study population respectively.

4. Co2 pressure used in laparoscopic cholecystectomy:-

Out of all laparoscopic cholecystectomy cases average of 12.37 mm of hg has been used. (SD 6.19)

5. Duration of Surgery :-

Table showing Duration of Surgery

Duration of Surgery (min)	Open cholecystectomy (n)	Percentage (%)	Laparoscopic cholecystectomy (n)	Percentage (%)
≤ 30	12	16.21	10	15.15
31 -40	20	27.02	28	42.42
41-50	24	32.43	20	30.30
>50	18	24.32	8	12.12
Total	74		66	
Mean ± S.D.	18.5±4		16.5±8	

The above table shows that Mean ± S.D. for duration of surgery in this study was found to be for open cholecystectomy is 18.5 ± 4 and for laparoscopic cholecystectomy is 16.5 ± 8 . Result revealed that in open cholecystectomy maximum cases i.e. 24 (32.43 %) has been completed within 41-50 minutes in comparison to laparoscopic cholecystectomy where maximum cases i.e. 28 (42.42%) takes time of 31-40 minutes.

6. Serum Bilirubin changes

a) Open cholecystectomy

Table Showing Mean Distribution of Serum Bilirubin from Preoperative to Postoperative at Day 1 & Day 3 in Open Cholecystectomy

Time Interval	Number (n)	Serum Bilirubin		P Value*
		Mean	± S.D.	
Preoperative	74	0.66	0.29	0.842
Post operative Day 1	74	0.68	0.22	
Post operative day 3	74	0.66	0.20	
<i>*ANOVA Test ; The p value is not significant at 5% level of significance .</i>				

Above table shows statistically insignificant changes both in post operative day 1 and day 3 in open cholecystectomy with p value 0.842.

b) Laparoscopic Cholecystectomy

Table Showing Mean Distribution of Serum Bilirubin from Preoperative to Postoperative at Day 1 & Day 3 in Lap Cholecystectomy

Time Interval	Number (n)	Serum Bilirubin		P Value*
		Mean	± S.D.	
Preoperative	66	0.49	0.29	0.168
Post operative Day 1	66	0.57	0.25	
Post operative day 3	66	0.55	0.21	
<i>*ANOVA Test ; The p value is not significant at 5% level of significance .</i>				

Above Table shows statistically insignificant change in serum bilirubin in laparoscopic cholecystectomy at both post operative day 1 and day 3 with p value of 0.168 .

7. Serum Albumin changes

a) Open cholecystectomy

Table showing mean distribution of Serum albumin from preoperative to post operative at Day 1 and Day 3 in Open cholecystectomy

Time Interval	Number (n)	Serum albumin		P Value *
		mean	± S.D.	
Preoperative	74	3.50	3.20	0.6318
Postoperative day 1	74	3.42	0.37	
Postoperative day 3	74	3.84	3.69	
<i>*ANOVA test; The p Value is not significant at 5% level of significance</i>				

Above table shows statistically insignificant changes of serum albumin both on post operative day 1 and day 3 in open cholecystectomy with p value of 0.6318.

b) Laparoscopic Cholecystectomy

Table showing mean distribution of serum albumin from preoperative to postoperative at day1 and Day 3 in Laparoscopic cholecystectomy

Time Interval	Number (n)	Serum Bilirubin		P Value*
		Mean	± S.D.	
Preoperative	66	3.50	3.20	0.8915
Post operative Day 1	66	3.39	0.32	
Post operative day 3	66	3.35	0.22	

**ANOVA Test ; The p value is not significant at 5% level of significance .*

Above table shows statistically insignificant changes of serum Albumin at post operative Day 1 and Day 3 in laparoscopic cholecystectomy with P Value of 0.8915 .

8. Serum ALT changes**a) Open cholecystectomy**

Table showing mean distribution of Serum ALT from preoperative to post operative at Day 1 and Day 3 in Open cholecystectomy

Time Interval	Number (n)	Serum albumin		P Value *
		mean	± S.D.	
Preoperative	74	26.32	12.00	0.667
Postoperative day 1	74	27.86	10.56	
Postoperative day 3	74	27.46	9.73	

**ANOVA test; The p Value is not significant at 5% level of significance*

Table shows statistically insignificant change of serum ALT in open cholecystectomy on post operative day 1 and day 3 with a p value 0.667 .

b) Laparoscopic cholecystectomy

Table Showing Mean Distribution of serum ALT from Preoperative to Postoperative at Day 1 & Day 3 in Lap Cholecystectomy

Time Interval	Number (n)	Serum Bilirubin		P Value*
		Mean	± S.D.	
Preoperative	66	38.00	20.00	< 0.001*
Post operative Day 1	66	67.74	17.65	
Post operative day 3	66	31.77	7.53	

**ANOVA Test ; The p value is significant at 5% level of significance .*

Table shows statistically significant change of serum ALT in post operative day 1 and 3 with p value <0.001.

9. Serum AST changes

a) Open cholecystectomy

Table Showing Mean Distribution of serum AST from Preoperative to Postoperative at Day 1 & Day 3 in Open Cholecystectomy

Time Interval	Number (n)	Serum albumin		P Value *
		mean	± S.D.	
Preoperative	74	34.50	20.00	0.7338
Postoperative day 1	74	34.31	10.56	
Postoperative day 3	74	34.82	9.73	

**ANOVA test; The p Value is not significant at 5% level of significance*

Table shows statistically insignificant raise of serum AST in open cholecystectomy at post operative day 1 and day 3 respectively.(p value = 0.7338)

b) Laparoscopic cholecystectomy

Table Showing Mean Distribution of serum AST from Preoperative to Postoperative at Day 1 & Day 3 in Lap Cholecystectomy

Time Interval	Number (n)	Serum Bilirubin		P Value*
		Mean	± S.D.	
Preoperative	66	32.92	20.00	< 0.001*
Post operative Day 1	66	73.33	17.65	
Post operative day 3	66	35.33	7.53	

**ANOVA Test; The p value is significant at 5% level of significance .*

Table shows statistically significant elevation of serum AST on post operative day 1 whereas on post operative day 3 it is statistically insignificant with p value <0.001 .

10. Duration of hospital stay

Table showing Duration of hospital stay

Duration of hospital stay	Open cholecystectomy(n)	Percentage (%)	Laparoscopic cholecystectomy (n)	Percentage (%)
< 3	0	0	10	15.15
3-5	14	18.91	41	62.12
5-7	48	64.86	15	22.72
>7	12	16.21	0	0
Total	74		66	
Mean ± S.D.	18.5±17.8		16.5±15.14	

The above table shows that Mean \pm S.D. for duration of hospital stay was found to be for open cholecystectomy is 18.5 ± 17.8 and for laparoscopic cholecystectomy is 16.5 ± 15.14 . Result revealed that in open cholecystectomy maximum cases i.e. 48 (64.86 %) has stayed in hospital for 5-7 days in comparison to laparoscopic cholecystectomy where maximum cases i.e. 41 (62.12%) has stayed in hospital for 3-5 days.

Discussion

This prospective, observational and comparative study was conducted among 140 purposively selected patients with evidence of cholelithiasis during the period from June 2020 to June 2021 in department of General Surgery, Assam Medical College and Hospital, Dibrugarh. Out of 140 cases 66 patients underwent laparoscopic cholecystectomy and remaining patients underwent open cholecystectomy. The study was done in order to determine the effect of CO₂ and its safety as pneumoperitoneum on liver functions during laparoscopic cholecystectomy in order to determine its importance as it has no such role in raising the liver enzymes. In this current study, post operative serum bilirubin doesn't change statistically in post operative cases of both open and laparoscopic cholecystectomy with p value of 0.842 and 0.168 respectively. Our study is comparable with other studies done by Hasukic S K et al. in 2002, Khalaf R et al.⁴(2013) and Arora B et al.⁵ in 2016. In a study by Anilkumar Bellad et al.³ done in 2019 in Karnataka, observed while comparing pre op and post op values of serum bilirubin levels there was mean difference of 0.51 and p value was < 0.0001 which is statistically significant but clinically not significant³. In 2013 Al-LuwaiziaKR et al.⁴ did a study of Changes of liver enzymes and serum bilirubin after laparoscopic cholecystectomy where they found no statistically significant changes of serum bilirubin in open cholecystectomy but found statistically significant raise in laparoscopic cholecystectomy which was clinically insignificant⁴. In a study done by Arora B et al.⁵ in 2016, they found no significant changes in post operative serum bilirubin levels⁵. In our current study, observed statistically insignificant changes in serum albumin in both post open cholecystectomy and laparoscopic cholecystectomy patients with p value of 0.6318 and 0.8915 respectively. Results from my study are not comparable with others studies done by Anilkumar Bellad et al.³ done in 2019 and Singh HO et al. in 2022. In our study serum AST doesn't show any statistically significant changes in post operative days of open cholecystectomy (p value 0.7338). Whereas in laparoscopic cholecystectomy, serum AST levels raises on post operative day 1 (p value < 0.001) but on day 3 AST levels reduces. Similar results were shown in other studies done by Rajesh Godara et al. at Haryana India in 2020⁸. This study is also comparable with study done by Anilkumar Bellad et al.³, in 2019 in Karnataka India, Arora B et al.⁵ in 2016 at Rohtak, 2013 Al-LuwaiziaKR et al.⁴. In our study serum ALT doesn't show any statistically significant changes in post operative days of open cholecystectomy (p value 0.667). Whereas in laparoscopic cholecystectomy, serum ALT levels raises on post operative day 1 (p value < 0.001) but on day 3 AST levels reduces (p value 1.374). Similar results were shown in other studies done Rajesh Godara et al.⁸ at Haryana India in 2020 and also comparable with other studies done by Anilkumar Bellad et al.³, in 2019, Al-LuwaiziaKR et al.⁴, Arora B et al.⁵ in 2016 at Rohtak. In our study serum ALT doesn't show any statistically significant changes in post operative days of open cholecystectomy (p value 0.667). Whereas in laparoscopic cholecystectomy, serum ALT levels raises on post operative day 1 (p value < 0.001) but on day 3 AST levels reduces (p value 1.374). Similar results were shown in other studies done Rajesh Godara et al.⁸ at Haryana India in 2020 and also comparable with other studies done by Anilkumar Bellad et al.³, in 2019, Al-LuwaiziaKR et al.⁴, Arora B et al.⁵ in 2016 at Rohtak. In the present study, open cholecystectomy

maximum cases i.e. 24 (32.43 %) has been completed within 41-50 minutes in comparison to laparoscopic cholecystectomy where maximum cases i.e. 28 (42.42%) takes time of 31-40 minutes and for duration of hospital stay in case of open cholecystectomy maximum cases i.e. 48 (64.86 %) has stayed in hospital for 5-7 days in comparison to laparoscopic cholecystectomy where maximum cases i.e. 41 (62.12%) has stayed in hospital for 3-5 days.

Laparoscopic cholecystectomy	Liver enzyme changes	Current study Mean \pm SD	Rajesh Godara et al. 2020	Bellad A et al. 2019	AlluwaiziaKR et.al.
Preoperative	Serum bilirubin	0.49 \pm 0.29	—	0.66 \pm 0.18	0.936 \pm 0.279
	Serum albumin	3.50 \pm 3.20	—	4.04 \pm 0.39	—
	ALT	38.00 \pm 20.00	18.3 \pm 10.4	30.9 \pm 7.63	11.48 \pm 2.15
	AST	32.92 \pm 20.00	20.6 \pm 12.8	24.58 \pm 8.76	11.21 \pm 2.60
Postoperative Change (statistically)	Serum bilirubin	insignificant	—	increased	increased
	Serum albumin	insignificant	—	Decreased	—
	ALT	increased	increased	increased	increased
	AST	increased	increased	increased	increased

Table : Comparing other studies with current study

Conclusion

Laparoscopic cholecystectomy (LC) has become the “gold standard” in treating symptomatic gallbladder stones and has replaced open technique. It has many advantages which include less patient discomfort, better cosmetic results, shorter hospital stay and shorter interval to return to work. There is no statistically significant changes of serum albumin and bilirubin post operative patients whereas there is transient rise of serum AST and ALT in laparoscopic cholecystectomy on day 1 which reduced on day 3. These changes are probably due to the use of co2 pneumoperitonium which increases the intra-abdominal pressure more than portal venous pressure. Even though these changes are statistically significant but clinically has no significance in healthy person. Hence laparoscopic cholecystectomy can be carried out safely but the operating surgeon should be more cautious in conducting laparoscopic cholecystectomy in patients with known liver disease.

CONFLICT OF INTEREST

There is no conflict to disclose .

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