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Evaluation of hepatic and renal functional changes in patients undergoing laparoscopic cholecystectomy

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ABSTRACT

Background: In this era of laparoscopic surgery, with the use of carbon dioxide insufflation in creating pneumoperitoneum for ease of trocar insertion and visualization of anatomy, it comes certain systemic changes in the patient due to the compression effect of the gas as well as resorption of it through peritoneum. **Aims and Objectives:** The aim of the study was to assess baseline standards of hepatic and renal functional status in pre-operative patients in comparison with post-operative patients undergoing laparoscopic cholecystectomy (LC). **Materials and Methods:** Cases were chosen among the persons who presented with chronic calculus cholecystitis to the surgical out-patient department of Ramakrishna Mission Seva Pratishthan, Vivekananda Institute of Medical Sciences, Kolkata. Pre-operative liver function tests (LFT) and renal function tests (RFT) values were recorded. Again, LFT and RFT values were evaluated on post-operative day 1 (POD1) and POD12. **Results:** Serum conjugated and unconjugated bilirubin, aspartate amino transaminase, alanine amino transaminase, urea, estimated glomerular filtration rate values increases immediate postoperatively on POD1 but returns to normal pre-operative levels on POD 12. Serum alkaline phosphatase, albumin, and creatinine values decrease on POD1 and return to normal pre-operative values in POD 12. **Conclusion:** Hepatic and renal function changes in the immediate post-operative period of 24 h following LC. This change is transient and returns to normal levels within POD 12.

Key words: Laparoscopic cholecystectomy; Post-operative day; Aspartate transaminase; Alanine transaminase; Alkaline phosphatase; Estimated glomerular filtration rate

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INTRODUCTION

Prevalence of gallstone ranges from 10% to 20% in India.[1] It affects nearly 4.3% of the population.[2] For the past 150 years, morbidity and mortality for surgical procedures have been accepted as unavoidable parts of the therapeutic process. Since the late 1980s, however, it has become evident that less invasive interventional methods have reduced overall risks of death and morbidity. This realization has given rise to the concept of minimally invasive surgery, which aims to "minimize the trauma of any interventions process but still achieve a satisfactory therapeutic result."[3]

Minimally invasive surgery has rapidly evolved as a major specialty since laparoscopic cholecystectomy (LC) was first performed in March 1987 by MOURET, in LYON, FRANCE.[4]

The widespread acceptance of this technique had been largely propelled by public awareness that LC is associated with less pain, quicker return to normal activities and better cosmetic results.

The procedure of LC operation involves artificial pneumoperitoneum with carbon dioxide insufflation to minimize visceral injury during trocar insertion, creation

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of space for easier manipulation of instrument and to avail facilities of diathermy.[5]

The inert nature of carbon dioxide gas facilitates all of the above, but brings forth certain patho-physiological changes related to raised intra-abdominal pressure due to pneumoperitoneum. Exaggeration of these effects is also related to change of posture frequently practiced in laparoscopic operation. These involve almost all the organ system with particular brunt on respiratory, cardiovascular, hepatic and urinary systems due to compression effects as well as peritoneal resorption of carbon dioxide.[6,7]

There are few prospective, randomized controlled trials comparing open and laparoscopic approaches to surgery and their resultant physiologic effects. Indeed, these studies would now prove difficult to undertake given the wide public knowledge and expectation of "keyhole surgery" and its potential advantages. There are, however, many observational and prospective studies assessing the physiologic consequences of peritoneal insufflations, alterations in patient position and other interventions inherent in laparoscopic surgery. The risks associated with general anesthesia can be compounded by the physiologic changes induced by pneumoperitoneum and patient positioning, in patients who are already compromised preoperatively.

Aims and objectives

1. The objectives of the study are as follows: To assess baseline standards of hepatic and renal functional status in pre-operative patients in comparison with post-operative patients undergoing LC
2. To evaluate the usual time required for return of deranged hepato- renal function, if any, to normal levels.

MATERIALS AND METHODS

Study design

This was a prospective and observational study.

Study area

Out-patient department (OPD) and in patient department (IPD) of Department of General Surgery, Ramakrishna Mission Seva Pratishthan, Vivekananda Institute of Medical Sciences. Department of Biochemistry, Ramakrishna Mission Seva Pratishthan, Vivekananda Institute of Medical Sciences.

Study period

The study period was August 2022–January 2024 (18 months).

Study population

All patients admitted in general surgery ward (IPD) of Ramakrishna Mission Seva Pratishthan, Vivekananda Institute of Medical Sciences with provisional clinical diagnosis of Cholelithiasis.

Sample size

The sample size was 79 patients.

Inclusion criteria

The following criteria were included in the study:

1. Patients having normal basal pre-operative parameters under study aspartate amino transaminase (AST), alanine amino transaminase (ALT), alkaline phosphatase (ALP), total and direct bilirubin levels, serum creatinine, blood urea, with no known comorbid illness involving the hepatic, renal and pulmonary illnesses that may have a false positive effect on the study
2. Any age group
3. Any gender.

Exclusion criteria

The following criteria were excluded from the study:

1. Conversion from laparoscopic to open surgeries
2. Patients undergoing emergency laparoscopic surgeries
3. Patients developing complications after the LC (bile duct injury, bile duct leak, and cholangitis)
4. Patients having history of comorbid conditions such as diabetes mellitus, chronic liver diseases, chronic renal diseases, cardiac disease, history of chronic drug abuse affecting liver and kidney function, evidence of bile duct stone, who had gone endoscopic retrograde cholangiopancreatography within 10 days before the laparoscopic procedure and post-operative mortality.

Statistical analysis

Analysis of variance (ANOVA) or paired t-test or Chi-square test, as found suitable. Repeated measures ANOVA, allow us to measure the change over time, t and F test would be used to check for the statistical significance at 5% level of significance. Chi-square test can be used to test for relationships between any categorical variables in the dataset.

Methodology

Cases were chosen among the patients who presented with chronic calculus cholecystitis to the Surgical OPD of Ramakrishna Mission Seva Pratishthan, Vivekananda Institute of Medical Sciences, Kolkata. Pre-operative liver function tests (LFT) and renal function tests (RFT) values were recorded. Again, LFT and RFT values were evaluated on post-operative day 1 (POD1) and POD12. The LFT and RFT on POD1 were done in the hospital as the patient being usually discharged on POD 2. The patient was asked

to repeat LFT and RFT on POD 12 follow-up visit and the values were recorded. The data had been collected and then was incorporated into an excel data sheet. ANOVA test has been used for statistical evaluation of pre- and post-operative values of AST, ALT, ALP, total bilirubin, conjugated and unconjugated bilirubin levels, serum creatinine, blood urea, and eGFR.

eGFR (mL/min) = [(140-age)×Wt/(0.814 × S.Cr in μmol/L)]×(0.85 if female).
P-value <0.05 is considered to be statistically significant.

RESULTS

Seven (59.5%) patients were female and 32 (40.5%) patients were male. The value of z is 2.3867. The value of P=0.01684. The result is significant at P<0.05.

The mean age (mean±SD) of patients was 54.9241±8.0651 years.

The mean body weight (in kg) (mean±SD) of patients was 53.3418±6.1012.

The mean pre-operative serum bilirubin conjugated (mean±SD) of patients was 0.1418±0.0496. The mean serum bilirubin conjugated POD 1 (mean±SD) of patients was 0.2481±0.1048. The mean serum bilirubin conjugated POD 12 (mean±SD) of patients was 0.1177±0.0384.

The mean serum bilirubin unconjugated pre-operative (mean±SD) of patients was 0.2835±0.0993. The mean serum bilirubin unconjugated POD 1 (mean±SD) of patients was 0.4013±0.1245. The mean serum bilirubin unconjugated POD 12 (mean±SD) of patients was 0.2253±0.1115.

The mean AST pre-operative (mean±SD) of patients was 29.4937±1.4489. The mean AST POD 1 (mean±SD) of patients was 42.3038±2.2891. The mean AST POD 12 (mean±SD) of patients was 28.2025±2.2780.

The mean ALT Pre-operative (mean±SD) of patients was 21.9747±2.9999. The mean ALT POD 1 (mean±SD) of patients was 34.4810±2.5463. The mean ALT POD 12 (mean±SD) of patients was 23.3418±0.8456.

The mean ALP pre-operative (mean±SD) of patients was 85.1392±7.7769. The mean ALP POD 1 (mean±SD) of patients was 76.6835±13.3585. The mean ALP POD 12 (mean±SD) of patients was 86.8101±3.8533.

The mean serum albumin pre-operative (mean±SD) of patients was 4.3519±0.1475. The mean serum albumin POD 1 (mean±SD) of patients was 3.5418±0.2378. The mean serum albumin POD 12 (mean±SD) of patients was 4.1873±0.1295.

The mean serum urea pre-operative (mean±SD) of patients was 18.4810±1.4751. The mean serum urea POD 1 (mean±SD) of patients was 20.6582±1.1971. The mean serum urea POD 12 (mean±SD) of patients was 16.6582±2.2411.

The mean serum creatinine pre-operative (mean±SD) of patients was 0.8013±0.0588. The mean serum creatinine POD 1 (mean±SD) of patients was 0.7013±0.0588. The mean serum creatinine POD 12 (mean±SD) of patients was 0.8418±0.00496.

The mean estimated glomerular filtration rate (e-GFR) (in ccs/min) pre-operative (mean±SD) of patients was 72.9203±10.5576. The mean e-GFR (in ccs/min) POD 1 (mean±SD) of patients was 83.3582±12.1368. The mean e-GFR (in ccs/min) POD 12 (mean±SD) of patients was 70.5392±7.3792 (Table 1).

DISCUSSION

In our study, out of 79 patients, female population (n=47, 59.5%) was significantly higher than the male population (n=32, 40.5%) (P=0.01684).

In our study, we found that serum conjugated bilirubin raises on POD1 (from mean 0.14 pre-operative value to mean 0.24 in POD 1), which comes to approximate pre-operative value on POD 12 (mean 0.11 on POD 12).

We also found that serum unconjugated bilirubin raises on POD 1 (from mean 0.28 Pre-operative value to mean 0.4 in POD 1), which comes to approximate pre-operative value on POD 12 (Mean 0.22 on POD 12). Malik et al.,[8] found that in LC at 14 mmHg pressure, mean bilirubin decreases by 14% immediately postoperatively and returns to normal level in 7 days. These changes are clinically and statistically insignificant. Enzyme elevations could mostly be attributed to the adverse effects of the pneumoperitoneum on the hepatic blood flow and renal blood flow and CO_2 absorption in the blood.

AST raises from mean of 29.49 in pre-operative period to mean of 42.3 during POD 1, comes to pre-operative mean of 28.2 during POD 12. In Kim et al.,[9] study, AST was increased at post-operative 1 day and 3 days, compared with that of the pre-operative in one group whereas post-operative 1 day in another group, but the values were within its normal limit.

Serum ALT shows mean value of 21.97 in pre-operative period, raises to mean of 34.48 during POD 1, and comes down to mean of 23.34 in POD 12.

Table 1: Parameters measured preoperatively, on POD 1 and POD 12 with their mean values summarized

Parameters studied	Pre-operative value (mean±SD)	Post-operative day 1 value (mean±SD)	Post-operative day 12 value (mean±SD)
Serum bilirubin (conjugated)	0.1418±0.0496	0.2481±0.1048	0.1177±0.0384
Serum bilirubin (unconjugated)	0.2835±0.0993	0.4013±0.1245	0.2253±0.1115
Serum AST	29.4937±1.4489	42.3038±2.2891	28.2025±2.2780
Serum ALT	21.9747±2.9999	34.4810±2.5463	23.3418±0.8456
Serum ALP	85.1392±7.7769	76.6835±13.358	86.8101±3.8533
Serum albumin	4.3519±.1475	3.5418±0.2378	4.1873±0.1295
Serum urea	18.4810±1.4751	20.6582±1.1971	16.6582±2.2411
Serum creatinine	0.8013±0.0588	0.7013±0.0588	0.8418±0.00496
e-GFR (cc/min)	72.9203±10.5576	83.3582±12.13	70.5392±7.3792

POD 1: Post-operative day 1, AST: Aminotransaminase, ALT: Aminotransaminase, ALP: Alkaline phosphatase, e-GFR: Estimated glomerular filtration rate

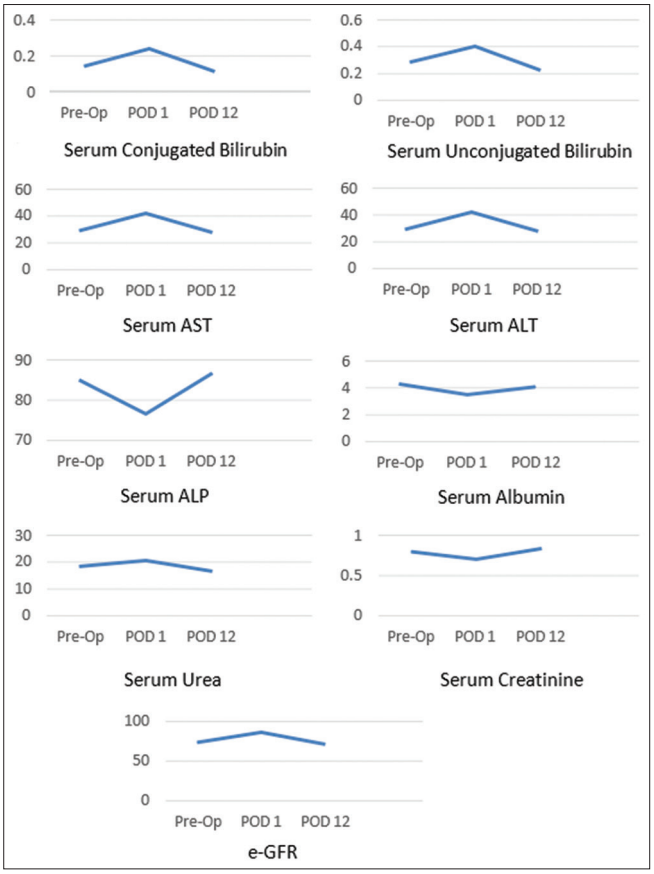

Figure 1: Graphical representation of the results obtained after analysis

Serum ALP shows decreasing trend of mean 85.12 in pre-operative period to mean of 76.68 in POD 1, which raises close to pre-operative range during POD 12 (Mean 86.81). Singal et al.,[10] found that in LC patients, there was a rise in the levels of serum bilirubin, AST, and ALT after 24 h of surgery from the pre-operative value and then again fall was noted (near to normal value) after 72 h of surgery except in that of ALP.

Serum albumin decreases from 4.3 (mean) in pre-operative period to 3.54 (mean) in POD 1, raises to 4.1 (mean) during POD 12.

Serum urea level shows minimal change from pre-operative mean of 18.48–20.65 (mean) in POD 1 and 16.65 (mean) in POD 12.

Serum creatinine decreases from pre-operative mean of 0.80–0.70 (mean) in POD 1, and increases in 0.84 (mean) during POD 12. In Kim et al.,[9] study, creatinine was not changed after anesthesia.

e-GFR raises from (pre-operative) 72.92 cc/min (mean) to 83.35 cc/min mean during POD 1 and comes down to mean of 70.53 cc/min during POD 12 (Figure 1).

Limitations of the study

1. Sample size was small. Only 79 patients were chosen
2. Study was conducted in a single center
3. Study was conducted in a tertiary care hospital, so hospital bias cannot be ruled out.

CONCLUSION

It can be appreciated that the transient changes of biochemical parameters of hepatic and renal function during immediate post-operative period of 24 h following LC are temporary as evident from normalization of all parameters close to pre-operative values during POD 12.

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SN- Definition of intellectual content, literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation, and submission of article; **DC-** Concept, design, clinical protocol, manuscript preparation, editing, statistical evaluation, and manuscript revision; and **SKH-** Coordination and manuscript revision.

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