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Original Research Article

Comparative study of postoperative hepatic and renal function changes in laparoscopic and open cholecystectomy

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ABSTRACT

Background: It has been shown that there is a transient elevation of serum liver enzymes after laparoscopic surgeries and major causative factor seemed to be the CO_2 pneumoperitoneum. In most of the cases, it does not have any clinical significance in the patient with normal preoperative liver function. However, in patients with deranged liver function, these changes can have great significance.
Methods: The present study was designed to determine and compare changes in liver function tests and renal function test following laparoscopic cholecystectomy and open cholecystectomy. This study was conducted on 100 patients admitted to Swaroop Rani Nehru Hospital, Allahabad, India from August 2017 to January 2019 who were having symptomatic cholelithiasis with a history of either acute cholecystitis, biliary colic or chronic cholecystitis. All patients were investigated for complete liver function tests and renal function test including serum bilirubin, SGOT, SGPT, alkaline phosphatase, LDH, S. urea, S. creatinine, S. Na^+, S. K^+, S. Ca^+ and urinary sodium (UNa^+). The laboratory tests were carried out in the same laboratory using one type of instrument.
Results: In open cholecystectomy, bilirubin decreased by 11% (p value equals 0.191) and remained decreased to the preoperative value on day 1 and day 7. While, laparoscopic cholecystectomy at 14 mmHg pressure, mean bilirubin decreases by 14% immediately postoperatively (p value equals 0.1733) and returns to normal level in 7 days. These changes are clinically insignificant and statistically insignificant.
Conclusions: 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. Though, these changes do not seem to be clinically significant, care should be taken before deciding to perform laparoscopic cholecystectomy. This study suggested that laparoscopic cholecystectomy is a safe operative procedure and have added advantages. The disturbances in the function of the kidney after laparoscopic cholecystectomy are self-limited and not associated with any morbidity in patients with a healthy kidney function.

Keywords: Laparoscopic cholecystectomy, Liver function test, Open cholecystectomy, Renal function test

INTRODUCTION

Surgical Removal of the gall bladder is known as a cholecystectomy. The operation is done via the open method and via the laparoscopic approach. Treatment modality of gall bladder diseases changed significantly after the introduction of open cholecystectomy by Karl Langenbuch in 1882.[1] It has the benefits of small

incision, improved cosmetic aspects, less postoperative pain and quick recovery time to normal activities.[2,3] Laparoscopic cholecystectomy is a gold standard and treatment of choice for gall stones and inflammatory gall bladder removal. Laparoscopic cholecystectomy has a number of an advantage as compared to conventional therapy including improved patients compliance and satisfaction and reduced cost but it is seen that in laparoscopic cholecystectomy commonly used the method of creating pneumoperitoneum by carbon dioxide gas has few disadvantages in critically ill patients having cardiovascular, respiratory and renal insufficiency.[4-8] It has been reported that hemodynamic disturbances in the abdomen reduce portal venous flow and cause physiological alterations in hepatic function.[9,10] It was shown that there is a transient elevation of serum liver enzymes after laparoscopic surgeries and major causative factor seemed to be the CO_2 pneumoperitoneum. In most of the cases, it does not have any clinical significance in a patient with normal preoperative liver function. However, in patients with deranged liver function, these changes can have great significance. Carbon dioxide pneumoperitoneum cause hypercapnia or increase intra-abdominal pressure during laparoscopic cholecystectomy it leads to decrease portal venous flow.[8,11,12] It has been shown that the duration and level of intra-abdominal pressure are responsible for changes in hepatic function during laparoscopic cholecystectomy. Halevy A et al, reported a significant increase in postoperative liver enzymes (alanine aminotransferase, ALT aspartate aminotransferase, AST) in up to 80% of patients undergoing laparoscopic cholecystectomy. Hence, the present study was designed to determine and compare changes in liver function tests following laparoscopic cholecystectomy and open cholecystectomy.[14]

METHODS

This study was conducted on 100 patients admitted to Swaroop Rani Nehru Hospital, Allahabad, India from August 2017 to January 2019, who were having symptomatic cholelithiasis with the history of either acute cholecystitis, biliary colic or chronic cholecystitis.

All patients had given informed consent and opted for laparoscopic cholecystectomy and open cholecystectomy. Patients were divided randomly into two groups by a random table chart.

The patients who were converted to open cholecystectomy, who developed complications after the laparoscopic and open cholecystectomy (bile duct injury, bile duct leak, cholangitis), history of prior major abdominal surgery, history of co-morbid conditions like 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 ERCP within ten days before the laparoscopic procedure and post-operative mortality are excluded.

Group A are those who will go for open cholecystectomy (OC). Group B are those who will go for laparoscopic cholecystectomy (LC).

All patients were investigated for complete liver function tests and renal function test including serum bilirubin, SGOT, SGPT, alkaline phosphatase, LDH, S. urea, S. creatinine, S. Na^+, S. K^+, S. Ca^+ and urinary sodium (UNa^+). The laboratory tests were carried out in the same laboratory using one type of instrument.

The anesthetic protocol was the same in all cases in one group. Care was taken to select drugs that interfered as little as possible with the enzymatic activity of liver and renal functions. The dissection of gall bladder from the liver was performed with cautery. Postoperatively, all patients have given the same intravenous infusions protocol of antibiotics Cefuroxime 750 mg pre and post-operatively. Use of hepatotoxic and nephrotoxic drugs was avoided.

To assess liver function and renal function serum level of bilirubin, SGOT, SGPT, ALP and LDH, S. urea, S. creatinine, S. Na^+, S. K^+, S. Ca^+ and U. Na, were measured before the operation, immediate postoperatively (at the time of reversal from anesthesia), 24 hour after the operation and on day 7.

Analysis of data done by t-test. Microsoft office 2007 software used for mathematical calculations and in-silico.net calculator used for statistical calculations.

Independent variables included age, sex, acute cholecystitis, anesthesia protocol (same for all patients in a group).

Dependent variables

- The pressure of pneumoperitoneum-14 mm,
- Clinical diagnosis- acute/chronic,
- The position of patients- same for all patients, 30-degree head up and 35-degree tilt towards left,
- Duration of surgery- less than 60 minutes for all patients,
- Manipulation of liver bed,
- Manipulation of biliary tract,
- Use of general anesthesia and hepatotoxic and nephrotoxic drugs intraoperatively,
- Comorbid condition.

RESULTS

In open cholecystectomy bilirubin decreased by 11% (p value equals 0.191) and remained decreased to the preoperative value on day 1 and day 7. While, laparoscopic cholecystectomy at 14 mmHg pressure, mean bilirubin decreases by 14% immediately postoperatively (P value equals 0.1733) and returns to normal level in 7 days. These changes are clinically

insignificant and statistically insignificant, and it can be observed that bilirubin level decreases 12.5% in a patient with laparoscopic cholecystectomy and 12% in patients with open cholecystectomy 24 hour after. There was a statistically significant increase in SGOT level in immediate postop (P <0.0001) and 24 hours postoperatively (P <0.0001) in comparison to pre-operative value in patients with laparoscopic cholecystectomy and return to near normal on day 7. There were also statistically significant changes occurred in the level of SGPT in immediate post-operative (p <0.0004) and 24 hours postoperatively (P <0.0004) in comparison to pre-operative value in patients with laparoscopic cholecystectomy and return to near normal on day 7. There are no significant changes in levels of alkaline phosphatase in either group in this study (p =0.3133). In this study, author had observed statistically significant (p <0.001) but the clinically insignificant difference between the change in LDH levels between two groups. In this study, no significant difference was found about age, sex, operation time, pneumoperitoneum time (all less than 60 minutes). In present study, author found that there was no clinically significant change occurred in renal function. Only statistically significant decrease occurred in UNa^+ value in immediate post-operative (p= <0.0001) and 24 hours post-operative (p= 0.005). Post-operative day seven value normalized to pre-operative value. In this study, there was a similar decrease in the level of UNa^+.

Table 1: Comparision of renal function before and after increased IAP.

Parameter value	Before increased IAP	After increased IAP
Urine flow rate (V)	8.4±1 (µl/min)	5.8±0.5 µl/min
Absolute Na^+ excretion (UNAV)	1.08±0.31 (meq/min)	0.43±0.1 (meq/min)
GFR	1.84±0.12 (ml/min)	1.3±0.06 ml/min
RPF	8.62±0.87 (ml/min)	3.82±0.16 ml/min

In this study, there was a similar decrease in the level of UNa^+. Effect of pneumoperitoneum in gastric bypass and found there is a decrease in urine output and slight derangement of renal function. Changes are transient and normalize within a week. This result was also similar to this study in which also transient renal dysfunction occurred and normalized in a week. The post-operative increase of liver enzymes was less when laparoscopic cholecystectomy was performed with pneumoperitoneum at 10 mmHg.

DISCUSSION

In open cholecystectomy bilirubin decreased by 11% (P value equals 0.191) and remained decreased to the pre-operative value on day 1 and day 7. While, LC at 14 mmHg pressure, mean bilirubin decreases by 14% immediately postoperatively (p value equals 0.1733) and returns to normal level in 7 days. These changes are clinically insignificant and statistically insignificant, and it can be observed that bilirubin level decreases 12.5% in a patient with laparoscopic cholecystectomy and 12% in patients with open cholecystectomy 24 hours after. There was a statistically significant increase in SGOT level in immediate postop (P <0.0001) and 24 hours post-operatively (P <0.0001) 29.85 Â±7.83 IU/L and 73.27 Â±11.52 IU/L respectively in comparison to pre-operative value in 52% patients with laparoscopic cholecystectomy as compared to 10% in open cholecystectomy. There were also statistically significant changes occurred in level of SGPT in immediate post-operative (P <0.0004) and 24 hours post-operatively (P <0.0004) 31.36 Â±9.41 and 77.59 Â±17.37 IU/L respectively in comparison to preop value in 50% patients with laparoscopic cholecystectomy as compared to 11% in open cholecystectomy. Similar results have previously been demonstrated and observed that the level of serum ALT and AST increased significantly during the first 48 hours of post-operations in laparoscopic cholecystectomy patients.[15] By the 7th day post operation, the level of both enzymes returned to average values. They concluded that transient elevation of hepatic transaminases occurred after laparoscopic surgery but showed no apparent clinical implications it was similar to this study in which SGOT and SGPT increased statistically significant level (p= <0.0001) and (p <0.0004) respectively.[16] Total bilirubin, ALP, GGT and LDH levels remained unchanged from baseline after laparoscopic cholecystectomy at 12-14 mmHg pneumoperitoneum. 26/50 patients had increased values of ALT and 25/50 had increased value of AST. The increased level decreased at 48 hours. The results indicated that laparoscopic cholecystectomy was associated with transient elevation of ALT and AST. The disturbances in the function of the liver after laparoscopic cholecystectomy are self-limited and not associated with any morbidity in patients with a healthy liver function. This result was similar to this study. Twenty-four hours after the procedure, ALT and AST increased statistically significantly in the laparoscopic cholecystectomy group. Slow return to normality occurred 7-10 days after the procedure. They concluded that alterations in hepatic function occur after laparoscopic cholecystectomy and appear to be clinically insignificant.[17] Changes of activity for AST, ALT and bilirubin during laparoscopic surgery are more outstanding with a higher degree of significance than what happened during laparotomy surgery.[18] Changes are transitory and after 72 hours they return to the preoperative values.

There are no significant changes in levels of alkaline phosphatase in either group in this study (P=0.3133). This was similar to present study. Total bilirubin, ALP, GGT and LDH levels remained unchanged after laparoscopic cholecystectomy at 12-14 mmHg pneumoperitoneum laparoscopic cholecystectomy.[19] A statistically significant change of all the eight parameters studied, except alkaline

phosphatase.[20] In present study, author had observed statistically significant (p <0.001) but the clinically insignificant difference between the change in LDH levels between two groups. Similarly, a significant increase in AST, ALT, GGT and LDH levels in the laparoscopic cholecystectomy group (12 mmHg) post-operatively but not clinically significant.[21] Contradictory to this study there was no change in levels of LDH.[19]

In present study, no significant difference was found concerning age, sex, operation time, pneumoperitoneum time (all less than 60 minutes). Similar results observed and they found no significant difference concerning age, sex, body weight, body height, operation time, pneumoperitoneum time and IAP.[22]

So, it can be concluded that all serum liver enzymes including bilirubin, SGOT, SGPT, LDH, alkaline phosphatase changes during laparoscopic cholecystectomy. Some changes are statistically significant without any clinical significance. These changes are attributed mostly to the adverse effects of the pneumoperitoneum on the hepatic blood flow with some contribution of extreme body position.

In this study, author found that there was no clinically significant change occurred in renal function. Only statistically significant decrease occurred in UNa^+ value in lap chole in immediate postoperative (p <0.0001) and 24 hours post-operative (p <0.0005). Post-operative day seven value normalized to pre-operative value. This finding is similar to the study on rats that increase intra-abdominal pressure during laparoscopy surgeries adversely affect kidney function. The mechanisms underlying this phenomenon are largely unknown. In his study, rat was subjected to increase intra-abdominal pressure of 14 mmHg for 1 hour after which deflation of 60 min (recover) was done in which four additional groups were divided and pretreated.

- Group I - ABT 627, an ETA antagonist,
- Group II - A192621, an ETB antagonist,
- Group III- Nitroglycerine,
- Group IV- NG Nitro L. arginine methyl ester (No synthase inhibitor).

In these groups, urine flow rate (V) total Na^+ excretion (UNAV) GFR and renal plasma flow were determined. Significant reduction in kidney hemodynamics observed when IAP was applied.[23]

CONCLUSION

It was concluded that elevated intraperitoneal pressure created during laparoscopic surgery causes increased liver enzymes and deranged renal functions. No significant difference was found concerning age and sex. No significant difference was found concerning operation time, pneumoperitoneum time (all less than 60 minutes). As all patients were operated in different position an OC at the level of SGOT and SGPT increases insignificantly. While, LC at 14 mm and anesthetic method and post-operative protocol, these factors were also responsible for differences between the two groups. This study suggests that LC is a safe operative procedure and have added advantages. The disturbances in the function of the kidney after LC are self-limited and not associated with any morbidity in patients with a healthy kidney function (Table 1). The disturbances in the function of the kidney and liver in patients of acute cholecystitis after LC or OC were clinically insignificant are self-limited and not associated with any morbidity in patients with a healthy kidney and liver functions.

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