

## THE EFFECT OF CARBON DIOXIDE PNEUMOPERITONEUM USED IN LAPAROSCOPIC CHOLECYSTECTOMY ON R RENAL FUNCTIONS

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### **Abstract**

**Backgrounds:** The effect of carbon dioxide pneumoperitoneum (co<sub>2</sub>pp) on the renal function of human being not properly evaluated. our Study will be done among patients sustained laparoscopic cholecystectomy Using co<sub>2</sub> pp. 50 patients were used as objective group (had laparoscopic cholecystectomy using co<sub>2</sub> pp ) while another group is used as a control group which is 20 in number, they sustained open cholecystectomy, the Study is done at Saddam Medical City Hospitals.

### **The aim of the research**

In the history of surgery, no new operating method has ever gained ground and developed as quickly as laparoscopy. When a serious interest In laparoscopy took place in 1987 christian klaiber and his colleagues<sup>(3)</sup>, Initially encountered. skepticism and even total rejection of their proposals' but after gaining valuable experience in diagnostic Laparoscopy, they became increasingly convinced that his technique could Open up unexpected opportunities for therapeutic surgery from technical points of view. However the physiological and the mechanical effects of the Co<sub>2</sub> used in insufflation of the peritoneal cavity on different organs till now was not fully understood, our study will concentrate on the effect of Co<sub>2</sub>.

pneumoperitoneum ( co<sub>2</sub> pp) on renal functions through the study of the serum creatinine and blood urea in order to know if there is any adverse effect on the kidney functions when we use co<sub>2</sub> pp during laparoscopic cholecystectomy in patients originally having normal function tests.

### **Methods:**

we compared both the serum creatinine and the blood urea of both, the objective group and the control group. We used three samples for each patient, pre – operative, immediately postoperative and 24 hours postoperative. We used objective group of 50 patients underwent lap cholecystectomy using co<sub>2</sub> pp and the other group of 20 patients underwent open cholecystectomy, all the patients included in the study are with normal renal functions.

**Results:**

Regarding the level of the serum creatinine, there is a transient mild elevating of it at the immediate postoperative samples although it does not exceed the normal level while it returns to the baseline in the Samples aspirated 24 hr. postoperatively. These results are similar for both objective and control groups.

Regarding the blood urea, in the objective group, there is a transient mild elevation at the immediate postoperative samples although it does not exceed the normal value and it returns to the baseline at the 24 hours, postoperative samples while in the control group no change in the blood urea at all.

**Conclusion:**

our study proved that there is no significant changes in the renal functions between both groups.

**Introduction:**

Abdominal laparoscopic surgery using CO<sub>2</sub> pneumoperitoneum is now getting increased, different types of abdominal surgeries can be done by laparoscope for example: appendectomy, cholecystectomy, adhesiolysis, gynaecological, urosurgery. It is used as a diagnostic specially following trauma, as a laparoscopic surgery using CO<sub>2</sub> pp. which is a new technique in which many of physiological changes which may result due to either the physiological effects of CO<sub>2</sub> or due to the mechanical effects of high pressure (> 10 mmHg) CO<sub>2</sub> directly on the abdominal organs like liver, kidneys, ...etc ? Our study will include just the effect of CO<sub>2</sub> pp on renal functions.

We will use the laparoscopic cholecystectomy operation for our Study as this operation becomes the technique of choice in removing gall bladder because it is minimally invasive with rapid recovery of the Patient and low complications as compared with open cholecystectomy<sup>(13)</sup>. In our center, laparoscopic cholecystectomy constitute about 70% of Cholecystectomy operations (50 cases out of 70 cases ) (70%), while in the advanced countries, it reaches up to 90%. We will try to know the effect of CO<sub>2</sub> on the renal functions through the study of the changes which may happen in blood urea and serum creatinine to create the balance between the advantages and disadvantages of this new technique.

Several studies done in U.S.A and Japan reveal no significant differences regarding haemodynamic response when operations done in Pigs or in humans that are healthy, hydrated and hyperventilated to keep the end tidal volume of CO<sub>2</sub> <40<sup>(2,9)</sup>.

Other studies done in Finland<sup>(9,12)</sup> suggest that the effect of CO<sub>2</sub> pp may cause reduction in intra-abdominal organs perfusion due to increase, of vascular resistance related to elevated abdominal pressure or to vasoconstrictive effect of absorbed CO<sub>2</sub>. These changes usually return to the baseline level after disinflation, we measured the blood urea and serum creatinine, for each three samples were aspirated, preoperative, immediate postoperative and 24 hours postoperatively .(Table2).

### Patients and methods

During the period from December 1997 till April 2000 our study which was done in the Saddam Medical City Hospitals- Baghdad, includes 50 patients (objective group) who underwent laparoscopic cholecystectomy using  $\text{CO}_2$  pp while the other group who underwent open cholecystectomy includes 20 patients (controlled group). A full history and clinical examination was done with special stress on the history of any renal problems or of any systemic disease which may affect the kidney functions.

We selected just the patients with normal renal functions, all patients diagnosed to have cholecystitis (acute or chronic), most of them (90%) were due to stones (calculus cholecystitis), both groups positioned supine during operation.

The  $\text{CO}_2$  pp pressure used is between 12-14 mmHg, while those sustained LC advised to evacuate their urinary bladder just immediately before going to the theatre, nasogastric tube used for both groups to decompress the stomach, the anaesthetic substances used were the same apart from the manipulation of respiration of those underwent laparoscopic cholecystectomy in which the minute volume is higher than those which underwent open cholecystectomy by 1 - 2 L /min. During anaesthesia, ECG, systemic blood pressure, heart rate, Respiratory rate, peak airway pressure, compliance and end tidal  $\text{CO}_2$  were continuously monitored in both groups. All patients of both groups had their prophylactic antibiotics with the induction of anaesthesia, intra-operative intravenous fluid was the same for both groups and the analgesia given to the patients during the first 24 hr. postoperatively is the same for both groups.

All data were expressed as mean  $\pm$  SD, the significance of the difference between the objective group and the controlled group was tested using Students t-test and  $\chi^2$ -test. A P value  $> 0.05$  was considered statistically not significant between the two groups and in both parameters (blood urea and serum creatinine).

The characters of the patients of both groups are summarized in table 1. Three venous samples of blood is aspirated from every patient in each group, pre-operatively, immediate postoperatively and 24hr. postoperatively to study both blood urea and serum creatinine, Postoperative need of oxygen is the same for both groups.

**Table 1 : Characteristics of Patients.**

	Laparoscopic cholecystectomy	Open cholecystectomy
No.	50	20
Age (year)	47.4	55.8
Male: female	1:3	1:1
Duration of operation(min.)	45	48

Data given as mean  $\pm$  SD.

### The Results

By the end of the collection of the data, we got the following results :-

- 1- **Age:-** the range of the age of the patients who underwent laparoscopic Cholecystectomy is between 28-80 years with mean of 47.4 year  
While those underwent open cholecystectomy aged between 42-80 Years with mean of 55.8 years, (Table.1)
- 2- **Sex:-** 37 patients out of 50 patients who underwent laparoscopic Cholecystectomy were females which constitute 74% (3F:1M) (graph-1) while those exposed to open cholecystectomy were 10F and 10M (1F: 1M ) (graph-2), this study is similar to the study done by M.W. Seriven (16), The percentage of female to male in general is 2.2:1 (graph-3).
- 3- **Duration of the operation:** in both groups, the range of the operative time is between 30-60 min. The experience of the surgeon plays important role, the average time needed for doing laparoscopic Cholecystectomy is 45 min, while for open cholecystectomy it is 48min. (Table.1)
- 4- **The effect on renal functions:**
  - a- Regarding serum creatinine. There is slight tendency to be increased transiently at the immediate postoperative samples in both, the objective group and the controlled group although this slight increase does not exceed the normal value and it is proved to be statistically not significant. This minimal increase returns to the baseline within 24 hour postoperatively (Table.2)

- b- Regarding blood urea, there is slight tendency for it to increase minimally at the immediate postoperative samples in the objective group, this slight increase does not exceed the normal value and Statistically it is not significant and it return to the baseline within the 24 hours postoperatively . In the objective group, there is no increase either in the immediate or 24 hours postoperative samples(Table2).

**Table 2: the changes in blood urea and serum creatinine in patients underwent laparoscopic cholecystectomy using CO<sub>2</sub> pp and in patients who underwent open cholecystectomy.**

	Laparoscopic cholecystectomy	Open cholecystectomy
Blood urea		
.Before operation	40	31
.Immediately postop	44	30.5
.24 hr. postop	40.5	30.5
Serum creatinine		
.Before operation	0.71	0.66
.Immediately postop	0.8	0.77
.24 hr. postop	0.7	0.74

- 5- **The clinical outcome:** the clinical outcome is shown in table 2, after 24 hours postoperatively, there is no changes in the renal functions at all in both the objective group and the controlled group.

### Discussion

Laparoscopic surgery offers numerous clinical advantages over traditional surgical techniques, but certain physiopathological effects still require more scrutiny. In fact from the first attempts at celioscopy surgery, anesthetists and physiologists have stressed that the fact , CO<sub>2</sub> used to create the pneumoperitoneum is an inert gas only in so far as combustion is concerned, because it has a highly haematic solubility, CO<sub>2</sub> may cause hypercapnia and respiratory acidosis. Furthermore the pneumoperitoneum itself causes an increase in the intraabdominal pressure which influences the cardiocirculatory system reducing the venous return to the right atrium, the pre-load to the left ventricle and consequently the cardiac flow<sup>(1)</sup>. In most cases, these, physiopathological effects do not have any clinical relevance in patients with normal renal functions .

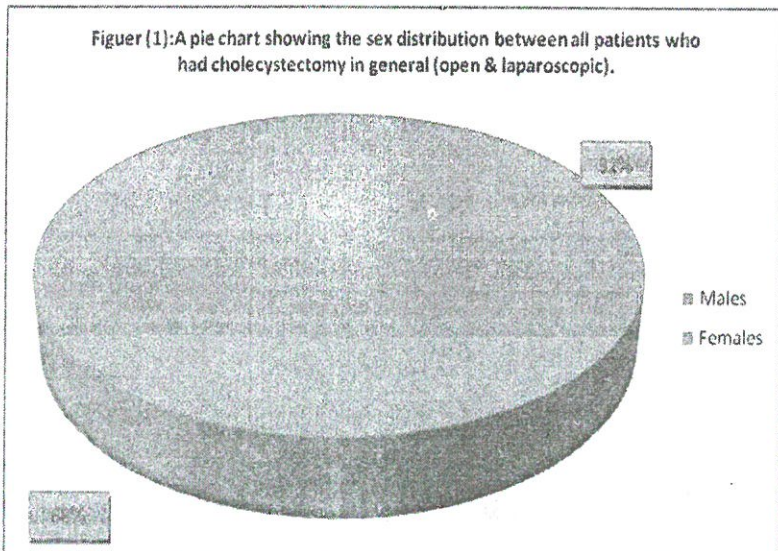
Very few studies have been done on the consequences of the pneumoperitoneum on renal function in the human being. Alteration in renal functions occurring during laparoscopic cholecystectomy in the clinical setting might be affected not only by changes in high intraabdominal pressure but also by general anesthesia, intraoperative infusion and by specific manipulation used in cholecystectomy .

In our study there was no significant differences in the preoperative renal function test results, method and type of anesthesia, and the volume of intraoperative infusion. Nasogatstric tube was used in both groups .

looking at the results of our study it is shown that the main bulk of the patients that underwent cholecystectomy in general ( open and laparoscopic cholecystectomy ) were with a mean age of 49 years as seen in table (1)

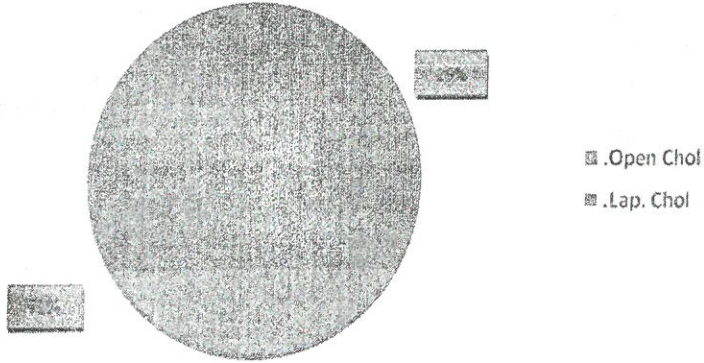
When we separate the patients who underwent laparoscopic cholecystectomy (objective group) the age is between 28-80 years with a mean age of 47.4 years old and those who underwent open cholecystectomy (control group) aged between 42-80 years with a mean of 55.8 years (as seen in table (1)). These results are compatible with the results of a study done in U.K.<sup>(16)</sup>

Looking at the sex distribution will show that the male-to-female ratio for patients who underwent cholecystectomy in general (open and laparoscopic cholecystectomy) is 1:2.2 as shown in figure (1)

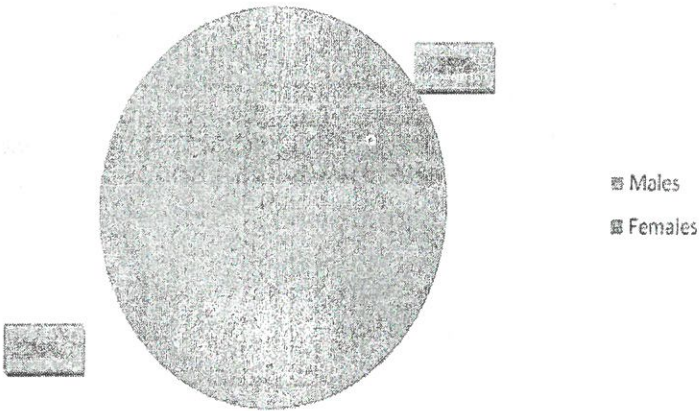


The popularity of removing the gall bladder by laparoscope has increased, in our center (Saddam Medical City), from the 70 patients who underwent cholecystectomy, 50 patients (71%) got their gall bladder removed laparoscopically, while 20 patients (29%) preferred open cholecystectomy (as shown in figure 2). 75% of patients who had laparoscopic cholecystectomy were females, while those who had open cholecystectomy were only 50% females and 50% male ( as shown in figure 3) These differences in ratio between those who underwent laparoscopic cholecystectomy and open cholecystectomy are due to female preference to get their gall bladder removal by laparoscope for good cosmetic results .

Figure(2): A pie chart showing the percentage of patients who performed an open chol. in comparison to those who performed a lap. chol.



Figure(3): A pie chart showing the sex distribution of patients who had laparoscopic chole.



Looking at the time needed to perform the operation, there is no significant difference between both types of operations. The mean time needed to perform laparoscopic cholecystectomy, was 45 minutes while in open cholecystectomy the mean time needed was 48 minutes (as seen in table 1)

The  $CO_2$  pneumoperitoneum pressure was ranging between 12-14 mmHg, this range of pressure gave us good insufflation, which resulted in a good view.

Based on our results, there are no complications reported related to the  $CO_2$  pneumoperitoneum whether due to mechanical pressure on the kidneys or due to its physiological effect in the renal functions of the patient with healthy kidneys. The analy-

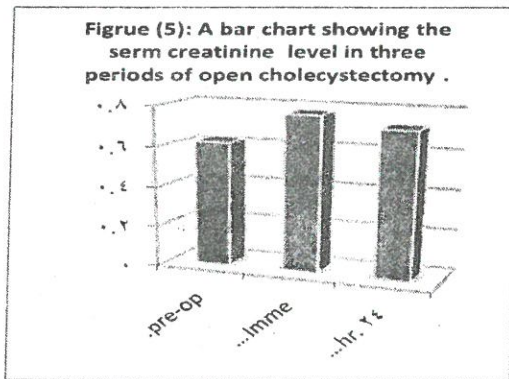
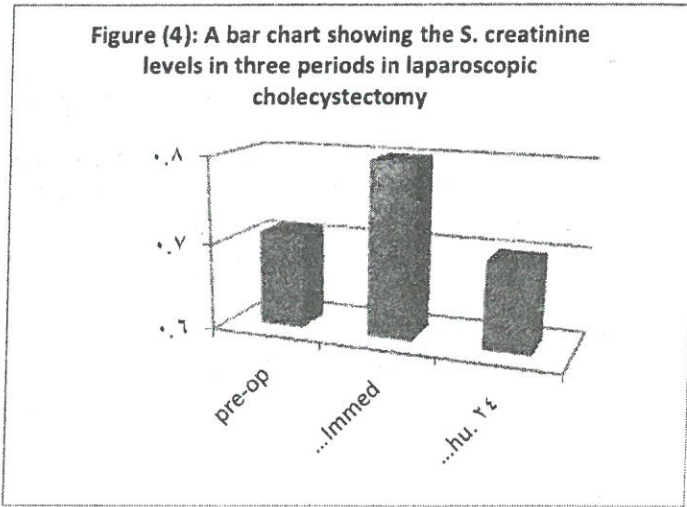
sis of the data collected in our study proved that the minimal transient change of serum creatinine which occurred at the immediate post-operative samples is within the normal values and it was statistically not significant in which the p-value was more than 0.5 and at the 24 hours post-operative samples, it returned to the baseline, the same results occurred in the control group, this means that the transient minimal elevation of serum creatinine at the immediate post-operative period may not be related to the CO<sub>2</sub> insufflation at pressure 12-14 mmHg with the mentioned manipulation of anesthesia in patient with normal renal functions. (See table 2 and figure 4).

The results of our study are similar to the study obtained in Japan<sup>(13)</sup> (as see in table 3) with a note that, in Japan they compared the laparoscopic cholecystectomy using CO<sub>2</sub>PP with laparoscopic cholecystectomy using abdominal wall lifting (gasless method).

**Table 3: Comparisons between the study in Iraq and the study done in Japan regarding the effect of CO<sub>2</sub>PP in renal functions.**

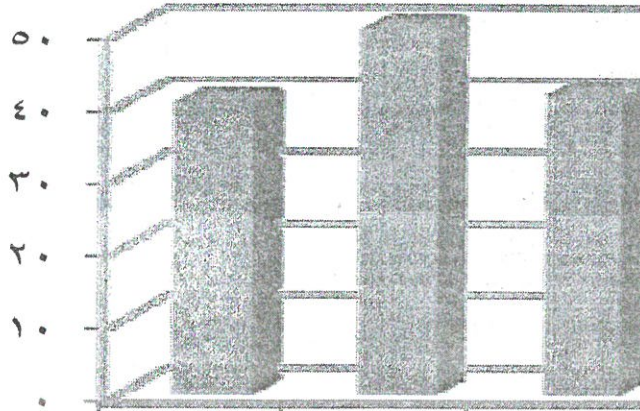
	Study done in Iraq	Study done in Japan <sup>(13)</sup>
Then name of The Center	Saddam medical City Hospitals	Nagasaki University school of Medicine
The number of Patients	70 (50 LC +20 OC)	27 (16 LC using CO <sub>2</sub> PP+11 LC using AWL-gasless method)
The characters of Patients	All are without any systemic diseases and all with normal renal function	All are without any systemic diseases and all with normal renal functions.
Parameters used	1) Blood urea 2) Serum creatinine	1)Creatinine clearance ratio 2)Plasma rennin activity
Statistical analysis and conclusions	CO <sub>2</sub> pneumoperitoneum has no significant effects on renal functions in patients with normal kidneys	CO <sub>2</sub> pneumoperitoneum has no significant effects on renal functions in patients with normal kidneys



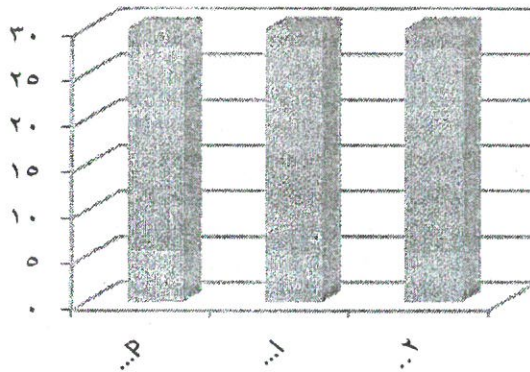


Regarding the blood urea, in the objective group, there is also a transient minimal increase in the blood of the samples withdrawn at the Immediate post-operative period but this increase is within normal value And it is statistically not significant ( $P > 0.5$ ) and it returned to the baseline at the 24 hour post-operatively. In the controlled group, the blood urea is nearly not changed at both the immediate post-operative and 24 hours Post-operative samples. (See table 2, figures 6 and 7).

**Figure (6) : A bar chart showing the blood urea levels in three periods of laparoscopic cholecystectomy**



**Figure (7) : A bar chart showing the blood urea levels in three periods of open cholecystectomy**



### Conclusion

The clinical recovery from the anaesthesia is the same in both groups, none of the patients got any renal complications at the post-operative period and no significant changes occurred to renal functions, the immediate post-operative period and all patients returned biochemically to the baseline with 24 hours postoperatively, so using CO<sub>2</sub> in laparoscopic cholecystectomy is suitable and safe for patients with normal renal functions.

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