AIM OF THE WORK

The aim of this work was to compare the use of monopolar cautery versus the conventional clipping of cystic artery in cases of laparoscopic cholecystectomy as regards the following points:

1. Safety.
2. Efficacy.
3. Operative time.

PATIENTS

The present study included fifty patients admitted to Alexandria main university hospital for elective laparoscopic cholecystectomy during the period from June 2013 till January 2014

Exclusion criteria:

Patients with a recent acute attack were excluded from the present study.

An informed consent was taken from all patients with a follow up period minimum 6 months.

METHODS

1. All patients were subjected to detailed history taking with particular stress upon:

- Recurrent attacks of biliary colics.
- Attack of acute cholecystitis .
- Attack of jaundice.
- Associated co-morbid conditions.

2. Complete physical examination:

3. Routine laboratory investigations:

- Complete blood count.
- Blood urea and serum creatinine.
- Alanine transaminase (ALT) & Aspartate transaminase (AST).
- Total, direct and indirect bilirubin, alkaline phosphatase.
- Prothrombin time (PT), Partial thromboplastin time (PTT) & International normalization ratio (INR).
- Hepatitis profile (HBsAg, HCVAb).

4. Abdominal ultrasonography:

With emphysis on: number of stones, size of gallstones, thickness of gall bladder wall as well as comment on intra and extra-hepatic biliary radicles.

Patients were randomized into two groups using closed envelopes before being admitted for surgery.

Operative details:

The operation was carried out under general anesthesia and prophylactic antibiotic was given.

The patient was placed in the standard supine, reverse trendelenburg position with the right shoulder up. A uniform technique of the laparoscopic cholecystectomy was applied, including the use of four trocar ports. Dissection of the gallbladder was initiated at the triangle of Calot with the identification and skeletonization of both the cystic duct and artery,the severity of inflammation of Calot's triangle was classified into five grades as shown in the following table (Table IV)[105].

Table IV-Grades of inflammation in calot's triangle

Grade	Defination
I	No inflammation
II	Mild inflammation.Calot's triangle structures are very easy to identify and separate
III	Moderate inflammation.Calot's triangle structures are rather easy to identify and separate
IV	Sever inflammation.Calot's triangle structures are rather difficult to separate,but identifiable
V	Sever inflammation.Calot's triangle structures are very difficult to identify and separate.Mostly conversion to open surgery is needed.

No structure was divided before demonstrating the space between the gallbladder and the liver clear of any structure other than the cystic artery (critical view of safety).

Cystic artery diameter was measured intraoperatively using endo clinch (the distance between the serrations=2mm),then closure of cystic artery was achieved by using monopolar electrocautery in group I and by applying titanium clips in group II whereas the division was achieved by cautery in the first case and by scissors in the second. When cautery was used to control the artery, this was done very close to the gallbladder wall, using short bursts with the power level set at 4–5.

The principles of surgical dissection described by American and French experts[106,107] were adequately followed including:

1- Adequate exposure and visualization of the operative field.

2- Opening of Calot's triangle by lateral and inferior traction on the gallbladder neck.

3- Dissection of Calot's triangle using great care while using cautery.

4- Low cautery setting should be used,coagulate small pieces of tissue at one time,being sure that the coagulation surface is free of any adjacent tissue.

5- Avoid blind use of clip or cautery to control bleeding.

6- Liberal conversion to open cholecystectomy when the anatomy remains unclear during the surgical dissection.

Also, we stuck strictly to the proposed safety measures published to guarantee avoidance of the inherent complications associated with the use of monopolar cautery in laparoscopy. [108]

These measures include:

1- Careful inspection of insulation.

2- Use of the lowest power setting.

3- Use brief intermittent activation.

4- Avoid activation in open circuit.

5- Avoid activation in close proximity or direct contact with another instrument.

6- Selection of an all metal cannula system as the safest choice.

7- Avoid applying cautery close to metal clips.

The cystic duct was then closed by applying simple titanium clips and divided by scissors. Mobilization of the gallbladder from the liver bed was started posteriorly at the triangle of Calot and proceeded anteriorly using the electrosurgical hook or spatula. Finally, the gallbladder was subsequently removed through the subxiphoid port. A subhepatic tube drain, inserted through the most lateral port, was not routinely used but whenever it was seen as needed by the surgeon.

At the end of surgery, data on details of cystic artery control were recorded in a separate sheet. The details included number, site, size, method of control of the cystic artery and position of its division relative to the cystic lymph node. The operative time, intraoperative difficulties, and postoperative complications were also recorded.

Post operative course:

Patients were discharged on the morning of postoperative day 1 after removal of the drain (if used).

At the end of the first postoperative week, patients were seen in the outpatient clinic and underwent a clinical examination. This was repeated after 3 months. At the end of the sixth postoperative month, clinical examination and abdominal ultrasonography were done. In addition, blood was sampled for bilirubin, aminotransferase, alkaline phosphatase, and gammaglutamyltransferase levels.

Patients were instructed to contact the surgical staff if any symptoms appeared between the scheduled visits or at any time after the discharge day.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0.

Qualitative data were described using number and percent. Quantitative data were described using mean and standard deviation median, minimum and maximum.

Comparison between different groups regarding categorical variables was tested using Chi-square test. When more than 20% of the cells have expected count less than 5, correction for chi-square was conducted using Fisher's Exact test or Monte Carlo correction.

The distributions of quantitative variables were tested for normality using Kolmogorov-Smirnov test, Shapiro-Wilk test and D'Agstino test, also Histogram and QQ plot were used for vision test. If it reveals normal data distribution, parametric tests was applied. If the data were abnormally distributed, non-parametric tests were used.

For abnormally distributed data, comparison between two independent populations were done using Mann Whitney test while Kruskal Wallis test was used to compare between different groups. To compare between two periods Wilcoxon signed ranks test was used. Correlations between ordinal variables were assessed using Spearman coefficient.

Significance test results are quoted as two-tailed probabilities. Significance of the obtained results was judged at the 5% level.

RESULTS

The present study included fifty patients who underwent laparoscopic cholecystectomy and were classified into two groups:

Group I: Twenty-five patients underwent laparoscopic cholecystectomy where the cystic artery was controlled using monopolar cautery, twenty three patients (92%) were females and two patients (8 %) were males, their age ranged from 25 to 67 years with a mean of 44.60 ± 12.96.

Group II: Twenty-five patients underwent laparoscopic cholecystectomy where the cystic artery was controlled using titanium clips, twenty-two patients (88%) were females and three patients (12%) were males, their age ranged from 23 to 65 years with a mean of 43.48 ± 13.59.

There was no statistically significant difference between the two groups as regard the age, sex or associated co-morbidities (table V, VI)

Table (V): Distribution of the studied cases according to demographic data

	Cautery (n= 25)		**Clipping (n = 25)**		**Test of sig.**	**P**
	No	**%**	**No**	**%**		
Sex						
Male	2	8	3	12	χ^2=0.222	^{FE}p=1.000
Female	23	92	22	88		
Age						
Min. – Max.	25– 67		23 – 65			
Mean ± SD.	44.60 ± 12.96		43.48 ± 13.59		t=0.298	0.767
Median	45		42			

Table (VI): Distribution of the studied cases according to co morbidities

Co morbidities	**Cautery (n= 25)**		**Clipping (n = 25)**		**χ^2**	**p**
	No	**%**	**No**	**%**		
No	15	60	15	60	0.00	1.000
Diabetes Mellitus	5	20	9	36	1.587	^{FE}p = 0.208
Hypertension	6	24	5	20	0.117	^{FE}p = 0.733
Cirrhotic liver	1	4	0	0	1.020	^{FE}p = 0.312

No statistically significant difference was found between history of acute attack or recurrent biliary colics and the method of cystic artery control as illustrated in table (VII)

Table (VII): Comparison between the two studied groups according to history of acute attack and recurrent biliary colics

	Cautery (n= 25)		Clipping (n = 25)		χ^2	^{FE}p
	No	%	No	%		
History of acute attack	5	20	5	20	0.0	1.000
Recurrent biliary colics	15	60	12	48	0.725	0.395

During surgery, Calot's triangle was carefully dissected and was graded according to the severity of inflammation, grade I was detected in 4 patients (16%), grade II in12 patients (48%) and grade III in 9 patients (36%) in group I while in group II grading was as follows, grade I was found in 6 patients (24%), grade II in 11 patients (44%) and grade III in 8 patients (32%).

There was no statistically significant difference between the degree of inflammation in Calot's triangle and method of cystic artery control as illustrated in table (VIII)

Table (VIII): Comparison between two studied groups according to inflammation grade in calot's triangle

	Cautery (n= 25)		Clipping (n = 25)		χ^2	p
	No	%	No	%		
Inflammation grade						
I	4	16	6	24		
II	12	48	11	44	0.502	$^{MC}p= 0.778$
III	9	36	8	32		

As regard the number of the controlled vessel, single artery was detected in twenty-four patients (96%) (Figure 17) while two arteries were controlled in one patient(4%) in group I (Figure 18).when two arteries were controlled, only data of the larger one was included.

In group II, single cystic artery was identified in twenty-five patients (100%).No double arteries were found in this group.

No statistically significant relation was found between number of arteries controlled and the method of their control.

In all patients, artery could be controlled efficiently using monopolar cautery in group I and using clips in group II. Details of cystic artery control are illustrated in table (IX).

In group I, cystic artery was located inside Calot's triangle (Figure 19) in 23 patients and outside the Calot's(Figure 20,21) in 2 patients whereas in group II it was identified inside the Calot's triangle in 22 patients and in 3 patients outside it.

The artery was graded as small in 7 patients(28%),medium in 16 patients(64%) and large in 2 patients(8%) in group I, while in group II it was graded as small in 4 patients(16%), medium in 12 patients(48%) and large in 9 patients(36%). (Figure22)

There was no stastically significant relation between the size of cystic artery and the method of its control.

A statistically significant relation was detected between method of cystic artery control and its site in relation to the LN where cauterization of the artery was frequently applied lateral to the LN (64 % of the patients in group I versus 28% of the patients in group II).

Table (IX): Comparison between two studied groups according to artery number, size, site, and LN

	Cautery (n= 25)		Clipping (n = 25)		χ^2	p
	No	%	No	%		
Artery No.						
Single	23	92	25	100	1.020	1.000
Multiple	2	8	0	0		
Site						
Inside	23	92	22	88	0.551	0.642
Outside	2	8	3	12		
Artery size						
Small (<2mm)	7	28	4	16		
Medium (2 – 3mm)	16	64	12	48	5.844	$^{MC}p=0.054$
Large (>3mm)	2	8	9	36		
LN						
Not identified	8	32	16	64		
Medial	1	4	2	8	19.444*	$^{MC}p<0.001$*
Lateral	16	64	7	28		

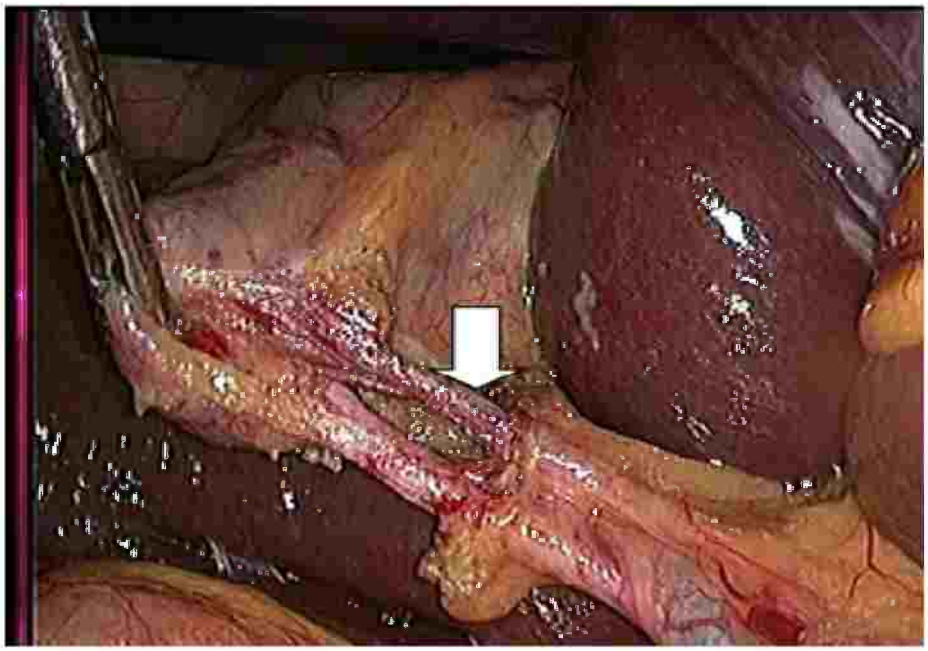

Fig (17): Single cystic artery

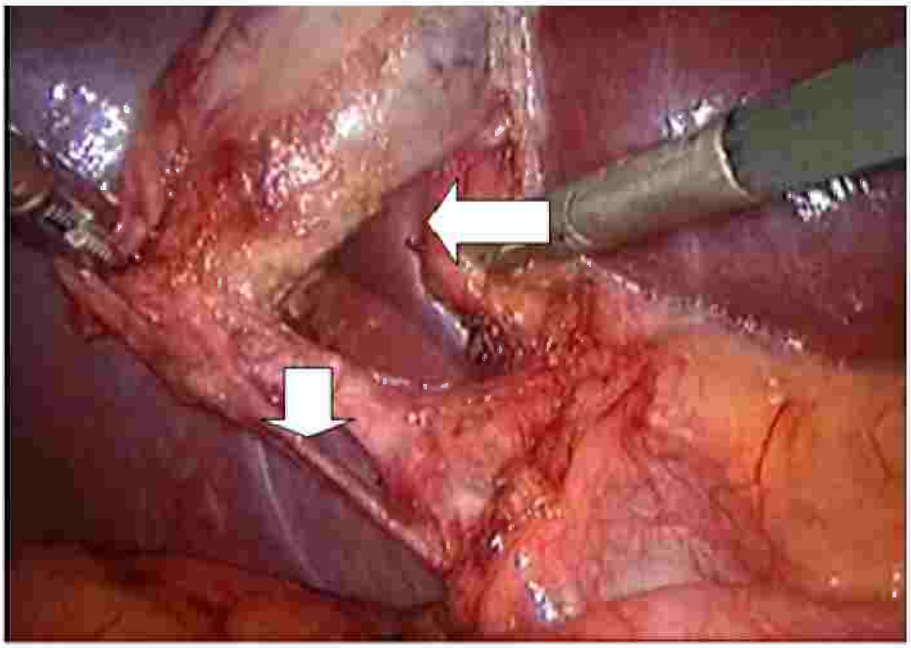

Fig (18): Double cystic arteries

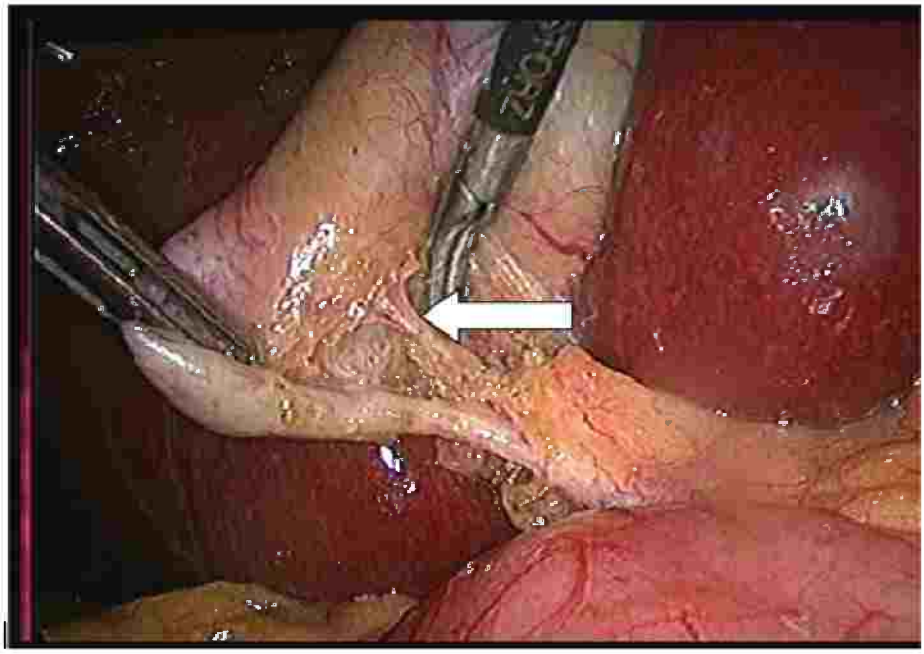

Fig (19): Cystic artery inside Calot's triangle

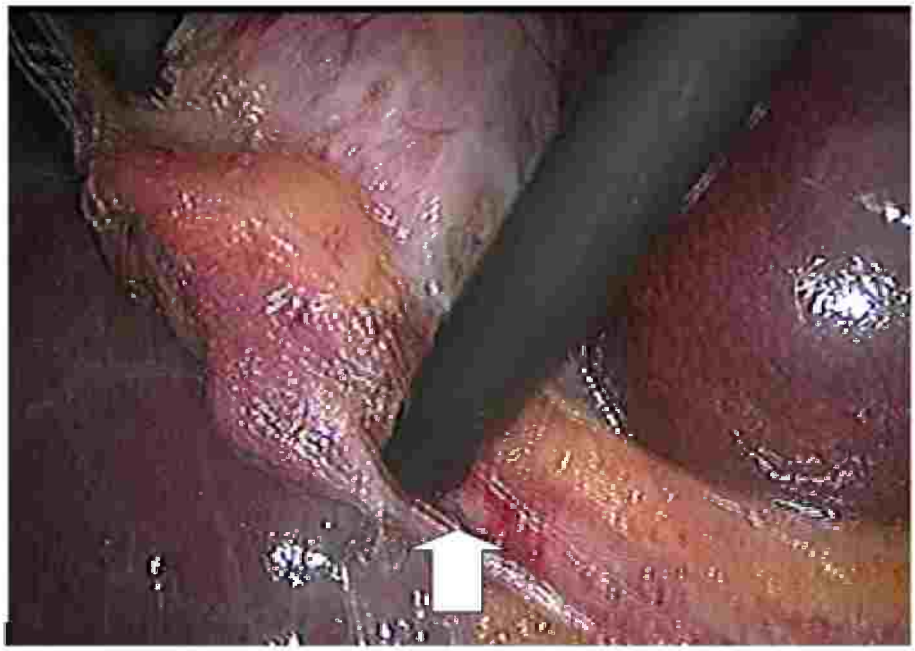

Fig (20): cystic artery outside Calot's triangle. (Cystic artery lies lateral to the cystic duct)

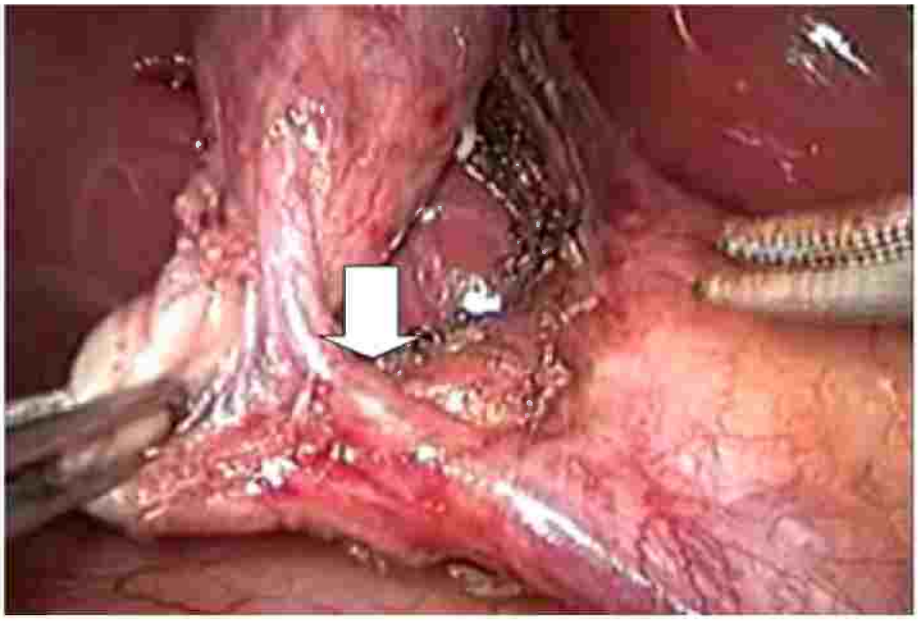

Fig (21): Cystic artery outside Calot's triangle (Cystic artery lies along and anterior to the cystic duct)

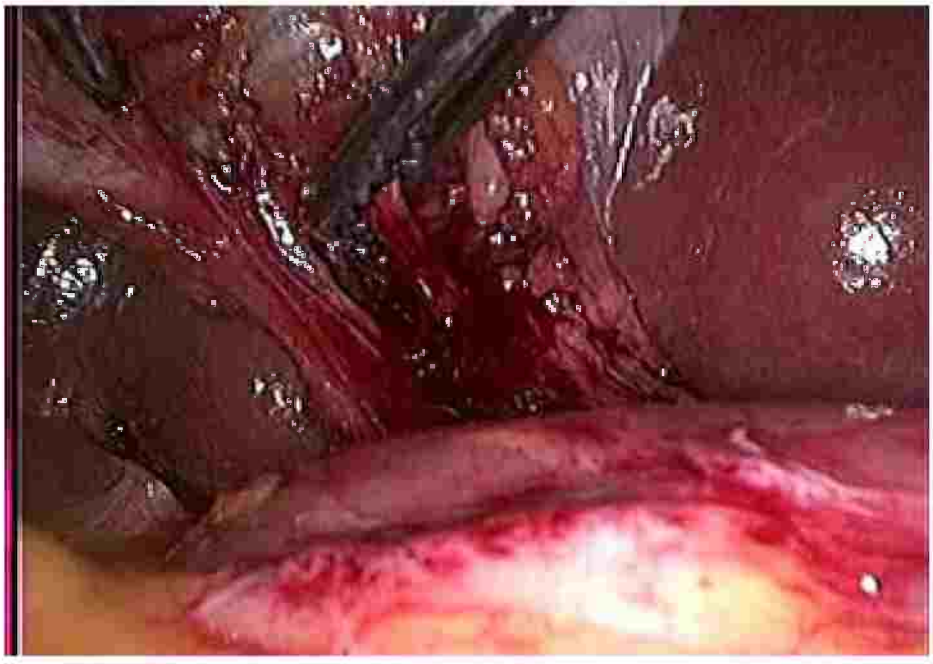

Fig (22): Intraoperative measurement of cystic artery diameter.

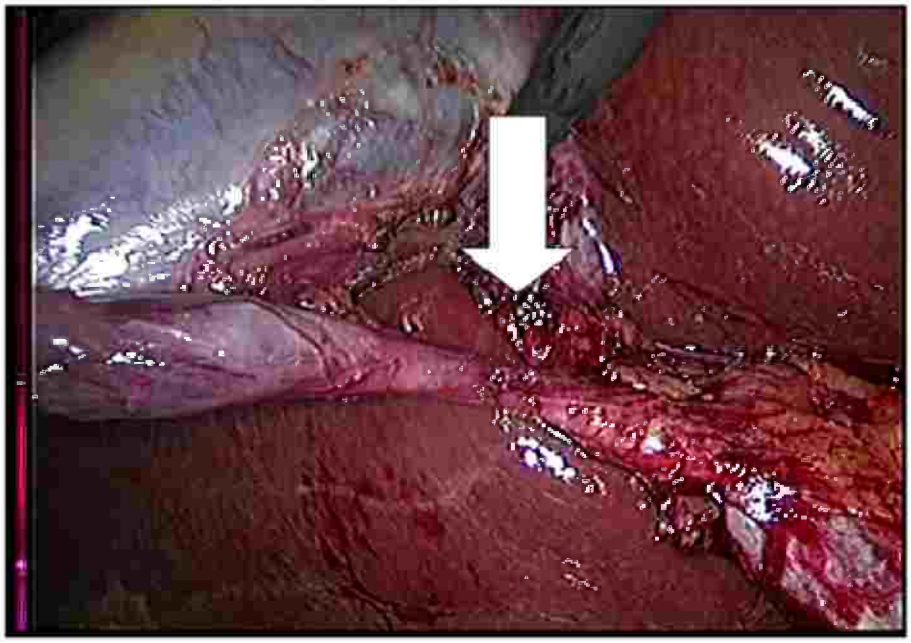

Fig (23): Cauterized and divided cystic artery before clipping of cystic duct.

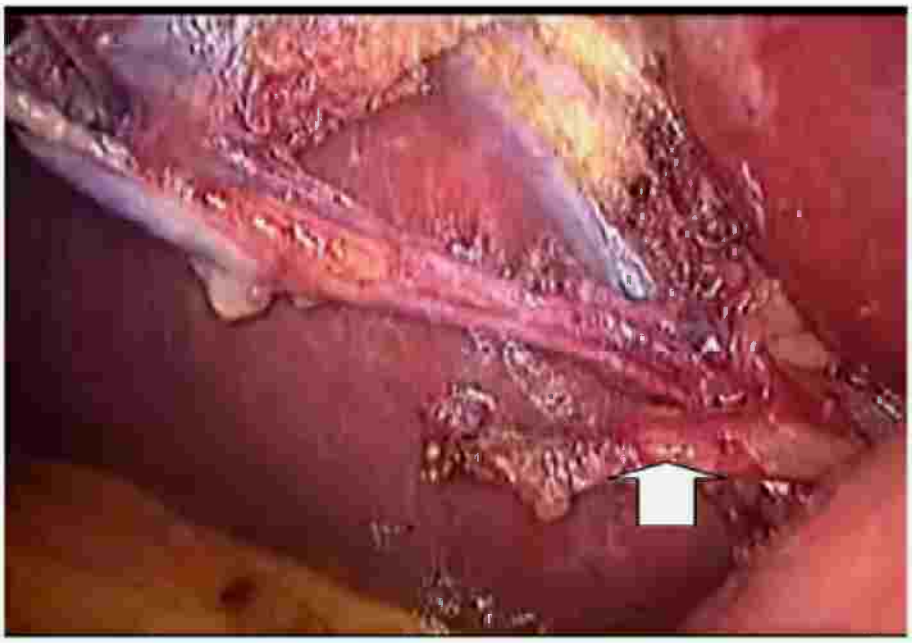

Fig (24): Large sized (4 mm) cystic artery efficiently cauterized.

Cystic artery was cauterized using Maryland in 76% of cases, hook in 8% or Maryland +hook in 16% according to the surgeon preference.

The diathermy setting was adjusted at power 4, short pulses were applied ranging from 4.0 to 10.0 with a mean of 5.28 ± 1.49

Table (X): Distribution of the studied cases according to use of Maryland OR Hook, and number of pulses in the cauterization group

	No	%
Maryland OR Hook		
Maryland	19	76
Hook	2	8
Maryland + Hook	4	16
No of pulses		
Min. – Max	4– 10	
Mean ± SD.	5.28 ± 1.49	
Median	5	

As regards the time needed for cystic artery control, In group I, the cauterization time ranged from 20–55 seconds with a mean of (36.60 ± 8.26) and a median of (35) whereas in Group II the time ranged from40.0 – 60.0 seconds with a mean of (50.20 ± 7.43) and a median of (50).

There was a statistical significant difference between the two groups. The cauterization time was significantly shorter in group I with p value = ($^{MW}p<0.001$). The difference between the two groups as regard to the control time is illustrated in table (XI).

As regard to the operative time which was calculated from first trocar to skin closure, in group I the operative time ranged from min35 – 75minutes with a mean of (52± 11.74) and a median of (60) while in group II, the operative time ranged from 30-60 minutes with a mean of (47.6 ± 10.12) and a median of 50.

There was no statistically significant relation between the operative time and method of cystic artery control. (Table XI)

Table (XI): Comparison between two studied groups according to bleeding, drain usage, operative time and time of control

	Cautery (n= 25)		Clipping (n = 25)		Test of sig.	P
	No	%	No	%		
Bleeding						
No	25	100	25	100	-	-
Yes	0	0	0	0		
Drain						
No	11	44	16	64	χ^2=1.969	0.161
Yes	14	56	9	36		
Operative time						
Min. – Max	35– 75		30– 60			
Mean ± SD.	52 ± 11.74		47.6 ± 10.12		t=1.613	0.113
Median	60.0		50.0			
Time of control						
Min. – Max	20– 55		40– 60			
Mean ± SD.	36.60 ± 8.26		50.20 ± 7.43		t =6.123*	<0.001*
Median	35		50			

No intraoperative bleeding occurred in our cases (Figure23, 24). Cystic artery was adequately controlled in both groups and all cases were completed laparoscopically with no conversion for any of them

No statistically significant relation was found between the use of drain and method of cystic artery control as shown in table (XI)

The patients were followed up for a period of 6 months; there were no complications in the form of abdominal collection, abdominal pain, fever or obstructive jaundice.