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RESEARCH ARTICLE

A COMPARATIVE ANALYSIS BETWEEN ELECTROSURGICAL VERSUS HARMONIC DISSECTION OF GALL BLADDER FROM ITS BED IN LAPAROSCOPIC CHOLECYSTECTOMY

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Abstract

Background: Various energy sources are now available like electrosurgical (monopolar and bipolar), ultrasonic shear devices, ultrasonic with bipolar and hydro dissection to separate gall bladder from liver bed. We conducted a study to compare electrosurgical and ultrasonic devices in dissection of gall bladder

Method: A prospective randomized controlled study was conducted involving 100 patients with gallstone disease. Patients were divided into two groups by the process of closed envelope randomization into electrosurgery (Group A) or ultrasonic dissection(Group B) groups. Both groups were compared for ease and feasibility of procedure, intra-operative complications during the procedure, operative time, conversion of laparoscopic to open cholecystectomy, post operative complication, comparison of pain, duration of stay in hospital and cost factor.

Observation: Various parameters were compared and it was observed that intraoperative bleeding was more in (28%) in the electrosurgery group in comparison to the harmonic group (8%). Injury to liver parenchyma was noticed less in the harmonic group (2%). Gall bladder perforation and bile leak were recorded more in electrosurgery patients (24%). Spillage of stone was 16% and 4% in Groups A and B respectively. Gut injury was observed in 2% of Group A in comparison to 0% in Group B. No CBD injury and postoperative complications were observed in either group. Post-operative hospital stay was lesser in Group B (1.98±0.51days) than in Group A (2.24±0.66 days). Postoperative pain was more in the electrosurgery group.

Conclusion: Dissection with harmonic scalpel in laparoscopic cholecystectomy is safe and technically feasible and may further improve surgical outcomes in terms of reduced duration of postoperative stay in hospital and pain with a significant reduction in intraoperative complications.

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Introduction:-

Gall bladder is an important organ in the human hepatobiliary system. It serves an important function of storage and concentration of bile gall bladder , which is the seat large number of pathologies ranging from inflammatory conditions to benign conditions such as polyp to malignant conditions. Choleliathiasis is the common type of biliary pathology .[1]

Laparoscopic cholecystectomy became preferred treatment for cholelithiasis as it is associated with less post operative pain, better rehabilitation and cosmetic appearance, shorter hospitalization stay and minimal tissue trauma,.[2]

Since its introduction into surgical practice, laproscopic cholecystectomy has under gone several modifications. Scientific research on the principle of ergonomics aim to identify better alternatives to improve surgical outcomes. With advancing times, new instrumentation, techniques and methodologies are being proposed, developed and used in surgical practice to be more compliant with operating team and strives to enhance efficacy of procedure.

Dissection of the gallbladder from its bed is an important step in laparoscopic cholecystectomy (LC). Successful dissection requires great experience, skill and patience. It is a critical step in laparoscopic cholecystectomy (LC) as any deviation from normal lines may lead to dissection in the wrong plane, gall bladder perforation, injury to the liver parenchyma, major vessels, biliary tree and viscera leading to increased morbidity rates.

Electrosurgery

Electrosurgery uses alternating electrical current and allow it to pass through tissue. At almost 500,000 cycles per second, the frequency is relatively high on average. By doing this, the current is guaranteed to flow through the patient's tissue rather than creating an electric shock. Electrodes are the instruments used to administer the electrical current, and the resistance of the tissue to the current generates the heat.[3]

Monopolar electrosurgical devices are most commonly used , easily available and helpful in the dissection and coagulation of small vessels and bleeding points. These devices are at risk of producing remote injuries and may perforate the gall bladder leading to bile leak and spillage of stone while performing LC. Similarly, bipolar devices were developed and had the advantage of sealing or coagulating vessels upto 5 mm but had a risk of lateral tissue damage or thermal spread and visceral injury.[4-7]

Ultrasonic / Harmonic

Ultrasonic energy is now commonly used where this energy is converted to mechanical energy at the active blade. High grade frictional force is produced at active blade while the inactive blade holds the tissue in place. Its primary benefits include accurate dissection, consistent hemostasis, reduced lateral tissue damage by means of less thermal spread and charring. Vessel coagulation is achieved primarily by exerting pressure and then using ultrasonic vibration to denature hydrogen bonds and closing the vessel with a denatured or distorted protein coagulum

Harmonic scalpel is better alternative than electrocautery as it results in decrease in temperature, smoke and lateral tissue damage by using the harmonic scalpel

Newer advancements

Modern devices apply the ideal mechanical pressure in conjunction with the thermo-fusion concept to ensure that the denatured protein forms a coagulum and that a robust seal is produced. Large tissue bundles and arteries up to 7 mm in diameter can now be surgically sealed.[5]

Various energy source devices are now available like electrosurgical devices (monopolar and bipolar), ultrasonic shear devices, ultrasonic with bipolar and hydro dissection to separate gall bladder from liver bed. Continuous initiatives are being undertaken in this aspect to develop better technologies as we have progressed from simple electrosurgical devices to Harmonics, Ligasure and Thunderbeat in present days.

Aims And Objectives:-

The present study was done to compare between electrosurgical versus harmonic dissection of gall bladder from its bed in laparoscopic cholecystectomy with respect to following parameters:

Ease and feasibility of procedure , intra operative complications during the procedure ,operative time ,conversion of laparoscopic to open cholecystectomy , post operative complication , comparison of pain , duration of stay in hospital and cost factor.

Materials And Methods:-

This study was a prospective randomised study aimed at comparing electrosurgical and harmonic scalpel dissection of gall bladder in laparoscopic cholecystectomy.

Inclusion criteria:

All symptomatic patients,patients fit for general anaesthesia, age >12 yrs

Exclusion criteria:

Patients unfit for general anaesthesia, previous major abdominal surgeries , refused consent, liver cirrhosis, chronic obstructive pulmonary disease, Pregnancy , features of choledocholithiasis, pancreatitis and malignancy on clinical and USG examination

1. An informed written and verbal consent explaining that he/she had understood underlying procedure was obtained.
2. Patients were divided in two groups before the surgery by the method of closed envelope randomization.

Patients were divided into two groups;

Group A — 50 patients undergoing electrosurgical dissection of gall bladder from its bed from liver.
Group B — 50 patients undergoing ultrasonic dissection of gall bladder from its bed from liver.

The details of the procedure performed, intra-operative findings, time taken for the procedure, complication during or after the procedure if any, difficulty encountered intra-operatively were recorded and statistically analyzed using appropriate methods.

Observations:-

Out of 100 patients , patients were equally divided in two groups as Group A and B with electrosurgery and harmonic as mode of dissection of gall bladder from its bed respectively.It was noticed that maximum individuals were in the age group of 21-50 years in both group A and group B. Mean age in group A was 41.42±13.72 years whereas it was 44.04±13.30 years in Group B with 80% females and 20% males in both groups.The mean time taken for the completion of cholecystectomy was 49.94±9.35 minutes in Group A whereas 44.34±8.16 minutes in Group B and was statistically significant (p =0.004).

It was observed that bleeding was seen in 14 patients (28%) in Group A in comparison to 4 patients (8%) in Group B.Injury to liver parenchyma was noticed in 11 patients (22%)and 1 patient (2%) in Group A and B respectively.Gall bladder perforation and bile leak were observed in 12 patients (24%) in Group A whereas 3 patients (6%) in Group B and was statistically significant. Spillage of stone is known common secondarycomplication of gall bladder perforation and was noticed in 8 patients (16%) and 2 patients (4%) in Group A and B.. Injury to gut was observed in 1 patients (2%) in Group A and 0 patient (0%) in Group B and difference was statistically non significant (p = 0.315). 1 patient (2%) in Group A was converted to open cholecystectomy in comparison to 0% in Group B. No CBD injury and post operativecomplications were observed in either group Post-operative stay in hospital was lesser in Group B (1.98±0.51days) as compared to Group A (2.24±0.66 days), and this difference was statistically significant. **Post** operative mean pain score were recorded with the help of Visual Analog scale. It was recorded that mean pain score was 4.74 , 3.78 and 3.08 at 6,12 and 24 hours in Group A patients in comparison to 4 , 2.50 and 1.74 in Group B patients . This difference was discovered to be statistically significant (p = 0.001) .It was observed that there little increase in cost for performing procedure in Group B in comparison to Group A and was statistically significant (p = 0.001)

Discussion:-

The present study was conducted with the objective to compare electrosurgeryand harmonic dissection of gall bladder from its bed in laparoscopic cholecystectomy.

Mean age of presentation of patients in Group A was 41.42±13.72 years whereas in Group B was 44.04±13.30 years. Maximum number of patients were in the age group of 21-50 years in both group A and group B. The male: female ratio was 1: 4 for both ES and HS.Both groups were comparable with respect to demographic indicators

Operative Time:-
The operative time of the procedure varies depending on the status of gallbladder, adhesions, intra operative bleeding, production of smoke, number of lens changes, gall bladder perforation, spillage of stones and number of instrument changes.

Mean time taken for the completion of cholecystectomy was 49.94±9.35 minutes in Group A and 44.34±8.16 minutes in Group B. The use of harmonic scalpel was associated with significant reduction in the time of surgery. Study conducted by **Mathur H et al[12]** reported mean time of surgery in electrosurgical group as 54.10 min and 37.24 min in harmonic group which was statistically significant. **Mahabaleshwar et al[15]** concluded significant decrease in operative time for ultrasonic group i.e. 27.20 min in comparison to electrosurgical group i.e. 34.37 min.

Intra operative complications :-
Intraoperative bleeding:-
Bleeding is common complication observed while performing the procedure. In our study, it was observed in 28% patients in electrosurgical group in comparison to 8% in harmonic group (p = 0.019). The study conducted by **Manoj et al[12]** observed that 15.3% patients had severe bleeding in electrosurgical group while it was 9.3% in ultrasonic group.**Kumar R et al[13]**recorded bleeding in 7.84% in electrosurgery and 1.69% in ultrasonic group and difference was statistically significant.Bleeding during LC can distort the operating field, increasing the risk of unintentional harm to the biliary system and lengthening the procedure. Bleeding from the liver bed is another often occurring issue that extends the duration of surgery.

Injury to liver:-
Liver damage spanning from small ruptures of Glisson's capsule to severe parenchymal cuts occurs either due to wrong plane or conductance of current directly to parenchymal tissue while performing dissection and is avoidable.[44] In our study, it was significantly decreased and noticed in 1 patient (2%) in harmonic group in comparison to 11 patients (22%) in electrosurgery group .**Manoj et al[12]** documented liver injuries in 6 patients (4%) and 2 patients (1.3 %) in ES and HS groups respectively which was relatively higher in ES group but not significant. With the HS, fewer cases of liver damage have been reported because of decreased lateral heat transfer.[12]

Gall bladder perforations and bile leak:-
Gall bladder injury or perforation is also most commonly encountered complication while performing the dissection of gall bladder. In our study, gall bladder perforations and bile leak while performing dissection were more in electrosurgical group 12 patients (24%) and 3 patients (6%) in harmonic group and was significant. It was asserted in a randomised clinical trial by **Janssen et al[14]**that the use of ultrasonic generators greatly reduced the gallbladder perforation rates and produced a more seamless procedure. **Mahabaleshwar V et al[15],** also reported a higher incidence of gall bladder perforation with ES (40%) compared to the HS (16.7%).

Spillage of stone:-
Gall bladder perforation was associated with stone spillage and was noticed in 8 patients (16%) and 2 patients (4%) in ES and HS Groups respectively(p = 0.047). **Janssen et al**[14] reported that slipped stones occurred in 20 patients (19%) and 3 patients (3%) of the patients who underwent laparoscopic cholecystectomy using the ES and HS.

Injury to CBD:-
In our study, no CBD injury was recorded while performing procedure in either group. Study conducted by **Zanghi A et al[16] and Manoj et al[12]**reported to 0% injuries in ES and HS group.

Injury to gut:-
Injury to gut was observed in 1 patient (2%) in Group A and (0%) patients in Group B (p = 0.315). Results were supported by study conducted by **Mathur H et al[17]**, reported 0% injuries in either group

Conversion of Laparoscopic to Open Cholecystectomy
It was seen that only 1 patient (2%) in Group A was converted to open cholecystectomy in comparison to 0% in Group B(p = 0.315). **Zanghi A et al**[18] observed 3.3% conversion to open cholecystectomy in ES group and 0% in US group.Similar findings were observed by **Manoj et al[12]** in which both groups recorded 0% conversion in both groups.

Post operative complications:-
Post operative complication refers to any complication directly leading to increased morbidity, post operative stay and residual disability. Additional complication counts any abdominal fluid collection, subclinical increase in pancreatic enzymes, pleural effusion, respiratory impairment, jaundice, urinary retention and fever.In our study, no post operative and additional complications were observed during the stay of patient in hospital. In the study conducted by **Singh K et al**[19], no complications were reported in either group.

Pain score
Post operative pain is commonly associated with increased morbidity, delayed mobilisation and increased post operative stay of patient in hospital. It is attributed to various intra operative factors like bleeding, injury to liver parenchyma and other visceral organs.In our study mean pain scores were 4.74, 3.78 and 3.08 in Group A and 4.00, 2.50 and 1.74 in Group B recorded at 6 hr , 12 hr and 24 hr post operatively.**Minhas et al**[20]recorded significant decrease in mean score in ultrasonic group than electrosurgery group.

Duration of post-operative stay:
It was observed that post operative hospital stay was less in ultrasonic group(1.98±0.51 days) in comparison to electrosurgical group (2.24±0.66 days)(p =0.03). The results of our study were supported by **Minhas et al**[20]**,** recorded significant difference in mean post operative stay i.e. 2.88 days in ES group and 1.64 in HS group.

Costfactor :
In our study, it was observed that performing gall bladder dissection in harmonic group was associated with increased cost of procedure in comparison to electrosurgical group. The dissection with ultrasonic devices requires specialised scalpel which needs to be replaced after 20-25 cases which adds to extra cost per case in comparison to standard electrosurgical devices.

Table No. 1:- Comparison of various Parameters.

Parameter	Electrosurgery group (n=50)	Harmonic group (n=50)	p value
Age (in years)	41.42+ 13.72	44.04+13.30	0.335
Male:Female	1:4	1:4	1.00
Operative time (in min)	49.94+9.35	44.34+8.16	0.04
Conversion to Open cholecystectomy	2%	0%	0.315
Duration of post operative stay(in days)	2.24+0.66	1.98+0.51	0.039
Post operative complications	0	0	1
Pain score	3.08	1.74	0.001

Table No. 2:- Comparison of Intra Operative Complications.

Intraoperative Complications		ELECTROSURGERY		HARMONIC		χ^2	p value
		Patients	Percentage	Patients	Percentage		
Bleeding	Yes	14	28%	4	8%	5.49	0.019
	No	36	72%	46	92%		
Injury to CBD	Yes	0	0%	0	0%	--	--
	No	50	100%	50	100%		
Injury to Gut	Yes	1	2%	0	0%	1.01	0.315
	No	49	98%	50	100%		
Injury to Liver	Yes	11	22%	1	2%	7.67	0.006
	No	39	78%	49	98%		
GB Perforation	Yes	12	24%	3	6%	5.02	0.025
	No	38	76%	47	94%		
Bile Leak	Yes	12	24%	3	6%	5.02	0.025
	No	38	76%	47	94%		
Spillage of Stone	Yes	8	16%	2	4%	3.96	0.047
	No	42	84%	48	96%		

Conclusion:-

This conclusion summarizes the key findings of a study on the use of harmonic scalpels during laparoscopic cholecystectomy. It highlights both the benefits and limitations of the technique.

Key Findings:

Safety and Feasibility:

The study concluded that using a harmonic scalpel for dissection during laparoscopic cholecystectomy is both safe and technically feasible.

Improved Outcomes:

The technique was associated with improved surgical outcomes, including:

1. Reduced hospital stay duration post-surgery.
2. Less postoperative pain.
3. A significant reduction in intraoperative complications.

Cost Considerations:

While the harmonic scalpel offers these advantages, it comes with a higher cost due to the expensive nature of the device. Additionally, each scalpel has a limited number of surgeries it can perform before needing to be replaced.

Limitations:

1. **Study Duration and Sample Size**: The study was limited in both duration and the number of patients enrolled, which may limit the reliability and generalizability of the results.
2. **Region-Specific Data**: The research was conducted in a specific geographic region, meaning the findings may not be applicable to populations in other areas. Further studies with larger sample sizes and longer durations are needed for more robust conclusions.

While the harmonic scalpel appears to offer clinical advantages in laparoscopic cholecystectomy, more extensive research is needed to fully validate these findings across broader and more diverse patient populations.

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