



**Research Article**

**USE OF BIPOLAR CAUTERY AS A NOVEL TECHNIQUE FOR OCCLUDING APPENDICULAR STUMP DURING LAPAROSCOPIC APPENDECTOMY**

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Laparoscopic Appendectomy, Bipolar Cautery

**ABSTRACT**

**Background:** Laparoscopic appendectomy is the gold standard method of treatment of acute appendicitis. Closure of appendicular stump is the most important step to prevent complications. The aim of this study is to investigate the safety and feasibility of application of bipolar cautery as an effective method for appendicular stump closure.

**Methods:** The present study was conducted in Krishna Institute of Medical Sciences, Karad where 50 patients diagnosed with acute and recurrent appendicitis were subjected to laparoscopic appendectomy during June 2018 to May 2019 and followed up. The presented study, consist of identifying the appendix and coagulating the appendicular stump with bipolar coagulation until there were no bubbles, and a constriction ring formed at the site of coagulation.

**Results:** The median duration of surgery was 28.52 minutes. For acute appendicitis the mean operative time was 29.3 min & for recurrent appendicitis it was 28.59 min. Majority of patients were started on diet on the 1<sup>st</sup> post-operative day. No fatalities were encountered during the study.

**Interpretation and Conclusion:** We demonstrated in this study of 50 patients over 1 year period that laparoscopic appendectomy with the use of bipolar coagulation can be performed with minimum morbidity and less cost and without compromising any safety.

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**INTRODUCTION**

Acute appendicitis is one of the most common clinical presentations that require emergency surgery, with a lifetime incidence of about 8%. Surgical operations have evolved over the decades from various techniques of open appendectomies to minimally invasive procedures. However, there is still ongoing discussion as to the most efficacious surgical intervention<sup>1</sup>.

Laparoscopic appendectomy is the widely accepted treatment for acute appendicitis. This approach offers the potential of less pain, shorter hospital stay, and quicker return to activities. In laparoscopic appendectomy various techniques have been used for the management of the appendicular stump, such as Roeder knot, preformed suture loops (Endoloops), endoscopic linear cutting staplers (endo GIA), the Liga-Sure System, the Harmonic scalpel, and even bipolar coagulation<sup>2</sup>. The key technical aspect in laparoscopic appendectomy is the treatment of appendiceal stump closure.

Bipolar electrocautery as a technique of appendicular stump ligation is associated with a lower risk of tissue injury from an inadvertent energy transfer compared with monopolar diathermy.

Bipolar coagulation has been effectively employed in various laparoscopic surgical procedure as well as obstetric and gynecologic procedures for hemostasis during laparoscopic procedures. However, the use of electrocoagulation for the intestines has been an alien technique in the field of general and laparoscopic surgery<sup>3</sup>.

In the presented study, consist of identifying the appendix and coagulating the appendicular stump with bipolar coagulation until there were no bubbles at the cautery site, and a constriction ring formed at the site of coagulation. The aim is to investigate the safety and feasibility of this modified technique as an effective method for stump closure.

**Aim and Objectives**

**AIM**

Analyse the results of Modified Technique for Appendicular stump closure during Laparoscopic Appendectomy.

**Objective**

To learn & perform Laparoscopic appendectomy by using bipolar coagulation as a technique of stump closure and assess efficacy of technique.

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In terms of following parameters

- Operative time.
- Postoperative pain.
- Complications.
- Hospital stay.
- Cost.

## MATERIAL AND METHODS

Study was conducted in our institute where 50 patients diagnosed with acute and recurrent appendicitis were subjected to laparoscopic appendectomy and followed up.

All the patients were subjected to full history taking, thorough clinical examination, routine laboratory investigations, x-ray chest and abdominal ultrasonography.

The patient and his/her close relatives were first briefed about the technique of laparoscopic appendectomy and its advantage and possible complications. Only those patients underwent laparoscopic appendectomy who voluntarily accepted this modality of treatment.

After pre anesthetic fitness, all patients were subjected to Laparoscopic appendectomy. Preoperatively all patients were catheterized using Foleys catheter & a nasogastric tube was inserted. All patients were operated under general anesthesia.

### Inclusion criteria

1. All patients attending to our institute diagnosed as a case of acute appendicitis & are willing for laparoscopic appendectomy irrespective of age.
2. Both sexes.
3. Patient diagnosed as recurrent appendicitis
4. Patient for interval appendectomy.

### Exclusion criteria

1. Patients unfit for laparoscopic procedure due to comorbid conditions.
2. Patient with appendicular lump.

### Equipment

1. Sony triton video monitor.
2. Hopkins type II forward viewing 0° and 30° laparoscopes.
3. Surgicraft medical system electronic CO<sub>2</sub> Insufflator.
4. Karl Storz SL II camera system.
5. Karl Storz Xenon light source with fiberoptic light cable.
6. Recording system.
7. COVIDIEN Force Fx Electrosurgical unit.

### Instruments used were

1. Puncture instruments.
2. Grasping and instruments.
3. Instruments for dissection and ligation.
4. Instruments for division and coagulation.
5. Instruments for irrigation and suction.
6. Wound closure instruments.
7. Back up instruments for open repair.

### Preoperative preparation

All patients willing for procedure were admitted and preoperative investigations were done after admission. Newly detected diabetic patients were started on oral hypoglycemic or

injectable insulin as per physician's advice. Patients on aspirin for heart disease were treated accordingly except that aspirin was discontinued for 5 days preoperatively.

All patients were posted for procedure electively. Diabetic and hypertensive patients were asked to continue their normal regime till day before surgery. The patients were kept nil by mouth overnight. Morning dose of insulin or oral hypoglycemic were omitted for diabetic patients, while morning dose of antihypertensive were administered for hypertensive patients. Preoperative dose of antibiotic was given.

### Procedure

The patient was positioned supine under general anesthesia with endotracheal intubation, cardiac and pulsoximetry monitoring. Nasogastric tube & Foleys catheterization was done using 16F Foleys catheter. Laparoscopy trolley checked and arranged. Surgeon stands to the left of patient. The abdominal and inguinal areas were prepared using betadine solution and patient draped.

The patient is kept in Trendelenburg position. Access to peritoneal space gained by open method (Hassan's technique). At this stage 10mm Hassons cannula inserted and peritoneal cavity insufflated using CO<sub>2</sub> maintaining pressure at 12 mm Hg.

### Ports

- 10mm umbilical for Telescope.
- 10mm long suprapubic incision for laparoscopic trocar.
- 5mm left iliac fossa.

### Steps

1. The diagnosis of appendicitis was confirmed when the appendix was seen inflamed or if it was covered with adherent omentum or if was not possible to see the appendix because of inflammatory adhesions or oedema in the pericecal region.
2. The appendix was then identified; adhesions were separated and dissected using Maryland forceps.
3. The mesoappendix was then coagulated and occluded by bipolar cautery and cut with scissors.
4. After the base of appendix is adequately exposed, the appendicular stump was coagulated 3–5 mm away from the cecum by using modified bipolar Maryland cautery forceps and coagulation was carried out until there were no bubbles at the cautery site and a constriction ring formed at the site of coagulation. The duration of BC ranged from 60–180 seconds with a median of 90 seconds.
5. The stump was then cut with scissors at the site of constriction. This gave a feeling of gritty sensation while cutting indicating that proper coagulation and occlusion has taken place.
6. The stump was then inspected to confirm that occlusion was complete.
7. The appendix was then removed.
8. In case of spillage or burst appendix, irrigation of the peritoneal cavity was done with normal saline after the removal of appendix.
9. Hemostasis achieved.
10. Peritoneal space reduced under vision by removing 5mm ports first and 10mm port at end.

11. All port sites closed and dressing done.

Post operatively all patients were given single dose of i.m diclofenac sodium injection. Patients were assessed for pain on post operative day 1 using visual analogue scale (VAS grading).

Patients were encouraged to mobilize after 8-10 hours postoperatively and resume their normal activity as soon as possible. Foleys catheter removed on postoperative day 1. All patients post operatively were given oral antibiotics and analgesics as required for 7 days. Patients were discharged from hospital once they felt comfortable and confident to go home usually between post operative days 1 to 5.

Port site dressings checked on post operative day 2 for evidence of soakage. Suture removed on 7<sup>th</sup> post operative day. Patients were inquired about day of return to work.

Patients were followed up for physical examination after 1month, 3 months and at the end of 6 months. If they couldn't follow up then they were asked about complaints if any by telephonic conversation. The collected data was organized, tabulated and statistically analyzed.

**Facilities and equipment**

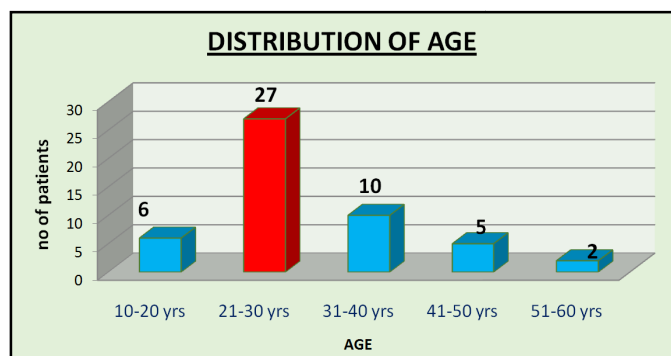
1. Patients from surgical wards our college hospital.
2. Laboratory facilities at central clinical laboratory at our hospital.
3. Radiology facilities at Department of Radiology.
4. Surgery facility at the major OT at our hospital.

The duration of our study was done over period of 1 year (June 2018 to May 2019). During this period 50 patients were subjected to laparoscopic appendectomy.

**RESULTS**

**Table 1** Distribution of Patients According To Age At Presentation

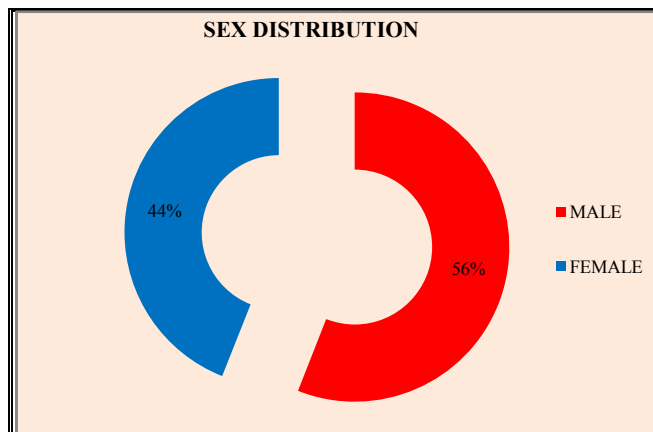
Age Group (Years)	No. of patients	Percent
10 to 20	06	12
21 to 30	27	54
31 to 40	10	20
41 to 50	05	10
51 to 60	02	04
Total	50	100



Age of 50 patients in present study was in between 10 to 60 years. Maximum patients i.e 27 (54%) were in 21 to 30 yrs of age. 10 pts (20%) in of 31 to 40 yearsof age. 6 pts (12%) in 10 to 20 yrs, 5 pts (10%) in 41 to 50 yrs and only 2 pts (4%) in 51 to 60 yrs.

**Table 2** Distribution of Patient According To Sex

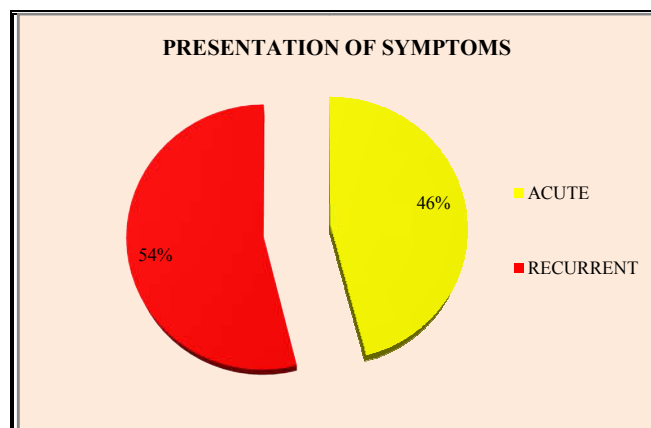
SEX	No. of patients	Percent
Male	28	56
Female	22	44
Total	50	100



Out of 50 patients included in study, 28 patients (56%) were male patients and 22 patients (44%) were female patients.

**Table 3** Distribution of Patients According To Presentation of Symptoms (Acute / Recurrent).

Presentation	No. of patients	Percent
Acute	23	46
Recurrent	27	54
Total	50	100



In present study 27 patients (54%) had recurrent appendicitis and 23 patients (46%) had presented with acute appendicitis.

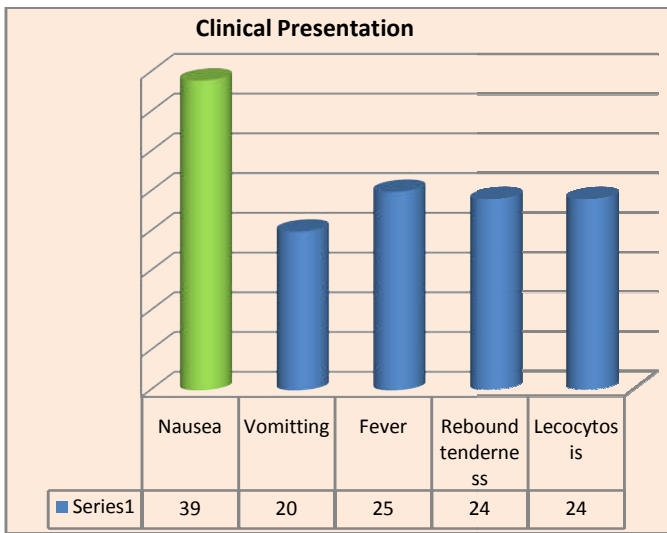
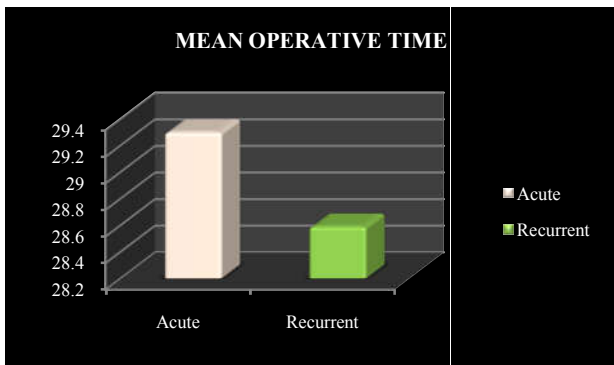


Table 4 Clinical Presentation

Table 5 Mean Operative Time Required

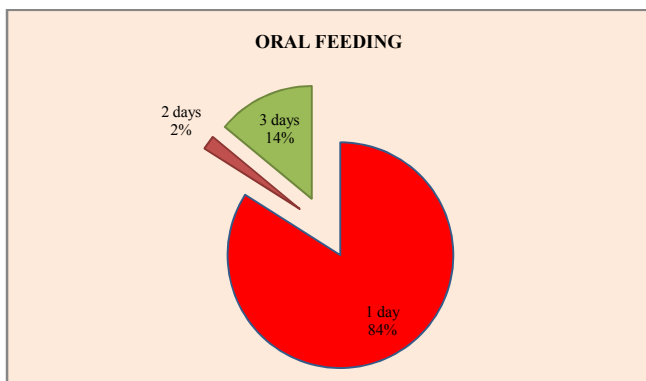
Appendicitis	Mean operative time (Mins)
Acute	29.3
Recurrent	28.59



The median duration of surgery was 28.52 minutes (range 24-40 minutes). For ACUTE appendicitis the mean operative time was 29.3 min & for RECURRENT appendicitis it was 28.59 min.

Table 6 Start of Oral Feeding

Oral feeding started on	No of cases
1 day	42
2 day	01
3 day	07



The oral feeding started for 42 (84) patients after 1 day of operative procedure, 3 patients who had post operative ileus

the feeding started by 2<sup>nd</sup> or 3<sup>rd</sup> day. For initial 5 (10%) cases the diet was started on 3<sup>rd</sup> day.

Table 7 Post-Operative Complications

Sr. No.	Complication	No. of patient	Percentage
1	Fever	0	00
2	Paralytic Ileus	3	06
3	Intra-abdominal abscess	0	00
4	Port site infections	1	02
5	Stump - Leak	0	00
6	Conversion to open	0	00
7	Death	0	00

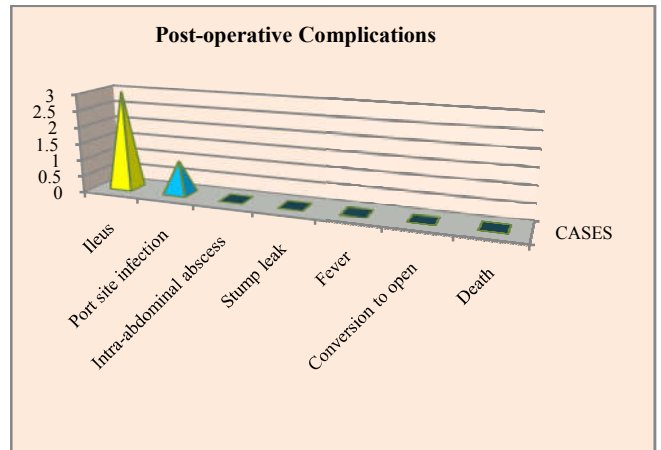
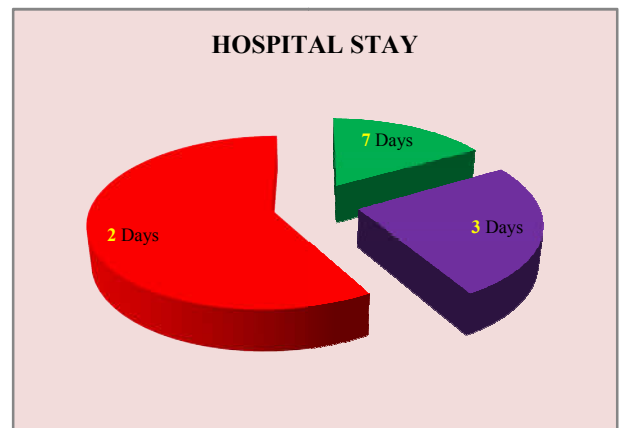


Table 8 Duration of Hospital Stay

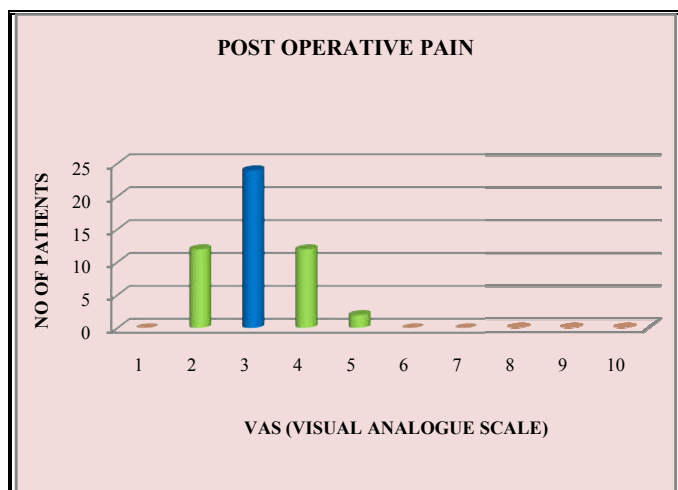
Sr.No.	Post-operative days	No. of patients	Percentage
1	2	35	70
2	3	10	20
3	7	5	10



Maximum no of patients i.e 35 (70%) had hospital stay of 2 days, 10 (20%) patients had hospital stay of 3 days, 5 (10%) patients which we observed initially had 7 days of hospital stay.

Table 9 Post Operative Pain

VAS (Visual Analogue Scale)	1	2	3	4	5	6	7	8	9	10
No of patients	0	12	24	12	02	0	0	0	0	0



**DISCUSSION**

**Age at Presentation**

In present study maximum number of patients was in age group 21-30 years i.e 27 patients (54 %), being commonest group. The youngest patient was 14 year old male and eldest was a 65 years old man. Study done by Rickert A *et al*<sup>4</sup> where the appendicular stump was managed by Titanium endoclips, the median age was 30.6 years (range, 13–84 years).

**Sex Distribution**

In present study out of 50 patients 28 (56%) were male patients and 22 (44%) were female patients. This was comparable with the study of Khanna *et al*<sup>5</sup> in which there were total 60 patients out of which 41 (68.33) were male & 18 (30 %) were female & one child (1.6 %).

**Presentation**

Majority of patients in present study was having Recurrent Appendicitis 27 patients (54%) and Acute Appendicitis 23 patients (46%). This was comparable with the study of Khanna *et al*<sup>5</sup> in which there were total 60 patients with acute or recurrent appendicitis.

**Alvarado Score**

In our study Alvarado score in 28 (56%) patients was above 7 which was highly suggestive of a diagnosis of appendicitis while in 22 (44%) patients it was less than 7.

The study showed that there was a significance between Alvarado score & Acute/Recurrent appendicitis (p<0.05).

(‘P’ value was calculated by YATES corrected chi square test)

**Mean Operative Time**

In our study mean duration of surgery was 28.52min (range 24-40min). Whereas mean operative time for acute appendicitis was 29.3min & 28.59min was for recurrent appendicitis. The study of Khanna *et al*<sup>5</sup> in which the mean duration of surgery was 25min (range of 15-47min)

Sr No.	Study	Technique Of Stump Ligation	Mean Operative Time (Mins)
1	Our Study	Bipolar Coagulation	28.52

Sr No.	Study	Method of Stump Ligation	Hospital Stay (days)
1	Khanna <i>et al</i> <sup>5</sup>	Bipolar Coagulation	3
2	Rickert A <i>et al</i> <sup>4</sup>	Titanium Endoclips	4
3	Hue Cs <i>et al</i> <sup>6</sup>	Polymeric Clips Hem-O-Lok	5.2
4	Galatioto C <i>et al</i> <sup>7</sup>	Gi Endostapler	2.7
5	Naiditch J <i>et al</i> <sup>8</sup>	Endoloop	3.7

**Post Operative Pain**

Early post-operative pain was observed in all patients ranging between grade 2 to grade 5 as per visual analogue scale (VAS) which was assessed after 24hrs. Maximum patient 48 (96%) was observed in VAS grade 2 to grade 4 while only 2 (4%) patient had VAS grade 5.

In our study, post-operative analgesics mainly non-steroidal anti-inflammatory drugs (NSAIDS) requirement was only for first 48 hours which is comparable with study of Khanna *et al*<sup>5</sup> where mean time of post operative analgesics was given for a period of 24 hours.

**Return of Day To Day Activity**

As patients was discharged on 2<sup>nd</sup> post operative day & were advised for suture removal on 7<sup>th</sup> post operative day. Patient was advised to performed light weight day to today activity, with complete return of the activity by 7 – 10 days.

**Associated Findings**

Out of total of 50 patients, 22 patients were female out of which 7 patient had associated finding of ovarian cyst which was diagnosed & managed during laparoscopic appendectomy.

**Cost of the Procedure**

Method of Bipolar coagulation for appendicular stump management is economical as no Clip, Endoloops, GI Staplers, DS Clip are required, and no foreign materials like ligatures are used.

Sr No.	Study	Method of Stump Ligation	COST
1	Our Study	Bipolar Coagulation	NIL

SR No.	Study	Method of Stump Ligation	Cost
1	Khanna <i>et al</i> <sup>5</sup>	Bipolar Coagulation	NIL
2	Kiudelis M <i>et al</i> <sup>9</sup>	Intracorporeal Knot-Tying Suture	€80
3	Janczak D <i>et al</i> <sup>10</sup>	Polymeric Clips Hem-O-Lok	€76.9
4	Delibegović S <i>et al</i> <sup>11</sup>	ENDOLOOP	€88.5
5	Rakić M <i>et al</i> <sup>12</sup>	Gi Endostapler	€900

**CONCLUSION**

Laparoscopic Appendectomy is a recent approach in the treatment of Appendicitis. Laparoscopic Appendectomy is a good alternative and feasible technique to open appendectomy. A newer modification in technique is use of bipolar coagulation in the appendicular stump management which has been applied in our study. We demonstrated in this study of 50 patients over 2 years period that laparoscopic appendectomy with the use of bipolar coagulation can be performed with minimum morbidity and less cost & without compromising any safety. The results from this series are comparable to other report of laparoscopic appendectomy where stump is managed by different techniques.

### **The Merits our technique includes**

1. Has all the advantage of laparoscopic appendectomy including;
  - Early commencement of routine activities and return to work.
  - Less post operative pain.
  - Good cosmetic scar.
  - Less wound infection.
  - Visualization of pelvic pathological conditions in females.
2. Cost of procedure is reduced as no clip, Endoloops, GI Staplers, DS Clip are required, and no foreign materials like ligatures are used.
3. The said technique is safe & without any complications.

### **The demerits of our technique include**

1. Requirement of infrastructure for laparoscopic surgery in surgery department.
2. Requirement of elaborate training facilities for surgeons.
3. Learning curve of the procedure.

### **Summary**

- This is the prospective study of 50 cases of laparoscopic appendectomy in our institute, conducted for duration of 2 years from August 2012 to August 2014.
- Majority of the patients who were diagnosed as appendicitis were belonging to 2<sup>nd</sup> and 3<sup>rd</sup> decade with almost equal distribution between both sexes.
- Presence of Nausea vomiting correlates more with the diagnosis of acute appendicitis.
- All patients were operated by laparoscopic appendectomy where the appendicular stump was managed by BIPOLAR COAGULATION .The duration of bipolar current ranged from 60-180 sec with a median of 90 sec. In present study mean operative time required for laparoscopic appendectomy was 28.52. For ACUTE appendicitis the mean operative time was 29.3 min & for RECURRENT appendicitis it was 28.59 min.

Post-operative pain in all patients observed at 24 hrs was significantly less ranging from grade 2 to grade 4 as per visual analogue scale (VAS), no patient had significant disturbing pain. In our study out of 50 patients only 4 (8%) had paralytic ileus, while 1(2%) patient had port site infection, while none of the patient had stump leak, intra-abdominal abscesses, fever.

- In our study none of the patient was converted to open surgery.
- In present study mean hospital stay of patient was 2 days.
- In our study recovery and return to work in all patients was within 7 days.
- Procedure is cost effective.
- The scars are more cosmetic as compared to open conventional appendectomy.
- The results of our study are similar to other studies in literature.

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