



## Comparative Evaluation of Haemostatic Techniques for Ovariohysterectomy in Dogs

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### ABSTRACT

This study was conducted on 18 clinically healthy female dogs irrespective of breed, body weight and aged between 1 to 8 years. All the animals were randomly divided into three equal groups, with 6 animals in each group. Group I was subjected for ligation, group II application of bipolar electrocoagulation and group III for application of haemoclips to achieve haemostasis. Rectal temperature and heart rate significantly ( $p \leq 0.05$ ) decreased at intra-operative period of surgery in all the groups as compared to pre-operative and post-operative period. Exudation in group II was non-significantly higher as compared to group I and III. A significantly ( $p \leq 0.05$ ) longer surgical time was recorded in ligation and endoclip technique as compared to electrocoagulation technique. Time required for locating and ligating uterus was significantly ( $p \leq 0.05$ ) longer in group I as compared to group II and III. Length of surgical incision was higher in group I and III as compared to group II. Haemorrhage was significantly higher ( $p \leq 0.05$ ) in group I and III as compared to group II. An abdominal ultrasonography was performed on day 7 after surgery and it revealed no complication in any animal. At different intervals, all haemato-biochemical parameters fluctuated within normal physiological ranges. On the basis of the present findings, it can be concluded that bipolar electrocautery was superior to titanium clips and suture ligation for achieving haemostasis during ovariohysterectomy (OVH) in dogs.

### HIGHLIGHTS

- Bipolar cautery system was superior to titanium clip and suture ligation.
- Cost of haemoclip application was high as compared to suture ligation to achieve haemostasis.

**Keywords:** Bipolar electrocautery, Titanium clips, Ovariohysterectomy

Over the last decade, dog populations have grown exponentially and remain unchecked. This has an ever greater potential to increase frightful and uncontrolled situation. Sterilization of female dogs is topic of interest for veterinary surgeons. With increasing advancement and the demand for mass sterilization, there is ever growing need for newer techniques for making the job simple and precise, which carries higher clinicosurgical feasibility (Shirodkar *et al.*, 2008). Many haemostatic techniques have been described for laparoscopic ovariohysterectomy including the use of harmonic scalpel, laser, monopolar

and bipolar cautery devices, vessel sealing devices and haemoclip application (Mayhew *et al.*, 2012).

Due to the cumbersome nature of suture ligation of vascular pedicles during minimally invasive surgery, the uses of all this haemostatic techniques have become extremely popular. On comparison of bipolar and monopolar electrocoagulation in laparoscopic ovariohysterectomy, it

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was concluded that bipolar electrocaugulation resulted in decreased surgical time, less intraoperative hemorrhage and facilitating the exteriorization of the ovaries (Bart *et al.*, 2003). Clip creates a seal by mechanical compression and poses little risk to surrounding tissue when accurately applied. Therefore, looking to the promising role of different haemostatic techniques, the present research work was conducted to evaluate three haemostatic techniques for ovariohysterectomy in dogs.

## MATERIALS AND METHODS

The research work was carried out in the Department of Veterinary Surgery and Radiology, Veterinary Clinical Complex (VCC), College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University (N.D.V.S.U.), Jabalpur (M.P.). The study was conducted on 18 female dogs irrespective of breed, body weight and aged between 1 to 8 years; referred for ovariohysterectomy for various reasons.

### Methodology

All the animals were kept off feed for 12 hours and off water for 6 hours prior to surgery. Ventral abdomen was prepared aseptically for surgical procedure.

### Experimental design

All the animals were randomly divided into three equal groups, with 6 animals in each group.

**Table 1:** Experimental design

Group	Surgical procedure	No. of animals
I	Ligation using suture material	6
II	Electrocoagulation using bipolar electrocautery	6
III	Haemoclip application	6
	<b>Total</b>	<b>18</b>

### Instrumentation

General surgical pack including four Allis tissue forceps, six hemostats, two scissors, one Bard Parker handle with blade, one thumb forceps, suture needle, one needle

holder, metal engineer's rule, sterile mops and four towel clamps along with tonsillar retractor hook were used for ovariohysterectomy.

Instruments used for achieving haemostasis: Suture material polygalactin<sup>1</sup> 910 no. 0 for ligation. Titanium haemoclip<sup>2</sup> was applied by using clip applicator. Electrocoagulation unit<sup>3</sup> consisting of a main cord, silicon rubber patient plate, pedal foot switch, connecting cords and two control switches with bipolar maximum output of 125 watts for coagulation and monopolar maximum output of 400 watts for cutting.

### Anaesthetic protocol

All the animals were premedicated with inj. atropine sulphate<sup>4</sup> @ 0.04 mg/kg body wt. IM, inj. diazepam hydrochloride<sup>5</sup> @ 1 mg/kg body wt. IV. This was followed by administration of inj propofol<sup>6</sup> @ 4.0 mg/kg bwt IV as general anaesthetic, 2 minutes after the administration of diazepam hydrochloride, maintenance of the anaesthesia was done using inj. propofol as per the requirement.

### Surgical procedure

All the animals were positioned in dorsal recumbency after preparing the ventral abdomen aseptically. A 4 to 8 cm long incision was made just caudal to umbilicus at ventral midline. A stab incision was given into the abdominal cavity and abdomen was explored. Tonsillar retractor hook was introduced towards the left flank into the abdominal cavity and by pulling the uterine horn in cranio-caudal direction and uterine horn was identified by uterine bifurcation. The suspensory ligament was

<sup>1</sup>Vicryl\* 0(3.5 metric) 135 cm, Ethicon manufactured in India by Johnson and Johnson PVT.

<sup>2</sup>MIRUSTM Ligating clip by Shree Balaji pharma, Paldi, Ahmedabad, Gujrat.

<sup>3</sup>Jahangir's electro surgical cautery machine, Katara medical OPC PVT. Bhopal.

<sup>4</sup>Tropine\* 0.6 mg/ml, Neon, Radical Enterprises, Nagpur, M.H..

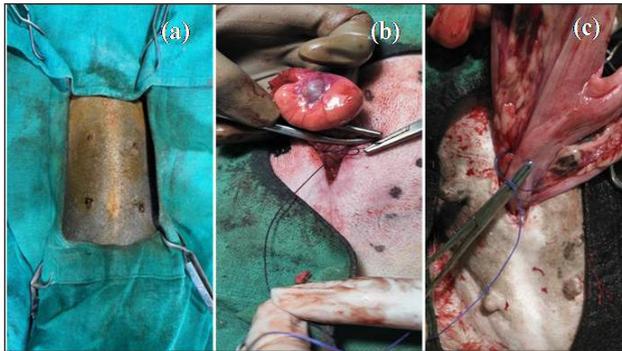
<sup>5</sup>Lori® 5mg/ml, Neon laboratories LTD, Rithiwik Pharma Bengaluru, Karnataka.

<sup>6</sup>Troypofol IP(1% w/v), Troikaa Pharmaceuticals Ltd. Uttarakhand, India.

identified and stretched or broken to easily exteriorize ovarian bursa (Fossum, 2013).

The haemostasis was achieved by following techniques:

**Group I:** Miller's knot ligature was placed proximal to (below) the ovarian pedicle and pedicle was severed between the mosquito forceps and the similar procedure was followed for opposite ovarian pedicle (Fig. 1). Cranial traction was applied on the uterus. After clamping Miller's knot was applied through the uterine body using the point of the needle and encircling the uterine vessels on each side and uterine stump was resected (Fossum, 2013).



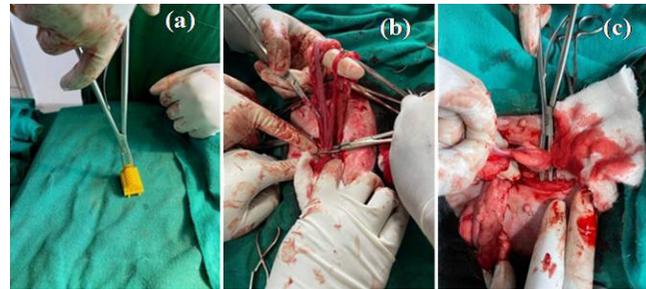
**Fig. 1:** Aseptic preparation of surgical site (a) ligation and resection of ovarian pedicle (b) and (c) in Group-I

**Group II:** Cauterization of ovarian pedicle was done by bipolar electrocautery to control haemorrhage and pedicle was severed between the mosquito forceps. Similar procedure was followed for opposite ovarian pedicle (Fig. 2). Cranial traction was applied on the uterus, after clamping electrocautery was used through the uterine body and uterine vessels and uterine stump was resected (Bart *et al.*, 2003).



**Fig. 2:** Ovarian pedicle and uterine stump resected and application of electrocautery forceps (a) and (b) in Group-II

**Group III:** Haemoclip was placed at ovarian pedicle and it was severed between the mosquito forceps. Similar procedure was followed for opposite ovarian pedicle (Fig. 3). Cranial traction was applied on the uterus, after applying artery forceps, haemoclip/ endoclip was applied through the uterine body and uterine stump was resected (Harold *et al.*, 2003). Laparotomy incision was closed in standard manner.



**Fig. 3:** Titanium clips (a) applied on uterine stump (b) and ovarian pedicle (c)

### Parameters of study

#### Clinical examination

Temperature ( $^{\circ}$ F) and heart rate (beat/min) were recorded before, during and after surgery to evaluate the clinical status of animal. Intra-operative parameters like intra operative bleeding, duration of surgery (min), soft tissue trauma were also recorded for all the animals. Degree of exudation of wound was monitored on day 0, 3, 7 and 14 post-operatively and exudation, if any was scored as per the score card stated by Bhowmick *et al.* (2013) (table 2).

**Table 2:** Score card for assessment of degree of exudation

Exudation	Grade	Score
Nil	-	0
Mild	+	1
Moderate	++	2
Marked	+++	3

#### Surgical parameters

The following surgical parameters were studied to assess the surgical techniques. Time (min) taken during surgery was measured from the first incision to the closure of the



skin incision in all the groups. Time taken in removal of uterus was measured from identification of uterus to complete removal of uterus from abdomen. Length of surgical incision was measured in cms using a sterile metal engineer's rule, immediately after the skin incision. Intra operative bleeding (g) was measured by weighing dry weight of mops and blood soaked mops.

### Abdominal ultrasonography

This was performed on day 7 post operatively to assess the free fluid in abdominal cavity.

### Haemato-biochemical estimations

Approximately 2 ml of blood was collected aseptically from cephalic vein or saphenous vein in vacutainer one day before surgery, on day 3 and on day 7 postoperatively for estimation of haematological parameters using automatic analyzer.

### Cost incurred

This was calculated and compared between two groups. Being an equipment, Bipolar electrocautery unit was one time expenditure only, hence it was excluded in comparison. The cost of suture material and cost of titanium clip were recorded to compare them.

### Post-operative management

Antiseptic dressing at incision site was done on alternate days using 5% povidone iodine. Inj, ceftriaxone sodium<sup>7</sup> @ 20 mg/kg body wt. i.v., twice daily for 5 days and Inj. Tramadol<sup>8</sup> @ 1.0 mg/kg body wt. i.m., for 2 days. Intra-operative complication if any, like organ trauma, bleeding and injury to abdominal wall during surgery in different groups, were recorded and treated accordingly.

## STATISTICAL ANALYSIS

The data obtained during the study were subjected to statistical analysis using one way ANOVA with post hoc multiple comparisons and applied descriptive value of

<sup>7</sup>Intacef®-0.5, 500 mg, Intas Pharmaceuticals LTD. India

<sup>8</sup>Contramal®100, Manufactured, Distributed and Marketed by Abbott Healthcare Pvt. Ltd.

( $p \leq 0.05$ ) was considered as significant. Qualitative data obtained was evaluated by visual analogue and arbitrary score card (Snedecor and Cochran, 1994).

## RESULTS AND DISCUSSION

A total 602 surgeries were performed in the Department during the year 2020-21. Out of these, 84 (13.95%) cases were of elective ovariohysterectomy, 77(12.79%) cases were of orthopaedic surgery, 80(13.28%) cases of ophthalmic surgery, 290 (48.17%) cases were of soft tissue surgery and 70(11.62%) others.

### Anamnesis

Eighteen apparently healthy non-pregnant female dogs irrespective of breed and body weight were selected for study, out of which two were Labrador retrievers, one Golden retriever, two German shepherds, one Pomeranian and rest of all were non-descript female. Two dogs were nulliparous, eight uniparous and ten multiparous. There was no history of systemic disease, concurrent vomiting and diarrhoea

### Clinical examination

Temperature (°F) and heart rate (beat/minute) were recorded at preoperative, intra-operative and post-operative periods. The mean values of temperature ranged between 100.53±0.13 to 102.00±0.17 and heart rate 119.83±03.10 to 141.33±06.17. These were significantly ( $p \leq 0.05$ ) decreased at intra-operative period of surgery in all the groups as compared to preoperative and postoperative periods (table 03).

**Table 3:** Mean values ( $\pm$ SE) of heart rate (beats per minute) at different time intervals

Group	Intervals		
	Pre-operative	Intra-operative	Post-operative
I	141.33 <sup>a</sup> ±06.17	127.00 <sup>b</sup> ±03.15	128.50 <sup>ab</sup> ±02.75
II	141.16 <sup>a</sup> ±05.49	124.83 <sup>b</sup> ±05.89	130.50 <sup>ab</sup> ±01.85
III	135.00 <sup>a</sup> ±02.88	119.83 <sup>b</sup> ±03.10	127.33 <sup>ab</sup> ±03.45

Mean values within same group with different superscripts differ significantly ( $p \leq 0.05$ ) at different time intervals.

The present findings are in accordance with Bornkamp *et al.* (2016) who evaluated the effect of anaesthesia in dogs undergoing ovariohysterectomy and found that rectal temperature ranged from 102.2 to 100.4 °F at during operative procedure. Høglund *et al.* (2011) performed a study to compare haemodynamic changes during two surgical methods of neutering in female dogs and concluded that the heart rate did not differ between two surgical methods or between different phases of surgery.

Degree of exudation of wound was assessed on day 3, 7 and day 14 post operatively. The exudation, if any, was analyzed using score card. No significant difference was observed between groups, however mean value of exudation in group II was non-significantly higher as compared to group I and III (Table 4).

**Table 4:** Mean values ( $\pm$ SE) of exudation score at different time intervals

Group/Day	3	7	14
I	00.83 <sup>a</sup> $\pm$ 00.30	00.16 <sup>b</sup> $\pm$ 00.16	00.00 $\pm$ 00.00
II	01.50 <sup>a</sup> $\pm$ 00.22	00.50 <sup>b</sup> $\pm$ 00.22	00.00 $\pm$ 00.00
III	01.33 <sup>a</sup> $\pm$ 00.21	00.33 <sup>b</sup> $\pm$ 00.21	00.00 $\pm$ 00.00

Mean values within same group with different superscripts differ significantly ( $p \leq 0.05$ ) at different time intervals.

These finding are in accordance with the findings of Murthy *et al.* (2012), Muraro and White (2014) and Acharya *et al.* (2016) who also found exudation on day 3 and day 5 post-operatively, in 30% to 50% female dogs subjected to conventional ventral midline ovariohysterectomy.

### Surgical parameters

Time (min) taken during surgery was measured from the first incision to the closure of the skin incision in all the groups. The mean value of duration of surgery was 76.00 $\pm$ 02.46 to 62.00 $\pm$ 01.71 minutes (Table 5). Significantly ( $p \leq 0.05$ ) longer surgical time was recorded in conventional ligature and endoclip technique as compared to electrocautery technique. Schiochet *et al.* (2009) conducted a study on three haemostatic techniques in LOVH in feline and concluded that bipolar electrocautery required less time (81 min) than titanium clip (73 min) and ligature (104 min). Guedes *et al.* (2017) evaluated electrosurgery and titanium clips to achieve haemostasis

in video assisted ovariohysterectomy in dogs and found that 61 minutes were required in electrosurgical group and 85 minutes were required for titanium clips group.

**Table 5:** Mean values of time for surgical procedure and removal of uterus in different groups

Group	Duration of surgery (min.)	Time for removal of uterus (min.)
I	76.00 <sup>A</sup> $\pm$ 02.46	33.66 <sup>A</sup> $\pm$ 01.56
II	62.00 <sup>B</sup> $\pm$ 01.712	23.33 <sup>B</sup> $\pm$ 00.88
III	74.33 <sup>A</sup> $\pm$ 01.68	27.66 <sup>B</sup> $\pm$ 1.87

Mean values between the groups with different superscripts differ significantly ( $p \leq 0.05$ ).

The time for identification and removal of uterus was recorded from entering into abdominal cavity to complete removal of uterus from abdomen. The mean values of time were observed 33.66 $\pm$ 01.56 minute, 23.33 $\pm$ 00.88 and 27.66 $\pm$ 1.87 minutes in group I, II and III respectively (table 05). Significantly ( $p \leq 0.05$ ) longer time was observed in group I as compared to group II and III. These findings are similar to the findings of Schwarrkopf *et al.* (2015) who studied vessel sealing versus suture ligation in open ovarioectomy in dogs and found that vessel sealing device required less time to remove uterus as compared to suture ligation.

Mean values of length of surgical incision were 4.95 $\pm$ 0.31, 4.90 $\pm$ 0.38 and 5.50 $\pm$ 0.16 cms in group I, II and III respectively. Incision length was non-significantly more in group III, as compared to group I and II (Table 6). Similarly, Reece *et al.* (2012) who evaluated right flank and minilaparotomy approach for OVH in canine and summarized that mean flank incision length for all spays was in range from 10 to 53 mm.

**Table 6:** Mean values ( $\pm$ SE) of length surgical incision (cm) in different groups

Group	Length of incision (cm)
I	4.95 $\pm$ 0.31
II	4.90 $\pm$ 0.38
III	5.50 $\pm$ 0.16

Intra-operative haemorrhage was measured by weighing the blood soaked gauzes just after the surgery and calculated

by difference in fresh gauzes and wet gauzes. The mean values ranged between  $58.3 \pm 02.24$  to  $71.16 \pm 01.74$  in all the groups, a significantly higher ( $p \leq 0.05$ ) value was found in group I than in group II and III (Table 7).

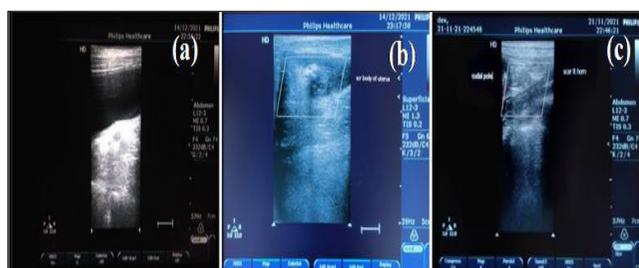
**Table 7:** Mean ( $\pm$ SE) values of blood loss (gm) in different groups

Group	Bleeding (gm)
I	$71.16^A \pm 01.74$
II	$58.33^B \pm 02.24$
III	$69.66^B \pm 04.18$

Mean values between the groups with different superscripts differ significantly ( $p \leq 0.05$ ).

All the dogs remained haemodynamically stable and no blood transfusions or other therapies were required. Berenjjan *et al.* (2010) compared monopolar and bipolar electrocauter in laparoscopic ovariohysterectomy in dogs and reported that a non-significant amount of haemorrhage was observed in both the groups. Guedes *et al.* (2017) evaluated the use of bipolar electrosurgery and titanium clips in two port video-assisted ovariohysterectomy technique. He observed that intra-operative bleeding was significantly lower in the electrosurgery group.

Abdominal ultrasonography was performed on day 7 post operatively to find out any complication. In group I and II, there was no complication in any animal and all the animals were clinically stable in both the groups (Fig. 2).



**Fig. 4:** Abdominal ultrasonography; No exudation was observed at the site of uterine stump (a) in Group-I, clinically normal but scar seen in uterine stump (b) in Group II; clinically normal but scar seen in uterine stump (c) in Group III

In group III, one patient had complaint of anorexia, but ultrasonographic examination revealed no abnormality, this might be due to excessive manipulation of viscera due

to slippage of clips. The animal was treated conservatively and recovered uneventfully. In another case which was clinically normal, USG examination revealed adhesion of clip at pole of kidney. Present findings were in consonance with findings of Silva *et al.* (2021) who investigated ovarian pedicle haemostasis technique in cats and stated that an abdominal ultrasonography performed 48 hours after surgery showed no pathological changes, or presence of free fluid in the abdominal cavity.

Similarly, Demir and Erdogan (2019) studied early ultrasonographic findings after ovariohysterectomy in dogs and observed that no difference was detected in ligation areas and concluded that abdominal ultrasonography during first week can be used for post operative monitoring of spayed dogs.

### Haemato-biochemical parameters

Haemato-biochemical parameters were estimated before surgery and on day 3 and 7 postoperatively. On day 0, in group II a significantly ( $p \leq 0.05$ ) higher value for total erythrocyte count was observed in comparison with group I and III. On day 3 and 7, no significant difference was observed between the groups. Although there was significant decrease ( $p \leq 0.05$ ) in mean values of RBC count on day 3 as compared to day 0 and day 7 within group at different intervals, but all values fluctuated in normal reference range. All other haemato-biochemical parameters decreased non-significantly on day 3 and returned to near normal range on day 7 (table 8, 9 and 10).

Intra-abdominal haemorrhage was observed in group I and III, one in each group. In group I, it occurred only after releasing the ligated ovarian pedicle and cervical stump back into the abdominal cavity and similarly in another case after applying the clips. In group III, haemorrhage was observed only during surgery and there was no oozing of blood through incision line after closing the abdomen. Haemorrhage could occur from the ovarian pedicle, uterine pedicle or from the broad ligament, but in this study source of bleeding was not ascertainable. Rafee *et al.* (2015) reported that intra-abdominal haemorrhage was one of most common complication secondary to an OVH and can even result in death of the patient, if severe. Abdominal wound dehiscence was observed in one animal of group I post-operatively. Wound was re-sutured and healed after few days.

**Table 8:** Mean values ( $\pm$  SE) of total erythrocytes count ( $10^6/\mu\text{l}$ ) and total leukocyte count ( $10^3/\mu\text{l}$ ) at different intervals in all the groups

Group/ Day	Total erythrocyte count ( $10^6/\mu\text{l}$ )			Total leukocyte count ( $10^3/\mu\text{l}$ )		
	0	3	7	0	3	7
Group I	6.67 <sup>abB</sup> $\pm$ 00.21	6.17 <sup>b</sup> $\pm$ 00.14	6.83 <sup>a</sup> $\pm$ 00.24	14.05 $\pm$ 01.10	15.49 $\pm$ 01.08	14.55 $\pm$ 01.07
Group II	7.57 <sup>aA</sup> $\pm$ 00.38	6.47 <sup>b</sup> $\pm$ 00.26	7.52 <sup>a</sup> $\pm$ 01.44	13.30 $\pm$ 00.95	15.85 $\pm$ 00.83	14.17 $\pm$ 00.66
Group III	6.40 <sup>abB</sup> $\pm$ 00.18	5.90 <sup>b</sup> $\pm$ 00.16	6.74 <sup>a</sup> $\pm$ 00.34	13.16 $\pm$ 00.72	14.26 $\pm$ 00.67	12.63 $\pm$ 00.58

Mean values between the groups with different superscripts (A,B) differ significantly ( $p \leq 0.05$ ); Mean values within groups with different superscripts (a,b) differ significantly ( $p \leq 0.05$ ).

**Table 9:** Mean values ( $\pm$ SE) of packed cell volume (%) and haemoglobin (g/dl) at different intervals in all the groups

	Packed cell volume (%)			Haemoglobin (g/dl)		
	0	3	7	0	3	7
Group I	44.00 $\pm$ 01.43	41.00 $\pm$ 01.46	44.08 $\pm$ 01.63	14.63 $\pm$ 00.66	13.28 $\pm$ 00.66	14.31 $\pm$ 00.82
Group II	41.66 $\pm$ 01.68	39.60 $\pm$ 01.61	41.26 $\pm$ 00.96	13.70 $\pm$ 00.58	12.23 $\pm$ 00.21	13.71 $\pm$ 00.47
Group III	45.08 $\pm$ 01.14	40.75 $\pm$ 01.75	43.45 $\pm$ 00.46	14.16 $\pm$ 00.65	13.15 $\pm$ 00.73	14.05 $\pm$ 00.49

**Table 10:** Mean values ( $\pm$ SE) of total plasma protein (g/dl) in different groups

Group/ Day	0	3	7
Group I	6.56 $\pm$ 00.43	6.48 $\pm$ 00.48	6.73 $\pm$ 00.48
Group II	6.33 $\pm$ 00.47	5.58 $\pm$ 00.40	6.57 $\pm$ 00.49
Group III	6.82 $\pm$ 00.57	6.28 $\pm$ 00.50	6.75 $\pm$ 00.51

**Table 11:** Mean values ( $\pm$ SE) of total cost (₹) incurred

Group	Cost (₹)
Group I	550.00 $\pm$ 00.00
Group III	654.00 $\pm$ 32.98

Mean value of expenditure was 550.00 $\pm$ 00.00 and 654.00 $\pm$ 32.98 rupees in group I and group III respectively; Group II was excluded from comparison (table 11).

## CONCLUSION

All the three evaluated techniques provided satisfactory haemostasis for ovariohysterectomy. Bipolar cautery system was superior to titanium clip and suture ligation. Bipolar electrocautery required minimum length of surgical incision and less time as compared to other techniques. Cost of haemoclclip application was high as compared to suture ligation to achieve haemostasis.

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