

## Comparison of the outcome of ultrasonic harmonic scalpel and electrocautry in open hemorrhoidectomy

Sheikh Atiq-ur-Rehman, Adil Irshad, Muhammad Younus Khan, Usman Rizvi, Rashid Khan, Nawab Ali

### Abstract

**Introduction:** Hemorrhoidectomies are being performed with new devices, such as bipolar electrothermal devices, ultrasonic scalpels, and circular staplers. The operation performed with these devices have recently been reported to result in better pain relief and less bleeding post-operatively compared to previous conventional surgical methods.

**Objectives:** To compare the outcome of ultrasonic harmonic scalpel and electrocautery in open hemorrhoidectomy.

**Study design:** Randomized controlled trial

**Settings:** Department of Surgery, Bahawal Victoria Hospital, Bahawalpur.

**Study duration:** 1<sup>st</sup> May 2019 to 30<sup>th</sup> November 2020.

**Materials and Methods:** Total 100 patients with grade III haemorrhoids, of 25-65 years of age of both genders were selected. Patients with recurrent haemorrhoids, thrombosed haemorrhoids, chronic liver failure (CRF), chronic liver disease (CLD) and diabetes mellitus (DM) were excluded. Group-A included the cases in which ultrasonic harmonic scalpel hemorrhoidectomy was done while group-B included the cases in which electrocautery open hemorrhoidectomy was done. All the procedures were performed by the same surgeon (with at least 3 years post-fellowship experience). All the patients were assessed by me and outcome (as per operational definitions) was noted.

**Results:** In our study, post-operative pain was seen in 01 (2.0%) patients after ultrasonic harmonic scalpel and in 17 (34.0%) after electrocautery in open hemorrhoidectomy (p-value = 0.0001). Post-operative bleeding was seen in 04 (8.0%) after ultrasonic harmonic scalpel and in 14 (28.0%) after electrocautery in open hemorrhoidectomy (p-value = 0.009). Recurrence was seen in 00 (0.0%) after ultrasonic harmonic scalpel and in 03 (6.0%) after electrocautery in open hemorrhoidectomy (p-value = 0.079).

**Conclusion:** Post-operative pain, bleeding and recurrence is less after ultrasonic harmonic scalpel use as compared to electrocautery in open hemorrhoidectomy.

**Keywords:** Haemorrhoids, ultrasonic harmonic scalpel, post-operative pain, electrocautery in open hemorrhoidectomy

### Introduction:

Haemorrhoids are dilated veins occurring in relation to anal canal. They are necessary for full continence. They can be internal or external being above or below dentate line respectively, in the anal canal.<sup>1</sup> They are more common when intra-abdominal pressure is raised, e.g. obesity, constipation and pregnancy. Classically, they occur at 3, 7 and 11 o'clock position with patient

in Lithotomy position. Symptoms of haemorrhoids are: bright red painless bleeding, mucus discharge, mucosal prolapse, pruritis and sometimes only pain.<sup>2</sup> Haemorrhoids are grade -1 which bleed only, grade-2 prolapse but return back automatically, grade-3 prolapse and stay reduced on reduction or grade-4 permanently prolapsed.<sup>3</sup> All haemorrhoids bleed but are classified into types according to the degree of

### Received

date: 15th December, 2020

### Accepted

date: 4th June, 2021

### Bhawal Victoria Hospital, Bahawalpur

SAur Rehman

A Irshad

MY Khan

U Rizvi

R Khan

N Ali

### Correspondence:

Dr. Sheikh Atiq-ur-Rehman,

Associate Professor Surgery, Quaid-e-Azam Medical College, In-charge Surgical Unit-III, Bahawal Victoria Hospital, Bahawalpur

Address: House No 9/A, Block 'X', Model Town C, Bahawalpur.

Cell No: +92 300-6808500

email: dratiq2002@gmail.com

com

prolapse. They produce symptoms only when complicated.<sup>4</sup>

Internal hemorrhoids are further classified in 1985 into four grades based on the degree of prolapse;<sup>4</sup> Grade I: No prolapse. Just prominent blood vessels; Grade II: Prolapse upon bearing down but spontaneously reduce; Grade III: Prolapse upon bearing down and requires manual reduction; Grade IV: Prolapsed and cannot be manually reduced.<sup>5</sup> Patients with grade I and II internal hemorrhoids lack advanced prolapse of the supporting subepithelial tissue of hemorrhoidal cushions. Nevertheless, these patients may experience acute attacks with severe discomfort and bleeding.<sup>6</sup>

Haemorrhoids are the most common benign condition seen by colorectal surgeons as painful, swollen veins in the lower portion of the rectum or anus.<sup>7</sup> Although conservative treatment is often sufficient for early stages (Grade I and Grade II), late stage disease (Grade III and Grade IV) usually needs surgical treatment.<sup>8</sup> Conventional hemorrhoidectomy, including open and closed methods, is accepted as the gold standard for surgical treatment of haemorrhoids worldwide. It is a mind-numbing procedure associated with significant morbidity and a prolonged recovery.<sup>9</sup>

In recent years, several pieces of surgical equipment have been developed due to advances in technology, and now hemorrhoidectomies are being performed with new devices, such as bipolar electrothermal devices, ultrasonic scalpels, and circular staplers.<sup>10,11</sup> Hemorrhoidectomies performed with these devices have recently been reported to result in better pain relief and less bleeding postoperatively compared to hemorrhoidectomies performed using previous conventional surgical methods.<sup>12,13</sup> In a study, there was a significant difference in pain (VAS = 4-10) in Harmonic Scalpel hemorrhoidectomy (20%) as compared with diathermy hemorrhoidectomy (66.7%) with p value < 0.0001.<sup>14</sup> Recurrence was highest in (26.08%) in diathermy group while lowest in (4.34%) in Harmonic Scalpel group. Post-operative bleeding was seen in 10.0% patients of harmonic scalpel group and

in 23.33% in diathermy group.<sup>14</sup> A local study has shown that the bipolar hemorrhoidectomy is significantly better than hemorrhoidectomy with harmonic scalpel.<sup>15</sup>

As post-operative morbidity following hemorrhoidectomy is of main concern which affects the patients physically and socially, so the purpose of this study is to compare the outcome of ultrasonic harmonic scalpel and electrocautery in open hemorrhoidectomy in local population. Although, previously studies are available on this but local and international literature have shown different results, so there must be re-evaluation of the better technique among these in open hemorrhoidectomy. Our study is more authentic than previous studies because we have decided to conduct this study on large population while previous studies are done on small population. Then on the basis of these results, some practical recommendations can be made in our routine practice guidelines for these particular patients to be provided with more effective technique which is associated with less post-operative morbidity.

The objective of the study was to compare the outcome of ultrasonic harmonic scalpel and electrocautery in open hemorrhoidectomy.

Operational definitions:

Haemorrhoids: All patients with Grade III (protrude spontaneously or with straining and require manual reduction) assessed on history and clinical examination were included.

Outcome: was measured at one month post-operatively in terms of following;

Post-operative Pain was assessed by using visual analogue scale. Score 4 and above was deemed as positive.

No Pain = 0, Mild Pain = 1-3, Moderate Pain = 4-6, Severe Pain = 7-10

Post-operative bleeding presence of any amount of bleeding/rectum that alarm the patient and presence of blood on clinical examination at any time during one month follow up.

Recurrence: presence of haemorrhoids (protrude spontaneously or with straining and require manual reduction) at the end of one month.

BMI was calculated by following formula;  
 $BMI = \text{weight in kilograms (measured by weight machine)} / \text{height in meters}^2$  (measured by measuring tape) and  $>27$  was taken as obese and  $\leq 27$  as non-obese.

Hypothesis: The outcome of ultrasonic harmonic scalpel is better in open hemorrhoidectomy as compared to electrocautery.

### Material and Methods:

Study design: It was a randomized controlled trial carried out at Department of Surgery, Bahawal Victoria Hospital, Bahawalpur. from 1<sup>st</sup> May 2019 to 30<sup>th</sup> November 2020. The calculated sample size is 100 i.e. 50 cases in each group, with 5% level of significance, 90% power of study and taking recurrence after ultrasonic harmonic scalpel as 26.08% and 4.04% after electrocautery.<sup>16</sup>

Sample technique: Non-probability, consecutive sampling.

In sample selection our inclusion criteria was all patients with grade III haemorrhoids as per operational definition. Duration of haemorrhoids  $>3$  months. Age 25-65 years. Both genders.

Our exclusion criteria was patients with recurrent haemorrhoids, thrombosed haemorrhoids (assessed on clinical examination). Patients with chronic renal failure (assessed on history and serum creatinine  $>1.5$  mg/dl). Patients with chronic liver disease (assessed on history and s/bilirubin  $>2.0$  mg/dl). Patients with diabetes mellitus (assessed on history and medical record).

Data collection procedure: After approval from our Ethical Review Committee, total 100 patients admitted to the Department of Surgery, Bahawal Victoria Hospital, Bahawalpur, fulfilling the inclusion criteria was selected. After

taking informed written consent, the selected patients were placed randomly into two equal groups i.e. Group-A (ultrasonic harmonic scalpel) and Group-B (electrocautery), by using lottery method. All selected cases were offered to pick up a slip from total mixed up slips (half-slips contained letter 'A' and other half-slips contained letter 'B') and he/she was placed in that respective group. Group-A included the cases in which ultrasonic harmonic scalpel hemorrhoidectomy was done while group-B included the cases in which electrocautery open hemorrhoidectomy was done. All the procedures were performed by the surgeons with at least 3 years post-fellowship experience. All the patients were assessed by the researcher himself and outcome (as per operational definitions) was noted. All data including demographic data was recorded on a specially designed proforma (Annexure-I).

Data analysis procedure: All the data was entered and analyzed by using SPSS version 20.0. The quantitative variables like age, duration of disease, BMI and post-operative pain score were presented as mean and standard deviation. The qualitative variables like gender, place of living (rural/urban), occupation (office worker/field worker/others), lifestyle (sedentary/simple), post-operative bleeding (yes/no) and recurrence (yes/no) of both groups were presented as frequency and percentage. Chi square was used to compare the post-operative pain, bleeding (yes/no) and recurrence (yes/no) of both groups. P-value  $\leq 0.05$  was considered as significant. Effect modifiers like age, gender, duration of disease, BMI, place of living (rural/urban), occupation (office worker/field worker/others) and lifestyle (sedentary/simple) were controlled through stratification and post-stratification chi square for post-operative bleeding (yes/no) and recurrence (yes/no). P-value  $\leq 0.05$  was considered as significant.

### Results:

Age range in this study was from 25 to 65 years with mean age of  $37.78 \pm 7.53$  years. The mean age of women in group-A was  $37.12 \pm 8.13$  years and in group-B was  $38.36 \pm 7.14$  years. Majority of the patients 83 (83.0%) were between 25 to

**Table 1: Age and gender distribution for both groups (n=100)**

Age (years)	Group A (n=50)		Group B (n=50)		Total (n=100)	
	No. of patients	%age	No. of patients	%age	No. of patients	%age
25-45	43	86.0	40	80.0	83	83.0
46-65	07	14.0	10	20.0	17	17.0
Mean ± SD	37.12 ± 8.13		38.36 ± 7.14		37.78 ± 7.53	

  

Gender	Group A (n=50)		Group B (n=50)		Total (n=100)	
	No. of patients	%age	No. of patients	%age	No. of patients	%age
Male	36	72.0	33	66.0	69	69.0
Female	14	28.0	17	34.0	31	31.0

**Table 2: Distribution of patients according to duration of disease and BMI**

Duration of disease (months)	Group A (n=50)		Group B (n=50)		Total (n=100)	
	Frequency	%age	Frequency	%age	Frequency	%age
≤6 months	32	64.0	32	64.0	64	64.0
>6 months	18	36.0	18	36.0	36	36.0
Mean ± SD	5.48 ± 2.12		5.30 ± 2.16		5.39 ± 2.15	

  

BMI (kg/m <sup>2</sup> )	Group A (n=50)		Group B (n=50)		Total (n=100)	
	Frequency	%age	Frequency	%age	Frequency	%age
≤27	16	32.0	26	52.0	42	42.0
>27	34	68.0	24	48.0	58	58.0
Mean ± SD	28.52 ± 3.44		28.68 ± 2.64		28.59 ± 2.89	

**Table 3: Distribution of patients according to place of living, occupation and life style**

	Group A (n=50)		Group B (n=50)		Total (n=100)	
	Frequency	%age	Frequency	%age	Frequency	%age
<b>Place of living</b>						
Rural	33	66.0	34	68.0	67	67.0
Urban	17	34.0	16	32.0	33	33.0
<b>Occupation</b>						
Office	21	42.0	23	46.0	44	44.0
Field	20	40.0	19	38.0	39	39.0
Others	09	18.0	08	16.0	17	17.0
<b>Lifestyle</b>						
Simple	28	56.0	28	56.0	56	56.0
Sedentary	22	44.0	22	44.0	44	44.0

**Table 4: Comparison of outcome of ultrasonic harmonic scalpel and electrocautery in open hemorrhoidectomy**

Outcome	Group A (n=50)		Group B (n=50)		p-value
	Yes	No	Yes	No	
Post-operative pain	01 (2.0%)	49 (98.0%)	17 (34.0%)	33 (66.0%)	0.0001
Post-operative bleeding	04 (8.0%)	46 (92.0%)	14 (28.0%)	36 (72.0%)	0.009
Recurrence	00 (0.0%)	50 (100.0%)	03 (6.0%)	47 (94.0%)	0.079

45 years of age as shown in table-I. Out of 100 patients, 69 (69.0%) were males and 31 (31.0%) were females with male to female ratio of 2.2:1 (table-I). Mean duration of disease was 5.39 ± 2.15 months (table-II). Mean BMI was 28.59 ± 2.89 kg/m<sup>2</sup> (table-II). Distribution of patients according to place of living, occupation and life-style is shown in table III.

In our study, post-operative pain was seen in 01 (2.0%) patients after ultrasonic harmonic scalpel and in 17 (34.0%) after electrocautery in open hemorrhoidectomy (p-value = 0.0001). Post-operative bleeding was seen in 04 (8.0%) after ultrasonic harmonic scalpel and in 14 (28.0%) after electrocautery in open hemorrhoidectomy (p-value = 0.009). Recurrence was seen in 00 (0.0%) after ultrasonic harmonic scalpel and in 03 (6.0%) after electrocautery in open hemorrhoidectomy (p-value = 0.079) as shown in table IV.

**Discussion:**

A hemorrhoidectomy is the standard treatment for patients with grade III or IV internal hemorrhoids. The most effective hemorrhoidectomy methods are the Milligan-Morgan open hemorrhoidectomy and the Ferguson closed hemorrhoidectomy. These methods are similar and are recognized as traditional methods.<sup>18,19</sup> However, although they may be the most effective treatment for hemorrhoids, complications, such as post-operative bleeding, surgical-site anal pain, anal stenosis, and incontinence, can occur after the surgery. These complications increase the patient's hospitalization period, can delay the return to ordinary life and the work place after surgery, and can increase the rate of revisits to the hospital.<sup>20</sup> In particular, post-operative pain and bleeding are experienced by many patients after undergoing a hemorrhoidectomy, and many patients complain of discomfort for a long time. As a result, various surgical equipment, surgical methods, and supportive therapies have been introduced to overcome the post-operative pain and bleeding.

In recent years, several pieces of surgical equipment have been developed due to advances in

technology, and now hemorrhoidectomies are being performed with new devices, such as bipolar electrothermal devices, ultrasonic scalpels, and circular staplers. Hemorrhoidectomies performed with these devices have recently been reported to result in better pain relief and less bleeding postoperatively compared to hemorrhoidectomies performed using previous conventional surgical methods.<sup>21,23</sup> The ultrasonic scalpel uses ultrasonic vibration to cut tissue and automatically stop bleeding at the same time. A hemorrhoidectomy performed with an ultrasonic scalpel has several advantages, including less damage to tissues, better hemostasis, less stimulation to neuromuscular tissues, and local control of the surgical site, compared to a hemorrhoidectomy performed with surgical scissors or monopolar electric cauterly.<sup>21,22</sup>

We have conducted this study to compare the outcome of ultrasonic harmonic scalpel and electrocauterly in open hemorrhoidectomy. In our study, post-operative pain was seen in 01 (2.0%) patients after ultrasonic harmonic scalpel and in 17 (34.0%) after electrocauterly in open hemorrhoidectomy (p-value=0.0001). Post-operative bleeding was seen in 04 (8.0%) after ultrasonic harmonic scalpel and in 14 (28.0%) after electrocauterly in open hemorrhoidectomy (p-value=0.009). Recurrence was seen in 00 (0.0%) after ultrasonic harmonic scalpel and in 03 (6.0%) after electrocauterly in open hemorrhoidectomy (p-value = 0.079). In a study, there was a significant difference in pain (VAS = 4-10) in Harmonic Scalpel hemorrhoidectomy (20%) as compared with diathermy hemorrhoidectomy (66.7%) with p value < 0.0001.<sup>14</sup> Recurrence was highest in (26.08%) in diathermy group while lowest in (4.34%) in Harmonic Scalpel group. Post-operative bleeding was seen in 10.0% patients of harmonic scalpel group and in 23.33% in diathermy group.<sup>14</sup> A local study by Shokhat H et al., has shown that the bipolar hemorrhoidectomy is significantly better than hemorrhoidectomy with harmonic scalpel<sup>15</sup>

In a study,<sup>24</sup> the mean ages of the conventional and the ultrasonic scalpel groups were, respec-

tively,  $20.8 \pm 1.6$  and  $22.4 \pm 5.0$  years ( $P = 0.240$ ). In comparison with the conventional method group, the ultrasonic scalpel group had a shorter operation time ( $P < 0.005$ ), less post-operative pain on the visual analogue scale score, pvalue  $P = 0.211$  on post-operative day 1, and less post-operative bleeding ( $P = 0.034$ ). No significant differences in post-operative complications were observed between the 2 groups.<sup>24</sup>

Ravi Kumar and colleagues<sup>25</sup> conducted a study on 60 patients to compare harmonic scalpel hemorrhoidectomy with conventional open method (Milligan–Morgan); they found that the VAS pain scores at days 1, 7, and 14 post-operatively were lesser in harmonic scalpel group compared with Milligan–Morgan group. Moreover, the blood loss during the procedure was lesser in harmonic scalpel group (6.1 ml for harmonic scalpel group vs. 19.4 for Milligan–Morgan group). Other post-operative complications such as hemorrhage and urinary retention were more in Milligan–Morgan group.

Bulus and colleagues<sup>26</sup> concluded that hemorrhoidectomy done by harmonic scalpel is more safe and effective, has fewer complications, and causes lesser blood loss and lesser post-operative pain when compared with conventional techniques. Their results were significant regarding operative time, mean hospital stay, and post-operative static pain for post-operative days 1, 7, and 28, respectively. The post-operative complications such as bleeding, anal incontinence, and anal stenosis were lesser in harmonic scalpel hemorrhoidectomy group but without significance.<sup>26</sup>

Talha et al.,<sup>27</sup> showed that both harmonic scalpel and ligasure were superior to conventional diathermy in hemorrhoidectomy, in having lesser operative time, lesser post-operative pain, and lesser analgesic consumption during the first day post-operatively in addition to faster wound healing. Abo-Hashem et al.,<sup>28</sup> reported a significant fast wound healing in harmonic scalpel hemorrhoidectomy. They attributed this higher rate of wound healing at 6 weeks post-operatively to the minimal tissue trauma, minimal char-

ring, lesser local edema in the surrounding tissues, and absence of tissue necrosis.

Both Ozer et al.<sup>29</sup> and Abo-Hashem et al.,<sup>28</sup> concluded that harmonic scalpel hemorrhoidectomy is superior to conventional hemorrhoidectomy regarding significant reduction in post-operative pain scoring, induction of better hemostasis of the wound, and lesser consumption of analgesic. Chung and colleagues compared the results of hemorrhoidectomy done by three different techniques: scalpel of harmonic, bipolar scissors, or by excision-ligation technique (Milligan–Morgan) using the ordinary surgical scissor. Both harmonic scalpel hemorrhoidectomy and bipolar scissors hemorrhoidectomy showed better results than Milligan–Morgan hemorrhoidectomy regarding reduction of blood loss. Harmonic scalpel hemorrhoidectomy had the lowest pain score and best satisfaction score when compared with the other two methods.<sup>30</sup>

In 2007, Ivanov Dejan et al.<sup>31</sup> made a study on 77-patients suffering from hemorrhoidal disease, stage III and IV, and underwent surgery during the last five years. The postoperative pain was determined using the visual analog scale on the 1<sup>st</sup>, 2<sup>nd</sup> and 7<sup>th</sup> post-operative days. Patients were divided into two groups in regard to the surgical procedure applied. The data were statistically processed using the Statistical 7.0 software. They concluded that ultrasonic coagulation hemorrhoidectomy, due to less thermal damage, statistically significantly reduced post-operative pain with better hemostasis, compared with Milligan-Morgan's method of treating hemorrhoidal disease. On the other hand Khan S et al.<sup>32</sup> conducted prospective study that compared Harmonic Scalpel hemorrhoidectomy with traditional closed hemorrhoidectomy, Here ultrasonic coagulation hemorrhoidectomy did not show any advantage in post-operative pain, fecal incontinence, operative time, quality of life, or other complications compared with traditional closed hemorrhoidectomy. Also in 2001, Tan JJ and Seow-Choen F in a prospective randomized trial comparing diathermy and ultrasound coagulation hemorrhoidectomy concluded that

there is there was no statistical difference between pain scores recorded by both groups.<sup>33</sup>

### Conclusion:

We conclude that the post-operative pain, bleeding and recurrence is less after ultrasonic harmonic scalpel use as compared to electrocautery in open hemorrhoidectomy. So, we recommend that ultrasonic harmonic scalpel use should be used routinely in our general practice for treating 3<sup>rd</sup> degree haemorrhoids in order to reduce morbidity of our population.

**Conflict of interest:** none

**Funding source:** none

### Role and contribution of authors:

Sheikh Atiq-ur-Rehman, collected the data, references and wrote the article.

Adil Irshad, collected the data, and helped in introduction writing.

Muhammad Younus Khan, collected the references, and helped in discussion writing and interpretation of the data.

Usman Rizvi, collected the references and helped in methodology writing.

Rashid Khan, collected the data, and helped in introduction writing

Nawab Ali, collected the data, references and helped in discussion writing.

### References:

1. D'Ugo S, Stasi E, Gaspari AL, Sileri P. Hemorrhoids and anal fissures in inflammatory bowel disease. *Minerva GastroenterolDietol.* 2015;61(4):223-33.
2. Hollingshead JR, Phillips RK. Haemorrhoids: modern diagnosis and treatment. *Postgrad Med J.* 2016;92(1083):4-8.
3. Elbetti C, Giani I, Novelli E, Fucini C, Martellucci J. The single pile classification: a new tool for the classification of haemorrhoidal disease and the comparison of treatment results. *Updates Surg.* 2015;67(4):421-6.
4. Vinson-Bonnet B, Higuero T, Faucheron JL, Senejoux A, Pigot F, Siproudhis L. Ambulatory haemorrhoidal surgery: systematic literature review and qualitative analysis. *Int J Colorectal Dis.* 2015;30(4):437-45.
5. Chen HL, Woo XB, Cui J. Ligasure versus stapled hemorrhoidectomy in the treatment of hemorrhoids: a meta-analysis of randomized control trials. *SurgLaparoscEndoscPercutan Tech.* 2014;24(4):285-9.
6. Siddiqui UD, Barth BA, Banerjee S, Bhat YM, Chauhan SS,

- Gottlieb KT, et al. Devices for the endoscopic treatment of hemorrhoids. *GastrointestEndosc.* 2014;79:8–14.
7. Yeung TM, D'Souza ND. Quality analysis of patient information on surgical treatment of haemorrhoids on the internet. *Ann R CollSurg Engl.* 2013;95(5):341-4.
  8. Hollingshead JR, Phillips RK. Haemorrhoids: modern diagnosis and treatment. *Postgrad Med J.* 2016;92(1083):4-8.
  9. Simillis C, Thoukididou SN, Slesser AA, Rasheed S, Tan E, Tekkis PP. Systematic review and network meta-analysis comparing clinical outcomes and effectiveness of surgical treatments for haemorrhoids. *Br J Surg.* 2015;102(13):1603-18.
  10. Lim DR, Cho DH, Lee JH, Moon JH. Comparison of a hemorrhoidectomy with ultrasonic scalpel versus a conventional hemorrhoidectomy. *Ann Coloproctol.* 2016;32(3):111–6.
  11. Mushaya CD, Caleo PJ, Bartlett L, Buettner PG, Ho YH. Harmonic scalpel compared with conventional excisional hemorrhoidectomy: a meta-analysis of randomized controlled trials. *Tech Coloproctol.* 2014;18(11):1009-16.
  12. Bulus H, Tas A, Coskun A, Kucukazman M. Evaluation of two hemorrhoidectomy techniques: harmonic scalpel and Ferguson's with electrocautery. *Asian J Surg.* 2014;37:20–23.
  13. Lim DR, Cho DH, Lee JH, Moon JH. Comparison of a hemorrhoidectomy with ultrasonic scalpel versus a conventional hemorrhoidectomy. *Ann Coloproctol.* 2016;32(3):111-6.
  14. Thiyyagarajan A, Bhatnagar S. Comparative study of management of grade III hemorrhoids by Harmonic Scalpel technique versus conventional surgical technique (Milligan Morgan method). *IntSurg J.* 2017;4:3007-14.
  15. Shoukat H, Iqbal M, Ullah S, Mirza A, Dar UF, Dar UF. Comparison of hemorrhoidectomy using bipolar diathermy vs harmonic scalpel. *Pak J Med Health Sci.* 2016;10:489-91.
  16. William NS. Anus and anal canal. In: Williams NS, Buldtrode CJK, O'Connell PR, editors. *Bailey and Love's short practice of surgery.* 25th ed. London: Arnold; 2010: 1240-69.
  17. MacRae HM, McLeod RS. Comparison of hemorrhoidal treatment modalities. A meta-analysis. *Dis Colon Rectum.* 1995;38:687–694.
  18. Milligan ET, Morgan CN, Jones LE, Office R. Surgical anatomy of the anal canal, and the operative treatment of hemorrhoids. *Lancet.* 1937;230:1119–1124.
  19. Ferguson JA, Heaton JR. Closed hemorrhoidectomy. *Dis Colon Rectum.* 1959;2: 176–79.
  20. Goligher JC, Graham NG, Clark CG, De Dombal FT, Giles G. The value of stretching the anal sphincters in the relief of post-haemorrhoidectomy pain. *Br J Surg.* 1969; 56: 859–61.
  21. Jayne DG, Botterill I, Ambrose NS, Brennan TG, Guillou PJ, O'Riordain DS. Randomized clinical trial of Ligasure versus conventional diathermy for day-case haemorrhoidectomy. *Br J Surg.* 2002;89:428–432.
  22. Bulus H, Tas A, Coskun A, Kucukazman M. Evaluation of two hemorrhoidectomy techniques: harmonic scalpel and Ferguson's with electrocautery. *Asian J Surg.* 2014;37:20–23.
  23. Jayaraman S, Colquhoun PH, Malthaner RA. Stapled versus conventional surgery for hemorrhoids. *Cochrane Database Syst Rev.* 2006;4:5393.
  24. Lim DR, Cho DH, Lee JH, Moon JH. Comparison of a Hemorrhoidectomy with Ultrasonic Scalpel versus a Conventional Hemorrhoidectomy. *Ann Coloproctol.* 2016 Jun; 32(3): 111–116.
  25. Ravi Kumar GV, Madhu BS, Vishal T, Navin Kumar Reddy M, Pawar PM. Harmonic scalpel compared with conventional open (Milligan-Morgan) method in surgical management of symptomatic haemorrhoids. *IntSurg J* 2017; 4:2010–2013.
  26. Bulus H, Tas A, Coskun A, Kucukazman M. Evaluation of two hemorrhoidectomy techniques: harmonic scalpel and Ferguson's with electrocautery. *Asian J Surg* 2014; 37:20–23.
  27. Talha A, Bessa S, Abdel Wahab M. Ligasure, harmonic scalpel versus conventional diathermy in excisional haemorrhoidectomy: a randomized controlled trial. *ANZ J Surg* 2017; 87:252–256. Back to cited text no. 15
  28. Abo-Hashem AA, Sarhan A, Aly AM. Harmonic scalpel compared with bipolar electro-cautery hemorrhoidectomy: a randomized controlled trial. *Int J Surg* 2010; 8:243–247. Back to cited text no. 16
  29. Ozer MT, Yigit T, Uzar AI, Menten O, Harlak A, Kilic S et al. A comparison of different hemorrhoidectomy procedures. *Saudi Med J* 2008; 29:1264–1269. Back to cited text no. 17
  30. Chung CC, Ha JP, Tai YP, Tsang WW, Li MK. Double-blind randomized trial comparing harmonic scalpel hemorrhoidectomy, bipolar scissors hemorrhoidectomy, and scissors excision: ligation technique. *Dis Colon Rectum* 2002; 45:789–794.
  31. Ivanov D, Babovic S, Selesi D, Ivanov M, Cvijanovic R. Harmonic Scalpel hemorrhoidectomy: a painless procedure? *Med Pregl.* 2007; 60: 421-426.
  32. Khan S, Pawlak SE, Eggenberger JC, Lee CS, Szilagyi EJ, Wu JS, et al. Surgical treatment of hemorrhoids: prospective, randomized trial comparing closed excisional hemorrhoidectomy and the Harmonic Scalpel technique of excisional hemorrhoidectomy. *Dis Colon Rectum.* 2001; 44: 845-849.
  33. Tan JJ, Soew-choen F. Prospective, randomized trial comparing diathermy and Harmonic Scalpel hemorrhoidectomy. *Dis Colon Rectum.* 2001; 44:677-679.