Clinics in Surgery

Research Article
Published: 09 Dec, 2016

Comparative Study of Outcome of Conventional versus Ultrasonic Coagulation Hemorrhoidectomy

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Abstract

Purpose: The aim of this study was to compare the outcome of patients receiving hemorrhoidectomy using ultrasonic coagulation versus conventional hemorrhoidectomy.

Methods: Twenty patients with grade 3 to 4 piles were randomly assigned using closed envelope method to receive 1) Modified Milligan-Morgan hemorrhoidectomy using scissors excision-ligation technique followed by hemostasis using diathermy or 2) Ultrasonic coagulation hemorrhoidectomy. The patient was not aware of the technique used at operation. Patients were followed up weeks after operation. The measured outcomes included 1) operation time; 2) blood loss; 3) postoperative hospital stay; 4) pain score; 5) wound healing duration 6) wound infection.

Results: There was high statistical difference between ultrasonic coagulation over conventional hemorrhoidectomy regarding intraoperative blood loss, operative time, wound healing and duration, post operative pain in day 1 & 2, no difference was shown in post operative pain after 1 week.

Conclusion: The study shows that the ultrasonic coagulation is superior to the conventional hemorrhoidectomy regarding intraoperative blood loss, operative time, and wound healing and early post operative pain.

Keywords: Harmonic scalpel; Ultrasonic coagulation; Hemorrhoidectomy; Milligan & Morgan

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Received Date: *28 Sep 2016*
Accepted Date: *06 Dec 2016*
Published Date: *09 Dec 2016*

Citation:
Elbarmelgi MY, Farag AFA. Comparative Study of Outcome of Conventional versus Ultrasonic Coagulation Hemorrhoidectomy. Clin Surg. 2016; 1: 1242.

Introduction

Piles (known also as Hemorrhoids) are part of the normal anatomy of the anal canal. When they become swollen or inflamed they are considered pathological. They are cushions composed of arterio-venous channels with connective tissue that helps easy passage of fecal matter. The symptoms of pathological hemorrhoids differ according to the type. Painless rectal bleeding is the main presentation of internal hemorrhoids while pain, bleeding and/or prolapse are characteristic for external hemorrhoids [1].

Hemorrhoids are vascular cushions that lie beneath the epithelial lining of the anal canal; they consist of arterio venous communications mainly between branches from superior rectal artery and others from superior hemorrhoidal artery, or may be between branches from inferior and middle hemorrhoidal arteries. They are usually found in three main locations: right anterior, right posterior and left lateral portions [2]. Proposed etiologic factors include vascular congestion that could be derived from prolonged straining or increase intra-abdominal pressure due to pregnancy, obesity or ascites and mucosal prolapse that may develop from derangement of the internal sphincter or aging that cause weakness of the anatomic structures that support the muscularis submucosa leading to prolapse of the hemorrhoidal tissues [3,4].

Hemorrhoids may be (1) external that originate below dentate line arising from the inferior hemorrhoidal plexus, and are lined with modified squamous epithelium, which is richly innervated with somatic pain fibers. (2) Internal hemorrhoids that originate above the dentate line, arising from the superior hemorrhoidal plexus, and are covered with mucosa. (3) Mixed hemorrhoids arising from both the inferior and superior hemorrhoidal plexi, they are covered by mucosa superiorly and skin inferiorly [5]. Patients with hemorrhoidal disease may experience any of the following symptoms: Bleeding, painful mass, anal swelling, discomfort and discharge, soiling and purities. However, the most frequent complaint is painless bleeding, which usually appears early in the progress of the disease, also some patients with grade III to IV may experience functional

Figure 1: Parts of the harmonic scalpel device.

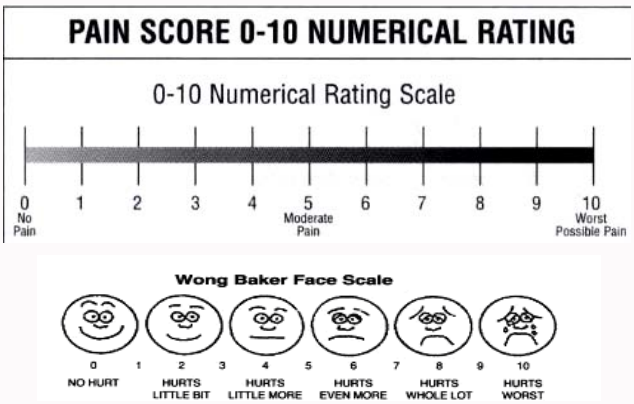

Figure 2: Pain scoring systems.

bowel symptoms which is associated with irritable bowel syndrome, that's need to be taken into consideration when selecting treatment [6]. Recommended treatment consists of increasing oral fluids to maintain hydration, fiber intake, sitz baths, NSAIDS analgesics and rest. Surgery is reserved for resistant cases that fail to improve following these measures [7]. Other nonsurgical methods of treatment include Sclerotherapy [8], rubber band ligation and infrared coagulation [9]. Surgical management includes Ferguson's (closed) hemorrhoidectomy [5] Milligan-Morgan (open) hemorrhoidectomy, Harmonic and LigaSure hemorrhoidectomy and Doppler guided hemorrhoidal artery ligation [10,11]. The search of the most effective and less painful technique for the treatment of hemorrhoids is still a major concern for colorectal surgeons. Ultrasonic coagulation is an evolving technique that uses the ultrasonic coagulation device in performing the classic Milligan and Morgan hemorrhoidectomy. This operation is the most used surgical option in treatment of grade III and IV hemorrhoids and is still considered the most effective treatment in term of hemorrhoid relapse [12].

Although this technique is considered as invasive as traditional diathermy Milligan and Morgan excision it has been demonstrated to improve significantly postoperative pain, bleeding and, therefore, in-hospital stay compared to Milligan–and Morgan, besides it has a fast learning curve [13]. The benefits mentioned above makes the operation easier, safer and quicker which justify the increased price of ultrasonic device compared to the diathermy [13]. Ultrasonic Coagulation and Cutting Devices use energy generated from ultrasonic vibration. Ultrasonic energy is an efficient alternative to electro surgery. The device cuts and coagulates by using much lower temperatures than those produced by traditional diathermy or lasers. Moreover, no electricity goes to or through the patient [14]. The ultrasonically activated scalpel (UAS) has the benefit of its ability to cut and coagulate tissues simultaneously with relatively limited lateral thermal injury. The UAS has been used in laparoscopic surgeries and open surgeries of the lung and liver [14].

The Harmonic scalpel is a cutting instrument used during surgical procedures to simultaneously cut and coagulate tissue.

Methodology

Patients

This was a prospective study that included 20 patients of 3rd or 4th degree hemorrhoids of age ranging twenty to fifty years old and from both sexes attending to faculty of medicine hospital (Kasr El-Aini) during the period from July 2010 till April 2011. The patients will randomly allocated into two groups each included ten patients, first group had had conventional hemorrhoidectomy (Milligan and Morgan), the second group had hemorrhoidectomy by ultrasonic coagulation using harmonic scalpel.

Methods

Proper history taking and full examination to exclude other causes of anal pain.

The following was monitored in both conventional and ultrasonic coagulation hemorrhoidectomy

During operation

- Length of the procedure
- Blood loss

Postoperative

- Postoperative pain
- Wound healing
- Duration of hospital stay

As regarding pain

A day before surgery, the patients will be instructed how to complete the 0 to 10 visual analog scale (VAS) interview. The intensity of postoperative pain will be measured every 8 hours during the first 24 hours by means of a 0 to 10 visual analog scale (VAS: 0….no pain and 10…maximum pain experienced) and during weekly follow up visits. The patient selects a number (verbal version) or marks the scale (written version), corresponding to the pain. A newer innovation is a picture scale. This tool consists of a series of four to six faces depicting different expressions ranging from a happy smiling face to a sad teary face. Patients reportedly prefer to use the face scale over the NRS or VAS scales because it is easier and may be particularly useful in the patient with a communication problem (e.g., hard of hearing, language fluency). Thus, pain is assessed before the

Table 1: Classification of patients according to gender.

			Group		Total
			Harmonic	Conventional	
Sex	female	Count.	2	4	6
		% Within Group.	20.0%	40.0%	30.0%
	male	Count.	8	6	14
		% Within Group.	80.0%	60.0%	70.0%
Total		Count.	10	10	20
		% Within Group.	100.0%	100.0%	100.0%

Table 2: Chi-square test for gender distribution.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	0.952(b)	1	0.329		
Continuity Correction(a)	0.238	1	0.626		
Likelihood Ratio	0.966	1	0.326		
Fisher's Exact Test				0.628	0.314
N of Valid Cases	20				

Table 3: Blood loss in each group.

			Group		Total
			Harmonic	Conventional	
Bl. loss	mild	count	4	7	11
		% within Group	40.00%	70.00%	55.00%
	moderate	count	0	3	3
		% within Group	0.00%	30.00%	15.00%
	no	count	6	0	6
		% within Group	60.00%	0.00%	30.00%
Total		count	10	10	20
		% within Group	100.00%	100.00%	100.00%

Table 4: Chi-square test for blood loss.

	Value	df	Asymp. Sig. (2-sided)(p-value)
Pearson Chi-Square	9.818(a)	2	0.007
Likelihood Ratio	13.305	2	0.001
N of Valid Cases	20		

Table 5: Patients sorted according to hospital stay.

		Group		Total
		Harmonic	Conventional	
Hospital stay	Count	10	10	20
	% within Group	100.0%	100.0%	100.0%
Total	Count	10	10	20
	% within Group	100.0%	100.0%	100.0%

Table 6: Chi-Square Tests for postoperative hospital stay.

Pearson Chi-Square	(a)
N of Valid Cases	20

operation or intervention and again immediately after the operation; it is subsequently measured at regular intervals. Repeated pain assessment is a fundamental tool for improving the quality of acute pain management.

Analgesia used

Patients of both groups will receive both local anesthesias before the operation and NSAIDs at regular interval (every 8 hours).

Exclusion criteria

- Patients suffering from other anal conditions e.g. (anal fistula, anal fissure, pilonidal sinus, etc...)
- Patient's stool or gas incontinence
- Patients with recurrent hemorrhoids
- Patients with chronic pain syndrome and neurologic deficits

The statistics

Data were statistically described in terms of range, mean±standard deviation (±SD), median, frequencies (number of cases) and percentages when appropriate. Comparison of quantitative variables between the study groups was done using Mann Whitney *U* test for independent samples. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. *P* values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs Microsoft Excel 2007 (Microsoft Corporation, NY, and USA) and SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

Gender distribution

Patients were divided according to gender in each group as shown in Table 1. Using Chi-square tests the 2 groups where found to be matched for gender distribution in Table 2.

Blood loss

Patients were divided according to blood loss in each group as shown in Table 3. Chi-square test shows significant difference in blood loss in both groups as shown in Table 4.

Postoperative hospital stay

Patients of both groups are sorted according to hospital stay as shown in Table 5. Chi-square test shows no difference between both groups regarding postoperative hospital stay as shown in Table 6.

Wound healing duration

Patients within both groups are divided according to wound healing duration as shown in Table 7. Chi-square test shows high statistical difference between both groups according to wound healing

Table 7: Patients of both groups are divided according to wound healing duration.

			Group		Total
			Harmonic	Conventional	
Wound healing Dur.	2 weeks	Count	4	0	4
		% within Group	40.00%	0.00%	20.00%
	3 weeks	Count	6	0	6
		% within Group	60.00%	0.00%	30.00%
	4 weeks	Count	0	5	5
		% within Group	0.00%	50.00%	25.00%
	5 weeks	Count	0	5	5
		% within Group	0.00%	50.00%	25.00%
	Total	Count	10	10	20
		% within Group	100.00%	100.00%	100.00%

Table 8: Chi-square test for wound healing duration.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.000(a)	3	0.000
Likelihood Ratio	27.726	3	0.000
Linear-by-Linear Association	14.943	1	0.000
N of Valid Cases	20		

Table 9: Patients divided according to wound discharge and infections.

			Group		Total
			Harmonic	Conventional	
Discharge & inf.	mild	Count	4	6	10
		% within Group	40.0%	60.0%	50.0%
	moderate	Count	0	4	4
		% within Group	0.0%	40.0%	20.0%
	no	Count	6	0	6
		% within Group	60.0%	0.0%	30.0%
Total		Count	10	10	20
		% within Group	100.0%	100.0%	100.0%

Table 10: Chi-square test for wound infection and discharge in both groups.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.400(a)	2	0.006
Likelihood Ratio	14.266	2	0.001
N of Valid Cases	20		

Table 11: Patients of both groups according to the perioperative pain.

Group		Pain-D1	Pain-D2	Pain-w1
Harmonic	Mean	2.30	3.00	5.30
	N	10	10	10
	Std. Deviation	1.494	1.886	1.947
	Minimum	1	2	3
	Maximum	6	8	10
	Median	2.00	2.00	5.00
Conventional	Mean	6.10	6.70	5.30
	N	10	10	10
	Std. Deviation	2.025	1.252	0.949
	Minimum	2	4	4
	Maximum	9	8	7
	Median	6.50	7.00	5.00
Total	Mean	4.20	4.85	5.30
	N	20	20	20
	Std. Deviation	2.608	2.455	1.490
	Minimum	1	2	3
	Maximum	9	8	10
	Median	3.50	5.00	5.00

duration as shown in Table 8.

Discharge & infection

Patients within both groups are divided according to wound discharge and infection as shown in Table 9. Chi-square test shows statistical difference between both groups regarding wound infection and discharge as shown in Table 10.

Table 12: Mann-witney test for postoperative pain.

	Pain-D1	Pain-D2	Pain-w1
Mann-Whitney U	8.000	9.000	43.500
Wilcoxon W	63.000	64.000	98.500
Z	-3.215	-3.165	-0.509
Asymp. Sig. (2-tailed)	0.001	0.002	0.611
Exact Sig. [2*(1-tailed Sig.)]	0.001(a)	0.001(a)	0.631(a)

Postoperative pain

Both Groups are sorted according to preoperative pain and post operative pain after 1 day, 2 days and 1 week as shown on Table 11. Mann-witney *U* test shows statistical difference between both groups in postoperative pain in which the group, which perform ultrasonic coagulation hemorrhoidectomy, experiences less postoperative pain in day 1 and day 2 than the group which perform conventional hemorrhoidectomy. There is no difference in both groups in postoperative pain after 1 week. This is shown in Table 12. Table 13 shows mean, median, standard deviation in both groups regarding age, Intraoperative time, wound healing duration, hospital stay, and postoperative pain. Table 14 shows Mann-Whitney test for age, intra operative time, hospital stay, wound healing duration, postoperative pain for both groups. Table 15 shows test statistics for Mann- Whitney test for both groups regarding age, wound healing duration, intraoperative time, hospital stay, postoperative pain shows statistical difference in wound healing duration, intraoperative time, and postoperative pain in day 1 and day 2, no statistical difference in postoperative pain after 1 week.

Discussion

Analysis of the results obtained from this study showed that the ultrasonic coagulation hemorrhoidectomy is better than the congenital Milligan & Morgan hemorrhoidectomy regarding Intraoperative time which was ranging between 15 to 20 minutes in the ultrasonic coagulation hemorrhoidectomy while it ranges between 30 to 35 minutes in the conventional hemorrhoidectomy. Also ultrasonic coagulation results in less Intraoperative bleeding in comparison to the conventional hemorrhoidectomy in which there was a high statistical difference between both groups as shown in the last chapter Table 4. Regarding wound healing duration, the ultrasonic coagulation leads to more rapid wound healing ranging between 2 to 3 weeks while in conventional hemorrhoidectomy wound healing duration ranges between 4 to 5 weeks. Regarding wound infection discharge, ultrasonic coagulation hemorrhoidectomy shows much less wound infection and discharge in comparison to the conventional hemorrhoidectomy which shows high statistical difference as shown in the last chapter Table 10. Regarding postoperative pain patients who undergo ultrasonic coagulation hemorrhoidectomy experiences less post operative pain in day 1 and day 2 compared to patients who undergo conventional hemorrhoidectomy. There was high statistical difference between both groups in post operative pain during day 1 and 2 but there was no clear difference in post operative pain after 1 week from the operation. This was shown in the last chapter Table 11 and 12. The results of this study appeared to be nearly the same as other studies. In 2002, Ramadan E, Vishne T and Dersnic Z described less post operative pain, less post operative hospitalization and decreased duration of surgery with ultrasonic coagulation hemorrhoidectomy compared to conventional Milligan and Morgan hemorrhoidectomy [15].

Table 13: Mean, median, standard deviation for both groups.

Group		Age	IO time	Hospital stay	Wound healing Dur. In weeks	Pain-D1	Pain-D2	Pain-w1
Harmonic	Mean	35.90	14.70	1.00	2.60	2.30	3.00	5.30
	N	10	10	10	10	10	10	10
	Std. Deviation	7.078	2.452	0.000	0.516	1.494	1.886	1.947
	Minimum	22	10	1	2	1	2	3
	Maximum	44	18	1	3	6	8	10
	Median	37.50	15.00	1.00	3.00	2.00	2.00	5.00
Conventional	Mean	32.90	31.70	1.00	4.50	6.10	6.70	5.30
	N	10	10	10	10	10	10	10
	Std. Deviation	10.503	2.058	0.000	0.527	2.025	1.252	0.949
	Minimum	19	30	1	4	2	4	4
	Maximum	50	35	1	5	9	8	7
	Median	31.00	31.00	1.00	4.50	6.50	7.00	5.00
Total	Mean	34.40	23.20	1.00	3.55	4.20	4.85	5.30
	N	20	20	20	20	20	20	20
	Std. Deviation	8.852	8.995	0.000	1.099	2.608	2.455	1.490
	Minimum	19	10	1	2	1	2	3
	Maximum	50	35	1	5	9	8	10
	Median	34.00	24.00	1.00	3.50	3.50	5.00	5.00

Table 14: Mann-Whitney test for both groups.

	Group	N	Mean Rank	Sum of Ranks
Age	Harmonic	10	11.80	118.00
	Conventional	10	9.20	92.00
	Total	20		
IO time	Harmonic	10	5.50	55.00
	Conventional	10	15.50	155.00
	Total	20		
Hospital stay	Harmonic	10	10.50	105.00
	Conventional	10	10.50	105.00
	Total	20		
Wound healing Dur.	Harmonic	10	5.50	55.00
	Conventional	10	15.50	155.00
	Total	20		
Pain-PreOp.	Harmonic	10	12.20	122.00
	Conventional	10	8.80	88.00
	Total	20		
Pain-D1	Harmonic	10	6.30	63.00
	Conventional	10	14.70	147.00
	Total	20		
Pain-D2	Harmonic	10	6.40	64.00
	Conventional	10	14.60	146.00
	Total	20		
Pain-w1	Harmonic	10	9.85	98.50
	Conventional	10	11.15	111.50
	Total	20		

Also in 2002, Chung CC et al. [16] conducted a prospective, double blinded study, comparing different excision techniques: Harmonic Scalpel hemorrhoidectomy, bipolar scissors hemorrhoidectomy, and regular scissors. The study population included 89 patients with grade 4 hemorrhoidal disease. The study showed that the Harmonic Scalpel was as efficient as were bipolar scissors in terms of reducing

Table 15: Statistics for Mann-Whitney test, grouping variable: group.

	Age	IO time in minutes	Hospital stay	Wound healing Dur. In weeks	Pain-D1	Pain-D2	Pain-w1
Mann-Whitney U	37.000	0.000	50.000	0.000	8.000	9.000	43.500
Wilcoxon W	92.000	55.000	105.000	55.000	63.000	64.000	98.500
Z	-0.985	-3.827	0.000	-3.907	-3.215	-3.165	-0.509
Asymp. Sig. (2-tailed)	0.325	0.000	1.000	0.000	0.001	0.002	0.611
Exact Sig. [2*(1- tailed Sig.)]	0.353(a)	0.000(a)	1.000(a)	0.000(a)	0.001(a)	0.001(a)	0.631(a)

postoperative hemorrhage. Harmonic Scalpel was superior to the other methods in terms of postoperative pain and, consequently, patient satisfaction. Recovery time was similar with all the techniques. In 2001, David N Armstrong et al conducted a prospective, randomized study on the same topic which demonstrates significantly reduced postoperative pain after harmonic scalpel hemorrhoidectomy compared to the electro cautery controls. They stated that reduced post operative pain in ultrasonic coagulation hemorrhoidectomy likely results from the avoidance of the lateral thermal injury [17]**.** In 2008, Abohashem AA, Sarhan A, Aly AM conducted a single blinded randomized trial at Zagazig University hospital during the period from July 2007 to December 2008. Patients underwent surgical excision of complex grade III or grade IV hemorrhoids. They were divided into two groups: (A) ultrasonic coagulation Hemorrhoidectomy group and (B) Bipolar Electro-cautery Hemorrhoidectomy group. Pain levels scoring and postoperative complications were analyzed. This study demonstrates significantly reduced postoperative pain after ultrasonic coagulation Hemorrhoidectomy compared with bipolar electro-cautery Hemorrhoidectomy. Most likely, this result came from the avoidance of excessive lateral thermal injury caused by bipolar electrocautery [18]. In 2007, Ivanov Dejan et al. [19] made as study on seventy-seven (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 1st, 2nd and 7th postoperative 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 postoperative pain with better hemostasis, compared with Milligan-Morgan's method of treating hemorrhoidal disease. On the other hand Khan S et al. [20] conducted prospective study that compared Harmonic Scalpel hemorrhoidectomy with traditional closed hemorrhoidectomy, Hear ultrasonic coagulation hemorrhoidectomy did not show any advantage in postoperative 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 [21].

Conclusion

Patients who perform ultrasonic coagulation hemorrhoidectomy experiences less post operative pain in day 1 & 2 but no difference after 1 week. Faster wound healing occurs with ultrasonic coagulation hemorrhoidectomy. Ultrasonic coagulation hemorrhoidectomy has less Intraoperative time. Ultrasonic coagulation hemorrhoidectomy has less Intraoperative bleeding.

References

1. Arbman G, Krook H, Haapaniemi S. Closed vs. open hemorrhoidectomy-is there any difference? Dis Colon Rectum. 2000; 43: 31-34.
2. Thomson WH. The nature of haemorrhoids. Br J Surg. 1975; 62: 542-552.
3. Milsom JW. Hemorrhoidal disease. In: Beck DE, Wexner SD, editors. Fundamentals of Anorectal Surgery. New York: McGraw-Hill Inc. 1992. 192-214.
4. Haas PA, Fox TA Jr, Haas GP. The pathogenesis of hemorrhoids. Dis Colon Rectum. 1984; 27: 442-450.
5. Corman ML, editor. Colon and rectal surgery. 5th ed. Philadelphia: Lippincott Williams & Wilkins. 2004.
6. Johanson JF, Sonnenberg A. The prevalence of hemorrhoids and chronic constipation. An epidemiologic study. Gastroenterology. 1990; 98: 380-386.
7. Altomare DF, Roveran A, Pecorella G, Gaj F, Stortini E. The treatment of hemorrhoids: guidelines of the Italian Society of Colorectal Surgery. Tech Coloproctol. 2006; 10: 181-186.
8. Madoff RD, Fleshman JW; Clinical Practice Committee, American Gastroenterological Association. American Gastroenterological Association technical review on the diagnosis and treatment of hemorrhoids. Gastroenterology. 2004; 126: 1463-1473.
9. Johanson JF, Rimm A. Optimal nonsurgical treatment of hemorrhoids: a comparative analysis of infrared coagulation, rubber band ligation, and injection sclerotherapy. Am J Gastroenterol. 1992; 87: 1600–1606.
10. Morinaga K, Hasuda K, Ikeda T. A novel therapy for internal hemorrhoids: ligation of the hemorrhoidal artery with a newly devised instrument (Moricorn) in conjunction with a Doppler flowmeter. Am J Gastroenterol. 1995, 90: 610-613.
11. Scheyer M, Antonietti E, Rollinger G, Mall H, Arnold S. Doppler-guided hemorrhoidal artery ligation. Am J Surg. 2006; 191: 89-93.
12. Infantino A, Bellomo R, Dal Monte PP. Transanal haemorrhoidal artery echodoppler ligation and anopexy (THD) is effective for II and III degree haemorrhoids: a prospective multicentric study. Colorectal Dis (Epub ahead of print). 2009.
13. Altomare DF, Milito G, Andreoli R, Arcanà F, Tricomi N, Salafia C, et al. Ligasure for Hemorrhoids Study Group. Ligasure Precise vs. conventional diathermy for Milligan–Morgan hemorrhoidectomy: a prospective, randomized, multicenter trial. Dis Colon Rectum. 2008; 51: 514-519.
14. http://www.findarticles.com/p/articles/mi_qa3909/is_200101/ai_n8931389.
15. Ramadan E, Vishne T, Dreznik Z. Harmonic scalpel hemorrhoidectomy: preliminary results of a new alternative method. Tech Coloproctol. 2002; 6: 89-92.
16. 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.
17. Armstrong DN, Ambroze WL, Schertzer ME, Orangio GR. Harmonic

Scalpel vs. electrocautery hemorrhoidectomy: a prospective evaluation. Dis Colon Rectum. 2001; 44: 558-564.

18. Abohashem AA, Sarhan A, Aly AM. Harmonic Scalpel® compared with bipolar electro-cautery hemorrhoidectomy: A randomized controlled trial. 2010; 8: 243-247.

19. Ivanov D, Babovic S, Selesi D, Ivanov M, Cvijanovic R. Harmonic Scalpel hemorrhoidectomy: a painless procedure? Med Pregl. 2007; 60: 421-426.

20. Khan S, Pawlak SE, Eggenberger JC, Lee CS, Szilagy 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.

21. Tan JJ, Soew-choen F. Prospective, randomized trial comparing diathermy and Harmonic Scalpel hemorrhoidectomy. Dis Colon Rectum. 2001; 44: 677-679.