Original Article

Comparison among LigaSure, Harmonic Scalpel, and Conventional Hemorrhoidectomy for Symptomatic Hemorrhoids

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Key Words
LigaSure;
Harmonic Scalpel;
Hemorrhoidectomy

Purpose. This study aimed to compare the short-term outcomes of LigaSure and Harmonic Scalpel hemorrhoidectomy with those of conventional hemorrhoidectomy.
Methods. We assessed patients with Grade III or IV hemorrhoids who underwent LigaSure, Harmonic Scalpel, or conventional hemorrhoidectomy from July 2018 to January 2019. A total of 50 patients were included in this study.
Results. The patients were divided into three groups: conventional (n = 18), LigaSure (n = 16), and Harmonic Scalpel hemorrhoidectomy (n = 16). The median operation time was 17.5 min for the LigaSure hemorrhoidectomy group, 18.75 min for the Harmonic Scalpel hemorrhoidectomy group, and 28.89 min for the conventional hemorrhoidectomy group ($p < 0.001$). Further, intraoperative blood loss and pain scores were significantly lower in the LigaSure and Harmonic Scalpel hemorrhoidectomy groups than in the conventional hemorrhoidectomy group ($p < 0.001$). The median number of analgesic injections used during admission and hospital days was lower in the LigaSure and Harmonic Scalpel hemorrhoidectomy groups than in the conventional hemorrhoidectomy group ($p < 0.05$). However, no significant difference was observed in terms of the incidence of early postoperative complications.
Conclusions. LigaSure and Harmonic Scalpel hemorrhoidectomy provide a superior alternative to conventional hemorrhoidectomy owing to shorter operation time and length of hospital stay as well as lower postoperative pain, volume of blood loss, and analgesic requirements.
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Hemorrhoids are an extremely common condition defined as the symptomatic enlargement and protrusion of the anal cushions.[1] However, there are no statistical data available about the incidence of hemorrhoids in Taiwan. According to an epidemiological study conducted in the USA, 4%-5% of adults develop hemorrhoids, with the highest prevalence being between 45 and 65 years.[2]

Conservative treatment is often sufficient for early-stage hemorrhoids (Grades I and II). However, in late-stage hemorrhoids (Grades III and IV), surgical treatment is usually required.

The most effective hemorrhoidectomy techniques include the Milligan-Morgan open hemorrhoidectomy

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and Ferguson closed hemorrhoidectomy. These methods are similar and considered conventional methods.[3,4]

In conventional hemorrhoidectomy, hemorrhoidal tissues are removed using a scalpel and electrocautery and the pedicle is ligated. The most significant complications of hemorrhoid surgery are postoperative pain and bleeding.[5] Postoperative pain is related to the surgical incisions, anal mucosa suturing, use of cautery, and possible surgical-site infection.[6]

In recent years, many surgical facilities have been established owing to technological developments. To date, hemorrhoidectomies are performed with novel instruments such as bipolar electrothermal devices, ultrasonic scalpels, and circular staplers. The evolution of techniques and equipment has resulted in decreased pain and number of complications, such as bleeding, after hemorrhoidectomy.

The Harmonic Scalpel is an energy source, which uses ultrasonic vibrations at a frequency of 55.5 KHz and simultaneously cuts and coagulates up to 2 mm of blood vessels. The Harmonic Scalpel is advantageous because it causes extremely minimal lateral thermal injury to tissues. Decreased lateral thermal injury (< 1.5 mm) at the surgical site results in decreased postoperative pain.[7]

The LigaSure vessel-sealing system is a bipolar electrothermal device that seals blood vessels with a calculated arrangement of pressure and radio frequency. It ensures complete coagulation of blood vessels up to 7 mm in diameter with minimal surrounding thermal spread and limited tissue charring. Sealing of hemorrhoidal tissues between the LigaSure forceps is assumed to be achieved with minimal collateral thermal spread and limited tissue charring, leading to a reduced incidence of postoperative pain.

Hemorrhoidectomy using these two energy devices might lead to better outcomes. Thus, performing hemorrhoidectomy with these two energy devices leads to lower operation time, and such devices provide a less painful alternative to conventional techniques. The present study aimed to compare the outcomes of patients with Grade III or IV hemorrhoids who underwent hemorrhoidectomy using these energy devices or the conventional closed technique.

Materials and Methods

Study design

This retrospective study was conducted at the Department of Surgery of Chia-Yi Christian Hospital. In total, 50 patients with symptomatic Grade III or IV hemorrhoids who underwent surgery conducted by a single surgeon between July 2018 and January 2019 were enrolled. The patients were divided into three groups: conventional (n = 18), LigaSure (n = 16), and Harmonic Scalpel hemorrhoidectomy (n = 16). The exclusion criteria were as follows: individuals with thrombosed/strangulated hemorrhoids, concomitant perianal disease, history of recurrent perianal surgery, those at risk of postoperative bleeding, and those unfit for surgery and anesthesia. One soaked 3 × 3 gauze is equivalent to 4 mL intraoperative blood loss. Patients who were receiving anticoagulant medication or aspirin were instructed to stop their use 7 days prior to the surgery.

Surgery

All patients underwent preoperative laboratory tests, chest radiography, electrocardiography, and urinalysis. They were admitted to the hospital on the day of surgery. All patients used monosodium phosphate enema once before the surgery, and prophylactic antibiotics were injected before transporting the patients to the surgical room. All patients received spinal or general anesthesia according to the preference of the patient, surgeon, and anesthesiologist. The patients were placed in the jackknife position. Tapes were attached to both sides of the buttocks to expose the anus, and a Hill-Ferguson retractor was inserted into the anal canal to visualize the surgical field. The Ferguson closed technique was used. Hemorrhoidal pedicles originating above the dentate line to above the hemorrhoidal plexus were removed using a scalpel and electrocautery device; 4-0 vicryl suture was used to close the wound.

LigaSure hemorrhoidectomy with submucosal dissection was first performed with a skin incision created at the junction of the hemorrhoids and peri-

anal skin using a scalpel followed by dissection of the hemorrhoidal bundles off the underlying sphincters. A LigaSure handset was used for the dissected hemorrhoids up to their pedicles while ensuring that the underlying sphincters were not injured. The device was activated to seal the mucosal edges. A feedback-controlled sensor signaled the completion of coagulation, and the coagulated tissue was excised along the line of the coagulum. During hemorrhoidectomy using the Harmonic Scalpel, the hemorrhoidal tissue and its pedicle were excised up to the apex region without damaging the internal sphincter using vascular forceps. The hemorrhoidal mucosa and coagulated blood vessels of the hemorrhoid were excised with a Harmonic Scalpel, and mucosal suturing with 4-0 vicryl was performed.

Postoperative intervention

After the surgery, neomycin ointment was topically applied on the wound, which was covered by gauze. Then, the gauze was removed, and sitz baths were initiated on the postoperative day 1 for all patients. Further, a combination of 37.5 mg oral tramadol and 325 mg acetaminophen (Traceton) was orally administered at a regular dose if the patients had no contraindications. If a patient continued experiencing pain, 30 mg ketorolac was intravenously administered. In cases of severe bladder distention or if a patient failed to urinate 8 h after the surgery, an intermittent Foley catheter was inserted. Once stable and when the wound stopped bleeding or oozing, the patients were discharged. We measured and recorded rest pain using the visual analog scale (VAS), volume of blood loss, and any occurrence of urinary retention. The VAS pain score ranges from 0 (indicating no pain) to 10 (indicating severe pain). All patients were instructed to grade the severity of pain on a scale of 0-10 in the evening of the surgery day (day 0), next day (day 1), and after a week during follow-up (day 7).

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences software version 16 (SPSS Inc., Chicago, IL, USA). A p-value of < 0.05 was considered statistically significant. Continuous and categorical variables were compared using the Kruskal-Wallis and chi-square test, respectively. One-way analysis of variance was used to compare the three groups in terms of age.

Results

The characteristics of 50 symptomatic patients with Grade III or IV hemorrhoids are summarized in Table 1. Among the patients, 18 (36%) were men and 32 (64%) were women. The mean ages of the patients in the conventional, LigaSure, and Harmonic Scalpel hemorrhoidectomy groups were 47.33 ± 10.13, 47.81 ± 9.70, and 49.13 ± 10.12 years, respectively. No sig-

Table 1. Characteristics of the patients in terms of type of operation

	Type of operation			p-value
	Conventional hemorrhoidectomy group n = 18	LigaSure hemorrhoidectomy group n = 16	Harmonic Scalpel hemorrhoidectomy group n = 16	
Age (years) mean ± SD	47.33 ± 10.13	47.81 ± 9.70	49.13 ± 10.12	0.985
Sex				0.888
Male	7 (38.89)	5 (31.25)	6 (37.50)	
Female	11 (61.11)	11 (68.75)	10 (62.50)	
Grade				0.913
III	4 (22.22)	4 (25.00)	3 (18.75)	
IV	14 (77.78)	12 (75.00)	13 (81.25)	

SD, standard deviation.

nificant difference was observed among the three groups in terms of age, sex, and grade of hemorrhoids. Table 2 shows the perioperative details and postoperative outcomes of the three groups. The median operation time of the conventional, LigaSure, and Harmonic Scalpel hemorrhoidectomy groups was 28.89 ± 6.76, 17.50 ± 3.16, and 18.75 ± 2.24 min, respectively, indicating significantly longer operation time in the conventional hemorrhoidectomy group than in the other groups ($p < 0.001$). Intraoperative blood loss was significantly higher in the conventional hemorrhoidectomy group than in the LigaSure and Harmonic Scalpel hemorrhoidectomy groups (28.06 ± 7.30, 13.44 ± 3.01, and 12.50 ± 2.58 mL, respectively; $p < 0.001$). The VAS pain scores on postoperative days 0, 1, and 7 were significantly higher in the conventional hemorrhoidectomy group than in the other groups ($p < 0.001$). In addition, the number of parenteral analgesic injections was higher and the length of hospital stay was significantly longer in the conventional hemorrhoidectomy group than in the other groups ($p < 0.05$). However, the operation time, volume of blood loss, postoperative VAS pain score, length of hospital stay, and number of parenteral analgesic injections did not significantly differ between the LigaSure and Harmonic Scalpel hemorrhoidectomy groups. Postoperative complications were observed in 2 (12.5%) patients each in the LigaSure and Harmonic Scalpel hemorrhoidectomy groups and in 5 (27.78%) in the conventional hemorrhoidectomy group. Urinary retention requiring temporary catheterization was observed in 1 (6.25%) patient in the LigaSure and Harmonic Scalpel hemorrhoidectomy groups and 3 (16.67%) in the conventional hemorrhoidectomy group. Bleeding in the early postoperative period (within 7 days of surgery) developed in 1 (6.25%) patient in the LigaSure and Harmonic Scalpel hemorrhoidectomy groups and 2 (11.11%) in the conventional hemorrhoidectomy group. All patients who presented bleeding recovered after conservative treatment, and none of them required further surgical intervention. Postoperative complications among these three groups did not show significant difference.

Table 2. Operative and postoperative parameters

	Type of operation			*p*-value
	Conventional hemorrhoidectomy group n = 18	LigaSure hemorrhoidectomy group n = 16	Harmonic Scalpel hemorrhoidectomy group n = 16	
Operation time (min) mean ± SD	28.89 ± 6.76	17.50 ± 3.16[a]	18.75 ± 2.24[a]	< 0.001
Volume of blood loss	28.06 ± 7.30	13.44 ± 3.01[a]	12.50 ± 2.58[a]	< 0.001
VAS pain score				
Day 0	6.22 ± 0.81	4.44 ± 0.63[a]	4.13 ± 0.72[a]	< 0.001
Day 1	5.22 ± 0.88	3.38 ± 0.62[a]	3.06 ± 0.44[a]	< 0.001
Day 7	2.33 ± 0.84	1.44 ± 0.63[a]	1.38 ± 0.50[a]	< 0.001
Length of hospital stay	1.94 ± 0.64	1.44 ± 0.51[a]	1.31 ± 0.48[a]	0.004
Postoperative complication				
Hemorrhage				0.831
N	16 (88.89)	15 (93.75)	15 (93.75)	
Y	2 (11.11)	1 (6.25)	1 (6.25)	
Urinary retention				0.499
N	15 (83.33)	15 (93.75)	15 (93.75)	
Y	3 (16.67)	1 (6.25)	1 (6.25)	
Number of ketorolac injections	1.28 ± 0.46	0.94 ± 0.25[a]	0.88 ± 0.34[a]	0.006

SD, standard deviation.

[a] *p*-value < 0.05 vs. conventional hemorrhoidectomy group.

Discussion

Hemorrhoids are an extremely common anorectal

disease defined as the symptomatic enlargement and distal displacement of the anal cushions. Globally, millions of individuals present this condition, and it is considered a major socioeconomic and medical issue. Approximately 10 million Americans present this condition annually, with a prevalence of 4.4%.[8] However, there are no statistical data available about the incidence of hemorrhoids in Taiwan.

Several factors, including constipation and prolonged straining, are associated with symptomatic hemorrhoids. Distortion of the vascular channel, with destructive changes in the supporting connective tissue within the anal cushions, is a common finding in hemorrhoids.[9]

Hemorrhoids are extremely vascular submucosal cushions that generally lie along the anal canal in three columns: left lateral, right anterior and right posterior positions. Hemorrhoids play an important physiological role in protecting the anal sphincter muscles and reinforcing closure of the anal canal during moments involving increased abdominal pressure (e.g., coughing and sneezing) to prevent incontinence and provide 15%-20% of the anal canal resting pressure.[10]

Increase in abdominal pressure elevates the pressure in the inferior vena cava, causing these vascular cushions to engorge and prevent leakage. This tissue is also believed to help distinguish stool, liquid, and gas in the anal canal.[10]

Conventional hemorrhoidectomy techniques, including Milligan-Morgan open hemorrhoidectomy and Ferguson closed hemorrhoidectomy, are effective and suitable treatments for Grades III and IV hemorrhoids. However, these conventional surgeries can cause complications such as postoperative pain and bleeding.[11]

The resulting pain-related complications after conventional hemorrhoidectomy are often the main factors that account for prolonged hospital stays and delayed recovery.

In the past few years, hemorrhoid surgeries conducted in newly developed facilities have resulted in less postoperative pain and bleeding as well as shorter operation time and hospital stay.[12,13]

Circular stapling devices for prolapsed hemorrhoids have recently been introduced. However, these devices have been criticized because they cannot treat the external component of hemorrhoids and skin tags. In addition, they are costly, and the procedure often leads to complications such as postoperative bleeding, rupture of the anastomotic site, pelvic sepsis, anastomotic stricture, and rectovaginal fistula.[14,15]

When performing hemorrhoidectomy with energy devices, intraoperative bleeding is minimized and the visualization of the surgical field is better. Performing simultaneous resection and hemostasis reduces the operation time and related complications, such as postoperative bleeding, pain, and infection, by decreasing damage to the surrounding mucosal tissues. In contrast, when performing conventional hemorrhoidectomy, the surrounding mucosal tissues and blood vessels can be damaged during resection of the hemorrhoidal tissue, and the time to hemostasis of blood vessels and tissues may increase the operation time and risk of postoperative bleeding. In addition, several studies have reported that the use of the LigaSure or ultrasonic scalpel hemorrhoidectomy results in significantly shorter operation time and less postoperative bleeding than that of conventional hemorrhoidectomy.[16,17]

The main finding of the present study is that Harmonic Scalpel and LigaSure hemorrhoidectomy obtained better results for the perioperative and postoperative parameters than conventional hemorrhoidectomy. Compared with the conventional Ferguson's method, LigaSure and Harmonic Scalpel hemorrhoidectomies lead to significantly shorter operation time ($p < 0.001$) and lower volume of blood loss ($p < 0.001$). The VAS pain scores at postoperative days 0, 1, and 7 were significantly lower in the LigaSure and Harmonic Scalpel hemorrhoidectomy groups than in the conventional hemorrhoidectomy group ($p < 0.001$). Further, the postoperative hospital stay and parenteral analgesic requirement were lower in the LigaSure and Harmonic Scalpel hemorrhoidectomy groups ($p < 0.05$). The incidence of early postoperative complications, such as hemorrhage and urinary retention, was higher in the conventional hemorrhoidectomy group than in the other groups, albeit the difference was not statistically significant. The incidence of early postoperative complication of LigaSure and Harmonic

Scalpel hemorrhoidectomy is comparable to that of conventional hemorrhoidectomy, without serious complications. After conservative management, all patients recovered uneventfully without subsequent surgical intervention.

Our study showed the pain control profile of LigaSure and Harmonic Scalpel hemorrhoidectomy to be superior to that of conventional hemorrhoidectomy. Moreover, the patients for whom such methods were used required fewer analgesic injections.

Similar results have been obtained in previous studies. For example, Chung et al.[18] reported that Harmonic Scalpel hemorrhoidectomy is superior to bipolar scissors hemorrhoidectomy because it is associated with less postoperative pain and better patient satisfaction. Further, Wang et al.[19] found that LigaSure hemorrhoidectomy is associated with significantly less postoperative pain and parenteral analgesic requirements than Ferguson hemorrhoidectomy.

LigaSure has been used in hemorrhoidectomy, and it has been compared with Harmonic Scalpel in a randomized controlled trial conducted by Kwok et al.,[20] which showed a significantly higher postoperative pain score, postoperative oral analgesic requirement, and operation time in the Harmonic Scalpel group. In this study, no significant difference was observed in terms of hospital stay, patient satisfaction score and complication rates. This difference could be explained by the relatively small number of patients included in their study, which is a factor that inhibits obtaining a more comprehensive conclusion.

The present study has some limitations. First, this was a nonrandomized retrospective study, which might have resulted in a baseline selection bias. Second, our follow-up period was extremely short; therefore, data about long-term outcomes were limited. Lastly, this study had a small sample size with only 50 patients. Thus, future studies with long follow-up periods that assess late complications must be conducted.

Conclusions

LigaSure and Harmonic Scalpel hemorrhoidectomy provide a superior alternative to conventional hemorrhoidectomy because they result in shorter operation time and hospital stay as well as lower postoperative pain, volume of blood loss, and analgesic requirements. However, studies with long-term follow-up and larger sample size must be conducted.

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原　著

使用組織凝集器 (LigaSure)、諧波刀 (Harmonic scalpel) 切除痔瘡與傳統痔瘡手術之比較

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目的　比較組織凝集器 (LigaSure)、諧波刀 (Harmonic scalpel) 切除痔瘡與傳統痔瘡手術的結果。

方法　收集並統計自 2018 年 7 月至 2019 年 1 月間，第三與第四級痔瘡使用組織凝集器、諧波刀手術及傳統痔瘡切除手術進行比較。共 50 位病人分為三組，比較彼此之間各方面的差別。

結果　使用組織凝集器及諧波刀進行痔瘡切除手術比傳統痔瘡手術能有效減少開刀時間及術中流血量；而且在住院天數、術後疼痛和術後施打止痛藥劑數用組織凝集器及諧波刀進行痔瘡切除手術也是明顯優於傳統痔瘡手術。

結論　使用組織凝集器 (LigaSure) 或諧波刀 (Harmonic Scalpel) 進行痔瘡切除手 術，能夠比傳統手術達到更好的結果。

關鍵詞　織凝集器 (LigaSure)、諧波刀 (Harmonic Scalpel)、痔瘡切除術。