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ORIGINAL ARTICLE

Procedure for prolapse and hemorrhoids (PPH) with low rectal anastomosis using a PPH 03 stapler: low rate of recurrence and postoperative complications

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Abstract
Purpose The procedure for prolapse and hemorrhoids (PPH) has the advantage of less postoperative pain. However, serious postoperative complications have been reported after PPH, and the postoperative recurrence rate is high in comparison with conventional Milligan-Morgan hemorrhoidectomy (MMH). The purpose of this study was to evaluate PPH with low rectal anastomosis (PPH-LA) in comparison with the original PPH and MMH.
Methods Among a total of 1315 patients with hemorrhoids, MMH was conducted in 322, original PPH using a PPH 01 stapler (PPH01) in 63, PPH-LA using 01 (PPH-LA01) in 236, 03 (PPH-LA03) in 649, and sclerotherapy (SCL) in 45.
Results Length of hospital stay and number of working days lost were significantly greater for MMH than for any form of PPH. The rate of massive postoperative bleeding was significantly lower after PPH-LA03 than after PPH01 or PPH-LA01. No serious postoperative complications occurred after any form of PPH. A significantly higher proportion of patients complained of continued prolapse after PPH01 than after MMH, PPH-LA01, or -LA03. The 5- and 16-year postoperative cumulative recurrence rates after PPH-LA03 were significantly lower than after PPH01.
Conclusions The postoperative cumulative recurrence rate after PPH-LA03 is as low as that after MMH for up to 16 years, and compared with the original PPH01, the effectiveness is higher and the postoperative cumulative recurrence rate for up to 16 years is significantly lower. We conclude that PPH-LA03 is a superior procedure for hemorrhoids, having less postoperative pain and a low rate of recurrence.

Keywords Procedure for prolapse and hemorrhoids (PPH) · Milligan-Morgan hemorrhoidectomy · Stapled hemorrhoidopexy · Stapled hemorrhoidectomy · Prolapsing hemorrhoids

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Introduction

The procedure for prolapse and hemorrhoids (PPH) was first reported by Longo for the treatment of symptomatic hemorrhoids in 1998 [1]. Although this technique has gained wide popularity due to the lower degree of postoperative pain associated with it, shorter hospital stay and shorter time required to return to work [2–4], systematic reviews have reported that the rate of recurrence after PPH is higher than that after conventional Milligan-Morgan hemorrhoidectomy (MMH) [5–11]. Furthermore, serious postoperative complications such as perforation of the rectum [12–14] and rectovaginal fistula [15, 16] have been reported. Since PPH was first introduced at our hospital in 2000, a number of patients have complained of postoperative continued prolapse. PPH involves the removal of a section of rectal mucosa followed by muco-mucosal anastomosis, providing a pulling-up effect. We have considered that one reason for continued prolapse may be limitation of the pulling-up effect. Therefore, we have newly developed a modified PPH with lower resection and anastomosis of the rectal mucosa, i.e., PPH-low rectal anastomosis (PPH-LA).

Here, we present a comparative study of various surgical procedures, including MMH, the original PPH, and PPH-LA, during a 16-year follow-up period.

Methods

Patients

We compared patient groups treated using MMH, the original PPH using a PPH 01 stapler (Ethicon Endo-Surgery, Cincinnati, OH, USA)(PPH01), PPH-LA using a PPH 01 stapler (PPH-LA01), and PPH-LA using a PPH 03 stapler (PPH-LA03), as well as sclerotherapy using aluminum potassium sulfate/tannic acid (SCL). The patients' characteristics are shown in Table 1. There were no significant differences among the patient groups in terms of age and sex. All the patients provided written informed consent at the start of the treatment. The study was reviewed and approved by the ethics committee of Fukui-ken Saiseikai Hospital.

Surgery

For PPH-LA01 and -LA03, purse-string sutures were applied at 2.5 cm from the anorectal junction, while for PPH01, they were applied at 4 cm from the dentinate line. For PPH-LA01 and -LA03, the distance from the anastomotic line to the anal verge was 33 mm. To prevent rectovaginal fistula, we used a colposcope to check whether the vaginal wall had been punctured by the stapler. SCL was performed under local anesthesia and other procedures were performed mainly under spinal anesthesia.

Follow-up and outcome measures

The length of hospital stay, the number of working days lost, the rate of postoperative complications, and the rate of postoperative continued prolapse were examined and compared among the groups. The patients were followed up on an outpatient basis at 11 or 12 days, 6 weeks, 4–5 months, and 12 months after surgery and followed for recurrent prolapse to the end of the follow-up period. Massive postoperative bleeding was defined as that requiring hospitalization, stenosis was defined as that requiring bougie dilatation or operation, and chronic pain was defined as pain lasting more than 3 months after a surgical procedure. The cumulative recurrence rate was examined using the Kaplan-Meier method at 1, 5, and 16 years after surgery. Statistical analysis was performed using the χ^2 test, Fisher's exact test, Wilcoxon test, and log-rank test. Differences at $p < 0.05$ were considered statistically significant.

Results

Length of hospital stay and number of working days lost

The mean length of hospital stay and the number of working days lost were obviously greater after MMH than after any of the other procedures ($p < 0.0001$) (Fig. 1). On the other hand, there was a significant difference between PPH01 and PPH-LA03 in the mean length of hospital stay ($p = 0.007$) (Fig. 1a) and between PPH-LA03 and SCL in the number of working days lost ($p = 0.008$) (Fig. 1b).

Postoperative complications

Among the various PPH procedures, the rate of massive postoperative bleeding was significantly lower after PPH-LA03 than after PPH01 ($p = 0.011$) or PPH-LA01 ($p = 0.035$), respectively (Fig. 2a).

A significant difference in the rate of postoperative stenosis was observed only between MMH (anus) and PPH-LA03 (rectum) ($p = 0.034$) (Fig. 2b).

The rate of chronic pain was low after all the PPH procedures (PPH01, 0%; PPH-LA01, 0.4%; PPH-LA03, 0.2%) and there were no significant differences among them (Fig. 2c). One patient who complained of chronic pain after PPH-LA01 underwent an elective procedure that involved transanal excision of the suture line and reconstruction of the anastomosis using hand-sewn sutures, and then became free of pain. There were no serious postoperative complications such as rectal perforation, pelvic abscess, or rectovaginal fistula after any of the PPH procedures.

Table 1 Characteristics of patients

	MMH	PPH01	PPH-LA01	PPH-LA03	SCL
Period	Jan 2000–Aug 2015	Jan 2000–May 2001	May 2001–May 2004	May 2004–Aug 2015	Apr 2006–Aug 2015
Number	322	63	236	649	45
Mean age	55 ± 15	55 ± 14	54 ± 14	55 ± 16	55 ± 16
Male	186	40	162	413	29
Female	136	23	74	236	16

There were no significant differences among the patient groups in terms of age and sex

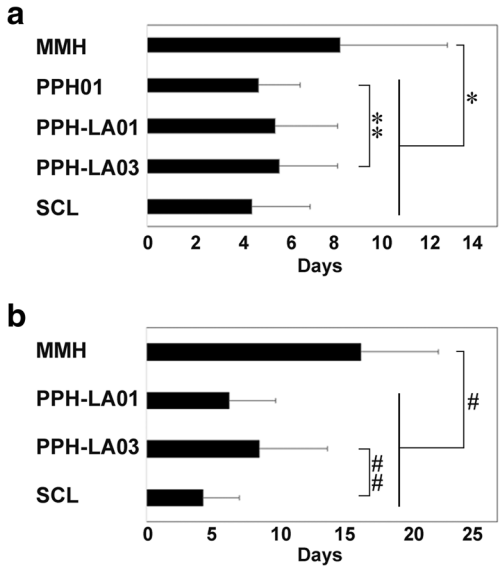

Fig. 1 Length of hospital stay and number of working days lost. **a** Mean length of hospital stay. This was significantly longer after MMH than that after any of the other procedures (single asterisk indicates $p < 0.0001$) and was significantly longer after PPH-LA03 than after PPH01 (double asterisk indicates $p = 0.007$). **b** Mean number of working days lost. The figure was significantly greater after MMH than after any of the other procedures (single number sign indicates $p < 0.0001$) and was significantly less after SCL than after PPH-LA03 (double number sign indicates $p = 0.008$)

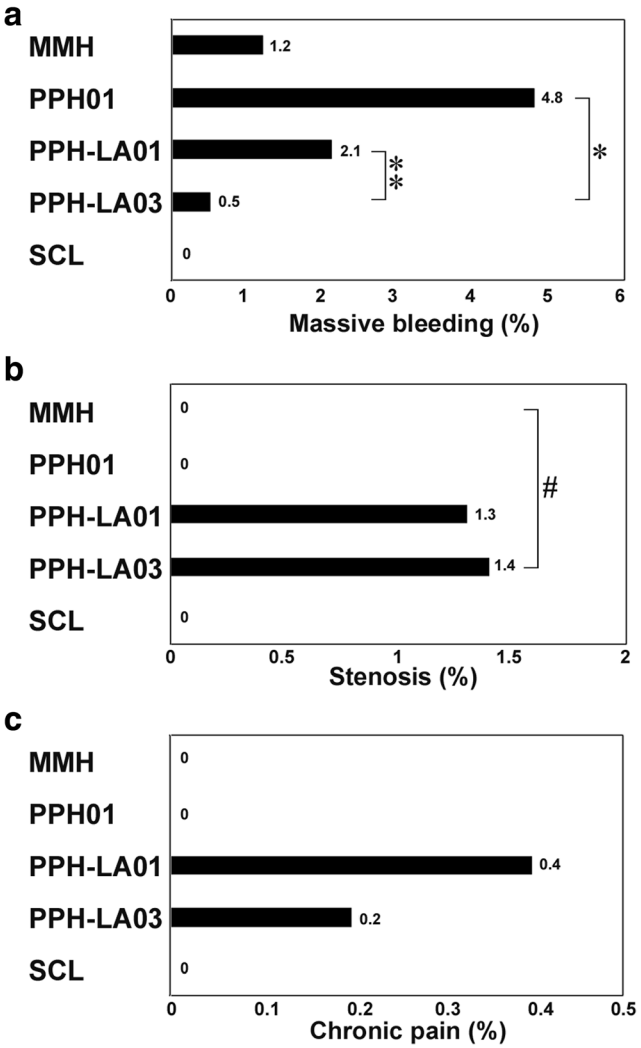

Fig. 2 Postoperative complications. **a** Postoperative massive bleeding. The rate after PPH-LA03 was significantly lower than that after PPH01 (single asterisk indicates $p = 0.011$) or PPH-LA01 (double asterisk indicates $p = 0.035$). **b** Postoperative stricture of the anus or rectum. The rate after MMH (anus) was significantly lower than that after PPH-LA03 (rectum) (number sign indicates $p = 0.034$). **c** Postoperative chronic pain. There was no significant difference between any of the procedures

Continued prolapse after surgery

The rate of patients who complained of continued prolapse was significantly higher after PPH01 than after MMH ($p = 0.008$), PPH-LA01 ($p = 0.002$), or -LA03 ($p = 0.002$) (Fig. 3). These patients were followed up without therapy or treated by either McGivney rubber band ligation or MMH. The rate of continued prolapse after SCL was significantly higher than after all of the other procedures, except for PPH01 ($p < 0.001$).

Postoperative cumulative recurrence rate

The 1-, 5-, and 16-year postoperative cumulative recurrence rates are summarized in Fig. 4. As shown in Table 2, most of the patients had completed 5 years of follow-up, but 16 years of follow-up was possible for some patients. There were no significant differences in the 1-year postoperative cumulative recurrence rate except for that between SCL (2.8%) and MMH (0%) ($p = 0.03$). The 5-year postoperative cumulative recurrence rates after PPH01 (6.3%) and SCL (4.4%) were both significantly higher than that after MMH (1.6%) ($p = 0.048$ and $p = 0.028$). It is noteworthy that the 5-year and 16-year postoperative cumulative recurrence rates after PPH-LA03 (1.8 and 2.5%) were significantly lower than those after PPH01 (6.3 and 9.5%) (5-year, $p = 0.048$; 16-year, $p = 0.018$). However, there were no significant differences between PPH01 and PPH-LA01. These results suggested that the use of low anastomosis with the PPH-03 stapler helped to reduce the rate of recurrence.

Discussion

PPH has gained wide popularity because of its many advantages, such as less severe postoperative pain, shorter hospitalization, and fewer working days lost, in comparison with conventional hemorrhoidectomy [2–4]. However, PPH is associated with a high rate of recurrence [5–11] and several severe complications, such as perforation of the rectum [12–14], rectovaginal fistula [15, 16], and chronic pain [16–21]. We

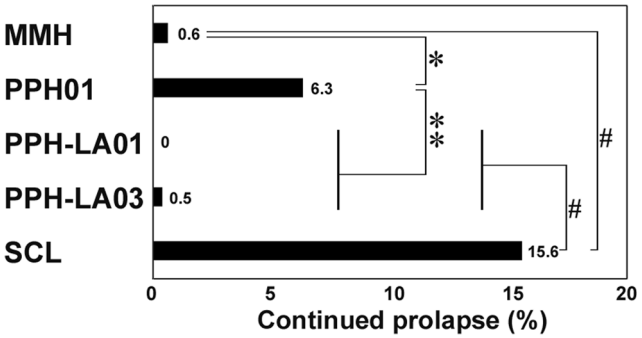

Fig. 3 The rate of continued prolapse after surgery
The rate after PPH01 was significantly higher than that after MMH (single asterisk indicates $p = 0.008$), PPH-LA01 (double asterisk indicates $p = 0.002$), or -LA03 (double asterisk indicates $p = 0.002$). The rate after SCL was significantly higher than that after MMH, PPH-LA01, or -LA03 (number sign indicates $p < 0.001$)

have devised a PPH-LA method characterized by rectal anastomosis at a site lower than that in the original Longo method.

Length of hospital stay and number of working days lost

It can be considered that the length of hospitalization and the number of working days lost reflect mainly the duration of postoperative pain. As reported previously, the length of the hospital stay and the number of working days lost were significantly greater after MMH [2–5]. It appears that prolonged pain after MMH arises from ischemia caused by ligation of the branches of the superior rectal artery, mechanical irritation of the open wound by transit of feces, and bacterial infection/inflammation. On the other hand, the length of the hospital stay in the PPH-LA03 group was significantly longer than that in the PPH01 group. One possible reason is that inflammation affected the anoderm because the anastomotic site in PPH-LA03 is closer to the anoderm. Another possible reason is that the lower level of resection and anastomosis might have reduced the blood supply from the internal iliac artery to the anal side of the anastomosis.

Postoperative complications

It is generally reported that use of the PPH-03 stapler, which has a smaller staple closure, is more hemostatic [18]; the closed staple height is 1 and 0.75 mm for the PPH-01 and -03 stapler, respectively. This is perhaps the most plausible reason for the significantly lower rate of massive postoperative bleeding after PPH-LA03 than after PPH-LA01.

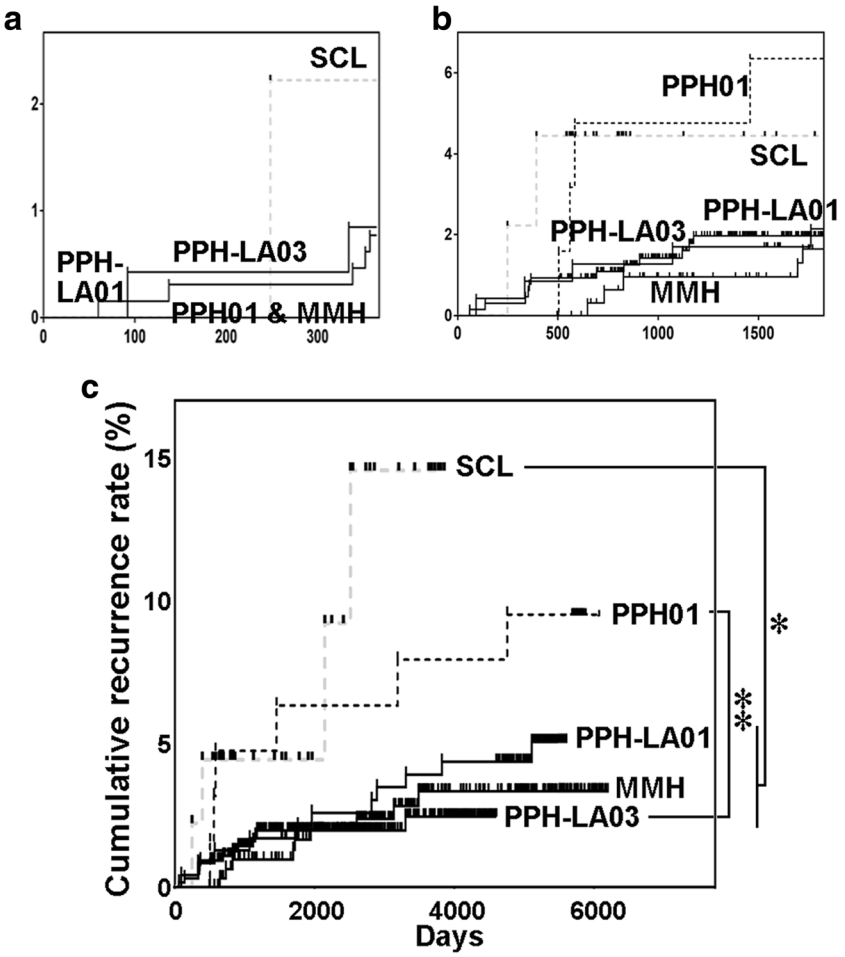

Fig. 4 Cumulative recurrence rate examined by the Kaplan–Meier method. **a** Cumulative recurrence rate at 1 year after surgery: the rate after SCL was significantly higher than that after MMH ($p = 0.03$). **b** Cumulative recurrence rate at 5 years after surgery: the rates after PPH01 (6.3%) and SCL (4.4%) were both significantly higher than that after MMH (1.6%) ($p = 0.048$ and $p = 0.028$, respectively), and the rate after PPH-LA03 (1.8%) was significantly lower than that after PPH01 (6.3%) ($p = 0.048$). **c** Cumulative recurrence rate at 16 years after surgery: the rate after SCL was significantly higher than that after MMH (single asterisk indicates $p = 0.002$), PPH-LA01 (single asterisk indicates $p = 0.016$), or -LA03 (single asterisk indicates $p = 0.0013$), and the rate after PPH-LA03 (2.5%) was significantly lower than that after PPH01 (9.5%) (double asterisk indicates $p = 0.018$)

Table 2 Numbers of patients who completed 5 and 16 years of follow-up

	MMH	PPH01	PPH-LA01	PPH-LA03	SCL
5 years	292 (91)	63 (100)	236 (100)	475 (73)	24 (53)
16 years	68 (21)	63 (100)	15 (6)	0 (0)	0 (0)

The figures in parentheses are percentages

In MMH, the rate of postoperative stenosis of the anus was significantly lower than that of the rectum after PPH-LA03. This is understandable considering that longitudinal wounds are created in MMH whereas a circular wound is created in PPH, and that we avoided excessive resection of the anoderm in MMH.

It has been reported that the rate of chronic pain after PPH is 1.6 ~ 31.0% [17–21], although the cause of such pain has not been identified. In this study, the rate of chronic pain was much lower after all of the PPH procedures. The reason for this clear difference between this study and previous ones is unclear.

No serious postoperative complications such as rectal perforation or pelvic abscess were observed in our study. One reason is that we usually use a blunt-tipped needle to perform the purse-string suture, because a sharp needle often stitches the rectal muscle layer, possibly leading to resection of the entire rectal wall coat.

No cases of rectovaginal fistula occurred. This is because we always use a colposcope to ensure that the vaginal wall is not incorporated in the staple line before firing.

Continued prolapse

Although PPH01 uses the same stapler as PPH-LA01, the rate of continued prolapse was significantly lower after the latter, probably because the lower resection and anastomosis pulls up the hemorrhoids more effectively.

Postoperative cumulative recurrence rate

The 5- and 16-year postoperative cumulative recurrence rates after PPH-LA03 were significantly lower than those after PPH01. The major reason for this is thought to be interruption of the blood supply to the hemorrhoids was effectively maintained over many years after PPH-LA03. The closed staple height for the PPH 03 stapler is smaller, and the lower resection and anastomosis results in a poor blood supply to the anus from the collateral circulation via the internal iliac artery.

The postoperative cumulative recurrence rate after SCL was significantly higher than that after MMH at 1, 5, and 16 years, suggesting that interruption of the blood supply to the hemorrhoids by the sclerosing drug became gradually degraded with time.

Many studies have shown that the rate of recurrence after PPH is significantly higher than that after MMH [5–11], and our present results reflected this. It can be considered that the use of low anastomosis with a PPH 03 stapler, i.e., PPH-LA03, has advantages over MMH and the original PPH, yielding a lower rate of postoperative recurrence and reduced postoperative pain.

The limitation of this study is its retrospective nature, and therefore, prospective randomized controlled studies will be needed in the future.

Conclusion

PPH-LA03 has a number of advantages, including a cumulative postoperative recurrence rate as low as that for MMH for up to 16 years, a higher degree of effectiveness than the original PPH, and a significantly lower postoperative cumulative recurrence rate for up to 16 years. Taken together, we conclude that PPH-LA03 is a superior procedure for hemorrhoids, associated with less severe postoperative pain and a low rate of recurrence.

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Conflict of interest The authors declare that they have no conflict of interest.

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