# Two-center experience in the treatment of hemorrhoidal disease using Doppler-guided hemorrhoidal artery ligation: functional results after 1-year follow-up

**Piotr Wałęga · Mathias Scheyer · Jakub Kenig · Roman M. Herman · Steffen Arnold · Marcin Nowak · Tomasz Cegielny**

**Abstract**

*Introduction* Doppler-guided hemorrhoidal artery ligation (DGHAL), as a method of treating hemorrhoidal disease, is currently used in many centers across Europe, Asia, and Australia. The aim of our study was to evaluate the clinical effectiveness and functional results of DGHAL as estimated by means of anorectal manometry.

*Materials and methods* Between 2000 and 2006 the DGHAL procedure was performed on 507 patients with II–IV degree hemorrhoids in two centers (Poland and Austria). Three hundred eight patients were included in the initial phase of the study, designed to estimate the method's effectiveness. During the second phase (199 patients) selected functional results were also assessed. Patients were classified as having grade II (144), III (319), and IV (44) hemorrhoids.

*Results* There were no intra- and immediate postoperative complications. Good results were reported by 351 patients (69.2%), and were acceptable in a further 75 cases (4.8%). When the patients were grouped according to the stage of hemorrhoidal disease, 133 out of 144 patients (92.4%) with grade II and 272 out of 324 (84%) with grade III had very good or good results. Only 18 out of 44 patients (41%) with grade IV were satisfied with the operation. Fifty-nine patients after anorectal folds, fissure or anal canal polyp excision required analgesics for 1–2 days. Apart from lower contraction amplitude and contraction speed after 1 month there were no differences in anorectal functional tests.

*Conclusion* Based on our results we may conclude that DGHAL is a safe and effective method and may offer an important alternative to operative hemorrhoidectomy with no risk of postoperative stool incontinence, minimal postoperative pain, and early return of patients to their normal activities. Nevertheless, this is a fairly new procedure with a short-term follow-up. Until 5-year observations of large, multicenter, randomized trials are published we cannot recommend this method as a gold-standard procedure, although it still can offer significant benefits to patients.

**Keywords** Doppler-guided hemorrhoidal artery ligation · DGHAL · Hemorrhoidal disease

P. Wałęga · J. Kenig (✉) · R. M. Herman · M. Nowak · T. Cegielny
3rd Department of General Surgery, Jagiellonian University School of Medicine, Pradnicka 35-37 31-202, Krakow, Poland
e-mail: jkenig@cm-uj.krakow.pl

M. Scheyer · S. Arnold
Chirurgische Abteilung des Krankenhaus der Stadt Bludenz, Bluden, Austria

Is it estimated that up to 75% of professionally active people suffer from hemorrhoidal disease (HD). In most cases the severity of ailments depends on the advancement of the disease [1]. Parks' four-stage classification provides a basis for selecting the correct treatment protocol [2].

Multicenter, randomized clinical trials have demonstrated that classical methods of radical hemorrhoidectomy, including the Milligan–Morgan and Fergusson methods and their modifications, are limited by numerous complications. The most common complications are sphincter dysfunction (in up to 25% of patients) and pain severe enough to eliminate 75% of patients from professional life for up to 3 weeks following surgery. Other complications include postoperative bleeding (in 5–15% of patients) and the risk of a recurrence of the disease, which reaches 30%. Therefore, efforts are being made to develop a new, more

effective, and less invasive method of HD treatment. None of the methods described so far, including sclerotherapy, photocoagulation, cryotherapy, Baron's ligation, or Longo's stapled mucosectomy, have achieved the effectiveness and safety of a gold-standard treatment method [3–7]. Complication rates after stapled hemorrhoidectomy vary between 6% and 31% and include such serious surgical complications as rectal anastomotic leakages with pelvic sepsis, rectal obstruction/perforation, recto–vaginal fistula, sphincter damage, retroperitoneal hematoma, and Fournier gangrene [8, 9]. Based on a study of the cessation of the blood supply, in 1958 Balisdell proposed an internal hemorrhoids ligature method [10, 11]. Subsequently Faraga in 1978 and Awojobi in 1983 confirmed the effectiveness of hemorrhoidal artery ligation as described by Milligan and Morgan in their classic paper [12, 13].

In 1995 Morinaga designed the proctoscope, combined with a Doppler device, which enables accurate blood vessel ligation [12–14]. Although several papers have discussed the effectiveness and safety of this method [15–17], there have been no studies on the influence of Doppler-guided hemorrhoidal artery ligation (DGHAL) on anorectal physiology. The aim of our study was to evaluate the clinical effectiveness and functional results of DGHAL as estimated by anorectal manometry.

## Materials and methods

Between 2000 and 2006 the DGHAL procedure was performed on 507 patients with II–IV degree hemorrhoids in two centers (Poland and Austria). In the first center in Bludenz in Austria (Chirurgische Abteilung des Krankenhaus der Stadt Bludenz) 308 patients (119 female and 189 male) with a mean age of 50.1 years (range 22–84 years), forming group 1, were included in the initial phase of the study – an estimation of the method's effectiveness (patient satisfaction questionnaire, clinical symptoms, and anoscopy). During the second phase, which took place in the 3rd Department of General Surgery in Krakow, Poland, 199 patients (69 female, 130 male) with a mean age of 41 years (range 21–76 years), forming group 2, were assessed for selected functional results (anorectal manometric studies performed before treatment and at 1, 3, and 12 months after surgery).

Patients were selected on the basis of a physical examination which confirmed the presence of II–IV degree hemorrhoids and a medical history revealing the presence of classical ailments, including stinging in the anal canal, pruritus, pain and bleeding. Any neoplastic changes within the anal canal and rectum were excluded during the initial evaluation. Anorectal manometry, including assessment of basal anal pressure (BAP), squeeze pressure (SAP), vector volume (VV), and radial asymmetry (RA) functions, was

**Table 1** Degrees of HD advancement, according to Parks' scale, in two groups of patients treated using the DGHAL method

| Center | n | Grade II | Grade III | Grade IV |
|---|---|---|---|---|
| Group 1 | 308 | 89 | 192 | 27 |
| Group 2 | 199 | 55 | 127 | 17 |

performed. The recto-anal inhibitory reflex (RAIR), speed of increase of contraction (SpCtr), and the difference in the amplitude (recto/canal anal) of contraction (Ampl) during recto-anal reflex (RAR) were also evaluated. The Jorge–Wexner scale was used to provide a subjective assessment of ability to control defecation. Manometry was repeated 1, 3, and 12 months after DGHAL treatment, using a water-perfused multilumen catheter and a Polygraph HR Uro computer-based system (Synectics–Medtronic).

Patients were discharged home within 24 h of an initial assessment of comfort and pain control. In order to evaluate the effectiveness of the technique we followed up the patients for 1 year. The procedure was considered "very good" when the patient was free of the disease, "good" when the patient enjoyed significant symptom relief, and "poor" when no improvement was observed.

Overall in the two groups, 144, 319, and 44 patients were classified as having grade II, III, and IV hemorrhoids, respectively (Table 1). Patients were fully informed of the surgical technique and their written consent was required.

### Technique

A simple cleansing enema was used to clean the rectum before the procedure. A single shot of Ceftriaxone sodium (Lendacin, Lek. Poland) 1.0 g iv and Metronidasol 1.0 g iv, was given 30 min before the procedure together with premedication based on midazolam maleate (Dormicum, Roche) 0.07–0.1 mg/kg s.c. in the second group. In the first group patients were locally infiltrated at 3 and 9 o'clock with 2% xylocaine (Astra Zeneca) and sedated with 5 mg midazolam. In the second group we used a 2% lidocaine hydrochloride (lignocainum hydrochloricum, Jelfa, Poland) local anesthetic jelly and, as before, the patients were sedated with midazolam.

In the first group 23 patients underwent simultaneous procedures such as: fissurectomy, resection of skin tags, and herniorraphies. In the second group 32 patients had their overgrown anorectal folds excised and 4 patients had an anal polyp excised, so they had additional local anaesthesia with injections including 1% lidocaine hydrochloride (lignocainum hydrochloricum, Jelfa, Poland).

Patients were operated on in the Lloyd–Davis position. Terminal hemorrhoidal arteries where localized with a specially designed proctoscope involving a Doppler device inserted into the rectum (AMI HAL-Doppler). The

hemorrhoidal arteries were identified by the sound signal of a flowmeter and were ligated using the Arnold–Shelygin technique: a double figure-of-eight using polyglycan 2–0 with a 5/8 needle on a long needle holder. Sutures were tied up with a 20-cm knot-pusher. Approximately 1–1.5 cm above the dentate line 3–7 ligatures were performed. Additional sutures were placed when needed. The completeness of the ligation was assessed with the use of a Doppler technique. We monitored the place of ligation and the hemostasis with a regular anoscope equipped with a fiber-optic xenon light source.

Statistics

Data are presented as mean values. Statistical analysis was performed using the $\chi^2$-test to compare discrete variables and by the $T$-test to compare continuous variables by using SPSS software for Windows. A p-value of less than 0.05 was considered to indicate statistical significance.

**Results**

It is interesting to note, that although traditionally it had been felt that most people had three hemorrhoidal arteries (one for each hemorrhoidal pile), the new Doppler technique indicates that people have up to six such vessels. Typically, the final branches of hemorrhoidal arteries are located in the right posterior lateral, right middle lateral, right anterior lateral, left anterior lateral, left middle lateral, and left posterior lateral position (1, 3, 5, 7, 8, and 11 o'clock) as was described by Meintjes and Thompson [18]. An effort has to be made during surgery to eliminate all of those vessels to achieve good results.

Of our patients 18.1% required an analgesic (acetaminophen, ketoprefen) for 1–2 days. All of these patients had additional surgery performed in addition to DGHAL.

No other patient reported pain the required pharmacological treatment.

Functional tests in the second group

No significant differences in BAP, SAP, and VV before versus after DGHAL were found. The mean BAP was 62.5 mmHg before the procedure, and was 56.5 mmHg 1 month after, 59.5 mmHg 3 months after, and 61 mmHg 12 months after the procedure. The mean SAP was 98 mmHg before, 91 mmHg 1 month after, 102 mmHg 3 months after, and 100 mmHg 12 months after the procedure. VV was 845, 646, 740, and 760, respectively. The radial asymmetry volume was significantly higher (27.4%) 1 month after as compared with before (21.2%) the procedure, but it returned to the preoperative values 3 and 12 months after the procedure (19.3% and 19.1%, respectively). In five patients a paradoxical recto-anal inhibitory reflex (RAIR) was observed 1 month after DGHAL, in two patients with paradoxical RAIR before operation it was also observed 3 and 12 months after the procedure.

In particular we analyzed the RAR components. One and 3 months after the procedure SpCtr was significantly lower than before DGHAL: 331 mmHg/s before, 204 mmHg/s 1 month after, 312 mmHg/s 3 months after, and 320.6 mmHg/s 12 months after the procedure. Also the difference in the amplitude of contraction (Ampl) was significantly lower 1 month after the operation: 21.8 mmHg compared with 29.3 mmHg before the operation. There were no significant differences between these groups 3 and 12 months after the operation. The results of the anorectal function studies are shown in Table 2.

Complications

There were no intra- and immediate postoperative complications. "Good" results were reported by 351 patients (69.2%), and "acceptable" results were reported in 75 cases (4.8%). When the patients were grouped according to hemorrhoidal disease stage, 133 out of 144 (92.4%) with grade II and 272 out of 324 (84%) with grade III had "very good" and "good" results. Only 18 out of 44 patients (41%) with grade IV were satisfied with the operation. Fifty-nine patients after simultaneous procedures required analgesics for 1–2 days. The detailed results are shown in Table 3.

**Discussion**

The ethiopathogenesis of hemorrhoidal disease causes it to be widespread among young, professionally active people.

**Table 2** Values of manometric studies obtained before and 1, 3, and 12 months after the procedure

| | BAP (mmHg) | SAP (mmHg) | VV (mmHg) | RA (%) | Ctr.T Sec. | Difference of amplitude rectum/anal canal | Sp. Ctr (mmHg/s) |
|---|---|---|---|---|---|---|---|
| Before the procedure | $62.5 \pm 19.5$ | $98 \pm 21.2$ | $845 \pm 412$ | $21.2 \pm 8.3$ | $0.37 \pm 0.18$ | $29.3 \pm 9.7$ | $331.9 \pm 99.6$ |
| 1 month after the operation | $56.5 \pm 21.0$ | $91 \pm 22.5$ | $646 \pm 301$ | $27.4 \pm 8.1*$ | $0.49 \pm 0.15$ | $21.8 \pm 10.0*$ | $204.9 \pm 75.0*$ |
| 3 months after the operation | $59.5 \pm 17.1$ | $102 \pm 23.2$ | $740 \pm 354$ | $19.3 \pm 7.4$ | $0.41 \pm 0.17$ | $25.8 \pm 10.0$ | $312.2 \pm 52.0$ |
| 12 months after the operation | $61 \pm 12.6$ | $100 \pm 18.3$ | $760 \pm 278$ | $19.1 \pm 6.2$ | $0.36 \pm 0.17$ | $28.7 \pm 11.4$ | $320.6 \pm 67.7$ |

* $p < 0.05$

**Table 3** Postoperative complication and recurrence rate of hemorrhoidal disease in the two study groups

| Group | Complication rate | | Grade II | | Grade III | | Grade IV | |
|---|---|---|---|---|---|---|---|---|
| | 1 ($n = 308$) | 2 ($n = 199$) | 1 | 2 | 1 | 2 | 1 | 2 |
| Thrombosis | 9 (2.9%) | 9 (4.5%) | 1 | 0 | 8 | 6 | 0 | 3 |
| Recurrence of HD | 48 (15.6%) | 41 (20.6%) | 6 | 5 | 26 | 26 | 16 | 10 |
| Pain at defecation | 3 (0.97%) | 2 (1.0%) | 1 | 0 | 2 | 1 | 0 | 1 |
| Fissure | 4 (1.3%) | 7 (3.5%] | 1 | 1 | 2 | 4 | 1 | 2 |
| Bleeding | 16 (5.19%) | 15 (7.5%) | 2 | 2 | 13 | 7 | 1 | 6 |
| Fistula | 1 (0.5%) | 0 (0%) | 0 | 0 | 1 | 0 | 0 | 0 |

This group of patients will not accept prolonged postoperative recovery, which would prevent them from returning to full professional activity [15]. Therefore new methods of treating hemorrhoidal disease must offer not only superior effectiveness and low morbidity but also short recovery and good postoperative comfort.

Rubber band ligation used in stage II and III hemorrhoids can be complicated by post-procedure bleeding in up to 5% of cases [10]. Some papers also report fatal septic complications [19, 20]. The efficacy of this method is 76% in stage II, 66% in stage III, and less then 20% in IV degree hemorrhoids. Rubber band ligatures are placed under limited visual control, near the dentate line; afferent arteries are left open, which results in a high probability of recurrence. Over 30% of patients have postoperative pain and discomfort lasting up to 7 days [20].

Moderately invasive methods such as Longo's operation are burdened with a relatively high risk of complications. With the passage of time increasing numbers of centers are publishing data on the Longo method, revealing increasingly number of complications, including severe complications such as perforation, occlusion of rectum, retroperitoneal hematoma, and Furnier's gangrene [4, 6, 7, 19–21].

Conventional surgical hemorrhoidectomy according to Milligan Morgan, Ferguson, and their modification represents the most effective treatment method of HD that is currently available. However, these methods require several days of inpatient treatment and may be connected with severe postoperative pain lasting up to 3 weeks, which can affect the daily functioning of up to 75% of patients. Additionally, the effectiveness of these methods is limited by various complications such as sphincter dysfunction (in up to 25% of patients), postoperative bleeding or infection up to 5–15% of patients, and a recurrence rate of up to 30% [22].

Kazumasa Morinaga's technique (DGHAL) is aimed at treating the disease at its very basis by focusing on selective ligation of hemorrhoidal arteries. Morinaga utilized a specially designed proctoscope coupled with a Doppler transducer to identify hemorrhoidal arteries. Through this instrument he was able to localize and ligate vessels supplying blood to hemorrhoidal piles. He reported a series of 60 patients all treated with no postoperative complications [14].

In 2000 Meintjes reported results of HD treatment in a group of 1,415 patients [18]. The DGHAL method was used with conscious sedation (midazolam) and local anaesthesia. Based on the Doppler findings Meintjes confirms, as suggested by Thomson, the localization of arteries, typically placed at the right posterolateral, right midlateral, right anolateral, left anolateral, left midlateral, and left posterolateral (1, 3, 5, 7, 9, and 11 o'clock position) positions. Based on anatomical studies suggesting that vessels were usually located at the 3 and 5 o'clock and 7 and 9 o'clock positions, Meintjes ligated both arteries with the same suture, thereby limiting the number of sutures to 3–6. In our series we used the same methodology and our range of necessary ligations extends from 3 to 7 per patient. Additionally, we used the mucosa elevation technique as proposed by Meintjes and Arnold. The first bite was used to elevate mucosa thus, enabling another deep bite to be taken with no risk of full-thickness penetration and low probability of "empty" sutures [15, 18].

Our study group included patients with stage II, III, and IV HD according to Parks' scale. According to our experience the DGHAL procedure is almost painless. Some patients reported minor discomfort in the rectum during the first few hours. All patients were discharged home within 24 h of the procedure.

DGHAL use can also be questioned in stage IV HD with large anodermal folds, although inflammatory process and scar formation caused by ischemia may decrease the prolapse of the rectal mucosa. Remnants can be excised in local anaesthesia, as was suggested by Shelygin, Arnold, and others [16]. Such a method of treatment could lower the extent of the surgical procedure and help to achieve better functional results and greater comfort during the treatment. To our knowledge none of the published studies have taken into consideration the functional results of the DGHAL procedure as assessed by anorectal manometry. It is widely known that surgical procedures within the rectum significantly affect the function of the anal sphincter.

Anorectal reflexes can be compromised by the insertion of a proctoscope alone [23]. We tried to give a precise analysis of the results of manometric evaluation of anorectal functions before and after the DGHAL procedure to estimate its influence on the functioning of the sphincter complex. Pathological recto-anal inhibitory reflex was detected in two patients before treatment and in ten cases at 4 weeks. At 12 weeks and after 12 months it remained paradoxical only in those patients who had paradoxical RAIR before treatment. An analysis of RAR components proves that DGHAL decreases the speed of contraction in response to the stretching of the rectal wall and decreases the amplitude of contraction as well. Likely this is concerned with an impairment of sensory receptors of the presphincteric part of the rectum caused by the procedure itself and prolonged proctoscope insertion. The return of changes in RAIR and RAR morphology proves that the influence of DGHAL on the anorectal reflectory function is transitory and the lack of changes in SAP and BAP suggests that it has no influence on the contractile activity of internal anal sphincter (IAS) and external anal sphincter (EAS). We may conclude that this makes DGHAL the only instrumental method for treating HD which involves such a low risk of fecal incontinence. We supplemented manometric assessment with the Jorge–Wexner fecal incontinence index. None of our patient scored higher then 2 points, either before or after treatment.

Sohn concluded that DGHAL procedure offers excellent results in all stages of hemorrhoids [17]. In our opinion, since the longest published observations are approximately 36 months long, such a conclusion is premature. Long-term follow-ups of randomized series are needed to confirm our findings.

We may conclude that DGHAL is a safe, effective method, with a short learning curve of the procedure, and may offer an important alternative to operative hemorrhoidectomy with no risk of postoperative stool incontinence, minimal postoperative pain, and early return of patients to their normal activities, which can be applied as one-day surgery [15, 18].

Nevertheless, this is a quite new procedure with a short-term follow-up. Until 5-year observations of large, multicenter, randomized trials are published we may not recommend this method as a gold-standard procedure, but it still can offer significant benefits to patients.

## References

1. Thomson WHF (1975) The nature of hemorrhoids. Br J Surg 62:542–552
2. Parks AG (1956) The surgical treatment of hemorrhoids. Br J Surg 43:337–351
3. Ferguson JA, Heaton JR (1959) Closed hemorrhoidectomy. Dis Colon Rectum 2:176–179
4. Ho YH, Cheong WK, Tsang C et al (2000) Stapled hemorrhoidectomy–cost and effectiveness. Randomized, controlled trial including incontinence scoring, anorectal manometry, and endoanal ultrasound assessments at up to three months. Dis Colon Rectum 43:1666–1675
5. Gupta PJ (2002) Novel technique: radiofrequency coagulation–a treatment for early-stage hemorrhoids. Med Gen Med 4:1
6. Ganio E, Altomare DF, Gabrielli F et al (2001) Prospective randomized multicentre trial comparing stapled with open hemorrhoidectomy. Br J Surg 88:669–674
7. Ortiz H, Marzo J, Armendariz P (2002) Randomized clinical trial of stapled hemorrhoidopexy versus conventional hemorrhoidectomy. Br J Surg 89:1376–1381
8. Pernice LM, Bartalucci B, Bencini L et al (2001) Early and late (ten years) experience with circular stapler hemorrhoidectomy. Dis Colon Rectum 44:836–841
9. Shalaby R, Deskoy A (2001) Randomized clinical trial of stapled versus Milligan–Morgan haemorrhoidectomy. Br J Surg 88:1049–1053
10. Barron J (1963) Office ligation of internal hemorrhoids. Am J Surg 105:563–567
11. Blaisdell PC (1958) Office ligation of internal hemorrhoids. Am J Surg 96:401–404
12. Farag AE (1978) Pile suture: a new technique for the treatment of hemorrhoids. Br J Surg 65:293–295
13. Awojobi OA (1983) Modified pile suture in outpatient treatment of hemorrhoids. A preliminary report. Dis Colon Rectum 26:95–97
14. Morinaga K, Hasuda K, Ikeda T (1995) 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 90:610–613
15. Armstrong DN (2003) Multiple hemorrhoidal ligation: a prospective, randomized trial evaluating a new technique. Dis Colon Rectum 46:179–186
16. Arnold S, Antonietti E, Rollinger G et al (2002) Doppler-guided hemorrhoid artery ligation–a new treatment of hemorrhoids. Chirurg 73:269–273
17. Sohn N, Aronoff JS, Cohen FS et al (2001) Transanal hemorrhoidal dearterialization is an alternative to operative hemorrhoidectomy. Am J Surg 182:515–519
18. Meintjes D. Doppler-guided hemorrhoidal artery ligation (HAL) for the treatment of hemorrhoids. Results in 1415 patients. Available at http://www.cjmedical.com/haemorrhoids. Accessed 10 February 2007
19. O'Hara VS (1980) Fatal clostridial infection following hemorrhoidal banding. Dis Colon Rectum 23:570–571
20. Russel TR (1985) Donohue JH (1985) Hemorrhoidal banding. A warning. Dis Colon Rectum 28:291–293
21. Hulme-Moir M, Bartolo DC (2001) Hemorrhoids. Gastroenterol Ciln North Am 30:183–197
22. Ortiz H, Marzo J, Armendariz P (2002) Randomized clinical trial of stapled haemorrhoidopexy versus conventional diathermy haemorrhoidectomy. Br J Surg 89(11):1376–1381
23. Herman RM, Richter P, Wałęga P et al (2001) Anorectal sphincter function and rectal barostat study in patients following trananal endoscopic microsurgery. Int J Colorectal Dis 16:370–376