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# Impact of Hemorrhoidal Artery Ligation with Mucopexy Versus Conventional Hemorrhoidectomy on Symptom Relief and Quality of Life

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**Research Article**

**Keywords:** Hemorrhoids, Transanal hemorrhoidal dearterialization, Hemorrhoidal artery ligation, Hemorrhoidal disease, Mucopexy, Conventional hemorrhoidectomy

**Posted Date:** June 5th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-9492022/v1

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**Additional Declarations:** No competing interests reported.

## Abstract

# Purpose

Conventional hemorrhoidectomy (CH) remains the standard treatment for advanced hemorrhoidal disease, whereas Doppler-guided hemorrhoidal artery ligation with mucopexy (DG-HAL) is a less invasive alternative. This study compared clinical outcomes, recurrence, and quality of life between these techniques in Grade III–IV hemorrhoids.

# Methods

This retrospective, non-randomized study included 235 patients with symptomatic Grade III–IV internal hemorrhoids who underwent CH (n = 105) or DG-HAL (n = 130) between 2020 and 2024 at a tertiary center. Treatment allocation was based on shared decision-making. Operative time, postoperative pain, analgesic use, complications, and recurrence were analyzed. Symptom severity and quality of life were assessed using the Hemorrhoidal Disease Symptom Score (HDSS) and Short Health Scale (SHS).

# Results

DG-HAL showed shorter operative time (25.4 vs. 31.5 minutes, $p < 0.001$) and lower postoperative pain on day 1 and week 1 ($p < 0.001$). NSAID use was lower in the DG-HAL group (49.2% vs. 90.5%, $p < 0.001$). Both groups had similar HDSS improvement and overall recurrence rates (7.7% vs. 7.6%). However, recurrence tended to be higher in Grade IV patients undergoing DG-HAL (20% vs. 5.4%, $p = 0.09$). SHS scores indicated better early recovery and lower anxiety with DG-HAL.

# Conclusion

DG-HAL provides effective symptom relief with less pain and faster recovery in Grade III disease, while CH remains preferable for Grade IV hemorrhoids due to lower recurrence.

## Introduction

Hemorrhoidal tissue refers to submucosal structures composed of vascular arteriovenous sinusoids, which are considered part of the anorectum and contribute to continence by supporting sphincter function (1). Hemorrhoidal disease (HD), on the other hand, occurs when these supporting structures prolapse distally and become symptomatic. HD is the most common benign anorectal condition in the general population. However, due to social stigma and patients' reluctance to report symptoms, the true prevalence remains uncertain. Although the prevalence of HD has been reported as 4.4% in some studies, it is estimated that nearly half of individuals aged 45–65 experience hemorrhoid-related symptoms at least once in their lifetime (2, 3).

Although conservative treatment modalities such as dietary modification, lifestyle changes, topical agents, and laxatives are commonly employed in the management of early-stage symptomatic hemorrhoidal disease, surgical intervention becomes necessary, particularly in grade III and IV cases, when these approaches fail to provide adequate relief (4). Among surgical options, traditional hemorrhoidectomy techniques—including the open (Milligan-Morgan) and closed (Ferguson) methods—remain widely used. In addition, several minimally invasive or novel techniques have been introduced, such as laser hemorrhoidectomy, hemorrhoidal artery ligation, rubber band ligation, and endoscopic injection sclerotherapy (5, 6).

The combination of Doppler-guided hemorrhoidal artery ligation and mucopexy (DG HAL + mucopexy) was first introduced in 1995 by Morinaga et al. as a minimally invasive alternative to conventional excisional hemorrhoidectomy for patients with grade III-IV hemorrhoids (7). Conventional hemorrhoidectomy is considered the gold standard due to its definitive nature, but it is often associated with prolonged recovery and an increased risk of postoperative complications such as pain, bleeding, urinary retention, and anal stenosis (8). In contrast, DG-HAL with mucopexy preserves anal anatomy by reducing arterial inflow and repositioning prolapsed tissue without excision, which results in significantly lower postoperative pain, shorter hospital stays, and faster recovery (9). Meta-analyses of randomized trials indicate similar long-term outcomes and recurrence rates between DG-HAL and conventional methods, though hemorrhoidectomy may carry slightly fewer recurrences in select cohorts, especially those with grade IV disease (10). When assessed on postoperative pain scores and quality of life scales, DG-HAL demonstrates positive short-term benefits without compromising long-term efficacy (11). Overall, DG-HAL with mucopexy presents a balanced option that may enhance patient comfort and satisfaction while maintaining comparable clinical effectiveness in suitable candidates.

This study is designed to evaluate and compare Doppler-guided hemorrhoidal artery ligation with mucopexy against conventional hemorrhoidectomy procedures. The aim of the study is to assess recurrence rates and their impact on the severity of hemorrhoidal symptoms. In addition, the study explores patient satisfaction levels and the influence of surgical intervention on quality of life. By examining both clinical efficacy and patient-centered outcomes, the research seeks to support the development of more effective and personalized surgical treatment strategies for hemorrhoidal disease.

## Materials and Methods

# Study Design and Patient Selection

This retrospective comparative study was conducted in accordance with the STROBE guidelines. The study cohort consisted of 235 individuals who underwent surgery for symptomatic grade III or IV internal hemorrhoids between 01.01.2020 and 01.01.2024. A total of 130 subjects were allocated to the DG-HAL intervention group, while 105 participants underwent traditional hemorrhoidectomy. Treatment allocation was not randomized; patients were assigned to either procedure based on shared decision-making

between the surgeon and the patient, taking into account clinical severity, anatomical characteristics, and patient preference.

Eligibility criteria included adults aged 18 to 75 years presenting with advanced-stage internal hemorrhoids unresponsive to conservative management strategies and classified as American Society of Anesthesiologists (ASA) physical status I through III. Exclusion parameters encompassed prior anorectal surgical interventions, presence of coexisting anorectal pathology such as fistula-in-ano or anal fissure, underlying inflammatory bowel disease, documented bleeding diatheses, and chronic anticoagulant therapy.

Informed written consent was obtained from all participants, and the protocol received approval from the institutional ethics review board (approval number: 78017789/050.01.04/3090386), adhering strictly to ethical guidelines outlined in the Declaration of Helsinki.

Data were extracted from a prospectively maintained database where the collection of patient-reported outcome measures (PROMs) like the HDSS and SHS is part of the standard clinical protocol for all patients undergoing proctologic surgery at our institution.

**Data Collection**

Comprehensive demographic and clinical characteristics were prospectively recorded, including age, sex, body mass index (BMI), comorbid conditions, American Society of Anesthesiologists (ASA) physical status classification, Charlson Comorbidity Index scores, and hemorrhoid severity graded according to Goligher's classification system. Detailed operative parameters encompassed anesthesia type (general or regional), surgical technique (Conventional hemorrhoidectomy or Doppler-guided hemorrhoidal artery ligation [DG-HAL]), and performance of concomitant mucopexy. Early postoperative outcomes were rigorously evaluated, including time to first defecation (days), pain severity measured by visual analog scale (VAS) at postoperative day 1, week 1, and month 1, daily analgesic requirements (paracetamol, NSAIDs, tramadol dosage), length of hospitalization, and early complications (hemorrhage, surgical site infection, urinary retention, incontinence, soiling). Long-term outcomes comprised assessments of anal stenosis, fecal incontinence, recurrence rates, time to recurrence (months), and mean follow-up duration.

Recurrence was defined as the return of symptomatic hemorrhoids (bleeding and/or prolapse) of Grade II or higher, confirmed on clinical examination, requiring any form of re-intervention (medical or surgical) after an initial symptom-free period.

**Patient-Reported Outcome Measures**

The Hemorrhoidal Disease Symptom Score (HDSS) was administered preoperatively and at postoperative day 1 and day 7 to evaluate symptom burden in both study groups. The HDSS questionnaire assessed five key domains: (1) rectal bleeding during defecation, (2) hemorrhoidal prolapse, (3) anal pain, (4) anal moisture/soiling, and (5) pruritus ani. Each symptom was graded on a 5-point Likert scale: 0 (never), 1 (occasionally), 2 (1-2 days/week), 3 (nearly every day), and 4 (always). The

total HDSS was calculated by summing individual item scores, yielding a possible range of 0 (asymptomatic) to 20 (most severe symptoms), with higher scores indicating greater symptom severity.

Patient-reported quality of life was evaluated using the Short Health Scale (SHS) during preoperative assessments and at the 1-month postoperative follow-up. This validated instrument measured four critical domains: (1) symptom burden ("How much does your condition affect you?"), (2) functional impairment ("To what extent does your condition restrict daily activities?"), (3) disease-related concern ("How worried are you about your condition?"), and (4) general health perception ("How would you rate your overall health status?"). Each domain was scored on an 11-point numerical rating scale ranging from 0 (most favorable status) to 10 (least favorable status). The composite SHS score was derived by summing responses across all four domains, providing a comprehensive measure of health-related quality of life, with higher aggregate scores indicating poorer outcomes

**Preoperative preparation**

All patients underwent standardized preoperative bowel preparation consisting of a sodium phosphate monobasic rectal enema administered on the morning of surgery. Although current evidence does not uniformly mandate routine enema administration prior to hemorrhoidal surgery, this practice reflects the longstanding institutional protocol at our tertiary referral center, aimed at providing a clean operative field and facilitating optimal visualization during anorectal procedures. For antimicrobial prophylaxis, a single preoperative intravenous dose of cefuroxime axetil (500 mg) combined with metronidazole (500 mg) was administered to all study participants prior to surgical incision, in accordance with established guidelines for prevention of surgical site infections in colorectal surgery.

**Surgical Team and Tecnique**

All surgical procedures were performed by experienced colorectal surgeons (defined as specialists with >5 years of independent practice and an annual volume of >50 anorectal procedures) following standardized operative protocols in a high-volume tertiary care center.

## Conventional Hemorrhoidectomy Techniques

Conventional hemorrhoidectomy is considered the gold standard for the surgical management of advanced internal hemorrhoidal disease, particularly in patients with substantial prolapse or those who have not responded to conservative and minimally invasive interventions. The two most commonly utilized approaches—Milligan-Morgan (open) and Ferguson (closed) techniques—remain prevalent due to their effectiveness in long-term symptom control and recurrence prevention.

All patients underwent closed hemorrhoidectomy using the Ferguson technique under general anesthesia in the lithotomy position. Following anal and rectal examination with an anoscope or rectal speculum, the primary hemorrhoidal columns—most often located at the 3, 7, and 11 o'clock positions—are identified. After gentle anal dilation and exposure of the hemorrhoidal cushions, the hemorrhoidal

tissue was grasped with forceps to provide traction. An elliptical incision was made over the external component of the hemorrhoid, and dissection is carried out using electrocautery to separate the hemorrhoidal tissue from the underlying sphincter complex and anoderm (figure 1). The vascular pedicle was ligated with an absorbable suture, and the hemorrhoidal tissue was excised. Mucosa and anoderm were approximated with a continuous absorbable suture (3-0 Vicryl); however, for adequate postoperative drainage, the most distal portion of the skin edge was intentionally left open instead of placing the final stitch (figure 2) . The same standardized technique was applied to all hemorrhoidal columns requiring excision, typically in the classical three-column configuration. No routine anal packing was used, and a perianal dressing was applied at the end of the procedure. Not all hemorrhoidal bundles are excised in the same session. Mucosal bridges between the excised segments are preserved to minimize the risk of postoperative anal stenosis.

All patients received standard postoperative analgesia and stool softeners. Oral intake was initiated on the same day of surgery once fully recovered from anesthesia. Patients were mobilized early and discharged on postoperative day one. Routine wound care instructions were provided, and patients were advised that they could take a shower after discharge.

**Doppler-Guided Hemorrhoidal Artery Ligation (DG-HAL) + Mucopexy Techniques**

Doppler-guided hemorrhoidal artery ligation (DG-HAL) is a minimally invasive surgical technique that directly targets the vascular pathophysiology of hemorrhoidal disease by ligating the terminal branches of the superior rectal artery. It has gained prominence, particularly for the management of advanced (Grade III–IV) internal hemorrhoids, due to its favorable safety profile and reduced postoperative discomfort compared to traditional excisional methods.

The procedure was conducted with patients placed in the lithotomy position under either spinal or general anesthesia. A specialized proctoscope equipped with a 8 MHz Doppler ultrasound probe was introduced into the anal canal to detect arterial blood flow. Hemorrhoidal arteries were typically localized at the 1, 3, 5, 7, 9, and 11 o'clock positions. Once an arterial signal was identified, targeted ligation was performed through a lateral window in the proctoscope using 2-0 absorbable sutures. (figure 3) The number of arteries ligated per patient varied between five and eight, depending on anatomical variations and Doppler signal intensity. (figure 4)

In patients with significant mucosal prolapse, an additional mucopexy procedure was carried out. This involved placing longitudinal running sutures beginning just proximal to the dentate line and extending 2–3 cm cranially. This technique served to lift and fix the prolapsed mucosa to the rectal wall, thereby restoring anatomical support and mitigating prolapse-related symptoms. Mucopexy has been shown to enhance the effectiveness of DG-HAL, especially in patients with Grade III hemorrhoidal disease.

**Follow-up**

*In accordance with the standardized postoperative monitoring protocol, all patients underwent scheduled clinical assessments by a dedicated colorectal surgical team at three key intervals: on the first postoperative day, one week after discharge, and one month following surgery. For long-term follow-up at the one-year mark, participants were systematically screened for hemorrhoid-related symptoms through structured telephonic interviews. Those reporting significant symptomatology were subsequently scheduled for an in-person proctologic evaluation at the outpatient clinic.*

### Statistical analysis

The data obtained in the study were evaluated using descriptive statistics and comparative analyses. For continuous variables, mean ± standard deviation (mean ± SD) or median (25th–75th percentiles) were used. Student's t-test was employed to assess differences between continuous variables based on the surgical method, while the Mann-Whitney U test was used to evaluate differences between ordinal variables. The Chi-square test ($\chi^2$ test) was applied to assess the relationship/association between surgical methods and categorical variables. A p-value of <0.05 was considered statistically significant. Data analysis was performed using the IBM SPSS Statistics version 25 software package.

Given the non-randomized design and potential confounding, a sensitivity analysis using propensity score matching was considered. However, due to the overall demographic and clinical similarity of the groups at baseline (see Results, Table 1), comparative analyses were performed on the entire cohort.

## Results

### Demographic and Baseline Characteristics

The study included **235 patients**, of whom **130** underwent Doppler-guided hemorrhoidal artery ligation (DG-HAL) and **105** received conventional hemorrhoidectomy. Both cohorts were **demographically and clinically comparable**, with no significant differences in mean age (**46.84 ± 12.09 vs. 46.53 ± 14.78 years**, $p = 0.862$), body mass index (**27.15 ± 3.71 vs. 26.77 ± 3.63 kg/m²**, $p = 0.438$), or Charlson Comorbidity Index scores (**0.87 ± 1.02 vs. 1.08 ± 1.01**, $p = 0.122$). Most participants had **grade III hemorrhoids (72.8%)**, while **27.2%** were classified as grade IV.

A significant difference was observed only in the distribution of preoperative symptoms. **Prolapse** was more frequent among DG-HAL patients (**81.5%**) compared with those undergoing hemorrhoidectomy (**62.9%**, $p = 0.002$). The incidence of **preoperative bleeding** (70.8% vs. 81.0%, $p = 0.08$) and the combined presence of **prolapse with bleeding** (58.5% vs. 46.7%, $p = 0.07$) did not differ significantly between groups. Overall, the two procedures were applied to **clinically similar patient populations** (Table 1A and B).

## Perioperative Outcomes and Postoperative Pain Palliation

The **DG-HAL procedure** was associated with a significantly shorter operative duration compared with conventional hemorrhoidectomy (**25.37 ± 5.97 vs. 31.54 ± 4.93 minutes**, $p < 0.001$). All DG-HAL operations were conducted under general anesthesia, whereas the conventional group employed a combination of anesthetic techniques (general 86.7%, spinal 10.5%, and sedoanalgesia 2.9%; $p < 0.001$). There were no significant intergroup differences in the **time to first defecation** (**2.2 ± 0.64 vs. 2.2 ± 0.76 days**, $p = 0.79$) or **length of hospital stay** (**1.29 ± 0.61 vs. 1.35 ± 0.64 days**, $p = 0.41$).

Postoperative pain control outcomes consistently favored DG-HAL across all assessed time points. **Visual Analogue Scale (VAS) scores** were significantly lower following DG-HAL on postoperative day 1 (**4.55 ± 1.44 vs. 7.77 ± 1.68**, $p < 0.001$) and week 1 (**1.68 ± 1.48 vs. 4.19 ± 2.07**, $p < 0.001$). By postoperative month 1, pain intensity had decreased to minimal levels in both groups, with no significant difference (**0.29 ± 0.79 vs. 0.36 ± 0.98**, $p = 0.548$).

Analgesic requirements demonstrated a clear divergence between techniques. **NSAID use** was markedly more common after hemorrhoidectomy (**90.5% vs. 49.2%**, $p < 0.001$), whereas **paracetamol** was administered to all DG-HAL patients (**100% vs. 55.2%**, $p < 0.001$). The use of **opioid-containing analgesics** did not differ significantly ($p = 0.59$), although the DG-HAL cohort exhibited substantially reduced reliance on stronger agents. Nearly half of DG-HAL patients (**49.2%**) achieved adequate analgesia with NSAIDs alone, compared with only **25.7%** in the conventional group ($p < 0.001$).

Taken together, these findings indicate that **DG-HAL offers superior early postoperative pain control and reduced need for potent analgesics**, thereby potentially minimizing opioid-related adverse effects. The convergence of pain scores by one month suggests that this advantage is confined primarily to the **early postoperative recovery period**, after which long-term pain outcomes become comparable between the two techniques.

**Functional Outcomes and Quality of Life Measures**

Significant differences were observed between the two surgical techniques regarding postoperative functional recovery and quality-of-life parameters. Patients undergoing **DG-HAL** achieved better early functional outcomes, reflected by higher physical function scores (**3.67 ± 2.25 vs. 2.38 ± 1.91**, $p = 0.016$) and lower anxiety levels (**3.70 ± 2.25 vs. 2.35 ± 1.89**, $p = 0.011$), particularly among those with **grade IV hemorrhoids**. These findings suggest that the minimally invasive nature of DG-HAL facilitates improved postoperative comfort and psychological well-being.

**Quality-of-life assessments** demonstrated comparable overall satisfaction between the groups, with **63.8%** of DG-HAL patients and **67.6%** of hemorrhoidectomy patients reporting being satisfied ($p = 0.720$). The enhanced functional performance observed after DG-HAL likely results from reduced tissue trauma and the absence of extensive perianal wounds, which are common sources of postoperative pain and restricted mobility following conventional excisional surgery.

**Complication rates** were low and did not differ significantly between groups ($p > 0.05$), with minimal incidences of bleeding (**1.5% vs. 2.9%**) and fissure formation (**3.1% vs. 1.9%**). The overall postoperative complication rate remained comparable (**5.7% vs. 4.6%**, $p = 0.70$), and the type of complication showed no significant variation ($p = 0.56$).

Functional symptom improvement, as measured by the **Hemorrhoidal Disease Symptom Score (HDSS)**, was comparable between procedures both preoperatively and postoperatively (preoperative: **12.2 ± 1.6 vs. 12.1 ± 1.6**, $p = 0.45$; day 1: $p = 0.92$; day 7: $p = 0.60$). Likewise, patient-reported symptom burden, physical function, and general health perception scores did not differ significantly at one month (all $p > 0.05$). Interestingly, **anxiety levels** at one month were slightly higher in the DG-HAL group (median **3**, IQR 2–4) compared to hemorrhoidectomy (median **2**, IQR 1–4; $p = 0.02$) Table 2.

Collectively, these findings indicate that **DG-HAL provides superior early postoperative recovery, reduced discomfort, and faster functional return**, while long-term functional outcomes and patient satisfaction are comparable between the two surgical methods. The results also underscore that **procedure selection should consider hemorrhoid grade**, as conventional hemorrhoidectomy may retain an advantage in advanced disease (Table 2).

**Disease-Specific Outcomes by Hemorrhoid Severity**

**Recurrence rates** were also similar between DG-HAL and hemorrhoidectomy (**7.7% vs. 7.6%**, $p = 0.98$). The mean time to recurrence did not differ significantly (**3.7 ± 2.4 vs. 4.5 ± 2.6 months**, $p = 0.68$). However, the **mean follow-up duration** was significantly longer in the DG-HAL cohort (**46.7 ± 17.5 vs. 40.0 ± 15.7 months**, $p < 0.001$), which may have increased recurrence detection rates.

Subgroup analysis revealed no significant differences in recurrence patterns across hemorrhoid grades. Among **grade III** patients, recurrence occurred in **4.0%** of DG-HAL cases versus **8.5%** following hemorrhoidectomy ($p = 0.19$). In the Grade IV subgroup, although a numerically higher recurrence rate was observed in patients undergoing DG-HAL, this difference did not reach statistical significance ($p = 0.09$) and should therefore be interpreted as a trend rather than definitive evidence of superiority or inferiority. Table 3. Accordingly, these findings should be interpreted with caution and warrant confirmation in larger, adequately powered prospective studies. The difference likely stems from DG-HAL's mechanism of action - while effective for vascular component reduction, it may not adequately address the significant structural prolapse characteristic of Grade 4 hemorrhoids. These findings emphasize the importance of careful patient selection, as DG-HAL appears most appropriate for Grade 3 hemorrhoids where its minimally invasive advantages can be realized without compromising treatment efficacy. For Grade 4 cases, conventional excisional techniques may remain preferable despite their more invasive nature, due to their superior durability in preventing recurrence. The study's long-term follow-up (mean 46.75 months for DG-HAL) strengthens these observations, as it allowed for comprehensive assessment of recurrence patterns beyond the immediate postoperative period.

# Discussion

This comparative study evaluated the outcomes of Doppler-guided hemorrhoidal artery ligation (DG-HAL) with mucopexy versus conventional hemorrhoidectomy in 235 patients with Grade III and IV hemorrhoids. DG-HAL was associated with shorter operative time, lower postoperative pain scores, and reduced opioid requirements, confirming its value as a minimally invasive alternative for symptomatic disease. However, a higher recurrence rate observed in Grade IV cases highlights the importance of appropriate patient selection to optimize surgical outcomes.

Perianal pain and discomfort are among the most significant symptoms affecting patients' quality of life and daily functioning, both before and after treatment of hemorrhoidal disease. In this study, postoperative pain levels were compared between patients who underwent conventional hemorrhoidectomy and those treated with Doppler-guided hemorrhoidal artery ligation (DG-HAL). The results demonstrated that patients in the DG-HAL group experienced significantly lower pain scores on postoperative day 1 and week 1. Consistent with previous studies, DG-HAL resulted in markedly reduced pain intensity at postoperative day 1 (4.55 vs. 7.77, $p < 0.001$) and week 1 (1.68 vs. 4.19, $p < 0.001$) compared with conventional hemorrhoidectomy. These findings suggest that the DG-HAL technique minimizes trauma to the sensitive perianal tissues, thereby reducing postoperative discomfort and facilitating earlier return to daily activities [12].

In terms of postoperative analgesic requirements, the Doppler-guided hemorrhoidal artery ligation (DG-HAL) procedure demonstrated a clear advantage over conventional hemorrhoidectomy. Randomized controlled trials have confirmed that patients undergoing DG-HAL required significantly lower doses of parenteral analgesics within the first 24 postoperative hours and achieved earlier transition to oral pain control (13). Similarly, in the present study, analgesic requirements differed substantially between groups. While 49.2% of patients in the DG-HAL group achieved adequate pain control with NSAIDs alone, 44.8% of those who underwent hemorrhoidectomy required opioid-containing combinations ($p < 0.001$). This finding is clinically meaningful, as reduced opioid use decreases the risk of constipation, sedation, and dependence—complications frequently observed after anorectal surgery (14).

Another major concern for both patients and clinicians following hemorrhoidal surgery is recurrence. In DG-HAL procedures, recurrence may occur either in the same or in a different hemorrhoidal bundle, whereas in conventional hemorrhoidectomy, the excised tissue eliminates the original site of recurrence but may not prevent new lesions from developing elsewhere. In the present study, DG-HAL demonstrated recurrence rates comparable to conventional hemorrhoidectomy in Grade III hemorrhoids (4% vs. 8.5%, $p = 0.19$); however, its effectiveness decreased in Grade IV cases (20% vs. 5.4%, $p = 0.09$). In a study comparing the HAL technique with the Milligan–Morgan (MM) approach over a mean follow-up of 41 months, 20 recurrences (28.9%) were reported in the HAL–RAR group and 9 recurrences (19.1%) in the MM group ($p = 0.229$) (15). Systematic reviews and meta-analyses have similarly shown that conventional excisional hemorrhoidectomy achieves lower long-term recurrence rates, whereas DG-HAL provides advantages in terms of reduced postoperative pain and faster recovery (16, 17).

The present study demonstrated comparable overall recurrence rates between DG-HAL and conventional hemorrhoidectomy (7.7% vs. 7.6%, $p = 0.98$), consistent with previously published series reporting recurrence rates ranging from 5% to 15% after DG-HAL procedures (18). However, when stratified by hemorrhoid grade, a clinically meaningful difference emerged: DG-HAL was associated with a recurrence rate of 20% in Grade IV disease compared to 5.4% following hemorrhoidectomy ($p = 0.09$), suggesting that the technique may be less durable in the setting of advanced prolapse. When compared with other minimally invasive modalities, the recurrence rate observed in our DG-HAL cohort (7.7%) was lower than typical rates after rubber band ligation (RBL), reported to range between 10% and 30% depending on follow-up (19, 20). On the other hand infrared coagulation and sclerotherapy achieve comparable short-term symptom relief but demonstrate higher long-term recurrence, particularly in Grade III hemorrhoids (21). Conversely, stapled hemorrhoidopexy (SH) offers similar or slightly lower recurrence rates than DG-HAL in most studies, but may be associated with greater risk of persistent pain, urgency, or bleeding (22). Compared with energy-based approaches such as laser hemorrhoidoplasty, DG-HAL provides a clearly defined mechanism targeting arterial inflow with minimal tissue trauma. Laser hemorrhoidoplasty offers comparable early pain reduction and faster recovery, but long-term recurrence data remain limited and heterogeneous (23).

Despite a higher recurrence rate in advanced cases, patients who underwent Doppler-guided hemorrhoidal artery ligation (DG-HAL) reported better postoperative physical function (3.67 vs. 2.38, $p = 0.016$) and lower anxiety levels (3.70 vs. 2.35, $p = 0.011$) among those with Grade IV hemorrhoids. This advantage is likely attributable to reduced tissue trauma, which minimizes postoperative tenesmus and discomfort, as well as the avoidance of anal stricture—a well-documented complication of excisional procedures. However, consistent with previous findings long-term satisfaction rates were comparable between the two techniques ($p = 0.720$), suggesting that while DG-HAL enhances early recovery and short-term quality of life, both procedures ultimately achieve similar patient-reported outcomes during extended follow-up (24).

In the present study, postoperative functional recovery and quality-of-life outcomes, assessed using the Hemorrhoidal Disease Symptom Score (HDSS) and Short Health Scale (SHS), were largely comparable between the DG-HAL and conventional hemorrhoidectomy groups. Mean HDSS values improved significantly after surgery in both cohorts, declining from approximately 12 preoperatively to 4 by postoperative day 7, with no significant intergroup differences at any time point. This finding suggests that both procedures are equally effective in alleviating hemorrhoidal symptoms in the short term. Comparable improvements have been reported by other study they demonstrated that DG-HAL effectively reduces bleeding, prolapse, and discomfort in Grades II–III hemorrhoids, achieving functional outcomes similar to those of excisional techniques (25). Similarly, SHS domains reflecting symptom burden, physical function, and general health perception demonstrated significant postoperative improvement in both groups, indicating meaningful gains in health-related quality of life. The only parameter showing an intergroup difference was the “worry” domain at one month, which was slightly higher in DG-HAL patients (median 3 [IQR 2–4] vs. 2 [IQR 1–4]; $p = 0.02$). This may reflect transient concern regarding recurrence or persistence of prolapse symptoms, particularly given the longer follow-

up duration and higher recurrence rates in advanced disease observed in this cohort. Comparable anxiety patterns following minimally invasive hemorrhoid surgery have been previously noted by other studies they attributed these findings to patient expectations regarding minimally invasive outcomes and the gradual resolution of prolapse-related symptoms (26, 27).

This study offers several strengths and limitations. It includes a relatively large cohort of Grade III–IV hemorrhoid patients and provides one of the few direct comparisons between DG-HAL with mucopexy and conventional hemorrhoidectomy with long-term follow-up (mean 46 months). The use of validated, patient-centered instruments (HDSS and SHS) strengthens the assessment of both clinical efficacy and quality of life. Detailed perioperative analyzes—including pain, analgesic use, and functional recovery—allowed a comprehensive evaluation of DG-HAL's early postoperative advantages. However, the study's retrospective and non-randomized design introduces potential selection bias, and differences in surgeon experience may have influenced outcomes. Another limitation of this study is that, although rectal enema administration is routinely performed according to our protocol, robust evidence supporting its use in hemorrhoid surgery is lacking in the existing literature. The longer follow-up period in the DG-HAL group could have led to higher recurrence detection. Despite these limitations, the findings provide clinically meaningful evidence that DG-HAL with mucopexy is a safe, effective, and patient-friendly option for Grade III hemorrhoids, while conventional hemorrhoidectomy remains superior for advanced (Grade IV) disease.

# Conclusion

This study demonstrates that Doppler-guided hemorrhoidal artery ligation (DG-HAL) with mucopexy offers significant short-term advantages over conventional hemorrhoidectomy, including reduced postoperative pain, shorter operative time, and lower opioid requirements. These benefits make DG-HAL an attractive option for Grade 3 hemorrhoids, particularly in patients seeking a minimally invasive approach with faster recovery.

However, the higher recurrence rate observed in Grade 4 hemorrhoids (20% vs. 5.4%) suggests that conventional excisional techniques may still be preferable for advanced prolapse cases. While DG-HAL improves early quality of life by minimizing pain and preserving functional outcomes, its long-term durability in severe hemorrhoidal disease requires further investigation.

DG-HAL represents a valuable advancement in proctology, but its role must be carefully contextualized within the spectrum of hemorrhoidal disease severity. As with all surgical innovations, technique success depends on matching the right procedure to the right patient. Future prospective randomized trials with standardized follow-up are needed to refine patient selection criteria and evaluate cost-effectiveness. Until then, surgeons should weigh the trade-offs between postoperative comfort and long-term efficacy when choosing between these techniques.

# Declarations

**Funding statement**

The authors received no financial support for the research and/or authorship of this article.

**Acknowledgements**

The authors used ChatGPT (OpenAI) for language editing and manuscript refinement. All scientific content and interpretations remain the responsibility of the authors.

**Informed consent**

Written informed consent was obtained from all patients prior to surgery for the selected surgical procedure. The requirement for additional consent for inclusion in this retrospective study was waived.

**Trial registration number/date**

Not applicable.

**Grant number**

Not applicable.

**Ethical statement**

This study was approved by the Institutional Ethics Committee of Mersin University, (Approval No: 78017789/050.01.04/3090386).

**Declaration of conflicting interests**

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

**Data Availability Statement**

The datasets generated during and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

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**Critical revision of the manuscript:** S.B, C.Ö, E.G
**Supervision:** T.Ç, M.Ö.T.

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# Tables

**Table1A and B. Comparison of Demographic, Operative, and Postoperative Characteristics Between Groups (n = 235)**

A. Demographic and Clinical Features

| Variables | Hemorrhoidectomy (n = 105) | DG-HAL (n = 130) | p value |
|---|---|---|---|
| Age, mean ± SD (years) | 46.5 ± 14.7 | 46.8 ± 12.1 | 0.86* |
| Sex, n (%) | | | 0.06† |
| Male | 79 (75.2) | 82 (63.1) | |
| Female | 26 (24.8) | 48 (36.9) | |
| Body Mass Index, mean ± SD (kg/m²) | 26.78 ± 3.63 | 27.14 ± 3.71 | 0.44* |
| Hemorrhoid Grade, n (%) | | | 0.11† |
| Grade III | 71 (67.6) | 100 (76.9) | |
| Grade IV | 34 (32.4) | 30 (23.1) | |
| Charlson Comorbidity Index, n (%) | | | 0.23† |
| 0 | 36 (34.3) | 59 (45.4) | |
| 1 | 37 (35.2) | 44 (33.8) | |
| 2 | 21 (20.0) | 15 (11.5) | |
| 3 | 10 (9.5) | 9 (6.9) | |
| 4 | 1 (1.0) | 3 (2.3) | |
| Preoperative Symptoms | | | |
| Prolapse, n (%) | | | 0.002† |
| No | 39 (37.1) | 24 (18.5) | |
| Yes | 66 (62.9) | 106 (81.5) | |
| Bleeding, n (%) | | | 0.08† |
| No | 20 (19.0) | 38 (29.2) | |
| Yes | 85 (81.0) | 92 (70.8) | |
| Prolapse + Bleeding, n (%) | | | 0.07† |
| No | 56 (53.3) | 54 (41.5) | |
| Yes | 49 (46.7) | 76 (58.5) | |

B. Operative and Postoperative Outcomes

| Variables | Hemorrhoidectomy (n = 105) | DG-HAL (n = 130) | p value |
|---|---|---|---|
| Operative time, mean ± SD (min) | 31.54 ± 4.93 | 25.37 ± 5.97 | <0.001* |
| Time to first defecation, mean ± SD (days) | 2.2 ± 0.64 | 2.2 ± 0.76 | 0.79* |
| Length of hospital stay, mean ± SD (days) | 1.29 ± 0.61 | 1.35 ± 0.64 | 0.41* |
| NSAID use, n (%) | | | <0.001† |
| No | 10 (9.5) | 66 (50.8) | |
| Yes | 95 (90.5) | 64 (49.2) | |
| Paracetamol use, n (%) | | | <0.001† |
| No | 47 (44.8) | 0 (0.0) | |
| Yes | 58 (55.2) | 130 (100) | |
| Opioid analgesics, n (%) | | | 0.59† |
| No | 48 (45.7) | 64 (49.2) | |
| Yes | 57 (54.3) | 66 (50.8) | |
| Complications, n (%) | | | 0.70† |
| Absent | 99 (94.3) | 124 (95.4) | |
| Present | 6 (5.7) | 6 (4.6) | |
| Type of complication, n (%) | | | 0.56† |
| Bleeding | 3 (50.0) | 2 (33.3) | |
| Fissure | 3 (50.0) | 4 (66.7) | |
| Patient satisfaction, n (%) | | | 0.71† |
| Satisfied | 71 (67.6) | 83 (63.8) | |
| Partially satisfied | 25 (23.8) | 37 (28.5) | |
| Dissatisfied | 9 (8.6) | 10 (7.7) | |
| Pain level (VAS), median (IQR) | | | |
| Day 1 | 8 (7–9) | 5 (3–6) | <0.001‡ |
| Week 1 | 4 (3–5) | 1 (1–2) | <0.001‡ |
| Month 1 | 0 (0–0) | 0 (0–0) | 0.68‡ |

**Abbreviations: SD – Standard Deviation; DG-HAL – Doppler-guided hemorrhoidal artery ligation; VAS – Visual Analogue Scale; IQR – Interquartile Range; * Student's t-test; † Chi-square test; ‡ Mann–Whitney U test; p < 0.05 considered statistically significant.**

**Table 2. Comparison of HDSS and Short Health Scale Scores Between Groups (n = 235)**

| Variables | Hemorrhoidectomy (n = 105) | DG-HAL (n = 130) | p value |
|---|---|---|---|
| HDSS, mean ± SD | | | |
| Preoperative | 12.2 ± 1.6 | 12.1 ± 1.6 | 0.45* |
| Postoperative Day 1 | 7.7 ± 1.2 | 7.7 ± 1.1 | 0.92* |
| Postoperative Day 7 | 4.5 ± 1.2 | 4.4 ± 1.2 | 0.60* |
| Short Health Scale (Median, Q1–Q3) | | | |
| Preoperative symptom burden | 7 (6–7) | 7 (6–7) | 0.15† |
| Preoperative physical function | 6 (5–6) | 5 (5–6) | 0.19† |
| Preoperative worry | 5 (4–5) | 5 (4–5) | 0.22† |
| Preoperative general health perception | 5 (4–5) | 5 (4–5) | 0.17† |
| Postoperative 1-month symptom burden | 2 (0–3) | 2 (1–2) | 0.47† |
| Postoperative 1-month physical function | 2 (1–4) | 2 (2–3) | 0.29† |
| Postoperative 1-month worry | 2 (1–4) | 3 (2–4) | 0.02† |
| Postoperative 1-month general health perception | 2 (2–4) | 2 (1–4) | 0.07† |

**Abbreviations: SD – Standard Deviation; DG-HAL – Doppler-guided hemorrhoidal artery ligation; Q1–Q3 – 25th–75th percentiles (interquartile range); * Student's t-test; † Chi-square test; ‡ Mann–Whitney U test; p < 0.05 considered statistically significant.**

Table 3. Comparison of Late Postoperative Outcomes According to Surgical Technique and Hemorrhoid Grade (n = 235)

| Variable | Hemorrhoidectomy (n=105) | DG-HAL (n=130) | p-value |
|---|---|---|---|
| **All Patients** | | | |
| Recurrence, n (%) | 8 (7.6) | 10 (7.7) | 0.98* |
| Time to recurrence (months), mean ± SD | 4.5 ± 2.6 | 3.7 ± 2.4 | 0.68† |
| Follow-up duration (months), mean ± SD | 40.0 ± 15.7 | 46.7 ± 17.5 | <0.001† |
| **Grade III Hemorrhoids** | | | |
| Recurrence, n (%) | 6 (8.5) | 4 (4.0) | 0.19* |
| Time to recurrence (months), mean ± SD | 3.5 ± 2.6 | 5.0 ± 2.2 | 0.63† |
| Follow-up duration (months), mean ± SD | 34.3 ± 15.1 | 47.2 ± 17.1 | <0.001† |
| **Grade IV Hemorrhoids** | | | |
| Recurrence, n (%) | 2 (5.9) | 6 (20.0) | 0.09* |
| Time to recurrence (months), mean ± SD | 7.5 ± 2.6 | 2.8 ± 1.8 | 0.11† |
| Follow-up duration (months), mean ± SD | 36.5 ± 16.7 | 45.3 ± 16.1 | 0.06† |

**Abbreviations: SD, Standard Deviation; DG-HAL, Doppler-guided hemorrhoidal artery ligation.**

***Student's t-test; †Chi-square test; p < 0.05 considered statistically significant.**

# Figures



**Figure 1**

**Dissection of the hemorrhoidal bundle using electrocautery and ligation of the hemorrhoidal vascular pedicle.**



**Figure 2**

**Intraoperative view following conventional hemorrhoidectomy.**

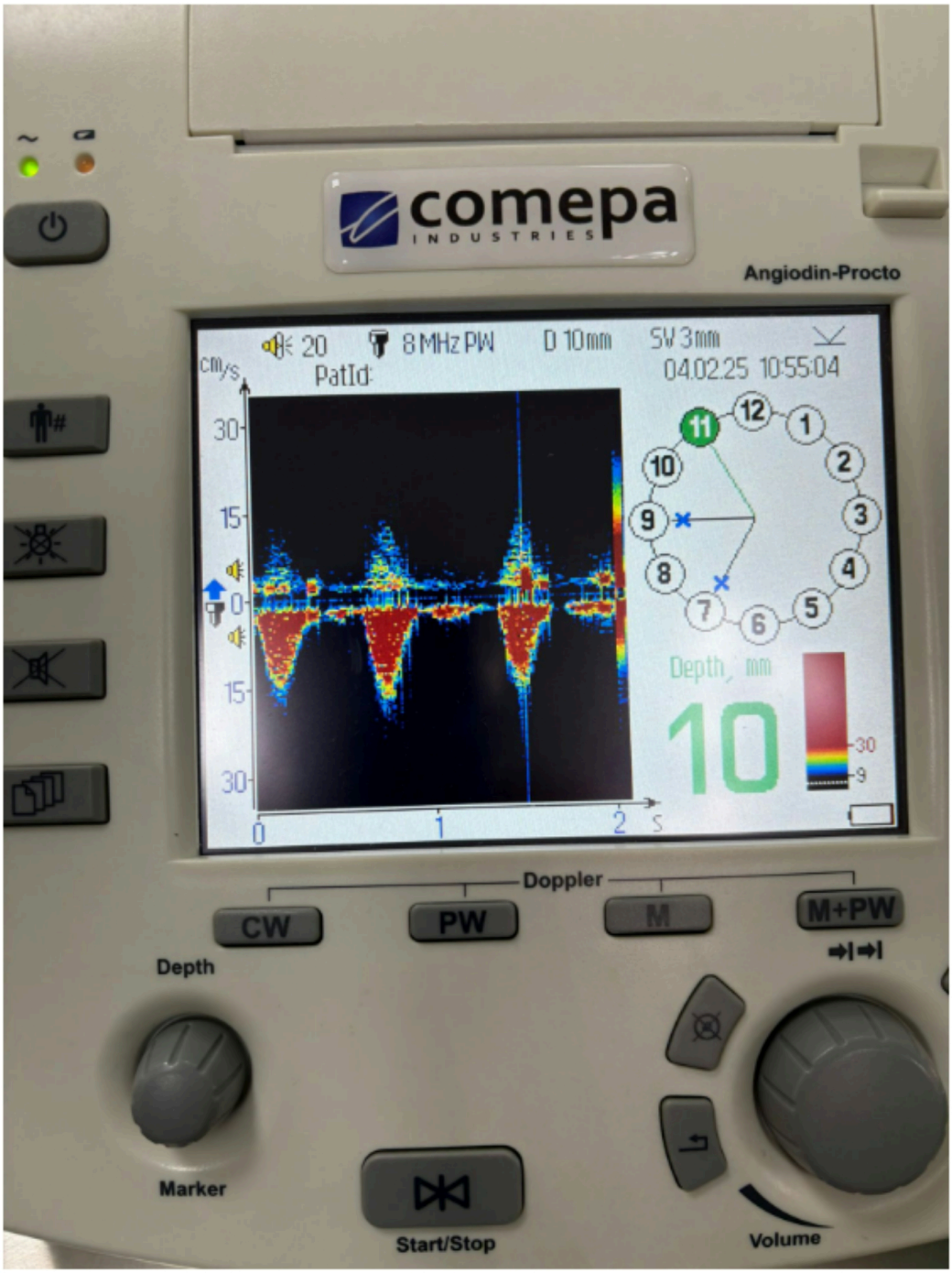



**Figure 3**

**Intraoperative Doppler signal identification of a hemorrhoidal artery.**

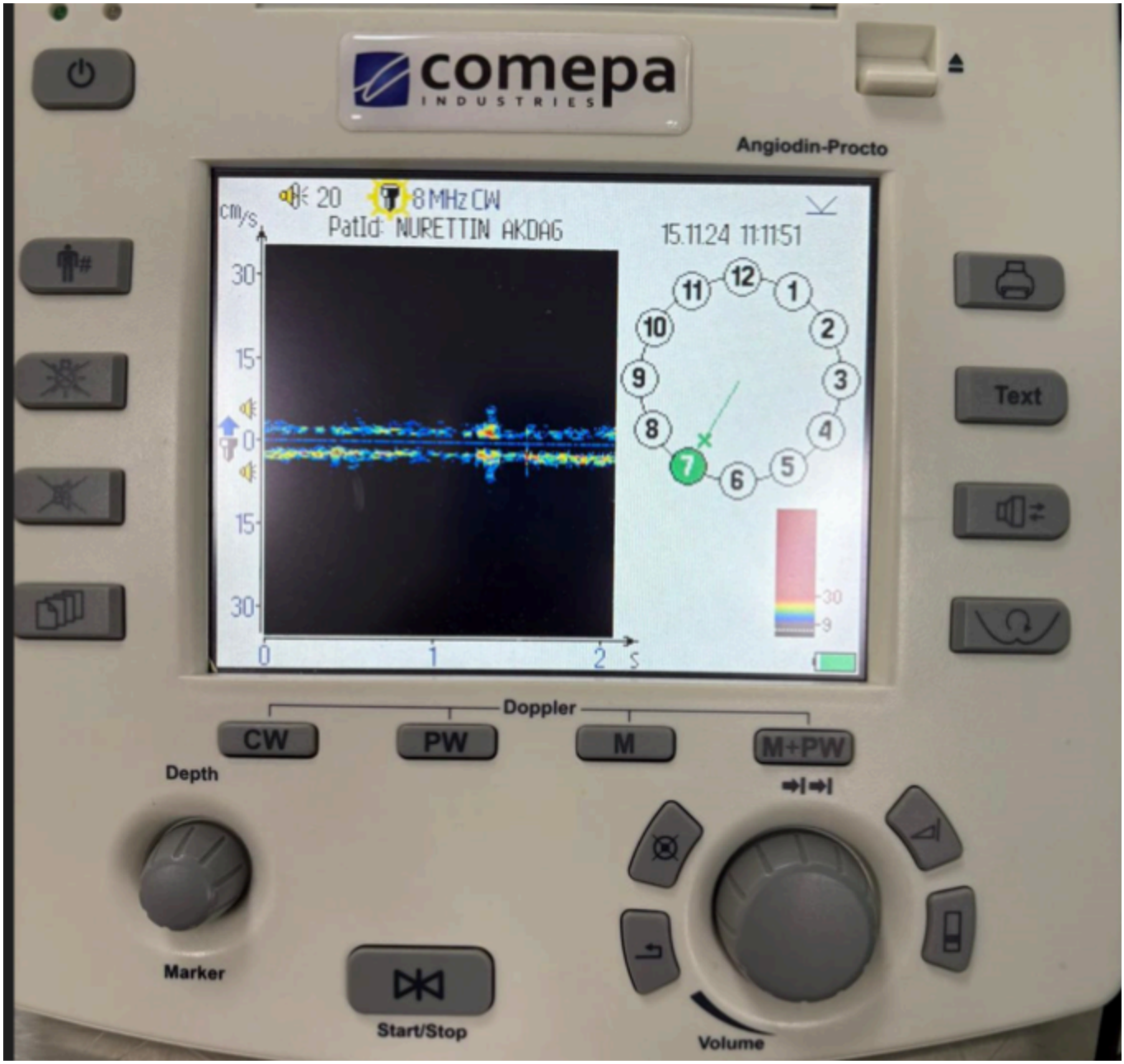



**Figure 4**

**Post-procedural flow pattern after Doppler-guided hemorrhoidal artery ligation (DG-HAL).**

## Supplementary Files

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- graphicalabbstract.png