INTRODUCTION

Low anterior resection (LAR) with sphincter preservation and anastomosis is currently the preferred surgical approach for low rectal cancer. This method avoids the need for permanent colostomy [1–3]. Unfortunately, a sizable proportion of patients (25%–80%) may develop symptoms of bowel dysfunction, including increased stool frequency, altered stool consistency, stool clustering, urgency, fecal incontinence, and difficulty emptying. Collectively, these symptoms constitute LARS, which substantially impairs the patient's quality of life [2–5].

LARS is a prevalent and complex medical condition that manifests in some patients who have undergone low anterior resection for cancer treatment [3]. While the etiology and mechanism of this syndrome remain unclear, it is generally accepted to be of multifactorial origin. Various risk factors for its development...
have been described in the literature. The most recognized risk factors include neoadjuvant radiotherapy [6, 7], low tumor position [8], and anastomotic complications [9]. A higher risk is implied when resection is more extensive due to tumor location, intersphincteric resection [8], or total mesorectal excision [7], compared to partial excision. Furthermore, a shorter distance from the anastomosis to the anal verge [10] or the absence of a colonic pouch [11] also heightens the risk. Additional risk factors that may contribute to LARS include the presence of a diverting stoma and delayed closure [12], preexisting pelvic floor disease [13], and obesity [14]. These factors can contribute to nerve or sphincter damage and dysfunction [15–17], reduced compliance, and alterations in the motility of the neorectum [18, 19], among other effects. While many patients with LARS symptoms exhibit gradual improvement within the first 2 years following surgery, a substantial number (40%–60%) may not respond favorably to conservative treatment methods. These patients continue to experience persistent symptoms [20–23].

Sacral neuromodulation (SNM) is currently utilized in the treatment of fecal incontinence of various etiologies [24]. It should be considered for LARS when incontinence symptoms persist despite the use of pharmacological and rehabilitative interventions [25]. In recent years, promising results for this minimally invasive procedure have been published [26–31]. In the context of SNM as a treatment for LARS, several areas warrant further research or contain gaps in understanding. First and foremost, a need exists for more comprehensive investigation into the long-term effectiveness of SNM. Second, it is imperative to establish optimal patient selection criteria to pinpoint those who are most likely to benefit from SNM, as well as to clarify the predictive factors for positive responses. Furthermore, comparative studies are necessary to evaluate how SNM measures up against alternative treatment options. In addition, the exploration of long-term safety and side effects, the assessment of the impact of SNM on patient quality of life, and a more profound understanding of the mechanism of action of this treatment—all of which could aid in optimizing its application and outcomes—are areas that merit further investigation.

This study was conducted to evaluate the role of SNM in the treatment of fecal incontinence following low anterior rectal resection for cancer. We present our results after a prolonged follow-up period. The Unit of Coloproctology of University Hospital of Navarra (Pamplona, Spain), in collaboration with the General Surgery Service of Reina Sofia Hospital (Tudela, Spain) found it worthwhile to undertake this study and share our results as a continuation of a previously published work [26]. This is particularly important given the lack of published data concerning the long-term outcomes of SNM in the treatment of LARS.

METHODS

Ethics statement
This study was approved by the Clinical Research Ethics Committee of University Hospital of Navarra (No. 641, 11/09/2018). Informed consent was waived due to the retrospective nature of the study.

Study design and patients
The study took place at University Hospital of Navarra, with clinical data retrospectively gathered from a consecutive cohort of 30 patients. These patients, who experienced fecal incontinence following LAR for rectal cancer, underwent SNM between 2005 and 2021 after displaying a lack of response to prior treatments. Inclusion in the study required patients to fulfill several criteria. They must have experienced fecal incontinence for a minimum of 6 months after stoma closure, despite the implementation of conservative treatments, such as lifestyle modifications, dietary guidance, antidiarrheal medication, pelvic floor muscle exercises, and biofeedback. Additionally, patients must have reported at least 1 day per week with liquid or solid leaks in their defecation diary over the past 6 months. Finally, they must have had a minimum of 2 years of follow-up without local or distant recurrence.

The study included 30 patients (21 men; median age, 70 years) who had fecal incontinence refractory to conservative treatment (Fig. 1). Each patient underwent total mesorectal excision and temporary diverting ileostomy. Of these, 5 patients with upper third rectal cancer had previously undergone total mesorectal excision and met the inclusion criteria. However, total mesorectal excision for upper third rectal cancer is not systematically performed at our institution. The types of anastomosis utilized were end-to-end, side-to-end, and J-pouch. Neoadjuvant chemoradiation (long course) was administered to 24 patients as part of their treatment. The median distance from the anal verge to the tumor location was 8 cm (range, 4–12 cm). All patients underwent R0 resection and had their ileostomy closed after completing adjuvant chemotherapy (Table 1).

Technique
All SNM interventions were performed by a single experienced colorectal surgeon (MJ de Miguel Velasco) from a public referral coloproctology unit. These procedures were part of an outpatient surgery protocol, with both temporary and permanent implantations detailed in a prior publication [26]. The selection of the sacral root for stimulation was determined based on the strongest sensory response to the lowest voltage stimulus. For the screening phase in 2 patients, temporary monopolar electrodes (R 3065,
Medtronic) were utilized, while quadripolar electrodes (R 3889-28, Medtronic) were employed for the remaining participants. External stimulation was initiated on the first postoperative day using continuous stimulation mode, with a pulse width of 210 msec and a frequency of 21 Hz.

During the screening phase, which lasted between 2 and 4 weeks, patients were asked to maintain a stool diary. A decrease of 50% or more in the number of days per week with leaks was considered a good response during the percutaneous nerve evaluation (PNE) phase. Patients who met this criterion were then fitted with a permanent implant, either the Medtronic InterStim R-3023 (Medtronic) or the Medtronic InterStim II R-3058 (Medtronic). In cases in which a patient had previously undergone PNE using a temporary monopolar electrode, the same nerve root was utilized for the placement of a quadripolar electrode during the procedure for the permanent implant.

**Functional results and follow-up**

This study employed objective health indicators such as the number of days with leaks per week, the Wexner score [32], and the LARS score [33]. It also utilized subjective utility measures, including Fecal Incontinence Quality of Life (FIQL) scores [34, 35] and the score index and visual analog scale (VAS) of the EuroQol-5D (EQ-5D) tool [36, 37]. The LARS score and EQ-5D questionnaire were incorporated over time. The LARS questionnaire has been in use since 2013 and was utilized for a total of 11 patients, while the EQ-5D questionnaire, utilized since 2015, was employed for 9 patients.

Health indicators were assessed during consultations at 3 key points: baseline, after electrode implantation for PNE, and following definitive pulse generator implantation. The last of these assessments were scheduled at regular intervals throughout the follow-up period, specifically at 1 month, 6 months, 1 year, and then annually. The maximum follow-up period was defined as the duration for which each patient remained in the study, starting from the receipt of the definitive implant until the study’s conclusion or until the patient withdrew from the study. Therefore, not all patients had the same follow-up duration; however, we compared the health indicators across patients at the same follow-up times. Furthermore, we contrasted their initial health status prior to PNE with their status at maximum follow-up. Programming adjustments were made as necessary, and ad hoc consultations were offered to patients experiencing any problem related to the implant throughout the entire duration of SNM treatment.

**Statistical analysis**

Quantitative variables were presented as mean ± standard deviation and median (range), while qualitative variables were represented by absolute frequencies and percentages. For the comparison of paired quantitative data, we utilized the Wilcoxon signed rank test, and for unpaired quantitative data, we employed the Mann-Whitney U-test. A P-value of less than 0.05 was considered to indicate statistical significance. All statistical analyses were conducted using IBM SPSS ver. 20.0 (IBM Corp).

**RESULTS**

During PNE, 1 patient exhibited no motor or sensory response, even with stimulation of both the S3 and S4 roots. The remaining 29 patients demonstrated both motor and sensory responses, with a median stimulation of 1 V (range, 0.4–5.5 V). To elicit the optimal response, it was necessary to stimulate more than 1 nerve root in 26 patients. Specifically, 12 patients required stimulation of 2 nerve roots, 7 patients needed stimulation of 3 nerve roots, 4

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patients required stimulation of 4 roots, and 3 patients needed stimulation of 5 roots.

In 22 patients, the S3 foramen was utilized for electrode placement, while the S4 foramen was the chosen site in 7 patients. The initial 2 patients were treated with a monopolar electrode, while a quadrupole electrode was employed for the subsequent 27 patients.

The temporary stimulation was monitored for a median duration of 22 days (range, 12–40 days), during which a good response was observed in 17 patients. The absence of radiotherapy and a relatively large colonic reservoir at the anastomosis site were both observed to be potential predictors of this positive response (Table 2).

Permanent implants were placed in all 17 patients with a positive response during the temporary stimulation phase. After a median follow-up period of 75 months (range, 18–145 months), 6 patients continued to receive active SNM therapy. Notably, 11 of the 17 patients had a follow-up period of at least 5 years (Fig. 2). Eleven patients withdrew from the study for various reasons and discontinued follow-up. Six patients died from several different causes, including abdominal sepsis (age, 82 years; follow-up period, 41 months), postoperative bowel obstruction surgery (age, 89 years; follow-up period, 77 months), lung cancer in 2 patients (age, 82 years and follow-up period 41 months; age, 82 years and follow-up period, 53 months), and acute myocardial infarction in 2 patients (age, 75 years and follow-up period, 32 months; age, 88

Table 1. Patient characteristics

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<th>Patient no.</th>
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<th>Height of anastomosis from anal verge (cm)</th>
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<th>Radiotherapy</th>
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SNM, sacral neuromodulation; PNE, percutaneous nerve evaluation.

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years and follow-up period, 104 months). Two elderly patients, aged 88 and 82 years, discontinued follow-up at 77 and 129 months, respectively. Throughout the study, 3 patients experienced a loss of efficacy at 20, 24, and 48 months respectively. One of these patients died, while the others had their devices explanted at 32 and 39 months of follow-up, despite adjustments to the device program. Another patient had the device explanted at 86 months of follow-up due to persistent pain at the implant site, even after reprogramming and relocating the generator. No other adverse events or complications were reported. In addition, the batteries of 3 stimulators became depleted at 62, 73, and 78 months postimplantation, and these were successfully replaced.

**Functional outcomes and quality of life**

By the conclusion of the follow-up period, most patients demonstrated a significant improvement in their condition (Table 3). Specifically, we noted a significant reduction in the median number of days per week with leaks, which decreased from 7 (range,
2–7) to 0.38 (range, 0–1). The median percentage improvement in weekly incontinence episodes was 85% (range, 60%–100%). Moreover, the frequency of defecation decreased to a median of 3 bowel movements per day (range, 2–10).

The median Wexner score significantly decreased to 12 (range, 4–16) (Fig. 3). Similarly, the LARS score decreased to a median of 16 (range, 3–33). Before the implementation of SNM, all patients were categorized as having major LARS (range, 36–44). By the end of the follow-up period, 58.9% of patients had no LARS (range, 4–20), while 41.2% had only minor LARS (range, 23–28) (Fig. 4). The FIQL questionnaire also revealed improvements across all measured scales for every patient (Fig. 5). The mean EQ-5D score index following permanent implantation was observed to be 75.78 ± 8.30, while the VAS value was 61.70 ± 17.46. These results align with the mean values reported in general population surveys conducted in Spain within the same age range (score index, 86.8; VAS score, 70.7) [38]. However, despite the significant improvement in continence, a high percentage of patients still reported issues across all scales of the questionnaire.

**DISCUSSION**

The results of our study align with existing evidence indicating the potential effectiveness of SNM in the treatment of LARS. We observed significant improvements in both functional outcomes and quality-of-life measures.

The initial treatment strategy recommended for symptoms of LARS is conservative management, which may include dietary changes, medication, transanal irrigation, pelvic floor rehabilitation, or biofeedback [7]. If symptoms persist despite these medical interventions, SNM can be considered, particularly for the treatment of fecal incontinence. This study demonstrated that SNM therapy provides sustained symptomatic benefits over time. However, the effectiveness of emerging treatments, such as percutaneous stimulation of the tibial nerve, endorectal botulinum toxin A injections, and serotonin receptor antagonist therapy, is still unclear. For severe cases of LARS, a definitive stoma is suggested as the final step in therapeutic escalation [7].

Three recent reviews and meta-analysis have furnished considerable evidence supporting the effectiveness of SNM in treating LARS refractory to medical therapy [39–41]. The first review [39], which incorporated 10 studies involving 94 patients, reported a response rate of 79.8% to PNE. The second [40], which included 114 patients, identified a response rate of 76.3%. Finally, a review published in 2023 [41], which comprised 18 studies with...
164 patients, demonstrated a successful response to PNE in 91% of patients.

At present, we lack sufficient evidence to ascertain the most accurate response rate to SNM among patients with LARS. Many studies in the literature are hindered by limited sample sizes, heterogeneity, and inconsistent criteria for defining a “good” response. In the present research, we noted a lower, but still acceptable, response rate of 58.6%. Based on our experience, the rate of successful outcomes is lower for patients with LARS than for individuals with other causes of fecal incontinence. For example, in a study conducted at our institution, permanent implantation in patients with idiopathic fecal incontinence yielded an 84% success rate [42]. It is plausible to suggest that the success rates of SNM may fluctuate based on the etiology of incontinence, particularly in patients who have undergone LAR for rectal cancer. These less satisfactory results for LARS could stem from the damage inflicted on the autonomic nerve supply of the rectum from surgery.

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and/or pelvic fibrosis secondary to radiotherapy.

Upon comparing the demographic profiles of our patients to those in recent systematic reviews, we found that our patient cohort had the highest average age and one of the highest male to female ratios. Furthermore, all our patients displayed the most severe form of the condition—major LARS—prior to permanent implantation, and they also had a higher average Wexner score than those reported in other published series [39]. These factors could potentially contribute to the achievement of less favorable outcomes.

The most commonly accepted standard for a successful response is a reduction of at least 50% in the frequency of weekly incontinence episodes. In our study, we utilized the standard of achieving a reduction of at least 50% in the number of days with leaks per week [24]. This method, while recognized, is not as commonly used, potentially due to its heightened stringency relative to the mere quantification of incontinence episodes. A more stringent criterion can contribute to lower success rates and less definitive implant outcomes.

Based on our clinical experience, achieving days without any leaks adds incremental value beyond simply reducing the total number of weekly leaks. This method could potentially lead to a heightened sense of satisfaction with the treatment approach. For instance, a patient might decrease their weekly leaks by more than half, yet still endure daily episodes of incontinence, which continues to meaningfully degrade quality of life.

Currently, no evidence is available in the literature that suggests predictive factors for a favorable response to SNM in patients with fecal incontinence [43]. However, our study proposes that the absence of radiotherapy and a larger colonic reservoir at the anastomosis may be associated with improved outcomes. Likewise, superior results of PNE were linked to longer temporary stimulation and fewer stimulated roots, demonstrating statistical significance.

One of the standout features of the present study is its median follow-up period of 75 months, which considerably exceeds the median durations noted in the previously reviewed studies [39–41]. This prolonged follow-up duration, along with the thorough analysis of the outcomes of our patient cohort, lends substantial strength to our study. It allowed us to assess the long-term functional response to SNM and potential adverse scenarios. Furthermore, our institution offers the most comprehensive dataset currently available on SNM, with a specific focus on patients who have undergone rectal cancer surgery and are affected by LARS.

Another noteworthy aspect of this study is the extensive utilization of various assessment tools to evaluate functional and quality-of-life outcomes of SNM therapy. In the evaluation of bowel function following rectal cancer surgery, several questionnaires are available and commonly employed, including the Memorial Sloan Kettering Cancer Center (MSKCC) Bowel Function Instrument, the LARS score, and the Wexner score [44]. In our research, we incorporated 2 of these questionnaires. To gauge quality of life, we utilized 2 distinct instruments: the disease-specific FIQL questionnaire and the standard generic measure, the EuroQol-5D score.

In the present study, we observed a substantial decrease in the Wexner score, by a mean of 10.8 points. This decrease was almost as substantial as the outcome observed in our previous cohort with idiopathic incontinence, in which the score dropped from a baseline of 16.8 to 6.7 [42]. We also achieved a notable mean reduction of 22.1 points in the LARS score. These findings are consistent with previous studies that reported similar reductions in Wexner and LARS scores of 9.86 [41] and 17.9 points [39], respectively. Moreover, we observed a significant decrease in the number of incontinent episodes per weekday and in the total number of defecation episodes per week. Importantly, also, after the batteries in the generators were exhausted, they were safely replaced without any impact on their effectiveness. The results of the permanent implants in our study were similar to those reported in other studies and were maintained over a long period.

As anticipated, the severity of fecal incontinence and LARS is recognized to adversely affect quality of life [2, 45]. Nevertheless, our findings indicate that SNM therapy can significantly enhance quality of life in all domains for patients with LARS. Moreover, we observed that the improvement in quality of life, as measured by the disease-specific FIQL questionnaire, was maintained over the long term. Although comorbid conditions may affect generic quality-of-life measures, it is important to highlight that their influence on disease-specific quality-of-life scores and treatment efficacy estimates is relatively minor [46].

Physicians may have overemphasized the impact of liquid stool loss or heightened defecation frequency on quality of life, while underestimating the distress induced by symptoms such as clustering or fecal urgency [47]. Our findings align with those of other research groups, demonstrating an enhancement in quality of life through the application of SNM therapy for LARS patients, as well as an improvement in fecal incontinence from other causes [27].

The aim of our study was not to evaluate the impact of SNM on concomitant urinary or sexual function in patients with LARS. Nonetheless, it is noteworthy that one patient, who also had erectile dysfunction, reported an improvement with SNM [26]. This area of research could prove to be an intriguing field of study, as, to date, only isolated cases have been reported [48].

To our knowledge, this is the first study to examine the long-
term outcomes of SNM treatment for fecal incontinence after LAR for rectal cancer. Additionally, it represents the largest sample size of publications on this topic. However, our findings must be interpreted within the context of certain limitations. First, like most published articles, this is a single-center retrospective study, which may introduce inherent biases and limit the generalizability of the findings. Furthermore, despite the inclusion of a large sample size, it may still be insufficient to achieve the statistical power necessary for drawing definitive conclusions. Lastly, the study is further limited by the absence of comparisons with other treatment options and the lack of randomization.

To establish more robust scientific evidence, future investigations should incorporate larger cohorts and extended follow-up periods. Additionally, the adoption of standardized design criteria, inclusion parameters, and outcome measurement tools is essential. Moreover, identifying predictive factors for successful treatment and establishing appropriate assessment methods for selecting suitable candidates for SNM therapy are crucial steps in advancing the field.

In conclusion, the findings of this study provide evidence supporting the potential long-term effectiveness of SNM therapy for patients with low anterior resection syndrome from rectal cancer surgery and failed conservative management.

ARTICLE INFORMATION

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REFERENCES


