Original Paper

Safety, Signal Quality, and Patient Satisfaction With Insertable Loop Recorder Implantation by Specialized Electrophysiology Nurses: Prospective Observational Study

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Abstract

Background: Insertable loop recorders (ILRs) are subcutaneous cardiac monitoring devices used in the diagnosis of arrhythmias and in the etiological investigation of syncope and cryptogenic stroke. Device miniaturization and procedural simplification have facilitated implantation in ambulatory settings. The involvement of specialized electrophysiology nurses may help meet rising clinical demand, although evidence in our setting remains limited.

Objective: This study aimed to analyze implantation safety, detection signal quality, adverse events during follow-up, and patient satisfaction when the procedure was performed by specialized nurses.

Methods: This prospective observational study (the CARDIONURSE study) was conducted in the Arrhythmia Unit of Hospital General Universitario Doctor Balmis between February 2022 and May 2023. Thirty-five patients with a clinical indication for ILR implantation were included. The procedure was performed by 2 specialized nurses under medical supervision. Sociodemographic, clinical, and technical implantation variables were collected, including detection signal amplitude (mV), together with adverse events and follow-up outcomes at 1 and 6 months. Patient satisfaction was assessed using a study-specific questionnaire at 4 time points. Descriptive statistical analysis was performed.

Results: Mean age was 71.1 (SD 11.3) years, and 62.9% (22/35) were women. The most frequent indication was syncope (27/35, 77.1%), followed by suspected atrial fibrillation (AF) in cryptogenic stroke (6/35, 17.1%). No objective procedural complications occurred (35/35, 100% of procedures); mild, transient procedural pain was reported in 5.7% (2/35) of patients, and the procedure lasted less than 5 minutes in 74.3% (26/35) of procedures. Mean signal amplitude was 0.45 (SD 0.29) mV, with a visible P wave in 94.3% (33/35) of patients. No wound-related adverse events were recorded among the 85.7% (30/35) of patients with available follow-up data at 6 months; data were unavailable for the remaining 5 patients. A diagnosis was obtained in 20% (6/30) of patients with an available diagnostic outcome at 6 months. Overall, 97.1% (34/35) of patients reported maximum or very high satisfaction with the intervention, and 100% (35/35) with the care received.

Conclusions: ILR implantation by specialized electrophysiology nurses in an ambulatory setting is a safe, fast, and technically adequate procedure, with adequate signal quality and high patient satisfaction. These findings support the feasibility of specialized nursing as ILR implanters in similar ambulatory care settings, although confirmation in larger, multicenter studies is warranted before broader implementation.

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Keywords: insertable loop recorder; implantable cardiac monitor; specialized nursing; syncope; atrial fibrillation; patient satisfaction

Introduction

Background

The insertable loop recorder (ILR), also known as an implantable cardiac monitor or implantable loop recorder, is a small subcutaneous device designed for continuous, prolonged monitoring of cardiac rhythm. Its main utility lies in the etiological diagnosis of conditions with suspected arrhythmic origin that cannot be documented using conventional methods, such as 24- to 48-hour surface Holter monitoring, baseline electrophysiological study, or tilt-table testing [1].

Indications for ILR use have grown considerably in recent years. Syncope of uncertain origin remains the most frequent indication, but detection of paroxysmal atrial fibrillation (AF) in patients with cryptogenic stroke has become increasingly relevant: epidemiological studies attribute approximately 25% to 35% of all ischemic strokes to AF [2], and prolonged monitoring has been shown to significantly increase AF detection rates compared with conventional Holter monitors [3]. Other indications include postablation follow-up for AF, investigation of undocumented palpitations, and monitoring of patients with structural heart disease.

Since its introduction, ILR technology has evolved considerably. The Reveal LINQ device (Medtronic), routinely used at our center, currently measures 44.8×7.2×4.0 mm and is inserted using a preloaded introducer through an approximately 10-mm incision, which has simplified the procedure into a minor surgical technique that can be performed in ambulatory settings [4]. This technical simplification, together with growing clinical workload pressure on arrhythmia specialist cardiologists, has driven interest in expanding the role of nursing staff specialized in electrophysiology and cardiac pacing as device implanters.

Study Rationale and Aim

International studies have shown that ILR implantation by specialized nurses is safe, effective, and cost-effective [5-7], with no significant differences in complication rates compared with physician-led implantation. However, evidence within the Spanish health care system remains limited. A recent publication by our group in Revista Española de Cardiología [8] described preliminary results from the CARDIONURSE program, demonstrating the feasibility of nurse-led implantation in an ambulatory setting. That earlier report involved a different, nonoverlapping cohort implanted with a different device and with procedures performed by both physicians and specialized nurses.

A technically important aspect of ILR implantation is the amplitude of the detection signal immediately after device insertion. The manufacturer establishes a minimum threshold of 0.2 mV to ensure adequate detection of the QRS complex and to avoid undersensing or oversensing. Device position—parasternal straight or tilted 45° relative to the sternum—together with anatomical variability between patients directly affects the quality of the signal obtained.

This study reports the results of the CARDIONURSE study, with the aim of analyzing implantation safety, detection signal quality, adverse events during 6-month follow-up, and patient satisfaction with the care process.

Methods

Study Design and Population

This was a prospective, observational, single-center study conducted as part of the CARDIONURSE research project. The study took place in the Arrhythmia Unit of the Department of Cardiology, Hospital General Universitario Doctor Balmis, Alicante, Spain, between February 2022 and May 2023. A total of 35 adult patients (aged ≥18 years) with an established clinical indication for ILR implantation during the study period who provided written informed consent were consecutively enrolled. The only exclusion criterion was refusal to participate.

Ethical Considerations

The study was approved by the Research Ethics Committee for Medicinal Products (Comité de Ética para la Investigación con medicamentos) of the Alicante Health Department–General Hospital (reference PI2021-14) and was registered with the Institute for Health and Biomedical Research of Alicante (reference 200377). All participants provided written informed consent prior to enrollment. The study was conducted in accordance with the principles of the Declaration of Helsinki and current data protection regulations (Spanish Organic Law 3/2018 and EU Regulation 2016/679 [General Data Protection Regulation]). All data were handled confidentially and deidentified prior to analysis. Participants did not receive any compensation.

Implant Procedure

Implantation was performed by 2 nurses from the Arrhythmia Unit with accredited specialized training in electrophysiology and cardiac pacing, with a supervising physician physically present in the room throughout the entire procedure, in accordance with Decree 74/2007 of the Consell de la Generalitat Valenciana governing minor surgical procedures performed by nursing staff. The device used was the Reveal LINQ (Medtronic). Insertion was performed under strict aseptic technique in an outpatient consultation room equipped for minor procedures, following local anesthesia with 2% lidocaine. Implant position was recorded as parasternal straight or tilted (45° relative to the sternum), according to the nurse's judgment based on the optimal signal vector obtained on prior telemetry.

Variables Collected

Variables were collected at 4 visits: baseline visit (implantation), wound-check visit (7-14 days), 1-month follow-up visit

(telephone and remote monitoring), and 6-month follow-up visit (telephone and remote monitoring).

Primary variables were (1) implantation safety, including the rate of immediate and follow-up complications; (2) detection signal amplitude (mV) immediately after implantation; and (3) surgical wound-related adverse events during follow-up. Secondary variables included implant indication, baseline clinical characteristics, procedure duration and ease, correct device detection, diagnostic yield at 6 months, and patient satisfaction.

Patient satisfaction was assessed using a study-specific questionnaire with a Likert scale ranging from 0 (none or not at all) to 5 (a great deal or excellent), including items on pain, irritation, restriction of movement, worry, impact on activities of daily living, satisfaction with the intervention and the care received, perceived safety, and adequacy of the implantation site (this questionnaire can be found in Multimedia Appendix 1).

Data Collection

Data were collected prospectively at the implantation visit and during the scheduled follow-up visits using direct clinical assessment, telephone interviews, and remote ILR monitoring. As this was an observational study based on routine clinical practice, some variables were unavailable because they had not been routinely documented in the medical record or because follow-up documentation or remote transmissions were incomplete. All participants remained in the study throughout the 6-month follow-up period; therefore, variations in denominators reflect variable-specific missing data rather than participant attrition.

Statistical Analysis

A descriptive statistical analysis was performed. Quantitative variables were expressed as mean (SD) or median (IQR), as appropriate, with ranges where relevant. Categorical variables were expressed as absolute frequencies and percentages. The Mann-Whitney *U* test was used to analyze detection signal amplitude in relation to implant position, given the nonparametric distribution of the variable. Statistical significance was set at $P<.05$. Statistical analysis was performed using SPSS Statistics (version 26.0; IBM Corp).

Results

Baseline Characteristics of the Sample

A total of 35 patients were included in the study (Figure 1). Mean age was 71.1 (SD 11.3; range 42-88) years. Overall, 62.9% (n=22) were women and 37.1% (n=13) were men. Mean weight was 69.6 (SD 9.4) kg, with a mean height of 1.62 (SD 0.07) m. Mean baseline heart rate was 66.3 (SD 12.9) beats per minute (n=23 patients with available data).

Regarding comorbidities, 62.9% (n=22) had hypertension, 54.3% (n=19) hypercholesterolemia, 31.4% (n=11) diabetes mellitus, 28.6% (n=10) a history of stroke, and 11.4% (n=4) obesity. Overall, 48.6% (n=17) were nonsmokers, 31.4% (n=11) former smokers, and 17.1% (n=6) current smokers. Renal insufficiency and chronic liver disease were each present in 11.4% (n=4) of patients. A history of thromboembolic events was present in 31.4% (n=11) of patients (stroke in n=10, 28.6%).

Regarding AF history, 80% (n=28) had no documented AF at the time of implantation, 8.6% (n=3) had paroxysmal AF, and 5.7% (n=2) had permanent AF. Overall, 91.4% (n=32) had not previously undergone AF ablation.

Table 1 summarizes the baseline characteristics of the sample.

Figure 1. Study flow diagram. Patient enrollment, follow-up, and availability of study data at each assessment time point. The n values in the boxes on the right indicate the number of patients with available data for each variable. The 7- to 14-day wound check visit was not part of routine clinical follow-up. No patient withdrew or was lost to follow-up during the 6-month observation period; variations in denominators reflect missing data for specific variables rather than participant attrition.

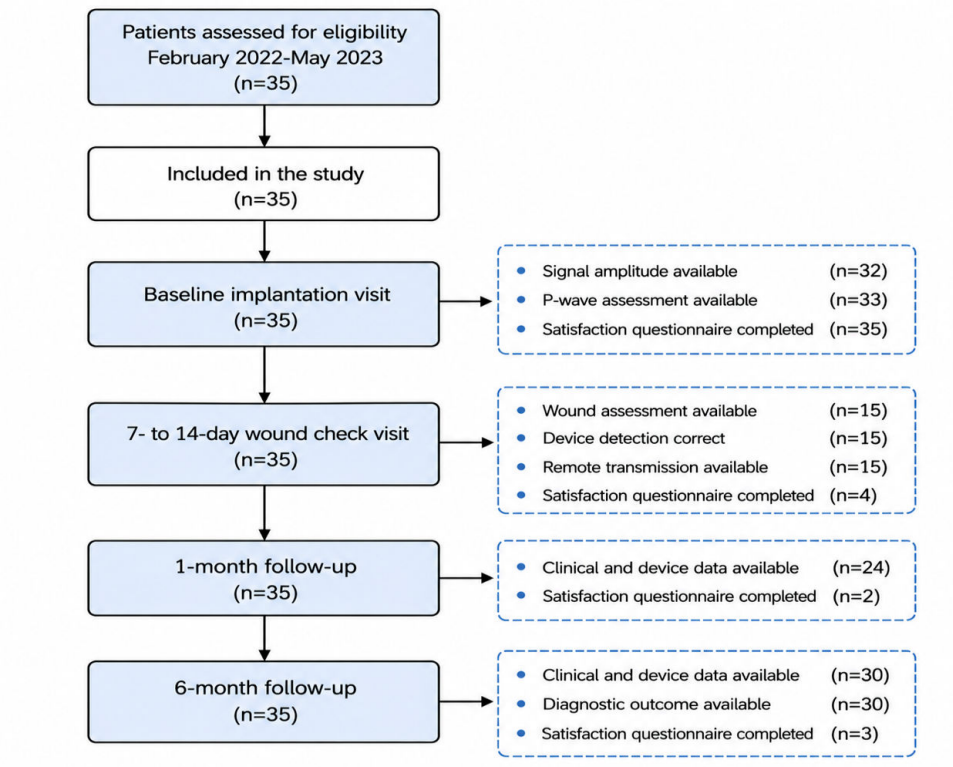


Table 1. Baseline characteristics of the patients (N=35).

Variables	Patients, n (%)	Patients, mean (SD)
Age (years)	35 (100)	71.1 (11.3)
Female sex	22 (62.9)	—[a]
Weight (kg)	35 (100)	69.6 (9.4)
Height (m)	35 (100)	1.62 (0.07)
Baseline heart rate (bpm[b])[c]	23 (65.7)	66.3 (12.9)
Comorbidities		
Hypertension	22 (62.9)	—
Hypercholesterolemia	19 (54.3)	—
Diabetes mellitus	11 (31.4)	—
Previous stroke	10 (28.6)	—
History of thromboembolic event	11 (31.4)	—
Current smoker	6 (17.1)	—
Former smoker	11 (31.4)	—
Chronic obstructive pulmonary disease	3 (8.6)	—
Obesity	4 (11.4)	—
Cardiac history		
Paroxysmal AF[d]	3 (8.6)	—
Permanent AF	2 (5.7)	—
Previous AF ablation	3 (8.6)	—

[a]Not applicable, mean (SD) is reported only for continuous variables.
[b]bpm: beats per minute.
[c]Data available for only 23 patients.
[d]AF: atrial fibrillation.

Implant Indications

The most frequent indication for implantation was syncope of uncertain origin, present in 77.1% (27/35) of patients. Suspected AF in the context of cryptogenic stroke was the second most common indication, with 6 (17.1%) patients. Overall, 71.4% (n=25) of patients were symptomatic at the time of implantation. Suspected conduction disorder and undocumented palpitations each accounted for 2.9% (n=1) of indications (Table 2).

Table 2. Indications for insertable loop recorder implantation (N=35).

Indication	Patients, n (%)
Syncope of uncertain origin	27 (77.1)
Suspected atrial fibrillation in cryptogenic stroke	6 (17.1)
Suspected conduction disorder	1 (2.9)
Undocumented palpitations	1 (2.9)

Procedure Characteristics

All implantations were performed in an equipped outpatient consultation room (35/35, 100%). The tilted position (45° relative to the sternum) was the most frequently used, in 65.7% (n=23) of procedures, compared with 34.3% (n=12) for the straight parasternal position. No objective procedural complications occurred in any patient (35/35), confirmed against clinical records; no infections, hematomas, seromas, or device migrations were reported. Mild, transient pain during the procedure was reported in 2 (5.7%) patients; this was recorded as an expected procedural symptom rather than a complication, consistent with its separate assessment in the patient satisfaction questionnaire (Table 3).

Table 3. Results of the satisfaction questionnaire at the baseline or implantation visit[a].

Item[b]	Score, mean (SD)	Score 0, n (%)	Score ≥4, n (%)
Symptoms during implantation (n=35)			
1A—pain during implantation	0.63 (0.91)	21 (60)	0 (0)
1B—irritation during implantation	0.03 (0.17)	34 (97.1)	0 (0)
1C—restriction of movement during implantation	0.00 (0.00)	35 (100)	0 (0)
Current symptoms (discharge)			
2A—current pain (n=35)	0.11 (0.32)	31 (88.6)	0 (0)
2B—current irritation (n=34)	0.21 (0.91)	32 (94.1)	1 (2.9)
2C—current restriction (n=34)	0.00 (0.00)	34 (100)	0 (0)
Impact and satisfaction			
Worry about the implant (n=35)	1.63 (1.90)	17 (48.6)	8 (22.9)
Problems with activities of daily living (n=34)	0.65 (1.35)	26 (76.5)	2 (5.9)
Satisfaction with the intervention (n=35)	4.74 (0.89)	1 (2.9)	34 (97.1)
Satisfaction with the care received (n=35)	4.94 (0.24)	0 (0)	35 (100)
Perceived safety during the procedure (n=35)	4.89 (0.40)	0 (0)	34 (97.1)
Adequacy of the implantation site (n=35)	4.69 (1.08)	1 (2.9)	33 (94.3)

[a]Scores were assessed on a Likert scale ranging from 0 to 5.
[b]Item codes (1A-2C) correspond to the item numbers in the study questionnaire (Multimedia Appendix 1). Items 1A-1C refer to symptoms during implantation and items 2A-2C to current symptoms at discharge (A: pain, B: irritation, C: restriction of movement).

Procedure duration (from incision to suture) was less than 1 minute in 20% (7/35) of procedures, 1 to 5 minutes in 57.1% (n=20), and more than 5 minutes in 22.9% (n=8). Total procedure time (from anesthesia administration to dressing placement) was less than 5 minutes in 74.3% (n=26) of procedures and 5 to 10 minutes in 20% (n=7). The implanting nurse rated the procedure as easy or very easy in 74.3% (n=26), of normal difficulty in 14.3% (n=5), and difficult in only 11.4% (n=4).

Incision closure was performed with Steri-Strips in 71.4% (n=25) of procedures and with staples in 28.6% (n=10). Device detection after insertion was correct in 100% (35/35) of patients. Implanter satisfaction was excellent in 45.7% (n=16), good in 51.4% (n=18) and fair in only 1 (2.9%) of procedures. Table 4 summarizes the procedure variables.

Table 4. Implant procedure variables (N=35).

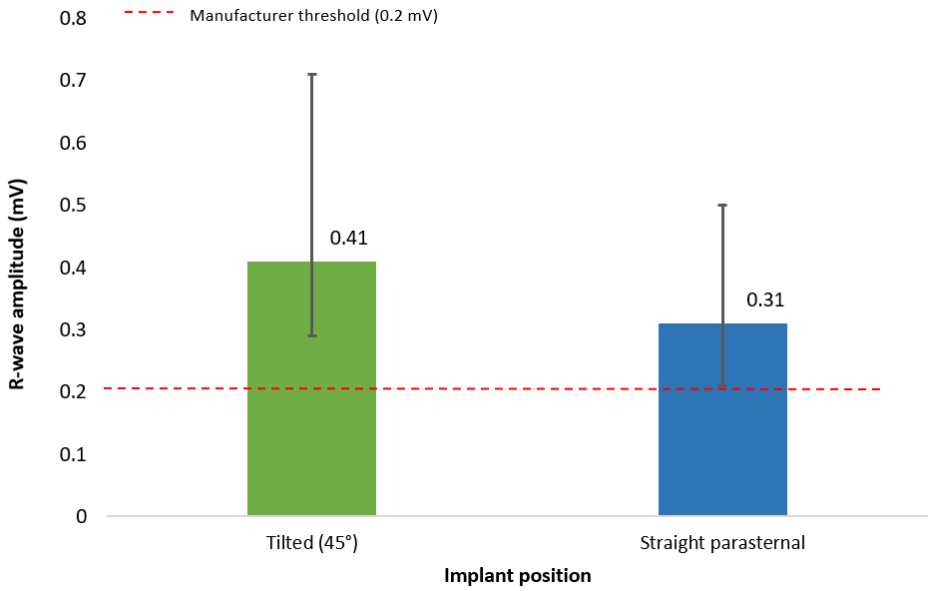
Variable	Procedures, n (%)
Implant position	
Tilted (45° relative to sternum)	23 (65.7)
Straight parasternal	12 (34.3)
Implant duration (incision to suture)	
<1 minute	7 (20)
1-5 minutes	20 (57.1)
>5 minutes	8 (22.9)
Total procedure time (anesthesia to dressing)	
<5 minutes	26 (74.3)
5-10 minutes	7 (20)
10-15 minutes	2 (5.7)
Implant ease	
Very easy	13 (37.1)
Easy	13 (37.1)
Normal	5 (14.3)
Difficult	4 (11.4)
Incision closure	
Steri-Strips	25 (71.4)
Staples	10 (28.6)
Implanter satisfaction	
Excellent	16 (45.7)
Good	18 (51.4)
Fair	1 (2.9)

Signal Quality

Mean detection signal amplitude recorded immediately after implantation was 0.45 (SD 0.29) mV (range 0.14-1.54 mV; n=32 with available data). The signal met or exceeded the manufacturer's recommended minimum threshold (0.2 mV) in 87.5% (28/32) of patients with available data; amplitude was below this threshold in 12.5% (4/32) of patients (range 0.14-0.19 mV). The P wave was visible in 94.3% (33/35) of patients. At the 7- to 14-day follow-up, the only available signal value was 0.46 mV, consistent with the baseline measurement.

When comparing signal amplitude by implant position, the median signal amplitude was 0.41 (IQR 0.29-0.71) mV in the tilted position versus 0.31 (IQR 0.21-0.50) mV in the straight parasternal position (Mann-Whitney U=162; P=.11; Figure 2). Given the small sample size, this comparison should be regarded as exploratory. Device repositioning due to insufficient signal was not required in any case.

Figure 2. Detection signal amplitude according to implant position. Bars represent the group median R-wave amplitude immediately after implantation according to ILR position (tilted position: n=20; straight parasternal position: n=12); error bars represent the IQR. The dashed red line indicates the manufacturer-recommended minimum sensing threshold (0.2 mV). ILR: insertable loop recorder.



Follow-Up and Adverse Events

At the 7- to 14-day visit (15/35 with available data; this visit is not part of routine clinical follow-up, and several patients did not attend, which limited data collection), no wound-related adverse events were recorded in any patient with available follow-up data. Device detection was correct in all of them, and remote transmission was satisfactory in 93.3% (14/15) of procedures.

At the 1-month visit, wound-related adverse-event data were available for 68.6% (24/35) of patients; data were unavailable for the remaining 11 (31.4%) patients. No wound-related adverse events were recorded among the 24 patients with available data (0/24). Detection was correct in 95.8% (23/24) of patients with available data. No final diagnosis was recorded at this visit.

At the 6-month visit, wound-related adverse-event data were available for 85.7% (30/35) of patients; data were unavailable for the remaining 5 (14.3%) patients. No wound-related adverse events were recorded among the 30 patients with available data (0/30). Device detection was correct in 96.7% (29/30) of cases with available data. Remote transmissions were satisfactory in 100% (30/30) of available records. Data on device position at 6 months were available for 20 of 35 patients; among these, the device remained in its original position in all 20 (100%), with no cases of migration observed.

Regarding diagnostic yield at 6 months, a final diagnosis was obtained in 20% (6/30) of patients with an available diagnostic outcome at 6 months: AF was detected in 1 (3.3%) patient, bradycardia in 2 (6.7%) patients, and other arrhythmias in 2 (6.7%) patients, plus 1 patient with a combined diagnosis of AF and syncope. Following diagnosis, a pacemaker was indicated in 3 (10%) patients, pharmacological treatment in 2 (6.7%) patients, and criteria for nocturnal block in 1 (3.3%) patient. The device was explanted in 3 (10%) patients once a diagnosis had been reached and further monitoring was no longer required.

Patient Satisfaction

Results of the satisfaction questionnaire at the implantation visit are shown in Table 3. Although the questionnaire was designed to be administered at all 4 visits, its completion at follow-up was markedly incomplete: valid responses were available for only 11.4% (4/35) of patients at the 7- to 14-day visit, 5.7% (2/35) of patients at 1 month, and 8.6% (3/35) of patients at 6 months. Because these follow-up sample sizes are too small to support meaningful estimates, longitudinal satisfaction results are not reported; the analysis below is therefore restricted to the implantation visit, all 35 patients completed the questionnaire (35/35). Regarding symptoms attributed to the procedure, 60% (n=21) of patients reported no pain during implantation (score 0), with a mean of 0.63 (SD 0.91). Overall, 97.1% (n=34) reported no irritation at the site (score 0), and 100% had no restriction of movement. Current symptoms (at discharge) were minimal: no pain in 88.6% (n=31), no irritation in 94.1% (n=32), and no restriction in 100% (n=34).

Only 48.6% (n=17) reported no worry related to the implant (score 0), with a mean of 1.63 (SD 1.90) on the 0-5 scale. Overall, 76.5% (n=26) reported no problems with activities of daily living after implantation.

Satisfaction levels were very high: 97.1% (n=34) of patients scored ≥4 (out of 5) for satisfaction with the intervention (mean 4.74, SD 0.89), 100% (35/35) for satisfaction with the care received (mean 4.94, SD 0.24), and 97.1% (n=34) for perceived safety during the procedure (mean 4.89, SD 0.40). Overall, 94.3% (n=33) rated the

implantation site as very appropriate or appropriate (mean 4.69, SD 1.08).

Discussion

Principal Findings

The results of the CARDIONURSE study show that ILR implantation by specialized electrophysiology nurses, performed under direct medical supervision, in an ambulatory setting is safe, fast, and technically adequate, with no objective procedural complications, adequate signal quality in the large majority of cases, and patient satisfaction close to the maximum possible score.

Comparison With Prior Work

No objective procedural complications occurred in our series, and no infections, hematomas, seromas, or device migrations were reported, which compares favorably with the complication rates reported in international series of specialized nursing practice. Lim et al [5] reported a complication rate of 5.1% in a series of 217 nurse-led implantations, mainly mild pain and hematoma. Eftekhari et al [7] reported similar results in a North American cohort led by advanced practice nurses, with no differences compared with physician-led implantation. In our series, mild, transient procedural pain, an expected symptom rather than a complication, was reported by 2 (5.7%) patients, with no need for additional treatment or device repositioning. These findings are also in line with those of Kipp et al [9], who reported low complication rates and high procedural success for ILR implantation performed by advanced practice providers in an ambulatory setting.

The mean detection signal amplitude obtained (0.45, SD 0.29 mV) falls within the range reported in the literature for ambulatory Reveal LINQ implantation. Rogers et al [4], in the randomized Reveal LINQ In-Office2 trial, reported a mean signal amplitude of 0.43 mV for in-office implantations performed by physicians and nurses. In our study, the recommended minimum threshold of 0.2 mV was met or exceeded in 87.5% (28/32) of patients with available data, and the P wave was visible in 94.3% (33/35) of cases, indicating adequate device positioning and signal vector orientation in most patients. These findings are particularly relevant because signal quality directly determines the device's long-term diagnostic capability [10].

The tilted position (45°) was the most frequently used (23/35, 65.7%), consistent with current manufacturer recommendations for optimizing the AF detection vector and minimizing T-wave oversensing. The tilted position, used in 65.7% (n=23) of cases, showed a numerical trend toward greater signal amplitude than the straight parasternal position, which may be related to the orientation of the sensing vector relative to the cardiac electrical axis in certain patients; however, this exploratory comparison did not reach statistical significance (P=.11), and the sample size does not allow definitive conclusions to be drawn.

The diagnostic yield observed (20% of diagnoses at 6 months among patients with an available diagnostic outcome at 6 months) is consistent with findings reported in long-term monitoring studies. It should be noted that the study follow-up period (6 months) is substantially shorter than the device's useful life (up to 3-4 years), so diagnostic yield would be expected to increase progressively over time. The detection of AF in patients implanted for syncope is a clinically important finding, as it changes therapeutic management toward anticoagulation or ablation.

From the patient satisfaction perspective, the results are favorable. The mean satisfaction scores for care received (4.94/5) and perceived safety (4.89/5) reflect that patients rated the care provided by specialized nurses very positively. These findings are consistent with those of Burr and Lampert [11], who noted that nurse-led clinics generate high patient satisfaction, partly owing to the greater availability and proximity of nursing staff to address concerns and provide health education. The low symptom burden associated with the procedure—40% (n=14) of patients reported some degree of procedural pain, although the mean pain score was low (0.63 out of 5)—confirms that this is a well-tolerated intervention.

In the context of the Spanish health care system, where clinical workload on arrhythmia specialist cardiologists continues to grow, shared-care models involving specialized nursing represent an opportunity to optimize resources without compromising quality of care. Framed within health care improvement science, this task-shifting from physicians to specialized nurses illustrates how early stakeholder engagement, from institutional leadership to the implanting nurses themselves, can support a manageable learning curve for both patients and professionals while contributing to the long-term sustainability of the arrhythmia workforce. The present study, which reports an independent cohort implanted exclusively by specialized nurses, together with our group's previous publication in Revista Española de Cardiología [8], provides converging evidence supporting the consolidation of this model in our setting.

Limitations

This study has several limitations. First, it was conducted at a single center with a relatively small sample size, which may limit the generalizability of the findings. Second, follow-up data for several variables were incomplete, which limited the longitudinal analyses; this was most pronounced for the satisfaction questionnaire, for which valid follow-up responses were available for only 6% to 11% of patients at each follow-up visit, precluding any longitudinal assessment of satisfaction beyond the implantation visit. Third, there was no physician-led control group, so direct comparisons between the 2 models of care could not be performed. Future studies could incorporate a retrospective historical cohort of physician-led implantations as a comparator to allow more robust statistical comparisons. Fourth, patient satisfaction was assessed exclusively through a quantitative Likert-scale instrument; this epistemological approach cannot capture the lived experience of patients and nursing staff throughout the

care pathway, and future research using qualitative methods could usefully explore this dimension. Fifth, implantation in this study was nurse-performed under direct, continuous medical supervision, with a supervising physician physically present throughout every procedure, rather than a fully independent nurse-led service; the results should therefore be interpreted as reflecting this supervised model of care, and further studies would be needed to evaluate outcomes under a more autonomous nursing practice model.

Conclusions

ILR implantation by specialized electrophysiology nurses under direct medical supervision in an ambulatory setting is a safe, fast, and technically adequate procedure. Detection signal quality met or exceeded the recommended minimum standard in the large majority of cases (28/32, 87.5%), with a visible P wave in nearly 95%. No objective procedural complications occurred, and no concerning safety signal was identified among patients with available follow-up data during the 6-month follow-up period; however, missing follow-up data for a proportion of patients limit a firm assessment of the true 6-month adverse-event rate. Patients reported very high satisfaction with the procedure, the care received, and perceived safety. These findings support the feasibility of specialized nursing as ILR implanters in similar ambulatory care settings, with potential to improve care efficiency and reduce waiting times; larger, multicenter studies are needed to confirm these results before broader implementation within the Spanish health care system.

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Generative AI Use

The authors used Claude (version Sonnet 5.5; Anthropic) exclusively for English language editing and proofreading. No AI tools were used to create content, data, or references. The authors created, drafted, and verified all aspects of this manuscript and take full accountability for its accuracy and integrity.

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Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request. The individual responses from the patients are not publicly available to protect participant privacy.

Authors' Contributions

ILR and RAF conceived and designed the study. ILR and HRG performed the device implantations. ÁMCM, MAF, and RAF conducted the patient follow-up visits. ILR, RAF, and SGK performed the data analysis. SGK and RAF drafted the manuscript. JGMM critically revised the manuscript for important intellectual content and approved the final version for publication. All authors read and approved the final manuscript.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Patient satisfaction questionnaire.
[DOCX File (Microsoft Word File), 10 KB-Multimedia Appendix 1]

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Abbreviations

AF: atrial fibrillation
bpm: beats per minute
ILR: insertable loop recorder

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