Implantable Electrocardiographic Event Monitors

Overview

This Coverage Policy addresses the use of implantable electrocardiographic event monitors, also referred to as implantable loop recorders (ILR), in the evaluation of patients with unexplained episodes of syncope and/or cryptogenic stroke.

Coverage Policy

An implantable electrocardiographic event monitor (i.e., implantable loop recorder) is considered medically necessary for the evaluation of an unexplained syncopal episode and/or cryptogenic stroke when a cardiac arrhythmia is suspected and EITHER of the following criteria are met:

- noninvasive ambulatory monitoring using a U.S. Food and Drug Administration (FDA) approved device failed to establish a definitive diagnosis
- noninvasive ambulatory monitoring is not expected to be diagnostic because the symptoms occur so infrequently and unpredictably that the length of the monitoring period would likely be inadequate to capture a diagnostic electrocardiogram (ECG) rhythm disorder
The use of an implantable electrocardiographic event monitor (i.e., implantable loop recorder) for ANY other indication including routine monitoring of a documented arrhythmia or assessing the effectiveness of arrhythmia treatment is considered experimental, investigational or unproven.

General Background

An implantable electrocardiographic event monitor, also referred to as an implantable loop recorder (ILR), is used to continuously monitor a patient’s electrocardiogram for the detection of cardiac arrhythmias. ILRs are most commonly used in the evaluation of palpitations or syncope of undetermined etiology, particularly when symptoms are infrequent (e.g., less than once per month) and/or other ambulatory monitoring has been inconclusive. The goal is to capture the ECG at the time of the event and to distinguish a cardiac cause for transient loss of consciousness from other causes such as epilepsy, hypoglycemia, and transient ischemic attack (Benditt, et al., 2020; Hayes 2016, annual review 2020).

ILRs are small leadless devices that are designed for subcutaneous implantation in the chest wall during a minimally-invasive surgical procedure. The preferred site for implantation is the left parasternal area of the chest. Sensing electrodes record a single-lead bipolar electrocardiogram (ECG), which can detect arrhythmias automatically or in response to patient activation. The episodes are recorded, stored and automatically transmitted wirelessly to the clinician through a cell phone, internet, or a patient monitor. According to the manufacturer, the battery has an estimated lifetime of 36–48 months (Galli, et al., 2016).

U.S. Food and Drug Administration (FDA)

There are numerous manufacturers of ILR’s which can be found in the FDA Center for Devices and Radiologic Health 510(k) database. Manufacturers of ILR devices include Abbott (Sylmar, CA), Biotronik (Lake Oswego, OR), Boston Scientific (Natick, MA), Sorin Group (Arvada, CO), Medtronic (Minneapolis, MN), Transoma Medical (St. Paul, MN) and St. Jude Medical (Sylmar, CA).

Syncope

Syncope is a clinical syndrome characterized by transient loss of consciousness (TLOC) and postural tone, which can be caused by temporary cerebral hypoperfusion characterized by rapid onset, short duration, spontaneous, and complete resolution. When the initial evaluation, including history, physical examination, and ECG, are non-diagnostic in a patient with suspected syncope, the patient is considered to have an unexplained diagnosis (Bisignani, et al., 2018).

Literature Review Syncope

The peer-reviewed medical literature supports the clinical utility of internal loop recorders. Evidence in the published literature primarily consists of systematic reviews and randomized controlled trials (Hindricks, et al., 2010; Giada, et al., 2007; Brignole, et al., 2006; Reiffel, et al., 2005; Farwell, et al., 2004; Sivakumaran, et al., 2003).

Systematic Reviews: A systematic review and meta-analysis of the literature (Solbiati, et al., 2017) analyzed the diagnostic yield of implantable loop recorders in patients with recurrent unexplained syncope in the absence of high-risk criteria and in high-risk patients after a negative evaluation. Prospective and retrospective studies with adults who underwent ILR implantation for undetermined syncope (49 studies; n=4381 patients) were included. The primary outcome was the overall diagnostic yield, defined as the proportion of patients with syncope recurrence and an available ILR recording or an automatic detection of a significant arrhythmia. Secondary outcomes were the proportions of patients with the specific etiologic diagnoses on the total of subjects and the proportion of an analyzable ECG recording during symptoms. The overall diagnostic yield was 43.9%. The proportions of subjects diagnosed with arrhythmic syncope, ventricular arrhythmias, supraventricular arrhythmias and bradycardia were 26.5%, 2.7%, 4.9% and 18.2%, respectively. The proportion of an analyzable ECG recording during symptoms was 89.5%. Median time to diagnosis was 134 days. The study concluded that about half of unexplained syncope subjects implanted with an ILR were diagnosed, and approximately 50% of them had an arrhythmia.
A Cochrane review of four randomized controlled trials (RCTs) (n=579 patients) by Solbiati et al. (2016) assessed the incidence of mortality, quality of life, adverse events and costs of ILRs versus conventional diagnostic workup in people with unexplained syncope. All randomized controlled trials of adult participants (i.e., ≥ 18 years old) with a diagnosis of unexplained syncope comparing ILR with standard diagnostic workup were included. The primary outcomes were short (i.e., within 30 days) and long-term all-cause mortality; other adverse events (cardiopulmonary resuscitation, intensive care unit admittance, major trauma, acute myocardial infarction, pulmonary embolism, major bleeding, aortic dissection ILR-related adverse events requiring either explant or treatment); and the quality of life during follow-up. The secondary outcomes were syncope relapse, economic costs and etiological diagnosis. The author concluded that all-cause mortality (death from any cause) was no different in people who received the ILR. Loop recorders did not seem to change quality of life, although people with an ILR had a significantly higher rate of diagnosis compared to participants in the standard assessment group. Moreover, data seemed to show a trend towards a reduction in syncope recurrences after diagnosis in people implanted with ILR.

A Hayes Medical Technology Directory report on implantable cardiac loop recorders for the diagnosis and management of syncope in adults included 14 studies that evaluated the efficacy and safety of ILR implantation for recurrent syncope. The review included seven randomized controlled trials (RCTs) and seven observational cohort studies. Study sample sizes ranged from 60–939 patients. Included adult patients had unexplained, recurrent syncope or a suspicion of an underlying cardiac arrhythmia and structural heart disease, inherited cardiac condition or heart failure. Patients may have had negative or inconclusive results on standard tests that required confirmation or clarification. ILR results were compared to the results of standard tests (echocardiography, standard 12-lead ECG, 24-hour Holter monitoring, head-up tilt-table testing (TTT), electrophysiological (EPS) testing, external loop recorder (ELR), telemetry, etc.). Outcomes measured were diagnostic yield, syncope incidence and recurrence, treatment initiation based on ILR test results, outcomes of ILR-directed treatment for syncope, syncope-related trauma, quality of life, complications and mortality. Evidence from a moderate-quality body of evidence suggested that ILR is relatively safe. Additionally, when used as a part of a stepwise process, is superior to standard test strategies for patients with recurrent, unexplained syncope (RUS) and an inconclusive or negative diagnosis after initial clinical evaluation. The annual review in 2020, did not change the conclusions of the original review (Hayes, 2016; annual review 2020).

**Randomized Controlled Trials:** Sulke et al. (2016) conducted a prospective randomized controlled trial (RCT) to evaluate the use of a remotely monitored implantable loop recorder (ILR) as the first line investigation in unexplained syncope. The ILR (Sleuth, Transoma Medical Inc.) was compared to conventional therapy and a dedicated syncope clinic (SC). The study included patients > age 16 years with normal complete blood count, urea, electrolytes and blood glucose who had more than two episodes of recurrent unexplained syncope (RUS) in last 24 months. Patients (n=246) were randomized into four groups: ILR alone group (n=66), ILR + SC group (n=59), SC group (n=60) or conventional treatment group (n=61). The syncope clinic included computed tomography (CT), magnetic resonance imaging (MRI), external loop monitoring (ELR), echocardiography, electrophysiological study, and standard implantable loop recorder implantation. All patients randomized to attend the syncope clinic (SC and ILR + SC) were offered tilt testing (HUT). The primary outcome measured the time to ECG diagnosis and the secondary outcome was the time to the second syncopal event after randomization. Median follow-up was 20 months with five patients withdrawing from the study after enrollment and four patients declining ILR implantation. The time to electrocardiogram (ECG) diagnosis was significantly shorter with the ILR alone group and SC group when compared to the conventional group (p=0.004 and p=0.002, respectively). Seventy-four percent of the first syncopal events documented in the SC groups occurred during provocative tilt testing. Twenty-two percent of patients who received an ILR were found to have a bradycardia indication for permanent pacing, compared with 3% of patients who did not receive an ILR. Overall, more investigative tests were undertaken in the conventional group than in any other. Only patients who received an ILR had a significant increase in time to second syncope (p=0.02), suggesting successful diagnosis and management of treatable causes of syncope. There were no implant related complications. An author noted limitation was head-up tilt induced syncope may not be the same as the initial syncopal episode, questioning if SC with or without HUT is beneficial. The authors summarized that implantable loop recorders offered rapid diagnosis, increased the likelihood of syncope being reported, demonstrated a high rate of intermittent bradycardia requiring pacing and reduced recurrent syncope. Furthermore, conventional management of syncope failed to achieve an ECG diagnosis despite a large number of investigative tests. Syncope clinic and provocative tilt testing delivered a rapid ECG diagnosis, but did not prevent recurrent syncope.
Podoleanu et al. (2014) conducted a multicenter randomized open-label controlled trial (n=78) to evaluate the early use of an implantable loop recorder during a syncope evaluation. Patients were randomized into two groups. The ILR group (n=39) received a Reveal® or Reveal® Plus (Medtronic) ILR and the conventional (CONV) group (n=39) received a conventional evaluation commonly used by the attending physician, excluding the use of an ILR. The study included patients presenting with an unexplained single, severe, and recent (≤ 6 months) syncope or patients having ≥ 2 unexplained syncopal episodes with in the last 12 months. All syncopal events were unexplained by standard tests. The primary outcomes compared the diagnostic yield and costs of a common evaluation strategy for syncope with the early use of an ILR in low-risk patients and analyzed the quality of life (QoL) associated with the two strategies. The groups were followed for 14 months, with outpatient consultations scheduled at two, six, 10 and 14 months in the ILR group and at six and 14 months in the CONV group. After 14 months of follow-up, a certain cause of syncope was established in 18 (46.2%) patients in the ILR group and two (5%) patients in the CONV group (p<0.001). Patients in the ILR group were hospitalized for a non-significantly shorter period than patients in the CONV group and advanced cardiology tests were performed less frequently in the ILR group than in the CONV group (p=0.05). There was no difference between the two groups in terms of QoL. There were no adverse events related to syncope. Author noted limitations of the study included the small patient population and the cost of the device. It was concluded that in patients with unexplained syncope, the early use of an ILR has a superior diagnostic yield compared with the conventional strategy, and lower healthcare-related costs.

Da Costa et al. (2013) reported the results of a multicenter randomized prospective study that evaluated the clinical impact of the implantable loop recorder in patients with isolated syncope, bundle branch block (BBB) and a negative workup. Patients (n=78) were randomized into two groups, ILR with the Reveal ILR (n=41) or conventional strategy (n=37) for 36 months. Patients were included if they experienced one syncope episode associated with any type of BBB with a QRS greater or equal to 120 millisecond; no evidence of second or third-degree AV block; and negative workup including an electrophysiological study (EPS). The primary endpoint was the time to occurrence of syncopal events associated with arrhythmias. Patients in the ILR group had follow-up visits every three months until the first symptomatic or asymptomatic episode was documented by electrocardiogram or until 36 months. Patients in the conventional strategy group were seen in the outpatient department at three, six, 12, 15, 18, 21, 24, 27, 30 and 33 months after randomization and at the study completion (36 months). At each visit, arrhythmic or cardiovascular events were recorded and a 12-lead electrocardiogram was obtained. Additionally, at each visit a Holter monitor was used for seven days, with analyses performed using the R Test Evolution (RTE) event recorder. ILR documented events occurred in 15 out of 41 patients after a median of six months; 11 (26.8%) patients presented with third-degree AV block; three (7.3%) presented with sick sinus syndrome (sinus arrest); and one (2.4%) presented with ventricular tachycardia. In the conventional group, three (8.1%) patients presented with third-degree AV block and one (2.7%) presented with sick sinus syndrome, after a median of nine months. Overall, 21 patients (27%) developed significant arrhythmic events: ventricular tachycardia (n=1; 1.3%); sudden death (n=2; 2.6%); third-degree (AV) block (n=14; 18%); and sick sinus syndrome (n=4; 5.1%). There was a clinically significant difference in relevant arrhythmias between the ILR group (n=15/41; 36.6%) and the conventional follow-up group (n=4/37; 10.8%) (p=0.02). Adverse events were not reported. Acknowledged study limitations included the small patient population, including patients after one episode of undiagnosed syncope and short term follow-up. The authors concluded this study demonstrated that ILR proved largely superior to conventional clinical follow-up in detecting recurrent events in patients with isolated syncope, BBB and negative EPS results, which may potentially impact therapeutic management.

Farwell et al. (2004) conducted a randomized controlled trial to investigate the effectiveness of the Reveal Plus ILR (Medtronic USA) compared to conventional treatment in the management of recurrent syncope. Patients (n=201) were randomized to either the ILR group (n=103) or conventional treatment group (n=98). Included patients were aged 16 years or older, presented with acute syncope, a history of recurrent syncope (≥ 2) without a definite diagnosis following an initial clinical workup which included tilt-test and 24 hour Holter recording (if clinically indicated). The primary outcome measured was time to ECG diagnosis and the secondary outcome was the time to first and second recurrence of syncope following study induction. Additionally, the secondary outcome measured the time to the introduction of ECG guided therapy. The tertiary outcome measured the quality of life. The initial follow-up, which was at least six months, was extended to 18 months because there was not a reduction in syncopal events or an improvement in quality of life after six months. Three patients were lost
to follow-up. In the Farwell et al., 2006 18-month follow-up the outcomes were reported on the patients (n=198) that completed the study (n=101/ILR group; n=97/conventional treatment group). Patients in the ILR group received an ECG diagnosis in 43% of patients compared to 6% in the conventional treatment group (p<0.001). Time to second syncope was significantly longer for ILR patients, although of borderline significance (p=0.04). A greater variety of diagnoses and treatments were seen in ILR patients. ILR patients had fewer post-randomization investigations and fewer days in hospital. There was a significant improvement in quality of life in the ILR group (visual analogue scales [VAS], p=0.03) for general wellbeing. Overall mortality was 12% with no difference between the two groups. There was no device related adverse events. It was noted that a limitation of the study was a decrease in sensitivity of the SF-12 and VAS questionnaires when used to assess quality of life in a syncopal population due to the rare and random nature of the symptom. The authors concluded that the ILR led to significantly more causes of syncope being diagnosed, rapid introduction of therapy and a greater variety of therapies being introduced.

Krahn et al. (2001) conducted a single-center crossover randomized controlled trial to compare diagnostic and clinical performance of ILR to standard testing in patients with unexplained syncope. Sixty patients were randomized to a “conventional” investigation strategy (n=30) or a prolonged monitoring strategy (n=30) with use of an ILR. Conventional testing included a 2–4 week period of monitoring with an external loop recorder, followed by tilt table testing and electrophysiological testing. If results were negative, patients immediately crossed over to ILR. Patients randomized to a prolonged monitoring strategy underwent implantation of a Reveal ILR (Medtronic). Patients were recruited if they had recurrent unexplained syncope or a single episode of syncope associated with injury that warranted cardiovascular investigation. After a clinical assessment patients were included in the study if they had negative results on Holter monitoring, no evidence of asymptomatic second- or third degree AV block, pauses > 3 seconds, sustained supraventricular tachycardia (SVT), or ≥ 10 beats of wide QRS complex tachycardia representative of ventricular tachycardia (VT). The outcomes measured syncope recurrence; diagnostic yield; infection at site of ILR implantation; treatment based on test findings and death. Patients were seen one week after loop recorder implantation for wound assessment and to reinforce patient understanding of the activation process. Subsequent follow-up occurred at one, two, three, six, nine and 12 months. Patients were seen immediately after a symptomatic event. A diagnosis was obtained in 14 of 27 (52%) patients randomized to prolonged monitoring compared to six of 30 (20%) patients undergoing conventional testing (p=0.012). Crossover (n=6) was associated with a diagnosis in one of six (17%) patients undergoing conventional testing compared to eight of 13 (62%) patients who completed monitoring (p=0.069). Overall, prolonged monitoring was more likely to result in a diagnosis than was conventional testing (p=0.0014). Bradycardia was detected in 14 patients undergoing monitoring compared with three patients undergoing conventional testing (p=0.005). There were no infections at the site of ILR implant. One patient in ILR group died of cerebrovascular accident at 10 months which was unrelated to study. Adverse events were not reported. Acknowledged limitations included the small patient population, selection bias, and using a single center for the study. The authors concluded that a prolonged monitoring strategy is more likely to provide a diagnosis than conventional testing in patients with unexplained syncope.

Non-Comparative Studies: Iglesias et al. (2009) conducted a single-center prospective, cohort study that evaluated the clinical performance of ILR in patients with recurrent unexplained syncope (RUS) as part of a standardized stepwise diagnostic evaluation. The study included 939 patients who were referred for evaluation of RUS or presyncope or near syncope event. All patients underwent a stepwise evaluation including history, physical examination, electrocardiogram, head up tilt testing (HUTT), carotid sinus massage (CSM) and hyperventilation testing (HYV). Echocardiogram and stress test were performed when underlying heart disease was initially suspected. Electrophysiological study (EPS) and implantable loop recorder (ILR) were only used in patients with underlying structural heart disease or major unexplained syncope. Patients without a diagnosis after initial noninvasive tests (n=54) received the Reveal device (Medtronic Inc.). The primary outcome measured the diagnostic yield of the tests. A cause of syncope was identified in 66% of patients, including 27% vasovagal, 14% psychogenic, 6% arrhythmias, and 6% hypotension. Noninvasive testing identified 92% and invasive testing an additional 8% of the causes. HUTT yielded 38%, CSM 28%, HYV 49%, EPS 22%, and ILR 56% of diagnoses. Results suggest that the cause of syncope was identified in 66% of patients undergoing stepwise evaluation, including in 56% of patients with negative results on initial, noninvasive tests. An author noted limitation of the study included the absence of objective criteria for the diagnosis of psychogenic pseudo-syncope, which may have overestimated the true prevalence of this disorder. The study concluded that a standardized stepwise
diagnostic evaluation focusing on noninvasive tests identified two-thirds of causes in patients referred to an
ambulatory clinic for unexplained syncope.

Brignole et al. (2006) reported the results of a prospective multicenter observational study (ISSUE 2) that
assessed the effectiveness of a diagnostic and treatment strategy in patients with recurrent suspected neurally
mediated syncope (NMS). Patients (n=392) included were at least 30 years of age with three or more clinically
severe syncopal episodes in the last two years without significant electrocardiographic and cardiac
abnormalities. Phase I measured the time to first syncopal recurrence after ILR implantation. Phase II measured
the rate and time of first syncopal recurrence; total burden of syncope after treatment initiation; multivariate
analysis of predictors for syncope; cardiovascular event rate; death rate; trauma secondary to syncope
recurrence; and the infection rate in ILR pocket. Follow-up occurred at three, six, 12, and 24 months. Among 392
patients, the one year recurrence rate of syncope during Phase I was 33%. One hundred and three patients had
a documented episode and entered Phase II: 53 patients received specific therapy (pacemaker: 47, catheter
ablation: four, implantable defibrillator: one, antiarrhythmic drug: one) and the remaining 50 patients did not
receive specific therapy. The one year recurrence rate in 53 patients assigned to a specific therapy was 10%
compared with 41% in the patients without specific therapy (p=0.002), and 92% for burden, (p=0.002). The one
year recurrence rate in patients with pacemakers was 5%. During Phase I, severe trauma secondary to syncope
relapse occurred in seven (2%) patients and mild trauma in 16 (4%) patients. During Phase II, no patient had
trauma. Finally, four patients had ILR pocket infections. An author noted limitation was the absence of a blinded
control group. The study concluded that a strategy based on early diagnostic ILR application, with therapy
delayed until documentation of syncope allows a safe, specific, and effective therapy in patients with NMS.

Professional Societies/Organizations
American College of Cardiology/American Heart Association/Heart Rhythm Society (ACC/AHA/HRS): The
ACC/AHA/HRS guidelines on the evaluation and management of patients with bradycardia and cardiac
conduction delay recommended that implantation of a cardiac monitor is reasonable if the initial noninvasive
evaluation is nondiagnostic with infrequent symptoms (> 30 days between symptoms) and suspected to be
cased by bradycardia (Kusumoto, et al., 2018).

The ACC/AHA/HRS 2017 guideline for the evaluation and management of patients with syncope stated that
internal cardiac monitoring can be useful when evaluating selected ambulatory patients with syncope of
suspected arrhythmic etiology (Shen, et al., 2017).

Cryptogenic Stroke
A stroke occurs in approximately 800,000 people each year in the United States; it can be a devastating
diagnosis, associated with high morbidity and mortality. The standard evaluation of a patient presenting with
stroke includes a comprehensive physical examination, basic hematologic tests, assessment of cardiac rhythm
with cardiac and neurologic imaging. Despite these efforts, a definitive cause for stroke cannot be identified in
10%–40% of patients; these patients are considered to have suffered a cryptogenic stroke. A significant
proportion of cryptogenic stroke survivors may have underlying atrial fibrillation (AF) which can be difficult to
diagnose with conventional monitoring strategies since the arrhythmia is commonly asymptomatic and often
occurs sporadically (De Angelis, et al., 2020; Musat, et al., 2018; Ringwala, et al.,2016).

Literature Review Cryptogenic Stroke: Evidence in prospective randomized controlled trials and observational
studies support using ILR to detect atrial fibrillation in patients with cryptogenic stroke.

Randomized Controlled Trials: The Cryptogenic Stroke and Underlying AF (CRYSTAL AF) trial was a parallel
group, randomized controlled trial conducted by Sanna et al. (2014) and compared the time to detection of atrial
fibrillation using an implantable cardiac monitor or conventional follow-up in patients with cryptogenic stroke or
transient ischemic attack (TIA). Patients (n=441) were randomized into two groups, the ICM group (Reveal XT;
Medtronic) (n=221) or the control group (n=220). Patients assigned to the control group underwent assessment
at scheduled and unscheduled visits, with ECG monitoring performed at the discretion of the site investigator.
Patients eligible for the study were age 40 years and older without evidence of atrial fibrillation during at least 24
hours of ECG monitoring. Patients underwent randomization within 90 days after the index event that was
supported by consistency between symptoms and findings on brain magnetic resonance imaging or computed
tomography. Stroke was classified as cryptogenic after extensive testing did not reveal a clear cause. The
In 2016, Brachmann et al. published the long-term results of the Cryptogenic Stroke and Underlying AF (CRYSTAL AF) trial which were collected ≤ 36 months after randomization. Cumulative AF detection rates in the ICM arm increased progressively during this period (30.0%), but remained low in the control arm (3.0%). Among ICM patients with AF detected, the median time to AF detection was 8.4 months, 81.0% of first AF episodes were asymptomatic, and 94.9% had at least one day with > 6 minutes of AF. At study closure, 379 patients had completed the 12-month visit (n=194 ICM; n=185 control), 177 patients had completed the 24-month visit (n=88 ICM; n=89 control), and 48 had completed the 36-month visit (n=24 ICM; 24 control). Acknowledged limitations of the study included, uncertainty on whether the stroke was caused by atrial fibrillation, because not all cryptogenic strokes are due to an arrhythmia. Additionally, the clinical significance of brief episodes of ICM detected atrial fibrillation is unknown and not all episodes of atrial fibrillation can be accounted for, because the device has a limited memory. Finally, the algorithm for detection of atrial fibrillation is not infallible, although the accuracy is reported to be 98.5%. The authors concluded that ECG monitoring with an ICM was superior to conventional follow-up for detecting atrial fibrillation after cryptogenic stroke.

In 2007, Giada et al. conducted a multicenter, prospective, randomized study to compare the diagnostic yield and the costs of an implantable loop recorder (ILR) with conventional treatment in patients with unexplained palpitations without severe structural heart disease. Patients (n=50) were randomized to conventional strategy (n=24) or to ILR implantation (n=26) with 1-year monitoring. Conventional treatment included 24 hour Holter recording, a four week period of ambulatory ECG monitoring with an external recorder, and electrophysiological study. The study included patients with infrequent (≤ 1 episode/month), sustained (> 1 minute) palpitations and a negative initial evaluation, including history, physical examination, and ECG. The primary end point was to establish the cause of the palpitations. A diagnosis was obtained in five patients in the conventional strategy group, and in 19 subjects in the ILR group (p<0.001). Despite the higher initial cost, the cost per diagnosis in the ILR group was lower than in the conventional strategy group. No adverse events were observed. Author noted limitations to the study included the highly specific study population preventing the results from being generalized to the entire population with palpitations and the open label structure of the study. This study concluded that, in subjects with infrequent unexplained palpitations and without severe structural heart disease, ILR is a safe and cost-effective diagnostic approach.

Non-Comparative Study: Ritter et al. (2013) investigated whether implantation of an insertable cardiac monitor (ICM) is feasible in patients with cryptogenic stroke, and compared the intermittent atrial fibrillation (iAF) detection rate of the ICM with seven day Holter monitoring. Sixty patients with acute cryptogenic stroke were included. All patients had to have embolic stroke patterns on cerebral imaging. ICM (Reveal XT) was implanted 13 days after the qualifying event. Seven-day Holter was performed after the ICM was implanted. The outcomes measured were the diagnosis of AF, time to first AF and recurrent stroke. The iAF was detected by the ICM in ten patients (17%) at 12 months. Only one patient (1.7%) had iAF during seven day Holter monitoring (P=0.0077). Episodes of iAF lasting two minutes or more were detected 64 days after implantation. There were no recurrent strokes during the observation period. The implantation procedure was well tolerated with no adverse events. The authors concluded that ICM implantation for the detection of iAF during outpatient follow-up is feasible in patients with cryptogenic stroke. ICMs offer a much higher diagnostic yield than seven day Holter monitoring.

Technology Assessment: A Hayes Technology Brief on implantable cardiac loop recorders for detection of atrial fibrillation following cryptogenic stroke included nine clinical studies (n=22–1247 patients) that evaluated ILRs for detection of atrial fibrillation (AF) following cryptogenic stroke. The review included a randomized
controlled trial (RCT), a prospective cohort study, a retrospective database review, and six nested case-control studies. Overall, the quality of the evidence was moderate. Despite a number of poor-quality observational studies, a large, fair-quality randomized controlled trial (RCT) found that the ILR detected a higher number of AF events in patients with cryptogenic stroke compared with standard methods of monitoring. Results of the other studies, while of poor quality, had consistent findings suggesting that ILR detected AF in patients with a history of cryptogenic stroke. Use of the ILR in this patient population appears to be safe; the only reported complications included local irritation or infection. The annual review in 2019, did not change the conclusions of the original review (Hayes, 2017; annual review 2019).

Professional Societies/Organizations
American Heart Association/American College of Cardiology/Heart Rhythm Society (AHA/ACC/HRS): The 2019 AHA/ACC/HRS focused update of the 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation recommended that implantation of a cardiac monitor (loop recorder) is reasonable to optimize detection of silent AF in patients with cryptogenic stroke (i.e., stroke of unknown cause) in whom external ambulatory monitoring is inconclusive (January, et al, 2019).

Heart Rhythm Society (HRS): The HRS expert consensus statement on the diagnosis and treatment of postural tachycardia syndrome, inappropriate sinus tachycardia, and vasovagal syncope stated that implantable loop recorders (ILRs) can be useful for assessing recurrent and troublesome syncope in older patients who lack a clear diagnosis and are at low risk of a fatal outcome (Sheldon, et al., 2015).

Other Indications
An implantable electrocardiographic event monitor (i.e., implantable loop recorder) has been proposed for the treatment of multiple other disorders including: routine monitoring of documented arrhythmias or assessing the effectiveness of treatment.

ILR placement has been investigated as a tool to monitor for arrhythmias after a cardiac ablation and to guide anticoagulation. Surveillance for recurrence of atrial arrhythmias is important in patients who have undergone cardiac ablation. The optimal method for screening for episodes of AF after ablation is unknown (Lee and Mittal, 2018). However, serial or symptom-initiated standard ECGs, Holter monitoring (24 hours to 7 days) and transtelephonic recordings, patient-activated and automatically activated devices, and external loop recorders are among the commonly used noncontinuous monitoring tools. Although implantable loop recorders appear promising for the long-term assessment of AF burden, important limitations include less than 100% specificity due to myopotentials and atrial and ventricular premature beats, as well as limited memory, resulting in unretrievable electrograms that cannot be used to verify the correct rhythm diagnosis (Di Biase, et al., 2018; Ciconte, et al., 2017).

Postablation anticoagulation is recommended in all patients for at least two months. After this two-month period of mandatory oral anticoagulation, the anticoagulant regimen in place prior to the procedure is restarted. For those patients without evidence of recurrent AF and whose risk for embolization is very low, anticoagulation can be stopped (Passman, 2019; Di Biase, et al., 2018).

Literature Review
Randomized Controlled Trials: Mamchur et al. (2020) conducted a randomized controlled trial that evaluated the efficacy of noninvasive ambulatory ECG monitoring (NIAM) compared to implantable loop recorder (ILR) in patients undergoing a cardiac ablation for atrial fibrillation (AF). Thirty-two patients with AF were included in the study. Patients were randomized into two groups. Group I (n=15) received the Reveal XT ILR for invasive ECG monitoring for up to three months and group II (n=17) used the Spyder noninvasive ambulatory ECG monitoring (NIAM) for up to 14 days. Scheduled visits were planned for a period of 14 days and three months after implantation. Unscheduled visits occurred after documentation of at least two episodes recorded manually, or when indicating the presence of automatic records on the patient's assistant. The outcomes measured the detection of symptomatic and asymptomatic AF episodes, as well as symptomatic and asymptomatic episodes of other arrhythmias. In both groups, at least one AF episode was detected during 14 days of monitoring. The overall count of AF episodes was 25 in NIAM group and 28 in ILR group. The mean time between AF start and its registration by a physician was significantly higher in the NIAM group at eight hours compared to 20 hours in ILR group (p=0.005). The NIAM group had a sensitivity of 80.1%, specificity of 73.1%, positive predictive value of
Corresponding values for the ILR group were 78.6%, 69%, 71%, and 77%. At the same time, continued monitoring with ILR for longer than two weeks did not lead to a significant change in the sensitivity and specificity of the method. An author noted limitation was that both methods were compared in different patient groups instead of simultaneous ECG recording of both types of devices in the same patients. The author concluded that in patients with paroxysmal AF, the diagnostic value of both NIAM and ILR is comparable. An increase in the duration of ECG monitoring for longer than two weeks does not provide additional diagnostic information.

Kapa et al. (2013) conducted a prospective, randomized trial (ABACUS study) to evaluate utility of an implantable loop recorder (ILR; Reveal XT, Medtronic, Inc) versus conventional monitoring (30-day transtelephonic monitors at discharge and after five months) for assessing arrhythmia burden and patient management post AF ablation. After AF ablation, patients (n=44) received ICMs and conventional monitoring. Conventional monitoring (CM) was monitored for 12 months which included wearing a monitor over three separate 30-day periods over the first year post-ablation and daily pulse checks. The conventional monitoring strategy was used for the first six months post-ablation. During the next six months, patients were monitored using the data from the Reveal device, transmitted from home every 30 days. The ILR was explanted in four patients. Over a mean follow-up of 6±1 months, 28 of the remaining 40 pts (70%) experienced AF (most within six weeks after ablation), which was correctly detected by ILR in 27 (96%) and by CM in 16 pts (57%). Patients with AF recurrences detected by both ILR and CM had a significantly higher AF burden than those with AF recurrences detected by ILR only (p<0.05). In eight patient (20%) ILR misclassified sinus rhythm with frequent premature atrial/ventricular complexes as AF. Additionally, signal under-sensing resulted in ILR rhythm misclassification as asystole or bradycardia in 10 patients (25%). ILR did detect true bradycardia or asystole in six pts (15%) which resulted in pacemaker implant in two pts and drug modification in three patients.

Pokushalov et al. (2011) conducted a prospective, randomized study to identify the optimal treatment of patients with AF recurrences after the first ablation. Two hundred eighty-six patients with highly symptomatic, drug-refractory paroxysmal AF underwent ablation (circumferential pulmonary vein isolation with linear lesions) and were monitored with an implantable cardiac monitor (Reveal XT, Medtronic). Patients without AF recurrences during the three month postablation period were assigned to group 1; those with AF recurrences to group 2. Patients in group 2 were randomly assigned to group 3 or group 4. Group 3 patients were treated only with antiarrhythmic drugs for six weeks, with no early reablation during the three month postablation period. In the case of AF recurrence after the 3-month postablation period, patients underwent reablation. Group 4 patients were treated according to the onset mechanism of AF recurrences, as detected and stored by the implantable cardiac monitor: antiarrhythmic drug therapy, but no reablation if AF was not preceded by triggers; early reablation if premature atrial beats or atrial tachycardia’s or flutter triggered AF. The measured outcome this study was to identify the most appropriate strategy for treating patients with AF recurrences after the first ablation, through the diagnostic data stored by a subcutaneous AF monitor. All patients were followed up for one year to assess maintenance of sinus rhythm in each group. On 12-month follow-up examination, of the 119 (42%) patients in group 1, 112 (94%) had no AF recurrences. Among the 83 patients in group 3, only 27 (33%) had no recurrences. Of the 84 group 4 patients, 67 (80%) had no AF recurrences (p<0.0001 versus group 3). Author noted limitations included small patient population and the usual definition for failures (>30 seconds of AF) was not used, which could result in a different result.

Evidence in the published, peer-reviewed scientific literature is inadequate to support improved clinical outcomes. A majority of the studies lack control groups, large sample populations, and measurement of long-term outcomes, therefore no conclusions can be made regarding the safety and efficacy of an implantable loop recorder to treat these conditions.

Professional Societies/Organizations
Heart Rhythm Society/European Heart Rhythm Association/European Cardiac Arrhythmia Society/ Asia Pacific Heart Rhythm Society/Latin American Society of Cardiac Stimulation and Electrophysiology. (HRS/EHRA/ECAS/APHRS/SOLAECE): The 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation recommended that arrhythmia monitoring for efficacy of catheter ablation is typically delayed for at least three months postablation unless required to evaluate arrhythmia symptoms during the early postablation period. The two main reasons to perform arrhythmia monitoring following catheter ablation are clinical care and as part of a clinical research trial.
Additionally, the consensus statement recommended that adherence to atrial fibrillation anticoagulation guidelines is recommended for patients who have undergone an AF ablation procedure, regardless of outcome of the procedure. If anticoagulation is needed for more than two months post ablation, the patient’s stroke risk profile should be used and not the perceived success or failure of the ablation procedure (Calkins, et al., 2016).

Use Outside of the US
The European Society of Cardiology (ESC) guidelines for the diagnosis and management of syncope, updated in 2018, included recommendations for implantable loop recorders. ILR is recommended during an early phase of evaluation in patients with recurrent syncope of uncertain origin, absence of high-risk criteria and a high likelihood of recurrence within the battery life of the device. ILR is indicated in patients with high-risk criteria (e.g., new onset chest pain, palpitations, syncope during exertion, severe structural or coronary artery disease) when a comprehensive evaluation does not demonstrate a cause of syncope or lead to a specific treatment, and without conventional indications for primary prevention ICD or pacemaker indication. ILR should be considered in patients with suspected or certain reflex syncope presenting with frequent or severe syncopal episodes. Additionally, ESC recommended that ILR may be considered in patients in whom epilepsy was suspected but the treatment has proven ineffective and in patients with unexplained falls (Brignole, et al., 2018).

ESC guidelines for the management of atrial fibrillation developed in collaboration with European Association for Cardio-Thoracic Surgery (EACTS) recommended that non-invasive ECG monitors or implanted loop recorders be considered to document silent atrial fibrillation in stroke patients. The guideline recommended that oral anticoagulation after catheter ablation should follow the general anticoagulation recommendations, regardless of the presumed rhythm outcome. According to the guidelines, the patient should be seen at least once in the first 12 months after ablation. If there are symptomatic recurrences, further options should be explored (Kirchhof, et al., 2016).

European Heart Rhythm Association (EHRA), Heart Rhythm Society (HRS), and Asia Pacific Heart Rhythm Society (APHRS) guidelines for the management of patients with ventricular arrhythmias (VAs) addressed the indications for diagnostic testing, the present state of prognostic risk stratification, and the treatment strategies that have been demonstrated to improve the clinical outcome of patients with VAs. The consensus recommendations on general diagnostic work-up stated that prolonged ECG monitoring by Holter ECG, prolonged ECG event monitoring, or implantable loop recorders should be considered when documentation of further, potentially longer arrhythmias would change management (Pedersen, et al., 2014).

The National Institute for Health and Clinical Excellence (NICE) (United Kingdom) clinical guideline on transient loss of consciousness (‘blackouts’) for patients aged 16 years or older stated that for people with a suspected cardiac arrhythmic cause of syncope, the type of ambulatory ECG offered should be chosen on the basis of the person's history (and, in particular, frequency) of TLoC. For people who experience TLoC infrequently (less than once every two weeks), offer an implantable event recorder (NICE, 2010; updated 2016).

Medicare Coverage Determinations

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Policy Name/Number</th>
<th>Revision Effective Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCD</td>
<td>National Electrocardiographic Services (20.15)</td>
<td>8/26/2004</td>
</tr>
<tr>
<td>LCD</td>
<td>No Local Coverage Determination found</td>
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Note: Please review the current Medicare Policy for the most up-to-date information.

Coding/Billing Information

Note: 1) This list of codes may not be all-inclusive.
2) Deleted codes and codes which are not effective at the time the service is rendered may not be eligible for reimbursement.

Considered Medically Necessary when criteria in the applicable policy statements listed above are met:
<table>
<thead>
<tr>
<th>CPT® Codes</th>
<th>Description</th>
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<tbody>
<tr>
<td>33285</td>
<td>Insertion, subcutaneous cardiac rhythm monitor, including programming</td>
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<table>
<thead>
<tr>
<th>HCPCS Codes</th>
<th>Description</th>
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<tbody>
<tr>
<td>C1764</td>
<td>Event recorder, cardiac (implantable)</td>
</tr>
<tr>
<td>E0616</td>
<td>Implantable cardiac event recorder with memory, activator and programmer</td>
</tr>
</tbody>
</table>


References


