# Leadless Pacing Update: Nanostim Battery Fix, Micra Safety Upheld

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June 27, 2017

VIENNA, AUSTRIA — There may be a resolution in sight for the sudden battery-depletion issue that has frustrated progress on the Nanostim (St Jude Medical/Abbott) leadless pacemaker, which should allow the first such device to be widely studied in patients to move forward in development.

But there's a kind of silver lining in Nanostim's battery troubles, made public last year after the device's erstwhile owner, St Jude Medical (now Abbott) learned that some of the small cylindrical pacemakers had suddenly lost all battery power only a few years after implantation[1]. Now there is an admittedly useful large experience retrieving the devices, which may have eased some concerns about how permanent a Nanostim implantation may or may not be.

And there seems to have been progress for both well-studied leadless pacemakers, Nanostim[2] and Micra (Micra Transcatheter Pacing System, Medtronic)[3] in some key safety issues, including the risk of poking a hole in the myocardium during the insertion procedure, causing pericardial effusion and perhaps tamponade, closely watched potential complications of both devices.

Those insights from a progress report on leadless cardiac pacing, presented here at the European Heart Rhythm Association (EHRA) EUROPACE-CARDIOSTIM 2017 sessions, show that despite bumps in the road, the emerging, potentially game-changing technology could well deliver on hopes it will provide an alternative to pacemakers with transvenous lead systems, at least for some patients.

Most commenting on the devices at the EHRA sessions expressed hope for a randomized comparison between leadless pacemakers and standard-lead pacemakers.

"The retrospective data suggest that leadless pacemakers will actually be superior, but I think we know the problems with retrospective studies," said Dr Vivek Reddy (Mount Sinai Hospital, New York, NY), as assigned discussant for presentations on both Micra and Nanostim.

Reddy, a prominent Nanostim investigator, cautioned that follow-up times for both devices have been only a few years, but still he is "impressed" with their demonstrated safety record. For example, the implantation risk of pericardial effusion, with or without tamponade, used to range between 1% and 2% with the devices, but seems to have dropped to well below 1%, "which I think is very much in line with what we see with traditional pacemaker implants."

The implantation procedure and pacing with the devices appear safe, Prof Gerhard Hindricks (University of Leipzig Heart Center, Germany) told **theheart.org**|Medscape Cardiology, and in particular, postmarket Micra data presented at the EHRA sessions seems to show "an excellent safety profile and excellent performance of the device even in the hands of early users." Hindricks wasn't involved in leadless-pacing presentations at EHRA.

## Nanostim Battery-Failure Update

In October 2016, St Jude announced a halt to the Nanostim trial it hoped to submit for market approval in the US, after the devices lost telemetry and pacing capability 29 to 37 months after implantation in seven patients, with no adverse events in any case. The device was extracted from pacemaker-dependent patients and replaced with another system, sometimes a transvenous-lead system, and was left in place in the remainder, who were monitored closely.

As of the end of March this year, said Prof Reinoud E Knops (Academic Medical Center, Amsterdam, the Netherlands) when presenting an update at the EHRA sessions, 34 of the 1423 worldwide Nanostim recipients have experienced the battery-depletion issue (2.4%). They include 30 in Europe (where the device has been available since 2013; Micra gained the CE Mark in 2015), three in the US (where Nanostim remains investigational and Micra was approved about a year ago), and one in Australia.

Since before the St Jude advisory, according to Knops, a differently designed battery has been in development for Nanostim. "The new battery will be available in the third quarter of this year, and Nanostim will be available from that time on."

There were no serious adverse events due to battery failures, Knops said, although six patients became symptomatic from bradycardia. None of the failed devices triggered the "recommended replacement time" alert that warned of limited remaining longevity.

Because the battery failures were sudden, Reddy said, all pacemaker-dependent patients still relying on the Nanostim should have some sort of revision or device replacement. As for that 2.4% failure rate, he added, "I think we know that rate is unfortunately going to increase."

## Device Retrieval Experience

In a key structural difference between Micra and Nanostim, the latter features a "docking button" extension on the proximal end, and the entire system includes a catheter device that can snare the button so the pacemaker can be pulled away from the implantation site. Such retrieval was attempted in 73 cases, but in about 70% it was decided to abandon the device, leaving it in place while another pacemaker system was inserted.

Of those 73 retrieval attempts, 66 (90%) were successful, Knops reported. Six of the seven retrieval failures were due to the docking button being inaccessible, and one because the button detached, Knops said.

There are little or no retrieval data for Micra, whereas with Nanostim, "data indicate that it can be done safely," Hendricks said in an interview. But that's with implants that haven't been in a long time.

**Nanostim Retrieval Success Rate by Time Since Implantation**

| End point | 0–1 y (n=22) | 1–2 y (n=30) | >2 y (n=21) |
|---|---|---|---|
| **Retrieval success (%)** | 86 | 93 | 90 |

No significant differences. Indications for retrieval included elevation in pacing threshold, n=8; device upgrade, n=9; battery failure, n=8; prophylactic explantation due to battery advisory, n=46; elective explantation, n=2

"We have only limited experience; the longest implant of the device was about 3 years," Hendricks observed. What about Nanostim retrieval safety at 6 years or 10 years? Postmortem retrievals show that the device soon becomes encapsulated with fibrous tissue.

"These patients are old, they have many comorbidities," Hendricks said. "We should have very good reasons to take the device out," he said; it will usually be better to abandon it and implant another beside it, "because you avoid the risk of traumatic heart injury."

So far, the Nanostim retrieval experience is limited and was "in experienced hands with the best precautions," Hendricks said. But if the procedure spreads into clinical practice, by operators with varying levels of experience, "I would not expect that device retrieval can be done without any complications."

Reddy agreed that both devices will probably become enveloped with tissue over time, and little is known about the tissue's long-term effects on ability to retrieve the devices. "What I take away from this is that patients with a Nanostim device for whom we're considering retrieval, it's probably a better idea to retrieve it sooner rather than later."

Knops related a Nanostim-retrieval case of his own, one that occurred 3.1 years after implantation. The retrieved device was virtually clean, with little or no adhering tissue, much different from the postmortem extraction experience.

When his team went back to the patient to insert a Micra replacement, contrast imaging (shown as part of his presentation) showed a radiographic "ghost" at the site of the previous implantation, the barest visual sign of what the Nanostim left behind, they guessed.

"It's the remnants, probably, of the fibrotic tissue that had surrounded the pacemaker," Knops said. "That gives me the impression that a lot of the leadless pacemakers will get covered with tissue, and probably the longer the tissue is there, the more difficult it is to retrieve them." So in this likely period of increasing Nanostim battery failures, "my advice would be to at least do an attempt at retrieval."

## Updated Micra Postmarket Registry

Given the Nanostim's battery-depletion troubles, many at the EHRA sessions wanted to know the Micra's expected longevity. So far it has shown no signs of early depletion, according to Dr Paul R Roberts (Southampton, UK), who presented an updated "real-world" Micra experience at the EHRA sessions.

He said the estimated median battery longevity is 14 years, based on 120 patients with at least 6 months of battery data.

**Micra Safety Events at 30 Days, Postmarket Registry vs Micra Transcatheter Pacing System Global Clinical Trial**

| Events at 30 days | Postmarket (n=1035) % | Clinical trial (n=726) % | OR, postmarket registry vs global clinical trial (95% CI) |
|---|---|---|---|
| **Total major complications** | 1.64 | 2.89 | 0.56 (0.29–1.07)* |
| **Death** | 0.29 | 0.14 | 2.11 (0.21–20.30) |
| **Hospitalization** | 0.68 | 1.10 | 0.61 (0.22–1.69) |
| **Prolonged hospitalization** | 0.87 | 1.93 | 0.45 (0.19–1.04) |
| **System revision** | 0.19 | 0.41 | 0.47 (0.10–4.99) |
| **Loss of device function** | 0.10 | 0.28 | 0.35 (0.03–3.87) |

*Results at adjusted analyses were similar and also nonsignificant at 0.64 (95% CI 0.32–1.29; *P*=0.2106)

According to the latest postmarket registry data presented by Roberts, the major complication rate by 30 days reached 1.64% and included four pericardial effusions with tamponade and three deaths adjudicated as procedure-related. Among the cohort numbering 1035 patients, all-cause mortality was 8.8% at 6 months, Roberts said.

Those numbers are a nonsignificant uptick from what Micra investigators reported at the recent Heart Rhythm Society (HRS) Scientific Sessions 2017 based on the 795 patients with data available at the time but still keeps the postmarket experience in line with what was achieved in the Micra TPS Global Clinical Trial.

*Roberts discloses research contracts with Medtronic and Boston Scientific and consulting for Medtronic, Boston Scientific, and Abbott. Knops discloses consulting for, receiving royalties from, or having equity interest in Medtronic, Abbott, and Boston Scientific. Reddy has reported grant support/research contracts and consultant fees/honoraria from or being on a speaker's bureau for Medtronic, St Jude Medical (now Abbott), and Coherex Medical.*

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**References**


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3. Roberts PR. Real-world experience with a leadless pacemaker: a comparison to the initial experience with the Micra transcatheter pacemaker. European Heart Rhythm Association (EHRA) EUROPACE-CARDIOSTIM 2017. June 19, 2017; Vienna, Austria. Late-breaking trial session: Leadless pacing. Available here.