December 20, 2017

Canadian Heart Rhythm Society
Device Committee

RE: ADVISORY – Boston Scientific Minute Ventilation oversensing advisory

Nature of the Advisory:

This advisory describes an issue with Boston Scientific pacemakers where the pacemaker can oversense the minute ventilation (MV) sensor signal which could result in inhibition of pacing with a potential for injury due to loss of pacing in patients who are pacemaker dependent.

Minute ventilation sensors work by sending a low energy signal from pacemaker lead rings to the device can at a frequency of 50 Hz to measure the impedance changes in the chest with respiration. Under certain circumstances where there may be a slight change in contact with the ring electrode in the header, the pacemaker could sense these signals as cardiac events and inhibit pacing leading to loss of pacing output. This could potentially lead to syncope or injury in patients who are pacemaker dependent.

Scope of the problem:

This potential oversensing may occur in Boston Scientific Accolade single or dual chamber pacemakers or Visionist CRT-pacemakers. There are 3850 patients in Canada implanted with affected devices. The incidence of this oversensing issue varies somewhat with the manufacturer of the lead connected to the pacemaker, occurring in less than 1% of devices at 5 years in patients with Medtronic or Abbott leads, and in about 0.1% at 5 years in patients with Boston Scientific leads. The difference in manufacturer rates is likely due to variances in surface finish and movement in the lead in the header between different leads and does not indicate higher rates of lead failure or fault. When the oversensing occurs, it is usually brief and may be asymptomatic in many patients, but in dependent patients could lead to syncope due to loss of cardiac stimulation. The estimated risk of injury from this issue is 0.05% (1 in 2,000) for patients with Medtronic or Abbott leads, or 0.008% (1 in 33,333) for patients with these pacemakers with Boston Scientific leads.

Response of the CHRS Device Committee:

- We recommend that all patients with these devices be evaluated for pacemaker dependency
- In patients who are pacemaker dependent, we recommend that MV be programmed "off" until a software update is available to resolve this issue. Note that when programmed to passive, the MV sensor signal is enabled and may be oversensed so it is imperative to program MV sensor to "off". These patients may still have rate response turned on via the accelerometer which is present in all of these devices.
- In patients who are NOT pacemaker dependent, the continued use of the MV sensor can be considered as long as the potential for risk of oversensing and loss of pacing is balanced against the benefit of that sensor to the patient.

Boston Scientific is working on a software fixes that will filter these signals and prevent oversensing. This software will likely be available in the new year. IT IS IMPORTANT TO NOTE THAT ALL NEW BOSTON SCIENTIFIC PACEMAKERS IMPLANTED FROM NOW UNTIL THE SOFTWARE UPDATE IS AVAILABLE WILL BE SUBJECT TO THIS VULNERABILITY. We have asked Boston Scientific to include notification of this advisory on the boxes of devices being implanted, and to make sure that individual pacemaker clinics are aware to avoid the use of the MV sensor until the software fix is available. It is important to note that the MV sensor is NOMINALLY ON, thus it will need to be turned "off" at the time of initial programming at implant, especially in patients who are pacemaker dependent.

Attached are copies of the clinic notification letter from Boston Scientific and a sample patient letter. The CHRS Device Committee agrees with their recommendations. If there are any further questions regarding this advisory, please direct them to your local Boston Scientific representative.

Larry Sterns, MD, FRCPC, FHRS, FCCS
Chair, Device Committee

François Philippon, MD, FRCPC, FHRS, FCCS
Past Chair, Device Committee, CHRS

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Important Medical Device Information

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December 2017

Dear Doctor,

Boston Scientific has received reports of intermittent oversensing of the Minute Ventilation (MV) sensor signal with certain Boston Scientific pacemaker and cardiac resynchronization therapy pacemaker systems (pacemakers). MV sensor signal oversensing may cause pre-syncope or syncope due to periods of pacing inhibition. This MV behavior may occur with any manufacturer's pacing lead system, but Boston Scientific has determined it to be more likely for affected Boston Scientific pacemakers using Medtronic or Abbott/St. Jude (Abbott) leads implanted in either the right atrium (RA) or right ventricle (RV).

Boston Scientific is actively developing a software update designed to automatically detect and resolve this MV sensor signal oversensing behavior. We anticipate submitting the software update to Regulatory Agencies in March 2018 and pending approval, will release it as soon as possible thereafter. Until this software update is available, Boston Scientific has additional recommendations to mitigate this risk for affected pacemaker systems.

Root Cause Investigation
The MV sensor in Boston Scientific pacemakers can be used for RightRate™ (rate adaptive pacing), Respiratory Rate Trend, or AP Scan™[1]. When the RA/RV pacing leads and lead terminal connections are operating as intended, the MV sensor signal is appropriately filtered and therefore is not detected by the pacemaker or displayed on electrograms (EGMs). However, intermittency related to the lead or pacemaker-lead connection[2] has the potential to create a transient high impedance condition. A high impedance condition may subsequently alter the MV sensor signal such that it becomes visible on EGMs and potentially subject to oversensing on the RA or RV channels. For a technical description of the Boston Scientific's MV sensor, please refer to Appendix A.

Engineering analysis and testing, as well as evaluation of post-market surveillance data, demonstrates an elevated potential for oversensing of the MV sensor signal in certain pacemaker systems connected to Medtronic or Abbott pacing leads. Although all leads evaluated in simulated testing environments comply with appropriate connector standards[3], we have discovered subtle differences amongst lead manufacturers in the surface finish of the lead terminal ring and amount of axial and radial terminal ring motion within the pacemaker header. These factors may result in intermittent increases in impedance leading to oversensing of the MV sensor signal or changes in daily impedance test measurements.

Clinical Impact
If MV sensor signal oversensing is observed on the atrial channel, the most common clinical outcome is an inappropriate mode switch. The worst-case reported harm associated with MV sensor signal oversensing on the RV channel is pacing inhibition, which has led to syncope with associated injury in some pacemaker-dependent patients. Boston Scientific investigation has shown that the probability of harm associated with MV sensor signal oversensing behavior is significantly greater when affected pacemakers are connected to Medtronic or Abbott pacing leads.

[1] RightRate is not available in CRT-Ps in all countries and AP Scan is not available in Pacemakers or CRT-Ps in all countries.
[2] Such as lead conductor fracture, under-insertion of the lead terminal, or axial/radial motion of the lead terminal's ring electrode within the pacemaker header
[3] ISO 5841-3:2013, Implants for surgery -- Cardiac pacemakers -- Part 3: Low-profile connectors (IS-1) for implantable pacemakers.

Affected pacemaker systems connected to the following RA/RV pacing leads[4]:	Probability of Injury at 5 years	Probability of Life Threatening Harm at 5 years
Medtronic or Abbott pacing leads	0.0005 (1 in 2,000)	0.00001 (1 in 100,000)
Boston Scientific pacing leads (including DEXTRUS)	0.00003 (1 in 33,333)	0.0000008 (1 in 1,250,000)
All pacing leads combined[5]	0.00008 (1 in 12,500)	0.000002 (1 in 500,000)

Affected Pacemakers

VALITUDE™ CRT-P Models U125 and U128	VISIONIST™ CRT-P Models U225, U226, and U228
ACCOLADE™ Pacemakers Models L300, L301, L310, L311, L321, L331	PROPONENT™ Pacemakers Models L200, L201, L209, L210, L211, L221, L231
ESSENTIO™ Pacemakers Models L100, L101, L110, L111, L121, L131	ALTRUA™ 2 Pacemakers Models S701, S702, S722

Note the MV sensor is nominally ON in affected pacemakers.

Recommendations

Until software is available to automatically resolve MV sensor signal oversensing, Boston Scientific recommends managing the risk for patients implanted with affected pacemaker systems as follows:

- For pacemaker-dependent patients, turn the MV sensor “OFF”. Note when programmed to passive, the MV sensor signal is enabled and may be oversensed. See Appendix B for details on turning the MV sensor “OFF”.
- For all other patients, evaluate the risks of oversensing the MV sensor signal against the benefits of MV sensor indicated pacing. If the risk outweighs the benefit, turn the MV sensor “OFF” (see Appendix B).
- If transient, abrupt changes or any out-of-range RA/RV pacing impedance measurements are observed, contact Boston Scientific Technical Services to explore all non-invasive programming options prior to surgical intervention. In most cases, management of the system can be done non-invasively through programming changes.
- In accordance with the pacemaker manual, if MV sensor signal artifacts are observed on EGMs and leads are performing appropriately, consider programming the sensor to “OFF” to prevent oversensing.
- For patients with the MV sensor enabled, periodically re-assess for pacemaker dependence.
- Enroll and follow patients using the LATITUDE™ NXT Remote Patient Management System.

Additional Information

Boston Scientific recognizes the impact of communications on both you and your patients, and wants to reassure you that patient safety remains our highest priority. If you have additional questions regarding this information or would like to report clinical events, please contact your Boston Scientific representative or Technical Services.

Sincerely,

John Zagala
Quality Assurance Canada

[4]For affected pacemaker systems using multiple manufacturer’s leads, the highest probability applies (e.g., for an affected pacemaker system using Medtronic in RA and Boston Scientific in RV, the probability for the system would be described as the probability for Medtronic or Abbott pacing leads).
[5]The combined rate for Boston Scientific, Medtronic, Abbott, Biotronik, and Sorin pacing leads.

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Appendix A: Description of Minute Ventilation for the December 2017 MV Product Advisory

Boston Scientific pacemakers use transthoracic impedance to measure MV which is a product of respiration rate and tidal volume. During inhalation, the increased volume of air in the chest cavity produces an increase in transthoracic impedance. Likewise, during exhalation, the decreased volume of air produces a decrease in transthoracic impedance. Transthoracic impedance measurements are obtained through delivering a subthreshold current waveform approximately every 50 ms between the lead ring electrode and the pacemaker case, and measuring the resultant voltage between the lead tip and the pacemaker case (Figure 1). Boston Scientific pacemakers use the MV sensor for RightRate™ (rate adaptive pacing), Respiratory Rate Trend, and AP Scan™[6].

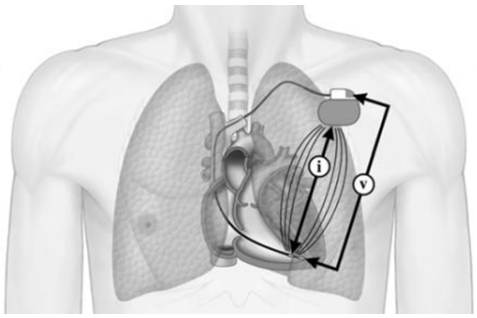


Figure 1. Measurement of the MV Signal from the RV lead

Boston Scientific pacemakers perform an MV lead check approximately every hour to assess lead and lead connection integrity. The active vector may be the primary vector (distal RA ring electrode to the pacemaker case) or secondary vector (distal RV ring electrode to the pacemaker case). Since either vector may be used to measure MV, at least one of the implanted leads must have normal bipolar lead impedances. Typically the MV sensor signal is appropriately filtered out by the pacemaker. However, if a high impedance condition is detected within the lead-pacemaker system, the MV sensor signal may be oversensed (Figure 2).

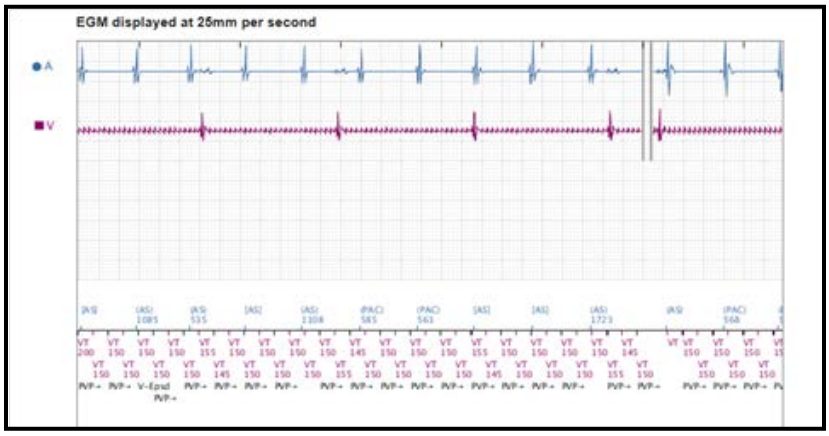


Figure 2. Example of MV signal oversensing

Pacemakers are designed to detect a variety of clinical events (e.g., atrial/ventricular arrhythmias), record annotated EGMs including the onset of the clinical event, and store up to fourteen minutes of EGM data. Boston Scientific pacemaker operator manuals caution the user to consider programming the MV sensor "OFF" if there are MV sensor signal artifacts observed on the EGMs. Pacemaker manuals are available online at www.BostonScientific-eLabeling.com.

[6]RightRate is not available in CRT-Ps in all countries and AP Scan is not available in Pacemakers or CRT-Ps in all countries.

Appendix B: Programming instructions supporting recommendations included in the December 2017 MV Product Advisory

For all affected pacemakers and INTL affected CRT-Ps, turn the MV Sensor "OFF" by disabling it within the Rate Adaptive Pacing settings

1. On the Summary page, select

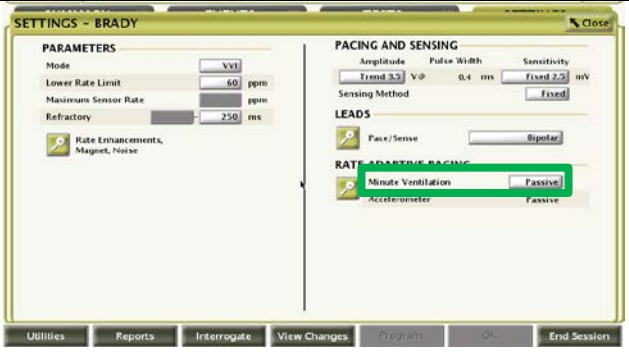
"*Settings*" Tab

2. On Settings Summary Tab, in the Brady section select

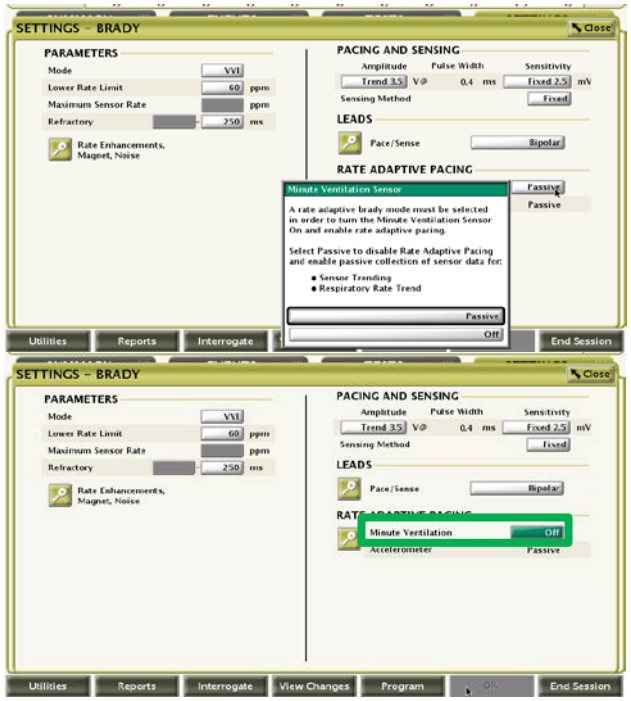
"*Settings*" button

3. On Settings – Brady page, in the Rate Adaptive Pacing section, review the Minute Ventilation programmed value.

If the value is "Passive" or "ON" the MV sensor is enabled.



4. To eliminate the potential for oversensing the MV sensor signal, program the Minute Ventilation Sensor to "OFF"



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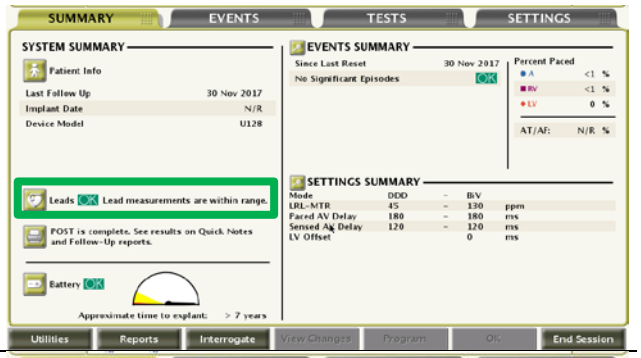
Appendix B: Programming instructions supporting recommendations included in the December 2017 MV Product Advisory

For US configurations of affected CRT-Ps, turn the MV Sensor "OFF" by disabling Respiratory Rate Trend.

1. On the Summary page, select

   "*Leads*" Button

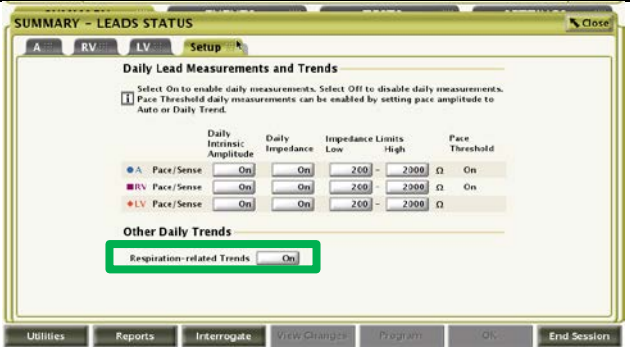


2. On the Summary – Leads Status page, select

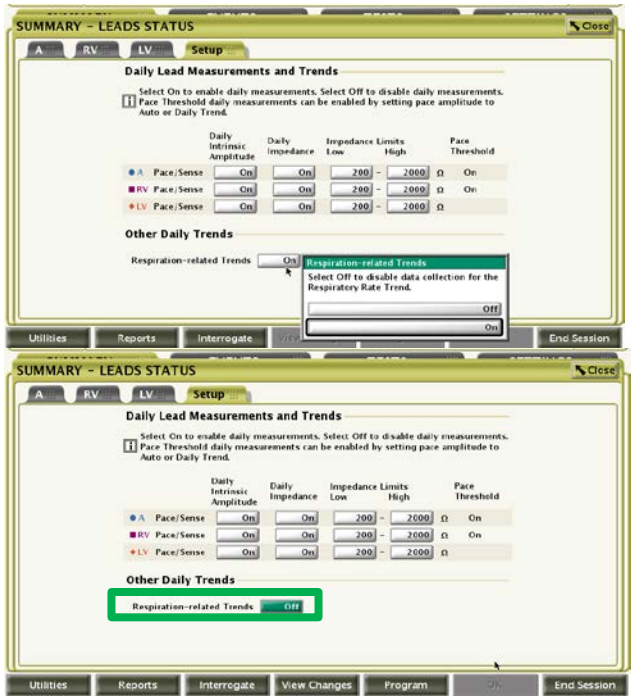
   "*Setup*" Tab

3. On the Summary – Leads Status page, in the Other Daily Trends section, review the Respiration-related Trends value.

   If the value is "ON" the MV sensor is enabled.



4. To eliminate the potential for oversensing the MV sensor signal, program the Respiration-related Trends value to "OFF"



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December 2017

Dear Patient,

Boston Scientific recently sent a letter to your heart doctor about your type of implanted cardiac pacemaker. The information in the letter explains that certain settings of the device may cause pauses in pacing. This can make some patients feel light headed or faint.

Your doctor is reviewing the information and will decide if any changes should be made to your pacemaker settings.

What should you do?
There is nothing you need to do at this time. Please continue to follow your doctor's instructions.

Patient safety is our highest priority. We recommend that you discuss this letter with your doctor, who knows best how this new information may affect you. Some patients have a LATITUDE™ home monitor nearby where they sleep so their doctor can check their pacemaker between office visits. If you do not have one, check with your doctor to find out if it would be an option for you.

Sincerely,

John Zagala
Quality Assurance Canada
Boston Scientific Corporation