# Effect of Electromagnetic Interference from an Electric Vehicle Tesla Supercharger Station on Implantable Cardioverter Defibrillators.

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## Background

Electric vehicle (EV) ownership is increasing worldwide. It is estimated that by year 2020, 20 million EV will be on the road. We previously demonstrated that there is no effect of electromagnetic interference (EMI) from an EV on implantable cardioverter defibrillator (ICD) performance when using an alternating current regular charging station port (17.2 KW, 30 A).

The effect of a supercharging station with direct current (120 KW, 85A) has not been evaluated. There are 1,043 Supercharger stations with 7,496 Superchargers in the United States. It is reported they charge EV in less than 30 minutes with 480-volt of direct current providing up to 120 kW of power, becoming the favored charging option.

## Objectives

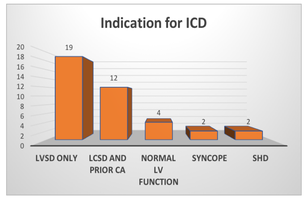
To assess potential influence of EMI from EV supercharger on ICD performance.

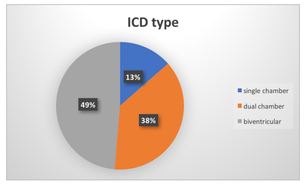
## Methods

This is a proof of concept study to explore potential effect of EMI from supercharger stations for EV on ICD. We enrolled 35 patients with stable ICD function; 14% (5/35) were single chamber, 40% (14/35) were dual chamber and 46% (16/35) were biventricular ICDs. 31% (11/35) of these were Medtronic, 51% (18/35) Boston Scientific and 17% (6/35) St Jude Medical.

Tesla Model S and Model X were used while charging at supercharging station. ICDs were interrogated before and after the procedure.

| | |
|---|---|
| Age in years (range) | 69+/-9 (46-86) |
| Male (%) | 27/35 (77%) |
| Body mass index (range) | 30.6 (21-52) |
| Ethnicity | |
| Caucasian (%) | 29/35 (83%) |
| African American (%) | 5/35 (14%) |
| Asian (%) | 1/345(2.8%) |
| Underlying rhythm | |
| Normal sinus rhythm (%) | 18/35 (51%) |
| Paced rhythm(%) | 17/35 (49%) |
| Device type | |
| Single chamber ICD (%) | 5/35 (14%) |
| Dual chamber ICD (%) | 14/35 (40%) |
| Bi-ventricular ICD, cardiac resynchronization therapy (%) | 16/35 (46%) |
| Device manufacturer | |
| Medtronic (%) | 11/35 (31%) |
| Boston Scientific (%) | 18/35 (51%) |
| St. Jude Medical (%) | 6/35 (17%) |
| Indication for ICD | |
| Cardiomyopathy only (%) | 19/35 (54%) |
| Normal LV systolic function (%) | 4/35 (11%) |
| Structural Heart Disease(%) | 2/35 (5%) |
| LV dysfunction with prior ventricular tachyarrhythmia or Cardiac arrest (%) | 12/35 (34%) |
| History of Syncope | 2/35 (5%) |




| position tested | Presence of interference |
|---|---|
| driver side rear high | not detected |
| driver side rear low | not detected |
| passenger seat high | not detected |
| passenger seat low | not detected |
| driver seat low | not detected |
| driver seat high | not detected |
| back seat pass low | not detected |
| back seat pass high | not detected |
| charging port low | not detected |
| charging port high | not detected |

| | Changes to the Device |
|---|---|
| over-sensing | absent |
| under-sensing | absent |
| mode switch | absent |
| tracking upper rate | absent |
| damage to device | absent |

Tracings were obtained while the patients sat in the driver seat, passenger seat, backseats, and supercharging port at nominal and highest sensitivity settings.

In each position the device and patient were monitored in real time by a certified technician from the manufacturer for any inappropriate sensing and delivery of therapies. A medical magnet was also available at the site of testing as a safety measure.

A medical magnet placed upon the chest wall will instantly switch the device to a different mode preventing it from detecting any outside signals.

We also had an emergency medical service team with a crash cart ready at the site of the study. Patients were followed up on the next day in order to ensure the well-being of participants.

## Results

Mean age of patients was 69. ±9.7 (40-86) years; 83% (29/35) were Caucasian, 14% (5/35) African American, 2.8% (1/35) Asian. 77% (27/35) were male. 49% (17/35) patients had an underlying paced rhythm. 54%(19/35) patients had LV systolic dysfunction only (LVSD), 34% (12/35) had LVSD with prior ventricular arrhythmia or cardiac arrest. 11% (4/35) had normal ventricular function. 5% (2/35) had history of syncope. 5% (2/35) has structural heart disease.

Using the nominal and highest sensitivity settings of the supercharger inside and outside the vehicle: driver seat, passenger seat, backseats, and supercharging port there was no sensing of EMI at any settings.

The was no device over-sensing under-sensing, mode switch or upper rate tracking no inappropriate ICD shock or damage to the device noted.

## Conclusions

In this single-center, in-vivo study, ICD functions were not influenced by EMI from EV while charging at a supercharging station.

## References

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