Perioperative Electrophysiology Training Program

Boston Scientific
Sub-Q ICDs

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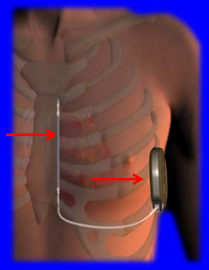
Boston Scientific Sub-Q ICD

- Provides defibrillation and temporary backup pacing without transvenous leads
  - Single, midline subcutaneous lead
  - Laterally placed pulse generator



Advantage of S-ICD over Standard ICD

- No intravascular component
  - No venous obstruction
  - Low risk of systemic infection
  - No need for complex lead extraction

What will you learn in this lecture?

- Components and Implantation
- Functional Characteristics
- Preoperative Considerations
- Intraoperative Management
- How to use the programmer for interrogation and reprogramming

Sub-Q ICD Components

Sub Q ICD Implantation

1. Pocket created
2. Lead inserted to midline

Sub-Q ICD Implantation

3. Lead inserted along sternal border

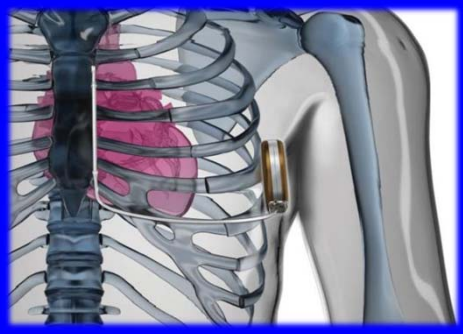
Sub-Q ICD Implantation

The lead will essentially be located here, but beneath the skin, after insertion

Sub-Q ICD Implantation

4. Connect the pulse generator to the lead and place in the pocket

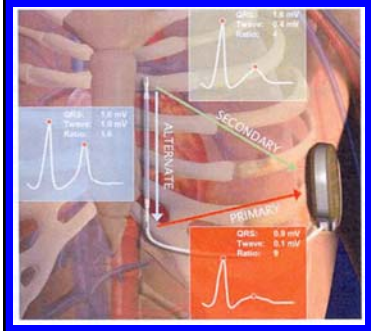
Sub-Q ICD Implanted



Sub-Q ICD Functional Characteristics

- Sensing
- Shocking
- Battery life
- Pacing
- Warning tones
- Magnet response

Sub-Q ICD Sensing



1. The device detects the extracardiac electrogram using one of three sensing vectors
2. The lead with the best QRS:T wave ratio is typically used to sense the patient's rhythm

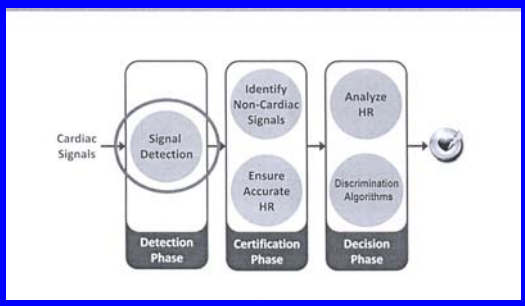
Essandoh et al, JCTVA June 2016 30(3):756-61

Sensing Report

Sensing Report

Standard ICD atrial and ventricular electrograms

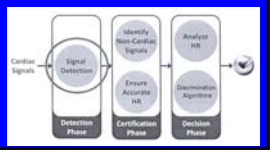
Sub-Q ICD Sensing



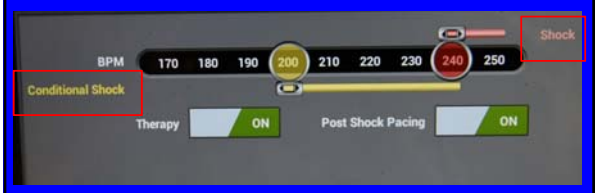
EMBLEM S-ICD System

Three Zones based on Sensed HR

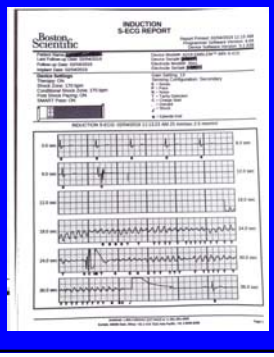
- Shock Zone
  - ICD shocks quickly
- Conditional Zone
  - *Discrimination algorithms* deployed to differentiate VT/VF from SVT before shock delivery
- Safe Zone
  - No shock



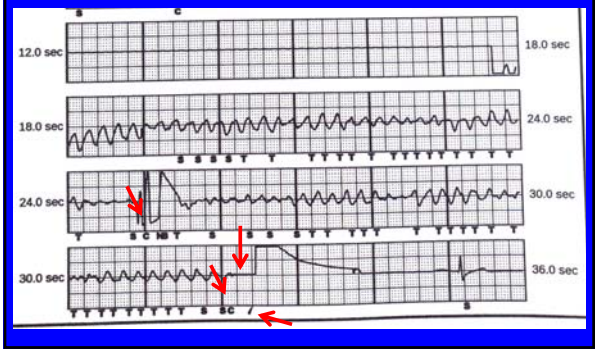
Sub-Q ICD Sensing



Example of S-ICD Detection and Shock during NIPS

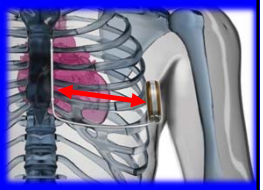


Example S-ICD Detection and Shock during NIPS



Sub-Q ICD Shocking

- Delivers 80 J biphasic shocks:
  - Up to 5 times per episode
  - The patient will likely move more in response to an S-ICD shock than a standard ICD shock



Important Concept

- *As is the case with standard ICDs, the S-ICD will confirm that the dysrhythmia is still present after the capacitor is charged. If the patient's rhythm has normalized, the shock will be aborted, but the battery will have been depleted. This means that the S-ICD is also susceptible to unrecognized battery depletion.*

Sub-Q ICD Battery Life

- Battery Life approximately 5.1 yrs
  - Do not want to have any unnecessary shocks or aborted charges which will deplete the battery while the patient is in the OR

Sub-Q ICD Pacing

- Post shock pacing only
  - 3.5 second delay after shock
  - Then VVI pacing at 50 bpm for 30
  - Paces coil to can with 200 mA at 7.5 ms
    - Very high output pacing with long pulse wave duration will obscure EKG

Sub-Q ICD Warning Tones

- Warning tones--16 beeps every 9 hrs
  - Battery at ERI or EOL
  - Impedance > 400 ohms
  - Prolonged charge time
  - Failed internal safety check

If you hear these tones, or your patient reports hearing these tones, contact an Electrophysiologist prior to elective procedures.

Magnets and the Sub-Q ICD

- Positioning
- Beeping tone emitted
- Effects of Magnet

Magnets and the Sub-Q ICD

- Magnet Positioning

Fig 3. The optimal zones for magnet application to the subcutaneous implantable cardioverter-defibrillator pulse generator.

The magnet should be placed on long side of pulse generator

Magnets and the Sub-Q ICD

- Beeping Tone
  - Tone emitted each second for 60 seconds
  - Tone Differs from that of standard Bos Sci ICDs

Magnets and the Sub-Q ICD

- Effect of the Magnet
  1. Suspends detection and therapy as long as magnet is on the device (even when tone stops)
  2. Terminates the temporary post shock pacing

Sub-Q ICD vs Bost Sci ICDs: Key Magnet Differences

- Standard Boston Scientific ICD
  - Magnet directly on device
  - Beeping tone lasts as long as the magnet is on ICD
  - Pacer not affected
- Sub-Q ICD
  - Magnet partially on long side of the device
  - Beeping tone stops after 60 seconds
  - Pacing is stopped

Magnet Application can cause S-ICD to enter Reset Mode

- If apply magnet for 60 seconds, then remove for 60 seconds, then re-apply for 2 sec the device will enter Reset Mode
  - Factory reset will be indicated by alternating high and low beeping tones
  - If this happens, contact the EP Service

Sub-Q ICDs and CPR

- What should one do if a patient with a Sub-Q ICD needs CPR?

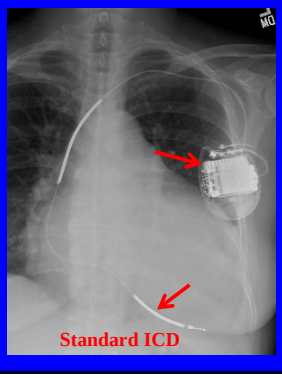
  - The ICD was designed to withstand CPR
  - *Do not withhold CPR for fear of compromising the lead*
  - *Be wary of a potential shock if the patient is in VF*

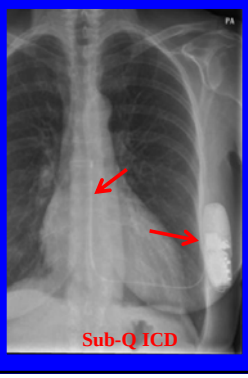
Preoperative Assessment

Preoperative Assessment

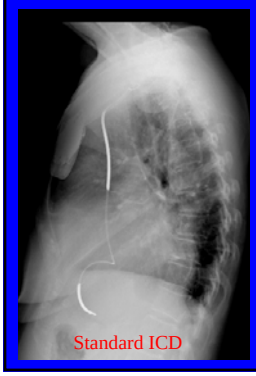
1. How to identify an S-ICD on CXR if you are not sure what device the patient has
2. What information should you try to obtain about the S-ICD and the patient

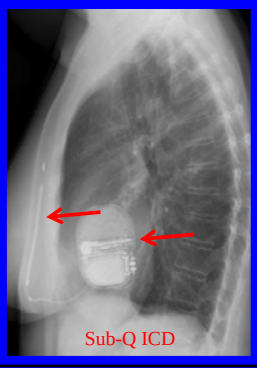
Standard ICD vs Sub-Q CXR





Standard vs Sub-Q ICD CXR





Required Preop Information

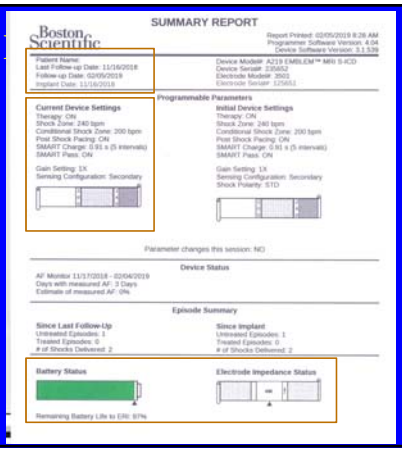
- Information to obtain from the Patient
  - Any new symptoms related to the ICD
    - Shocks
    - Beeping tones
  - Last interrogation
    - Should be within 3 months at MGH

Required Preop Information

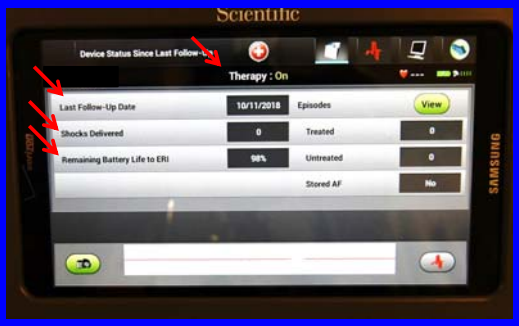
- Last interrogation should provide the following:
  - Battery life
  - Confirm that therapy is ON
  - Recent shocks
  - HR zones for shocks

Required Preop Information

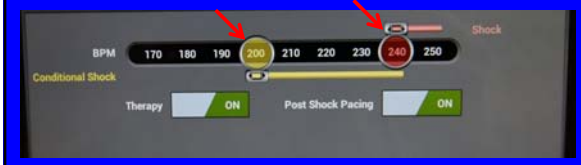
- How to get the interrogation information:
  - Patient's chart
  - Patient's cardiologist
  - Interrogate the device



Basic Information from Programmer



Basic Information from Programmer



- The lowest HR that will precipitate a shock is 200 bpm
- Therapy and Post-Shock Pacing are ON

Intraoperative Considerations

Intraoperative Management of the Sub-Q ICD

- Standard Considerations
  - Surgical procedure
  - Need for cautery
  - Patient position
  - Access to device
  - Duration

Intraop Management of the S-ICD

- Does the S-ICD need to be reprogrammed?
  - Pacemaker component
  - Anti-tachy component

Intraop Management of S-ICD

- Pacemaker considerations
  - Sub-Q ICD only provides backup VVI pacing for 30 secs after a shock—therefore nothing to change or worry about
  - Patient may have a separate pacemaker which may need reprogramming

Intraop Management of the S-ICD

- Anti-tachy therapy management
  - Theoretically cautery could be detected and the patient could get a shock or have unrecognized aborted charges.
  - The company thinks its SMART algorithms etc. may be able to differentiate cautery from VF/VT, but it is too early to know for sure
  - Until this issue is resolved, I will recommend managing the S-ICD the same way as standard ICDs

Intraop Management of the S-ICD

- Anti-tachy therapy management
  - If bipolar cautery, no change necessary
  - If unipolar cautery, particularly if above the waist, suspend the anti-tachy therapy

How to Inhibit the ICD's anti-tachy therapy

- Magnet
- Programmer

Sub-Q ICD inhibition with a Magnet

Using a Magnet in the OR can be challenging

- It may be hard to keep a magnet on the ICD reliably given the ICD's lateral location
  - Magnet induced tone disappears after 60 secs, so not able to monitor magnet position
- Makes sense to learn how to turn off the ICD with a programmer

Advanced Perioperative EP Training: How to use the S-ICD Programmer

Boston Scientific Programmer

The Boston Scientific Programmer cannot communicate with the S-ICD

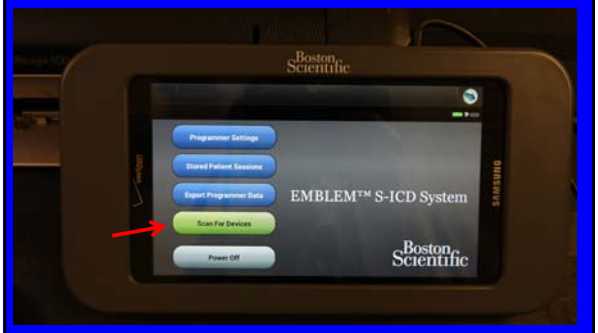
Sub-Q ICD Programmer

Sub-Q ICD Programmer

Programmer Powering Up— it looks like a Cell Phone

Sub Q ICD Programmer Wand

Initial Screen



Click on Scan For Devices

Initiating an Interrogation

Click on the name of your patient

Initial Screen

Click on Blue Arrow to get into the Programming options

Main Menu Screen

Click on “Follow Up”

Device Settings Screen

Note that the ICD is ON and pacing is ON

How to Turn Off the ICD

To turn OFF the ICD, click on Therapy

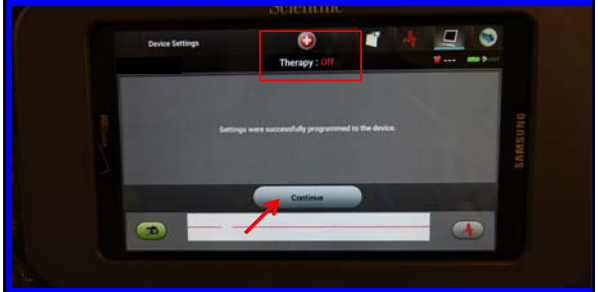
How to Turn Off the ICD

Notice the Therapy is still ON

How to Turn Off the ICD

To turn off the anti-tachy therapy, you must press Program

How to Turn Off the ICD



Therapy is now off …click continue to return to the Main Menu

Main Menu with ICD OFF

How Turn the ICD back ON

Click on Follow Up again

How Turn the ICD back ON

Click Therapy Box again and it will turn ON

How Turn the ICD back ON

Click Program again

How Turn the ICD back ON

ICD Therapy is back On

Additional Programmer Tests

- Two other tests that you will occasionally perform before or after the surgery:
  - Assess lead impedance
  - Assess sensing

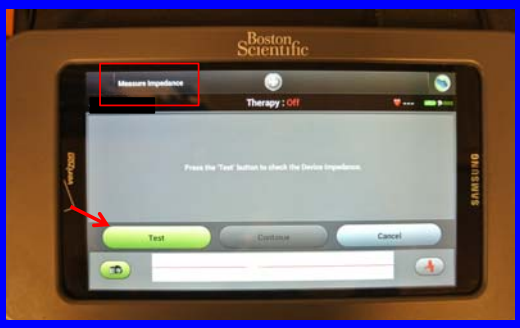
Assessment of Lead Impedance

The first step to assessing either lead impedance or sensing electrograms is to enter the Utilities Menu from the Main Menu

Assessment of Lead Impedance

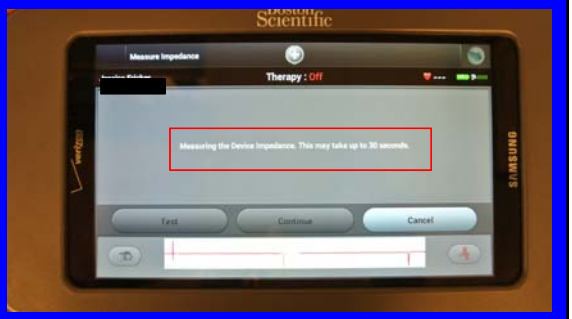
Open the Manual Setup Function

Assessment of Lead Impedance



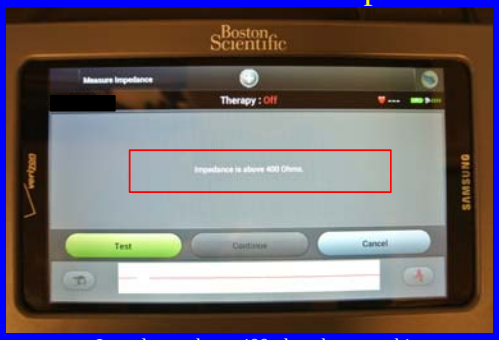
Click on Test to initiate the Device Impedance Test

Assessment of Lead Impedance



Device reports “Measuring the device impedance. This may take up to 30 seconds”

Assessment of Lead Impedance

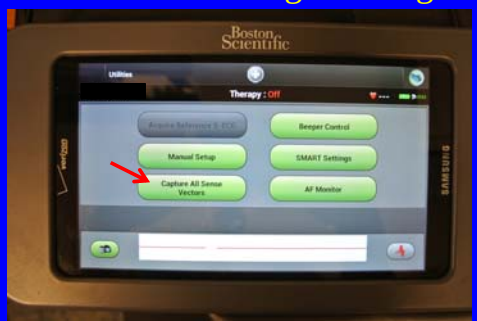


Impedance above 400 ohms because this is an explanted device

Assessment of Sensing Electrograms

Enter the Utilities Menu from the Main Menu

Assessment of Sensing Electrograms



Click on “Capture All Sense Vectors”

Assessment of Sensing Electrograms

This takes approximately 60 seconds
The results need to be printed

Printing Reports

- Summary report
- Captured S-Electrograms
- Episode reports

Printing Reports

Printer must be plugged in and turned on
Uses wireless connection
Paper in the programmer bag

Printing Reports

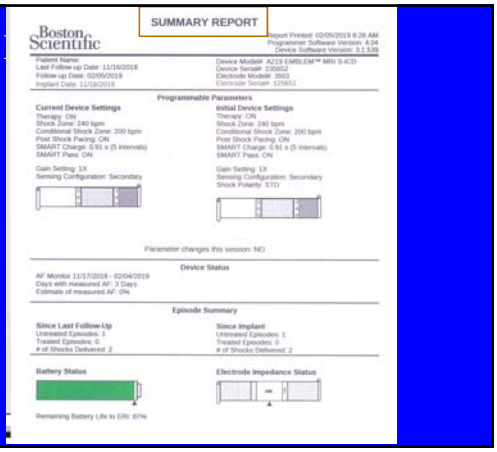
If you want to print a report, click Print Reports in the Main Menu

Printing Reports

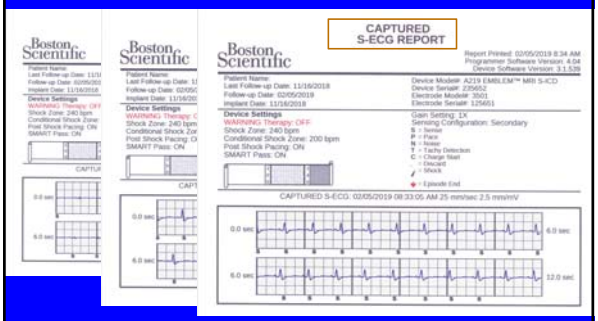
Select what you want to print…

Printing Reports

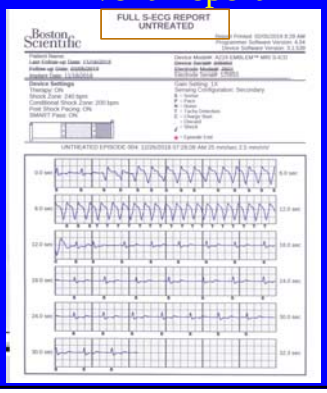
…and then click Print



Captured S-ECG Reports



Event Report



When to Print

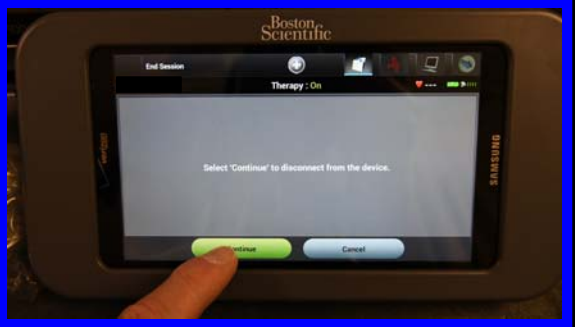
- Baseline Report after turning off ICD
  - Include episodes if applicable
- Post op Report after turning ICD back on
  - Include S-electrograms and Impedance test if surgery close to the device

Must end session after any Interrogation

To finish, click “End Session”

Click End Session

Second Step to End Session



Interesting Case #1

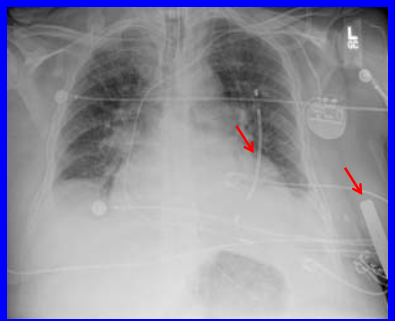
- Pt presents for emergency craniotomy
- Chart says patient has a device, but team not sure what it is

Rotated and suboptimal CXR

Interesting Case #1

- Based on the CXR, team decided patient had a pacemaker
- Used a magnet on the pacer during procedure

Post Op CXR



What else do you see in the CXR?

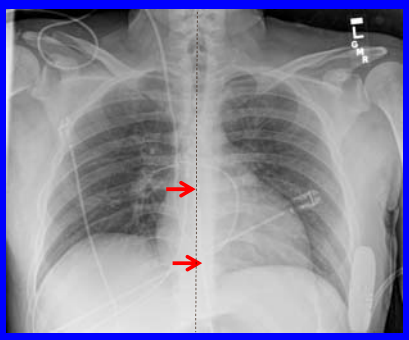
Interesting Case #1

- Take Home Points
  - If a patient has a S-ICD, always look for a separate pacer
  - A midline lead likely indicates an S-ICD whose pulse generator may be lying outside the CXR view

Interesting Case #2

- Young male pt with recently implanted S-ICD who needed a VAD

CXR



What are your concerns?

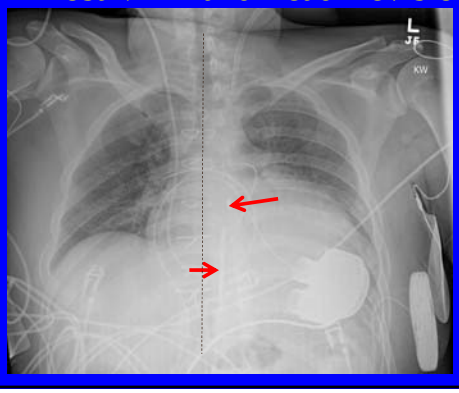
Interesting Case #2

- I notified the surgeon and the implanting electrophysiologist
- Discussion ensued and plan developed:
  - Take out the lead prior to sternotomy
  - Replace the lead laterally after sternal closure

Removal of the Lead prior to Sternotomy

Re-Implantation Post Surgery

CXR Post VAD and Lead Revision



Interesting Case #2

- Take Home Points
  - Make sure that surgeon's aware of the lead location of the S-ICD
  - May need to remove the lead prior to a sternotomy to minimize risk of lead injury

Quiz

- Name two ways you can determine if the patient has an S-ICD?
- Describe the S-ICD pacing capability
- Why might a patient with an S-ICD move more when shocked compared with a patient with a standard ICD?
- How should you apply a magnet on the S-ICD?
- What happens when you place a magnet on a S-ICD? (list three things)
- Can you use a Bost Sci programmer to interrogate the S-ICD?

Sub-Q ICD Summary (1/3)

- The Sub-Q ICD provides shocking for VF/VT and temporary post-shock pacing
- The electrode is positioned subcutaneously along the sternum, and the pulse generator on patient's left lateral chest wall
- The S-ICD can be easily identified by CXR

Summary (2/3)

- Dysrhythmia detection depends on the HR of sensed R-waves
- We should assume that cautery can be sensed as VF until proven otherwise
- The device delivers 80 J biphasic shocks
- Charging takes approximately 10 secs and there is a confirmation prior to shock delivery
- Pacing is very limited—30 sec post shock only
- Pacing can obscure the EKG, but a magnet can stop the pacing
- The battery life is only 5.1 years—unintended shocks in the OR could significantly deplete the battery

Sub-Q ICD Summary (3/3)

- A magnet may be used to inhibit the anti-tachy therapy, but magnet positioning may be a challenge in the OR
- The magnet-induced beeping tone of a Sub-Q ICD differs from that of a standard Bost Sci. ICD. The S-ICD only beeps for 60 seconds
- A Sub-Q ICD specific programmer is required to interrogate and reprogram the device

The End

Drone view over Salzburg *DS Photos*