

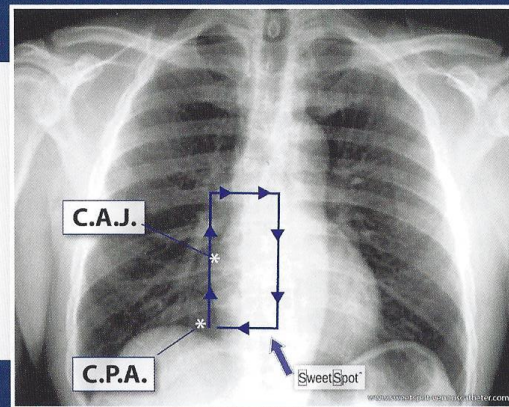
# SweetSpot™

{ The Solution to the  
Venous Catheter Tip  
Controversy

# SweetSpot™

Dr. Ken Symington's

# SweetSpot™



#### SCOPE:

*"Venous access will be required with essentially all hospitalized patients plus the vast majority of the remaining patients with significant acute and chronic illnesses."*

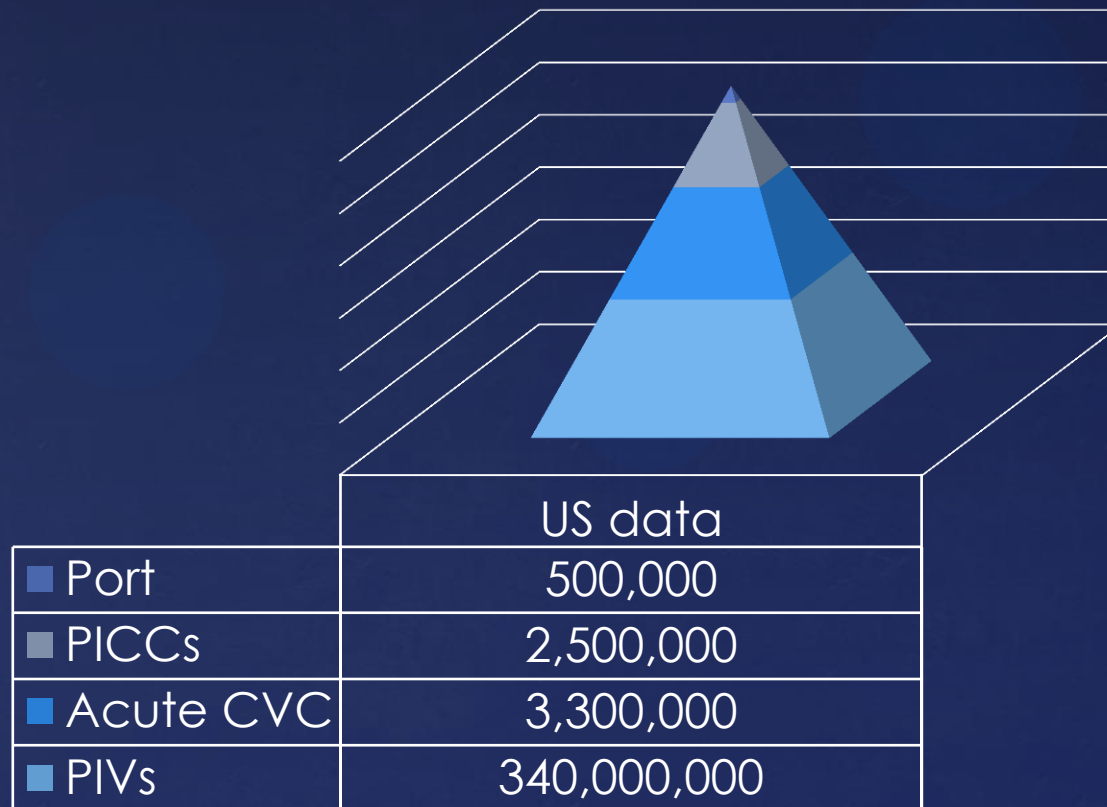
*-Ken Symington*

Sweet Spot™ Home Page

[www.sweetspot-venouscatheter.com](http://www.sweetspot-venouscatheter.com)

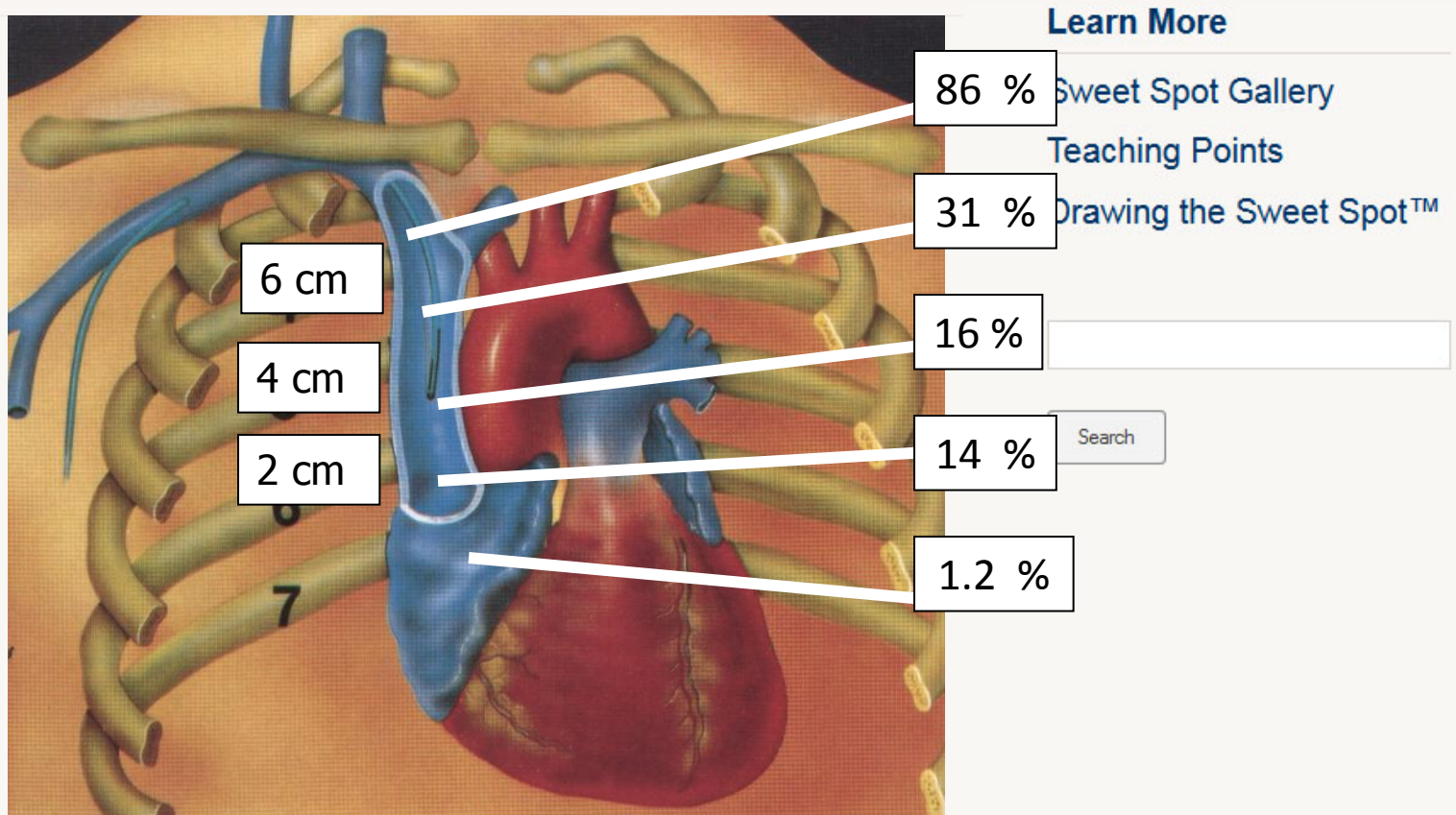
Venous  
Access  
Consultant

## Annual Estimated Usage of VADs in U.S.



□ U.S. unit data on Vascular access usage (IMS 2012)

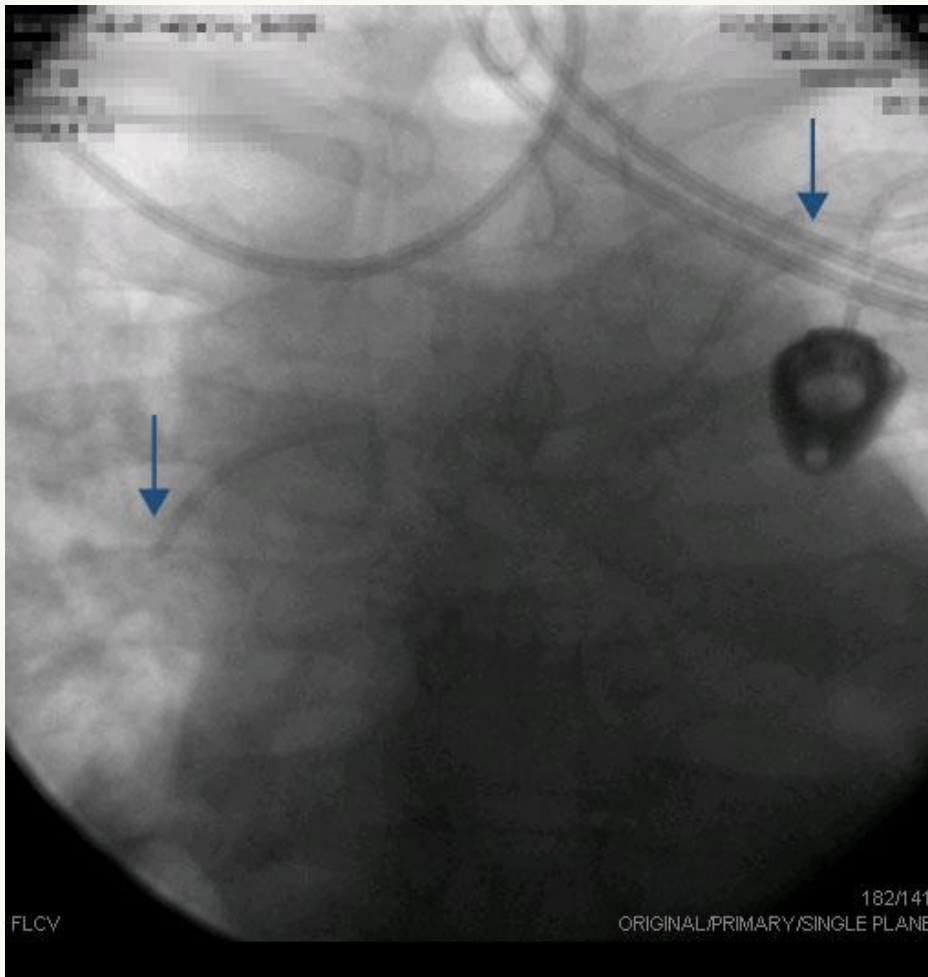
# HISTORICAL CATHETER TIP LOCATION AND REPORTED MALFUNCTION RATES (PETERSON, J AM SUG 1999)<sub>1</sub>



***Petersen et al, Am J Surg 1999, 178:38-41***



## A Recent Case:



### Learn More

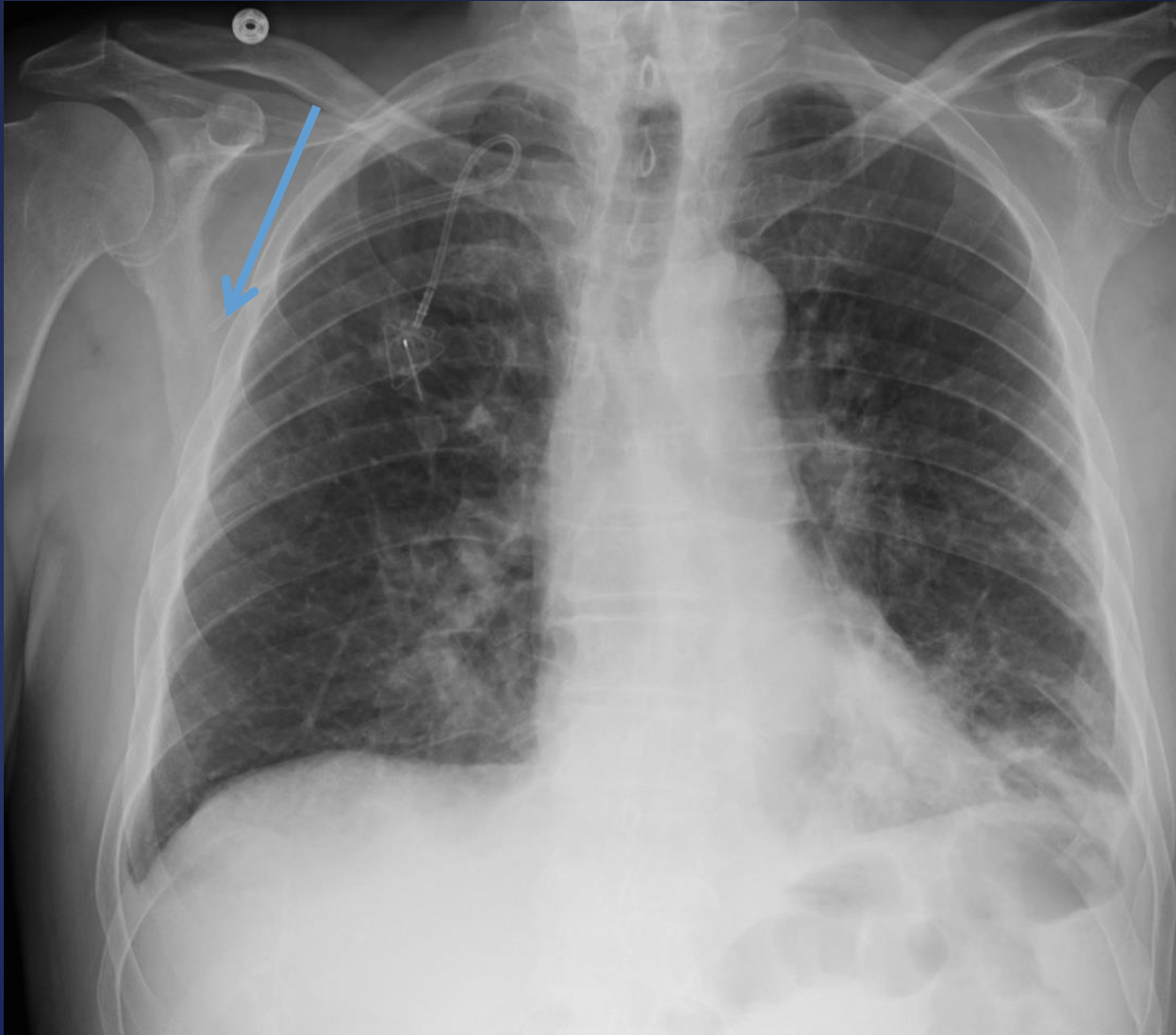
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# Recent Surgical Port



## ❖ Initial position

- ❖ Force of flushing
- ❖ Thoracic pressure (Ex. Coughing)
- ❖ Repair/ partial removal
- ❖ Pt. position (supine, upright, etc...)
- ❖ Lung volumes (insp., exp., sup., up)
- ❖ Pt. body habitus (Ex. Breast size)

### [Learn More](#)

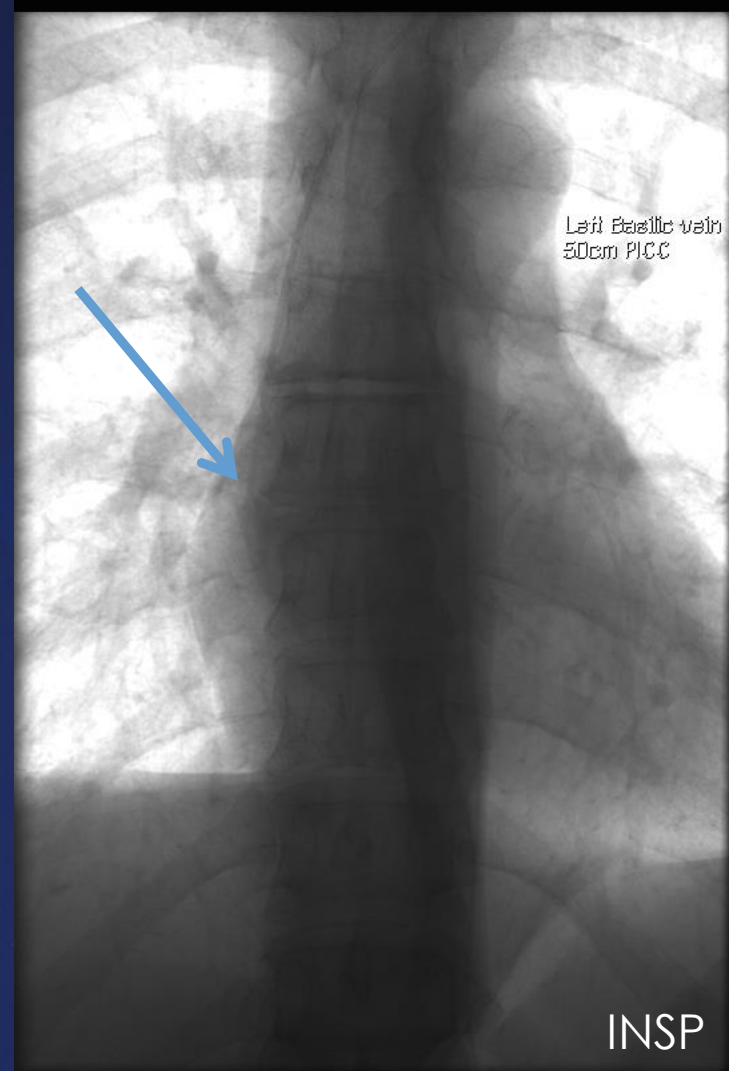
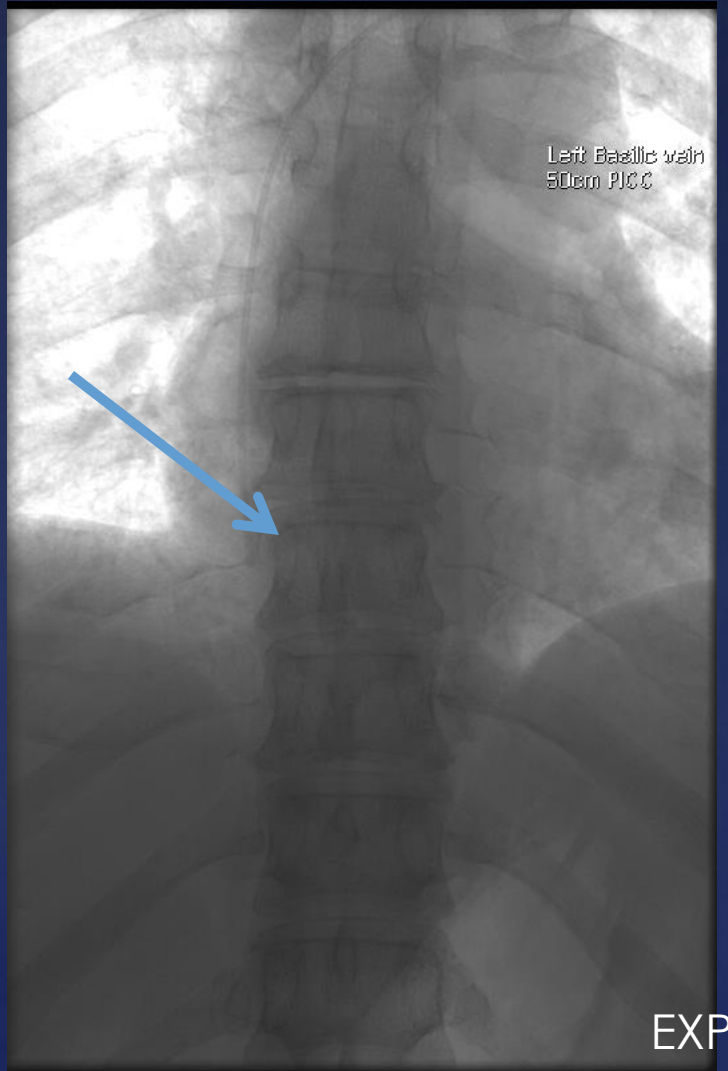
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# Respiratory Variation: VAD

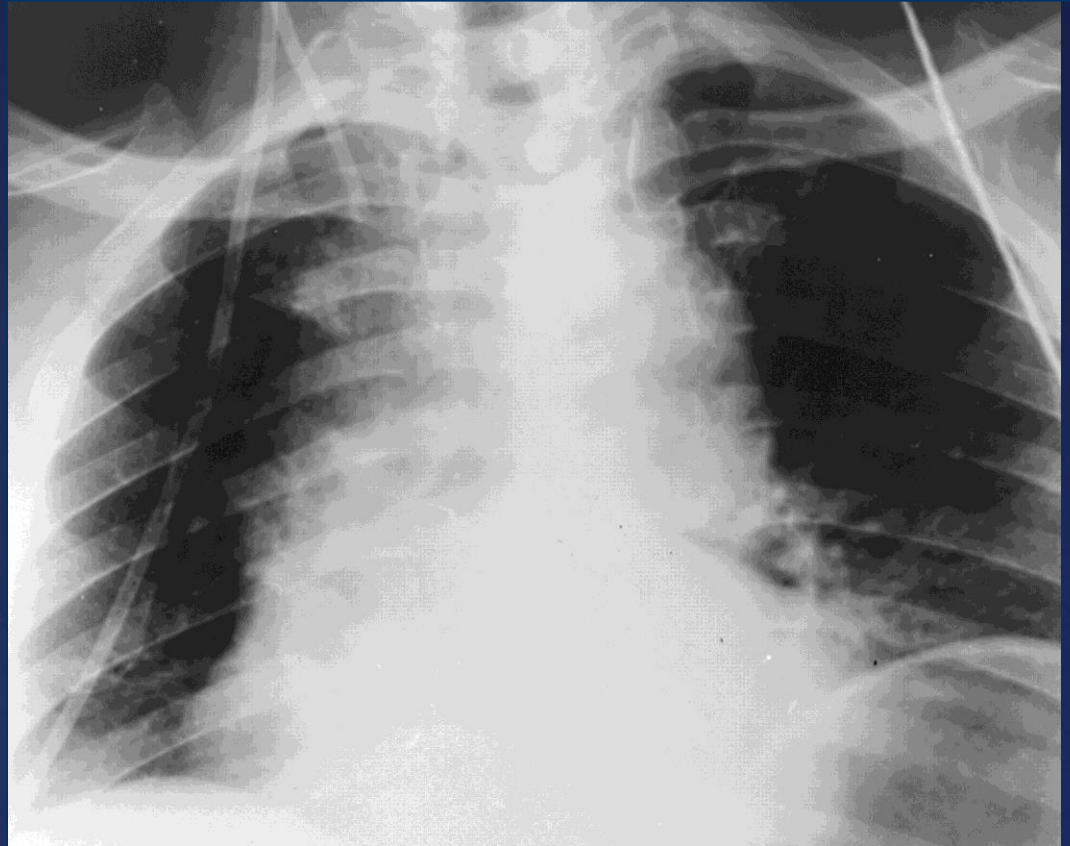




# Effect of Large Breasts

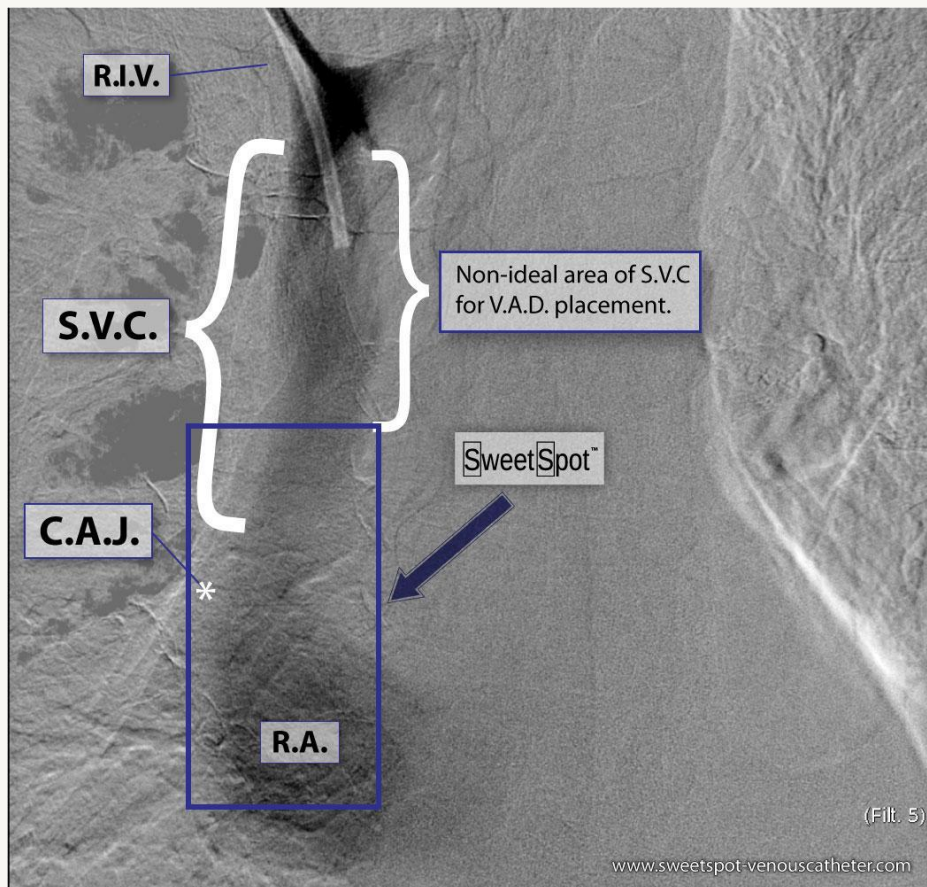


Supine



Upright

The superior vena cava is surprisingly long - particularly in patients with long cardiomeastinal silhouette. Ex: COPD



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Right-sided V.A.D.  
contrast injection.

## DEFINITION OF SWEET SPOT®

- ❖ The **SWEET SPOT®** is a rectangular template superimposed on a frontal CXR, whose margins and internal area are acceptable for VAD catheter tip position
- ❖ **Tailored to the individual patient's chest x-ray**
- ❖ It has **no fixed length or width** but does have **fixed proportions** with the craniocaudal length being twice the width on a frontal chest x-ray-no ruler
- ❖ Depending on patient/ radiographic variables, it can exceed 8 x 4 cm
- ❖ The template is simply **compared in size to the CXR at hand**
- ❖ This template is **very easy to memorize and just as easy to teach**

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## The SWEET SPOT®

- ❖ Has a **fixed center point**
- ❖ The **most accurate radiographic estimation** of the **cavo-atrial junction**, i.e. on a frontal CXR, the **initial outward bulge of the lower right cardiomedial margin**
- ❖ It was **designed to be twice as wide as the lower third of the SVC** to allow for the curving course of many catheter tips as they enter the right atrium - especially with left-sided access
- ❖ The SWEET SPOT® extends from the lower third of the SVC to the most inferior extent of the right atrium - stopping at the frontal CXR's cardiophrenic angle

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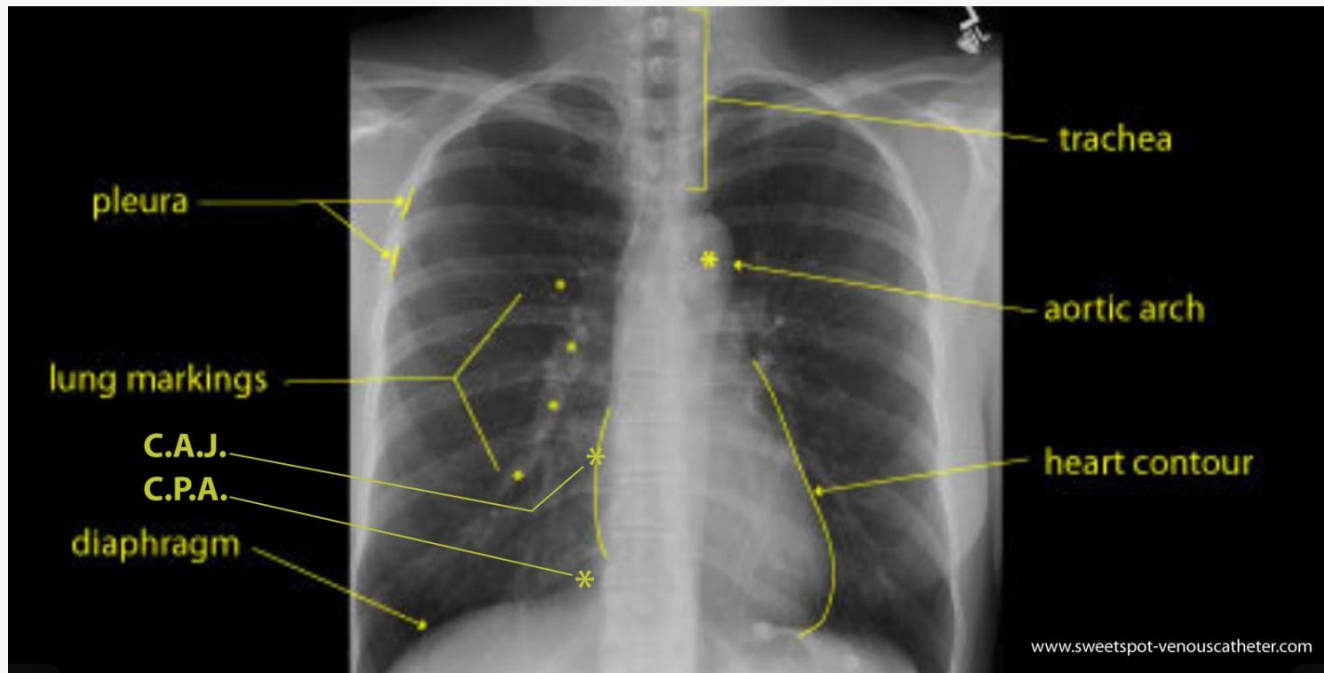
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## The Anatomy of the Frontal Chest X-Ray



### Learn More

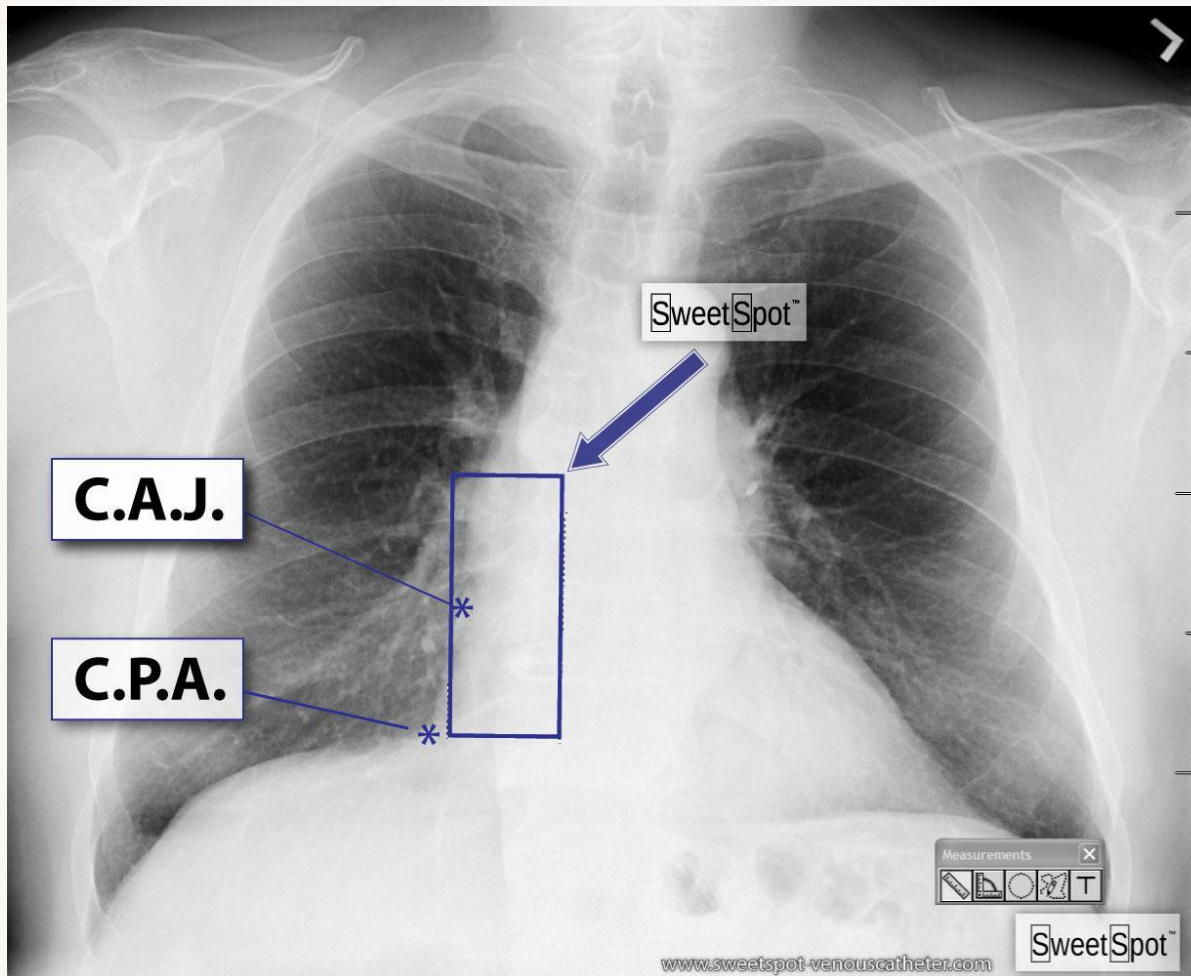
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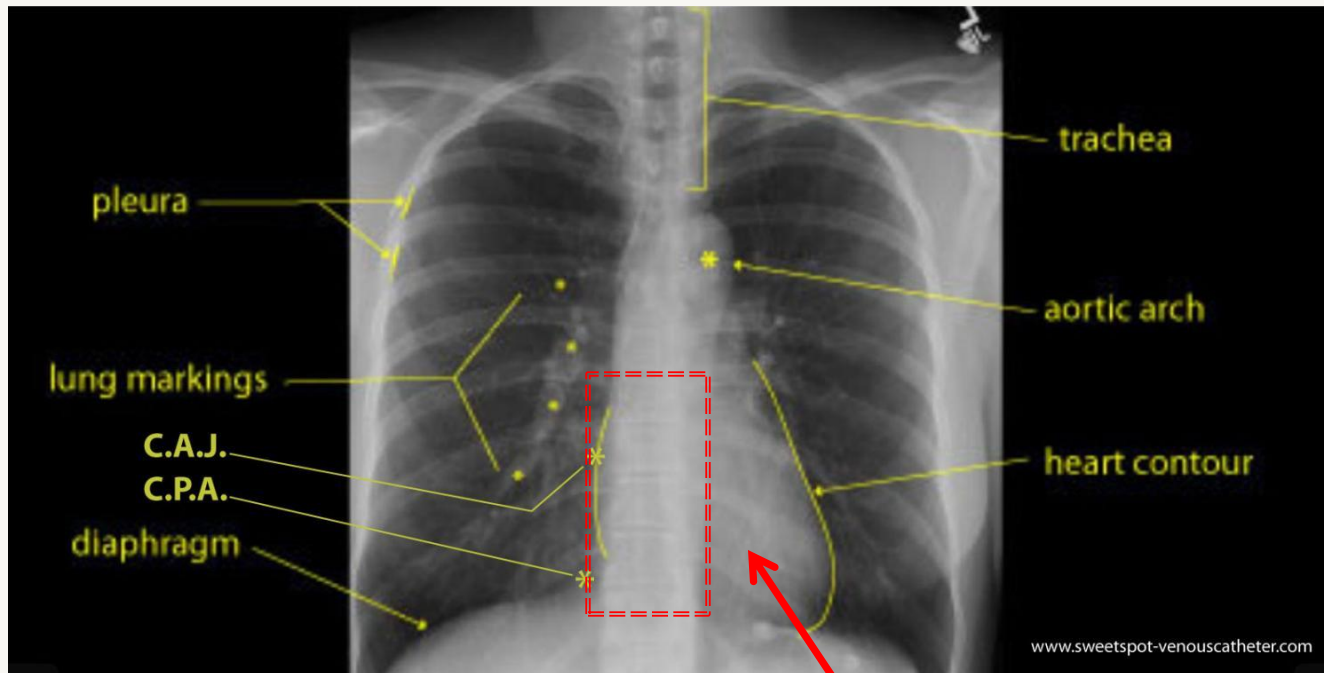
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## Chest X-Ray

## The Anatomy of the Frontal Chest X-Ray



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## ORIGIN OF SWEET SPOT®

- ❖ The **SWEET SPOT®** was created for two main reasons:
  - ❖ The first was to **improve patient safety by decreasing the complications caused by improperly positioned venous access devices (VAD)**
  - ❖ The second was to **remove the always subjective and sometimes erroneous chest x-ray (CXR) interpretation of VAD tip position-including those of my partners**

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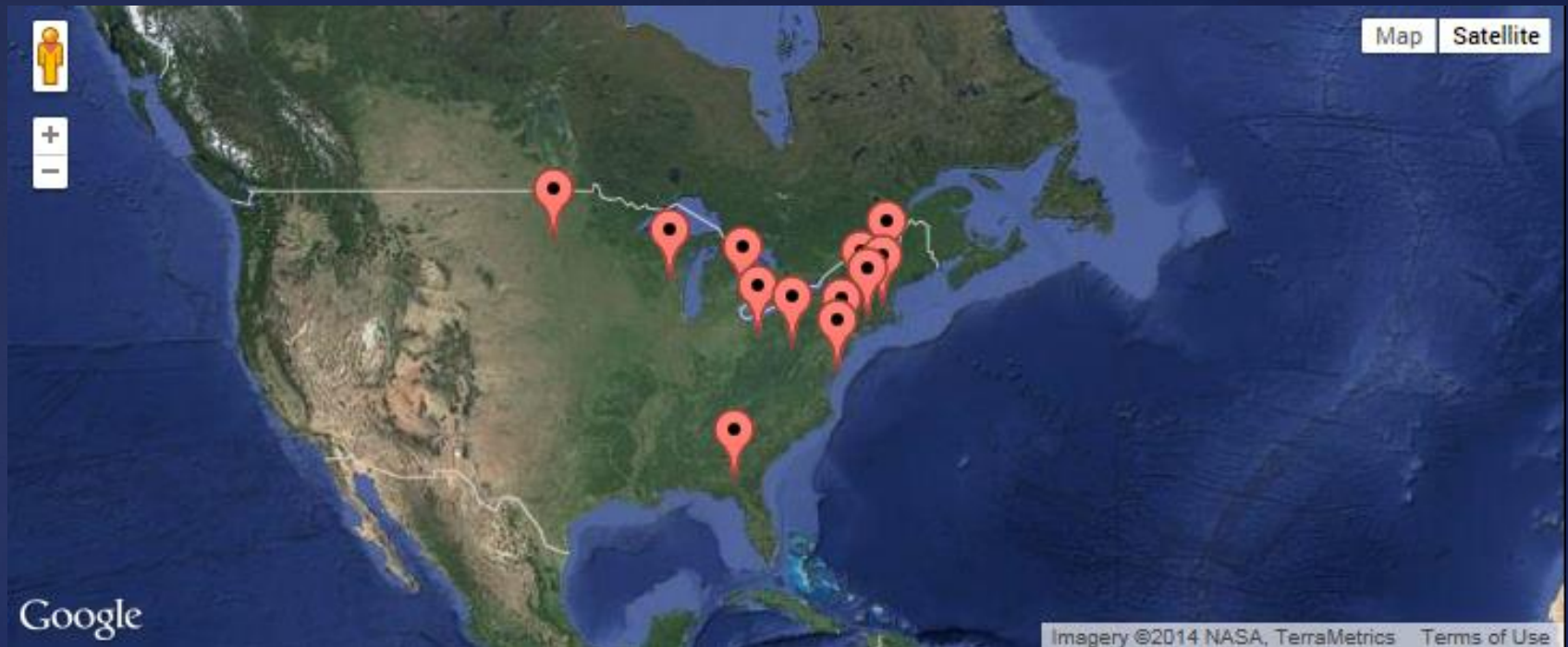
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Words = Misinterpretation

“Meet Me In Berlin”



# Meet Me in “Berlin”







# Meet Me in “Berlin”





“Health professionals  
love progress. They just  
hate change.”

“Radiographs don’t lie –  
Radiologists do.”

## Seinfeld on Venous Access...



Radiologist  
As played by  
Jerry Seinfeld



VAD Inserter  
As played by  
"Kramer"

SweetSpot™

A Lesson from Seinfeld...



# What's in a Name???

## Abstract

- ❖ Word
- ❖ Subjective
- ❖ SVC,  
SVC/RA,  
RA,

## Concrete

- ❖ Picture
- ❖ Objective
- ❖ Sweet  
Spot/CXR



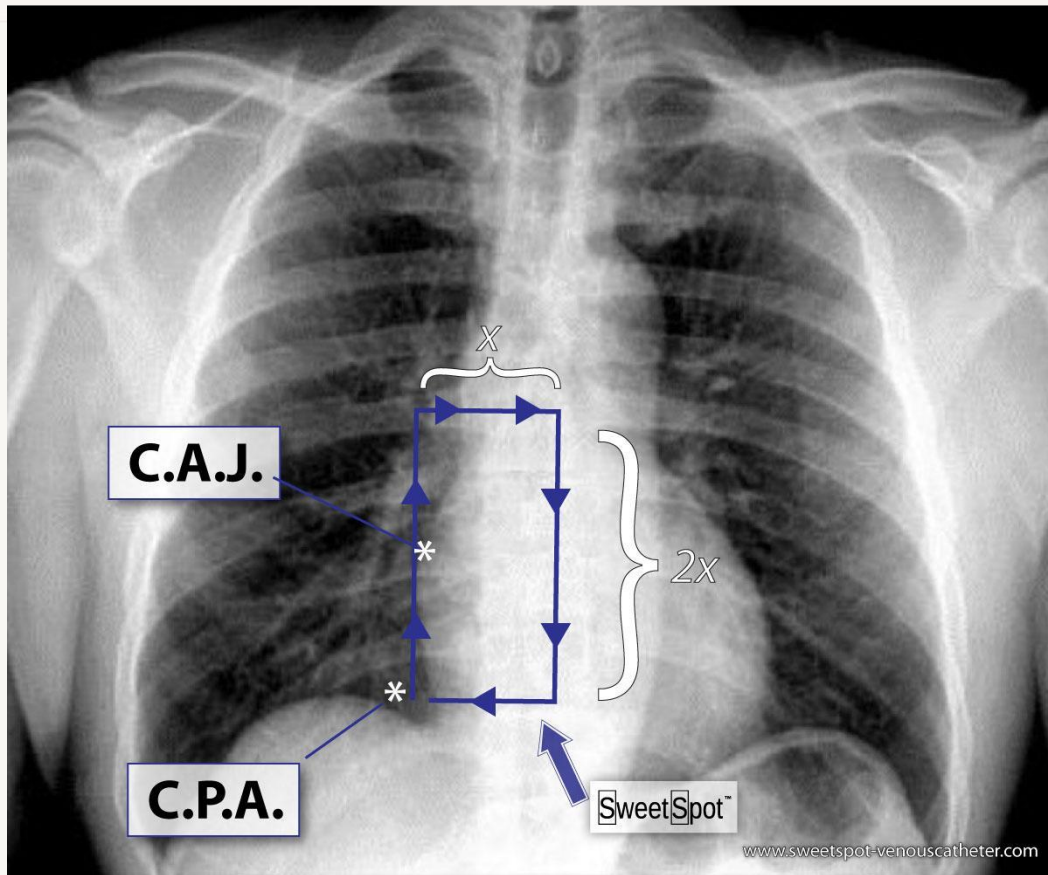
1. On a frontal CXR, identify the CAJ and the right CPA.
2. Start at a point as close as possible to the CPA that permits a vertical line to be drawn along the right edge of the cardiac silhouette.
3. Go twice the distance of the CPA to the CAJ.
4. Next, continue a horizontal line to your right equaling one-half the length of the previous vertical line.
5. Lastly, turn inferiorly and complete the rectangle.

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## How to Draw the Sweet Spot®

## CLINICAL USE OF SWEET SPOT®

- ❖ Adopted practice wide by my group in **2007 as the sole acceptable chest x-ray standard for VAD tip location - which it still is**
- ❖ Was the standard of acceptability for our recently completed Sherlock 3CG trial
  - ❖ In this same trial, the vast majority of the Sherlock 3CG guided catheter tips — whose technology targets the S.A. node, were at the center of the SWEET SPOT®, i.e. the radiographic cavoatrial junction, thus confirming both chest x-ray and ECG methods of catheter tip verification
- ❖ **The two methods, therefore, cross-validate and have the same end point — optimal VAD tip location**
- ❖ Approx. 2,700 PICCs/year in Spokane or 22,000 PICCs since Sweet Spot® adopted- no “right atrial” events when in Sweet Spot

## Learn More

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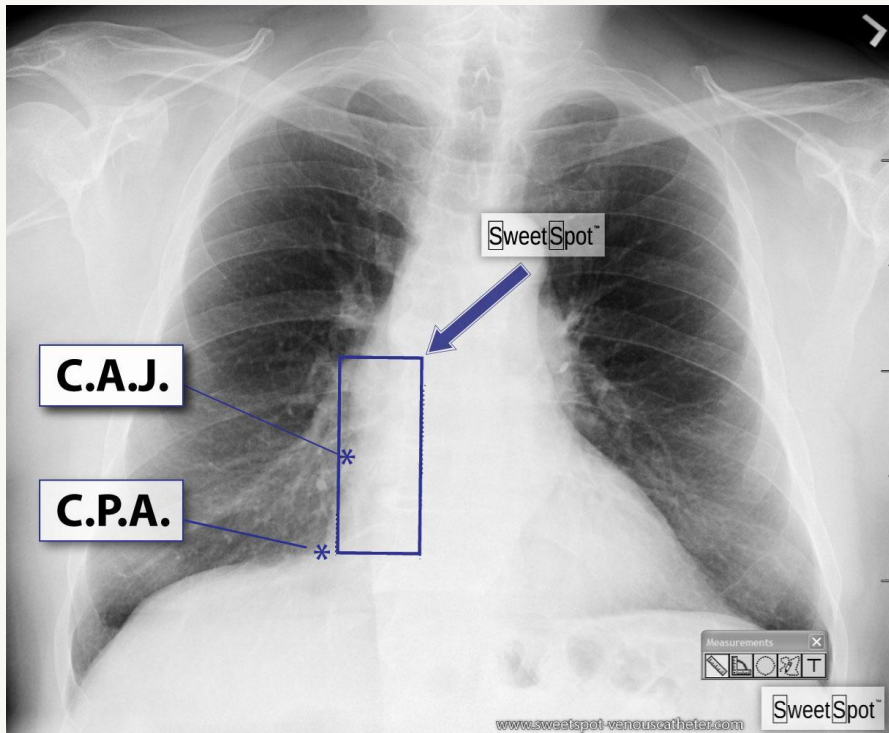
- ❖ Started October 2011
- ❖ Finished January 2013

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## Why a Trademark Status?

- ❖ Control the educational message
- ❖ Maintain the quality of the concept
- ❖ Maintain the integrity of the concept
- ❖ Protect my intellectual property interests



## Seven Faces of The Sweet Spot®

-- More than a CXR

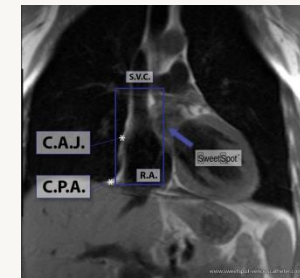
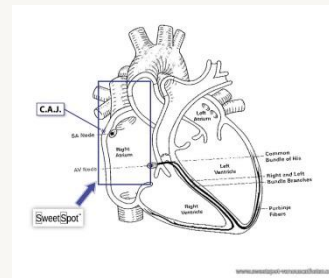
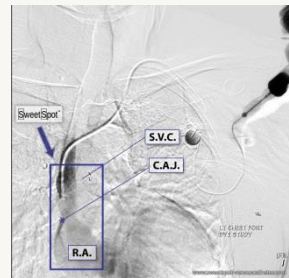
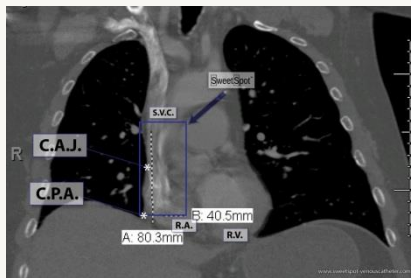
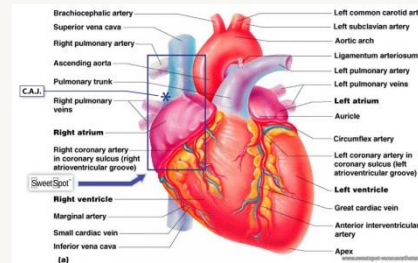
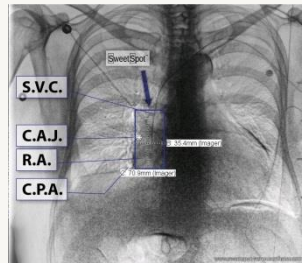
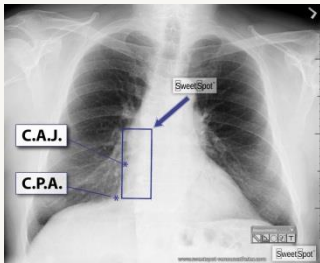
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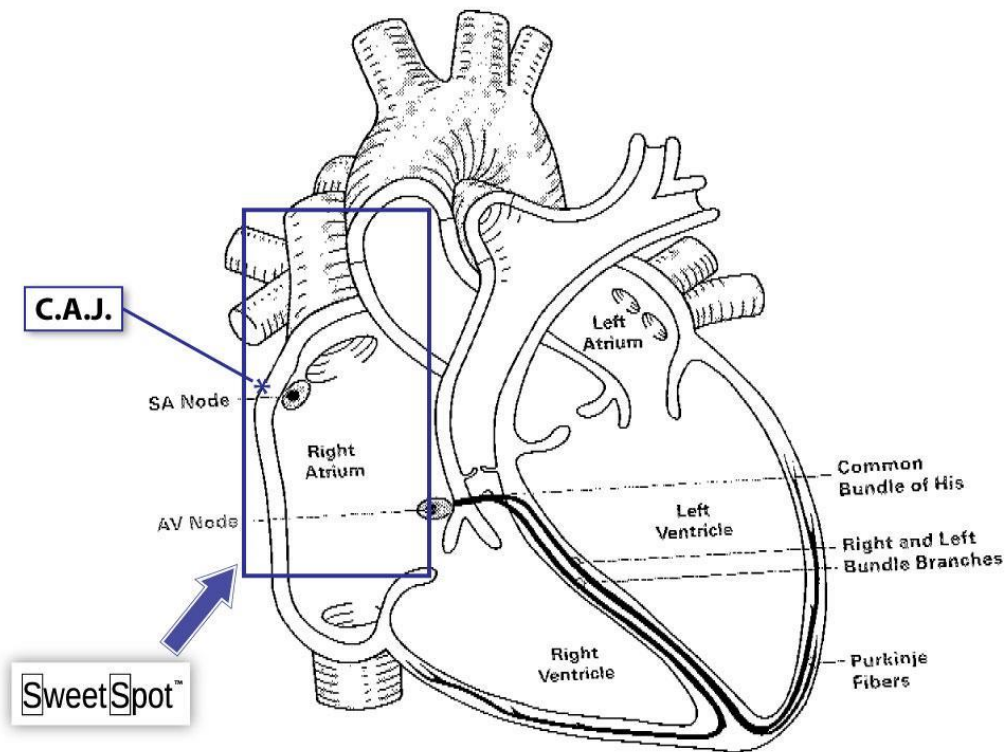
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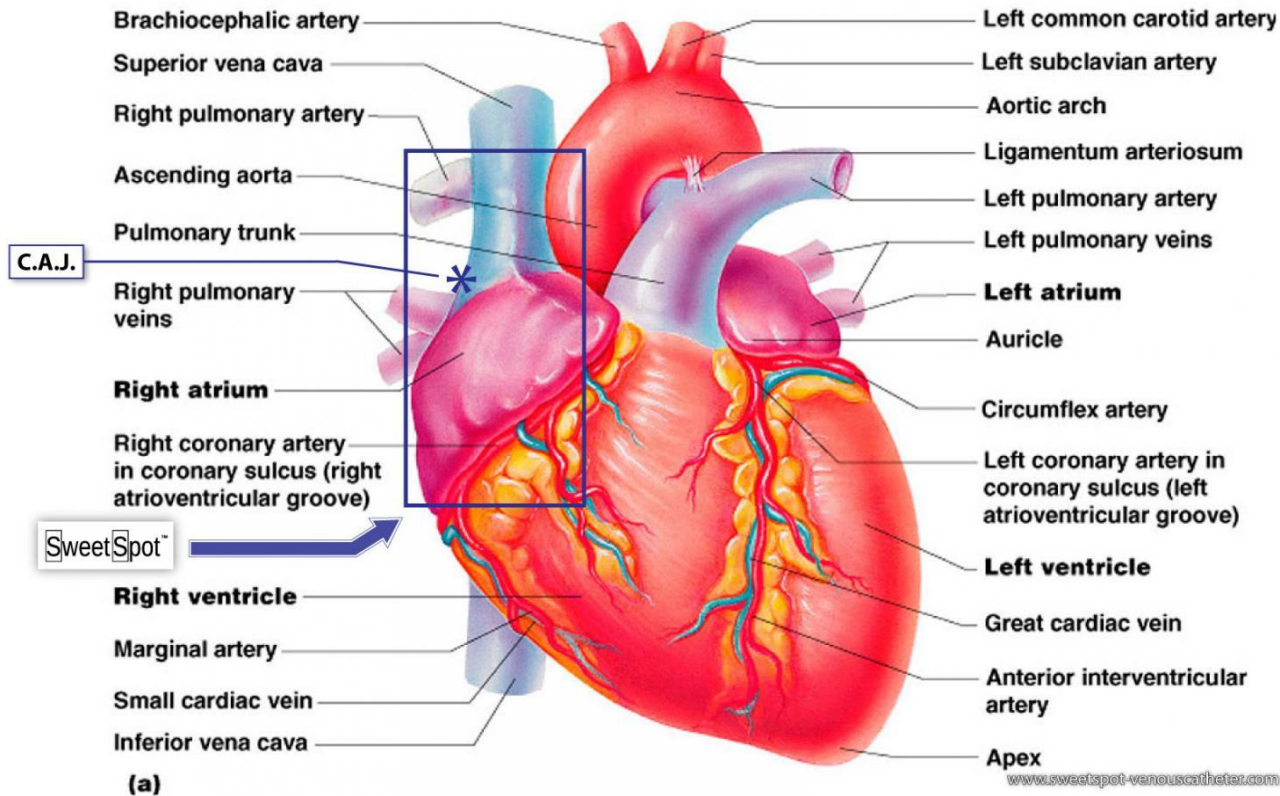
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## Cardiac conduction pathways



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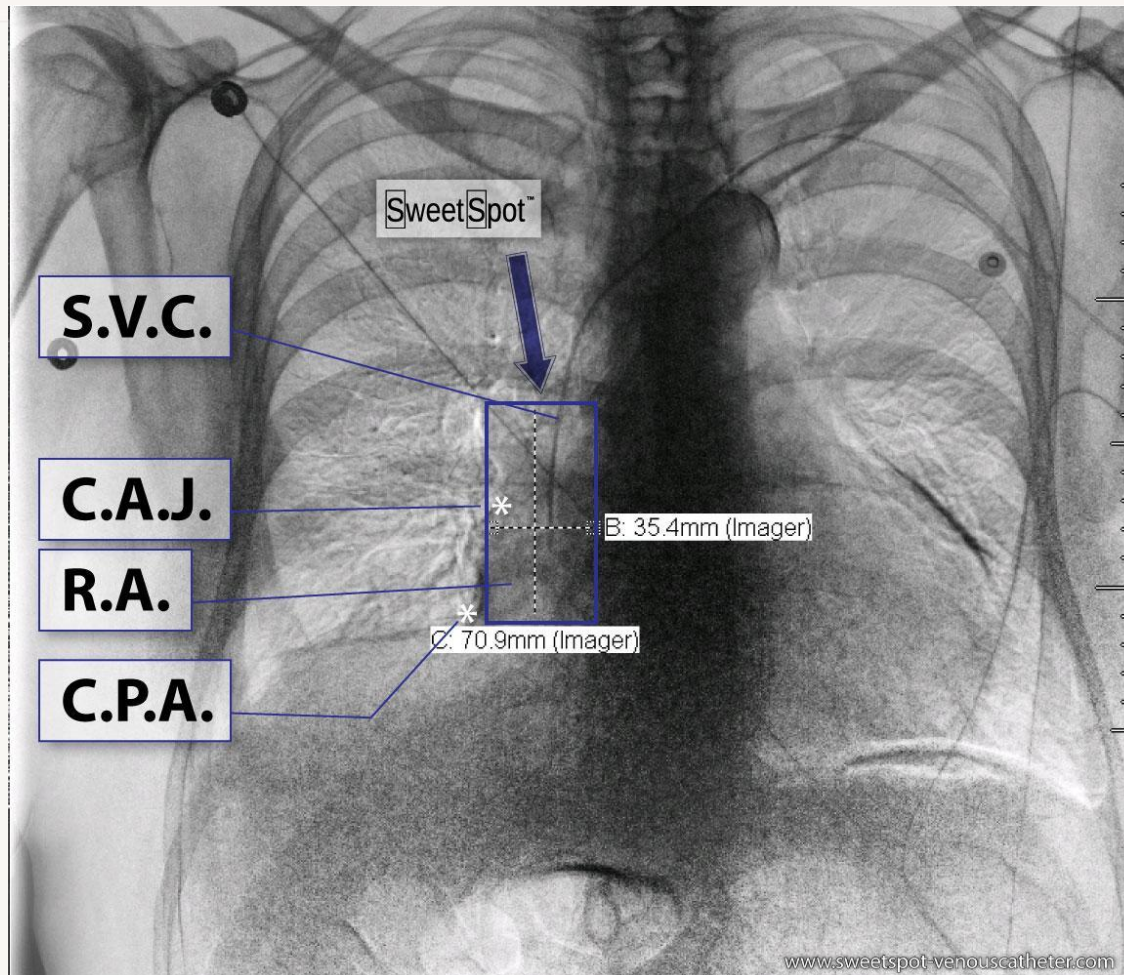
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## Gross Anatomy





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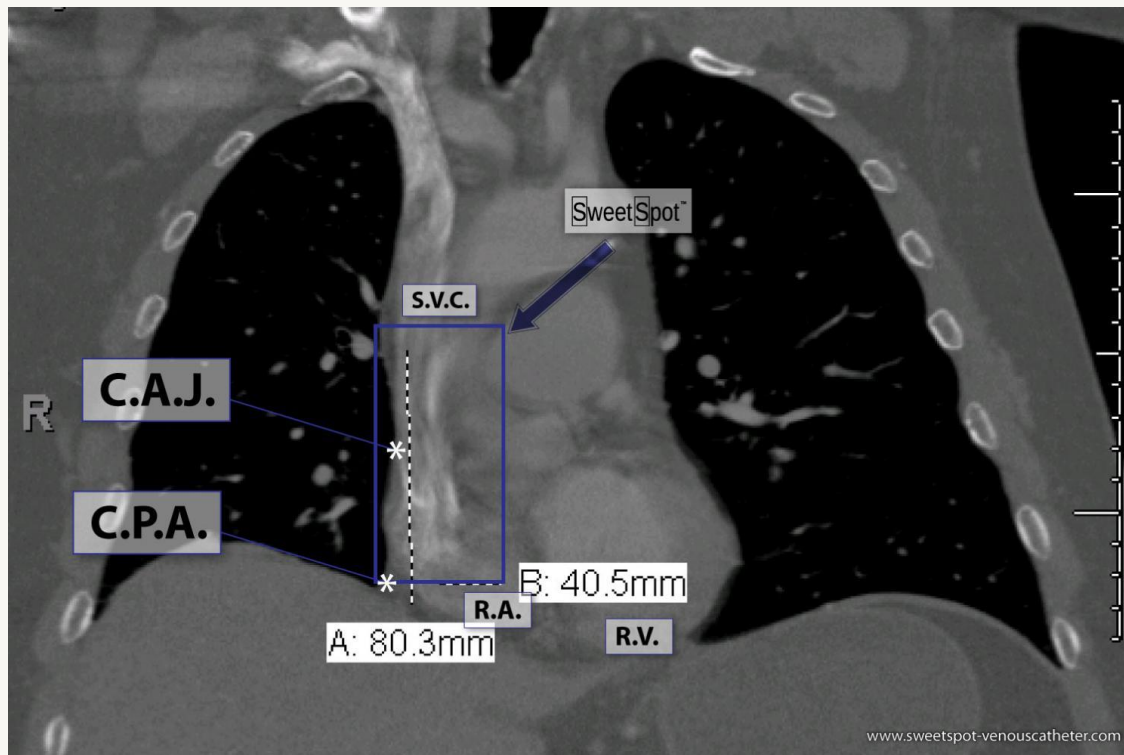
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## Dual Energy CXR



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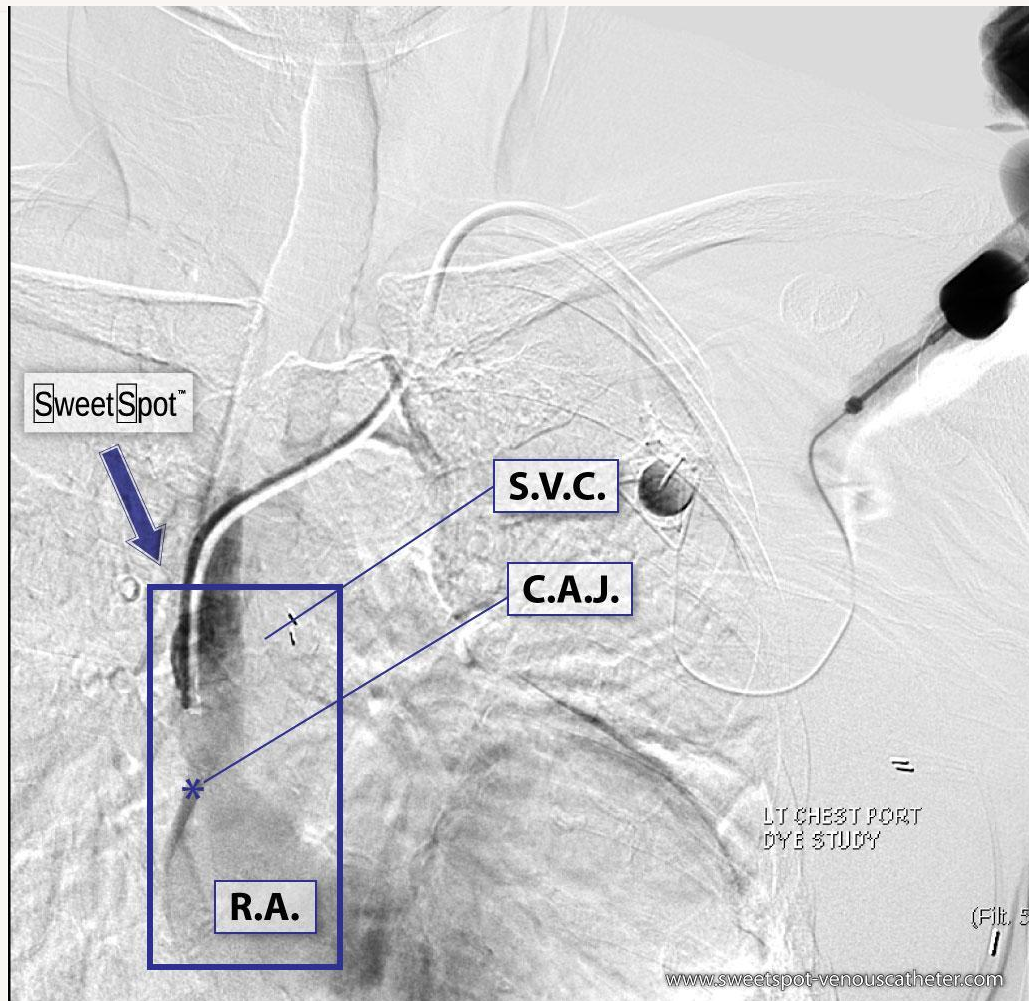
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Coronal CT  
Scan  
Reconstruction





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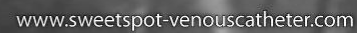
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## Catheter Contrast Injection



## SOCIETAL RECOMMENDATIONS FOR V.A.D. CATHETER TIP LOCATION

- ❖ In **1989**, the US FDA (Task Force FDA Drug Bulletin 1989:15) issued an advisory statement that it is unacceptable for catheter tips to be placed or permitted to migrate into the heart for fear of cardiac tamponade<sup>2</sup>
- ❖ During this time, other studies provided evidence that catheter tips placed high in the SVC or outside the SVC increase the risk of thrombus and catheter malfunction. (Kearns<sup>3</sup>, Caers<sup>4</sup>, Cadman<sup>5</sup>)
- ❖ In **1998**, the National Association of Vascular Access Networks (NAVAN), published a position statement recommending that the “most appropriate location for the tip of PICCs is the lower one-third of the SVC, close to the junction of the SVC and the right atrium” and not extending into the right atrium. (NAVAN tip position)<sup>6</sup>

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## SOCIETAL RECOMMENDATIONS FOR V.A.D. CATHETER TIP LOCATION

- ❖ In **2006**, the Infusion Nurses Society updated their Standards of Practice and again in 2011 stating that “CVC tips should be located in the lower third of the SVC to the CAJ” (INS 2011)<sup>7</sup>
- ❖ European Society of Parental and Enteral Nutrition (ESPEN) Guidelines (Pittiruti **2009**)
- ❖ Interventional Radiology (SIR) states (in their Quality Improvement Guidelines for Central Venous Access) that the tip should be “in the cavoatrial region or right atrium” (**2010** SIR Dariushnia)<sup>8</sup>

\*Historically this inferior migration of catheter tip position acceptability is coincident and not unrelated to manufacturers developing V.A.D.'s made out of softer materials.<sup>9</sup>

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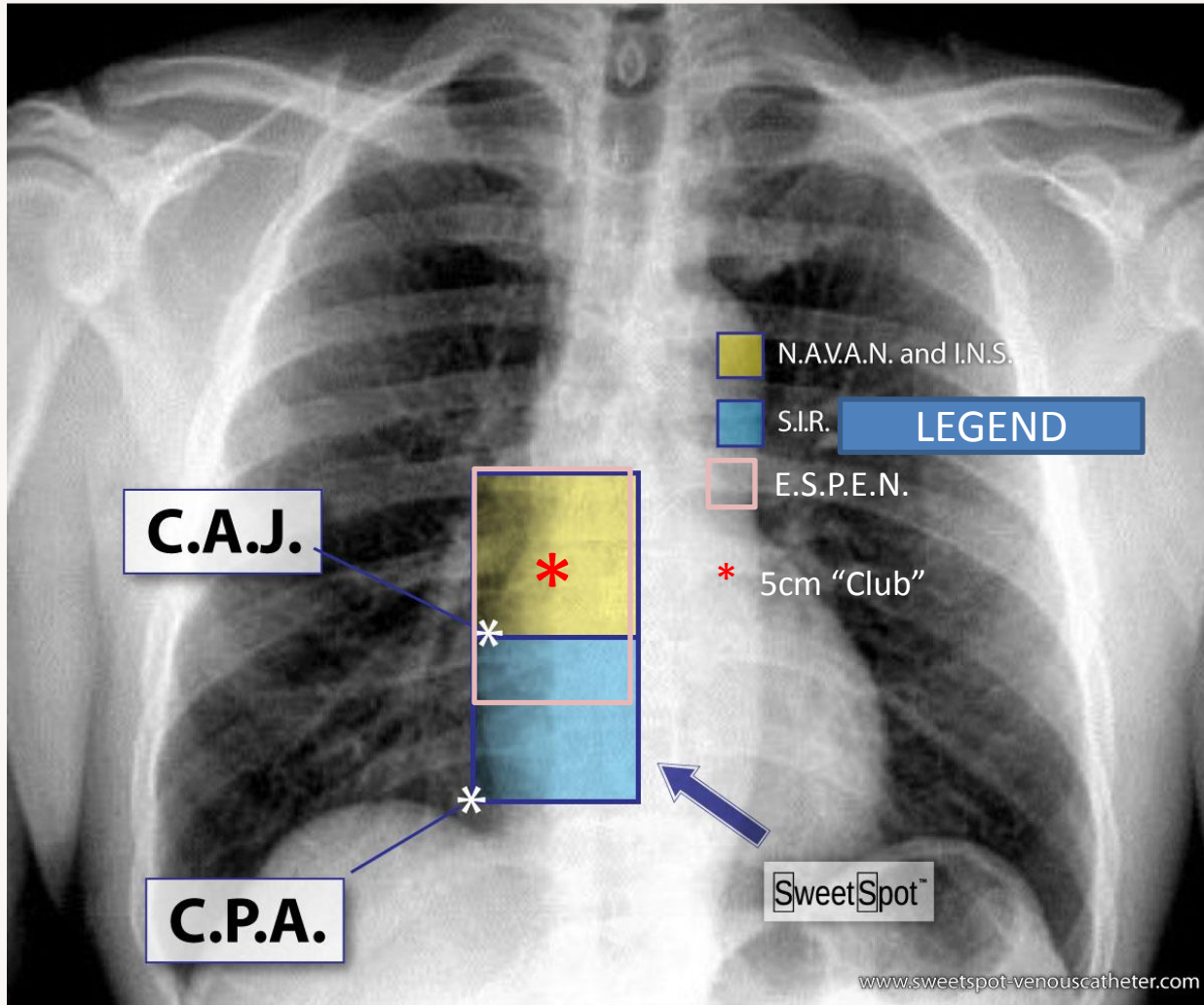
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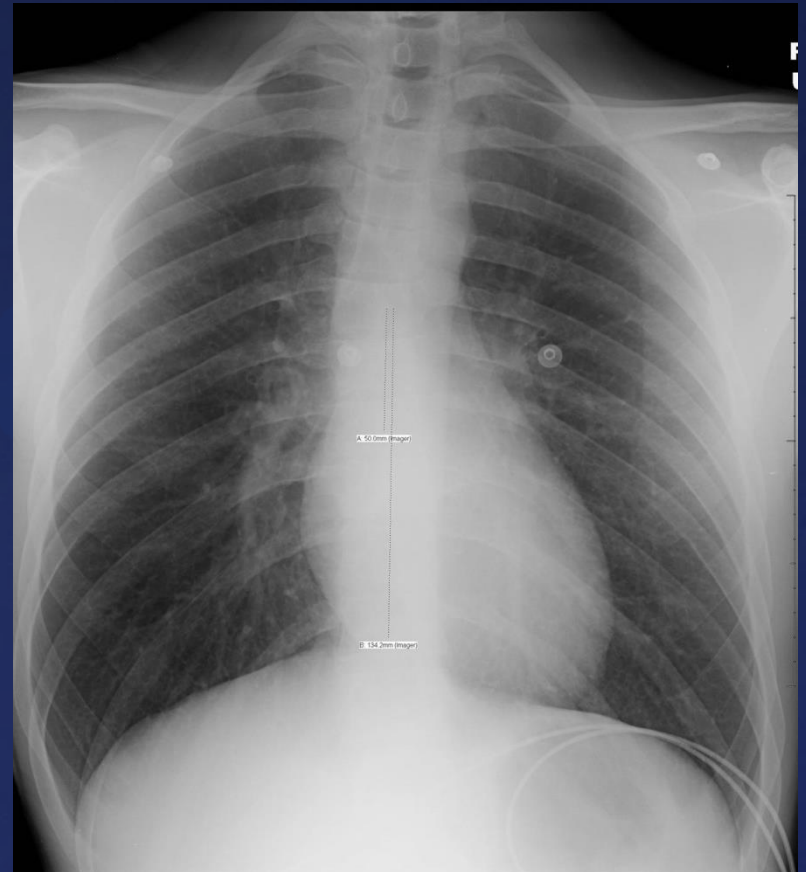
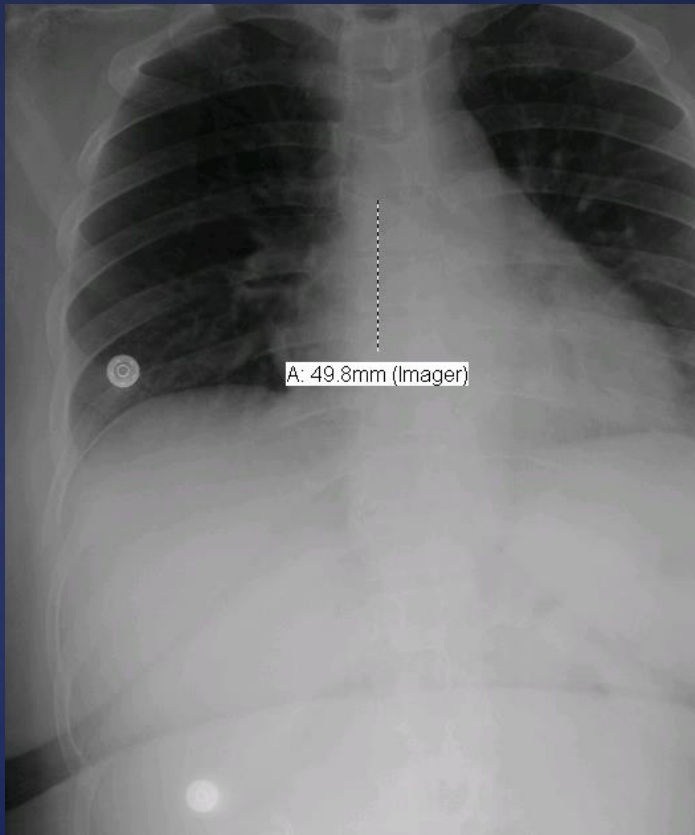
The  
"Switzerland"  
of Societal  
Acceptability



## 5cm Below Carina Criteria

- ❖ Rigid
- ❖ Untailored
- ❖ Need a measuring device
- ❖ Often too short
- ❖ Uncertain, undependable relationship to any given patient's anatomy
- ❖ Has a limited but definite role

## 5cm Criteria



# Bigger is Better!



## FDA patient safety, February 2002

The FDA reports the danger that the tip of a catheter, if positioned in the right atrium, might progressively cause an erosion and perforate the myocardium; or, that the tip of a catheter, if positioned in the lower third of the SVC, might perforate the wall and cause a pericardial effusion.

**THIS HAS NOT BEEN DOCUMENTED IN ADULT PATIENTS IN THE LAST 20 YRS.**





## Personal Experience – VAD's and the Sweet Spot

- ❖ > 3000 PICC's & 300 Ports/yr. x 7 years-Supervising Head of Venous Access
- ❖ 22 total years of using Sweet Spot Criteria
- ❖ Not one case of delayed complication Right atrial catheterization
- ❖ No delayed arrhythmias if placed in IR suite-all patients cardiac monitored



*'The most feared catheter-related complications, such as vascular perforation and cardiac arrhythmias, are rare. Importantly, these complications are often caused by physician errors during catheter insertion procedures'*

(Tom Vesely, JVIR 2003)

# The Elephant in the Room

- ❖ The immediate and the obvious arrhythmia-rarely life-threatening, overstated/ dramatized & readily correctable

Vs.

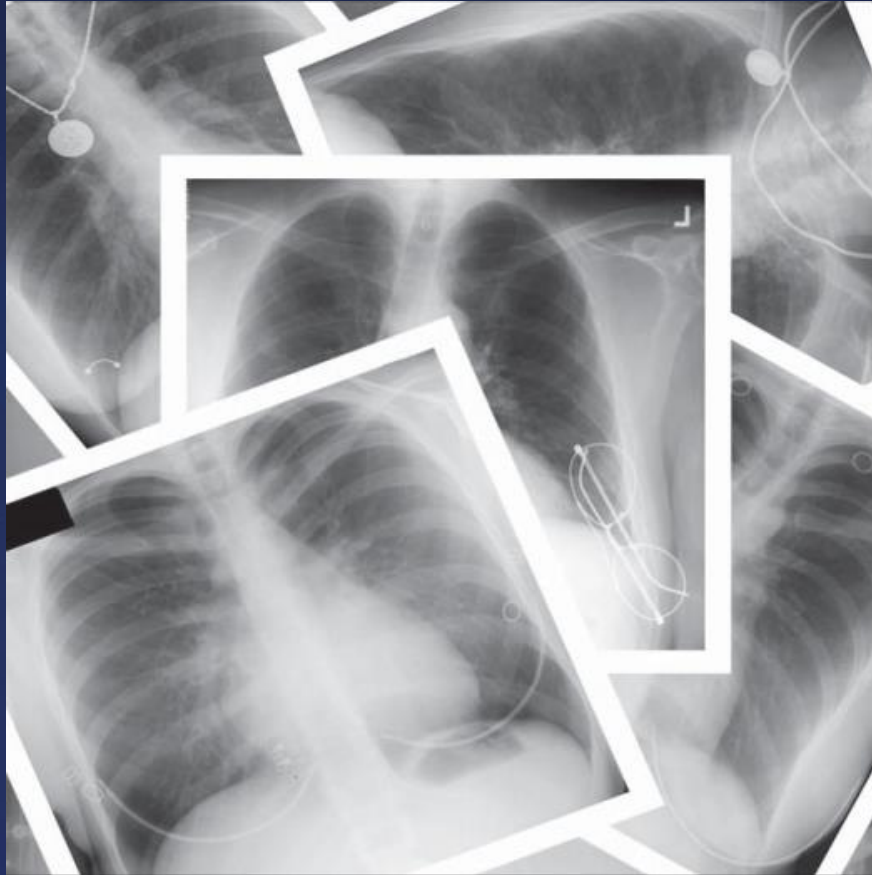
- ❖ The insidious, under-emphasized, poorly treatable, rarely correctable late sequelae of SVC stenosis, occlusion and DVT

# CXR – Not Going Away

- ❖ 68,000,000 in the United States: (2007)
- ❖ Radiation dose < flight to Berlin
- ❖ 2.5 PICC's, 0.5 Ports, 3.3 Acute CVC's (millions) 2012
- ❖ Not all alternative technologies available to all inserters
- ❖ No vendor has new technology across all VAD product lines
- ❖ No matter what methodology/ “technology” used for VAD placement – all follow up is by imaging (primarily CXR)

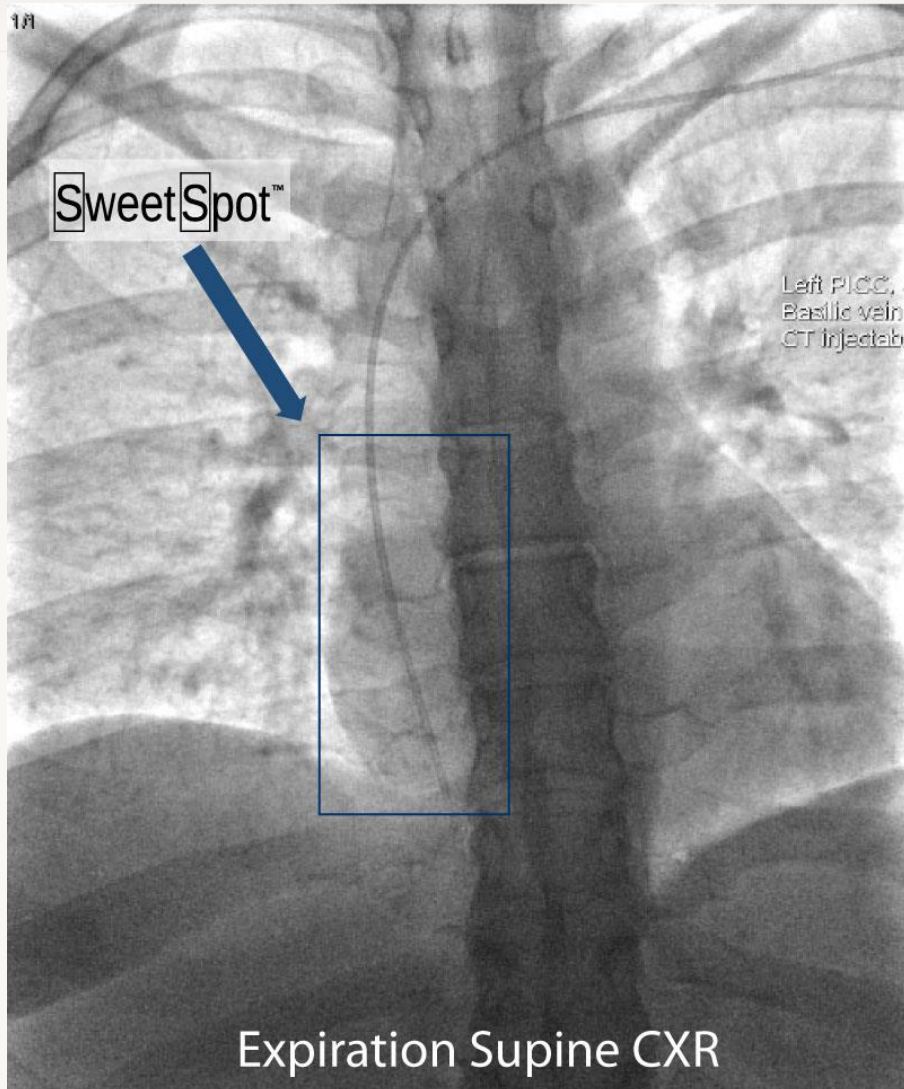
# Relative Radiation Risk

For this procedure:	* Your approximate effective radiation dose is:	Comparable to natural background radiation for:	** Additional lifetime risk of fatal cancer from examination:														
<b>CHEST:</b>																	
Computed Tomography (CT)-Chest	7 mSv	2 years	Low														
Computed Tomography (CT)-Chest Low Dose	1.5 mSv	6 months	Very Low														
Radiography-Chest	0.1 mSv	10 days	Minimal														
<table><tr><th>Risk Level</th><th>Approximate additional risk of fatal cancer for an adult from examination:</th></tr><tr><td>Negligible:</td><td>less than 1 in 1,000,000</td></tr><tr><td>Minimal:</td><td>1 in 1,000,000 to 1 in 100,000</td></tr><tr><td>Very Low:</td><td>1 in 100,000 to 1 in 10,000</td></tr><tr><td>Low:</td><td>1 in 10,000 to 1 in 1000</td></tr><tr><td>Moderate:</td><td>1 in 1000 to 1 in 500</td></tr><tr><td colspan="2"><b>Note:</b> These risk levels represent very small additions to the 1 in 5 chance we all have of dying from cancer.</td></tr></table>				Risk Level	Approximate additional risk of fatal cancer for an adult from examination:	Negligible:	less than 1 in 1,000,000	Minimal:	1 in 1,000,000 to 1 in 100,000	Very Low:	1 in 100,000 to 1 in 10,000	Low:	1 in 10,000 to 1 in 1000	Moderate:	1 in 1000 to 1 in 500	<b>Note:</b> These risk levels represent very small additions to the 1 in 5 chance we all have of dying from cancer.	
Risk Level	Approximate additional risk of fatal cancer for an adult from examination:																
Negligible:	less than 1 in 1,000,000																
Minimal:	1 in 1,000,000 to 1 in 100,000																
Very Low:	1 in 100,000 to 1 in 10,000																
Low:	1 in 10,000 to 1 in 1000																
Moderate:	1 in 1000 to 1 in 500																
<b>Note:</b> These risk levels represent very small additions to the 1 in 5 chance we all have of dying from cancer.																	



*“Not all CXRs are created equal”*





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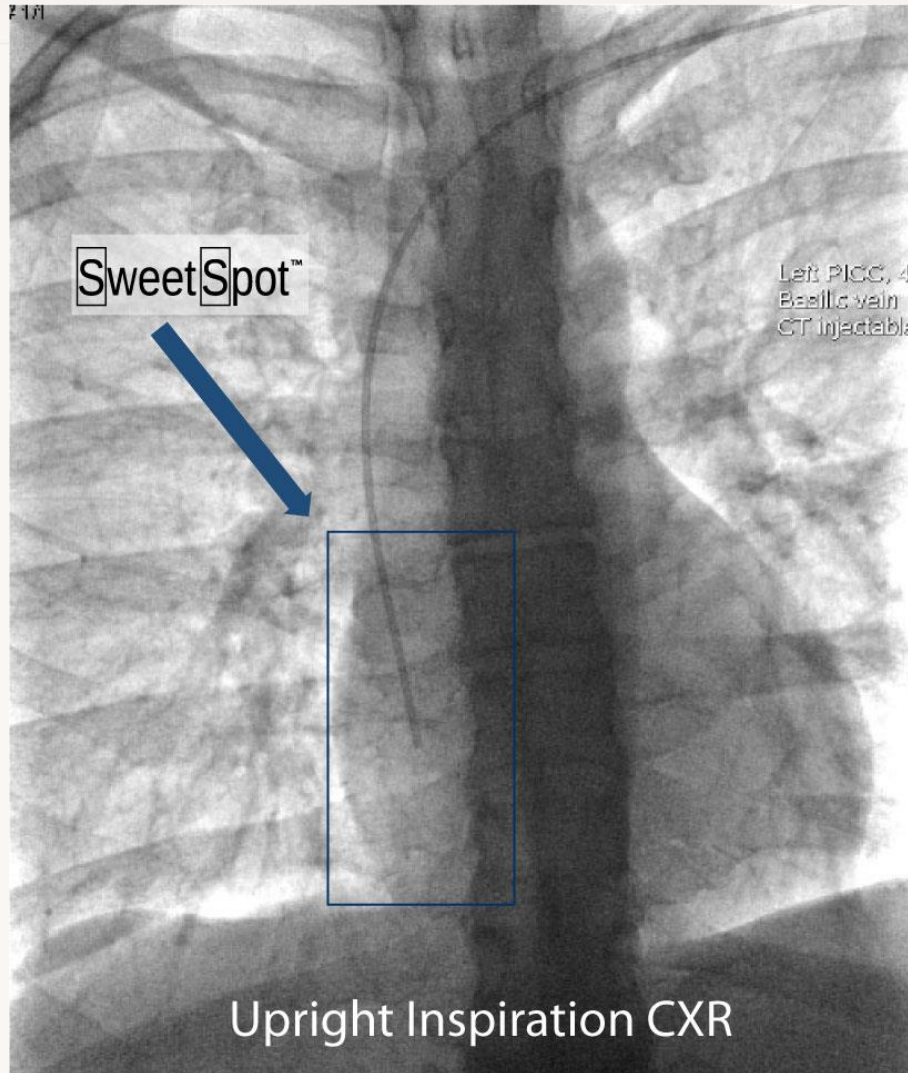
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1. When I place a VAD under fluoroscopic visualization, my optimal tip position is in the bottom of the box at expiration. (**No Advance**)



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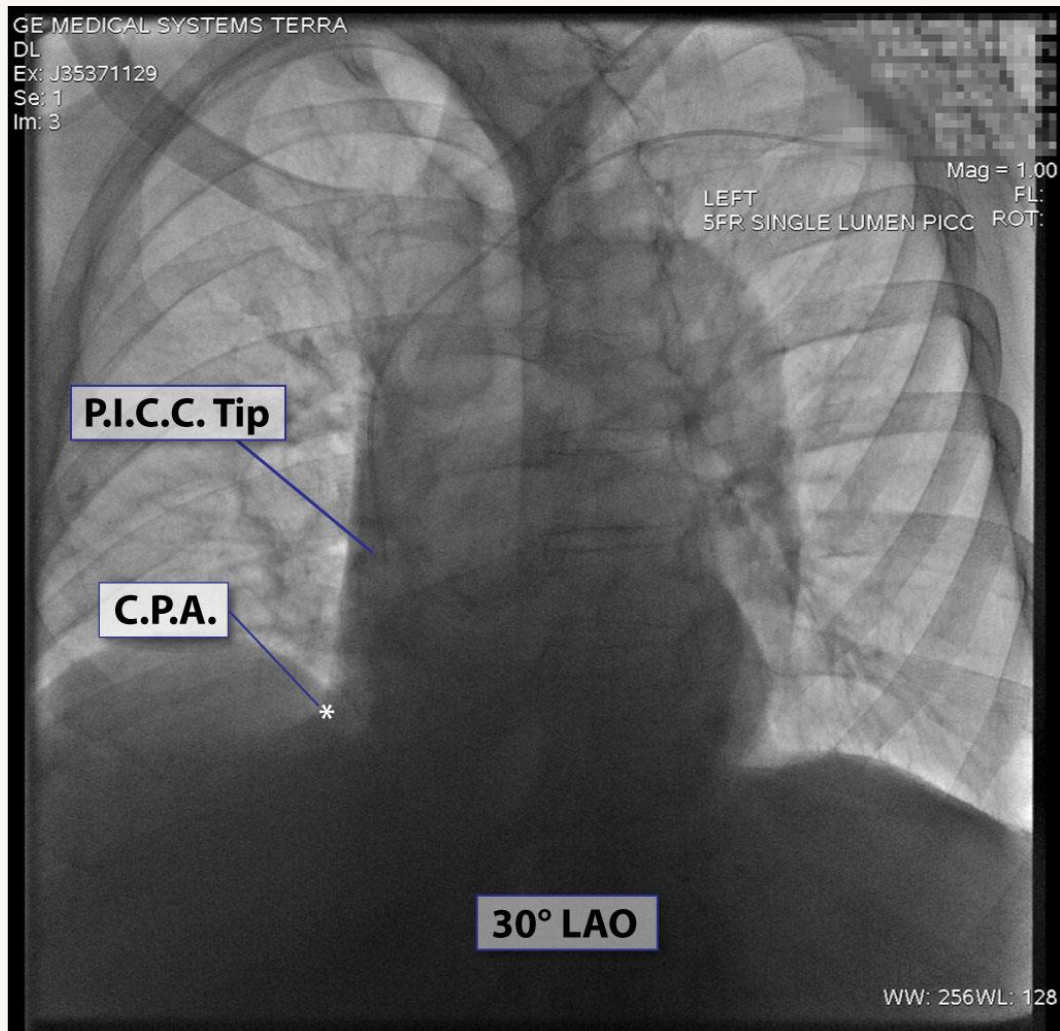
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2. On inspiration upright CXR, the tip of VAD is ideally at C.A.J.

- ❖ Not infrequently, the chest x-ray will be rotated causing the right cardiac margin to deviate from its normal AP appearance
- ❖ Depending on the degree of rotation, an estimation of the SWEET SPOT® is all that may be possible.
- ❖ The right cardiophrenic angle becomes the most reliable anatomic landmark
- ❖ Since the right atrium is immediately cephalad to a normally positioned right cardiophrenic angle, **a reliable estimation of acceptable catheter tip location is still possible**
- ❖ The height, and consequently the width of the rectangular Sweet Spot® box will be less exact
- ❖ An apparently short catheter tip position may benefit from a non-rotated chest x-ray to confirm an acceptable location

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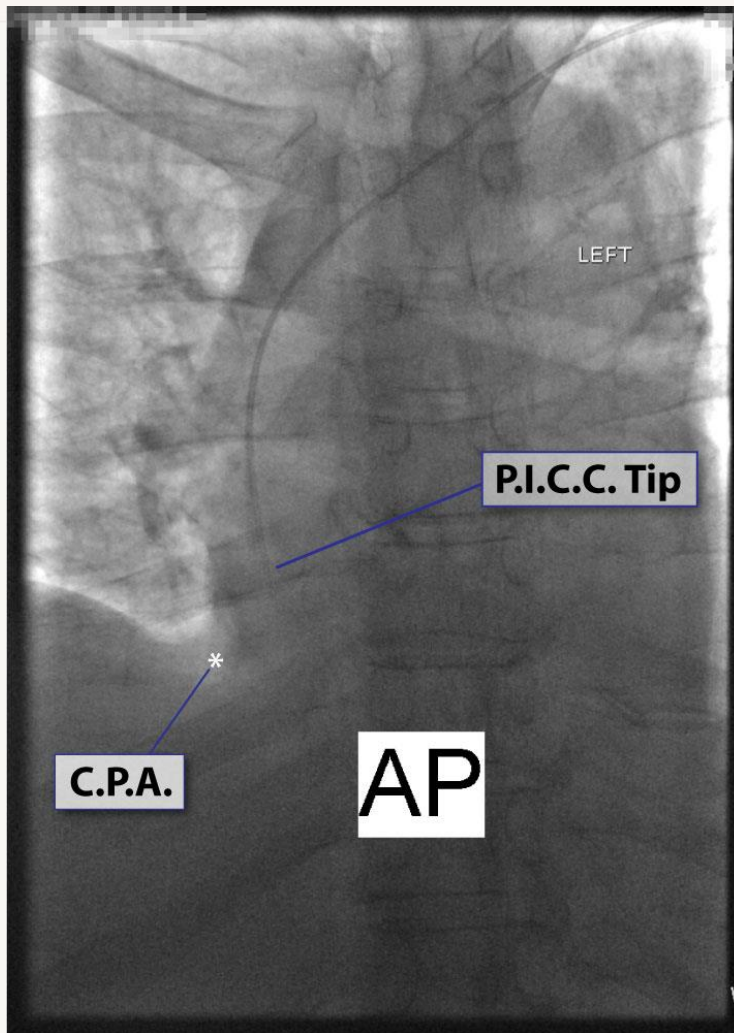
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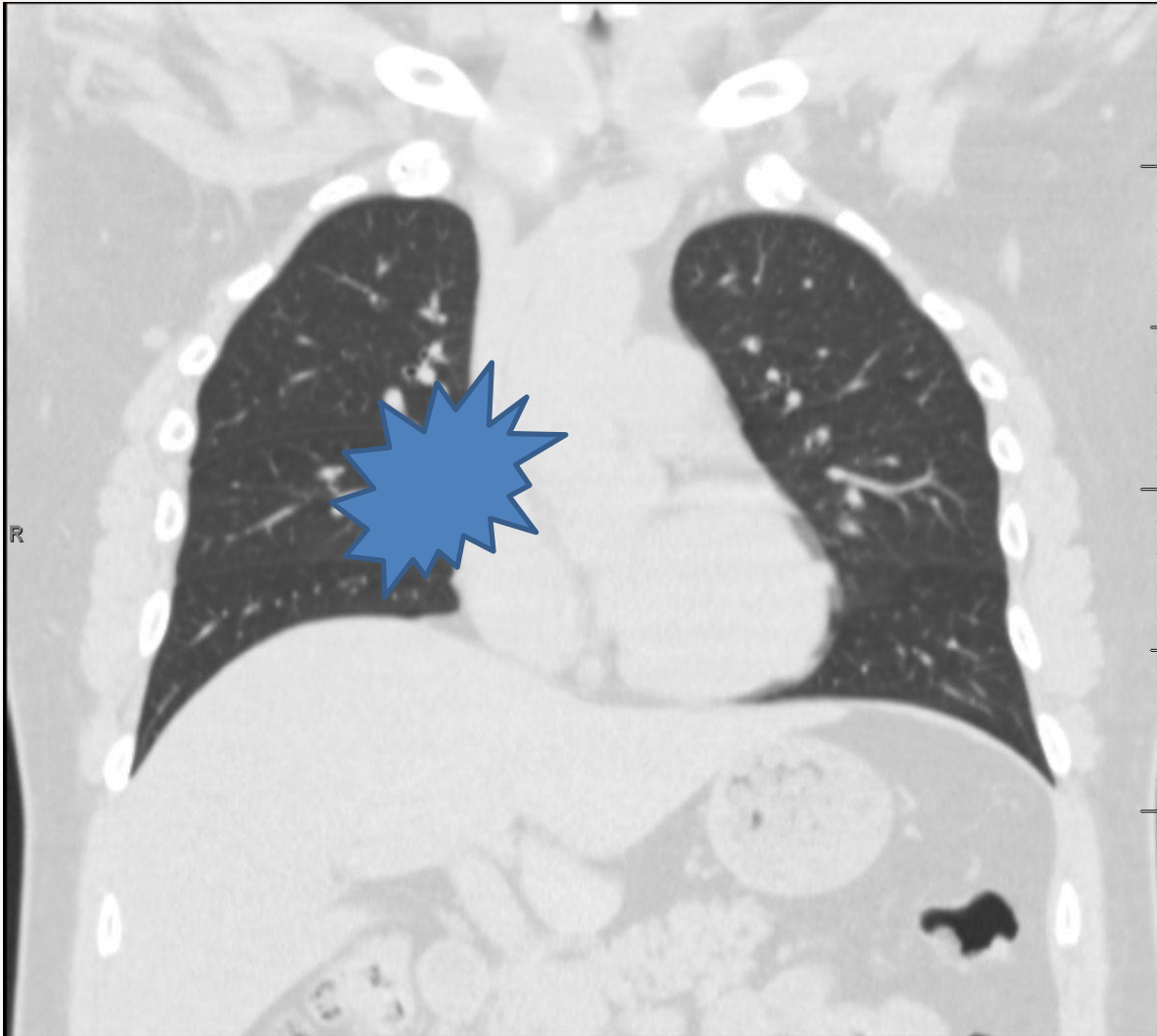
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❖ Again, the cardiophrenic angle is the most reliable landmark and thus the same principles apply as before.

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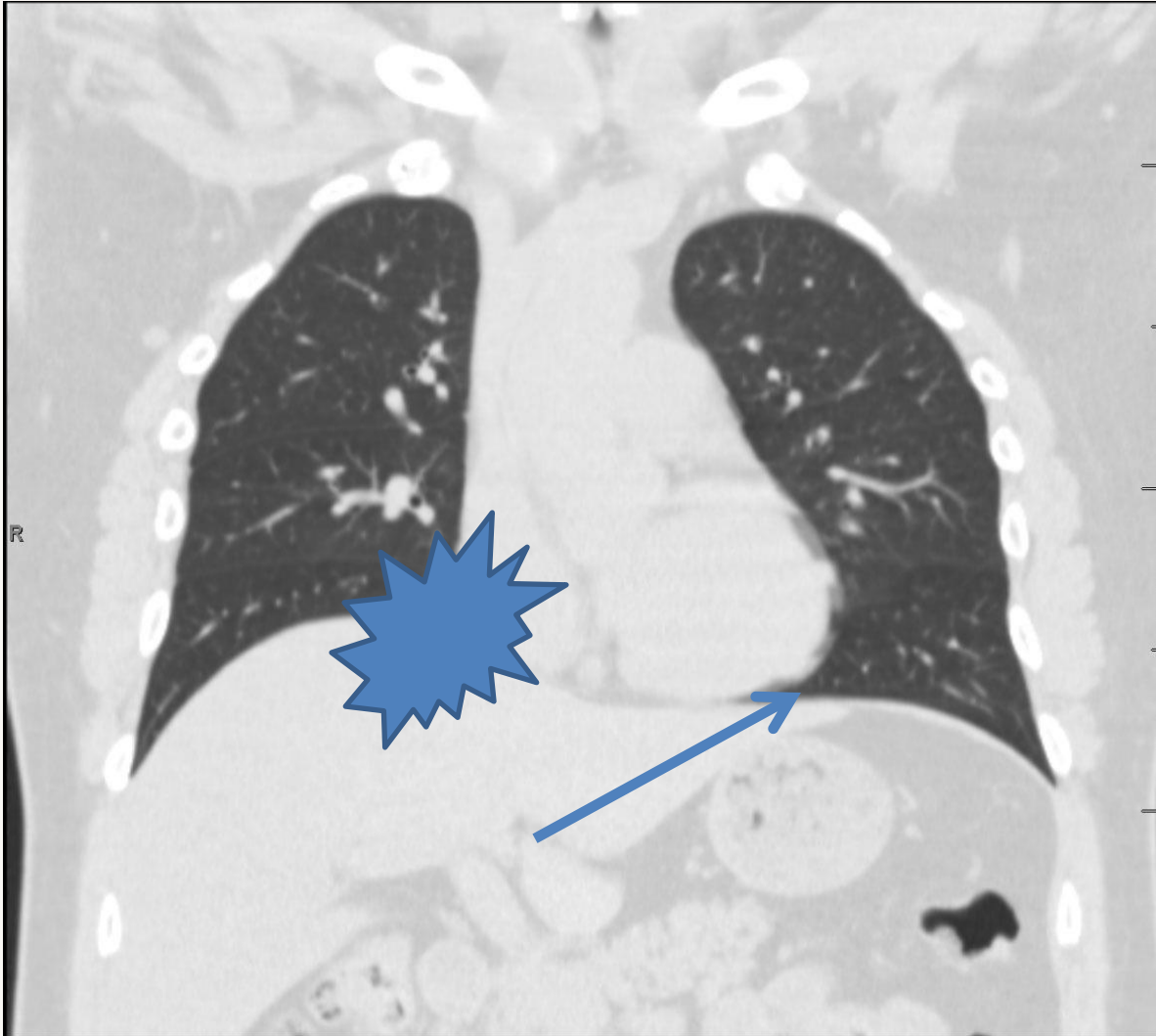
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Obscured Sweet  
Spot®  
Landmarks

- ❖ The best way to confirm a normally positioned right cardiophrenic angle is to look at the left cardiophrenic angle
- ❖ Generally speaking, the right cardiophrenic angle should be at approximately the same horizontal position as the left cardiophrenic angle
- ❖ In the case of an elevated right cardiophrenic angle, experience and an understanding of the underlying anatomy SWEET SPOT® may suffice
- ❖ Aim for CAJ -- is by definition always center of Sweet Spot®

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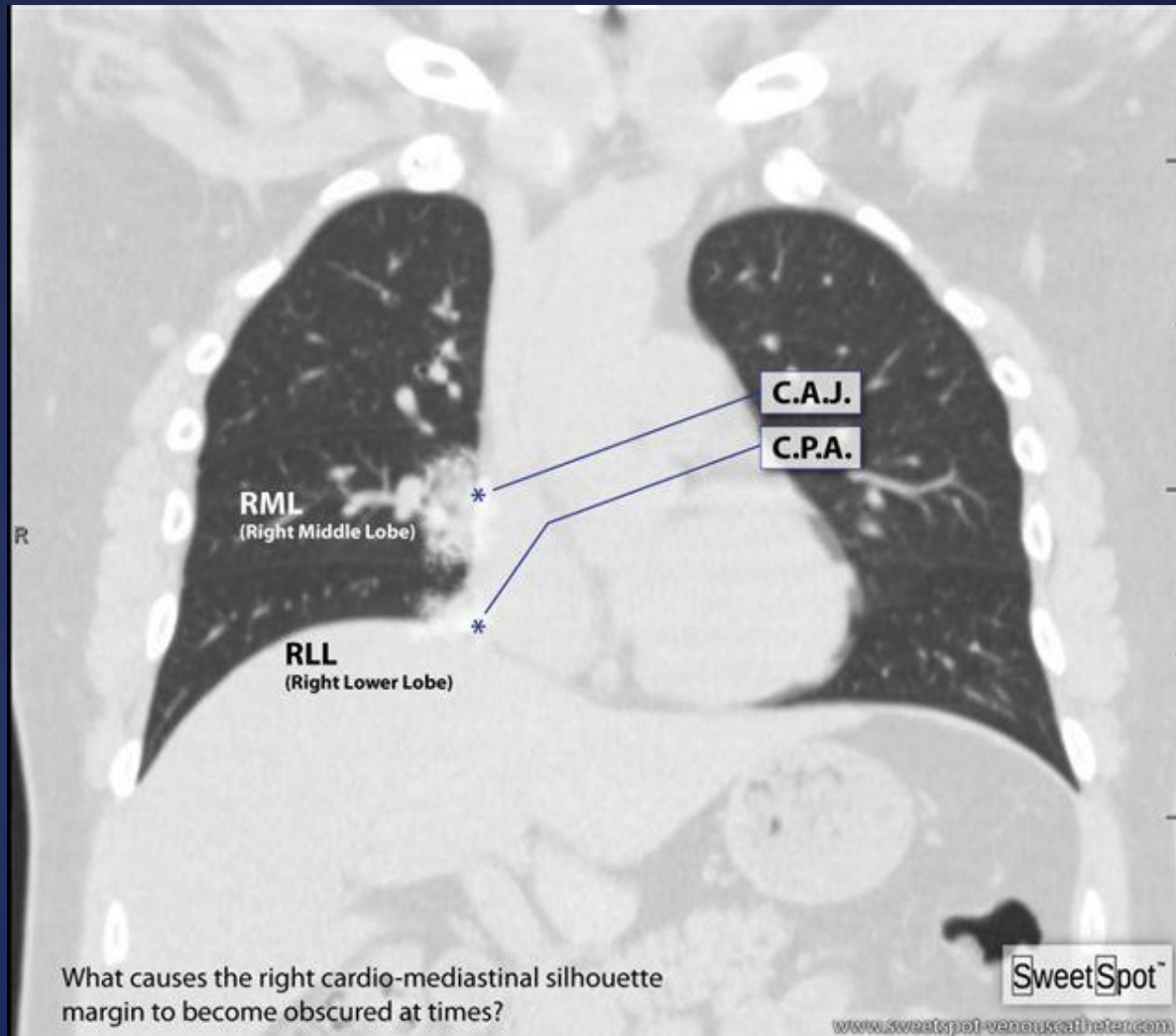
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Obscured Sweet  
Spot®  
Landmarks

## Teaching Point





Often causes the tip of the venous access device to curve to the patient's left, necessitating a relatively wide SWEET SPOT® design.

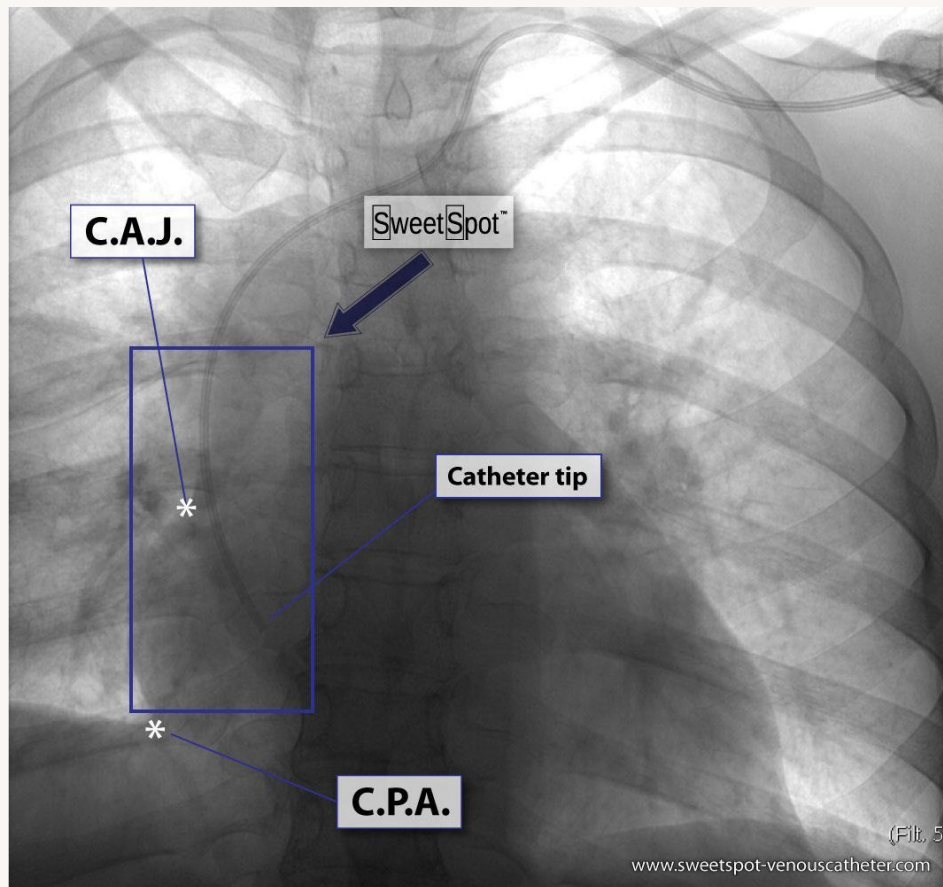
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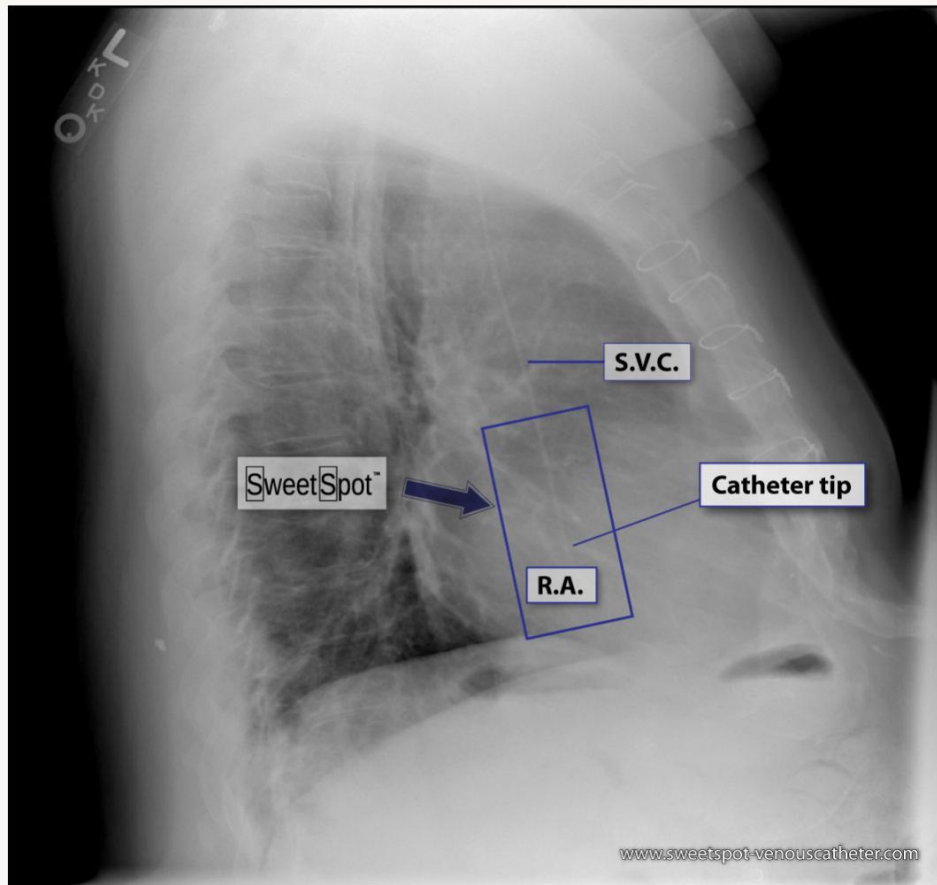
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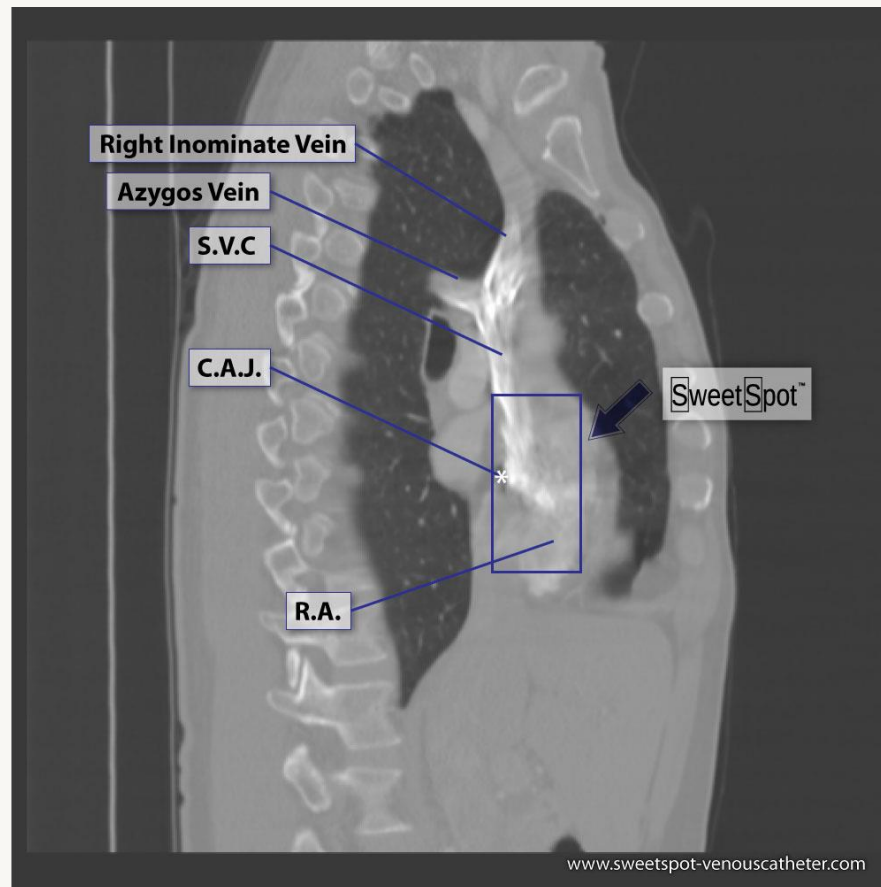


Example of why  
Sweet Spot®  
needs to be so  
wide

On , the catheter should course in an almost straight line from the superior vena cava into the right atrium. **If it deviates posteriorly from this straight orientation, suspect that it has entered the azygos vein.** If this is the case, reposition the catheter.

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# Lateral CXR Sweet Spot®



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## Sagittal CT Reconstruction

- ❖ A catheter tip that is short of the SWEET SPOT® runs the risk of flipping into the left innominate vein or the right innominate vein( depending on what side access was from) during either the cardiac and/ or the respiratory cycle-causing potential intimal injury / fibrin sleeve / thrombus, etc.
- ❖ With lower lung volumes, both cardiophrenic angles will be in a more cephalic location relative to the mediastinum. The patient will correspondingly have a shorter(and narrower) Sweet Spot®

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## SWEET SPOT® Limitations

- ❖ Loss of radiographic landmark(s)
  - ❖ Right cardiac margin (CAJ)
  - ❖ One or both CPAs
- ❖ Distortion of radiographic landmark(s)
  - ❖ Severely rotated CXR
  - ❖ Severely deformed chest (ex. Scoliosis)
  - ❖ Lordotic CXR
- ❖ Very low lung volumes
  - ❖ Mediastinum shortens less than lungs
- ❖ Solutions
  - ❖ At worst, left with whatever criteria you had before (Sweet Spot® is additive).
  - ❖ Place PICC conventionally and if questionable CXR get additional cross-sectional imaging (ex. CT/MRI) Many patients are getting this anyways for their underlying medical condition.
  - ❖ ECG guided PICC

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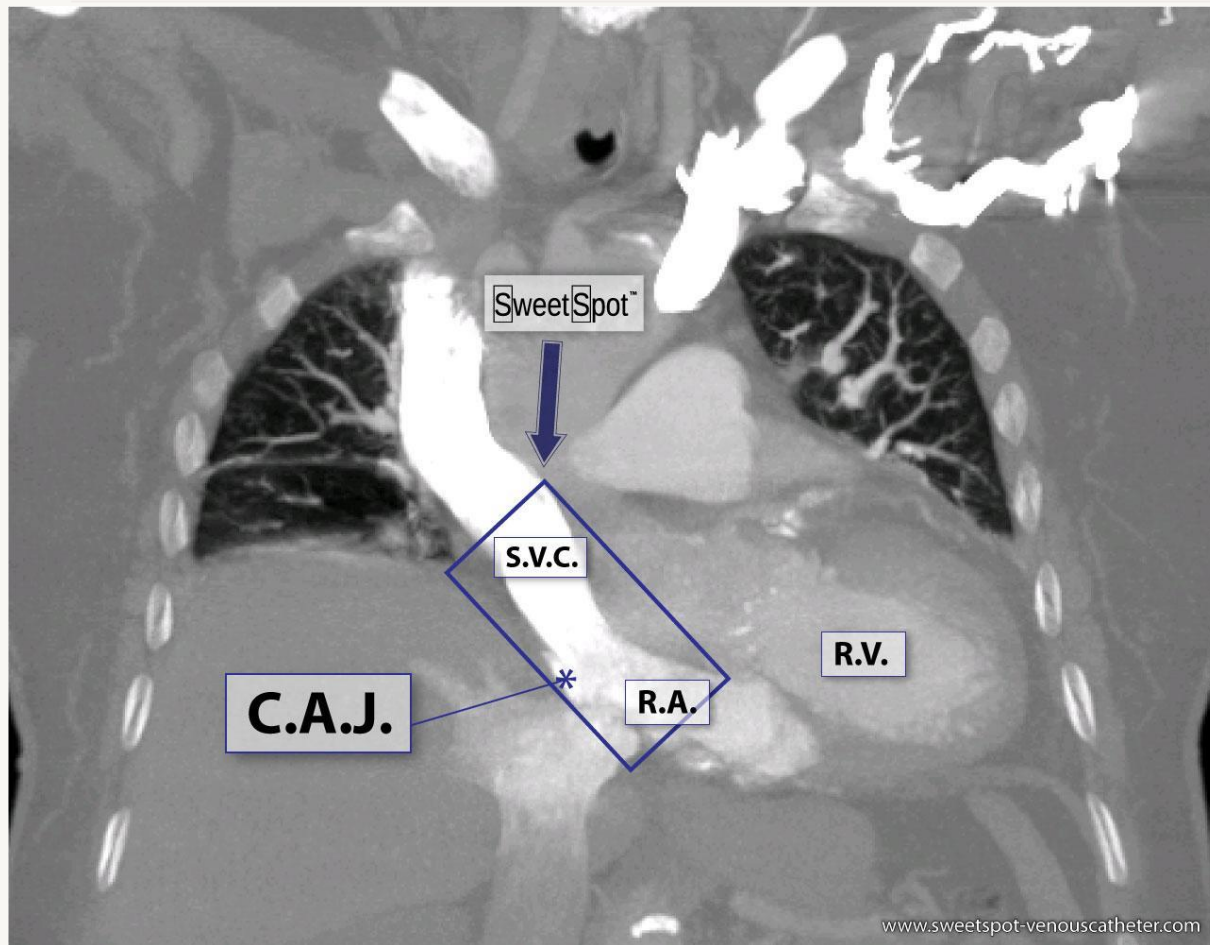
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**\* Sweet Spot® is applicable in >95% of cases**





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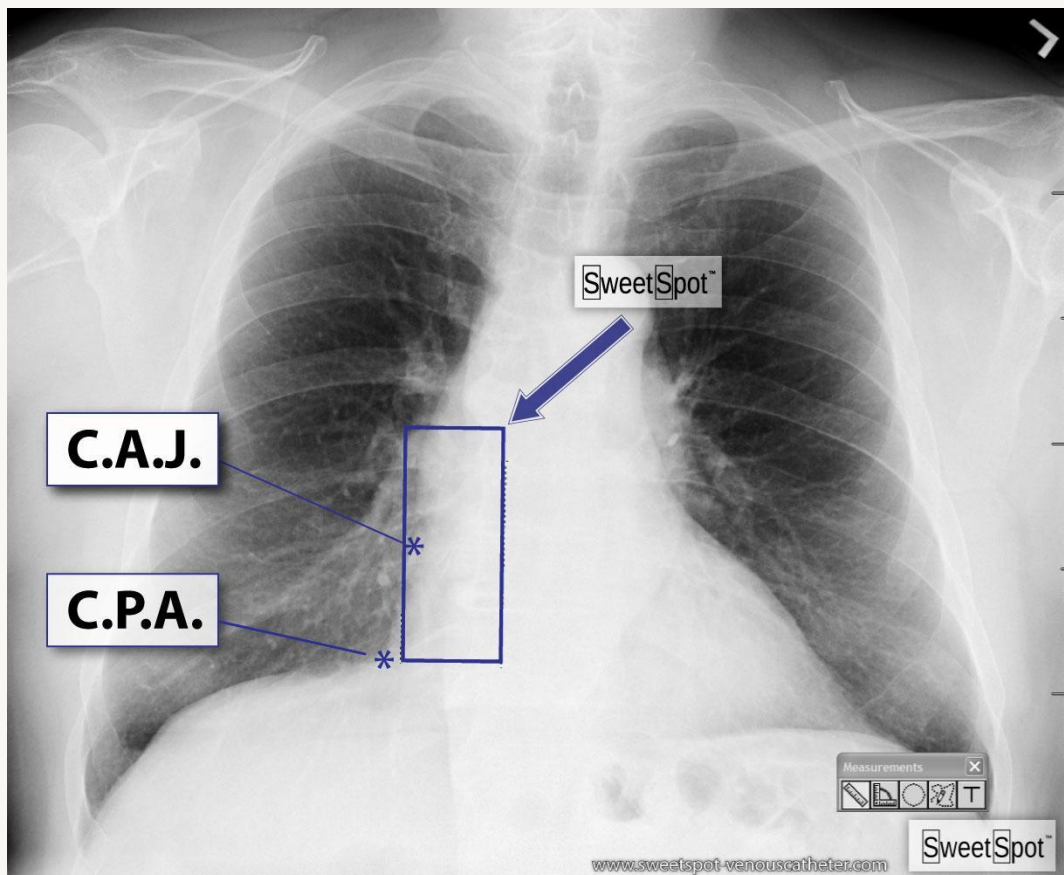
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Ex. Very low lung volumes - Sweet Spot® useless

If you find that you are having information overload, just try to memorize this image.



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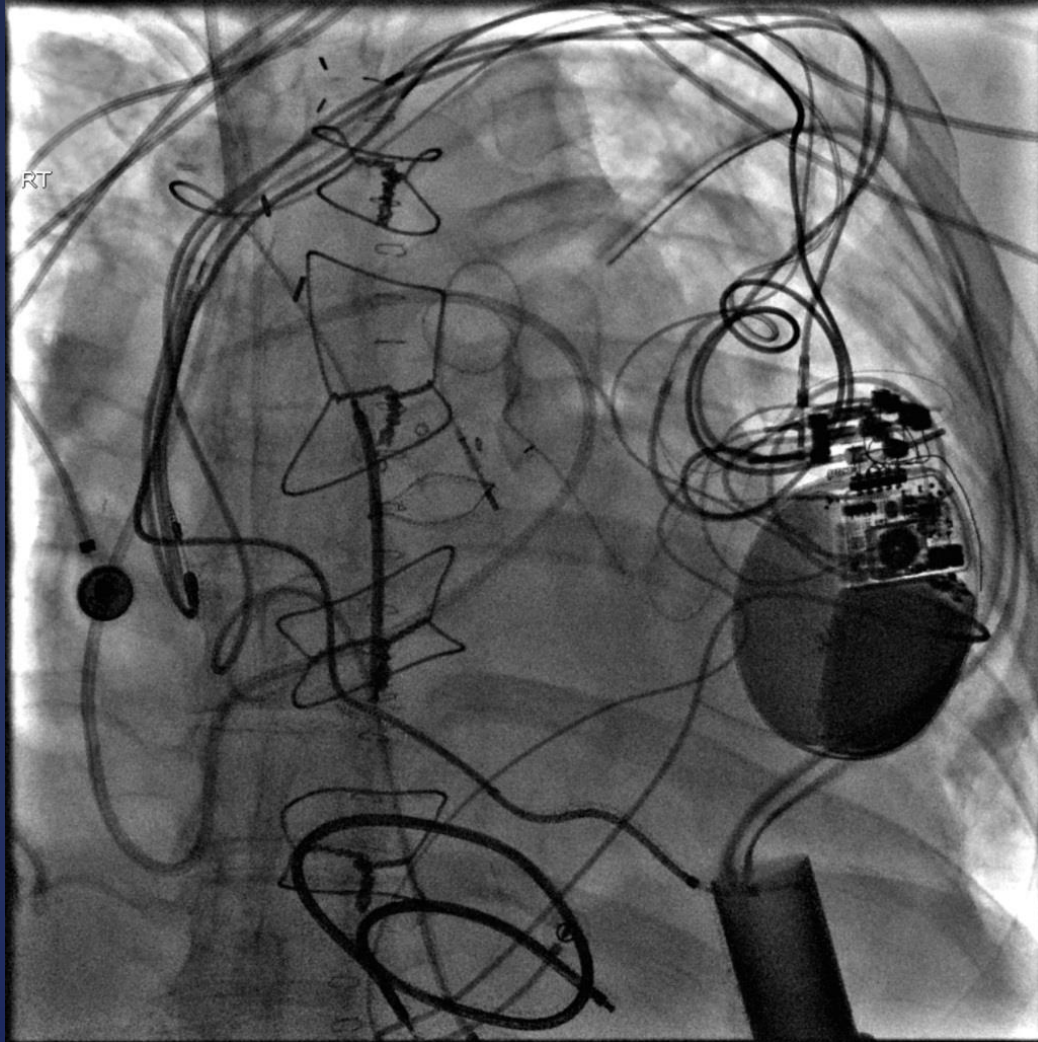
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“Not all CXRs are Created Equal”



- ❖ **The SWEET SPOT® is the best anatomically based and radiographically confirmed practical approximation of the cavo-atrial junction**
- ❖ **It is independent of patient factors** such as age, size, patient position for chest x-ray, lung volume or **type of VAD**
- ❖ It also **encompasses the various leading societal recommendations/** other practices for catheter tip location
- ❖ As such, it **allows for the necessary significant flexibility** in acceptable **VAD tip location** based not only on patient, chest x-ray and catheter variables as just mentioned but also **inserter variables such as societal affiliations, personal experience and personal convictions**

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## SWEET SPOT® Summary

- ❖ Practical
- ❖ Objective
- ❖ Allows standardization
- ❖ Easy to learn
- ❖ Based on clinical experience, anatomy & clinical research
- ❖ Should be embraced by industry
- ❖ Improves patient care
  - ❖ Increase dwell times
  - ❖ Decreased problems
  - ❖ Decreased costs
  - ❖ Decreases morbidity & mortality
    - ❖ Preventing lost access
    - ❖ Decreased thrombosis (↓ PE, Infection and Sepsis)

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# GOAL

- ❖ Make SWEET SPOT® the gold standard V.A.D. tip assessment/acceptability worldwide



Please consider adopting and promoting the SWEET SPOT®.

Together we can end the confusion and the complications of catheter malpositioning.



A detailed National Geographic world map, showing continents, oceans, and various geographical features. The map is oriented with North at the top. Overlaid on the map is a semi-transparent white rectangular box containing a quote in blue text. At the bottom of the map, there are several smaller inset maps and a decorative border.

“If you save a single life, it is as if you save the world.”

-The Talmud

NATIONAL  
GEOGRAPHIC

THE  
WORLD

VEGETATION AND LAND USE

POPULATION DENSITY





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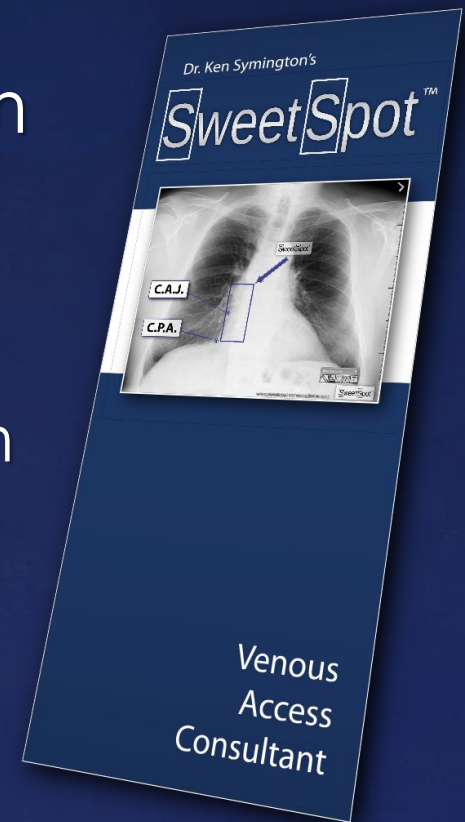
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WEB

[www.sweetspot-venouscatheter.com](http://www.sweetspot-venouscatheter.com)

CELL (PST)

509-990-4455



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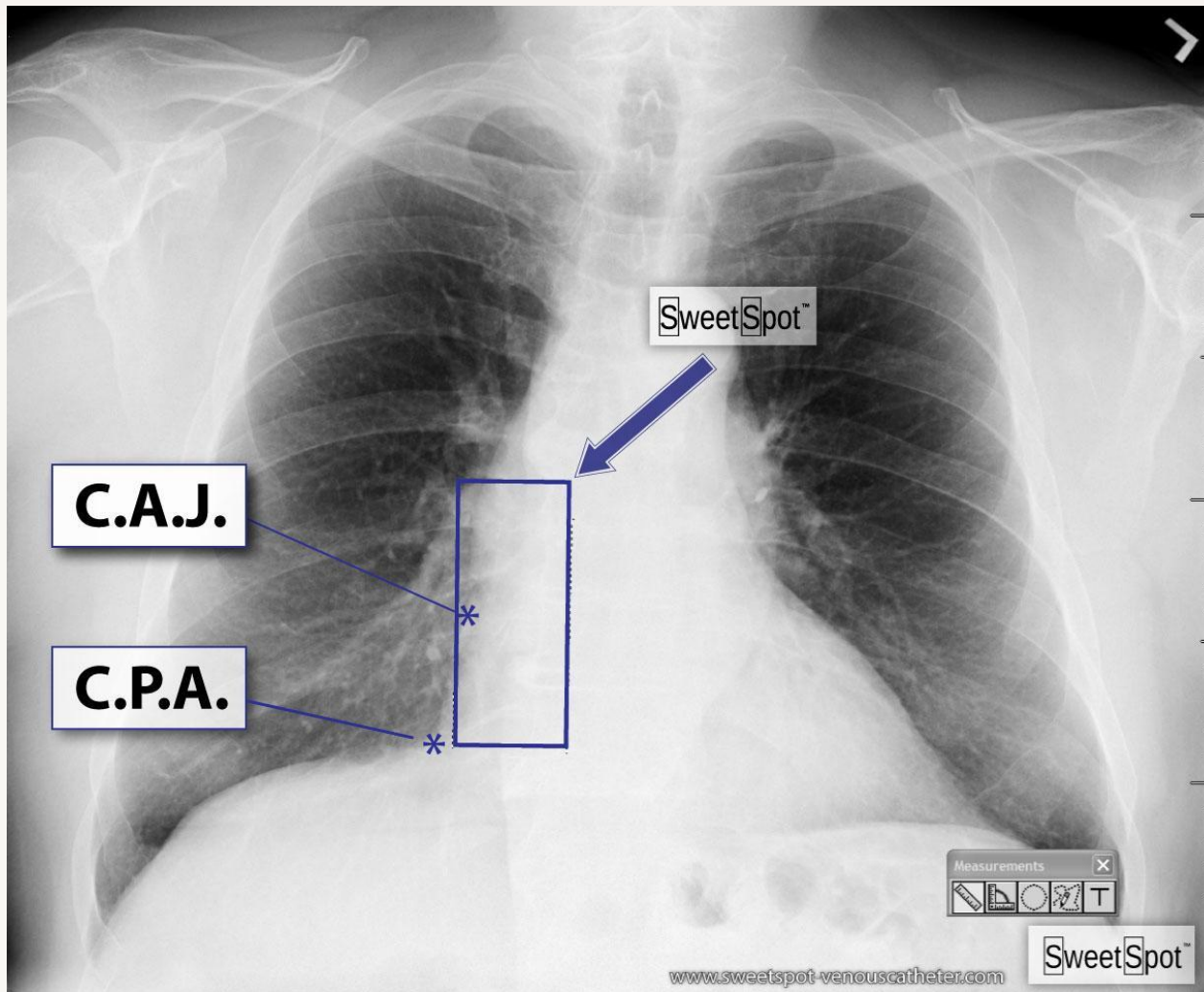












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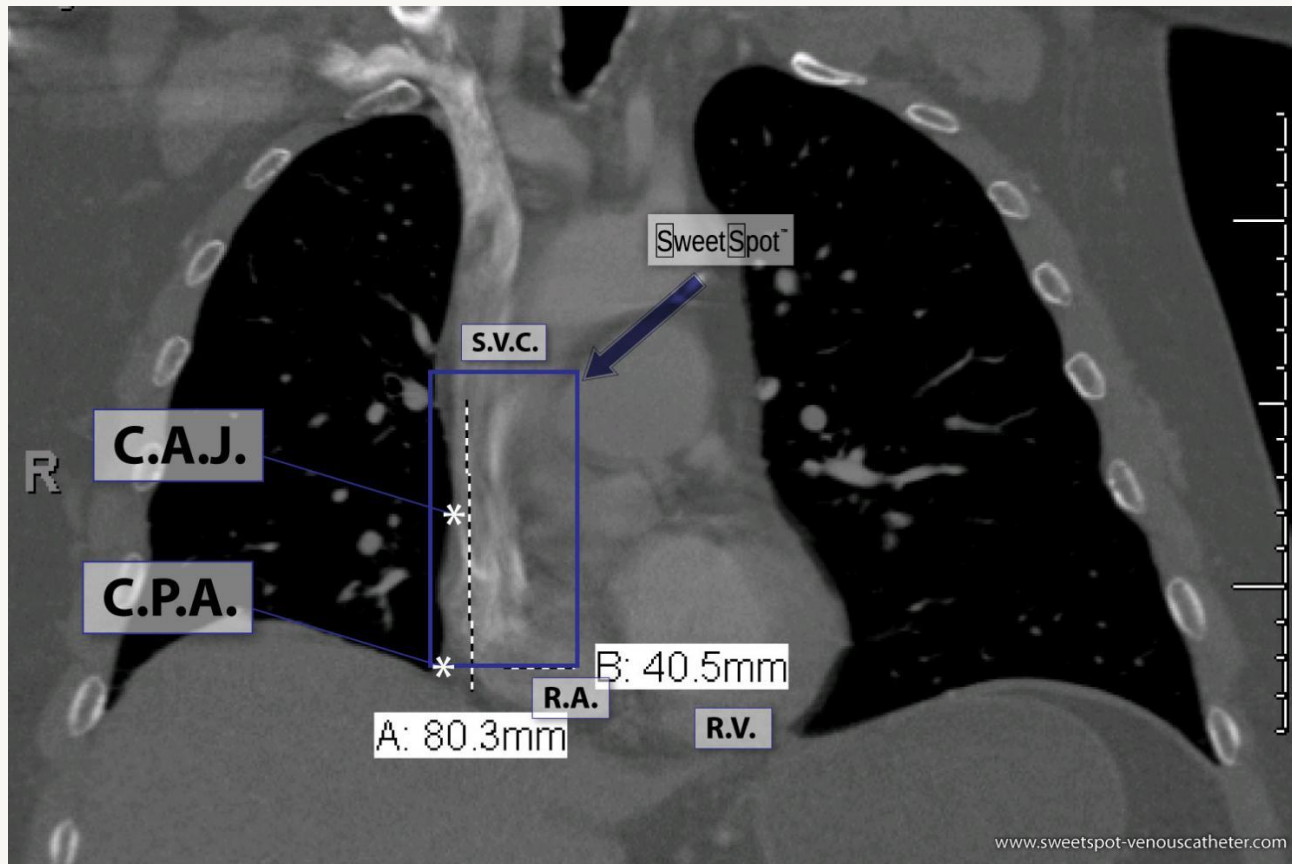
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