

Vein Preservation

Puget Sound Infusion Nurses
Society Seminar

6/7/18

Gale Tang, MD, FACS



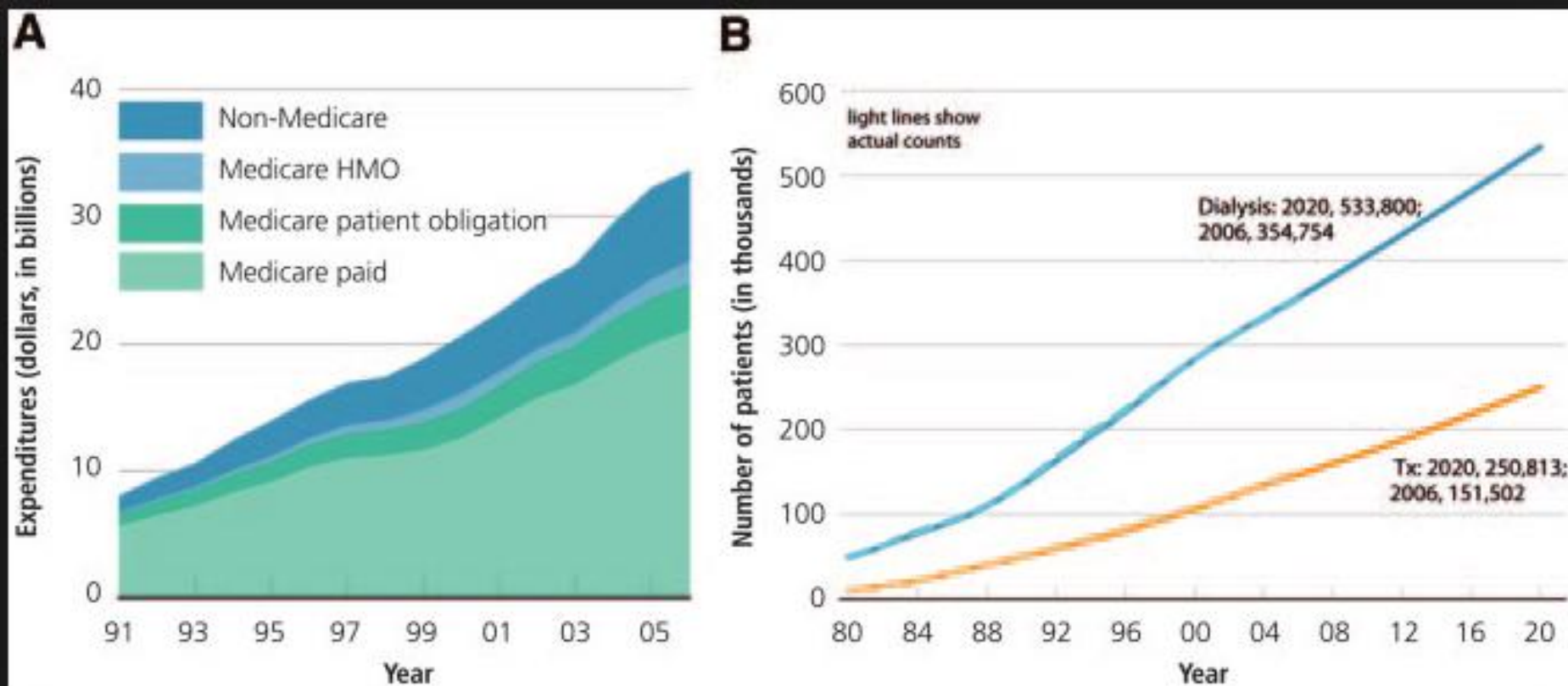


Talk outline

- I. Scope of the problem
 - A. Incidence of ESRD
 - B. KDOQI guidelines (Why Fistula First)
- II. Venous anatomy
- III. HD Access options
- IV. DVT/central venous stenosis
- V. Other considerations
- VI. IV access required for arterial imaging



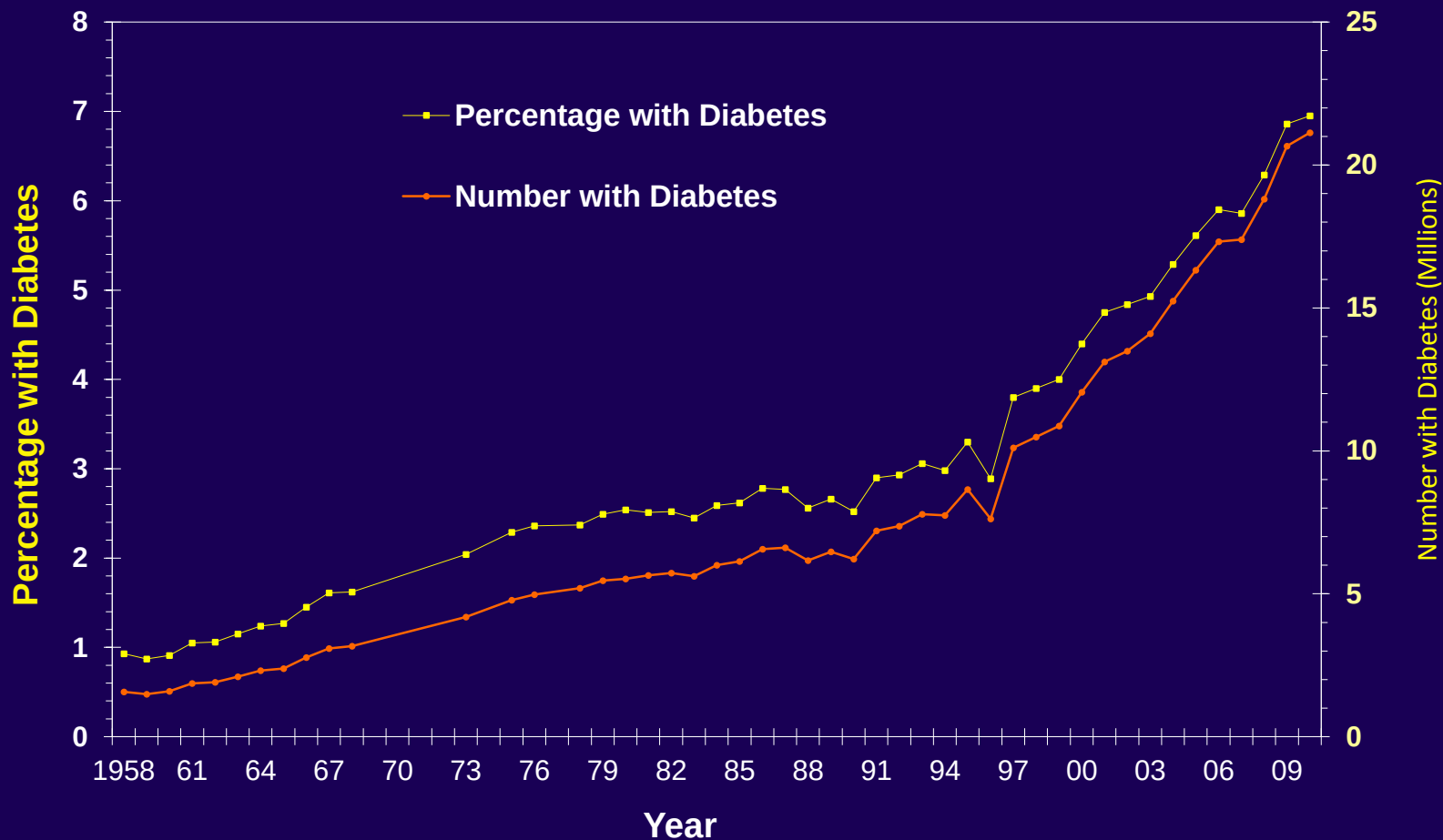
ESRD Increasing in the US



Knauf *et al.* J of the Am Society of Nephrol. 2009; 20:2093-7.



Diabetes Mellitus Increasing in US

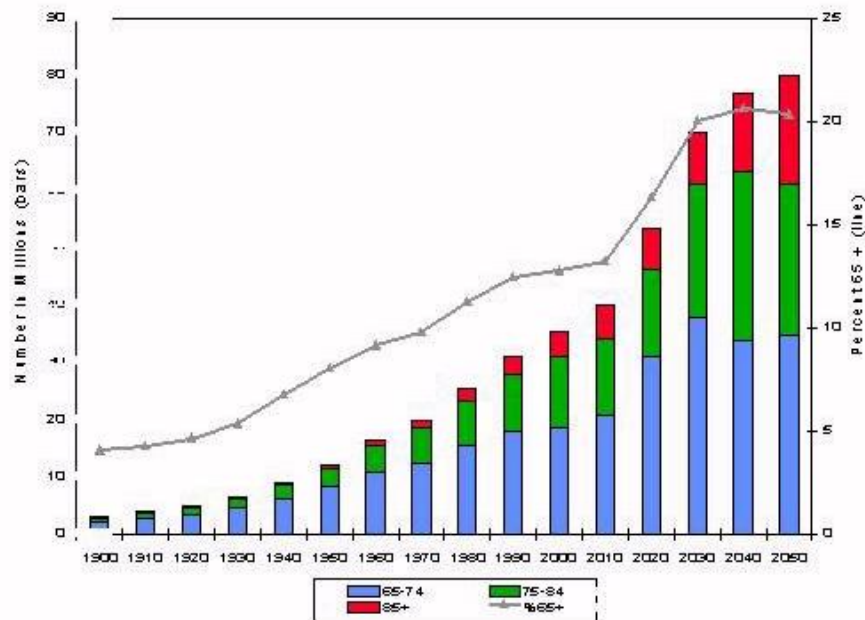




“The Silver Tsunami”

Source: U.S. Bureau of the Census. Current Population Reports, Special Studies P-23-190, 65+ in the U.S. U.S. Government Printing Office, 1996.

Growth of the 65+ Population,
by Age Group: 1900 to 2050



U.S. Senior Population (65 and older)

2009

39.6 million

U.S. senior population, 2009

12.9%

percentage of the U.S. population in 2009

2030

72.1 million

projected number of U.S. seniors
by 2030

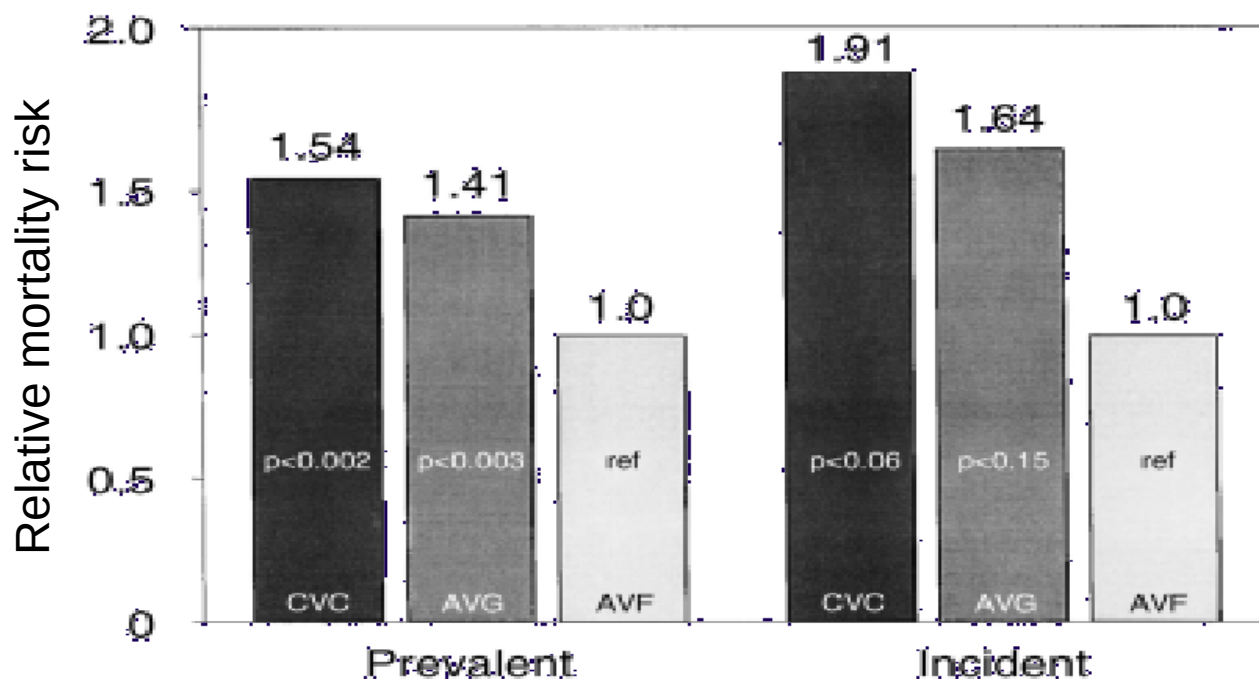
19%

projected percentage of U.S. population in 2030



Lowest Mortality with AVF

Mortality Risks By Vascular Type among U.S. Hemodialysis Patients



CVC= central venous Catheter; AVG=arteriovenous graft; AVF=arteriovenous fistula



KDOQI Guidelines

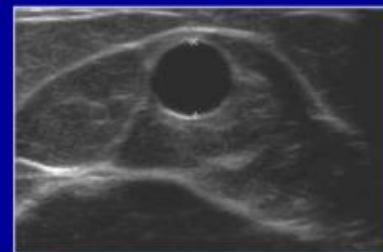
- US HD population 2003 33% AVF
- Fistula First Initiative (2003)
 - Primary failure risk
 - Infection risk
 - * ~10% annual risk for tunneled catheter
 - * ~5% annual risk for arteriovenous graft
 - * <1% annual risk for arteriovenous fistula



Requirements for Successful AVF

- Rule of 6's
 - 6mm diameter
 - 600cc/min volume flow
 - Within 6mm of the skin
- Adequate arterial inflow
- No central vein stenosis

Transverse US of draining vein

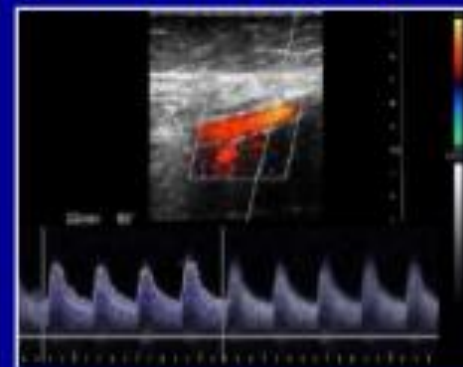


Anteroposterior diameter of draining vein: **6 mm**

Distance from skin surface to anterior vein wall: **4.8 mm**

Singh P et al. Radiology 2008 ; 246 : 299 – 305.

Brachial artery



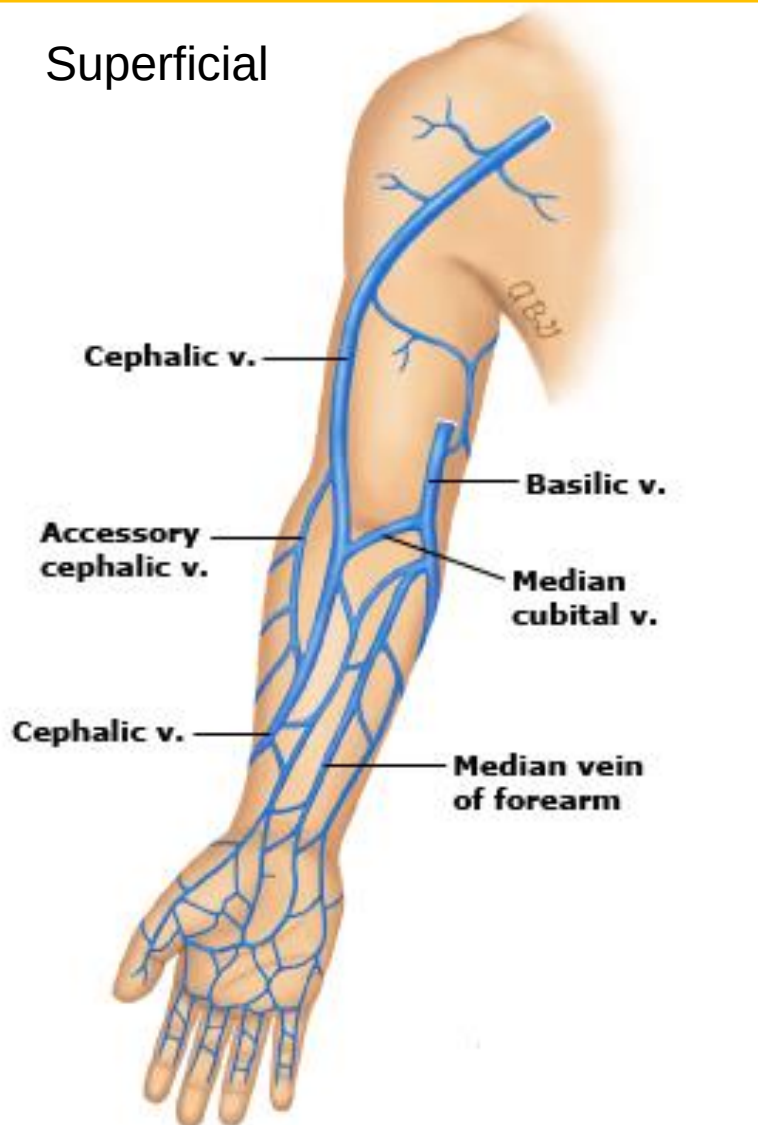
PSV: 350 cm/sec

Volume flow: 1.1 L/min

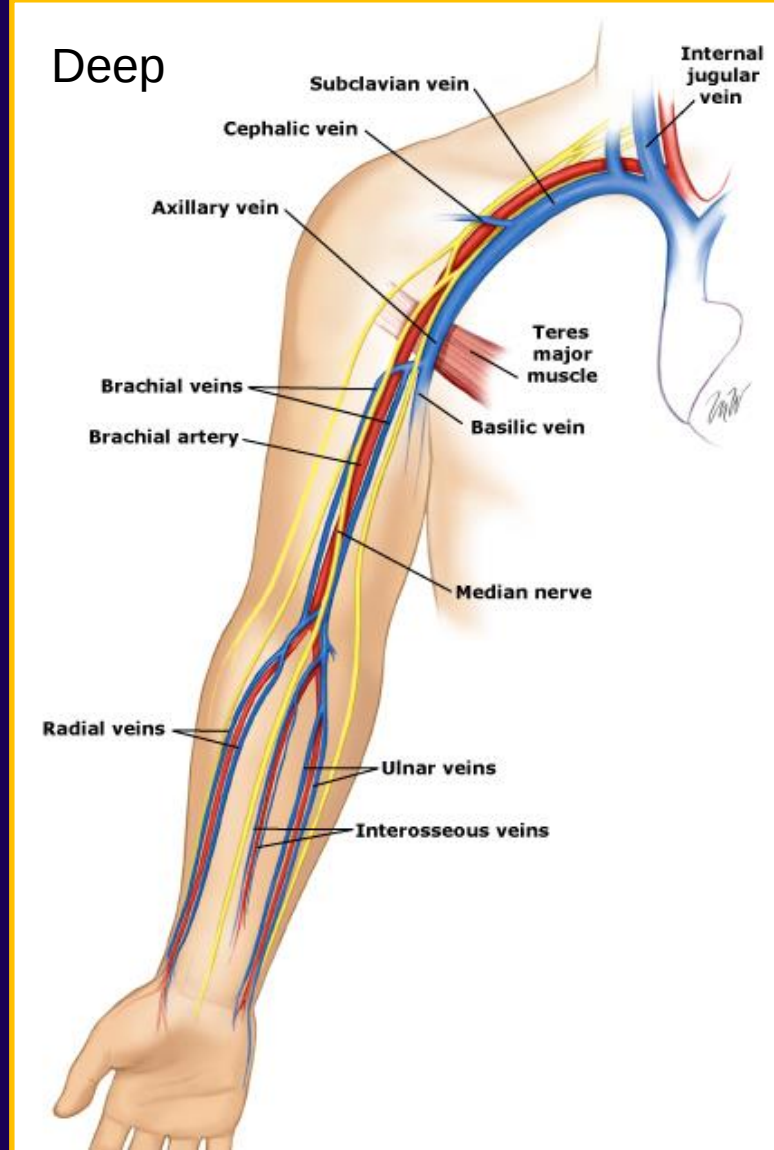


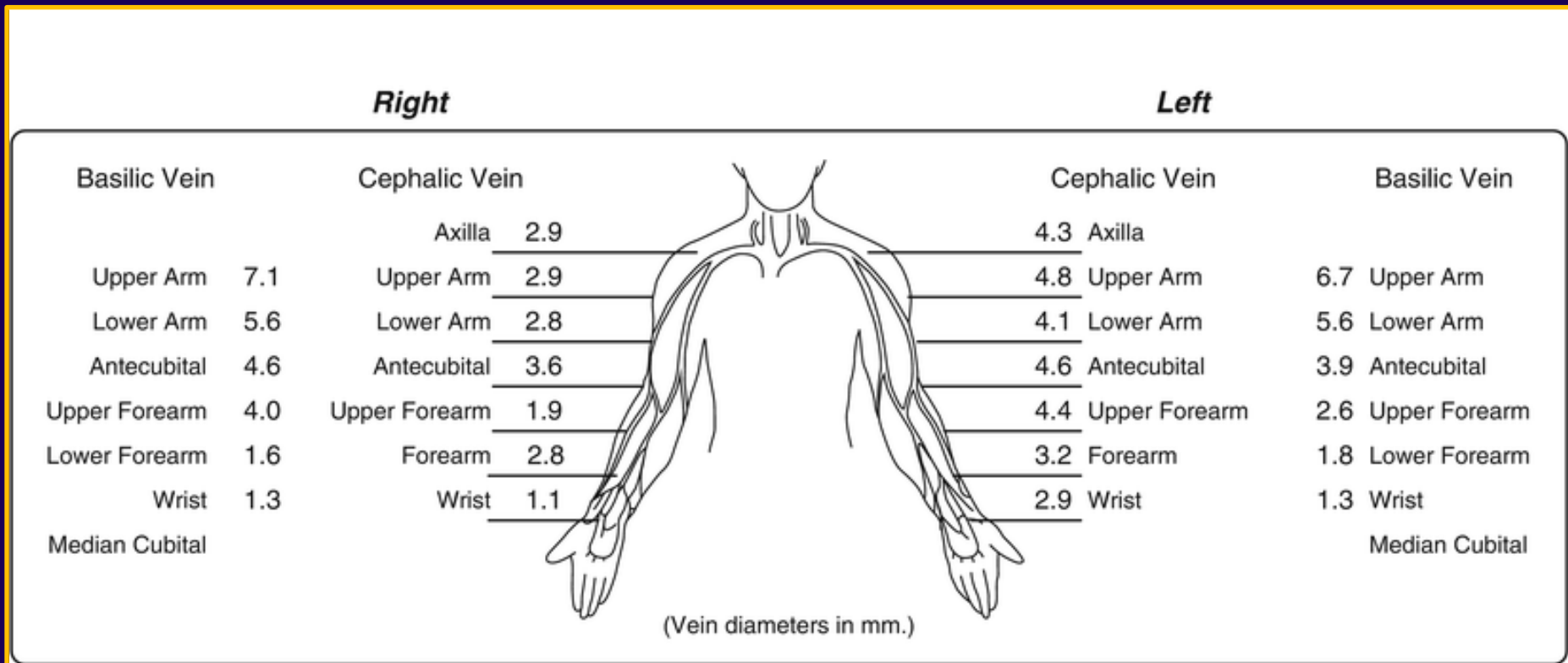
Venous Anatomy

Superficial



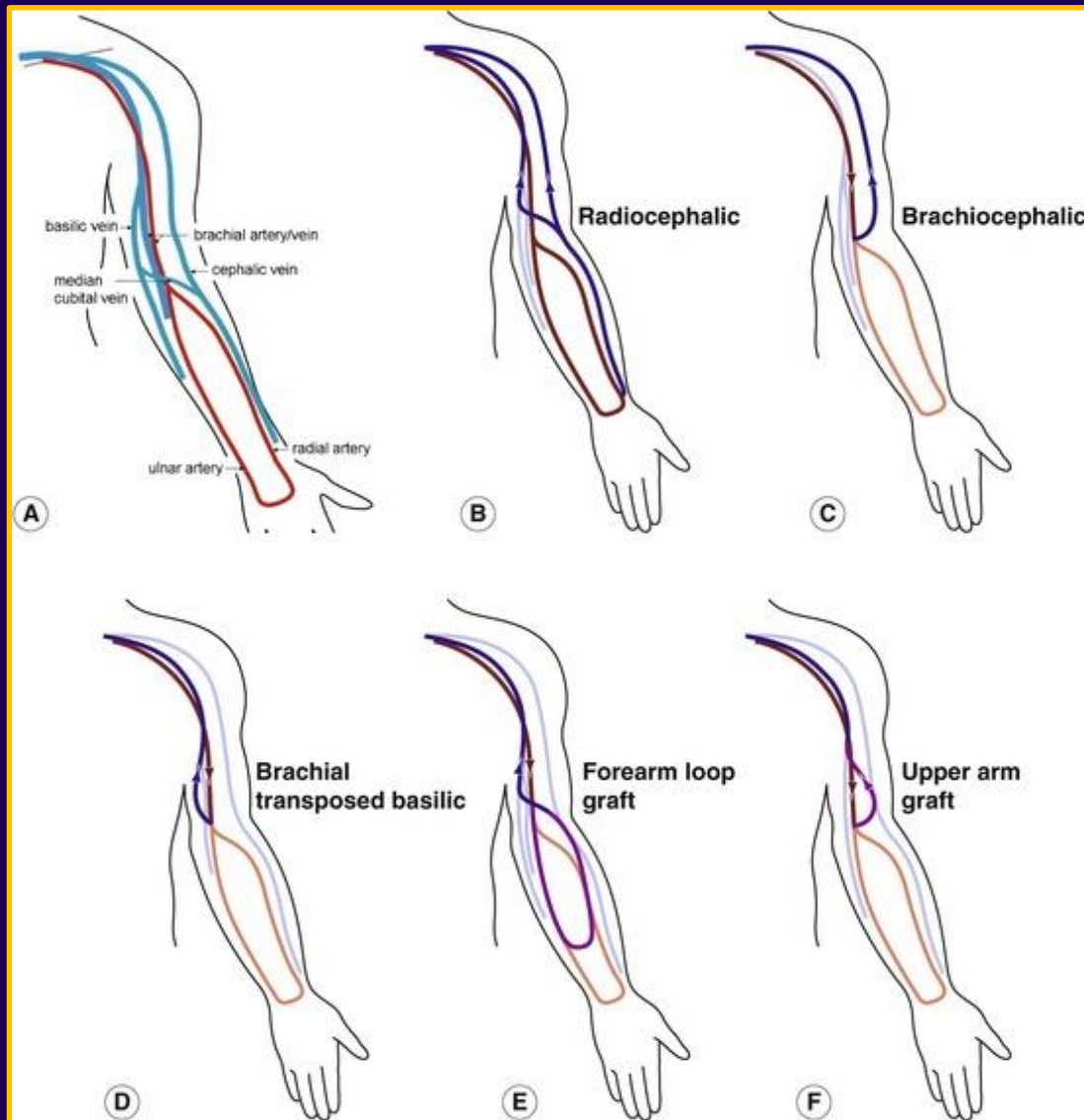
Deep





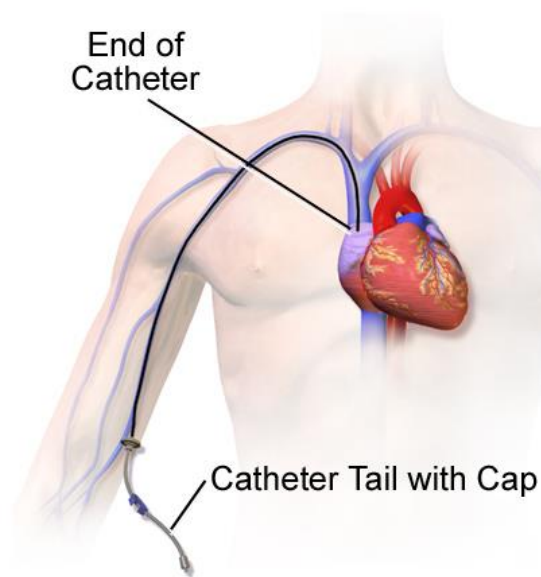


Dialysis Access Variations

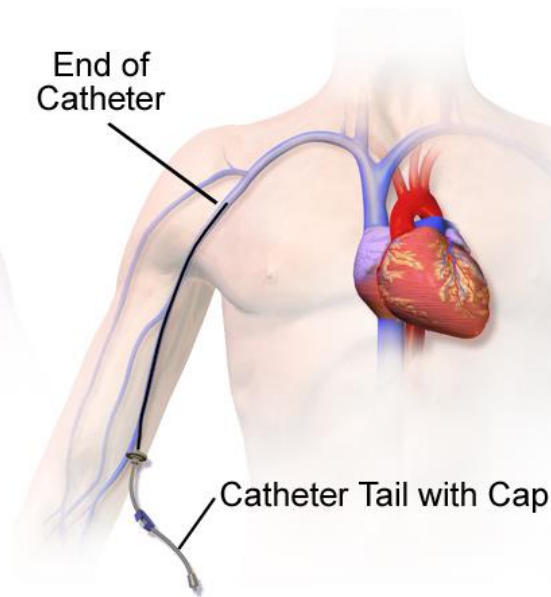




Peripheral Inserted Long Catheters



PICC Catheter

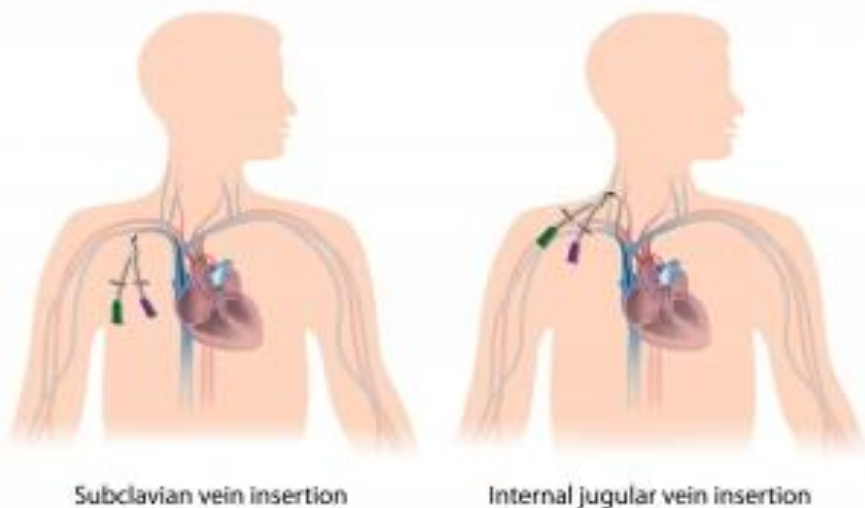


Midline Catheter

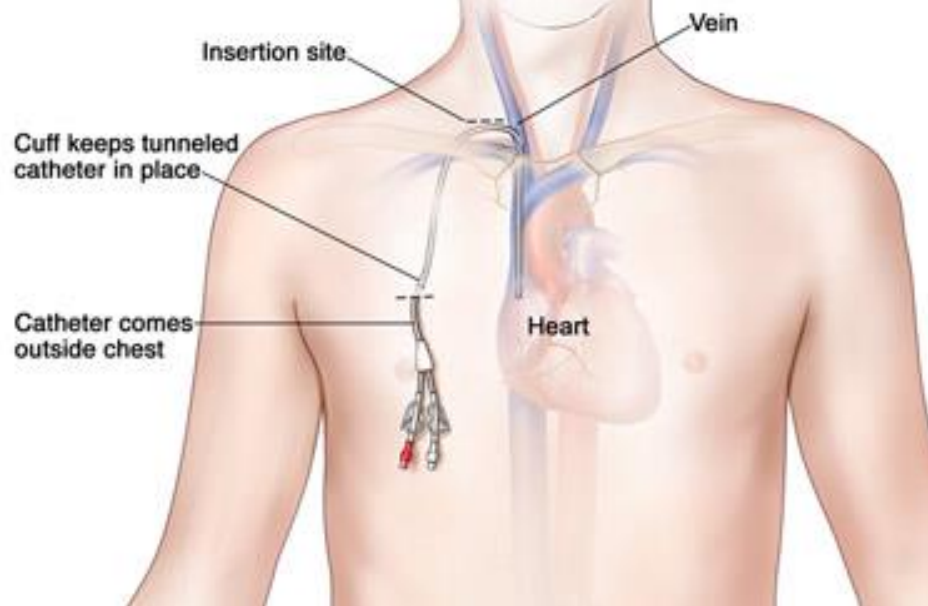


Central Catheters

Central Venous Catheter



Central Venous External Line: Hickman Catheter



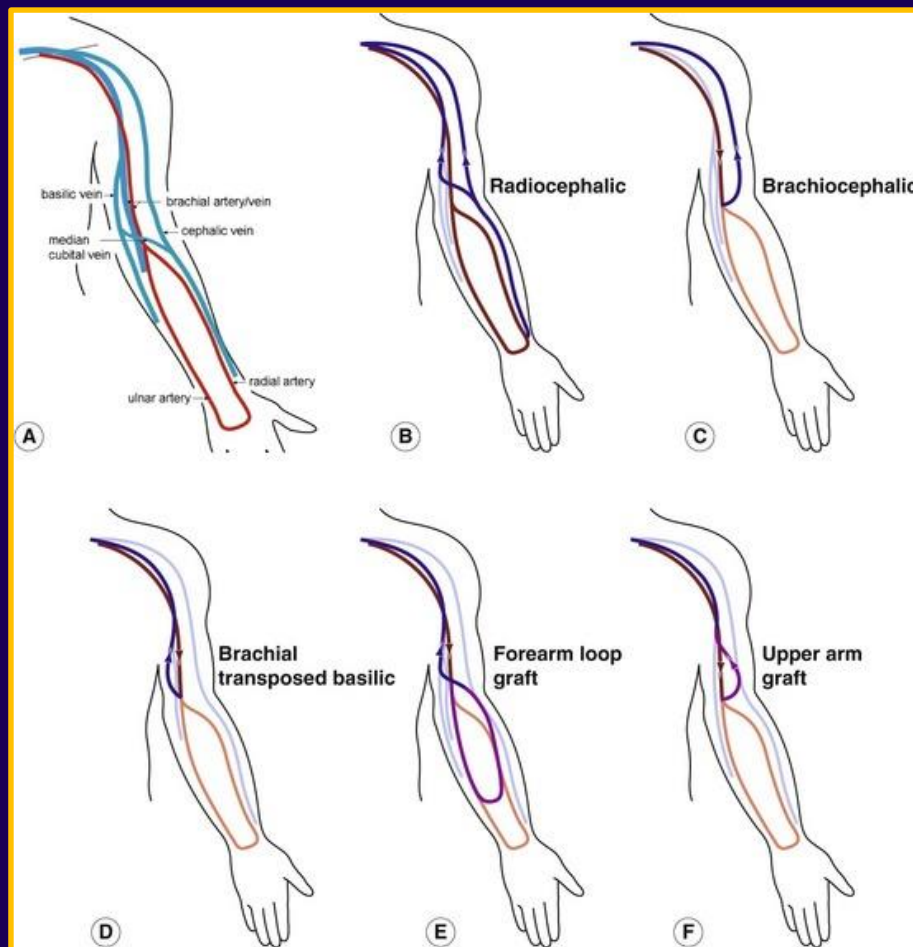
Catheter Nomenclature

- Insertion site into vein
- Tunneled vs temporary



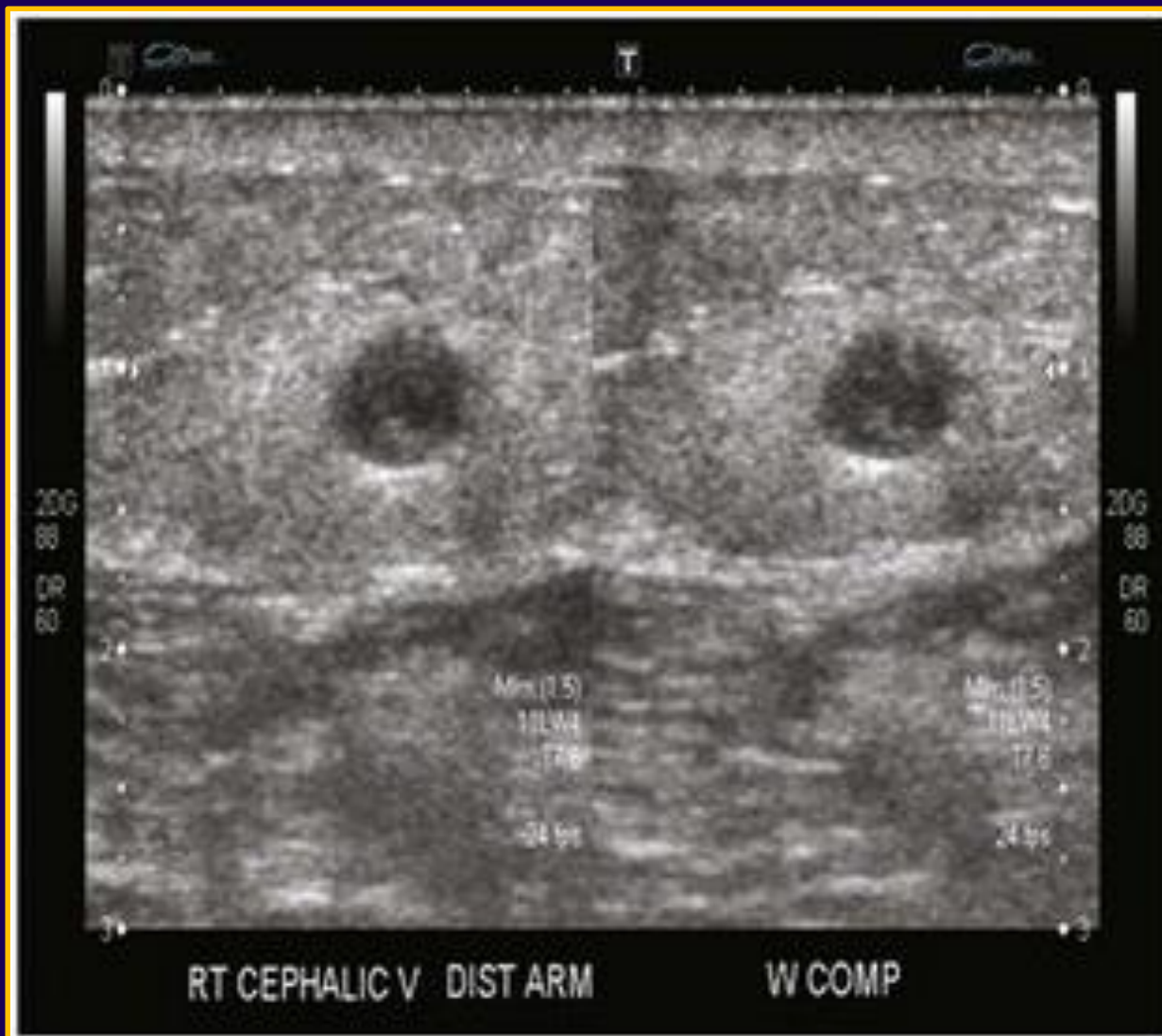
Dialysis Threatening IV's

- Median antecubital
- Cephalic vein
- Basilic vein
- Brachial vein



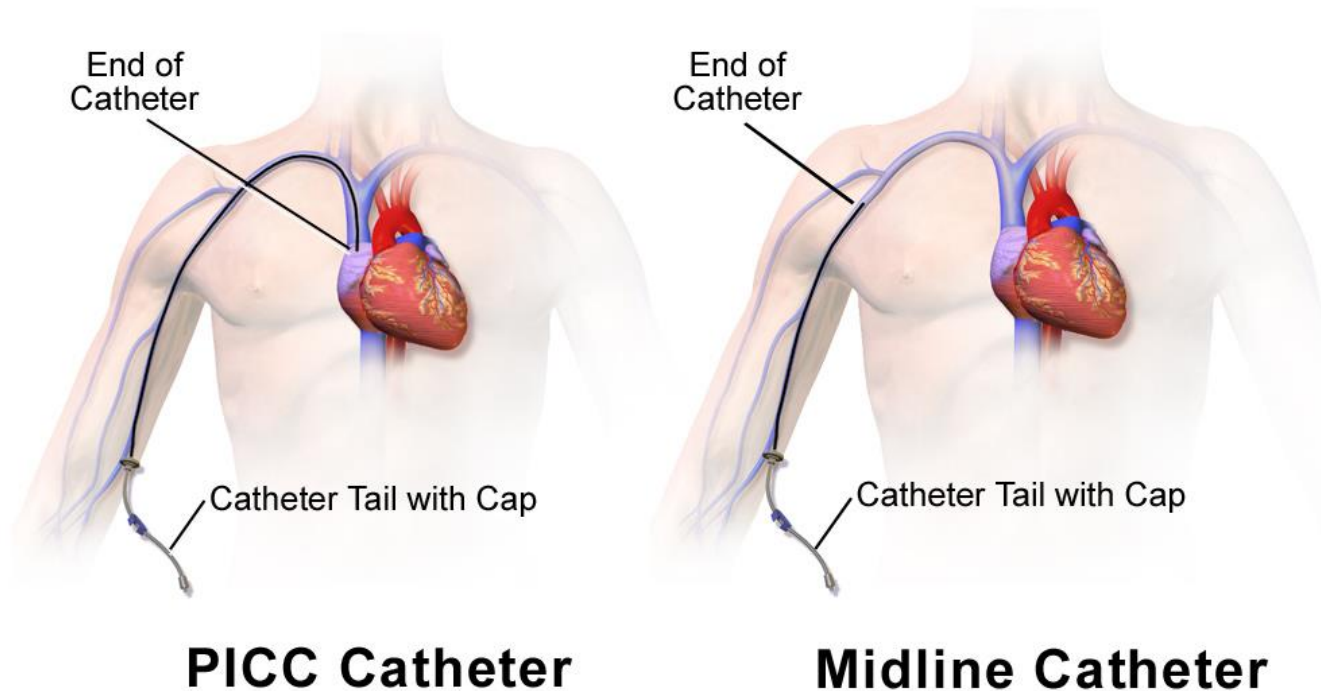


Superficial Thrombophlebitis



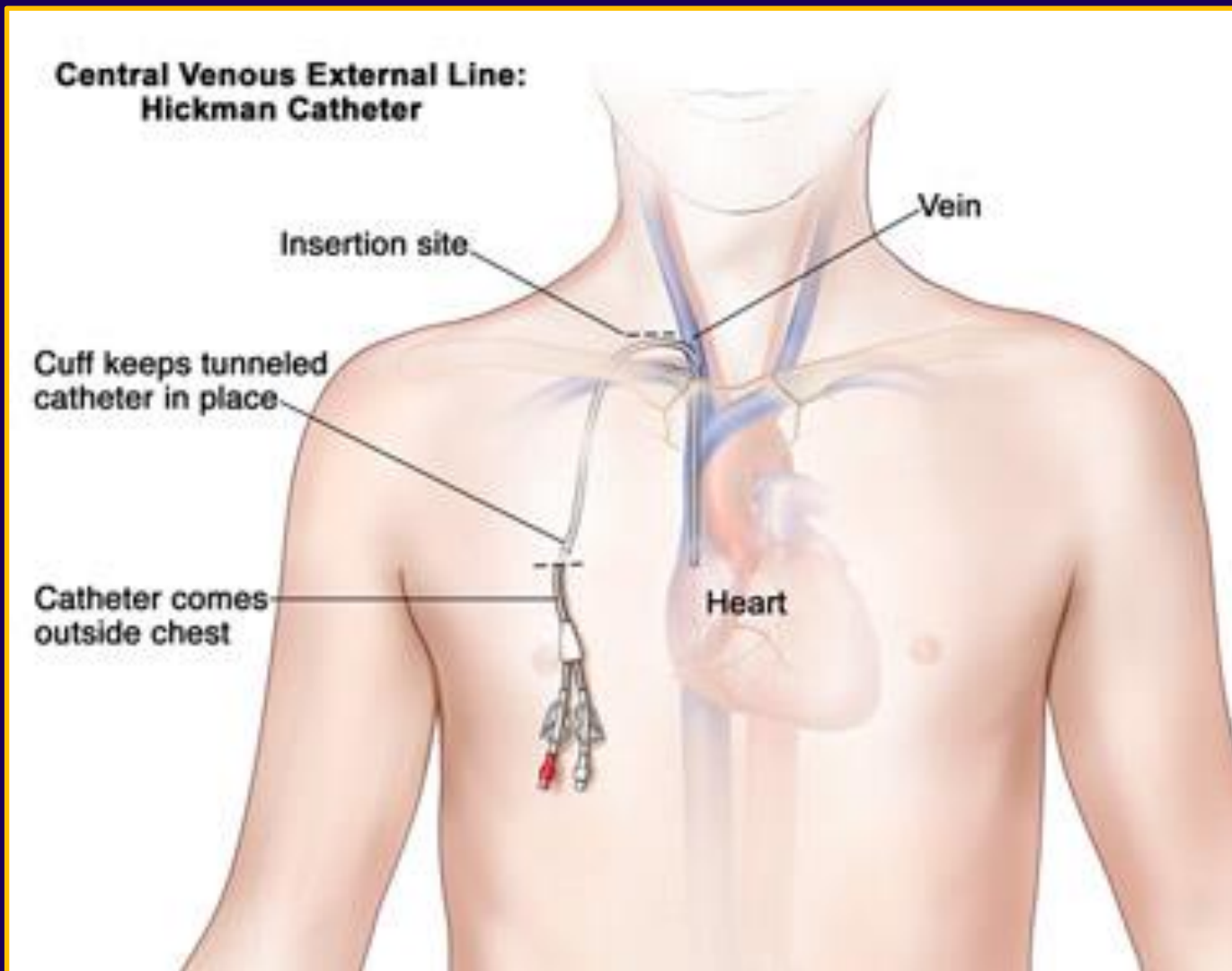


Dialysis Access Threatening Lines I





Dialysis Access Threatening Lines II





Upper Extremity DVT from Lines

- Midline—unknown (3.7% in one study)
- PICC—reported range 3-75%
- Central catheter—similar range, but likely ~50% less risk than PICC
- Factors influencing DVT
 - Size of catheter vs size of vein
 - Tip location
 - Prothrombotic state
 - Chemical phlebitis
 - Dwell time



Central Vein Stenosis





Chronic Kidney Disease

Stage	Clinical	eGFR*	~Cr range
I	Kidney disease with normal renal function	>90	<0.9
II	Mild renal dysfunction	60-89	1-1.4
III	Moderate renal dysfunction	30-59	1.5-2.5
IV	Severe renal dysfunction	15-29	2.5-4
V	End-stage renal disease	<15	>4

*May overestimate renal function (age extremes, amputees, patients with muscle wasting)



Risk Factors for CKD Progression

- Older age
- HTN
- Diabetes
- CHF
- Proteinuria
- African American race



Other Considerations for PICC/Midlines

- Line associated DVT management
- Brachial artery pseudoaneurysm
- Median nerve injury
 - Direct injury
 - Brachial sheath hematoma



And now
for something
completely different...





Arterial Imaging with CT Angiography

- Contrast bolus (4-4.5cc/sec up to 10cc/sec)
- Power injector ~300-325 Psi
- Preferentially antecubital IV of adequate size





Poiseuille's Law

$$R = \frac{8\eta L}{\pi r^4}$$

- R = Resistance to flow
- η = Viscosity
- L = Length
- r = radius



Diffusics IV



Power Injection Flow Rates

Gauge and Length	BD Catalog #	Max Flow Rate (mL/sec)	Max Injector Setting (PSI)
24 G 0.75 IN	383590	3.0	325
22 G 1.00 IN	383591	6.5	325
20 G 1.00 IN	383592	10.0	325
20 G 1.25 IN	383593	10.0	325
18 G 1.25 IN	383594	15.0	325



A Tale of Two Contrasts



76% Iopamidol

Viscosity:

9.4 cP 37° C

20.9 cP 22° C



62% Iopromide

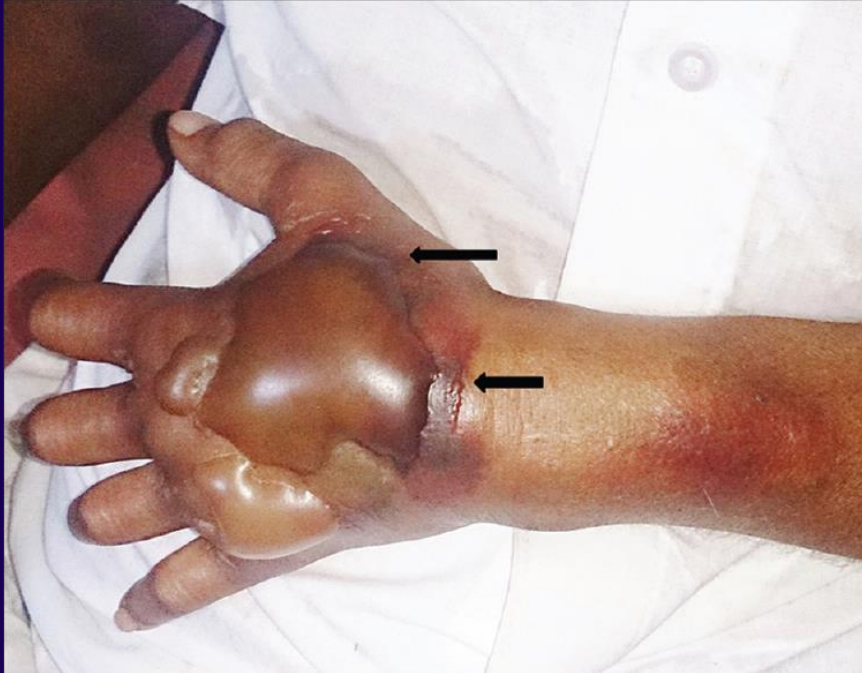
Viscosity:

4.7 cP 37° C

8.9 cP 22° C



Contrast Extravasation



Vinod *et al*, J. Pharmacol Pharmacother 2016;7:44-7



Conclusions

- IV complications → long term consequences
- CKD patients require special consideration
- Arterial imaging places special demands on IV access



Resources

- http://therenalnetwork.org/qi/resources/HospitalSystemChangeConcept_Tools/GuidelinesForPICCAvoidanceInChronicKidneyDisease-TipSheet.pdf
- http://modules.choosingwisely.org/modules/m_01/content/2_40_noPICCwoNephrology.htm