

COMPLICATIONS of Cardiac Cath & PCI

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MAJOR POST-PCI COMPLICATIONS:

- Sheath Site Bleed / pseudo aneurysm / Retroperitoneal Bleed (femoral sites)
- MI (dissection / stent thrombus / stent strut occlusion of side-branch vessel)
- Dysrhythmias
- Pericardial Tamponade (vessel perforation)
- Thrombocytopenia (heparin and IIb/IIIa inhibitor induced)
- CVA
- Infection
- Contrast Induced Renal Failure

CHRONOLOGICAL CONSIDERATIONS

- **Procedural -- in Lab, during procedure**
 - Vascular (dissection, stent strut occlusion)
 - Dysrhythmia / Cardiac Arrest (catheter induced, reperfusion, contrast induced)
 - *And more . . .*
- **Post-procedural** – may have been induced in the Lab, but symptoms are most likely to present later, during patient's RECOVERY phase.
 - Sheath site complications
 - Stent thrombosis
 - Contrast Induced Renal Failure
 - Pericardial Tamponade
 - *And more . . .*

Risk Factors for Complications:

- Advanced Age
- ACS
- Decreased EF
- Renal Insufficiency
- Diabetes
- Multi-vessel disease
- Peripheral Vascular Disease



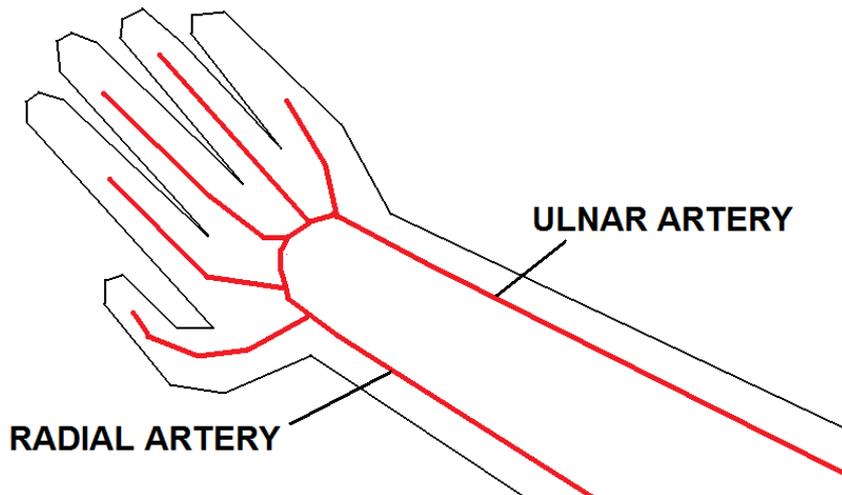
SIMPLY STATED, THE WORSE THE PATIENT'S UNDERLYING HEALTH, THE MORE LIKELY THERE WILL BE COMPLICATIONS !!

SHEATH SITE COMPLICATIONS:

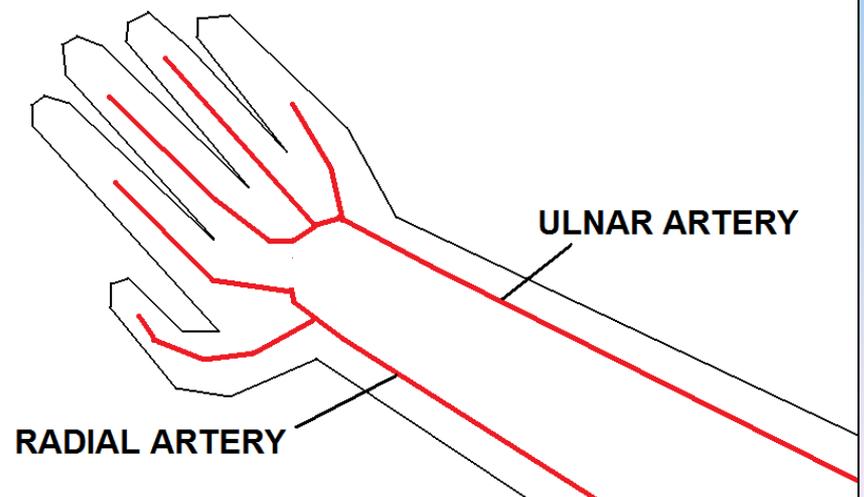
FEMORAL vs. RADIAL

- **FEMORAL ARTERY** *site most common for vascular complications.* Harder to achieve hemostasis. Large volumes can be lost without obvious signs (Retroperitoneal bleed).
- **RADIAL ARTERY** – minimal complications, but can be very serious. Positive ALLEN'S TEST before procedure assures very low complication rate.

NORMAL CIRCULATION TO HAND



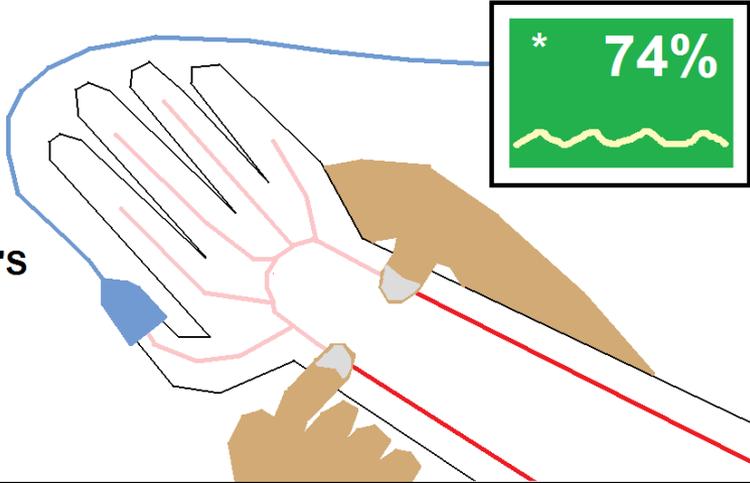
ABNORMAL CIRCULATION TO HAND



ALLEN'S TEST

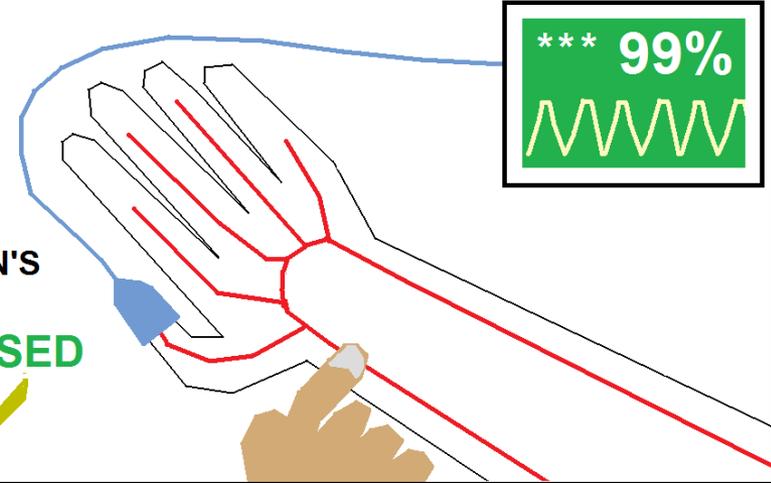
NORMAL CIRCULATION TO HAND

ALLEN'S TEST



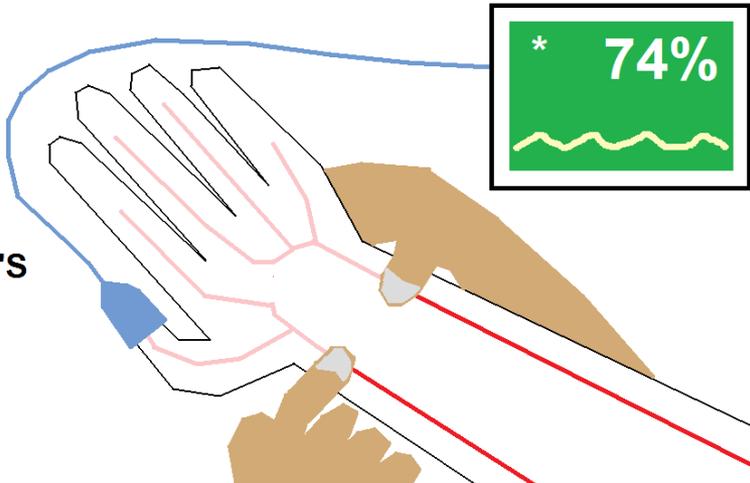
NORMAL CIRCULATION TO HAND

ALLEN'S TEST
PASSED



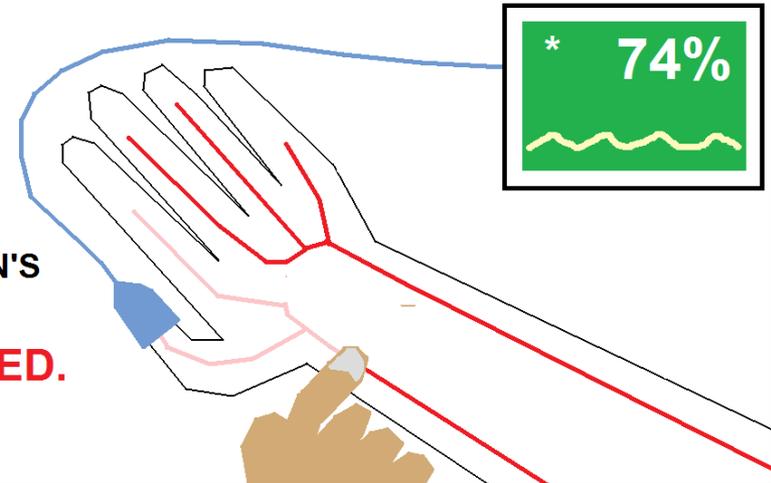
ABNORMAL CIRCULATION TO HAND

ALLEN'S TEST



ABNORMAL CIRCULATION TO HAND

ALLEN'S TEST
FAILED.



SHEATH SITE MANAGEMENT:

RADIAL (or brachial):

- **MONITOR SAO₂, with the SAO₂ PROBE on the patient's THUMB of the hand used for CARDIAC CATHETERIZATION. You can also assess CAPILLARY REFILL, compare to other hand.**
 - **IF TR BAND in place, FOLLOW PHYSICIAN'S ORDER for deflation and removal.**
 - **FOLLOW PROTOCOL for monitoring of sheath site.**
 - **ANY INTERNAL or EXTERNAL BLEEDING WILL BE OBVIOUS**
 - **APPLY DIRECT PRESSURE to HEMATOMA / BLEEDING SITE (if TR band is off, put it back on – inflate with air until bleeding stops).**
- ELEVATE** wrist above heart level.

SHEATH SITE COMPLICATIONS:

WORST REPORTED COMPLICATIONS

RADIAL: LOSS OF HAND

FEMORAL:

RETROPERITONEAL BLEED - **DEATH**

DISSECTION OF FEMORAL ARTERY WITH LOSS OF
BLOOD FLOW: **AMPUTATION OF LEG**

SHEATH SITE COMPLICATIONS:

NORMAL:

- ECCHYMOSIS, MILD PAIN, and MILD SWELLING are COMMON after Cardiac Catheterization
- These symptoms should gradually IMPROVE.
- THERE SHOULD BE *NO WORSENING* of the ECCHYMOSIS, PAIN or SWELLING.

SHEATH SITE COMPLICATIONS:

ABNORMAL:

- PALPABLE HEMATOMA at or NEAR SHEATH SITE.
- SWELLING / HEMATOMA THAT IS **WORSENING**.
- PAIN LEVEL THAT IS **WORSENING**.
- DISCOLORATION of EXTREMITY (pale, ashen, cyanotic, mottling: compare to opposite extremity !)
- DECREASE in DISTAL PULSE QUALITY
- DECREASE in TEMPERATURE of EXTREMITY (compare to opposite extremity !)
- BE SUSPICIOUS of any CHANGES IN SENSATION reported by the patient.

Radial site BLEEDING and/or HEMATOMA:

- **APPLY DIRECT PRESSURE to HEMATOMA / BLEEDING SITE**
- **(if TR band is off, put it back on – inflate with air until bleeding stops).**
- ***ELEVATE* wrist above heart level.**

Radial site BLEEDING and/or HEMATOMA:

- **APPLY DIRECT PRESSURE to HEMATOMA / BLEEDING SITE**
- **(if TR band is off, put it back on – inflate with air until bleeding stops).**
- ***ELEVATE* wrist above heart level.**

IF THE ABOVE INTERACTIONS FAIL TO RESOLVE BLEEDING and/or HEMATOMA IS GROWING:

- ***CALL RAPID RESPONSE TEAM***
- ***NOTIFY PHYSICIAN STAT***

DURING FEMORAL SHEATH REMOVAL:

- When pressure is being applied to control femoral bleeding, we sometimes see

VAGAL RESPONSES:

- Bradycardia
 - Patient suddenly becomes pale, clammy and diaphoretic
 - Hypotension.
-
- ***IV FLUIDS***
 - ***ATROPINE for bradycardia (follow ACLS)***
 - ***Reassure Patient!***

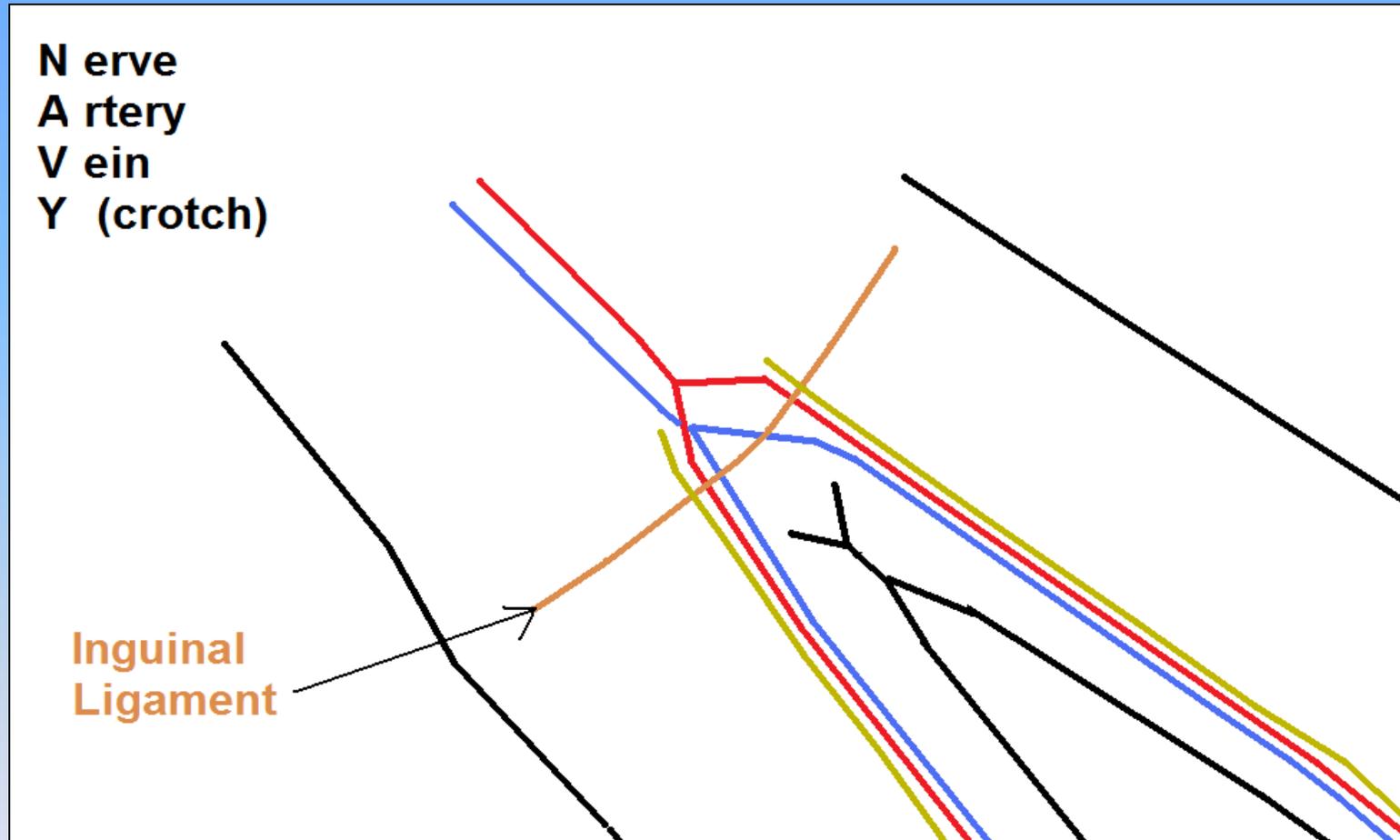
SHEATH SITE COMPLICATIONS:

FEMORAL ACCESS SITE COMPLICATIONS

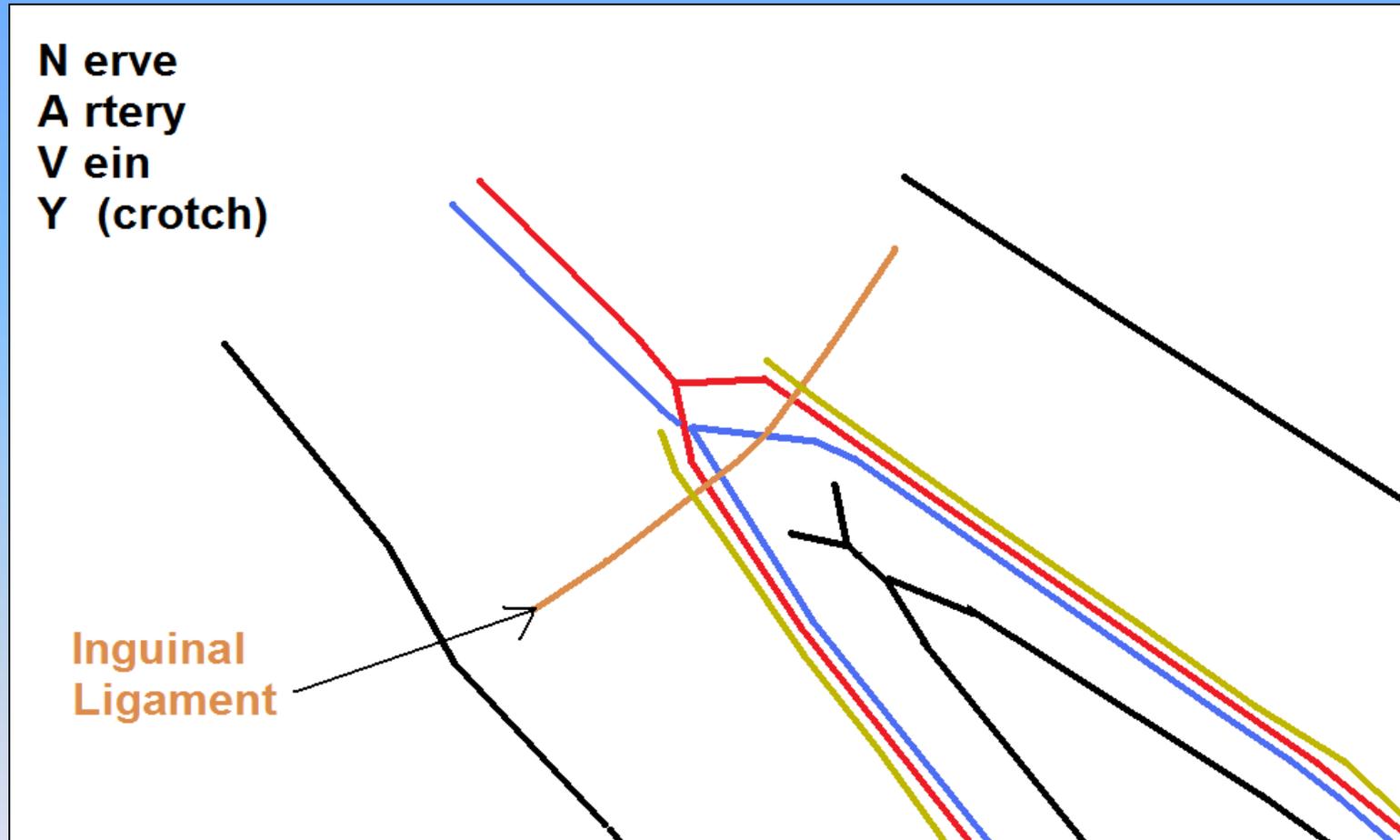
INCIDENCE: 6 – 20%

- **EXTERNAL BLEEDING (usually pulsatile)**
- **HEMATOMA (often expands rapidly)**
- **A-V FISTULA (looks like hemtoma – confirm w/ ultrasound)**
- **DISSECTION (internal lumen – may result in loss of blood flow to leg - DIRE EMERGENCY).**
- **PSEUDO-ANEURYSM (treated with compression)**
- **RETROPERITONEAL BLEED (elevated risk when access site is above Inguinal Ligament)**
- **INFECTION (Tx: Antibiotics, worse cases: I&D)**

SHEATH SITE COMPLICATIONS:

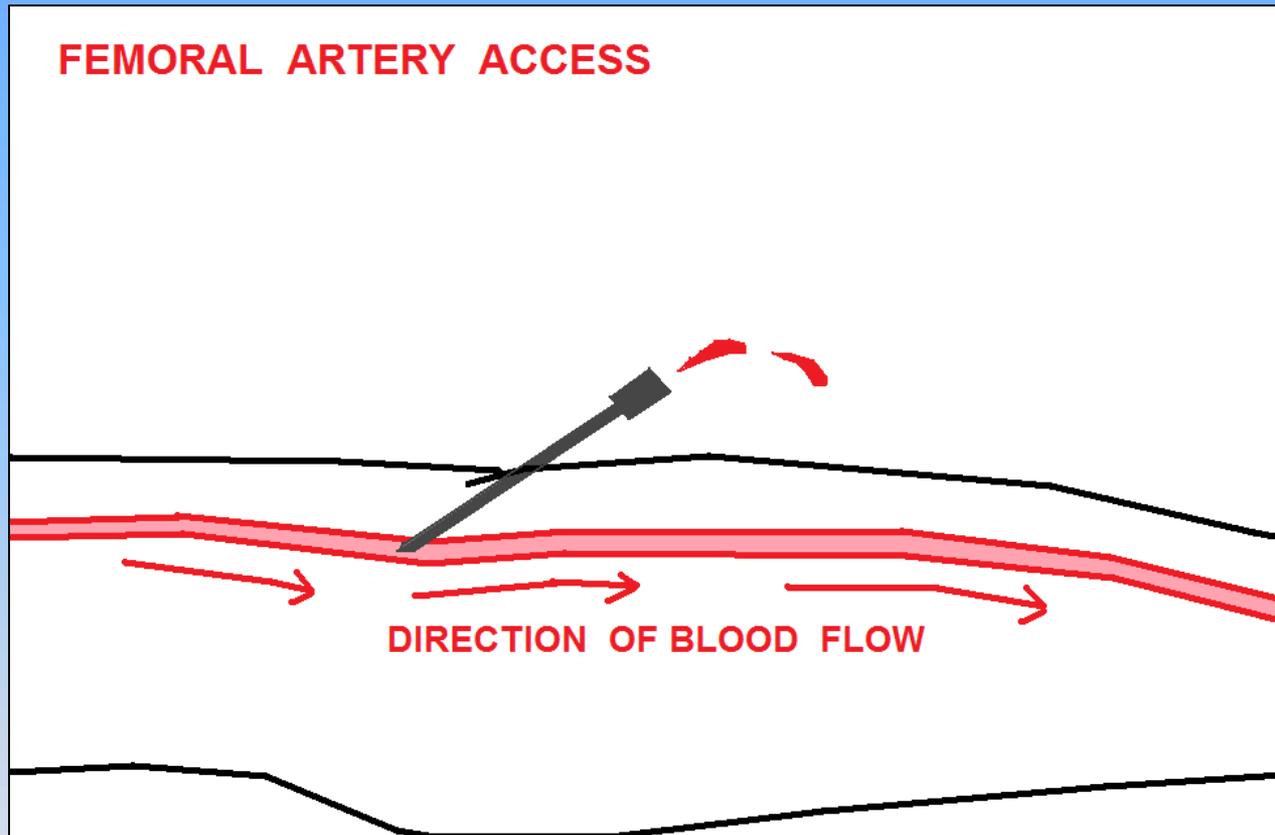


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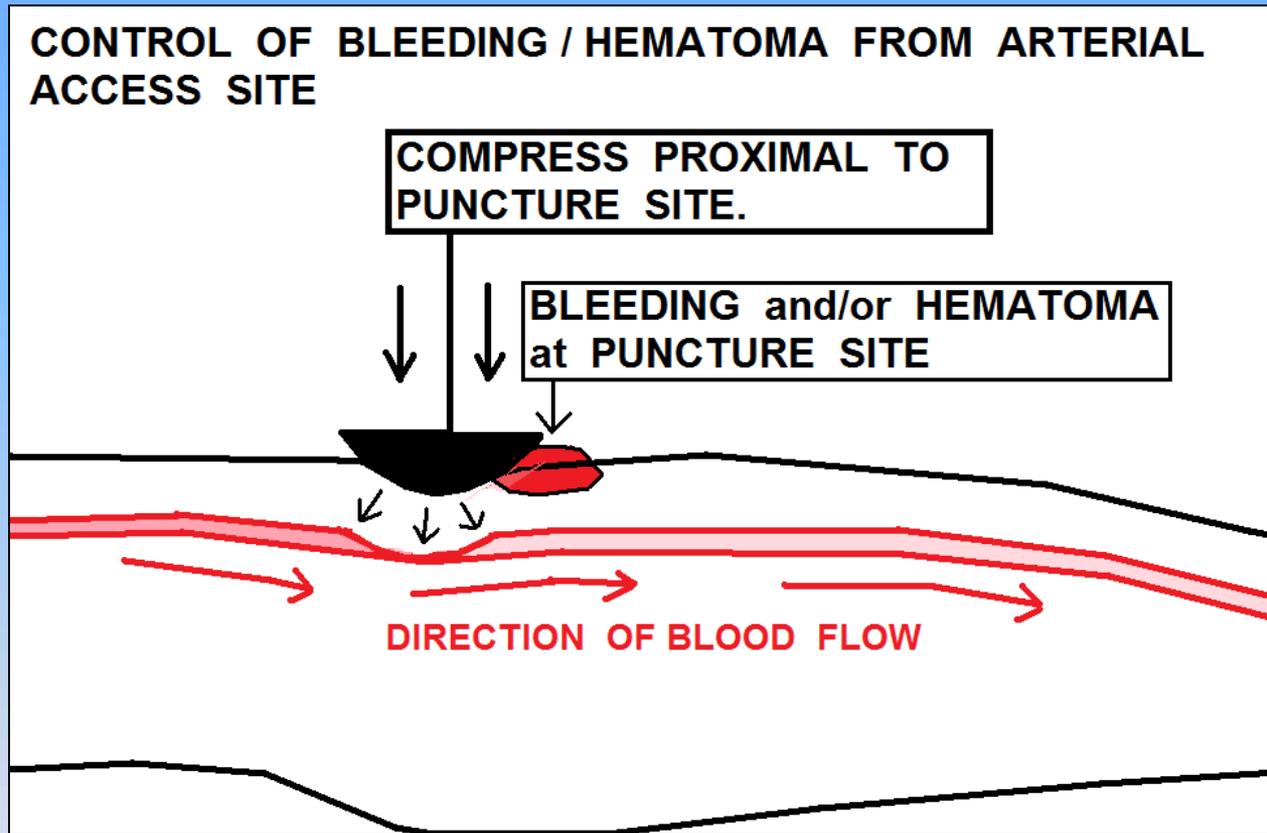


Sheath enter FEMORAL ARTERY ABOVE Inguinal Ligament = HIGHER INCIDENCE of RETROPERITONEAL BLEED.

SHEATH SITE COMPLICATIONS:

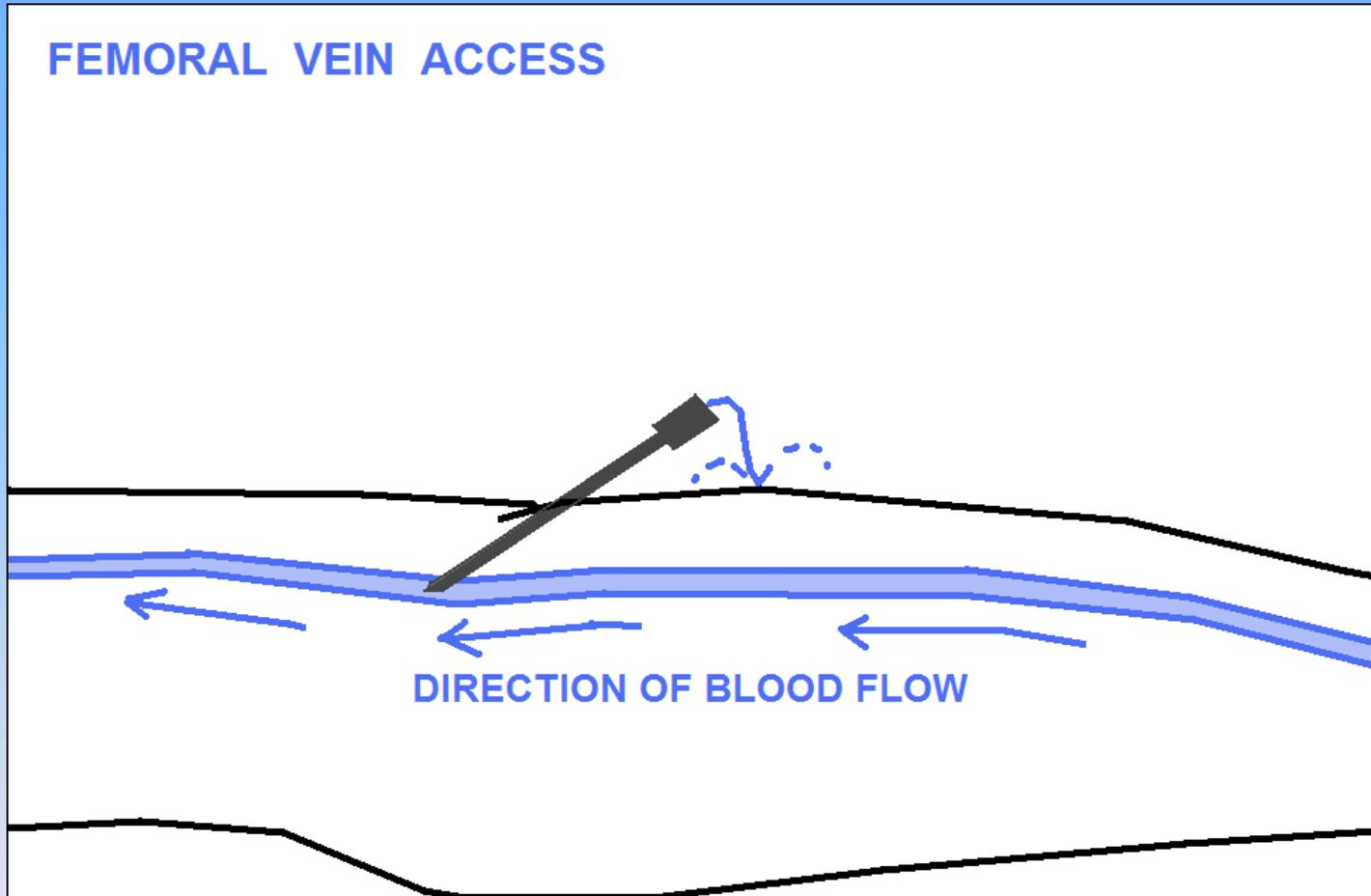


SHEATH SITE COMPLICATIONS:

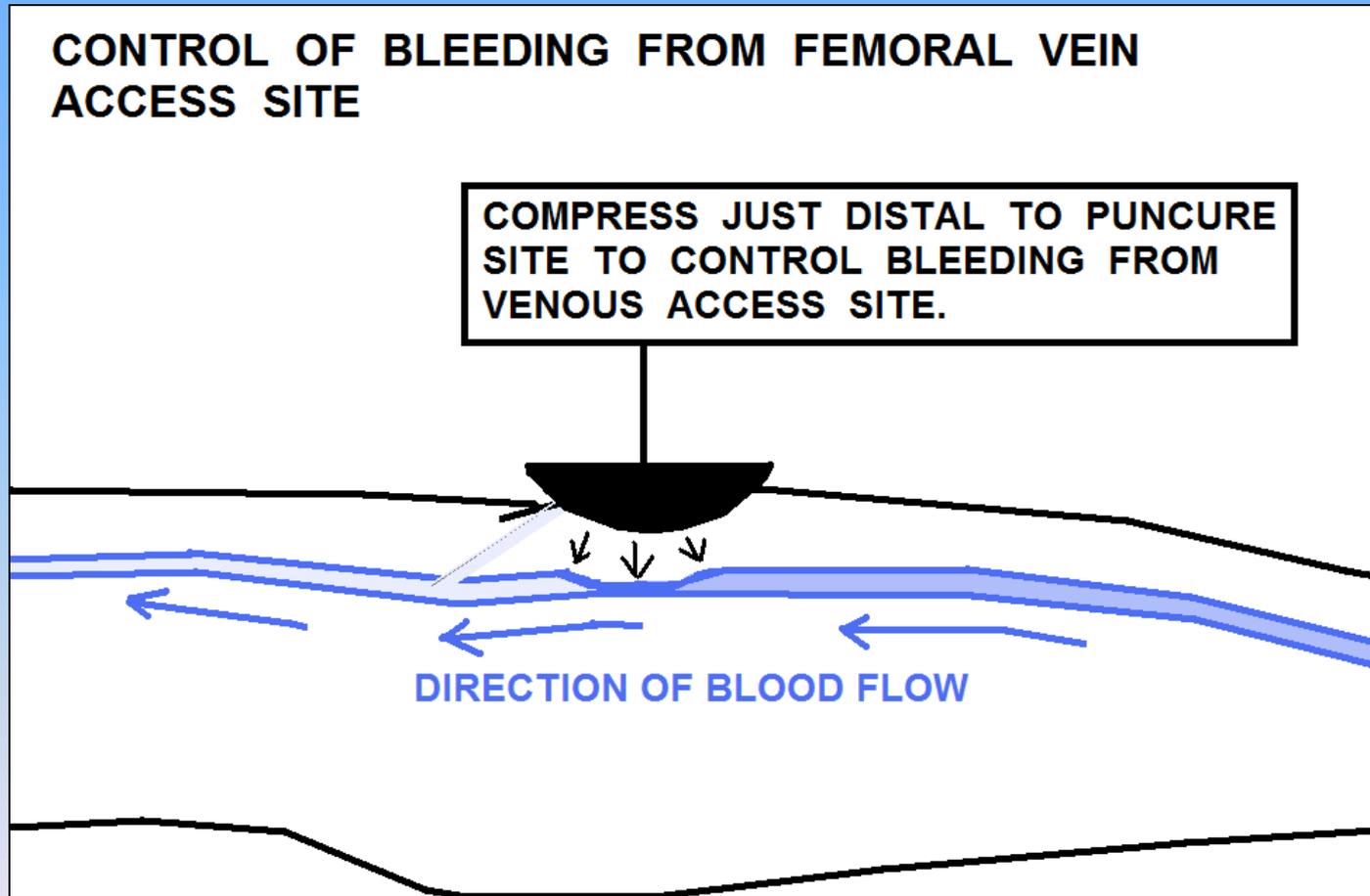


COMPRESSION IS TREATMENT FOR: HEMATOMA, A-V FISTULA, PSEUDOANEURYSM

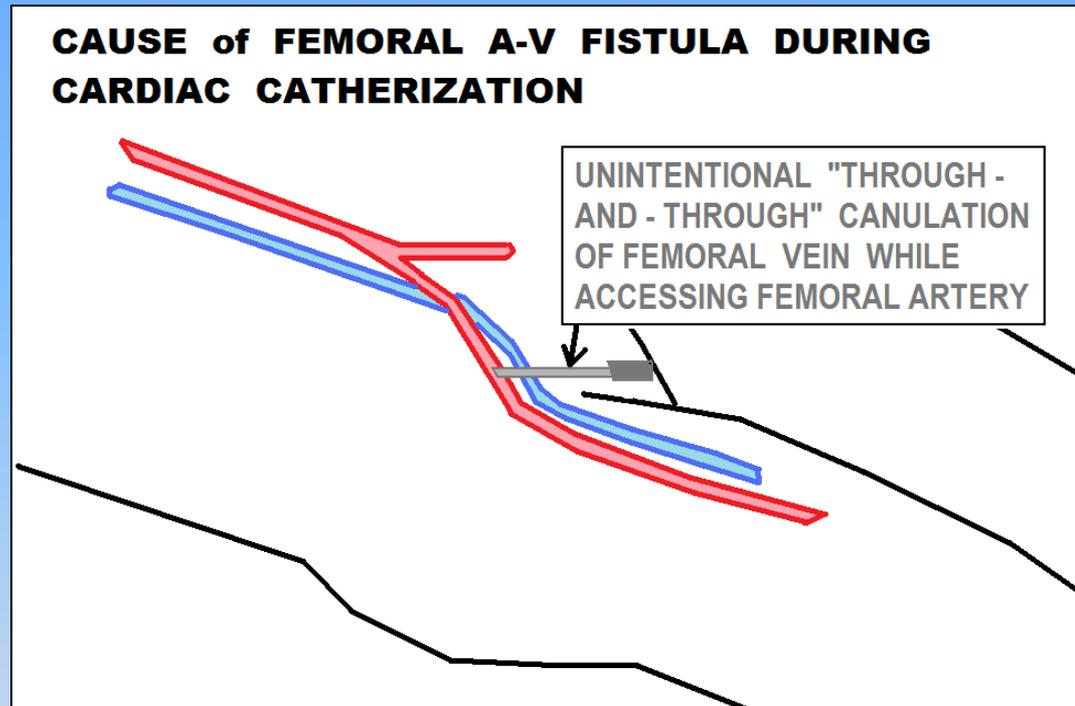
SHEATH SITE COMPLICATIONS:



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SHEATH SITE COMPLICATIONS:



- FISTULA FORMATION - APPEARS LIKE "NORMAL" HEMATOMA, PATIENT OFTEN COMPLAINS OF INCREASING PAIN.
- MAY AUSCULTATE BRUIT
- CONFIRMED BY ULTRASOUND
- TREATED WITH COMPRESSION (SAME AS HEMATOMA)

SHEATH SITE COMPLICATIONS:

INFECTION MAY OCCUR IN LATER RECOVERY, EVEN AFTER HOSPITAL DISCHARGE.

PAIN & SWELLING PRESENT. FEVER MAY BE PRESENT.

INCREASED INCIDENCE OF INFECTION WHEN VASCULAR CLOSURE DEVICES USED.

MAY REQUIRE ANTIBIOTIC THERAPY, WORSE CASES REQUIRE SURGICAL / INFECTIOUS DISEASE INTERVENTION.

SHEATH SITE COMPLICATIONS:

- **DILIGENTLY FOLLOW PHYSICIAN ORDERS and HOSPITAL PROTOCOL for POST CARDIAC CATH SHEATH SITE CARE.**
- **POST PCI PATIENTS ARE AT INCREASED BLEEDING RISK DUE TO USE OF ANTIPLATELET / ANTICOAGULATION MEDS**
- **ANY LOSS OF PULSES IS AN EMERGENCY – PHYSICIAN MUST BE NOTIFIED IMMEDIATELY. THE PATIENT IS AT EXTREME RISK FOR LOSS OF THE EXTREMITY.**
- **IF IN DOUBT, GET ANOTHER OPINION – e.g. CHARGE NURSE**
- **CALL RAPID RESPONSE TEAM FOR ANY SIGNS OF SHOCK and/or UNCONTROLLABLE BLEEDING.**

RETROPERITONEAL BLEED:

POST DIAGNOSTIC CARDIAC CATH or PCI:

- SUSPECTED WHEN SIGNS OF SHOCK DEVELOP AND THERE ARE NO OTHER OBVIOUS CAUSES OF SHOCK.
- PATIENT HAS HAD FEMORAL ARTERY (or VEIN) ACCESS
- PUNCTURE SITE OFTEN ABOVE INGUINAL LIGAMENT
- PATIENT MAY or MAY NOT HAVE PAIN IN LEG, FLANK AREA and/or LOWER BACK.

MYOCARDIAL INFARCTON:

DURING IN-HOSPITAL RECOVERY:

- STENT THROMBOSIS
- STENT DISSECTION
- STENT STRUT OCCLUSION OF SIDE-BRANCH VESSEL

AFTER HOSPITAL DISCHARGE:

- DISCONTINUANCE OF PLAVIX and ASA in patients with DRUG ELUTING STENTS --- CAN HAPPEN WITHIN FIRST YEAR post STENT PLACEMENT, POSSIBLY GREATER THAN ONE YEAR !

MYOCARDIAL INFARCTON:

- **IN CASES OF STENT STRUT OCCLUSION OF A SIDE-BRANCH VESSEL, THE PHYSICIAN IS USUALLY AWARE OF THIS FROM THE MOMENT IT OCCURS IN THE CATH LAB.**
- **THIS UNFORTUNATE AND OFTEN UNAVOIDABLE PROBLEM IS A KNOWN POTENTIAL COMPLICATION OF PCI.**
- **IT OCCURS WHEN THE STENT OCCLUDES THE OPENING OF A SMALLER SIDE-BRANCH ARTERY.**

MYOCARDIAL INFARCTON:

STENT STRUT OCCLUSION OF A SIDE-BRANCH VESSEL IS A TRUE MYOCARDIAL INFARCTION.

THE PATIENT WILL COMPLAIN OF CHEST PAIN, WILL HAVE ECG CHANGES CONSISTENT WITH AMI, ELEVATED CARDIAC MARKERS, and IS SUSCEPTIBLE TO ALL COMPLICATIONS OF AMI, SUCH AS

- SUDDEN CARDIAC ARREST**
- LETHAL DYSRHYTHMIAS**

THE PHYSICIAN SHOULD MAKE THE PATIENT – AND STAFF – AWARE THAT THIS IS OCCURRING.

THE PATIENT SHOULD REMAIN IN CCU/ICU UNTIL THE MI IS RESOLVED.

MYOCARDIAL INFARCTON:

UP TO 50% OF POST-PCI PATIENTS REPORT CHEST PAIN.
“NORMAL” POST PCI CHEST PAIN IS DUE TO “BENIGN STENT SENSATION.”

NORMAL POST PCI CHEST PAIN:

- IS MILD – MODERATE IN INTENSITY
- DOES NOT INCREASE IN INTENSITY
- 12 LEAD ECG IS NORMAL

MYOCARDIAL INFARCTON:

UP TO 50% OF POST-PCI PATIENTS REPORT CHEST PAIN.
“NORMAL” POST PCI CHEST PAIN IS DUE TO “BENIGN STENT SENSATION.”

ABNORMAL POST PCI CHEST PAIN:

- SEVERE CHEST PAIN
- CHEST PAIN that is INCREASING
- 12 LEAD ECG SHOW SIGNS OF ISCHEMIA / INFARCTION



TYPICAL SYPTOMS of **ACUTE CORNARY SYNDROME:**

- ✓ **CHEST PAIN - DESCRIBED AS . . .**
 - "HEAVINESS, PRESSURE, DULL PAIN, TIGHTNESS"
 - CENTERED IN CHEST, SUBSTERNAL
 - MAY RADIATE TO SHOULDERS, JAW, NECK, LEFT or RIGHT ARM
 - NOT EFFECTED by:
 - MOVEMENT
 - POSITION
 - DEEP INSPIRATION

- ✓ **SHORTNESS OF BREATH**
 - MAY or MAY NOT BE PRESENT

- ✓ **NAUSEA / VOMITING**
 - MAY or MAY NOT BE PRESENT

Common atypical complaints associated with AMI without chest pain include:

Malaise (weakness)

Fatigue

Indigestion

Abdominal pain

Nausea

Cold sweats

Dizziness

Elevated heart rate

Syncope

Dyspnea

MYOCARDIAL INFARCTON:

IF THERE IS ANY REASON TO SUSPECTED AMI IS OCCURING:

- OBTAIN STAT 12 LEAD ECG
- CONTACT CARDIOLOGIST
- OBTAIN STAT CARDIAC MARKER PROFILE

MYOCARDIAL INFARCTON:

As a GENERAL RULE, it is good practice to MONITOR AT LEAST ONE ECG LEAD which views the REGION OF THE HEART SUPPLIED BY THE VESSEL THAT WAS STENTED:

ARTERY STENTED:

LEFT ANTERIOR DESCENDING (LAD) ARTERY
-Includes DIAGONAL BRANCHES

CIRCUMFLEX (Cx) ARTERY
-Includes OBTUSE MARGINAL (OM) Arteries

RIGHT CORONARY ARTERY (RCA)

MONITOR ECG LEAD(S):

V1, V2, V3 or V4

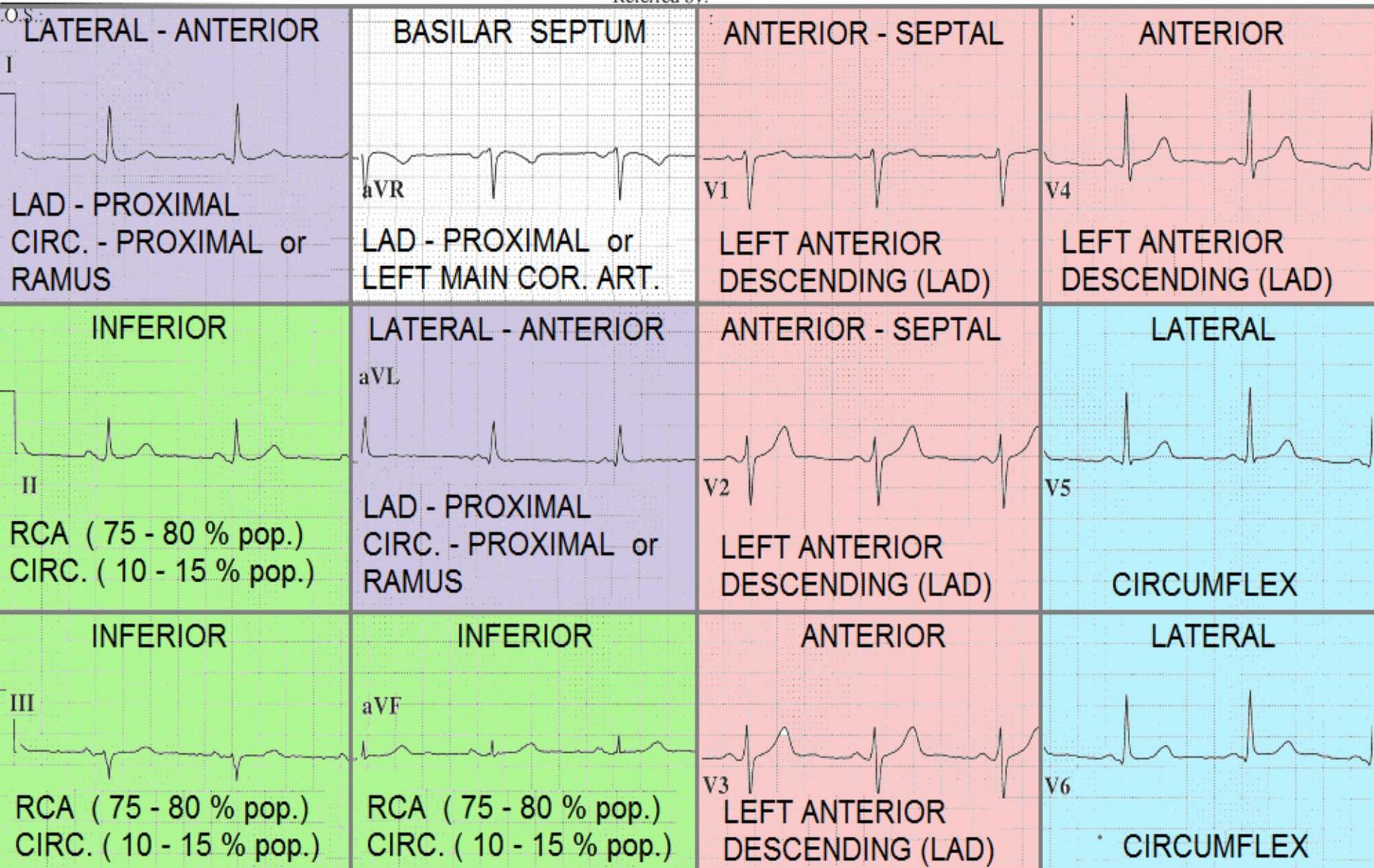
V5 or V6

II, III, or AVF

 IF PATIENT WAS A STEMI, MONITOR THE ECG LEAD THAT SHOWED THE MOST AMOUNT OF ST SEGMENT ELEVATION PRIOR TO THE CARDIAC CATHETERIZATION.

Vent. rate	64	BPM	Normal sinus rhythm
PR interval	130	ms	Normal ECG
QRS duration	96	ms	No previous ECGs available
QT/QTc	396/408	ms	
P-R-T axes	40 11 61		

Referred by:



MYOCARDIAL INFARCTON:

- ➡ **A PRE-CARDIAC CATH 12 LEAD ECG SHOULD ALWAYS BE OBTAINED.**
- ➡ **A POST CARDIAC CATH 12 LEAD ECG SHOULD ALWAYS BE OBTAINED.**
- ➡ **ADDITIONAL 12 LEAD ECG(S) SHOULD BE OBTAINED WHENEVER THE PATIENT COMPLAINS OF:**
 - ANY INCREASE of CHEST PAIN / PRESSURE / TIGHTNESS / HEAVINESS
 - INCREASE in SHORTNESS OF BREATH
 - PRESENCE of ANY TYPICAL or ATYPICAL SYMPTOMS of ACS

MYOCARDIAL INFARCTON:



COMPARE THE ECG TAKEN DURING CHEST PAIN TO THE PRE-CARDIAC CATH 12 LEAD ECG.

IN EACH LEAD, COMPARE THE:

- **J POINTS**
- **ST SEGMENTS**
- **T WAVES**

IF THERE ARE MORE ECGs THAT HAVE BEEN TAKEN BETWEEN THE PRE-CATH ECG and the ECG TAKEN WITH CHEST PAIN, REVIEW THEM FOR SERIAL CHANGES.

NORMAL ST - T WAVES

- WHEN QRS WIDTH IS NORMAL (< 120 ms)



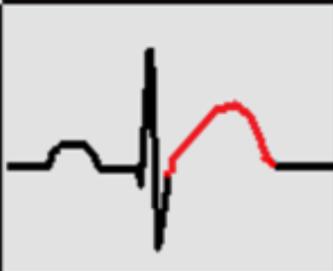
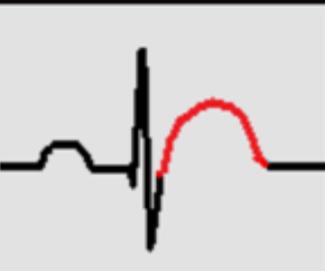
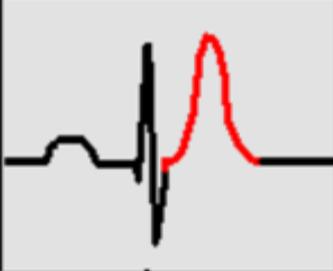
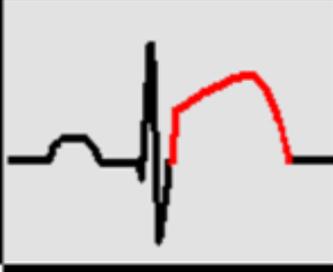
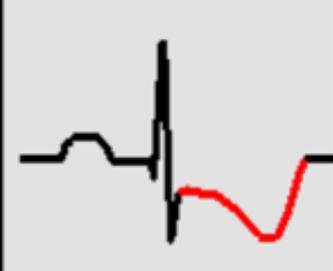
ASSESS:

- J POINT: ISOELECTRIC (or < 1 mm dev.)
- ST SEG: SLIGHT, POSITIVE INCLINATION
- T WAVE: UPRIGHT, POSITIVE

 **in EVERY LEAD EXCEPT aVR !!**

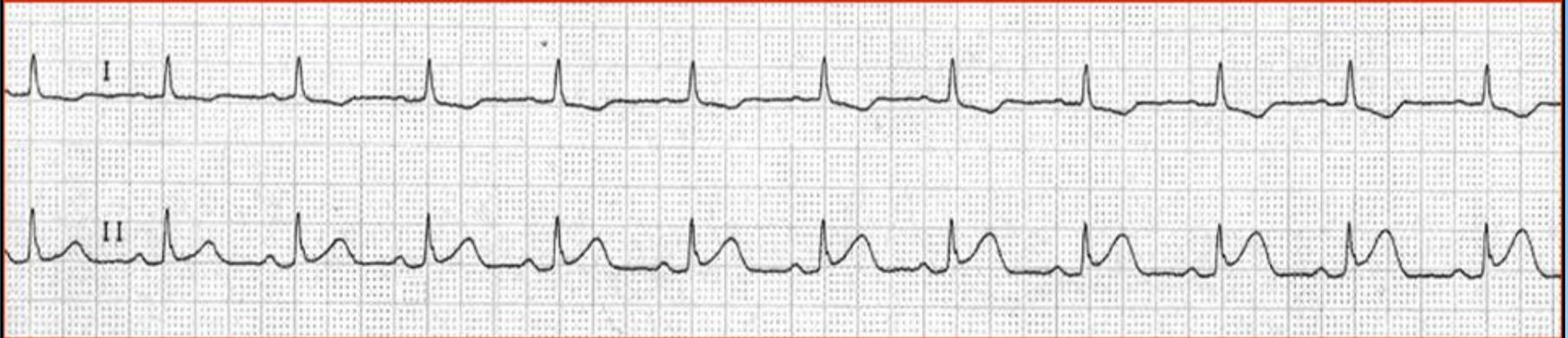
PATTERNS of ACS & ISCHEMIA

-- J POINT, ST SEGMENT, and T WAVE ABNORMALITIES --

! FLAT or CONVEX J-T APEX SEGMENT			<i>ACUTE MI</i> <i>EARLY PHASE</i>
! HYPER-ACUTE T WAVE		<i>ACUTE MI</i> <i>EARLY PHASE</i>	
! S-T SEGMENT ELEVATION at J POINT		<i>ACUTE MI</i>	
! DEPRESSED J pt. DOWNSLOPING ST and INVERTED T		- ACUTE (NON-Q WAVE) MI - ACUTE MI - (RECIPROCAL CHANGES) - ISCHEMIA	

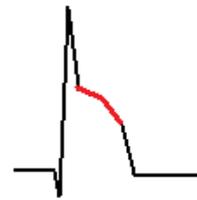
ST SEGMENT ELEVATION:

S-T SEGMENTS ELEVATE WITHIN SECONDS OF CORONARY ARTERY OCCLUSION:



IN THIS CASE, a normal response to balloon occlusion of the RIGHT CORONARY ARTERY during PTCA in the CARDIAC CATH LAB

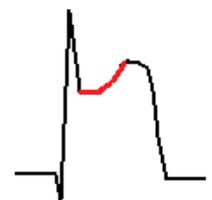
**3 COMMON PATTERNS of
ST SEGMENT ELEVATION
From ACUTE MI:**



**DOWNSLOPING
S-T SEGMENT**



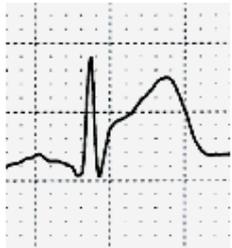
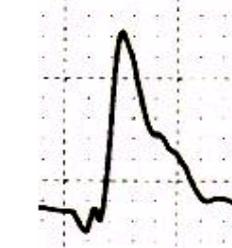
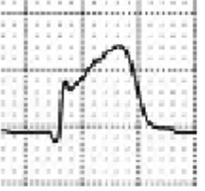
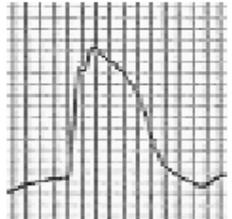
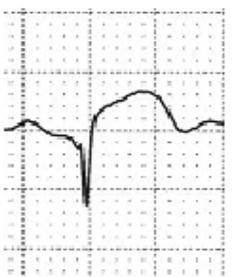
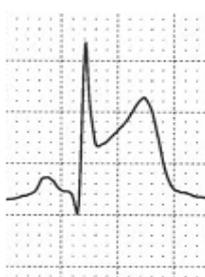
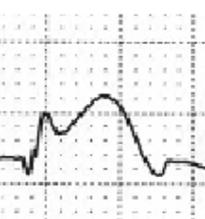
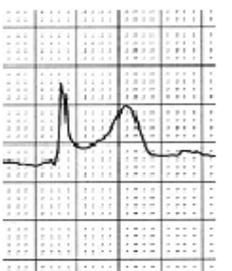
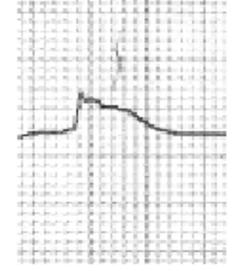
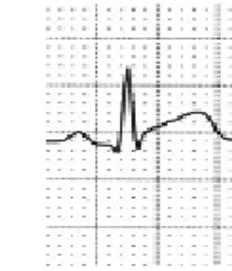
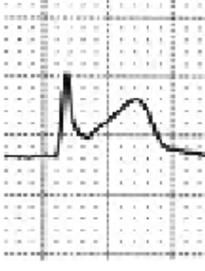
**FLAT
S-T SEGMENT**



**UPSLOPING
S-T SEGMENT**

ST SEGMENT ELEVATION in ACUTE MI:

The following samples are from patients with ACUTE MI, as confirmed by discovery of total arterial occlusion in the Cardiac Cath Lab:

 <p>V5 - ANTERIOR LATERAL MI</p>	 <p>V4 - ANTERIOR LATERAL MI</p>	 <p>aVL - ANTERIOR LATERAL MI</p>	"TOOMBSTONE" PATTERN  <p>V2 - ANTERIOR LATERAL MI</p>	"FIREMAN'S HAT" PATTERN  <p>V3 - ANTERIOR LATERAL MI</p>
"TOOMBSTONE" PATTERN  <p>V4 - ANTERIOR LATERAL MI</p>	 <p>V5 - ANTERIOR LATERAL MI</p>	 <p>V5 - ANTERIOR LATERAL MI</p>	 <p>II - INFERIOR POSTERIOR MI</p>	"FIREMAN'S HAT" PATTERN  <p>aVF - INFERIOR POSTERIOR MI</p>
 <p>III - INFERIOR MI</p>	 <p>III - INFERIOR POSTERIOR MI</p>	 <p>III - INFERIOR MI</p>	 <p>III - INFERIOR MI</p>	 <p>II - INFERIOR POSTERIOR MI</p>

PERICARDIAL TAMPONADE:

- NOT TYPICAL
- RESULTS FROM VESSEL INJURY: RUPTURE / PERFORATION
- WORSENER BY BLOOD THINNERS USED FOR PTCA
- BLOOD SLOWLY ACCULULATES IN PERICARDIAL SACK.
- 55 – 60% of cases NOTED IN THE CATH LAB, HOWEVER THE REMAINING 40 – 45% MAY NOT BE APPARENT FOR SEVERAL HOURS POST PCI.
- SYMPTOMS MAY BECOME APPARENT 6 - 8 HOURS POST PCI

PERICARDIAL TAMPONADE:

- PATIENT MAY COMPLAIN OF CHEST PAIN / DISCOMFORT
- POSSIBLE SHORTNESS OF BREATH
- PATIENT MAY SHOW SIGNS OF SHOCK
- VITAL SIGN TREND:
 - PULSE RATE INCREASING
 - BLOOD PRESSURE DECREASING
- BECK'S TRIAD:
 - DISTENDED NECK VEINS
 - PULSUS PARADOXUS
 - MUFFLED HEART TONES

PERICARDIAL TAMPONADE:

- CALL CARDIOLOGIST STAT
- STAT ECHO
- TX = PERICARDIOCENTESIS. CAN BE DONE BY ECHO, or
UNDER FLOUROSCOPY (IN CATH LAB)

SCENARIO

You're working the night shift.

You have a 53 year old POST PCI patient. She had STENT implanted in her Right Coronary Artery earlier today.

When you first assess her, she is ASYMPTOMATIC, her skin is warm and dry, color normal. BP 136/82, P 67, R 20, SAO2 99% on room air.

2 HOURS into your shift the patient is restless, anxious, states "I don't feel right," but no specific pain. Skin pale cool and moist, BP 98/68, P 102, R 26, SAO2 95% on room air.

- What would you do?
- What are possible diagnoses?

SHOCK ASSESSMENT



SECONDS

SHOCK =

INADEQUATE TISSUE
PERFUSION

- STARTS THE INSTANT YOU SEE PATIENT
- ENDS WHEN YOU REACH THE PATIENT'S SIDE

SHOCK ASSESSMENT

LOC:	ANXIOUS RESTLESS LETHARGIC UNCONSCIOUS	AWAKE ALERT & ORIENTED
SKIN:	PALE / ASHEN CYANOTIC COOL DIAPHORETIC	NORMAL HUE WARM DRY
BREATHING:	TACHYPNEA	NORMAL
PULSE:	WEAK / THREADY TOO FAST or SLOW	STRONG
STATUS:	 SHOCK 	NORMAL

**ANY PATIENT WITH
SIGNS of SHOCK:**

***CALL
RAPID
RESPONSE
TEAM
STAT***

SCENARIO

IMMEDIATE ACTIONS – POST CARDIAC CATH PATIENT WITH SHOCK:

- **RAPID RESPONSE TEAM**
- **NOFIFY Physcian**

- **RULE OUT COMMON LIFE THEATENING POST-CATH / POST-PCI Conditions:**
 - **Retroperitoneal Bleed.** Patient can lose up to 2 liters of blood in retroperitoneal space. Nearly undetectable during physical exam. More common when sheath puncture ABOVE Inguinal Ligament. **SUSPECT THIS diagnosis if the next two are ruled out:**
 - **Acute MI.** In-stent thrombus common cause.
 - **Pericardial Tamponade.** Caused by accidental perforation of coronary artery during PCI.

SCENARIO

SHOCK in POST Cardiac Cath Patients – RULE OUT:

- Retroperitoneal Bleed. Assess lower extremity distal pulses, palpate abdomen, area around sheath site.
- Acute MI. Assess for TYPICAL and ATYPICAL ACS Symptoms, obtain and evaluate 12 Lead ECG. Compare to previous ECGs.
- Pericardial Tamponade. Chest Pain (sharp, may increase with inspiration), Beck's Triad

CONTRAST INDUCED RENAL FAILURE:

PATIENTS AT INCREASED RISK FOR CONTRAST INDUCED RENAL FAILURE – PATIENTS WITH HISTORY of:

- Renal insufficiency
- Diabetes
- Congestive heart failure
- Hypertension
- Pre-procedural shock

CONTRAST INDUCED RENAL FAILURE:

- SERUM CREATININE PEAKS 2 – 5 DAYS POST CARDIAC CATH
- RETURNS TO BASELINE LEVEL IN UP TO 2 WEEKS.
- MONITOR CREATININE POST PCI. OBSERVE FOR ABNORMAL LEVELS, REPORT TO PHYSICIAN
- AVOID NSAIDS in cases of KNOWN RENAL DISEASE and/or ABNORMALLY ELEVATED CREATININE.

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- **Notify physician immediately**

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- Notify physician immediately
- **CBC / platelet count should be obtained / monitored**

POST PROCEDURAL DYSRHYTHMIAS:

- MAY BE RELATED TO REPERFUSION.
- OBSERVE, IF POTENTIALLY LIFE-THREATENING, MANAGE PER UNIT PROTOCOL and/or ACLS
- CONTACT CARDIOLOGIST, and/or HOSPITALIST

INFECTION:

- NOT COMMON
- SHEATH SITE or ENDOCARDIAL /MYOCARDIAL
- SYMPTOMS: UNEXPLAINED FEVER, MALAISE,
SIGNS OF SHOCK
- ELEVATED / INCREASING WHITE COUNT
- CONTACT PHYSICIAN.

REFERENCE SOURCES:

- Int J Clin Pract. 2006;60(5):582-589
- MEDSCAPE: POST PCI COMPLICATIONS
- EUROPEAN HEART JOURNAL / OXFORD PRESS
- 12 LEAD ECG INTERPRETATION in ACS
(by Wayne Ruppert, CVT, NRP)