

Complications of Coronary Angiography

By

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Major Complications

- ◊ Mortality
- ◊ Myocardial infarction
- ◊ Cerebrovascular accident
- ◊ Arrhythmias
- ◊ Vascular complications
- ◊ Contrast reactions
- ◊ Hemodynamic complications
- ◊ Perforation of heart chamber

Minor Complications

- Air embolus (0.1%).
- Cholesterol embolization.
- Nerve pain.
- Lactic acidosis may develop in diabetic patients taking metformin.
- Infection.

Risk of cardiac catheterization and coronary angiography (based on 59,792 patients)

	Percent
Mortality	0.11
Myocardial infarction	0.05
Cerebrovascular accident	0.07
Arrhythmia	0.38
Vascular complications	0.43
Contrast reaction	0.37
Hemodynamic complications	0.26
Perforation of heart chamber	0.28
Other complications	0.28
Total of major complications	1.70

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Patients at Increased Risk for Complications after Coronary Arteriography

- o Increased Medical Risk
- o Increased Cardiac Risk
- o Increased vascular Risk
- o Risk of Death

Increased Medical Risk

- Age >70 years
- Morbid obesity
- General debility or cachexia
- Uncontrolled DM.
- Arterial oxygen desaturation
- Severe COPD
- Renal insufficiency with creatinine greater than 1.5 mg/dl

Increased Cardiac Risk

- o Three-vessel coronary artery disease.
- o Left main coronary artery disease.
- o Functional class IV.
- o Significant mitral or aortic valve disease or mechanical prosthesis.
- o Ejection fraction less than 35%.
- o High-risk exercise treadmill testing (hypotension or severe ischemia).
- o Pulmonary hypertension.
- o Pulmonary artery wedge pressure greater than 25mmHg.

Increased vascular Risk

- o Anticoagulation or bleeding diathesis.
- o Uncontrolled systemic HTN.
- o Severe PVD.
- o Recent stroke.
- o Severe AR.

Risk of Death

- Death rates: 0.08 – 0.14%.
- Age : < 1 years and > 60 y.
- Females.
- Class IV CHF 10 times > I or II.
- LMCA or MVD 20 times > SVD.
- LVEF <30% 10 times > normal.
- Valvular heart disease.
- Severe non-cardiac disease (RI, Uncontrolled DM).

AMI

- **Incidence** < 0.1 %.
- **Caused** mostly by coronary dissection , coronary embolization , rupture of atheromatous plaques & thrombosis.
⇒ Patients with ACS have a higher risk.
- **Recently, incidence reduced** by improvement in the equipment , operator skill, the use of more potent antithrombotic, beta blockers , statins & low osmolar contrast agents.

Cerebrovascular Complication

o **Incidence:** 0.07- 0.1 %

o **Caused by:**

- Embolization (80%)
- Hemorrhage (20%)

⇒ Patients with AS have a higher risk

o **Prevented by:**

- Careful flushing & injection technique.
- Minimize time of guide wire in aortic root
- Carefully Wipe & immerse guide wires in heparinized saline before reintroduction.

⇒ Periprocedural stroke patients have poor outcome (in-hospital mortality about 32%)

Vascular Complication

- A) Dissection of great vessels & coronaries.**
- B) Local complications at the site of puncture:**
 - Acute thrombosis.
 - Distal embolization.
 - Bleeding (femoral or retroperitoneal hematoma & free bleeding at puncture site).
 - Pseudoaneurysm.
 - AV fistula.
 - Local complications are less in radial approach.

Complication	Number	Percent
Entry site bleeding	173	1.25%
Hematoma	278	2.00%
Retroperitoneal bleeding	26	0.19%
Dissection	25	0.18%
Pseudoaneurysm	45	0.32%
Surgical device removal	6	0.04%
Entry site infection	2	0.03%
Occlusion	10	0.07%
Pulse loss	7	0.05%
Fistula	3	0.02%
Any vascular complication	468	3.37%

Risk Factor	Odds Ratio	95% CI	p-Value
Female	1.73	[1.38–2.17]	< 0.0001
Sheath size (<i>actual size</i>)	1.32	[1.13–1.54]	0.0004
Renal failure	1.70	[1.08–2.68]	0.02
Emergency indication	1.43	[1.08–1.89]	0.01
Previous PCI	0.76	[0.59–0.98]	0.03
Interventional cath.	3.18	[2.40–4.22]	< 0.0001
Institutional cath. volume	0.50**	[0.39–0.63]	< 0.0001

Dissection & perforation of great vessels

- o **Incidence:** 0.04 %.
- o **Caused by** retrograde passing of wires & catheters through tortuous or stenotic arteries.
- o **Treatment:**
 - Small retrograde dissections → Sealed down by antegrade blood flow.
 - Large and flow limiting dissections :
 - Immediate → Proximal balloon inflation.
 - Later → Stenting (great vessels) , CABG or ligation (coronaries) & pericardiocentesis (tamponade).

Femoral artery laceration

⇒ Free bleeding around the sheath.

o **Treatment:**

- Placement of upsized sheath.
- Manual pressure around the sheath till procedure completed.
- Reverse anticoagulation & removal of the sheath with compression for 30-60 min.
- Closure device.
- Not controlled → Vascular surgery.

Femoral Hematoma

- o More common than free bleeding.
- o May cause femoral nerve compression → sensory or motor deficit which take weeks or months to resolve.
- o Spontaneous reabsorption within days.
- o Prevented by accurate puncture , rapid removal of the sheath within 2-4 hrs. & effective manual compression (20-30 min) or closure device.

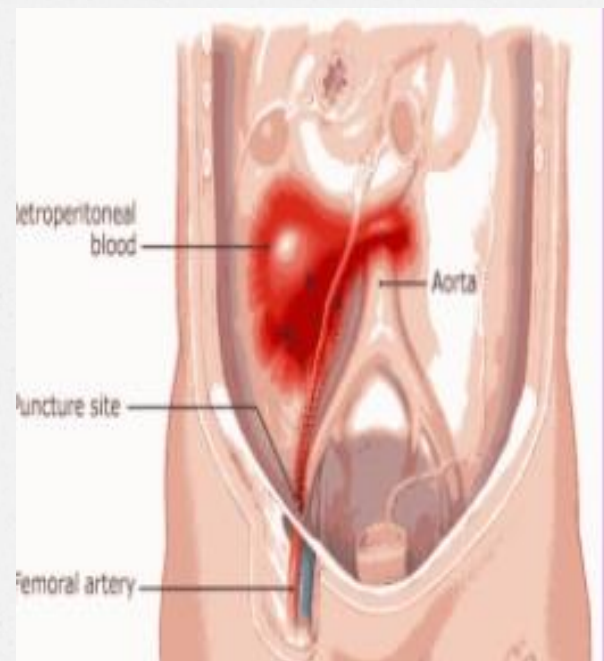
Retroperitoneal hematoma

⇒ Potentially life threatening complication.

o **Caused by** high puncture above inguinal lig.

o **Clinically suspected** → unexplained hypotension , ipsilateral flank pain & ↓↓ hematocrit.

o **Diagnosis:** U/S & CT



Retroperitoneal hematoma

o Treatment :

- **Conservative:** bed rest, reversal of anticoagulation , blood transfusion & manual compression at the puncture site.

- **Interventional:** ipsilateral or contralateral catheter approach → localization of bleeding site
→ peripheral angioplasty balloon & covered stent.

Arteriovenous fistula

- o **Caused by:**
 - low puncture site at the level of superficial femoral artery.
 - Ongoing bleeding from arterial puncture site → decompress into adjacent V. puncture site.
- o **Diagnosis:** Thrill or continuous bruit over the puncture site confirmed by Doppler U/S or CT.
- o **Treatment:** Surgical repair in about 2/3 of patients without spontaneous closure



Angiographic appearance of an arteriovenous fistula with simultaneous filling of the femoral artery (left) and vein (right)

Pseudoaneurysm

- o **Incidence:** 0.1-0.2 % in diagnostic angio & 0.8-2.2 % in PTCA.
- o Develops if hematoma forming a blood filled cavity continuous with arterial lumen.
- o Blood flows in and out the cavity during systole and diastole.
- o Mostly occur within first 3 days after removal of arterial sheath.
- o **Predisposing factors:** Low puncture, brief compression, large pore sheath, aggressive antithrombotic, severe HTN, age > 65 yrs , RI , obesity & PVD.
- o **Diagnosis:** Pulsatile mass with systolic bruit over the puncture site confirmed by Doppler U/S.

Pseudoaneurysm

o Complications:

- Rupture
- Distal embolization
- Local pain
- Neuropathy
- Local skin ischemia
- Infection

Pseudoaneurysm

o Treatment :

- **Conservative:** Aneurysm < 2 cm (serial U/S confirm cavity thrombosis).
- **Interventional:** Aneurysm > 2 cm without surgical indication (either by U/S guided compression or cavity injection of thrombin or collagen).
- **Surgical management:** when aneurysm (very large, rapidly expanding, at the site of vascular anastomosis, causing skin necrosis or infected).



Crossover angiography was performed from the right groin showing a large pseudoaneurysm over the left common femoral artery



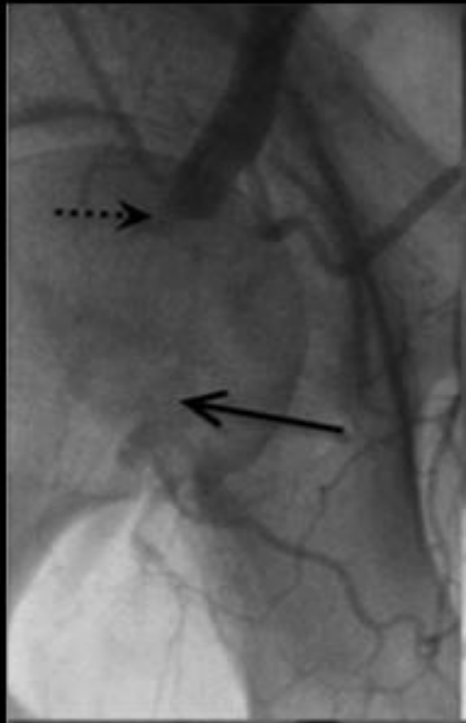
An angioplasty balloon was positioned under the prior puncture site as a needle (arrow) was advanced to puncture the pseudoaneurysm cavity confirmed by contrast injection



After occlusion of the common femoral by inflation of the angioplasty balloon, thrombin was injected through the needle into the pseudoaneurysm cavity, causing it to clot, as shown by the absence of further contrast flow into it on the postprocedure angiogram

Arterial thrombosis

- o **Incidence:** Rare.
- o **Predisposing factors:** small vessel lumen, PVD, DM, females, large sheath (IABP) & prolonged procedures.
- o **C/P:** pain, parasthesia, pallor, absent pulse & coldness of LL.
- o **Prevention:** frequent flushing, adequate anticoagulation in prolonged procedures.
- o **Treatment:** Percutaneous thrombectomy, thrombolytic therapy & surgical consultation.



Crossover from the contralateral side showed occlusion of the common femoral



After balloon dilation, there was a prominent filling defect consistent with thrombus



After thrombectomy, the filling defect has decreased in size

Arrhythmias

o Types:

A) Tachyarrhythmia:

- PVCs (common, induced by catheter introduction in LV or RV & of no clinical significance)
- VT & VF

B) Bradyarrhythmia:

- Sinus bradycardia
- CHB.

Ventricular tachycardia & Fibrillation

o **Causes:**

- Excessive catheter manipulation & intracoronary injection of ionic high osmolar contrast especially in RCA.
- Prolonged catheter engagement inspite of damped pressure.
- Profound transmural ischemia or early MI.
- Incidence increases in patients with baseline prolonged QT interval.

Ventricular tachycardia & Fibrillation

o Treatment:

- Immediate catheter repositioning.
- Hemodynamically stable VT → IV lidocaine or amiodarone.
- Hemodynamically unstable VT & VF → DC.
- $Mgso_4$ in patients with torsades.

Bradycardia

o Causes:

- Injection of ionic high osmolar dye especially in RCA (forceful coughing enhances coronary perfusion & help restoring normal rhythm).
- Vasovagal reactions (anxiety, pain, cardiac perforation).
- Development of LBBB due to LV septal scraping in a patient with pre-existing RBBB → CHB.

Bradycardia

o **Prevention :**

- Use of non ionic dye.
- adequate periprocedural hydration.
- adequate local anesthesia.
- sedation.

o **Treatment:**

- Forceful cough.
- IV atropine 0.5- 1 mg.
- IV fluids.
- Temporary pacing in resistant CHB.

Allergic reactions

Precipitated by local anesthesia , contrast media , protamine sulfate.

Allergy to iodinated contrast agents

o **Incidence:** up to 1%

- Higher risk in patients with (past history of reactions , asthma , atopy & sea food allergy).

o **Prevention:**

- Premedication with steroids, antihistaminic & H₂ blockers
- Use of non ionic dye.

o **Treatment:**

- IV epinephrine 1:10000 every min. until pulse restored.
- Rapid IV fluid infusion.
- IV vasopressors , hydrocortisone & atropine in bradycardia.

Contrast
induced nephropathy
(CIN)

Hemodynamic Complications

A. Hypotension:

➤ **Types & causes:**

- Hypovolemic (blood loss, inadequate prehydration, excessive contrast induced diuresis).
- Cardiogenic (massive transmural ischemia, tamponade, arrhythmia & valvular regurge).
- Distributive (contrast, vasovagal, nitrates & VD of inotropes).

➤ **Treatment:**

According to the cause.

Hemodynamic Complications

B. Volume overload:

➤ **Causes:**

- Use of hypertonic contrast agent.
- Myocardial depression due to (contrast agent , massive ischemia & baseline LV dysfunction)
- Excessive prehydration

➤ **Treatment:**

- Diuretics.
- Nitrates.
- Inotropes.

Cholesterol embolization

- o **Caused by** catheter scraping of friable atheromatous plaques in aorta.
- o **C/P:** according to the site of embolization
 - Cerebral → stroke
 - Coronaries → AMI
 - Renal → infarction or ARF
 - Intestinal → MVO
 - Cutaneous → digital cyanosis or gangrene.
- o **Prevention:** ?? Preprocedural use of simvastatin
- o **Treatment:** Supportive

Blue toe syndrome



Livedo reticularis



Summary

- o Proper patient selection, preparation and attention to details efficiently reduce the complications of coronary angiography.
- o There is no routine procedures.
- o Be careful with high risk patients.
- o Never force the equipment.
- o Catheters must fit the anatomy.
- o Surgical pack-up is necessary.
- o Patient safety is the first priority.
- o Always remember that you are treating a patient not a coronary vessel.



THANK YOU