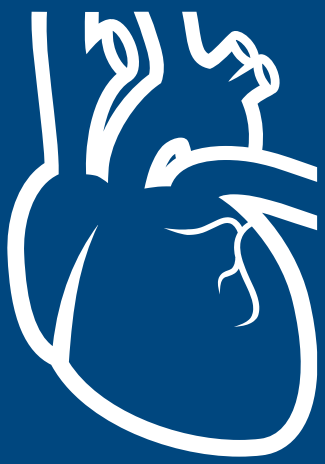
ISCAP
Interventional Society for Cathlab Allied Professionals



Cardiac Catheterisation

Manual - Module 2

EDUCARE

ISCAP Interventional Society for Cathlab Allied Professionals

The ISCAP Catheterisation Manual

Endorsed by
The South African Society of Cardiovascular Intervention (SASCI)
The Society for Cardiovascular Angiography and Interventions Foundation (SCAI)

SASCI
South African Society of Cardiovascular Intervention

SCAI
The Society for Cardiovascular Angiography and Interventions Foundation

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Should one notice unintentional errors, or any information that could improve the content within, please connect with the ISCAP members within the editorials to suggest these improvements.

Foreword

Where once we were a murmur, we now have the opportunity to find our own rhythm and become the true heart of the cath lab.

Though the quality of South African Cardiology has always been on a par with the rest of the world, the training of professional nurses, technologists and radiographers (Allied Professionals), in the highly specialised field of cardiovascular intervention has been neglected. Our country has lacked guidelines that describe the requirements for a cardiovascular interventional laboratory to be managed successfully. There continues to be no official course to provide credentialing in the subject to the registered nurse.

The national Interventional Society of Cath Lab Allied Professionals (ISCAP) aims to uphold a high standard of cardiovascular interventional laboratory practice and improve the standing of the nursing and allied professional working within that environment. By these means our members will gain recognition as important participants in patient management within the cardiovascular interventional laboratory.

This second edition of the Cath Lab Manual is the continuation of this process. The Manual has been written for all those who work in the cardiovascular interventional laboratory, both as an introductory aid for the novice and as a reliable reference for the experienced practitioner.

By ensuring that educational material such as this is available on line and in hard copy , we are enabling ourselves to assume greater responsibility for our staff's development and our own job satisfaction. We also hope that the overall morale will also be enhanced.

CPD points will be attainable for those who wish to complete the questions at the end of each Chapter. There will also be a component whereby we can share information and experiences on line.

We need to equip staff with the knowledge and specific skills necessary for invasive physiology and anatomical assessment, also for the diagnosis and management of coronary and structural disease.

We trust you will find the Manual helpful. We look forward to hearing your comments and criticisms, so as to contribute to the greater value of this ongoing process of sharing information and thus learning from each other.

If you want to go quickly, go alone. If you want to go far go together

~ African proverb

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All new content is to be reviewed as it is created and thereafter approved by the panel below. This is for all digital and print versions.

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Contents

Module 2

2.1 The Roles and Responsibilities of the Cath Lab Team

The cath lab may differ depending on the country and also the individual hospital groups or institution. In most centres in South Africa, the Electrophysiology laboratory (EP Lab) has its own specialised team. Some cardiac catheterisation laboratories have grown into "heart and vascular institutes," performing not only cardiac procedures but also endovascular procedures (peripheral, carotid, and cranial).

The exciting news is that once you have a broad knowledge base and have a high degree of manual dexterity and the ability to work in emergency situations you are able to move in your career span through all these areas. Apart from endovascular even the medical technologists can experience EP lab and cath lab. The radiographers are already working in all these areas.

A nurse that has worked in EP Lab or cath lab can easily adapt to the hybrid lab and do the endovascular procedures. The hybrid lab is becoming part of the cardio-thoracic operating theatre so more theatre staff can choose to circulate through these areas during their working career. Another opportunity to cross-pollinate staff in these areas. In the future these nurses could be the new HYBRID Nurse!

Nurses and allied staff (technologists and radiographers) should hold certification in basic life support (BLS), advanced life support (ACLS), and paediatric advanced life support (PALS), if the cath lab does paediatric cardiac studies and procedures.

There are 4 broad categories pf tasks performed by the cath lab team: scrub, floor person, technologist (monitoring), radiographer (fluoro). Other duties may include the anaesthetic nurse if there is an anaesthetist present, and a person who does the charging of equipment and stock control. Nursing staff are often required to capture the stock and vital signs of the patient, on the computer, as digitisation is the future.

PATIENT PREPARATION

As the patient is helped onto the X-ray table, a description of the X-ray tube, monitors, and procedure table is helpful in decreasing the anxiety in some patients.The procedure room can be filled with lots of equipment and can be overwhelming.

The scrub and floor nurse will have obtained a fairly good picture of the patients state of mind. A nervous patient is often very talkative. Some can even be aggressive towards the staff. The nurse should listen as much as time allows. The nurse should also try to learn if the patient has any specific worries that can be cleared up.

An anxious patient tends not to talk and gives only the shortest possible answer to any question. It is important that the patient receives adequate reassurance from the nurse, both in manner and words. The staff should make sure

that the anxious patient are informed about their procedure and the reasons for it, even if they have heard the explanation before. The nurse's manner should show that the nurse is both competent and confident, that the procedure is routine, and that all possible care will be taken.

There are different levels of anxiety :

- Level 1 : Diazepam 5mgms and reassurance
- Level 2 :Diazepam 5mgms and a good dose of reassurance!
- Level 3: Conscious sedation - Fentanyl and Dormicum as required - Sedationists
- Level 4 : General Anaesthetic

A cath lab needs to have friendly, positive staff to boost the patients confidence. The patient gets the impression that the staff are competent and they enjoy their work. This allows them to relax enough to place themselves in the hands of the staff for the duration of the procedure.

The right amount of sedation can be of benefit to both the patient and the team, as the patient can become restless and agitated, if over-sedated. Enough sedation allows the patient to be aware and to inform the staff if they are feeling pain or discomfort. The patient is often aware of a complication before we notice it on the monitor or X-ray screen.

The floor person should talk to the patient as often as is practical. This is reminds everyone including the cardiologist that the patient is awake and able to hear everything that is going on.
If the patient preparation has been thorough, there should be little that has to be done for him or her during a procedure of normal duration. If the procedure is prolonged then the cardiologist needs to explain to the patient why it is prolonged and if there is a complication.

CARDIAC TECHNOLOGIST

The cardiac technologists in private hospital cath labs are self-employed. (Registered with the HPCC) Health Professionals Council of SA.

Roles and Responsibilities:

- Sets up the haemodynamic monitoring equipment. Set up the bridge in plenty of light so that you can see the bubbles/air in the connections in the transducer.
- She/he also checks the Intravascular ultrasound (IVUS), Instant wave-free ratio (IFR), Optical Coherence Tomography (OCT) consoles, intra-aortic balloon pump (IABP), temporary pacing lead and pacing box.
- Assists and guides the cardiologist on IVUS,IFR and OCT measurements and findings.
- Understands the risks associated with the procedures and knows how to trouble-shoot for machines eg. rotoblator.
- Checks the defibrillator and ensures that there are defibrillator and pacing pads available. Trained also to activate the defibrillator when required.
- Connects patient to haemodynamic monitoring equipment and monitors the patient continuously, providing records of monitored data.
- Recording of patients vital signs: heart rate and rhythm, respiratory rate, peripheral saturation, blood pressure. To record and inform cardiologist if there is ST elevation,depression, T wave inversion etc.
- Alerts the cardiologist if there is any change in patient's condition. To be aware and record pre-angiogram haemodynamics and post-angiographic measurements.
- Recording of all procedural measurements,

stents, balloons and inflation device pressures in order to compile a detailed procedural record . A copy of this record is required by the cardiologist and for the hospital file. We attach it to the Peri-Operative form. If your hospital is digitalised then it is automatically captured onto the system.

- Assists with cardiopulmonary resuscitation.
- To have knowledge of products used in the cath lab.
- Attends Continuous Professional development meetings to stay up to date with the latest procedures, products and knowledge (guidelines etc).

RADIOGRAPHER

In South Africa, a radiologist or radiographer is required to sign the Licence for the x-ray equipment. The Holder of the Licence remains the responsibility of the Hospital Manager. The radiographers in most private hospital cath labs are self-employed.

It is a requirement that diagnostic x-ray units in cath lab are operated by a qualified radiographer who is registered with Health Professional Council.

Cardiologists are not allowed to operate the x-ray units in South Africa, although he Europe it is common practice.

Basic radiation training should be given to cardiologists, surgeons, nursing staff, technologists and other non-radiation workers involved in cath lab and hybrid theatres. A refresher course should be available to those who have worked for a long period in the labs. These can be organised with the Medical Physicist responsible for that area.(Private Hospitals).

Each cath lab should have a Radiation Protection Committee (RPC) organised, and are required to have two RPC Meetings annually.

The radiographer plays an important role in the cath lab, and can become experts in this field.

The length of the procedure can be reduced when the radiographer uses her/his knowledge and experience to produce the right views so that the cardiologists can identify and locate the lesion/ lesions as quickly as possible, and then carry out the procedure and intervention timeously.

Key areas:

- Patient care
- Use of technology – quality assurance
- Optimisation of dose
- Clinical responsibility
- Organisation
- Education and training

Roles and Responsibilities: may vary depending on the country and hospital.

- Ensures the smooth operation of all radiographic equipment.
- Ensure that only qualified, registered radiographers perform clinical radiation procedures.
- Be familiar with and adhere to all DoH DRC regulations and requirements. (Code of Pracitice & Requirements for License Holders).
- Be familiar with and implement As Low As Reasonably Achievable (ALARA) principles and techniques.
- Keeps a Radiography Patient Record;
- Reports any incidents or accidents to the hospital Radiation Safety Officer. Incident form to be completed immediately, when the doses are above 30,000. Ensures that the

cardiologists is aware of high dose so that he/she can keep track of the patient.

- Does daily basic quality checks on the machines and informs the Unit Manager if there are problems. There is also a form for Weekly Basic QA Records.
- Performs all tasks related to diagnostic radiology: setting up of the injector, lesion quantification. (This may differ depending on the country and the cath lab).
- Ensures good quality examinations and appropriate views to identify the lesions. This can assist the cardiologists in decision-making and the amount of time spent doing the procedure. Also, a radiographer who is proficient with views can reduce the amount of contrast used.
- Focuses cardiologists attention to problems (e.g dissection of vessel) during the case.
- Manage patient radiation doses within safe limits and participate in the Dose Optimisation Programmes. (DAP)
- Screens lead aprons/thyroid shields every 12 months. Cracked lead aprons, shields are disposed of in the right manner.
- Index book with record of cases so that it is quick to access patient data.
- If the cath lab still archives the CD's: files the CD's under the individual cardiologists.
- Reminds staff and cardiologists to be aware of radiation scatter and to wear their dosimeters and lead protection.
- Participate as a member of the Hospital Radiation protection committee and attend the meetings when required.

PROCEDURE COMPLETION

The pressure bandage may need to be applied to the groin if manual compression has been applied or a vascular seal has been used. The TR band or Quikclot may be used to apply pressure on the radial /ulnar artery, once the sheath has been gently removed.

If the sheath in the groin, is not to be removed immediately following the procedure, the area should be cleaned with saline covered with an opsite dressing. The nurse should inform the patient when the dressing will be removed, and how important it is not to move the limb that we have worked on.

Patients must be given verbal and written instructions regarding post procedure care.

Invasive Cardiology – A Manual for cath lab personnel. Third edition Sandy Watson RN, BN, NFESC Kenneth A. Gorski RN, RCIS, RCSA, FSICP

ROLE OF SCRUB SISTER: ASSISTANT TO THE DOCTOR

A procedure done in the cath lab often requires too many complex psychomotor demands for one set of hands, and scrub nurses/assistants are the cardiologists right hand. They must anticipate the cardiologists needs and be prepared to change course rapidly. They must maintain a strict sterile field and properly prepare the equipment per manufacturer and hospital protocol.

PROCEDURE OBJECTIVES:

- To introduce her/himself to the patient, and to check Peri-operative Checklist -Pause Form with the patient.
- To ensure that safety to patient and staff is maintained throughout the procedure, and to be aware of any risks that may contribute to complications eg. bleeding problems.

- To ensure that correct equipment is opened and to anticipate what will be required next.
- To observe patient and doctors movements and to be aware of the x-ray and monitoring screens.
- To anticipate what the next step in the plan will be and to prepare timeously .
- Multi-tasking: to assist the cardiologist, observe the haemodynamic pressures, ECG.

PRE – PROCEDURE:

1. Pause Form to be completed. This informs the assistant and staff of the patient's history and the risks that may be associated with the procedure. eg. diabeteic, anticoagulants, previous procedures.
2. Adequate radiation protection – thyroid/gown, head/glove
3. Gown & glove – mask (optional)
4. Before cleaning the patient check again that they are not allergic to iodine, if you are using a betadine solution.
5. Prepare trolley and equipment – to use hibitane solution (non-iodine solution) if patient is allergic to iodine/contrast.
6. Identify all drugs on the trolley preferably with labels if possible. When in doubt of a medication, dispose of it.
7. Check that the O2 satuation is satisfactory before sedation is administered. Also, has the patient had adequate sedation, if there is no anaesthetist.
8. To know if patient has had anti-coagulant therapy, so that the plan to use to a closure device if the groin is used is confirmed.
9. Check all equipment is correct that is opened onto trolley

INTRA-OPERATIVE:

1. Always preflush catheters and store them carefully so that they don't spring off the table.
2. Never force equipment(guidewire or catheter), into the patient. If resistance is met, stop; evaluate the situation and assess the patient.

3. Always hold the syringes with the tip down, and aspirate a small amount of blood immediately prior to flushing. Tip the syringe so that any bubbles will rise, reducing the chance of air embolism.
4. Stand back when doctor is gaining access that you are not splashed by blood.
5. Be aware of sharps – dispose of sharps immediately if patient has HIV/CRE
6. Check that equipment is in good working order – no faulty equipment
7. To ensure that the patient is comfortable and stable
8. To observe the pressures and ECG before injecting contrast, and watch how the contrast disperses in the heart. Warn the patient when he/she may feel a hot flush and will feel like they are passing urine, (wetting the bed). This also allays anxiety in the patient.
9. If the pressures drop with contrast injection of the RCA then ask the patient to cough, to clear the contrast quickly. Observe the ECG carefully.
10. Check patient if he/she is restless – conscious state and level of pain
11. Anticipate the equipment that will be required for the procedure, and have it prepared and ready.
12. Do not force the wire or catheters, when advancing them in the patient.
13. Always suck back on the sheath side-arm before flushing in saline (if clot is present in syringe, suck again and check that patient does not require heparin) .
14. Do not inject medication directly into catheter, eg, nitrocene or adenocor directly – ensure that they are titrated correctly.
15. Observe carefully to prevent complications or unnecessary events happening e.g –wires falling on floor, injecting when pressure is down, wire dissecting the artery

POST- PROCEDURE:

1. If closure device is used, check that there is no residual oozing. Apply pressure bandage or radial artery dressing/TR band.
2. Check for pedal/dorsal pulses if femoral artery puncture.
3. Check colour warm & sensation for radial artery compression device. If radial artery pulse is easy to access - check. Show the patient how to compress the radial artery also.
4. Complete Radial Checklist form.
5. Pressure dressing/bandages to be applied.

POST PROCEDURE - EDUCATION AND INSTRUCTIONS:

1. Ensure that staff on the ward/CCU have been educated on the post-procedure care – femoral/ radial access.
2. Patient information sheets to given to patient.
3. Verbal instructions to be given also. Ensure that patients understand them

2.2 Indications and Contraindications for Coronary Angiography

Cardiac catheterisation is an umbrella term for all aspects of right and left heart catheterisation from any percutaneous route.

Coronary angiography is the term used to indicate selective right and left coronary artery cannulation. Non-coronary angiography refers to aortagraphy, pulmonary and renal angiography.

Coronary angiography is a powerful tool for risk stratification during acute myocardial infarction (MI) and for facilitating revascularisation. Emergency coronary angiography with the intent to perform primary percutaneous coronary intervention is applicable to most patients presenting within 12 hours of an acute ST-segment elevation (STEMI) or new left bundle branch block (American Heart Association: 2012). This strategy can also be applied to patients with non-STEMI who have persistent or recurrent symptoms despite optimal medical therapy or high risk features which include: elevated troponin, new ST-segment depression signs, symptoms of congestive heart failure, haemodynamic or electrical instability, and prior revascularisation. Patients with persistent chest pain or ST-segment elevation following fibrinolytic therapy should also undergo angiography with the intent to perform primary percutaneous intervention. Patients who are successfully resuscitated from sudden cardiac death have a high probability of underlying coronary disease and warrant a coronary angiogram (Joint Commission:2012).
Ideally, door-to-balloon time in patients with ST-segment elevation should be less than 90 minutes (ACC:2012).

INDICATIONS FOR CORONARY ANGIOGRAPHY

The most current guidelines for diagnostic coronary angiography, reported by a joint Task Force of the American College of Cardiology (2012) and the American Heart Association (2012), divide the indications for coronary angiography into 3 classes:

Class I:

Conditions for which there is evidence and/or general agreement that the procedure is useful and effective.

Class II:

Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of performing the procedure.

Class III:

Conditions for which there is evidence and/or general agreement that the procedure is not useful/effective.

CLASS I - THESE PATIENTS SHOULD HAVE A CARDIAC CATHETERISATION PROCEDURE.

UNSTABLE CORONARY SYNDROMES

- Unstable angina/ACS (Acute Coronary Syndrome) refractory to medical therapy or recurrent symptoms after initial medical therapy
- Unstable angina/ACS with high risk indicators
- Unstable angina/ACS initially at low short-term risk, with subsequent high-risk non-invasive testing
- Prinzmetal angina with ST-segment elevation
- Suspected acute or sub-acute stent thrombosis after percutaneous coronorary intervention (PCI)

ANGINA

- High-risk non-invasive testing
- Canadian Cardiovascular Society class III or IV angina on medical therapy
- Recurrent angina 9 months after PCI

ACUTE MYOCARDIAL INFARCTION

- Intended PCI in acute STEMI or new left bundle branch block (LBBB): Within 12 hours of symptom onset
  - Ischaemic symptoms persisting after 12 hours of symptom onset
  - Cardiogenic shock in candidates for revascularisation
  - Persistent haemodynamic or electrical instability

- Angiography in non-STEMI
  - As part of an early invasive strategy in high-risk patients (positive Trop-t, ST-segment changes, congestive heart failure (CHF), haemodynamic/electrical instability, recent revascularisation)
  - Persistent/recurrent symptomatic ischaemia with or without associated ECG changes despite anti-ischaemic therapy
  - Resting ischaemia or ischaemia provoked by minimal exertion following infarction
  - Prior to surgical repair of a mechanical complication of MI in a sufficiently stable patient

PERI-OPERATIVE RISK STRATIFICATION FOR NON-CARDIAC SURGERY

- High-risk non-invasive testing
- Unstable angina or angina unresponsive to medical therapy
- Equivocal non-invasive test result in patient with high clinical risk undergoing high-risk surgery

CONGESTIVE HEART FAILURE

- Systolic dysfunction associated with angina, regional wall motion abnormalities or ischaemia on non-invasive testing

OTHER CONDITIONS

- Valvular surgery in patients with angina, significant risk factors for coronary artery disease (CAD) or abnormal non-invasive testing
- Valvular surgery in men 35 years or older, any post-menopausal women and pre-menopausal women 35 and older with cardiac risk factors
- Correction of congenial heart disease in patients with angina, high-risk non-invasive testing, any form of congenial heart disease frequently associated with coronary artery anomalies, or in those with known coronary anomalies
- After successful resuscitation from sudden cardiac death, sustained monomorphic ventricular tachycardia, or non-sustained polymorphic ventricular tachycardia
- Infective endocarditis with evidence of coronary embolisation
- Diseases of the aorta necessitating knowledge of concomitant coronary disease
- Hypertrophic cardiomyopathy with angina

CLASS II - THESE PATIENTS MAY BE CONSIDERED FOR A CARDIAC CATHETERISATION PROCEDURE.

ANGINA

- CCS (Canadian Cardiovascular Society) class I or II, EF < 45% and abnormal but not high-risk non-invasive testing
- Patients with an uncertain diagnosis after non-invasive testing in whom the benefits of the procedure outweighs the risk
- Patient who cannot be risk stratified by other means
- Patients in whom non-atherosclerotic causes such as anomalous coronary artery, radiation vasculopathy, coronary dissection etc. are suspected
- Recurrent angina/symptomatic ischaemia within 12 months of coronary artery bypass graft (CABG)
- Recurrent angina poorly controlled with medical therapy after revascularisation
- Patients with CHF who have chest pain, have not had evaluation of their coronary anatomy, and do not have contraindications to revascularisation

ACUTE MI

- MI suspected to have occurred by a mechanism other than thrombotic occlusion of atherosclerotic plaque (coronary embolism, arteritis, trauma, coronary spasm)
- Failed thrombolysis with planned rescue PCI
- Post-MI with ejective fraction (EF) <40%, CHF, or malignant dysrythmias
- CHF during acute episode with subsequent demonstration of LVEF > 40%
- Patients with recurrent acute coronary syndromes (ACS) despite therapy without high-risk features

PERI-OPERATIVE RISK STRATIFICATION FOR NON-CARDIAC SURGERY

- Planned vascular surgery with multiple intermediate clinical risk factors
- Moderate-large region of ischaemia on stress test without high-risk features or decreased EF
- Equivocal non-invasive testing in patient with intermediate clinical risk undergoing high-risk surgery
- Urgent non-cardiac surgery while recovering from an acute myocardial infarction (MI)

OTHER CONDITIONS

- Systolic left ventricular (LV) dysfunction with unexplained cause after non-invasive testing
- Episodic CHF with normal LV systolic function with suspicion for ischaemia-mediated LV dysfunction
- Before corrective surgery for congenital heart disease in patients whose risk factors increase likelihood of CAD
- Recent blunt chest trauma and suspicion for acute MI
- Before surgery for aortic dissection / aneurysm
- Periodic follow-up after cardiac transplantation or for prospective immediate cardiac transplant donors
- Asymptomatic patients with Kawasaki disease and coronary artery aneurysms on echocardiography

CLASS III - THE CARDIOLOGIST MUST WEIGH UP THE RISKS OF THE PATIENT UNDERGOING A CARDIAC CATHETERISATION PROCEDURE.

UNSTABLE ANGINA

- Symptoms suggestive of unstable angina but without objective signs of ischaemia and with normal coronary angiogram during the past 5 years
- Unstable angina in patients who are not revascularisation candidates or for whom revascularisation will not improve the quality or duration of life
- Unstable angina in a post-bypass patient who is not a revascularisation candidate
- Patients with extensive co-morbidities in whom risks of revascularisation likely outweigh the benefits

ANGINA AND CAD

- Angina in patients who do not desire revascularisation
- Screening test for CAD in asymptomatic patients
- Patients with co-morbidity in whom the risk outweighs the benefit of the procedure
- Provocative testing in patients with high-grade obstructive disease
- Non-specific chest pain with normal non-invasive testing
- Patients with CCS class I or II responsive to medical therapy with no ischaemia on non-invasive testing
- Routine angiography in asymptomatic patients after PCI or CABG (except in unprotected left main artery PCI in which angiographic follow-up in 2 – 6 months is reasonable)

MI: STEMI OR NEW LBBB

- Patients beyond 12 hours from symptom onset who have no evidence of ongoing ischaemia

- After thrombolytic therapy with no evidence of ongoing ischaemia
- Routine angiography and PCI within 24 hours of thrombolytic therapy
- Patients with extensive co-morbidities in whom risk of revascularisation likely outweighs benefits

ALL MI: HOSPITAL MANAGEMENT AND RISK STRATIFICATION PHASE

- Patients who are not revascularisation candidates or do not desire revascularisation

PERI-OPERATIVE RISK STRATIFICATION FOR NON-CARDIAC SURGERY

- Low-risk surgery with known CAD and no high-risk results on non-invasive testing
- Asymptomatic after revascularisation with excellent exercise capacity
- Mild stable angina, good left ventricular function, and not high risk by non-invasive testing
- Patients who are not candidates for revascularisation or do not desire revascularisation
- Part of work-up for renal, liver, or lung transplant without high-risk non-invasive test results

VALVULAR HEART DISEASE

- Prior to surgery for infective endocarditis in patients lacking risk factors for CAD or evidence of coronary embolisation
- Routine angiography in patients not being assessed for surgery

Table 6.1: The Canadian Cardiovascular Society Classification of Angina

I	Ordinary physical activity does not cause angina
II	Slight limitation of ordinary activity (walking >2 blocks or climbing >1 flight of stairs)
III	Marked limitation of ordinary physical activity (walking 1 – 2 blocks or climbing 1 flight of stairs)
IV	Inability to carry on any activity without discomfort

CONTRAINDICATIONS FOR CORONARY ANGIOGRAPHY

The advisability of any test is dependent on weighing the risk and the benefit for every patient. The American College of Cardiology/American Heart Association Task Force on Practice Guidelines (1999) published the following contraindications for coronary angiography:

ABSOLUTE CONTRAINDICATIONS FOR CORONARY ANGIOGRAPHY

1. Patient refusal for the procedure
2. The patient ineligible for revascularisation

RELATIVE CONTRAINDICATIONS FOR CORONARY ANGIOGRAPHY

1. Acute renal failure or advanced chronic renal dysfunction
2. Active bleeding
3. Unexplained fever or significant leukocytosis
4. Untreated active infection
5. Acute stroke
6. Malignant hypertension
7. Significant electrolyte imbalances
8. Concomitant severe illness reducing life expectancy
9. Digitalis toxicity
10. Decompensated heart failure or acute pulmonary oedema precluding adequate patient positioning or oxygenation
11. Severe anaemia or coagulopathy aortic valve endocarditis

2.3 Basic Concepts in Cardiac Catheterisation

These preparations are related to all the stock and equipment used during the angiographic procedure.

THE VASCULAR SHEATH

Butler (2007) elaborates on the vascular sheath as follows:

- The vascular sheath contains an inner obturator (dilator), a diaphragm (non-return valve) and a side-arm
- The side-arm can used to record invasive pressures, serves as a drug administration port, and with the use of venous sheaths, as a fluid administration port
- The obturator is made from hard plastic (Teflon or poly-ethylene) that allows it to pass through fibrous tissue and calcified vessels
- The common sheaths range from 4 – 8 French (Fr)
- The length of the sheath varies from 6 cm to 35 cm
- Longer sheaths are used when one encounters tortuous femoral or iliac vessels, in order to facilitate torque control of the angiography catheters. If using 6F catheters, insert a 7 Fr long sheath
- 5 Fr sheaths are generally used to give more stability and support for brachial access
- 5 Fr or 6 Fr sheaths are used for femoral access
- 4 Fr – 5 Fr sheaths are used for radial access
- Sheaths are used for venous and arterial access
- The side-arm of the sheath is regularly flushed with heparin/saline solution
- The sheath is flushed when changing to a guiding catheter. If you are unable to unblock the sheath, the sheath must be changed
- Clots are often found in the side-arm and is thus important to flush the side-arm after the procedure and before the insertion of a vascular closure device
- There is a universal sheath color-coded system used to grade the size of the sheath:
  - Blue: 8 Fr
  - Orange: 7 Fr
  - Green: 6 Fr
  - Grey: 5 Fr
  - Red/pink: 4 Fr

(French size (Fr) is an international measurement used for catheters and other devices.
1 French size = ⅓ mm (6 Fr = 2 mm)).

THE ACCESS NEEDLE

Kern (2011) comment of the access needle as follows:

- There are generally 2 types of access needles: The open bore needle: these needles are easier to manage since they signal immediate blood return when the vessel is punctured. They may need periodical flushing if repeated attempts are done, because they become clogged with subcutaneous tissue, fat, or blood. Potts and Cournand needles are the common types.
- Seldinger-type needle: this needle has a stylet/short guide wire in place. Once vessel puncture is done, the wire is fed into the vessel, and then the sheath is placed once the needle is removed.
- Most needles are 6.5 – 7.5 cm in length. The

smaller, 3.75 cm, 21 – 22 gauge needle is used for radial artery puncture
- 18-gauge needles are used for femoral and brachial artery punctures
- Needles are conventionally sized by their outer diameter
- The gauging system is an arbitrary system: the higher the gauge, the smaller the outer diameter and vice versa

THE STANDARD GUIDE WIRE

Nguyen et al (2008) describe the standard guide wire as follows:

- Guide wires are used to facilitate passage of diagnostic or guiding catheters to the aorta
- Most guide wires consists of 3 components:
  - A central core (made from stainless steel or nitinol)
  - A distal flexible spring coil (made from platinum or tungsten)
  - The outer coating to decrease friction (usually silicone or teflon)
- Lengths of guide wires:
  - Short wires: 30 – 45 cm
  - Medium length: 125 – 150 cm
  - Long length: 250 – 300 cm

- Wire tips are flexible and are either straight tipped or J-tipped
- For majority of cases, J-tip wires are used, because it is less likely to induce vessel dissection and it avoids entering small vessel branches
- A straight tip wire is mainly used in attempting to cross a stenotic aortic valve
- The diameters of guide wires:
  - Small diameter wires: 0.018; 0.021; 0.025 inches
  - Medium diameter wires: 0.032; 0.035; 0.038 inches. These are the most frequently used wires
  - Large diameter wires: > 0.038 inches. Used with larger sheaths and larger catheters. Mostly used in peripheral cases Terumo wires are soft-tipped hydrophilic wires used when plaque-laden/burdened vessels are cannulated. These wires will minimise the risk of intimal plaque embolisation.

THE DIAGNOSTIC CATHETER

Uretsky (1997) addresses the diagnostic catheter in the following manner:

- The sections of a diagnostic catheter include a body (which is mostly straight throughout its course) and the tip, with various curves
- The curves are classified as primary, secondary and tertiary starting from the tip
- The hub of the catheter is a female luer-lock which allows attachment of a syringe or a manifold system
- The winged hubs helps to facilitate catheter rotation
- Diagnostic catheters are sized by the external diameters, and range from 4 Fr – 8 Fr
- Catheter lengths are usually 100 cm, but the angled pig-tail is 110 cm
- Both the left Judkins (JL) and right Judkins (JR) catheter have a primary curve of 90°
- The JL have a secondary curve of 180° and the JRa 30° secondary curve
- The JL catheter comes in various arm sizes (distance between the primary and secondary curve) e.g. JL5 have an arm length of 5.2 cm and the JL6 an arm length of 6.2 cm
- During most cases, a JL4 catheter is used, and if the aortic root is more dilated, a longer catheter arm will suffice e.g. JL 5 or JL 6
- In cases where a short left main trunk is encountered, a JL 3.5 can be used. If the JL range is unsuccessful, the Amplatz (AL) class can be used

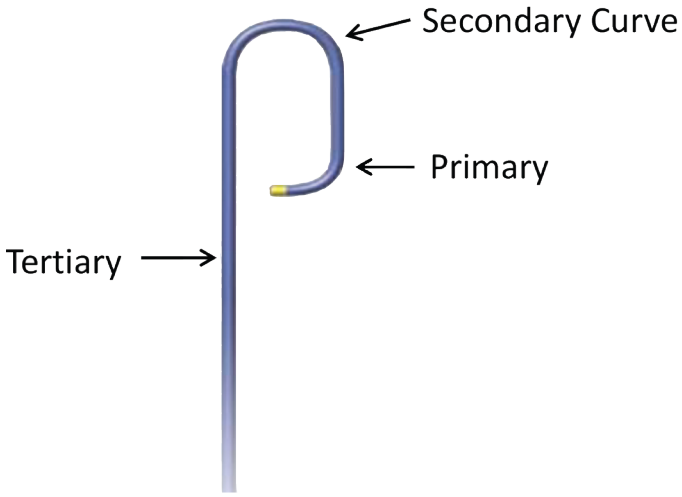


Figure 7.1: Judkins Left Catheter

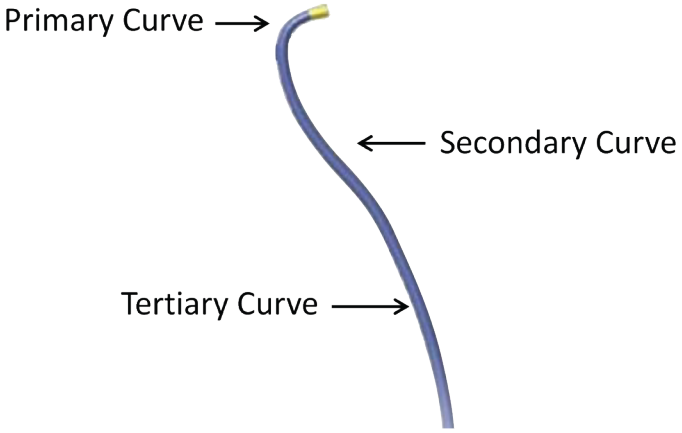
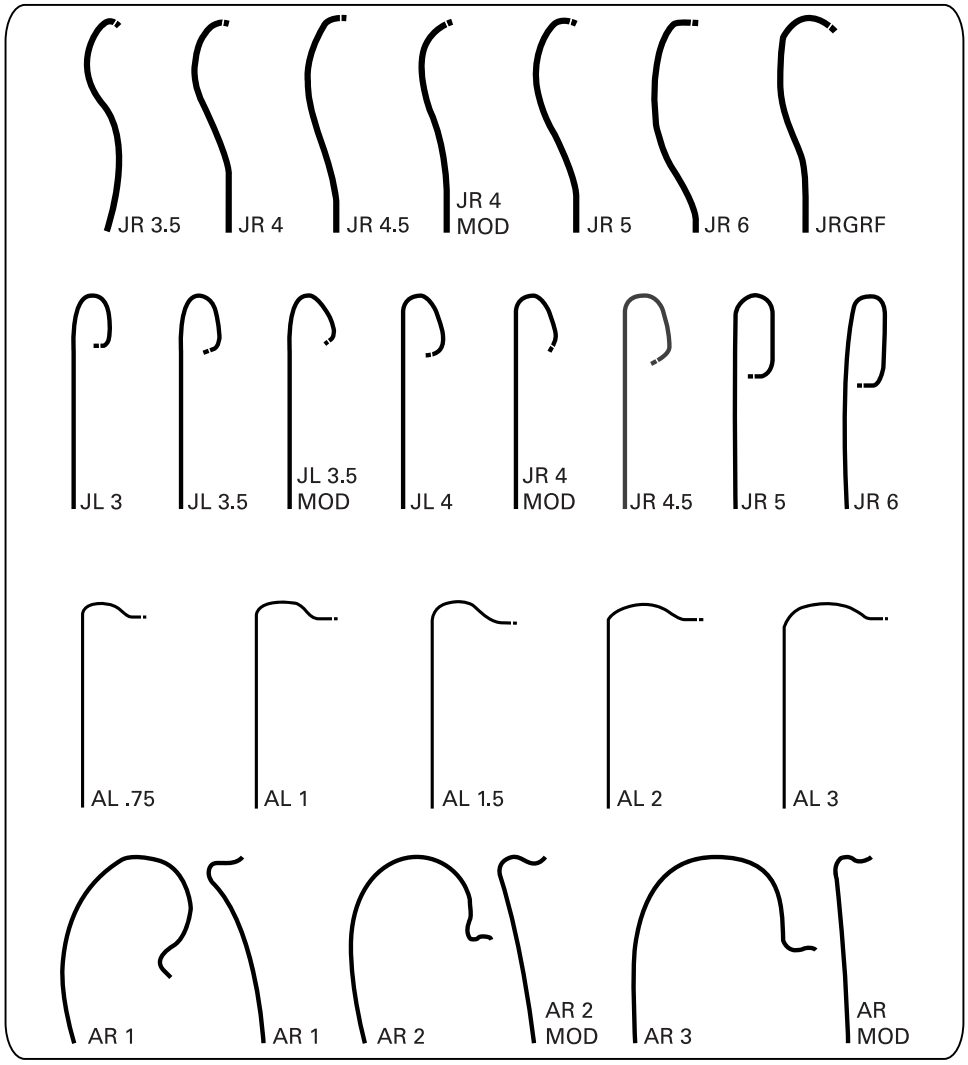


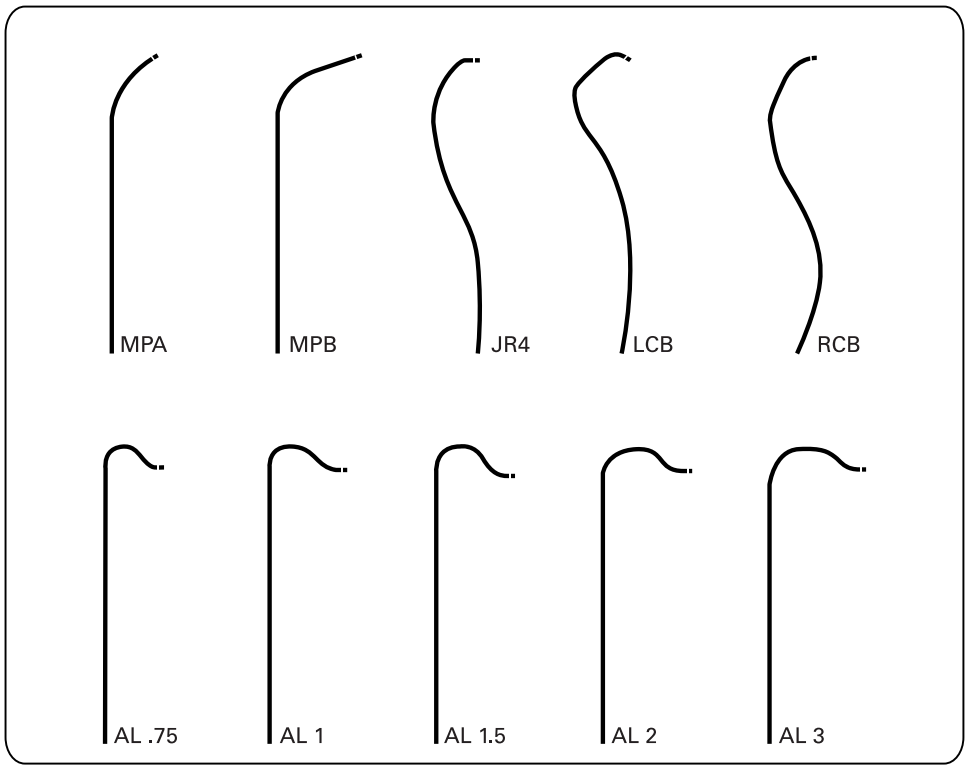
Figure 7.2: Judkins Right Catheter

- Amplatz (AL) catheters are suitable for engaging a short left main trunk or in cases where the left circumflex coronary artery and the left anterior descending artery have separate ostia. The AL range can also be used to engage high-anterior RCA's
- Right Amplatz (AR) catheters are useful for can nulating RCA's that have an inferior orientation
- In cases where the RCA ostium cannot be engaged by any of the above catheters, a 3DRC (No Torque Right) or Williams catheter can be used. The 3 DRC has a three-dimensional curve configuration
- Cannulating of saphenous bypass grafts: JR or JL can be used or the LCB and RCB catheters. Multi- purpose and modified Amplatz catheters can also be used
- Cannulating of internal mammary arteries: IMA catheters can be used, and sometimes the JL4 is also successful
- All catheters are sterile and sterility should be maintained when removing it from the packaging
- Remove guiding catheter on the cardboard to prevent the catheter from kinking. (Guiding catheters are often braided and are more prone to kinking)
- Flush all catheters with Heparin/Saline solution until flush-solution is expelled at catheter openings
- Guide-wire can now be positioned in preferred catheter before procedure commences

PREPARATION OF THE MANIFOLD SYSTEMS/ BRIDGES

- The 5 way manifold system is prepared by using Heparin/Saline pressure bag, and is done by the technologist. Ensure that all en-trapped air is expelled from the system before calibration is done and before the procedure commences
- The scrub nurse prepares the 3-way injection system by using the flush line from the 5-way manifold system
- Flush the Heparin/Saline line port first and ensure that all air is expelled from system
- Flush the pressure line and ensure all air is expelled from the injection system
- Prepare contrast line, by withdrawing with the pre-fixed luer lock syringe on far right side of manifold
- Ensure all air is expelled and maintain an erect syringe position (syringe tip is showing up)
- The rest of the injection system can be flushed





MPA – Multi-purpose
AMPB – Multi-purpose
BLCB – Left coronary bypass
RCB – Right coronary bypass
AL – Amplatz left
AR – Amplatz rightJR

Figure 7.3: Commonly used diagnostic catheters

with Heparin/Saline and ensure that all air is expelled from system.

- The 3-way manifold is now ready for calibration
- The manifold/pressure line is balanced at the level of the mid chest which should be equivalent to the level of the mid right atrium

PREPARATION OF THE PERCUTANEOUS TRANSLUMINAL CORONARY ANGIOGRAPHY (PTCA) BALLOON

- Always confirm correct size with the cardiologist and circulating nurse, as well as the expiry date of the product
- Remove balloon from packaging and keep the inflation pressure guide
- Flush the balloon tip using supplied needle-connector
- The balloon can be vented/de-aired via an attached 3-way stopcock
- Tip: If the balloon is utilised for numerous inflations, a 3-way stopcock can be kept attached to the balloon catheter hub. It saves time venting it if it is required to be used again.
- The balloon can be wetted with the heparin/saline solution. Do not wet a drug eluting balloon.

PREPARATION OF THE INTRA-CORONARY STENT

- Always confirm correct size with the cardiologist and floor nurse/sister, as well as the expiry date of the product.
- Remove stent from packaging and keep the inflation pressure guide.
- Flush the stent-mounted tip using supplied needle-connector (not frequently practiced).
- Bare metal stents can be dipped into with the heparin/saline solution.

PREPARING THE INDEFLATOR

- Prepare a mixture of 50:50 (may be varied) contrast medium and Heparin/Saline in a 20ml syringe or a galli-pot on the sterile tray. Use a contrast medium that has good visibility and is not too viscous, otherwise the balloon deflates slowly.
- Withdraw mixture from syringe or gallipot by pulling down the Indeflator plunger.
- Expel all air from Indeflator by turning the plunger-mechanism clockwise or by pressing down on the release valve of the Indeflator. Devices may vary.
- Ensure that ± 10 – 12 ml of mixture remains in Indeflator.
- When preparing the Indeflator, always make sure that device is in an upright position and that air is expelled in the 3-way tap's direction .
- Close the 3-way tap towards the Indeflator. If no 3-way tap or syringe is used: aspirate the pre-mixture of heparin/saline and contrast directly from the gallipot with the Indeflator. Follow the above principles to ensure that all air is expelled from the Indeflator.

THE GUIDING CATHETER (PROVIDES BACKUP)

An optimal guide catheter provides a stable platform for the cardiologist to advance devices to the coronary ostium, through tortuous arterial segments, and across tight lesions.

Askari et al (2011) discuss the guide catheter as follows: The guide catheter is selected according to the size of the ascending aorta, the location of the ostia to be cannulated, and the degree of tortuosityand calcification of the coronary artery segment proximal to the targeted area. The guiding catheter tip is soft, to ensure atraumatic ostial engagement.

Compared to diagnostic catheters, guide catheters have a stiffer shaft, larger internal diameter, shorter and more angulated tip (110° vs. 90°) and a re- enforced construction (3 vs. 2 layers).

As a device is pushed forward, any guide with a tip held still, not being displaced, will be considered an ideal guide catheter for the procedure. The most commonly used guide catheters are the Judkins, Amplatz and extra-back-up catheters.

Others include the multipurpose (for the RCA bypass or a high left main take-off) and the internal mammary catheter (for the superiorly orientated graft and the right and left Internal Mammary Artery (IMA) coronary bypass grafts). Guide catheters are also differentiated into guides with passive support and guides with active support:

- Passive support: the strong support is given by the inherent design of the guide with good back- up against to opposite aortic wall and stiffness from the manufactured material. Added manipulation of the guide is not required.
- Active support: is achieved by either manipulation of the guide into a configuration conforming to the aortic root, or by selective intubation with deep engagement of the guide into the coronary vessel.

STANDARD SAFETY TECHNIQUES WHEN USING A GUIDE CATHETER

1. Aspirate the guide catheter after it is insertedinto the ascending aorta for any thrombus oratheromatous debris floating into the guide.
2. Allow for generous bleed back and introduce devices into the Y-adaptor on flush to avoid air embolism.
3. Flush the guide catheter frequently to avoid stagnation of blood and thrombus formation inside the guide catheter.
4. Constantly observe the tip when withdrawing an interventional device and especially in patients with ostial or proximal plaques to recognise and prevent deep intubation of the guide secondary to withdrawal.
5. Observe the blood pressure curve for dampening to avoid inadvertent deep engagement of the guide tip.
6. During contrast injection, keep the tip of the syringe pointed downward so that any air bubbles will float up and not into the coronary system.
7. It is good practice to withdraw the guide catheter on a wire.

THE INTERVENTIONAL GUIDE WIRE (ANCHOR)

Guide wires are required to cross the target lesion and to provide support for the delivery of balloons, stents and other devices whilst at the same time minimizing the risk of vessel trauma. The suitability of a particular wire to different clinical situations depends on its performance characteristics that are determined by variations in the guidewire components. The main performance characteristics of the guide wire are: flexibility, torque control, steerability, trackability, crossing, radiopacity, lubricity, lubricity retention, tip shape retention, support, tactile feedback, pushability and prolapse tendency.

There are 3 main components to the coronary guidewire: the central core (inner part) extends through the shaft of the wire from proximal to

the distal part where it begins to taper. Core taper designs provide optimum guide wire tracking. The longer core taper offers wire tracking and have a lower propensity to prolapse. The shorter core tapers yield longer segments of consistent support. The central core is the stiffest part of the wire. It consists of a shaft which provides body, stability, flexibility and support for balloon tracking and torque transmission.

The core materials currently available are: stainless steel, durasteel and elastinite. Stainless steel is the original core material technology. Durasteel is stronger than conventional stainless steel and provides outstanding durability. Elastinite is an advanced material known for its flexibility and durability properties that offers exceptional pushability and torque control (Abbott Vascular.com).

A large core diameter provides increased support for device delivery and vessel straightening and more material for superb torque. Smaller core diameter provides enhanced tracking and flexibility. The next segment consists of a variable length of flexible spring coil and contains a forming ribbon for tip shaping. Coils provide tactile feedback, radiopacity and maintain constant overall diameters. Polymer covers provide smooth surfaces that allow lower guide wire profiles. The distal weld tip allows atraumatic passage of the wire. It is essential for lesion crossing and precise steering (Abbott Vascular.com).

There are two designs for tip styles: shaping ribbon and core-to-tip. The shaping ribbon design is respon- sible for tip shape retention and softness, while the core-to tip design allows tactile feedback and tip control, enabling exceptional torque. All guide wires have a specific surface design such as stainless steel coils, polymer or plastic covers, and hydrophyllic or hydrophobic coatings. Hydrophilic coatings attract water to create a slippery "gel-like" surface. Hydro- phobic coatings repel water to create a "wax-like" surface (Abbott Vascular.com).

Unfortunately, the perfect guidewire does not exist. Features to consider include: torque-control, steerability, visibility, flexibility and tractability. Coronary guidewires are available in 0.010", 0.014", 0.016" and 0.018" diameters. The most popular wires are 0.014". The 0.010", because of its extreme flexibility, is recommended when proximal vessel tortuosity is present. Because of its small diameter, there may be difficulty in balloon tracking. Large diameter wires (0.016"–0.018") have increased steerability, resulting in greater straightening of tortuous coronary segments, and provide more support for balloon catheter advancement. The normal length is 175 cm (Abbott Vascular.com).

Visualisation of the guidewire is due to the presence of a platinum coil wrapping. Most guidewires are radiopaque over the distal 1 – 3 cm. Radiopaque wires may occasionally interfere with visualization of dissection planes during contrast injections.

TYPES OF GUIDE WIRES

Di Mario et al (2011) differentiate between the following guide wires:

THE WORK HORSE WIRE

This wire possesses the balance between flexibility, support and steerability.

THE SUPPORT WIRE

This wire can accommodate challenging cases where extra support is needed for device delivery.

THE ACCESS WIRE

The access and crossing wires are designed to provide additional advancement or device delivery needed when facing tortuous anatomy and tightly stenosed lesions.

THE SPECIALITY WIRE

These wires are designed to exert force in a different plane to allow for successful device delivery in a calcium burdened vessel as well passage through a previously deployed intra-coronary stent.

- The core diameter affects the flexibility, support and torque of the guide wire
- The core material provides varying strength, durability and flexibility of the guide wire
- "Core-tapers" affect the tracking properties of the guide wire
- Coils & covers affect the support, tracking, lubricity and radiopacity of the wire
- Different tip styles are designed to provide shape retention, safety and tactile feed back
- The coatings of the guide wire effect the lubricity and tracking properties of the guide wire

VENTRICULOGRAPHY

Left ventriculography is the visualisation of the left ventricle by filling it with contrast media using an electrically driven power injector. Ventricle size, global systolic function and regional contractions can be assessed visually or by computerised calculation derived from its angiographic contours.

Left ventriculography is also employed to evaluate the degree of mitral regurgitation or the presence of a ventricular septal defect (Baim & Grossman:2000).

CONTRAINDICATIONS FOR LEFT VENTRICULOGRAPHY

1. Critical left main disease
2. Critical aortic stenosis
3. Fresh intra-cardiac thrombus
4. Contrast medium reactions
5. Tilting-disc aortic valve prosthesis
6. Decompensated heart failure/or renal failure
7. Haemodynamic unstable patient

GLOBAL VENTRICULAR FUNCTIONING

Watson & Gorski (2005) elaborate on ventricular functioning in the following manner:

The ventricle is evaluated as enlarged, normal or small. The following Objective measurements exist for a ventriculogram:

End diastolic volume (EDV)	Volume in ml at the end of diastole
End systolic volume (ESV)	Volume in ml at the end of systole
Stroke volume (SV)	Volume in ml ejected during every contraction (SV = EDV – ESV)
Ejection fraction (EF)	The percentage of the EDV that is ejected during systole (EF = SV X 100%) EDV

The following is a rough overview of the implications of an abnormal EF:

< 20%	Severe heart failure
20 – 40%	Severe reduction, heart failure
40 – 50%	Moderate reduction: patient may have symptoms of heart failure
50 – 60%	Slight reduction: patient may be asymptomatic
60 – 80%	Normal
>80%	Hypercontractile, usually found with severe hypertrophy

REGIONAL FUNCTION

Uretsky (1997) stipulates that each region of the ventricle is subjectively judged as being normal, hypokinetic, akinetic or dyskinetic.

- Hypokinetic: reduction of inward motion during systole
- Akinetic: absence of inward motion during systole
- Dyskinetic: paradoxical outward motion during systole

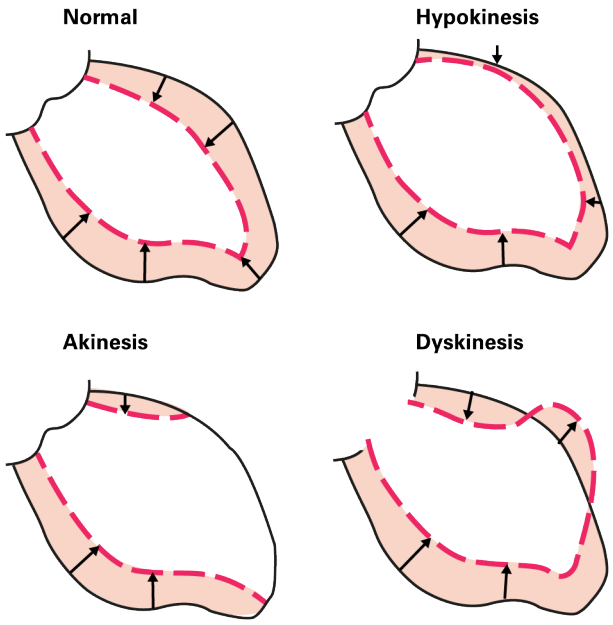


Figure 7.5: The areas/regions of the ventricle

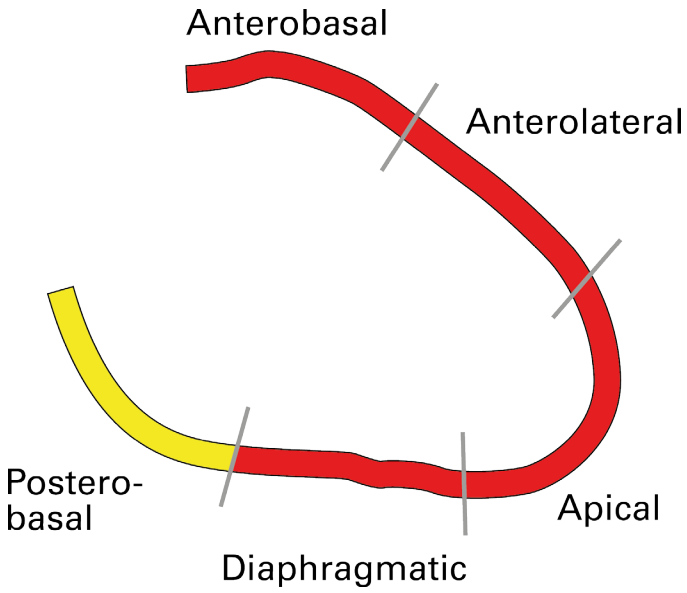


Figure 7.6: Presentation of abnormal ventricular contraction

THE PROCEDURE FOR THE PERFORMING OF A LEFT VENTRICULOGRAM

- A left ventriculogram may be omitted in patients with severe renal impairment, to minimise the risk of contrast induced nephropathy, or in long PCI procedures where high amounts of contrast medium was used
- Some cardiologists start the coronary angiogram with a LV Angiogram
- Some cardiologists conclude the coronary Angiogram with a LV Angiogram
- A 5F or 6F 145° - straight or angled pigtail catheter with multiple side-holes is used (this prevent endocardial staining and reduce catheter recoil)
- Guide wire is advanced to the aortic root, where after the cardiologist guides the wire across the Aortic valve, into the left ventricle
- The pigtail catheter is advanced over the wire until freely positioned into the left ventricle (mid-chamber placement is more accurate)
- Ventricular ectopy is expected
- The guide wire is removed and the catheter is flushed heparin/saline
- The pigtail catheter is now connected to haemo-dynamic system and the LVEDP is measured
- The haemodynamic system is disconnected, and the pigtail catheter is now connected to the power injector, using a high pressure tubing
- The radiographer may aspirate on the high pressure line to ensure that no air bubbles is in the system
- The injection rate and volume is set: 10–15 ml/s with 30 – 45 ml/s contrast
- Filming projection: 30° RAO: it projects the left ventricle off the spine, producing a higher quality picture
- 60° LAO: most useful for functional assessment of the ventricular septum, lateral wall, and posterior wall. The aortic valve is well visualised in this projection
- The patient is warned about the sudden and transient effects of the contrast medium! (Hot flush and feeling that he/she is passing urine)
- A valvular gradient can be assessed by pulling the pigtail catheter across the aortic valve
- Crossing a stenotic aortic valve may be more difficult. Some authors suggest using a straight-tip wire and an Amplatzer L1 multipurpose or JR4 diagnostic catheter. A straight terumo exchange wire and a JR4 is often very successful.

THE IMPORTANCE OF A MID-CAVITARY POSITION OF THE PIG-TAIL CATHETER

The mid-cavity position ensures:

- That adequate contrast agent is delivered to the chamber's body and apex
- That the catheter does not interfere with mitral valvular function
- That the side holes of the catheter are not wedged within the ventricular trabeculae (possibly causing endocardial staining)

COMPLICATIONS ASSOCIATED WITH THE LEFT VENTRICULOGRAM PROCEDURE

Baim & Grossman (2000) and Butler et al (2007) identified the following complications associated with the performance of a ventriculogram:

1. VENTRICULAR DYSRHYTHMIAS

This is due to the mechanical stimulation of the left ventricle by the catheter or jet of contrast medium. It can be minimised by repositioning of the catheter.

2. COMPLETE HEART BLOCK

This is mostly seen in patients with underlying right bundle branch block and left posterior fascicular block. Because of the proximity of the anterior fascicle of the left bundle to the left ventricular outflow tract, transient left anterior fascicular block may occur.

3. ENDOCARDIAL STAINING

This complication is ascribed to the deposition of contrast medium within the endocardium and myocardium. It is usually caused by improper placement of catheter so that the catheter passes under a papillary muscle or a side-hole lying firmly against the endocardium. A small endocardial stain is unproblematic, but a large stain can lead to ventricular tachycardia or ventricular fibrillation. Myocardial perforation due to the contrast jet is very rare.

4. EMBOLISM

This complication includes air embolism and thrombotic embolism. Thrombus can be found within the catheter or thrombus in the left ventricular apex. Air embolism is usually due to air in the power injector syringe or tubing. Extra care must be taken when purging the injector syringe otherwise air enters the catheter.

5. CARDIAC TAMPONADE

This is a rare and potentially fatal complication due to ventricular wall perforation by the diagnostic catheter or a powerful contrast jet through diagnostic catheters with only one end-hole.

6. CATHETER ENTRAPMENT

Entrapment may occur in patients with tilting-disc mechanical valve prosthesis, or the catheter may be entrapped in the mitral valve apparatus

ANGIOGRAPHY OF GRAFTED VESSELS

In patients with previous coronary bypass surgery, the operative, prior catheterisation records and previous angiograms should be reviewed for helpful remarks. Special care must be taken to visualise all grafts and native vessels. An aortic root injection may be necessary to document the occlusion of an aortic anastomosis of a vein graft. Metallic clips placed during the operation are helpful in locating the aortic anastomosis site, but do not always pinpoint the graft ostia (Pepine: 1994).

SAPHENOUS VEIN GRAFTS

Pepine (1994) states that saphenous vein grafts are the most commonly employed conduits in surgical revascularisation. These conduits' patency can decrease with 63% over a 10 year period. IMA grafts may last more than 20 years.

The proximal anastomosis of most aorto-coronary Saphenous vein graft SVG's lies on the anterior surface of the aorta, several centimetres above the sinus of Valsava. Grafts to the left circumflex artery are typically placed most superior, followed in succession inferiorly by grafts to the diagonal branches of the left anterior descending artery, the LAD itself and the right coronary artery (Pepine:1994).

Because of variations in surgical technique, exceptions to this rule exist. If prior angiograms are available, they should be viewed before commencing the coronary angiography, because it can be valuable in locating the graft ostia.

The proximal anastomosis sites of these grafts lies superiorly to the native ostia. Most surgeons don't place ostial markers on the outer surface

of the aorta at the time of surgery. Surgical clips may also provide clues as to where grafts are located.

Steady "up and down" movements of diagnostic cath- eters in the ascending aorta with slight clockwise or counter clockwise rotations, typically from the second to the forth sterna suture, facilitate engagement of the various grafts. The catheter tip often "jumps" for- ward when it engages a conduit ostium. Dampening of the pressure waveform may indicate that the cath- eter tip is lying against the vessel wall or that an ostial lesion may be present. In this situation, the catheter is cautiously withdrawn while simultaneously reversing its torque (Pepine: 1994).
Occasionally, the pressure waveform remains dampened and it may be necessary to perform a rapid injection of contrast with quick removal of the catheter to rule out stenosis or subtotal conduit occlusion. It is important to remember that contrast injection through a deep-seated manoeuvre may not define an ostial lesion. Occluded conduits will appear as a "stump" upon contrast injection.

If a conduit cannot be cannulated, do not assume that the conduit is occluded. Other diagnostic catheters with different angulation may be necessary. If further attempts fail, aortography may be helpful to locate conduits.

Evaluating the native coronary flow can also provide clues regarding conduit patency:

- If a bypassed native artery demonstrates competi- tive distal flow, the conduit supplying that artery is likely patent
- If normal distal flow is seen in the bypassed native vessel, without competitive filling, the graft is most likely occluded.

INTERNAL MAMMARY GRAFTS

Freed & Grines (1992) are of the opinion that these conduits provide superior patency rates compared to venous grafts in the long term. It has been reported that the patency rate is 90% in 10 years.
When these conduits fail, the culprit lesion usually lies at the distal anastomosis or in the artery just beyond the anastomosis.

The Left Internal Mammary (LIMA) is often anasto- mosed to the mid- or distal LAD, but may also be grafted to the diagonal branches or the circumflex artery. It typically arises anterior-inferiorly from the left subclavian artery 1 - 3 cm beyond the vertebral artery. Because the LIMA arises with a 90° angle from the subclavian artery, a diagnostic catheter with a sharp curve may be needed to cannulate the ostium (JR 4 and IMA catheter).

Contrast injections may cause a burning or painful sensation. The patient is instructed to turn his/her head to the left or the right, and this manoeuvre may change the orientation of the catheter to aid in cannulation.

When difficulty arises in cannulating the LIMA ostium, a blood pressure cuff can be inflated on the left arm, to aid in directing the contrast flow preferentially down the LIMA instead of distally into the brachial artery.
The RIMA is cannulated in the same fashion, but poses a more challenging procedure. Do not apply a blood pressure (BP) cuff to the R/arm.

RADIAL GRAFTS

Nguyen et al (2008) asserts that these conduits are placed in the same manner as the SVG's. Studies reveal that these conduits have a patency rate of 92% at 5-7 years post surgery. Angiographically, these grafts have a smaller calibre and smoother appearance than the SVG conduits.

DIAGNOSTIC CATHETERS USED

Diagnostic catheters used for LEFT graft angiography include: JR 4, Multipurpose, LCB.

Diagnostic catheters used for RIGHT graft angiography include:
JR 4, RCB, 3-DRC, Multipurpose, right modified Amplatz.

2.4 Asepsis in the Cardiac Catheterisation Laboratory

Asepsis involves the preparation of the equipment, skin, environment and the sterilisation methods and the maintenance of aseptic techniques by all personnel involved in procedural care.

Asepsis in the cardiac catheterisation laboratory spans across the following areas and principles: the geographical lay-out of the laboratory, the sterile field, the catheterisation laboratory personnel, scrub technique, gowning and gloving technique, patient preparation and cleaning of the catheterisation laboratory.

THE CATHETERISATION LABORATORY ENVIRONMENT

Bashore et al (2001) state that the activity and the type of attire segregate the different operational areas in the catheterisation laboratory. If the geographical lay out of the operational area is well thought through as well as the flow of personnel through the laboratory, it will contribute to the asepsis in the laboratory.

In an unrestricted area or at the control station, the ward clerk, catheterisation laboratory manager, cardiologists and all external personnel can enter, and civilian clothes are permitted. All the non- clinical administrative activities take place in this area. The staff dining room and on-suite ablution facilities are also considered an unrestricted area (Bashore et al: 2001).

In semi-restricted areas (equipment room, stock room and access corridors), personnel are required to wear theatre attire. The scrub room is usually located outside the catheterisation laboratory procedure room and is considered part of the semi-restricted area.

In the restricted areas (the procedure room where angiography and intervention is performed), theatre attire is mandatory. Masks should be worn when open procedures are performed, e.g. permanent pacemaker insertion (Bashore et al: 2001).

Bashore et al (2001) state that there are 3 strategies that are employed to inhibit microorganism in the catheterisation laboratory:

- Humidity is maintained between 30 – 60%
- The laboratory is kept cool between 16 – 18°C
- The laboratory is ventilated through high efficiency filters at a rate of 20 – 25 total room exchanges per hour. A filter system is used the ensure maximal microorganism entrapment

THE STERILE FIELD

The sterile field is the area considered free of virulent particles. It is referred to as the draping of the patient as well as the procedure trolley.The edges of a sterile field are considered unsterile. If a sterile field or item is left
unattended, it is deemed unsterile (SATS: 2011). Scrubbed personnel are considered sterile in the front from the waist to the chest and from the elbows to the fingertips. Hands should be held at chest level when not performing a task, and should never touch an unsterile object (SATS: 2011).

Non-scrubbed personnel are not allowed to lean or stretch over the sterile field and should stay clear at least 30 cm away from it. Non-scrubbed personnel are not permitted to pass through two sterile fields. Sterile stock should be opened onto the sterile field away from the staff member's body. A sterile item that touches an unsterile area must be discarded and replaced. Wiping of these items with any disinfectant is still considered unsterile (Uretsky:1997).

CATHETERISATION PERSONNEL

The strict operating room environment is not necessary for the catheterisation laboratory, because infection prevalence after percutaneous cardiovascular procedures is extremely low. The infection incidence in the cardiac catheterisation laboratory is 0.35% (Uretsky: 1997).

The cardiologist and scrub nurse must employ the appropriate hand washing technique and should be dressed in a sterile gown and gloves. The wearing of caps is advocated, but the wearing of masks remains controversial. When open procedures (cut-down, insertion of permanent pacemaker or defibrillator etc) are planned, masks, caps and sterile attire are mandatory (ACC: 2012).

All personnel must practise good personal hygiene. Nails are kept short and free from nail varnish and chipping. No artificial nails must be worn due to the risk of fungal infections underneath them. No hand jewellery is to be worn, but earrings and necklaces remain controversial. Jewellery can potentially act as hiding places for microorganisms, and removal of all jewellery remains the best practice (SATS: 2011).

Personnel suffering from colds, sore throats, open injuries and sores and other infections should not be permitted to work in the catheterisation laboratory until they are well.

THE SCRUB TECHNIQUE

The purpose of surgical scrubbing is to remove debris and transient microorganisms from nails, hands and forearms. It reduces the resident microorganismcolonization and inhibits the rapid rebound growth of skin microorganisms (www.tpub.com).

THE SCRUB TECHNIQUE

Hands and forearm are scrubbed for 8 minutes for the first scrub of the day. Hands should be held above the elbows so that the water drips from the hands to the elbow. It is recommended that hard brushes should not be used as they may damage the skin and promotes dermatitis. Hands are dried with a sterile cloth or paper towel from the fingers to the elbows. Drying of your hands is important, because microorganisms are transferred in larger numbers from wet hands than dry hands (www.tpub.com).

THE GOWNING TECHNIQUE

The floor nurse usually assists the scrub nurse or cardiologist. It is important to check the surroundings to ensure adequate space for the outstretched arms.

a. The scrub nurse and cardiologist must hold the folded sterile gown away from the body by the collar
b. Allow the gown to drop open, ensuring that the gown doesn't touch the floor or any other object
c. Slide the arms into the sleeves, keeping them above the waist at all times. Flex the elbows and abduct the arms.
d. The circulating nurse must grasp the collar of the gown, pull it over the shoulders and fasten it at the back of the neck.

THE GLOVING TECHNIQUE

There are two methods practised to don sterile gloves, namely the open and closed method.
The open method involves applying gloves with bare hands and pulling them over the gown sleeves.

a. The sterile gown is donned.
b. Using the non-dominant hand, pick up the glove for the dominant hand at the cuff, using only your fingertips.
c. Slide this hand into the glove until fitted over the thumb joint and the knuckles. The un-gloved hand must only touch the folded cuff.
d. Slide the gloved fingertips into the folded cuff of the remaining glove. Slide the un-gloved hand into the glove until fitted.
e. Unfold the cuffs of both gloves down over the gown cuffs and up the sleeves as far as they will go. The closed method involves applying gloves with the hands remaining covered by the cuffs of the sterile gown.
f. The arms are pushed only so far into the sleeve of the sterile gown that the hands are still covered by the cuff.
g. The non-dominant hand (covered completely by the cuff) is used to pull the sterile glove onto the dominant hand.
h. The gloved hand then applies the remaining glove to the other hand.
i. The gloves are adjusted once both hands are covered.

PATIENT PREPARATION

The scrub nurse needs to explain the sterile principles to the patient. This usually entails where to touch and where not to touch once the surgical towels or drape has been positioned. The skin is prepared by using the aseptic technique. Most infections arise from the patient's endogenous skin flora, mucous membranes or hollow viscera.

Hair removal should be done by using clippers instead of a razor, preventing micro-breaks in the skin which serve as a source of infection.

The Joint Commission (2012) advocates the use of an appropriate skin preparation (isopropyl alcohol, chlorexidine or povidone-iodine) and preparation of the skin for at least 30 seconds. The site is swabbed using a circular motion from the centre of the puncture site to the outside. The antiseptic solution should remain on the skin for at least 30 seconds before it is swabbed dry. It is important to check any sensitivity with the patient first!

SKIN PREPARATION SOLUTIONS:

a. 70% Isopropyl alcohol:
- Denaturates protein, but is short acting.
- Effective against gram-positive and gram-negative organisms
- It is fungicidal and virucidal

b. 0.5% Chlorexidine:
- An ammonium preparation that disrupts the bacterial cell wall
- It is bactericidal, but ineffective against
- spore forming bacteria
- It possesses a long acting duration
- More effective against gram-positive organisms

c. 70% Povidone-iodine
- Acts by oxidation/substitution of free iodine
- Bactericidal and effective against spore forming organisms
- Effective against gram-positive and gram-negative organisms
- It is rapidly inactivated by organic material such as blood

CLEANING IN THE CATHETERISATION LABORATORY

The Joint Commission (2012) advocates that the laboratory must be cleaned between cases. Soiled linen and garbage is removed. Spills are cleaned from the floor, and the procedure table and monitoring cables are cleaned with a disinfectant. All equipment must be spot cleansed if soiled with body fluids.

Septic patients and infected patients should be done as the last procedure for the day. In some catheterisation laboratories, new pressure transducers are used with every patient. The common practice is to use the pressure transducer for all the cases and then discard it at the end of the day, unless contaminated.

TERMINAL DISINFECTION OF THE CATHETERISATION LABORATORY

Depending on where the Cath Lab is situated, e.g. theatre or separate area, the floor, walls, equipment and all surfaces are washed to remove contaminants and dust. This also includes the scrub area, utility area, surgical lights, tracks and handles of cabinets. Lead aprons and thyroid shields should also be cleaned (Joint Commission:2012).

Yellow bags in the lab are used for septic linen and blood stained gowns and lotion cloths. Red bags are to be used for paper and plastic that are blood- stained or contaminated.

This Module is Linked to a CPD Accredited Online Questionaire at www.sasci.co.za

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