Peripheral vascular disease is a condition seen in elderly adults which results in reduced blood flow to legs and arms due to various causes. Patients come for procedure like embolectomy, vascular bypass, amputations etc., at various stages of their disease. Associated systemic complications like CAD, CKD, hypertension and diabetes make anaesthesia risky. Use of general and regional anaesthesia requires special care depending on patients’ morbidity and procedure planned. Anticoagulation and advanced age make decisions more complicated. More endovascular procedures are done in high risk patients compared to open bypass surgery now a days to reduce postoperative morbidity and mortality due to cardiac or respiratory complications.

KEYWORDS
Gangrene, Claudication, Endarterectomy, Bypass, Antiplatelets, Cardiac Risk Assessment.


INTRODUCTION
Peripheral vascular diseases are diseases affecting the blood vessels of the legs and arms. It includes cerebrovascular and cardiovascular diseases. Most common causes are diabetes, smoking, dyslipidaemia and chronic kidney disease. They affect peripheral vessels in the arms and legs and so the term peripheral occlusive disease is used. It can affect both arteries and veins leading to deep vein thrombosis and arterial obstruction to varying degrees.

PATHOPHYSIOLOGY
In PVD there is narrowing of blood vessels due to arteriosclerosis. This is a condition where there is hardening of vessels due to deposition of plaques called atheroma inside their lumen. The resulting narrowing of blood vessels leads to reduced blood flow to arms and legs and ischemia in the early stages of disease, symptomatically resulting in claudication and ischemic changes in the skin. Severe narrowing and thrombus formation leads to occlusion of vessel in the later stages resulting in non-healing ulcers, damage to toes and finally gangrene requiring amputation (Critical limb ischemia).

The incidence of PVD is 12-20%, especially in adults over 65 years with risk factors like diabetes, hypertension, dyslipidaemia etc. that can accelerate atherosclerosis and result in narrowing of vessels.

Other causes like TAO, embolism, immunological disorders, homocystinuria may lead to peripheral vascular diseases in younger patients. Changing lifestyle alters the course of the disease, prevent rapid progression and improves lifespan. Minimally invasive surgeries improve survival and reduce the amputation rates even in advanced stage.

Risk Factors for PVD
Smoking.
High blood pressure (Uncontrolled).
DM.
Dyslipidaemia.
History of cerebrovascular disease/Heart disease.
CKD.
Haemodialysis.
Obesity.

Symptoms
In chronic ischemic limb, the patient experiences symptoms such as pain, skin colour changes, wound ulcers, reduced hair growth, intermittent claudication etc. Affected limb may become gangrenous when blood flow is critically reduced. In case of acute obstruction, symptoms such as pain, paraesthesia, paralysis and absence of pulse may be seen and may require urgent embolectomy to save the limb from amputation.

Diagnosis
The diagnosis may be made clinically by detecting absence or decreased pulse in the affected limb compared to normal one.

High Risk Patients with one of the following Symptoms should have detailed Evaluation using Ultrasound
1. Exertional leg symptoms.
2. Non healing wounds.
3. Age>65 years.
4. History of diabetes, smoking etc.

Ankle and Toe Brachial Index is a commonly used index. It measures the ratio of pressure in leg and hand, Normal ratio is >1.4 and a ratio of <0.9 is abnormal.

Segmental Pressure Examination measures each segments of leg separately. Exercise TMT and 6 minute walk test can also be used as screening test to identify patients with PVD.

Continuous wave Doppler helps in accurate assessment of blood flow, severity of obstruction and for follow up of patients.
Angiography or CT-angiography helps in accurate assessment of the obstruction and to know about the severity and site of obstruction in the vessels. MRI and MRA can be used in patients who cannot undergo CT angiogram. Duplex ultrasound helps in diagnosis and anatomic localization.

Treatment
Treatment for peripheral artery disease include lifestyle changes, medicines, and surgery or procedures. The overall goals of treating POVD include reducing risk of heart attack and stroke; reducing symptoms of claudication; improving mobility and overall quality of life; and preventing complications.

Non-Surgical Treatment
Reducing risk factors helps to reduce the incidence of stroke and myocardial ischemia in addition to slowing progress of POVD. Lifestyle changes like exercise, stopping smoking and weight reduction has to be encouraged.

Exercise improves blood flow and reduce other risk factor like cholesterol and hypertension. It also helps towards better control of diabetes. Supervised exercise programmes are better than unsupervised programmes and for patients with heart disease and graded exercise programme should be used and gradually increased as tolerated.

Medications which are commonly used for early symptomatic relief of pain and to improve walking distance for POVD are Cilostazol 100 mg oral bd improves symptoms and walking distance, patient should not have cardiac failure. Pantoprazol 400 mg three times daily is used as second line treatment. Antiplatelets like aspirin 75-325 mg [Clopidogrel is an alternative to aspirin in intolerant patients] Anti-coagulation with warfarin Lipid lowering drugs to reduce LDL level to less than 70 mg Homocysteine lowering drugs Pain control during walking using analgesics, paracetamol tramadol etc., Sympathetic blockade with local anaesthetics followed by permanent medical ablations using alcohol in case of severe intractable rest pain. Other treatment tried without much success are L-arginine, propionyl-L carnitine and ginkgo biloba.

Surgery
Major aorto-bifemoral surgery has significant mortality which has started coming down. In comparison to mid 1980s when the mortality was 7%, the mortality has come down to 4% in the late 90s. All aspects of morbidity have come down with the exception of infection compared to previous decade.

With limited open vascular surgical techniques and more endovascular procedure along with the use of drugs like statins, Beta blocker and antiplatelets less amputation rate is seen in the present decade.

SURGERIES COMMONLY DONE FOR POVD ARE

End arterectomy
Open or special laser devices are used to perform endarterectomy, where atheromatous plaques are shaved off from the vessel intima.

Angioplasty
Of the narrowed segment and stenting can be done even in high risk patients, reducing amputation rates. Medicated stents are also available.

Bypass Procedures

For more patency open vascular surgeries like bypass of vessels using vein/synthetic graft may be done in selected patients. Bypass should be constructed using autologous vein as far possible. Indications for bypass surgery are patients with acceptable risk, suitable lesion for endovascular repair, need for more durable repair and failure of endovascular repair. Commonly done bypass procedures are femoro-popliteal bypass, aorto-femoral bypass and aorto-tibial bypass.

In cases of acute obstruction due thrombus or embolus, embolectomy and catheter based thrombolysis may be done. Surgeries are used to give symptomatic treatment. They do not alter the progress of disease. The 2011, ACCF/AHA, focussed update guidelines for management of peripheral artery disease in circulation April 2013, recommendation for patients with critical limb ischemia and life expectancy of more than 2 years recommends autologous vein bypass. If conduit is not available, then balloon angioplasty is to be performed as a choice. In patients with low risk for surgery, bypass with autologous vein has less complication rates and better patency. In high risk patient with less than 2 years lifespan endovascular repair is safer.

Anaesthetic Implications
Advanced age and comorbid conditions. Multiple drugs on which patient is on like insulin, antihypertensive, statin CAD drugs like antiplatelets, clopidogrel etc., Post-operative issues like MI, pneumonia, cognitive disorders, stroke. Technique of anaesthesia to be chosen- Regional vs. General. Effect of aortic cross clamping/partial cross clamping on haemodynamics and myocardial ischemia.

Arrange blood, Two large 16 gauge iv Cannula, Fluid warmers, EKG with lead v5 and ST analysis. Heparin, arterial line, in high risk patients with aortic procedure CVP monitoring, TEE, ACT monitoring may be required. Drugs like vasodilators to control BP and intraoperative ischemia Inotropes, HDU admission for post-operative care are required.

Goals
Hemodynamic stability during surgery. Temperature should be maintained. Good pain management using RA or PCA. Anticoagulants and antiplatelets in the immediate postoperative period. Avoid strain to the heart by appropriate control of BP.

Anaesthesia Techniques
GA or RA can be used depending on experience and patient conditions. Concerns during Regional anaesthesia are anticoagulation, patient cooperation, long duration of some surgeries which may require planning depending on intraoperative findings, unstable patients, hypothermia, patients that are disoriented or have dementia. Continuous catheter RA methods preferred than single bolus methods considering extensibility of anaesthesia time. Some earlier studies showed better graft patency with RA compared to GA, but now no such difference is seen as per recent studies.[3,4,5,6]

Preoperative risk assessment mainly involve cardiac risk assessment. Postoperative MI and CCF is a leading cause of mortality and poor outcome.[7] Cardiac risk assessment can be done using AHA/ACCF preoperative risk assessment for non-cardiac surgery or Eagles revised cardiac risk index. The
vascular study group of new England also have risk assessment criteria.\textsuperscript{[8]}

**VASCULAR SURGERY GROUP CARDIAC RISK INDEX**

**Risk Factor**

- Age > 80 Points : 4
- 70-79 : 3
- 60-69 : 2
- CAD : 2
- CCF : 2
- COPD : 2
- Creatine : 2
- Smoking : 1
- Insulin dependent Diabetes : 1
- Long Term Beta Blocker : 1
- CABG/PCI : 1

Patients with more than 3 risk factors and poor functional capacity < 4 METS have poor outcome. Age corrected revised cardiac index also can be used for better assessment. Peripheral nerve block with catheters can be used in very high risk patients, who cannot withstand spinal or epidural. Regional anaesthesia is associated with better postoperative respiratory functions, postoperative pain control. Use of RA may be associated with Epidural Hematoma due to aspirin, clopidogrel and heparin use intraoperative and postoperative if not timed properly, so ASARA 2014 guidelines for anticoagulated patients has to be followed. Nerve Blocks commonly employed are femoral sciotic, popliteal. Lumbar paravertebral blocks.\textsuperscript{[9]}

If spinal/epidural is planned unfractonated heparin is given at least 4 hours before or 1 hours after spinal to avoid epidural bleed. LMW heparins need longer duration 12 hours is needed before putting epidurals and 4 hours should be given after putting before giving LMW heparin. Better to put the previous day of surgery, care should be taken during removal also as per ASARA guidelines 2014.Post-operative good communication between surgeon and anaesthesiologist i needed to optimally time removal of catheter.

Some anaesthesiologist prefer GA due anticoagulation and medico -legal issues if hematoma should occur. GA not associated with more mortality or postoperative cognitive disturbances. But postoperative respiratory complications were more with GA vs. RA.\textsuperscript{[10]}

Postoperative pain management also has to be taken care of additionally in GA cases. LMA can be used in cases with care depending on experience of anaesthesiologist and avoids need for ETT and less postoperative respiratory disturbance. But care should be taken to prevent aspiration. LMA is beneficial in COPD patient who do not cooperate for RA. Both TIVA and inhalational agents can be used with care to maintain hemodynamic stability during usage especially in CAD patients. Graft patency is same in both forms of anaesthesia.\textsuperscript{[11,12,13]}

Goals of General Anaesthesia Optimal hydration, good pain control, hemodynamic stability. Intraoperative Tachycardia and hypertension should be treated to avoid ischemia to heart. In case of cross clamping optimal blood pressure control and avoidance of myocardial ischemia during cross clamping should be our aim.

**INVESTIGATIONS**

All patients should undergo cardiovascular evaluations using resting E.C.G, TMT, Echo, stress Echo as noninvasive methods. If found to have Myocardial ischemia they may need angiography followed by stenting or Coronary bypass grafting as revascularization before surgery to avoid postoperative myocardial infarct which is one cause for postoperative mortality. Patients with unstable coronary state like unstable angina, MI<30 days, heart failure, serious arrhythmias serious valvular diseases may require detailed investigations and corrective valve surgery, stenting or CABG prior to procedure for PVD. They may be posted 4 to 6 weeks for the procedure for myocardium to stabilize. Detection of occult heart failure may be difficult in bed ridden old patients. BNP level can be estimated to detect occult heart failure if echo is inconclusive. Heart failure should be managed medically before vascular procedure to improve survival. If limb saving situation arises then both CABG or stenting can be done simultaneously with peripheral bypass graft without delaying. CARP (Coronary artery revascularization programme) on outcome of vascular surgery did not show any difference in mortality or MI following coronary revascularization in patient with associated CAD. The majority of patients. In CERP study had only single or two vessel diseases and with good left ventricle functions. In DECREASE –V PILOT STUDY a cohort of 101 subjects with extreme stress induced ischemia were studied, and were randomized to medical treatment or revascularization for CAD The author concluded that to study the efficacy of revascularization it would require to study 9000 patients with coexisting CAD.

Coronary revascularization is recommended in patients with high risk anatomy like left main CAD, two vessel disease with significant proximal disease, left anterior descending artery stenosis, patients with EF less than 50%. PCI is indicated in patients with acute STEMI, unstable angina and NSTEMI. Antiplatelet should be started keeping in mind requirement for surgery within 3 year for PVD.

Patients may be put on B blockers if found to be high risk for cardiac events. Beta blockers help reduce myocardial ischemia, myocardial mortality and death in high risk patients during surgery. Benefit in low risk patients is questionable. POISE study showed decreased mortality but more strokes rates with B blockers. Some study shows benefit with Alpha blockers also. Patients already on B blockers they were put on Bisoprolol with Fluvastatin 80 mg group, beginning 30 days before surgery, if not already on beta blockers they were put on Bisoprol, the death from MI was 4.8% compared with placebo of 10%.

**MANAGEMENT OF ANAESTHESIA**

Patients should be hydrated preoperatively optimally, avoid dehydration during perioperative period especially in CRF patients. Hypothermia increase shivering and oxygen requirement postoperative and leads to vasoconstriction and poor peripheral perfusion and should be avoided using fluid warmer and heating blankets. Standard monitoring should be used as in any general anaesthesia cases, along with ST analysis for ischemia detection, if five leads available V5 monitoring is useful for early ischemia detection. Depending
on patient's morbidity and procedure planned non-invasive cardiac doppler, intra-arterial blood pressure monitoring, CVP, COP can be monitored. All patients should have temperature monitoring intra operative for early detection of hypothermia and early corrections, urinary catheter is placed routinely intra operative for output monitoring ACT also can be monitored after giving heparin. All Patients operated for major aortic bypass procedure needs intense monitoring for coronary ischemia using TEE and v5 lead ecg monitor during cross clamping and immediate post clamping since the acidosis that follows release of cross clamp may worsen cardiac ischemia. Prophylactic Nitroglycerin use to prevent myocardial ischemia is not needed. It can be used intra operative during ischemia if blood pressure is normal.

Preoperative hypertension should be optimally controlled using drugs to a target BP of 130/90. ACE inhibitors and Angiotensin receptor blockers are to be held on the day of surgery. Beta blockers are titrated to heart rate of 50-60 Statins are continued in peri operative period. Both GA and RA can be used with equal safety.

General anaesthesia was compared with spinal and epidural. From data collected from NSQIP of Veteran affair medical centers from 1995 to 2003. 30-day mortality and morbidity were compared. General anaesthesia had poor graft survival in only some studies Perler et al noted that general anaesthesia caused increased plasminogen activator inhibitor level and more graft occlusions. Rosened et al found increased plasminogen activator inhibitor in general anaesthesia cases compared with epidural group, further study by parker has also shown better patency with epidural/spinal group.[15][16] Reasons for better patency in regional group was improved blood flow, increase arterial inflow and venous emptying. PIERCE et al noted that the type of anaesthesia had no effect on graft patency and mortality of patients. The study was planned initially to study cardiac mortality. Cook et al also found no difference in rate of amputation in lower limb between spinal and general anaesthesia, although both were single centre studies with limited patients. In general GA does not lead to increased amputation rates compared to RA.[17][18, 19,20]

Direct Aorto iliac femoral disease is associated with mortality of 2% which is more than in other type of peripheral bypass grafts. Mortality after direct aortic reconstruction is more in patients with age greater than 65 and COPD. In PREVENT III trial for patients undergoing infrainguinal procedure the 30 days Mortality was 2.7%, MI was 4.7% and incidence of stroke/TIA was 1.4%. Incidence of mortality was more with surgery done for critical ischemia than for claudication. As per NSQIP programme Nicoloff and colleagues followed 112 patients who underwent bypass procedure and found that only 14% had ideal surgical results defined as uncomplicated operations long symptom relief, wound healing, no recurrence or re surgery. Dependent patients or dementia was associated with higher MI and CCF. Aorto-femoro procedures required infra aortic cross clamping or sometimes partial cross clamping leading to hypertension, increased myocardial strain and ischemia and postoperative MI or CCF. The impact can be minimized by deepening anaesthesia during clamping and controlling blood pressure, and monitoring for RWMA. Postoperative period patient may develop MI, stroke, TIA, mesenteric ischemia leading to intestinal gangrene, so mortality and morbidity is more in aortic procedure. Trend nowadays is to do limited open procedure for aortic vessels and do more endovascular procedure, especially in high risk patients.

Postoperative Period
Mortality was not different in case done using GA/RA. No difference in length of stay/ stroke/ MI was noted in General vs regional anaesthesia case. Common postoperative medical complications are, MI, stroke, TIA, pneumonia, sepsis, and CCF.

Adverse outcome during surgery were wound infections, graft occlusion, bleeding haematoma. Poor outcome was seen more in females, diabetic patient, infrapopliteal knee bypass patients, impaired ambulatory status, dementia patients.

SUMMARY
POVD is a major problem in elderly, they have multiple comorbidity and when they come for revascularization procedure they have to be on optimum medical control of risk factors and need good postoperative care for good results.

REFERENCES


