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Research Protocol

Dilated Arteries (Aneurysms)

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An aneurysm is an abnormal widening or ballooning of a portion of the artery due to weakness in its wall.

Causes

It is not clear what causes aneurysms. Some are present at birth (congenital). Defects in some parts of the arterial wall may be responsible.

Common locations for aneurysms are:

- Major arteries from the heart (Abdominal Aorta Aneurysm)
- Brain (cerebral aneurysm)
- Behind knee joint (popliteal artery aneurysm)
- Intestine (mesenteric artery aneurysm)
- Artery in the spleen (splenic artery aneurysm)

High blood pressure, high cholesterol, cigarette smoking raise risk of you having an aneurysm. High blood pressure plays a role in abdominal aortic aneurysms. Atherosclerosis may also be responsible. Pregnancy is often linked to formation and rupture of splenic artery aneurysm.

Copper deficiency

Copper deficiency affects the elastin tissue strength. The lysyl oxidase that cross links connective tissue is secreted normally but with reduced activity. People who die of aneurysms have liver content of copper 26% of normal. The median layer of blood vessel containing elastin is thinner but the copper content of elastin is the same as or normal people. Aneurysms are relatively rare is women because oestrogen increases the efficiency of copper absorption. Alcohol increases copper uptake while alcohol in diabetics reduces iron, zinc and copper uptake. Those who handle iron have a 100% reduction in copper. Excessive zinc can reduce copper levels by reducing absorption of copper from the gut.

Pathophysiology

Local hemodynamic factors are responsible for damage to the arterial segment. Aorta is a low resistance circuit for circulating blood while lower extremity is a high resistance circuit. Repeated trauma of the reflected arterial wave on distal aorta may injure the weakened distal aortic wall leading to aneurysmal formation. Systemic hypertension compounds the injury. Thus aneurysm formation is multifactorial. Increasing aneurismal dilatation leads to increased arterial wall tension and stress. According to Laplace's law increase in diameter increases the wall tension which in turn increases the wall diameter and promotes risk of wall rupture. The arterial wall supplied by blood from its vasa vasorum. Thus in a developing aneurysm the most ischemic portion is at the farthest end. This aids in weakening the wall and causing further expansion. Thus eventually all aneurysms will if left to complete their evolution rupture without intervention.

Classification of aneurysms

They are either true or false.

True aneurysm involves all 3 layers of the arterial wall – adventitia, media and interna. True aneurysms are atherosclerotic, syphilitic, congenital or vertricular following transmural myocardial infarctions.

False aneurysms are pseudoaneurysms which do not involve the arterial wall. The leaking blood is confined by the surrounding tissue. This blood filled either thromboses to seal the leak or flow out into the surrounding tissue. These are caused by trauma that

punctures the artery as percutaneous puncture of the artery as in angiography, arterial grafting or puncturing the artery as by drug pushers. They may present as a pulsatile mass on palpation.

Morphological classification

They are classified according to their macroscopic shape and size as saccular or fusiform.

Saccular aneurysms are spherical in shape and involve a portion of the arterial wall. They are 5-20 cm in diameter and filled partially or completely with thrombus. Fusiform aneurysms are spindle shaped and extend up to 20 cm in length. They are present in the ascending, arch and descending aorta involving iliac arteries.

Classification due to location

- Cerebral aneurysms mostly occur in the anterior communicating artery or circle of willis. The other common site is internal carotid artery
- 94% of the non-intracranial aneurysms arise below the level of renals and caused by atherosclerosis.
- The root of the thoracic aorta may be involved giving rise to aortic insufficiency.
- Popliteal artery aneurysms may occur behind the knee.

Arterial aneurysms are common but venous aneurysms do occur as popliteal venous aneurysm.

Classification according to underlying condition

- Atherosclerotic aneurysms
- Mycotic aneurysms - due to infection of the wall and is mostly due to gram positive cocci
- Berry aneurysm of the circle of Willis is associated with autosomal dominant polycystic kidney disease
- The third stage of syphilis involves aneurysms of the aorta due to loss of vasa vasorum in tunica adventitia.

Symptoms

These depend on the location of the aneurysm. If present near the body surface, pain and swelling with a throbbing mass are seen. However aneurysms within the body or the brain are asymptomatic. If an aneurysm ruptures, pain, low blood pressure, rapid heart rate and light headedness may occur. The risk of death after a rupture is very high.

Symptoms of cerebral aneurysm

These occur when the aneurysm pushes on the surrounding brain structures. The symptoms of a ruptured aneurysm are different from a non-ruptured one. In the latter case they are:

- Fatigue
- Loss of perception
- Loss of balance
- Speech problems

In case of ruptured cerebral aneurysm:

- Severe headache
- Loss of vision
- Double vision
- Neck pain and stiffness
- Pain above and behind the eyes

Cerebral aneurysm

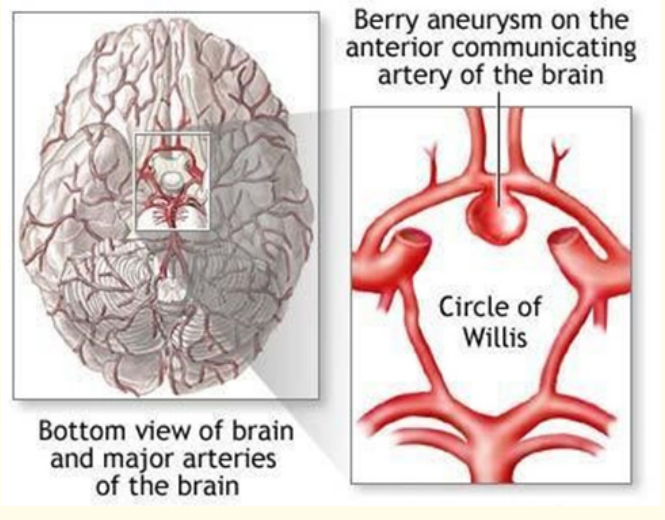

Figure 1

Examination and tests

Physical examination is a must. The tests include.

CT scan

- Ultrasound

Diagnosis of cerebral aneurysm

- CT scan shows signs of subarachnoid hemorrhage.
- Lumber puncture shows blood in the CSF
- CT angiogram – reveals the aneurysm or its rupture in the brain.

Treatment

Surgery is mostly recommended. The type of surgery needed depends on symptoms and type of aneurysm. Some have an endovascular stent repair which is a tiny tube used to prop open a vessel and reinforce its weak wall. No major cut is needed and so recovery is faster. With successful surgical repair the outlook (prognosis) is excellent.

Treatment of brain aneurysm

This is either surgical intervention of watching and waiting along with control of blood pressure. Endovascular treatment includes clipping or endovascular coiling. In clipping of the aneurysm a craniotomy exposes the aneurysm and a clip is applied to the base of the aneurysm. This is the best method to permanently eliminate aneurysms. In endovascular coiling. The catheter is passed from the femoral artery via the aorta into the carotids and then the brain arteries reaching the aneurysm. The coils are released into the aneurysm. These coils start a thrombotic reaction within the aneurysm and eliminate it. In broad based aneurysms a covered stent is passed to occlude the neck of the aneurysm. Comparing clipping versus coiling, the latter has shown a 7% reduced mortality rate compared to clipping. However coiling is associated with a higher recurrence rate, almost 30% and increases over time. The patients with endovascular coiling must have annual investigations to look for early recurrence and treated with further coiling or surgery if recurrence is detected.

Aortic and peripheral aneurysms

In these the weakened segment of the arterial wall is replaced by bypass graft. Endovascular stenting is a less traumatic option where a covered stent is placed across the aneurismal artery.

Complications

Compression of the adjoining structures mainly nerves giving rise to weakness of the extremity and numbness. This is more common in popliteal artery aneurysms behind the knee.

Infection may lead to body-wide illness (sepsis) and rupture.

Rupture can lead to massive bleeding and death – commonly seen in abdominal aortic aneurysms, mesenteric artery aneurysms, splenic artery aneurysms. Rupture of brain aneurysms leads to stroke, disability and death.

When to contact the doctor?

See a doctor if you develop a lump on the body even if it is not painful and throbbing.

Prevention

Blood pressure control may help prevent some aneurysms. Healthy diet, regular exercise and keeping cholesterol under check helps prevent aneurysms and their complications. Stop smoking to lower the risk.

Abdominal aortic aneurysms (AAA)

This is the large blood vessel that supplies blood to the pelvis and legs, balloons outwards.

Aortic aneurysm

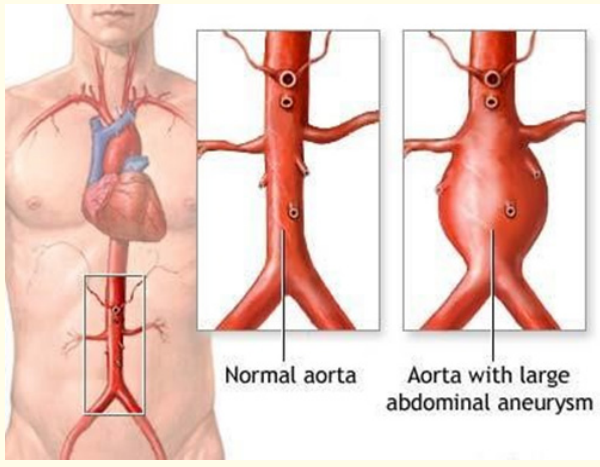

Figure 2

Symptoms

AAA develop slowly over years with no symptoms. If it develops rapidly and breaks open (rupture) or leaks along the wall (dissection) then symptoms develop rapidly. If rupture occurs then: there is severe, sudden, persistent pain in the abdomen or back radiating to the groin buttock or legs.

- The skin is clammy.
- Nausea and vomiting
- Rapid heart rate
- Shock

Examination and tests

Evaluation of the abdomen along with the pulses and sensation in the legs. There may be an pulsating abdominal mass, stiff and rigid abdomen.

- CT scan of the abdomen
- Ultrasound of the abdomen

Treatment

If there is bleeding from aortic aneurysm then open repair will have to be done.

Asymptomatic aneurysms that are small are generally left alone. Yearly ultrasound is done to see if the aneurysm is becoming bigger. Surgery is recommended for those whose aneurysm is growing over 1 cm / annum or is 5.5 cm on presentation.

There are 2 approaches to surgery:

- Traditional surgery (open repair) – large cut in the abdomen and diseased vessel is replaced by graft.
- Endovascular stent grafting – here no large cut in the abdomen is done and is not done for bleeding or rupture.

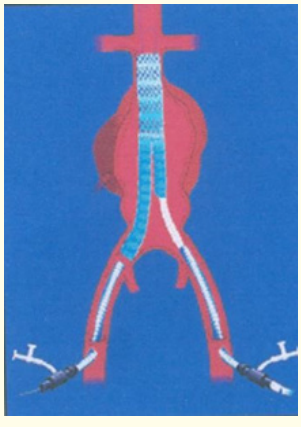

Figure 3: Diagrammatic representation of endovascular graft in AAA.

Outlook (prognosis)

It is good in experienced hands and < 40% survives a ruptured aneurysm.

Ruptured aneurism is an emergency. Dissection is when the innermost lining of the artery tears and blood leaks within the wall.

Complications

- Arterial embolism
- Heart attack
- Hypovolemci shock
- Kidney failure
- Stroke

When to call a doctor?

Go to the casualty if belly or back ache does not go away or is unbearable.

Prevention

To reduce the risk of developing aneurysm:

- Eat a healthy diet, exercise and stop smoking and reduce stress.
- Lower cholesterol levels
- Treat blood pressure and diabetes.
- Ultrasound abdomen at 65 years and if dilated aorta then yearly.

Risk factors

These include diabetes, hypertension, obesity, tobacco use, alcoholism, high cholesterol, copper deficiency and advancing age.