ATHEROCLEROSIS

Arteriosclerotic Vascular Disease, Asvd

The thickening, hardening and loss of elasticity of the walls of arteries.

Diagnosis

Male & Female

Related Diagnoses:
Polycystic ovary syndrome

About Atherosclerosis

Atherosclerosis is characterized by endothelial (lines the interior surface of blood vessels, forming an interface between circulating blood in the lumen and the rest of the vessel wall) dysfunction, vascular inflammation, and the buildup of lipids, cholesterol, calcium, and cellular debris within the intima (the innermost layer of an artery) of the vessel wall.

This construction results in plaque formation accumulating on the inner walls of arteries, and as the artery walls thicken, the pathway for blood narrows, and this can decrease or block blood flow diminishing oxygen supply to target organs (Pic. 1, 2, 3, 4). Atherosclerosis represents a leading global cause of death and disability.

Atherosclerosis is a complex multifocal arterial disease of medium- and large-size arteries (Pic. 5, 6) involving interactions of multiple genetic and environmental factors.

Although environmental factors such as diet or smoking play an important role in atherosclerosis development, genetic factors represent consequential determinant of atherosclerotic cardiovascular disease risk. Advances in techniques of molecular genetics have revealed that genetic disorders significantly influence susceptibility to atherosclerotic vascular diseases.

The genetic risk of atherosclerosis is conferred in part through known metabolic risk factors such as hypertension (high blood pressure), dyslipidaemia (an abnormal amount of lipids in the blood), and diabetes mellitus, but together, the known risk features appear to be insufficient to explain the hereditary propensity to
atherosclerosis. However, these risk factors alone do not account for the entire contribution to risk of atherosclerotic disease.

Atherosclerosis is treated with drugs which are used to decrease high blood pressure and high levels of lipids. Surgical methods are performed in case of complications such as block of blood flow.

**Associated diseases**

Usually, atherosclerosis is an asymptomatic condition that might begin from childhood, whereas symptomatic organ-specific clinical manifestations often do not appear until 40 years of age or older when it is most commonly diagnosed.

Elevated blood pressure reflects the existence of atherosclerosis. There is irresistible evidence that high blood cholesterol increases the risk of developing atherosclerosis; but cholesterol is not the damaging mechanism. In fact, the risk of atherosclerosis is more precisely assessed by measuring the proportional association between lipoproteins of high density (HDL) cholesterol and LDL cholesterol.

Atherosclerosis is the primary cause of coronary heart disease (CHD), ischemic stroke, and peripheral arterial disease (a narrowing of the arteries other than those that supply the heart or the brain).

In the last decades a large amount of evidence linked rheumatoid arthritis (RA) (a long-term autoimmune disorder that primarily affects joints) to atherosclerosis. In fact, RA patients have an increased risk of cardiovascular events that is not fully explained by other classic cardiovascular risk factors. RA and atherosclerosis may share several common pathological mechanism and inflammation undoubtedly plays a primary role.

**Complications**

Atherosclerosis-related diseases often lead to serious outcomes such as sudden cardiac death, unstable angina pectoris (a type of chest pain that is irregular), acute myocardial infarction, stroke, and intermittent claudication (a symptom that describes muscle pain on mild exertion, classically in the calf muscle, which occurs during exercise, such as walking, and is relieved by a short period of rest) due to vessel obliteration (the occlusion of the lumen of the blood vessel) or plaque rupture with subsequent thrombosis (the formation of a blood clot inside a blood vessel, obstructing the flow of blood through the circulatory system) (Pic. 7).

**Risk factors**

**Age**

Atherosclerosis is a multifactorial disease (having many factors). The pathology of atherosclerosis is a progressive process with increasing age that is related to some risk factors such as hypertension (high blood pressure), hyperlipidemia (abnormally elevated levels of any or all lipids or lipoproteins in the blood), diabetes mellitus, obesity, and cigarette smoking. Genetic factors represent consequential determinant of
atherosclerotic cardiovascular disease risk.

Infection

Epidemiological studies further indicate that infection by various types of bacteria and the presence of products of these bacteria in serum contributed to the development of atherosclerosis.

Stress and cardiovascular disease

Cardiovascular disease has a number of behavioral risk factors, some of which are related to chronic stress. Medical researchers are not sure exactly how stress increases the risk of heart disease. However, it could be that high levels of stress make other risk factors (such as high cholesterol or high blood pressure) worse. Many researchers argue that the relationship between stress and cardiovascular disease is a combination of these factors.

Heart transplantation

Syndrome of accelerated atherosclerosis (faster development) has been classically described in patients undergoing heart transplantation.

Impact on fertility

With advanced age, men experience decreases in important health indicators (muscle amount, muscle power, physical activity, bone density, blood generation, and sexual drive). Doctors think of atherosclerosis to be the main cause of erectile dysfunction (ED). With ED, man is not able to deliver sperms into woman’s body, where the fertilization takes place.

The thought was driven from the hypothesis that small arteries will be clotted before the large or medium ones. Since erection depends mainly on the amount of delivered blood to the penis, normal arteries thought to have no problem in supporting the process of blood delivering. In contrast, if the arteries become stiffen due to the deposition of atherosclerosis (which in turn will reduce their compliance as a result of the increment in arteries walls resistance), the amount of delivered blood will be declined which affects the process of erection.

In these cases, there are methods of assisted reproduction, which are able to fertilize eggs outside the body, and than insert embryo to the woman’s womb.

Women’s fertility is not strictly affected by atherosclerosis.

Prevention
Atherosclerosis treatment usually begins with lifestyle changes such as a low cholesterol diet, regular exercise, and quitting smoking.

In some cases the atherosclerosis is caused by familial hypercholesterolemia (FH) (high LDL cholesterol levels). In this case the disease leads to atherosclerotic plaque deposition in the coronary arteries and aorta at an early age. Thanks to prenatal testing called preimplantation genetic diagnosis (PGD) it is possible to detect the embryo with familial hypercholesterolemia.

**Symptoms**

Depending on which part of blood stream is damaged several signs and symptoms occur. The most prone to atherosclerosis are heart arteries, cerebral arteries and retinal arteries.

**Heart atherosclerosis**

For most people, the first symptoms result from atheroma progression within the heart arteries, most commonly resulting in a heart attack. It is plaque ruptures, showing debris & clots which obstruct blood flow downstream, sometime also locally, which reduce/stop blood flow.

However, the heart arteries, because they are small (from about 5 mm down to microscopic), they are hidden deep within the chest and they never stop moving, have been a difficult target organ to track, especially clinically in individuals who are still asymptomatic.

**Cerebral atherosclerosis**

Cerebral atherosclerosis is a type of atherosclerosis where build-up of plaque in the blood vessels of the brain occurs. Diseases associated with cerebral atherosclerosis include:

**Alzheimer's disease**

Alzheimer's disease is a form of dementia that entails brain atrophy. The most common early symptom is difficulty in remembering recent events (short-term memory loss). As the disease advances, symptoms can include problems with language, disorientation (including easily getting lost), mood swings, loss of motivation, not managing self care, and behavioural issues.

**Cerebral microbleeds (CMB)**

Cerebral microbleeds have been observed during recent studies on dementia sufferers using MRI (magnetic resonance imaging). Microbleeds does not have to cause any symptoms, but if they did, the manifestation depend on which part of brain is damaged.
**Stroke**

Strokes occur from the sudden loss of blood flow to an area of the brain. The loss of flow is generally either from a blockage or hemorrhage. Studies of postmortem stroke cases have shown that intracranial atherosclerotic plaque build up occurred in over half of the individuals and over one third of the overall cases had stenotic build up.

Sudden-onset face weakness, arm drift (i.e., if a person, when asked to raise both arms, involuntarily lets one arm drift downward) and abnormal speech are the findings most likely to lead to the correct identification of a case of stroke.

**Retinal atherosclerosis**

Central retinal artery occlusion is a disease of the eye where the flow of blood through the central retinal artery is blocked (occluded). There are several different causes of this occlusion; the most common is carotid artery atherosclerosis. Central retinal artery occlusions cause sudden, acute, and painless loss of vision in one eye.

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**Therapies**

**Self therapy**

Atherosclerosis can be treated with alternative therapy which has origin in China. Several methods are used to cease symptoms and decrease the risk of complication. Traditional Chinese medicine use herbs, exercise called Tai chi and also meditation. Every method is up to patient's choice and preference.

**Traditional Chinese medicine**

Traditional Chinese medicine, especially herbal medicine, has been used for the treatment of cardiovascular diseases for hundreds of years. In Taiwan, Chinese herbal medicine is commonly used as complementary and alternative therapy for the treatment of cardiovascular-related diseases.

In addition to herbal medicine, acupuncture has been used for a long time in the treatment of cardiovascular disease in Asia. Acupuncture is applied in the treatment of hypertension and hyperlipidemia, which are risk factors leading to atherosclerosis.

**Tai chi**

Tai chi chuan (tai chi) is a Chinese traditional mind–body exercise with low to moderate exercise intensity. Previous studies have shown that it offers benefits for aerobic capacity, muscular strength, balance, and cardiovascular risk factors such as hypertension, diabetes mellitus, and dyslipidemia. Furthermore, tai chi appears to be safe and effective for patients with acute myocardial infarction,
coronary artery bypass grafting surgery, congestive heart failure, and stroke. A study conducted in India shows that regular yogic practices can significantly reduce blood pressure, heart rate, body fat, cholesterol, and LDL.

**Meditation**

Certain mental disorders and stress are conducive to atherosclerosis. Meditation is an alternative medicine practice for mental and physical health. It has salutary effects on patients with anxiety, depression, and stress.

**Conventional medicine**

Conventional medicine include drugs, which are used to decrease blood pressure and cholesterol levels to prevent the complications of atherosclerosis. There is no drug which can be use to directly heal atherosclerosis.

Surgical therapy is used in case of complications such as myocardial infarction and they are life saving surgeries.

**Pharmacotherapy**

Therapies currently available primarily focus on alleviating hypertension and low-density lipoprotein cholesterol levels while ignoring the rampant levels of inflammation and other causes of cell death in arterial walls and their consequences on atherosclerotic progression. This inflammation and cell death drives the transition of the stable plaque to a vulnerable plaque, which is prone to rupture leading to thrombosis.

Patients currently receive therapeutic cocktails containing statins (a class of lipid-lowering medications), aspirin, adrenaline inhibitors (decreases the blood pressure), and angiotensin-converting enzyme inhibitors (decreases the blood pressure).

**Surgical therapy**

In patients with advanced disease, certain medical procedures such as coronary artery bypass surgery or percutaneous transluminal coronary angioplasty may be necessary.

**Coronary artery bypass surgery**

Coronary artery bypass surgery, and colloquially heart bypass or bypass surgery, is a surgical procedure to restore normal blood flow to an obstructed coronary artery.

There are two main approaches. In one, the left internal mammary artery is diverted to the branch of the left coronary artery. In the other, a great
saphenous vein is removed from a leg; one end is attached to the aorta or one of its major branches, and the other end is attached to the obstructed artery immediately after the obstruction to restore blood flow.

Other therapy

Percutaneous coronary intervention (PCI)

Percutaneous coronary intervention is a non-surgical procedure used to treat narrowing (stenosis) of the coronary arteries of the heart found in coronary artery disease. After accessing the blood stream through the femoral or radial artery, the procedure visualises the blood vessels on X-ray imaging (Pic. 8).

After this, an interventional cardiologist can perform a coronary angioplasty, using a balloon catheter in which a deflated balloon is advanced into the obstructed artery and inflated to relieve the narrowing; certain devices such as stents can be deployed to keep the blood vessel open.

Assisted reproduction

Atherosclerosis is associated with erectile dysfunction, which can be treated with several methods of assisted reproduction.

The first-line method for sperm retrieval in men with erectile dysfunction is penile vibratory stimulation (PVS). The penile vibratory stimulator is a plier-like device that is placed around glans penis to stimulate it by vibration. In case of failure with PVS, sperms are sometimes collected by electroejaculation.

If there is a significant number of sperm and/or there is any other dysfunction, the retrieved sperm is placed inside woman’s uterus. This process is called intrauterine insemination (IUI).

If the number of sperm is not sufficient or the procedure is not successful, surgical methods of the sperm retrieval can be used:

- **TESE** - Removal of a small portion of testicular tissue in order to extract a few viable sperm.
- **MESA** - A microsurgical procedure to harvest sperm from the single epididymal tubule (epididymis), used in the case of obstructive azoospermia.
- **PESA** - Sperm aspiration procedure in which a needle is inserted into the epididymis in order to retrieve sperm.
- **micro TESE** - Microsurgical method used to identify areas of sperm production within the testes with the aid of optical magnification.

These techniques are used to collect the spermatozoa suitable for egg fertilization by intracytoplasmic sperm injection (ICSI).

In case of familial hypercholesterolemia, almost all individual have an affected
parent. In very rare cases FH is caused by a de novo (an alteration in a gene that is present for the first time in one family member) pathogenic variant. Each child of an individual with FH has a 50% chance of inheriting the disease.

The PGD allows studying the DNA of eggs or embryos to select those that carry certain damaging characteristics. It is useful when there are previous chromosomal or genetic disorders in the family, within the context of in vitro fertilization programs.

If the pathogenic variant of a family member with FH has been identified, prenatal testing can help to choose the embryo without this kind of mutation.

Find more about related issues

Diagnoses

Polycystic ovary syndrome
A condition in which a woman has an imbalance of female sex hormones. This may lead to changes in the menstrual cycle, cysts in the ovaries, trouble g
Learn more at: www.fertilitypedia.org/therapy/diag/polycystic-ovary-syndrome

Therapies

Egg donation
Process by which a woman donates eggs for purposes of assisted reproduction or biomedical research.
Learn more at: www.fertilitypedia.org/edu/therapies/egg-donation

ICSI
A micromanipulative fertilization technique in which a single sperm is injected directly into an egg.
Learn more at: www.fertilitypedia.org/edu/therapies/icsi

Sperm donation
The procedure in which a man (sperm donor) provides his sperm for fertility treatment.
Learn more at: www.fertilitypedia.org/edu/therapies/sperm-donation

Standard IVF
A process in which an egg is fertilised by sperm outside the body: in vitro. Own or donated gametes may be used.
Learn more at: www.fertilitypedia.org/edu/therapies/standard-ivf

Gallery
Pic. 1: Normal vs
Illustration comparing a normal blood vessel and partially blocked vessel due to atherosclerotic plaque. Notice the enlargement & absence of much luminal narrowing.

Normal and Partly Blocked Blood Vessel

Pic
The process of atherosclerosis development in general.

Pic
Illustration of development of atherosclerosis on the left and on the right histological cut of blood vessel with atheromatous plaque.

Pic
Micrograph of the distal right coronary artery with complex atherosclerosis and luminal narrowing.
Atherosclerotic plaque from a carotid endarterectomy specimen. This shows the bifurcation of the common into the internal and external carotid arteries.

Aorta which is cut opened showing multiple ruptured atheromatous plaques.

Illustration of plaque rupture with subsequent thrombosis.
Coronary angiogram, showing the circulation in the left main coronary artery and its branches.

Sources

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