Journal of Biomedical and Pharmaceutical Research
Available Online at www.jbpr.in
CODEN: - JBPRAU (Source: - American Chemical Society)
PubMed (National Library of Medicine): ID: (101671502)
Index Copernicus Value 2018: 88.52
Review Article
Volume 9, Issue 2: March-April: 2020, 14-22
ISSN (Online): 2279-0594
ISSN (Print): 2589-8752

A REVIEW: ANGIOGRAPHY AND ANGIOPLASTY

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Article Info: Received 18 February 2020; Accepted 27 March 2020
DOI: https://doi.org/10.32553/jbpr.v9i2.731
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Conflict of interest statement: No conflict of interest

ABSTRACT:
The cardiovascular system refers to the heart, blood vessels and the blood. Blood contains oxygen and other nutrients which your body needs to survive. The body takes these essential nutrients from the blood. Angiography is an imaging test that uses X-rays to view your body's blood vessels. The X-rays provided by an angiography are called angiograms. This test is used to study narrow, blocked, enlarged, or malformed arteries or veins in many parts of your body, including your brain, heart, abdomen, and legs. Angioplasty is a procedure to restore blood flow through the artery. You have angioplasty in a hospital. The doctor threads a thin tube through a blood vessel in the arm or groin up to the involved site in the artery. The tube has a tiny balloon on the end. Cardiovascular disease generally refers to conditions that involve narrowed or blocked blood vessels that can lead to a heart attack, chest pain (angina) or stroke. Other heart conditions, such as those that affect your heart's muscle, valves or rhythm, also are considered forms of heart disease.
Keyword: cardiovascular system, angiography, angioplasty

Introduction

Cardiovascular System

The cardiovascular systems of humans are closed, meaning that the blood never leaves the network of blood vessels. In contrast, oxygen and nutrients diffuse across the blood vessel layers and enter interstitial fluid, which carries oxygen and nutrients to the target cells, and carbon dioxide and wastes in the opposite direction. The other component of the circulatory system, the lymphatic system, is open.[1]

Arteries

The aorta arches and gives branches supplying the upper part of the body after passing through the aortic opening of the diaphragm at the level of thoracic ten vertebra, it enters the abdomen.

Capillaries

Arteries branch into small passages called arterioles and then into the capillaries.[2] The capillaries merge to bring blood into the venous system.[3]

Veins

The venous system feeds into the two major veins: the superior vena cava which mainly drains tissues above the heart and the inferior vena cava which mainly drains tissues below the heart.

Portal veins

The general rule is that arteries from the heart branch out into capillaries, which collect into veins leading back to the heart.

Heart

The heart pumps oxygenated blood to the body and deoxygenated blood to the lungs. In the human heart there is one atrium and one ventricle for each circulation, and with both a systemic and a pulmonary circulation there are four chambers in total: left atrium, left ventricle, right atrium and right ventricle. The right atrium is the upper chamber of the right side of the heart. The blood that is returned to the right atrium is deoxygenated (poor in oxygen) and passed into the right ventricle to be pumped through the pulmonary artery to the lungs for re-oxygenation and removal of carbon dioxide. The left atrium receives newly oxygenated blood from the lungs as well as the pulmonary vein which is passed into the strong left ventricle to be pumped through the aorta to the different organs of the body.

Coronary vessels

The heart itself is supplied with oxygen and nutrients through a small "loop" of the systemic circulation and derives very little from the blood contained within the four chambers. The coronary circulation system provides

a blood supply to the heart muscle itself. The coronary circulation begins near the origin of the aorta by two coronary arteries the right coronary artery and the left coronary artery.[1]

Lungs

The circulatory system of the lungs is the portion of the cardiovascular system in which oxygen-depleted blood is pumped away from the heart, via the pulmonary artery, to the lungs and returned, oxygenated, to the heart via the pulmonary vein.[1]

Systemic circulation

away the heart from Systemic circulation is the portion of the cardiovascular system which transports oxygenated blood through the aorta from the left ventricle where the blood has been previously deposited from pulmonary circulation, to the rest of the body, and returns oxygen-depleted blood back to the heart.[1]

Brain

The brain has a dual blood supply that comes from arteries at its front and back. These are called the "anterior" and "posterior" circulation respectively. The anterior circulation arises from the internal carotid arteries and supplies the front of the brain.

Kidneys

The renal circulation receives around 20% of the cardiac output. It branches from the abdominal aorta and returns blood to the ascending vena cava. It is the blood supply to the kidneys, and contains many specialized blood vessels.

PHYSIOLOGY OF HEART

Blood Flow

The heart functions as a pump in the circulatory system to provide a continuous flow of blood throughout the body. This circulation consists of the systemic circulation to and from the body and the pulmonary circulation to and from the lungs. Blood in the pulmonary circulation exchanges carbon dioxide for oxygen in the lungs through the process of respiration. The systemic circulation then transports oxygen to the body and returns carbon dioxide and relatively deoxygenated blood to the heart for transfer to the lungs.[4]

Cardiac cycle

The cardiac cycle refers to the sequence of events in which the heart contracts and relaxes with every heartbeat. The period of time during which the ventricles contract, forcing blood out into the aorta and main pulmonary artery, is known as systole, while the period during which the ventricles relax and refill with blood is known as diastole . The atria and ventricles work in concert, so in systole when the ventricles are contracting, the atria are relaxed and collecting blood. When the ventricles are relaxed in diastole, the atria contract to pump blood to the ventricles. This coordination ensures blood is pumped efficiently to the body.[4][5]

Cardiac output

Cardiac output (CO) is a measurement of the amount of blood pumped by each ventricle (stroke volume) in one minute. This is calculated by multiplying the stroke volume (SV) by the beats per minute of the heart rate (HR). So that: CO = SV x HR. The cardiac output is normalized to body size through body surface area and is called the cardiac index.[4][6][7]

Electrical conduction

The normal rhythmical heart beat, called sinus rhythm, is established by the sinoatrial node, the heart's pacemaker. The sinoatrial node is found in the upper part of the right atrium near to the junction with the superior vena cava.[8] Here an electrical signal is created that travels through the heart, causing the heart muscle to contract.[9][10][11][12]

Heart rate

The normal resting heart rate is called the sinus rhythm, created and sustained by the sinoatrial node, a group of pacemaking cells found in the wall of the right atrium. Cells in the sinoatrial node do this by creating an action potential. The cardiac action potential is created by the movement of specific electrolytes into and out of the pacemaker cells. The action potential then spreads to nearby cells.[13][14][15]

CARDIOVASCULAR DISEASES , DIAGNOSIS AND TREATMENT

Cardiovascular Diseases

Cardiovascular diseases, which include diseases of the heart, are the leading cause of death worldwide.[16] The majority of cardiovascular disease is noncommunicable and related to lifestyle and other factors, becoming more prevalent with ageing. Heart disease is a major cause of death, accounting for an average of 30% of all deaths in 2008, globally.[17]

Ischaemic heart disease

Coronary artery disease, also known as ischaemic heart disease, is caused by atherosclerosis a build-up of fatty material along the inner walls of the arteries. These fatty deposits known as atherosclerotic plaques narrow the coronary arteries, and if severe may reduce blood flow to the heart.[18]

Heart failure

Heart failure is defined as a condition in which the heart is unable to pump enough blood to meet the demands of the body.[19] Patients with heart failure may experience breathlessness especially when lying flat, as well as ankle swelling, known as peripheral oedema.

Cardiomyopathies

Cardiomyopathies are diseases affecting the muscle of the heart. Some cause abnormal thickening of the heart muscle (hypertrophic cardiomyopathy), some cardiomyopathies such as hypertrophic cardiomopathy are linked to a higher risk of sudden cardiac death, particularly in athletes.[4][19]

Valvular heart disease

Valvular heart disease may cause breathlessness, blackouts, or chest pain, but may be asymptomatic and only detected on a routine examination by hearing abnormal heart sounds or a heart murmur.[20][21]

Cardiac arrhythmias

While in the healthy heart, waves of electrical impulses originate in the sinus node before spreading to the rest of the atria, the atrioventricular node, and finally the ventricles (referred to as a normal sinus rhythm), this normal rhythm can be disrupted.[22]

Pericardial disease

The sack which surrounds the heart, called the pericardium, can become inflamed in a condition known as pericarditis. This condition typically causes chest pain that may spread to the back, and is often caused by a viral infection (glandular fever, cytomegalovirus, or coxsackievirus).[23]

Congenital heart disease

Some people are born with hearts that are abnormal and these abnormalities are known as congenital heart defects. These are known as cyanotic congenital heart defects and are often more serious. Major congenital heart defects are often picked up in childhood, shortly after birth, or even before a child is born (e.g. transposition of the great arteries), causing breathlessness and a lower rate of growth.[24][25]

Diagnosis

Heart disease is diagnosed by the taking of a medical history, a cardiac examination, & further investigations, including blood tests, echocardiograms, ECGs and imaging. Other invasive procedures such as cardiac catheterisation can also play a role.[26]

Examination

The cardiac examination includes inspection, feeling the chest with the hands (palpation) and listening with a stethoscope (auscultation). It involves assessment of signs that may be visible on a person's hands (such as splinter haemorrhages), joints and other areas.[27][28]

Heart sounds

Typically, healthy hearts have only two audible heart sounds, called S1 and S2. The first heart sound S1, is the sound created by the closing of the atrioventricular valves during ventricular contraction and is normally described as "lub". The second heart sound, S2, is the sound of the semilunar valves closing during ventricular diastole and is described as "dub".[5][29][30]

Electrocardiogram

Using surface electrodes on the body, it is possible to record the electrical activity of the heart. This tracing of the electrical signal is the electrocardiogram (ECG) or (EKG). An ECG is a bedside test and involves the placement of ten leads on the body.[46][5]

Imaging

Several imaging methods can be used to assess the anatomy and function of the heart, including ultrasound (echocardiography), angiography, CT scans, MRI and PET. An echocardiogram is an ultrasound of the heart used to measure the heart's function, assess for valve disease, and look for any abnormalities.[32][29]

Treatment

Ischaemic heart disease

Medications to improve angina symptoms include nitroglycerin, beta blockers, and calcium channel blockers,while preventative treatment include antiplatelets such as aspirin and statins, percutaneous coronary intervention, during which narrowings can be expanded by passing small balloon-tipped wires into the coronary arteries, inflating the balloon to expand the narrowing, and sometimes leaving behind a metal scaffold known as a stent to keep the artery open.[33][34][35]

Valvular heart disease

Diseased heart valves that have become abnormally narrow or abnormally leaky may require surgery. This is traditionally performed as an open surgical procedure to replace the damaged heart valve with a tissue or metallic prosthetic valve. In some circumstances, the tricuspid or mitral valves can be repaired surgically, avoiding the need for a valve replacement.[20]

Cardiac arrhythmias

Abnormal heart rhythms (arrhythmias) can be treated using antiarrhythmic drugs. If medications fail to control an arrhythmia, another treatment option may be catheter ablation. In these procedures, wires are passed from a vein or artery in the leg to the heart to find the abnormal area of tissue that is causing the arrhythmia. If medications fail to control an arrhythmia, another treatment option may be catheter ablation. In these procedures, wires are passed from a vein or artery in the leg to the heart to find the abnormal area of tissue that is causing the arrhythmia. The abnormal tissue can be intentionally damaged, or ablated, by heating or freezing to prevent further heart rhythm disturbances. Whilst the majority of arrhythmias can be treated using minimally invasive catheter techniques, some arrhythmias (particularly atrial fibrillation) can also be treated using open or thoracoscopic surgery, either at the time of other cardiac surgery or as a standalone procedure. Cardiac devices in the form of pacemakers or implantable defibrillators may also be required to treat arrhythmias. Pacemakers, comprising a small battery powered generator implanted under the skin and one or more leads that extend to the heart, are most commonly used to treat abnormally slow heart rhythms.[22]

Heart failure

Heart failure treatment is with medication. These include drugs to prevent fluid from accumulating in the lungs by increasing the amount of urine a patient produces (diuretics), and drugs that attempt to preserve the pumping function of the heart (beta blockers, ACE inhibitors and mineralocorticoid receptor antagonists).[19]

ANGIOGRAPHY

Angiography

Angiography or arteriography is a medical imaging technique used to visualize the inside, or lumen, of blood vessels and organs of the body, with particular interest in the arteries, veins, and the heart chambers. This is traditionally done by injecting a radio-opaque contrast agent into the blood vessel and imaging using X-ray based techniques such as fluoroscopy.[36]

Technique

Depending on the type of angiogram, The X-ray images taken may either be still, displayed on an image intensifier or film, or motion images. For all structures except the heart, the images are usually taken using a technique called digital subtraction angiography or DSA. The heart images are taken at 15–30 frames per second, not using a subtraction technique.[37]

Uses

Coronary angiography

One of the most common angiograms performed is to visualize the blood in the coronary arteries. A long, thin, flexible tube called a catheter is used to administer the X-ray contrast agent at the desired area to be visualized. To detect coronary artery disease, a CT scan is more satisfactory than an MRI scan.[38][39]

Fluorescein angiography

Fluorescein angiography is a medical procedure in which a fluorescent dye is injected into the bloodstream. The dye highlights the blood vessels in the back of the eye so they can be photographed. This test is often used to manage eye disorders.[40][41]

Microangiography

Microangiography is commonly used to visualize tiny blood vessels.

Neuro-vascular angiography

Another increasingly common angiographic procedure is neuro-vascular digital subtraction angiography in order to visualise the arterial and venous supply to the brain.

Peripheral angiography

Angiography is also commonly performed to identify vessels narrowing in patients with leg claudication or cramps, caused by reduced blood flow down the legs and to the feet; in patients with renal stenosis (which commonly causes high blood pressure) and can be used in the head to find and repair stroke.

Post mortem CT angiography for medicolegal cases

Post mortem CT angiography for medicolegal cases is a method. . Originating from that project, both watery[42] and oily[43] solutions have been evaluated. While oily solutions[43] require special deposition equipment to collect waste water, watery[42] solutions seem to be regarded as less problematic. Watery solutions also were documented to enhance post mortem CT tissue differentiation whereas oily solutions were not. Conversely, oily solutions seem to only minimally disturb ensuing toxicological analysis, while watery solutions may significantly impede toxicological analysis, thus requiring blood sample preservation before post mortem CT angiography.[44]

Compliation

After an angiogram, a sudden shock can cause a little pain at the surgery area, but heart attacks and strokes usually don't occur, as they may in bypass surgery. A heart attack occurs when blood flow to a part of the heart is blocked, usually by a blood clot.

Cerebral angiography

Bleeding or bruising at the site where the contrast is injected are minor complications, delayed bleeding can also occur but is rare.[45]

Additional risks

If the patient is allergic to the contrast medium, much more serious side effects are inevitable; however, with new contrast agents the risk of a severe reaction is less than one in 80,000 examinations.

ANGIOPLASTY

Angioplasty

Angioplasty, also known as balloon angioplasty and percutaneous transluminal angioplasty (PTA), is a minimally invasive endovascular procedure used to widen narrowed or obstructed arteries or veins, typically to treat arterial atherosclerosis. Angioplasty has come to include all manner of vascular interventions that are typically performed percutaneously. [46][47]

Uses And Indication

Coronary angioplasty

A coronary angioplasty is a therapeutic procedure to treat the stenotic (narrowed) coronary arteries of the heart found in coronary heart disease. These stenotic segments of the coronary arteries arise due to the buildup of cholesterol-laden plaques that form in a condition known as atherosclerosis. A percutaneous coronary intervention (PCI), or coronary angioplasty with stenting, is a non-surgical procedure used to improve the blood flow to the heart.[46][49]

Peripheral angioplasty

Peripheral angioplasty refers to the use of a balloon to open a blood vessel outside the coronary arteries. It is most commonly done to treat atherosclerotic narrowings of the abdomen, leg and renal arteries caused by peripheral artery disease.[50]

Chronic Limb Threatening Ischemia

The bypass versus angioplasty in severe ischemia of the leg (BASIL) trial investigated bypass surgery first compared to angioplasty first in select patients with severe lower limb ischemia. The BASIL trial found that angioplasty was associated with less short term morbidity compared with bypass surgery, however long term outcomes favor bypass surgery.[51][52][53]

Renal artery angioplasty

Atherosclerotic obstruction of the renal artery can be treated with angioplasty with or without stenting of the renal artery. There is a weak recommendation for renal artery angioplasty in patients with renal artery stenosis and flash edema or congestive heart failure.[54][55]

Carotid angioplasty

Carotid artery stenosis can be treated with angioplasty and carotid stenting for patients at high risk for undergoing carotid endarterectomy (CEA).[56][57]

Venous angioplasty

Angioplasty is used to treat venous stenosis affecting hemodialysis access, with drug-coated balloon angioplasty proving to have better 6 month and 12 month patency than conventional balloon angioplasty.[58][59][60]

Technique

Access to the vascular system is typically gained percutaneously (through the skin, without a large surgical incision). An introducer sheath is inserted into the blood vessel via the Seldinger technique.At the conclusion of the procedure, the balloons, wires and catheters are removed and the vessel puncture site is treated either with direct pressure or a vascular closure device. Transradial artery access (TRA) and transfemoral artery access (TFA) are two techniques for percutaneous coronary intervention.[62][63][64][65]

THE TOP 10 CARDIO DEVICE COMPANIES

The Top 10 Cardio Device Companies: Highlights From Tct

Here are the 10 companies that Evaluate Med Tech expects will lead the cardiology space by 2020, along with descriptions of how their businesses are evolving:

Table 1:

Rank	Company	2020 Sales (Projected)	2014 Sales	% Change
1.	Medtronic	$11.588B	$9.361B	+3.6%
2.	St. Jude Medical	$6.336B	$5.185B	+3.4%
3.	Boston Scientific	$6.116B	$5.046B	+3.3%
4.	Edwards Lifesciences	$3.518B	$2.289B	+7.4%
5.	Abbott Laboratories	$3.229B	$2.844B	+2.1%
6.	Johnson & Johnson	$2.620B	$2.208B	+2.9%
7.	Getinge	$2.514B	$2.061B	+3.4%
8.	Terumo	$2.332B	$1.778B	+4.6%
9.	W. L. Gore & Associates	$1.936B	$1.559B	+3.7%
10.	Lepu Medical Technology	$1.252B	$270M	+29.2%

Drugs Used In Treatment of Heart Failure

Preventative Drug Treatments

Heart failure helps target effective treatment. Secondary prevention measures, including aspirin. and intensive treatment of hypertension. and dyslipidaemia,improve outcomes in patients with ischaemic heart disease, the commonest cause of CHF. Warfarin may be beneficial in selected patients with heart failure.[67][68][69][70]

Diuretics

In severe heart failure, thiazide diuretics and metolazone have a synergistic effect with loop diuretics and may be used in combination.[67][71][72]

Vasodilators

ACE inhibitors. Other vasodilators, including the α-blocker prazosin and the calcium channel antagonist amlodipine, had neutral effects on mortality in patients with CHF.

ACE inhibitors. Other vasodilators, including the α-blocker prazosin[73] and the calcium channel antagonist amlodipine,[74] had neutral effects on mortality in patients with CHF.

Digoxin

Digoxin may be used to control the ventricular response rate in those CHF patients with atrial fibrillation.It would also be reasonable to use digoxin in those patients who remain symptomatic despite adequate treatment with diuretics, ACE inhibitors, and β-blockers The Digitalis Investigation Group reported no mortality benefit in CHF patients on digoxin treatment over three years.[75][76][77]

Angiotensin Converting Enzyme Inhibitors

ACE inhibitors prevent the conversion of angiotensin I to angiotensin II, and also inhibit bradykinin degradation. ACE inhibitors shift the balance between the unwanted effects of angiotensin II and the beneficial vasodilatory and natriuretic effects of bradykinin.[78][79][80][81][82]

Angiotensin II blockers (AT1 antagonists)

Angiotensin II acts via a family of cell bound angiotensin receptors. The AT1 receptor has been shown to mediate the detrimental effects of angiotensin II in patients with heart failure and angiotensin II antagonists block the AT1 receptor.[83][84][85]

β-Blockers

Metoprolol is a second generation β_1-selective antagonist with no intrinsic sympathomimetic activity. In CHF patients, it has been demonstrated to improve cardiac function, left ventricular remodelling and capacity for exercise, and lessen the symptoms of heart failure.[86][87][88]

Spironolactone

Spironolactone, a potassium sparing diuretic, is a competitive antagonist of aldosterone and has been shown to have additional beneficial effects in patients already treated with an ACE inhibitor.[89]

CONCLUSION

Coronary angiography is done with a cardiac catheterization procedure. For this procese will clean and numb an area on the arm, groin or upper thigh, or neck before making a small hole in a blood vessel. Your doctor will insert a catheter tube into your blood vessel take X- ray pictures to help place the catheter in your coronary artery.After the catheter is in place the contrast dye through the catheter to highlight blockages and will take X- ray pictures in heart. Angioplasty is a procedure to open narrowed or blocked blood vessels that supply blood to the heart. These blood vessels are called the coronary arteries. A coronary artery stent is a small, metal mesh tube that expands inside a coronary artery. A stent is often placed during or immediately after angioplasty. It helps prevent the artery from closing up again. A drug-eluting stent has medicine embedded in it that helps prevent the artery from closing in the long term. Coronary artery disease, a narrowing of the arteries that carry blood and oxygen to the heart muscle. By clinical guidelines, an artery should be clogged at least 70 percent before a stent should be placed, Resar said. “A 50 percent blockage doesn't need to be stented he said.

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