CONVENTIONAL ANGIOGRAPHY

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- ***Objectives***- Review the indications for angiography.
- Describe the technique of angiography.
- Review the appropriate evaluation of the potential complications of angiography.
- Explain the importance of improving care coordination among interdisciplinary team members to improve outcomes for patients undergoing angiography

Index Terms- Conventional radiography, Angiography

I. INTRODUCTION

II. In the past 50 years, medical imaging has seen a boom in innovation, which has boosted interventional radiology. Contrast is injected into a blood artery during an angiogram to highlight the inner vessel wall and demonstrate blood flow into the lumen. Initially utilized as a diagnostic tool, angiograms are now employed in interventional therapy. Angiography has advanced from being a static, two-dimensional film recording of the vasculature to a real-time, two-dimensional TV projection and a three-dimensional reconstruction from CT scans. Angiography achieves real-time, dynamic imaging utilizing x-rays or CT and offers therapeutic alternatives at early diagnosis. Invasive angiography. Angiography is the gold standard for identifying intravascular diseases and giving therapeutic alternatives. Advances in imaging technology have broadened angiography to include non-invasive CT and MRI procedures.

III. Angiographs can produce a wide range of different types of pictures, each optimized for its specific application. X-ray images are typically limited to a 2D output due to several factors. 2D outputs have foreshortening, making it hard to precisely evaluate diffuse long and eccentric lesions, as stated by Ramasamy et al. (2020). Similarly, 3D quantitative coronary angiography has been recommended by several imaging specialists. In their 2020 paper, Ramasamy et al. claim that their method can recreate individual coronary geometry. Low contrast, motion artifacts from breathing and heartbeat, and the angiogram's catheter and spine integration create these difficulties (Fan et al., 2018). The availability of imaging results also means that machine learning technology can help to refine diagnostic methods. The goal of the study by Yang et al. (2019) was to explore how well deep learning models may aid in the segmentation of coronary angiography, particularly for the major channels. Since there are many different imaging modalities and technologies available, this model can be dynamically used to meet the specific requirements of an imaging specialist or physician

Indications

- Determine the diagnosis and presence of ischemic heart disease.
- If you've recently had revascularization surgery (restoration of perfusion to a body part or organ that has suffered ischemia)
- Heart defects and vascular abnormalities are present at birth.
- Conditions affecting the heart's valves, muscles, and ventricles; myocardial disease.
- Arterial plaque
- Brain Aneurysms
- Aneurysmal ductal thrombosis
- Arterial Ischemia
- Accidents and Scars

Contraindications

Absolute Contraindications

- Weight beyond 350 pounds
- Renal failure
- Recent cardiac surgery

Relative Contraindications

Allergy to contrast media, Low renal function, Blood coagulation disorders, Anticoagulant medicines Unstable cardiopulmonary/neurological status

Equipment

The procedure room for angiography and procedures linked to angiography should be large enough to fit all the equipment and the crew. The essential equipment needed for conventional angiography includes:

- Set of catheters and guide wires
- Autoinjector
- Image intensifying screen
- Sliding table
- Remote computerized equipment
- Biplane C-arm digital imaging
- Generator

Preparation

Based on the patient's features, the planned type of angiography, and the indication, customized patient preparations are made for conventional angiography. To reduce the risk of contrast medium-induced nephrotoxicity, all patients undergoing conventional angiography should be adequately hydrated. In some cases, it may be necessary to fast for 6 to 8 hours. To ensure the safety of the procedure, patients with impaired renal function, diabetics taking metformin, those taking antiplatelet or anticoagulant medications, and those with a history of iodinated contrast allergy should be adequately examined before angiography.

Technique

Several distinct big and medium-sized arteries may be used as entry sites for angiography, depending on the specifics of the treatment. In many cases, a retrograde approach is preferred, and the femoral route is chosen, while working on the iliac arteries, abdominal and thoracic aorta, upper limbs, head, and neck. Larger devices, such as stents or occlusive aortic balloons, can be used because of their high capacity. In contrast to the more traditional femoral and brachial approaches, the radial approach, which is now commonly employed in coronary angiography, carries a decreased risk of problems. Collagen plugs and percutaneous suture devices are commonly employed with the femoral approach, along with sheaths of a larger size. Both the antegrade femoral approach and the popliteal route are used for lower limb angiography.

Depending on the procedure, a guide wire system is used to insert an appropriate catheter through the access site and into the target vessel. A contrast agent is injected into the bloodstream to highlight the vascular system farthest from the catheter tip. Digital subtraction angiography (DSA) allows for the collection of either static or fluoroscopic X-ray images at a rate of 2–3 frames per second. A visual examination can determine the degree of stenosis or other abnormalities.

During thoracic aorta procedures, the aortic root, ascending aorta, aortic arch, and proximal descending

aorta are initially scanned. The head is tilted and rotated to the right to facilitate access to the patient's branches. Commonly, an image of the aortic arch at 40° LAO (left anterior oblique) is taken at the beginning of surgery to determine the aortic arch type, which predicts the difficulty of the treatment because type II and type III arches make cannulation of the common carotid more challenging (Madhwal. S. et. al 2008).

The patient will be in a prone position for abdominal aorta imaging. Both the PA and the 90-degree lateral view are utilized. During the initial angiographic run, the pigtail catheter is placed at the level of the first lumbar vertebra, and the angiographic field of view runs from the diaphragm to the iliac wing margins (L1). After the catheter is traditionally lowered to the level of the aortic bifurcation, the iliac arteries are inspected using the anterior oblique projections (L4). with the femoral approach, along with sheaths of a larger size. For lower limb angiography, both the antegrade femoral approach and the popliteal route are utilized.

Minor Complications

A temporary decline in renal function, Temporary hot flushes or a burning feeling, Bruising Nausea, Pain at the puncture site, Minor allergic reactions like rash, itching, or hives

Major Complications

- Significant bleeding,
- hematoma or false aneurysm occurs in <5% of angiograms, (Tavakol M. et. al)
- Significant allergic reaction (anaphylactoid reaction)
- Acute renal failure

One significant cause of morbidity is contrast-induced nephropathy (CIN), which may necessitate a brief course of renal replacement treatment. The use of low contrast volume and proper peri-procedural hydration are two crucial preventive measures for problems connected to contrast-related procedures (Tavakol M. et. al). The following equation was used by Cigarroa et al. to determine the maximum allowable contrast dose (MACD): serum creatinine in mg/dl divided by five times body weight in kilograms, up to a maximum of 300 milliliters (Cigarroa RG et. al 1989). Since it is less useful in high-risk patients with illnesses including anemia, diabetes, heart failure, and cardiogenic shock, this formula is rarely used in clinical settings. A low incidence of CIN is associated with a contrast volume to an estimated creatinine clearance ratio of less than two, according to Gurm et al. However, the risk of CIN significantly increases when the ratio exceeds three (Gurm HS et. al 2011).

Clinical Significance

Traditional invasive angiography is rarely used for diagnostic purposes now that non-invasive alternatives like computed tomography and magnetic resonance angiography are available. Even more so than with conventional angiography, CTA and MRA allow for functional evaluation of vascular problems, beyond merely morphological diagnosis. When the computed tomography fractional flow reserve (CT-FFR) value is between 0.70 and 0.80, invasive FFR is crucial because the CT-overall FFR has a diagnostic accuracy of only 46.1% in this range. This is supported by several studies (Cook CM et al., 2017; Alfakih K et al., 2018). Despite the rapid development of therapeutic percutaneous interventions such as percutaneous coronary intervention (PCI), mechanical thrombectomy for cerebrovascular accidents, peripheral vascular stenting, renal artery stenting, and transarterial chemoembolization, invasive angiography is still of great value. Fractional flow reserve (FFR) derived via invasive pressure wires has long been the gold standard, however recently discovered physiological measurements derived from angiograms have proven to be highly accurate (Fearon WF et. al 2019).

Risks

Coronary angiography, like other procedures involving the heart and blood vessels, carries the potential danger of radiation exposure from the X-rays utilized. Even yet, major problems are unusual. Heart attack, stroke, damage to the artery being catheterized, irregular heartbeats (arrhythmias), allergic responses to the dye or drugs used during the treatment, kidney damage, excessive bleeding, and infection are only some of the potential concerns and difficulties.

Results

Doctors can determine what is wrong with your blood arteries using an angiography. It can: Display the number of your coronary arteries that have atherosclerosis—fatty plaques that clog or constrict the arteries—and Identify the locations of blockages in your blood vessels.

Check the results of past coronary bypass surgery, demonstrate how much blood flow is obstructed by your blood vessels, and measure the blood flow through your heart and blood vessels.

Other imaging modalities

Triple-phase CT is typically acquired in CT angiography (CTA), where intravenous contrast is delivered through a peripheral vein. Angiographic two- or three-dimensional reconstruction is performed after acquiring high-resolution CT data, which is the foundation of CTA. Patients suffering from cardiovascular illnesses have benefited greatly from the development and adaptation of CTA concepts. Although this is a great first diagnostic tool, because of its small diameter it is not as helpful in determining how well blood is circulating to the extremities. Interventional angiography produces higher-resolution images and can detect abnormalities in tiny vessels.

With the rapid development of imaging technology, clinical uses of magnetic resonance angiography (MRA) have grown more important to both patients and doctors. MRI scans use the magnetic properties of bodily tissues in a laboratory setting. The use of ionizing radiation is unnecessary. There isn't enough space here to go into the specifics of CTA and MRA.

radiographs is equal at this resolution. Computed radiography magnification methods may be used to overcome the limitations brought on by a poor spatial resolution12. The resolution for skeletal images using screen film radiography is typically 8 lines per millimeter. Another characteristic is that the size shown in the photographs could not accurately reflect anatomical proportions. The pictures are so challenging to template for preoperative surgical planning. For example, the templates for hip replacement surgery are frequently 15% to 20% larger than the original size, which corresponds to screen film radiography. A digital image with a range of magnification cannot be templated since the image will not fit any conventional template. Some implant manufacturers are creating digital templating alternatives to overcome this issue.

IV. CONCLUSION

ANGIOGRAPHIES RELY ON X-RAY IMAGING EQUIPMENT, BUT THEY ALSO NEED A SPECIAL TECHNIQUE FOR INSERTING CONTRAST MEDIA. THE PROCEDURE BEGINS WITH A LOCAL ANESTHETIC AND AN INCISION OVER AN ARTERY IN THE PATIENT'S BODY (OFTEN IN THE GROIN OR THE WRIST), AS EXPLAINED BY THE NHS IN THE UNITED KINGDOM. AFTER THE INCISION HAS HEALED, A CATHETER IS THREADED INTO THE BLOOD VESSEL AND THE TARGET LOCATION FOR DIAGNOSIS. CATHETERS, GUIDE WIRES, AUTOINJECTORS, SLIDING TABLES, REMOTE COMPUTER EQUIPMENT, GENERATORS, AND C-ARM DIGITAL IMAGING SYSTEMS ARE ALL NECESSITIES FOR AN ANGIOGRAPHY (OMEH & SHLOFMITZ, 2022). THE NATIONAL HEALTH SERVICE (NHS) STATES THAT POPULAR FORMS OF ANGIOGRAPHY INCLUDE CORONARY, CEREBRAL, PULMONARY, AND RENAL, WHICH RESPECTIVELY EXAMINE THE ARTERIES AND VEINS THAT SUPPLY THE HEART, BRAIN, LUNGS, AND KIDNEYS ("ANGIOGRAPHY", N.D.). AFTER INJECTING THE DYE INTO THE AREA UNDER SCRUTINY, X-RAYS CAN BE TAKEN TO TRACK THE DYE'S PROGRESS THROUGH THE CIRCULATORY SYSTEM. THE NHS WARNS OF POTENTIAL SIDE EFFECTS SUCH AS BRUISING, PAIN, BLOOD CLOTS, ALLERGIC REACTIONS, STROKES, AND HEART ATTACKS, DESPITE THE PROCEDURE'S EASE. ALTHOUGH INFREQUENT, THESE PROBLEMS ARE USUALLY RELATIVELY MINOR. AS A RESULT, IT IS A FLEXIBLE, INEXPENSIVE, AND SAFE METHOD.

Coronary angiography using X-rays is the gold standard for diagnosing heart disease. The morphology of the coronary arteries can be seen, as stated by Yang et al. (2019). In this way, the imaging team can assess the patient's current health situation in real-time. X-ray imaging is discussed by Cervantes-Sanchez et al. (2019). It is widely accepted that coronary angiograms are the gold standard for diagnosing and keeping tabs on heart disease related to blocked arteries in the heart. Therefore, the method facilitates the detection of several problems by providing clinicians with unobstructed views of the coronary arteries. Angiography, for instance, has been used to predict plaque vulnerability, as described by Yang et al. (2019). Wan et al. (2019) also mentioned that the method had been applied to the diagnosis of coronary artery disease. So, the approach can be used by cardiologists to treat complex cardiac diseases. Coverage of many anatomical aspects contributes to the success of X-ray coronary angiography. To assess "vessel diameter, reflectivity, tortuosity, and aberrant branching, stenosis grading, and navigation and localization of coronary stents," cardiologists can use pictures from coronary angiography, as reported by Wan et al. (2019). (179). Because of this adaptability, cardiologists can identify a wide range of illnesses. As a bonus, Suzuki et al. (2019) imply that angiography, in conjunction with other procedures, can aid in the diagnosis, management, and tracking of a variety of cerebrovascular illnesses. Therefore, this method can be used to monitor the progression and treatment efficacy in cerebrovascular diseases if cardiologists and neurologists combine its ability to visualize blood flow through the large vasculature with perfusion imaging for microvascular information of downstream brain tissue (Suzuki et al., 2019). This imaging technique is a realistic way to advance medical practice because it can be applied to the treatment of conditions other than cardiovascular disease. X-rays provide crucial insight into the causes of coronary heart disease. Radiation exposure is kept to a minimum using plain X-ray imaging, which can be a good first step (Storey, 2022, p.673). Cardiomegaly and other cardiac problems can now be diagnosed with the help of the first pictures created from simple X-rays. Because coronary heart disease mostly affects the heart's surface arteries, a simple X-ray cannot provide an accurate diagnosis. But X-ray angiograms help see the blood pumping through the body. To see how coronary heart disease is affecting blood flow in the major arteries, angiograms are essential. Even though angiograms are typically used for diagnosis, they may also have a prophylactic purpose. Control angiography for perioperative myocardial ischemia following coronary surgery was found to be a potentially life-saving method by Biancari et al. (2018), who also demonstrated that it was effective in guiding repeat revascularization in hemodynamically stable patients. From their research, however, we learn that certain professionals may be reluctant to perform the surgery because transporting such patients from the ICU to the catheterization laboratory can be difficult. Imaging after surgery, the study indicated, could assist quickly in identifying any additional hazards while confirming the outcomes of the procedure, despite the practical constraints.

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