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Analysis of interventional cardiological risk in emergency aid: Indications and procedures

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ABSTRACT

Introduction: Interventional cardiology procedures require special preparation recommended in the form of a protocol for each service. It is understood that the need for this is an advance for the ICHS, mainly because anxiety and fear accompany patients. Objetives: The aim of this study is to carry out an up-to-date literature review on information about hemodynamics and interventional cardiology services. Material and Methods: The methodology used was a literaturereview. The health terminologies consulted in the Health Sciences descriptors (DeCS/BIREME) were used; information on Hemodynamics and Interventional Cardiology services. Results and Discussions: Hemodynamics and interventional cardiology is an area of cardiology that diagnoses and treats diseases of the heart and blood vessels using catheters. The Hemodynamics service is responsible for performing cardiac catheterization for the diagnosis and treatment of heart disease. The department performs the procedure on adults and children. Many patients are referred to the interventional cardiologist after an assessment with the clinical cardiologist. However, some go to the emergency department first because they have symptoms that could beconsidered serious, such as chest pain or even because they are already having a heart attack.

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Conclusions: Through procedures such as catheterization, angioplasty, intracoronary ultrasound, among others, interventional cardiology is a procedure without cuts, which allows patients to recover quickly. In this case, it can be used both to treat coronary artery disease, such as angina and heart attacks, as well as structural heart disease, such as problems with heart valves like severe aortic stenosis.

Key-words: Hemodynamics and Interventional Cardiology, Catheterization, Angioplasty, Intracoronary Ultrasound.

INTRODUCTION

Interventional cardiology is a specialized field of cardiology dedicated to the diagnosis and treatment of cardiovascular diseases using minimally invasive procedures. Currently, this subspecialty of cardiology has replaced conventional surgical interventions [1].

Procedures performed by catheter and other minimally invasive devices and instruments are used to restore healthy blood flow to the heart and repair or replace damaged or malfunctioning heart valves, with the aim of reversing high-risk cardiac conditions, such as congestive heart failure, in order to reduce the risk of heart attacks and strokes [2].

Interventional Cardiology offers several benefits to the patient, including a faster recovery because there is no need for large surgical incisions and sutures. Even so, the procedures are as effective and safe as the surgical treatments traditionally available [2].

Cardiovascular diseases are the main cause of morbidity and mortality in society, with Acute Myocardial Infarction (AMI) being the leading isolated ischemic cause of death in the adult population, leading to a greater indication for hemodynamic procedures in the Hemodynamic Intensive Cardiology Services (HICS) [2].

Interventional cardiology procedures require special preparation recommended in the form of a protocol for each service. It is understood that the need for this is an advance for the ICHS, mainly because anxiety and fear accompany patients. The follow-up of patients treated in these services is strongly recommended as a way of assessing quality [4] .

Hemodynamics and Interventional Cardiology services have expanded in order to provide individuals with immediate and safe procedures. In this way, percutaneous coronary interventions have grown as an efficient indicator of resolving cardiac injury with high resolubility[2].

In order to carry out hemodynamic procedures, services need to follow routine manuals that guide the process from patient preparation[2].

The processes involved must be based on national guidelines and the profile of the patients being treated. In this way, care can be targeted and individualized to promote the systematization of care.

OBJECTIVES

The aim of this study is to carry out an up-to-date literature review on information about hemodynamics and interventional cardiology services.

MATERIAL AND METHODS

The methodology used was a literature review. The research was carried out by means of an electronic search for scientific articles published on the Scielo (Scientific Electronic Library Online)and Lilacs (Latin American Health Sciences Literature) and Pubmed websites. The health terminologies consulted in the Health Sciences descriptors (DeCS/BIREME) were used; informationon Hemodynamics and Interventional Cardiology services.

The inclusion criteria were: original article, published in Portuguese and English, freely accessible, in full, on the subject, in electronic format and published in the last ten years (2010 - 2024), totaling 23 articles.

RESULTS AND DISCUSSION

Hemodynamics and interventional cardiology is an area of cardiology that diagnoses and treats diseases of the heart and blood vessels using catheters[2].

The Hemodynamics service is responsible for performing cardiac catheterization for the diagnosis and treatment of heart disease. The department performs the procedure on adults and children[2].

Many patients are referred to the interventional cardiologist after an assessment with the clinical cardiologist. However, some go to the emergency department first because they have symptoms that could be considered serious, such as chest pain or even because they are already having a heart attack[7].

Interventional procedures cannot be considered cardiac surgery, as no cuts or seams are made during their execution. They are therefore called percutaneous. This technique consists of puncturing a vein or artery to insert catheters, guides and other tools to carry out the required procedure [7].

Endovascular treatment is used to treat arterial or venous blood vessel diseases. The treatment reaches the vessels through punctures, through which catheters, guide wires, balloons for dilation and stents (metal devices) are placed inside the vessels to keep them open [8].

Catheterization is used to diagnose and treat cardiovascular diseases. The catheter, an extremely thin flexible tube, is almost always inserted after an arterial or venous puncture, advancing to the organ chosen for action. The preferred puncture sites are the wrist, groin and arm [7].

Angioplasty is a much less traumatic technique than surgery for unclogging arteries. The procedure is performed by puncture (it doesn't cut the skin) and uses a tiny balloon at the tip of a

catheter, which is inflated inside the artery clogged with fatty plaques and blood, restoring blood flow to the heart, brain or any organ with a blood supply deficit. After unblocking, devices called stents are placed, which keep the artery open and prevent a new local obstruction [6].

Interventional neuroradiology is a medical specialty that allows the diagnosis and surgical treatment, using minimally invasive techniques, of some vascular diseases of the central nervous system, such as cerebral aneurysms and ischemic stroke. Surgical access is performed percutaneously, through a small puncture in the groin, with the introduction of micro catheters that are guided through the vessels, using advanced imaging resources. The procedures can be performed under local or general anesthesia, depending on the duration of the surgery [6-9].

These technologies allow cardiovascular diseases to be treated quickly and effectively, providing patients with health and quality of life [7].

Brazil's Unified Health System (SUS) stipulates that citizens should be cared for by the public health system according to the hierarchy of units (from basic to highly complex) and that patients should be referred and counter-referred between them depending on the health service they need. Therefore, the first emergency care should be provided at the health service in the area where the patient lives or is currently staying, i.e. the Emergency Care Unit [4].

If the clinical condition is serious, requiring hospitalization or evaluation by a specialist, the doctor at the unit where the patient was seen will contact the Health Services Supply Regulation Center (CROSS) which, in turn, will communicate with Santa Casa to schedule the transfer safely [7].

It consists of a procedure to diagnose or treat heart disease, by inserting a catheter, which is an extremely thin and long flexible tube, into the artery in the arm or leg of the individual, which will be led to the heart, also called coronary angiography, coronary angiography or hemodynamic study (FIGURE 1) [9].

It is indicated in the diagnosis and treatment of heart attacks or angina, and is capable of detecting and removing accumulations of fatty plaques, cholesterol, calcium and other substances found in the blood, showing whether the plaques have narrowed or blocked the coronary arteries. Plaque buildup narrows the inside of the arteries and restricts the flow of blood to the heart [10].

Cardiac catheterization is widely used to diagnose and/or treat various heart conditions, including: assessing the coronary arteries that supply the heart muscle, unclogging arteries and valves due to fatty plaque buildup, checking for valve and heart muscle damage, checking for

changes in the heart's anatomy not confirmed by other tests, showing congenital malformationsin newborns and children [10].

Recovery from the procedure is quick, and if there are no complications, the patient is discharged after a few hours, as long as there are no other associated procedures. Performed under local anesthesia, a small opening is made for the catheter to enter the skin of the groin or forearm at the wrist or elbow, then the catheter is inserted into the artery (usually radial, femoralor branchial) that will be led to the heart [10-12].

The entrances to the right and left coronary arteries are located, followed by the injection of iodine-based contrast, which allows images of the arteries and possible clogging points to be visualized. Contrast is also injected into the left ventricle to visualize heart pumping. The test is painless, but it is normal for the patient to feel a passing wave of heat in the chest when the contrast is injected. Normally, the test takes no more than 30 minutes, and is usually longer in patients who have already undergone coronary artery bypass grafting or coronary artery disease [4].

Blockages in the arteries can also be seen using ultrasound during cardiac catheterization to help define whether or not surgical treatment is necessary (coronary angioplasty, heart surgery or correction of congenital heart disease). The most common justification for requesting catheterization is to assess chest pain, a symptom of coronary artery disease showing whether plaque is narrowing or blocking the heart arteries [17].

It is an invasive test that can be carried out electively, to confirm the presence of obstructions in the coronary arteries or assess the functioning of the valves and heart muscle, or in emergency situations, to determine the exact location of the obstruction that is causing the acute myocardial infarction and plan the best intervention strategy [4].

The entire examination involves the acquisition and generation of images which are then made available to the patient on film and photos. When the artery is punctured (either in the arm or groin), an introducer is installed through which the catheter will be inserted. Once the diagnosis has been made and the degree of arterial obstruction has been established, the interventional cardiologist can decide on immediate interventional treatment, which would be coronary angioplasty, or schedule subsequent treatment [8].

Figure 1. Coronary angiography is a test that uses a special dye (contrast material) and X-rays to find out if you have an obstruction in a coronary artery. Source:[9]

CORONARY STENT IMPLANTATION

Stent implantation (FIGURE 2) is a minimally invasive procedure during which a stent and a balloon are used together to push back plaque deposits inside a coronary artery to treat heart disease [8].

Stents are small, usually made of metal or metal alloys, tubular devices that expand. They are inserted inside canals, ducts or blood vessels in the body to prevent or even correct some kind of narrowing along the way. In the case of arteries, more precisely, the stent plays an important role in preventing any blockage from occurring in the area [9].

Stents are used when it is necessary to reverse significant reductions in arterial diameter caused by the deposition of substances such as calcium and cholesterol, restoring good blood flow [1].

There are different types of stents that can be used in different parts of the body; they should be chosen by your trusted doctor, taking into account your specific characteristics and the clinical case in general [19].

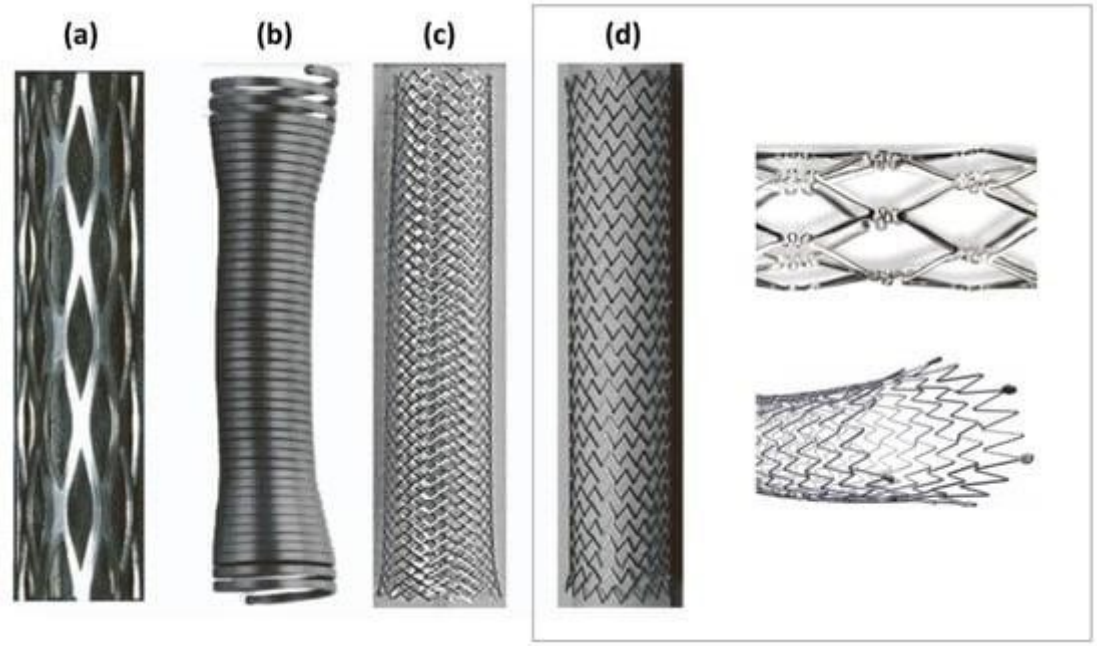
Although they are most commonly used in arteries such as the carotid, coronary and iliac arteries, stents can be placed in bile ducts, central veins, colon, esophagus, ureters and trachea [16].

A stent is placed by a surgeon. Despite being an invasive method, it is considered less aggressive than revascularization of the region, allowing the patient to be discharged from hospital in approximately 24 hours [13].

During the procedure, the closed stent is placed through a peripheral artery (in the leg or arm) and guided to the target site. When placed in the desired position, the prosthesis is inflated by means of an internal balloon that expands the vessel walls, restoring blood flow immediately [7].

Stents can be made from sheets, wires, ribbons or tubes, although most balloon-expandable and self-expanding cardiovascular stents are made from metal wires or tubes. The choice of manufacturing method is strongly influenced by the form of the raw material used, including machining of tubular shapes and machining and rolling of sheets, as well as welding, braiding, knitting and winding of wires to form the tubular structure of the stents. Probably the most common manufacturing process involves laser cutting of tubes, which also allows for great precision in creating complex patterns on very small tubes (from 0.5 mm in diameter) (Figure 2) [3].

Figure 2. Different stent geometries according to the choice of the shape of the raw material: (a) revolution of a blade, (b) coil, (c) braided wires and (d) grooved tubes, with closed cell detail (above). and open cell designs (below). Source: [8] .



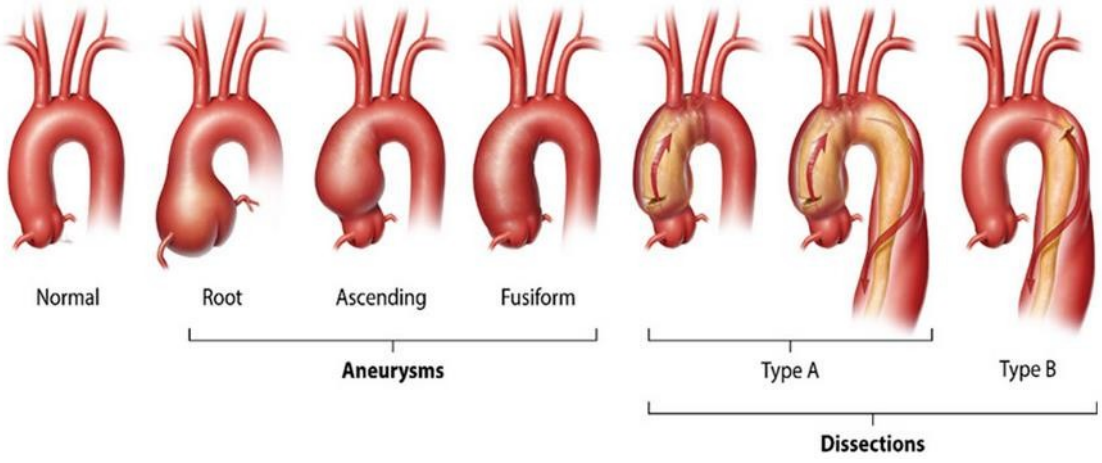
TREATMENT OF AORTIC DISEASES (ANEURYSM AND DISSECTION)

Aortic diseases can be treated percutaneously, i.e. without the need for open surgery, orby traditional surgery. The choice between approaches depends on the type and location of the aneurysm or dissection. However, early and accurate diagnosis is very important [8].

Aortic dissection (FIGURE 3) is the entry of blood by dilaceration of the aortic intima, with separation of the intima and media, as well as the creation of a false lumen (canal). Dilation of the intima can be a primary event or secondary to hemorrhage within the media. Dissection can occur anywhere along the aorta and extend proximally or distally to other arteries [20].

Hypertension is an important factor. Signs and symptoms include the abrupt onset of tearing thoracic or lumbar pain, and dissection can lead to aortic regurgitation and compromised circulation in arterial branches. Diagnosis is made using imaging methods (e.g. transesophageal echocardiography, CT angiography, MRA and contrast aortography). Treatment involves strict blood pressure control and serial imaging to monitor the progression of the dissection. Surgical repair of the aorta and insertion of a synthetic graft are necessary for dissections of the ascending aorta and for certain dissections of the descending aorta. Endovascular stent grafts are an option for selected patients with descending dissections, especially when the dissection involves the descending thoracic aorta [17].

Figure 3. Schematic representation of thoracic aortic aneurysms and aortic dissections. Source: 7



MYOCARDIAL BIOPSY

Biopsy continues to be the reference method for diagnosing various myocardial pathologies, assessing rejection in patients undergoing heart transplantation and clarifying the etiology of some intracardiac masses [16].

Endomyocardial biopsy (FIGURE 4) consists of obtaining small fragments of cardiac muscle for microscopic analysis (anatomopathological study) [1].

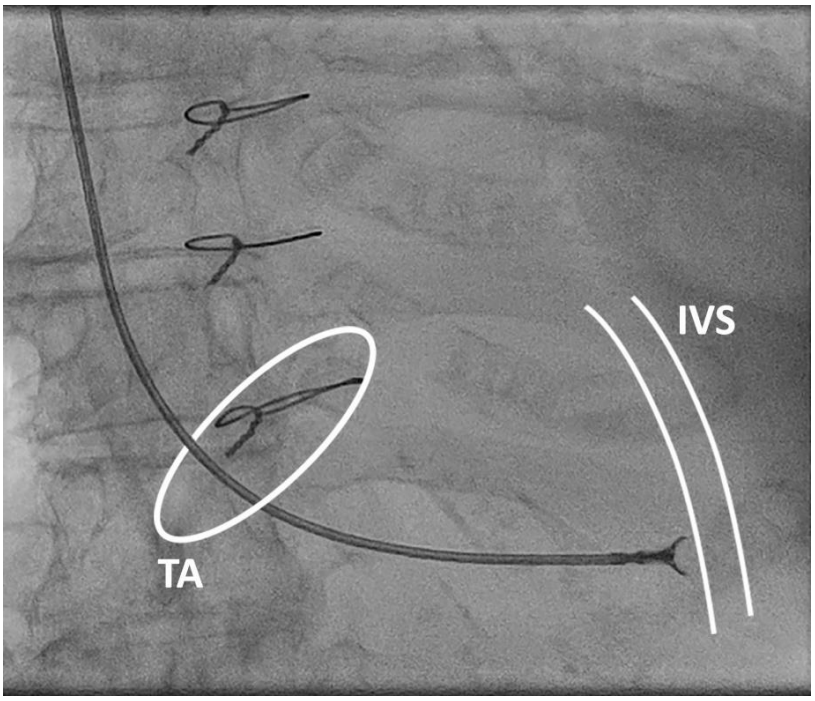
The procedure is usually performed under local anesthesia only and the patient remains awake during the intervention. Depending on the severity of the case, it may be necessary to use general anesthesia. After anesthesia, a femoral vein (in the groin) or jugular vein (in the neck) is punctured. A special biopsy forceps is inserted into the vein until it is properly positioned in the heart cavity (right ventricle). With these forceps, small fragments of the heart muscle are removed, placed in appropriate vials and sent to the Pathology Laboratory. The procedure is painless and there may be minimal discomfort and palpitations [6].

The technique of endomyocardial biopsy (EMB) has been improved over the last 50 years, so that it now represents a safe investigation of particular use both in the search for a specific group of diagnoses and the most effective way of detecting rejection in the transplanted heart. However, it is not without risks and its implementation varies greatly between centers [22].

A joint scientific statement by the American Heart Association (AHA), the American College of Cardiology (ACC) and the European Society of Cardiology (ESC), published in 2007, remains the core of current guidance, but admits that large-scale randomized data is scarce and some recommendations are based on the accumulated opinion of experts [18].

However, experts don't always agree, as demonstrated by the recommendations contained in two contemporary consensus documents. The 2013 statement from the ESC Working Group on Myocardial and Pericardial Diseases recommends EMB for most cases in which myocarditis is suspected (level of evidence C),2 while the 2013 ACC/AHA Guideline for the Treatment of Heart Failure recommends that EMB should not be performed in the routine evaluation of patients with heart failure (level of evidence C)[21].

Figure 4. Myocardial Biopsy. Source: [1]



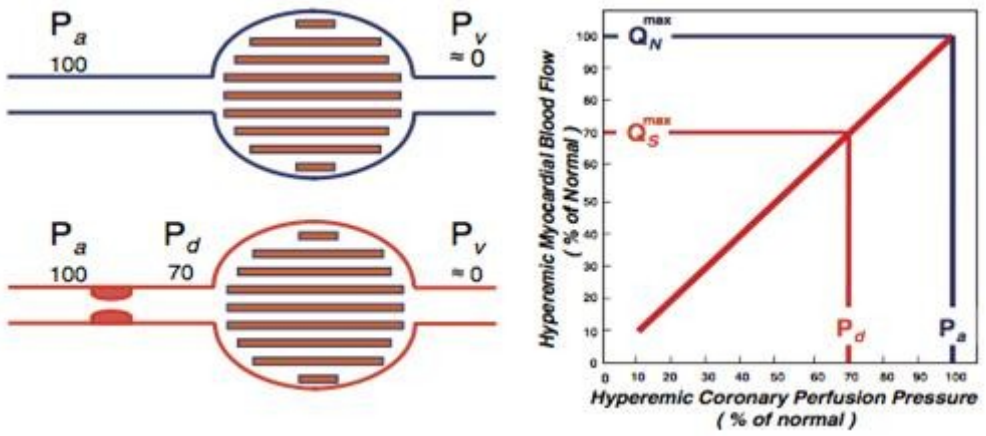
FFR (FRACTIONAL FLOW RESERVE TEST)

Fractional Flow Reserve (FFR) is an invasive physiological assessment method to help interventional cardiologists diagnose coronary artery lesions (FIGURE 5) [13].

A small catheter is inserted into the wrist or groin, which, through pressure measurements before and after coronary lesions, provides information on whether the lesion has functional repercussions for the patient (causes pain or ischemia) and therefore whether or not it needs to be treated with angioplasty. It is the most effective method for assessing the presence of ischemia related to coronary obstruction. The procedure and its risks are similar to those of cardiac catheterization and coronary angioplasty [23].

The FFR is determined by dividing the mean pressure distal to the stenosis (Pd) by the pressure proximal to the stenosis (Pa) or mean pressure in the aorta during maximum vasodilation (induced by intracoronary or intravenous papaverine or adenosine). Maximum hyperemia is essential for inducing vasodilation and measuring FFR (Lima A). Therefore, FFR=Pd/Pa [7].

Figure 5. Fractional Flow Reserve (RFF or FFR as it is better known in English) is an invasive physiological assessment method to assist the interventional cardiologist in the diagnosis of coronary lesions. Source: [13]



INTRACORONARY ULTRASOUND

Intracoronary ultrasound (ICUS) (FIGURE 6) is a diagnostic modality that also works as an adjuvant therapy. It allows analysis of the wall of the coronary artery vasculature, whether it is normal or compromised by atherosclerotic plaques [16].

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Through the acquisition of tomographic images of the interior of the vessels, it provides quantitative and qualitative characteristics involved in atheroma, helping in the proper planningof interventions and optimization of their results. It has now become an important tool in percutaneous therapy, especially in the era of drug-eluting stents [18].

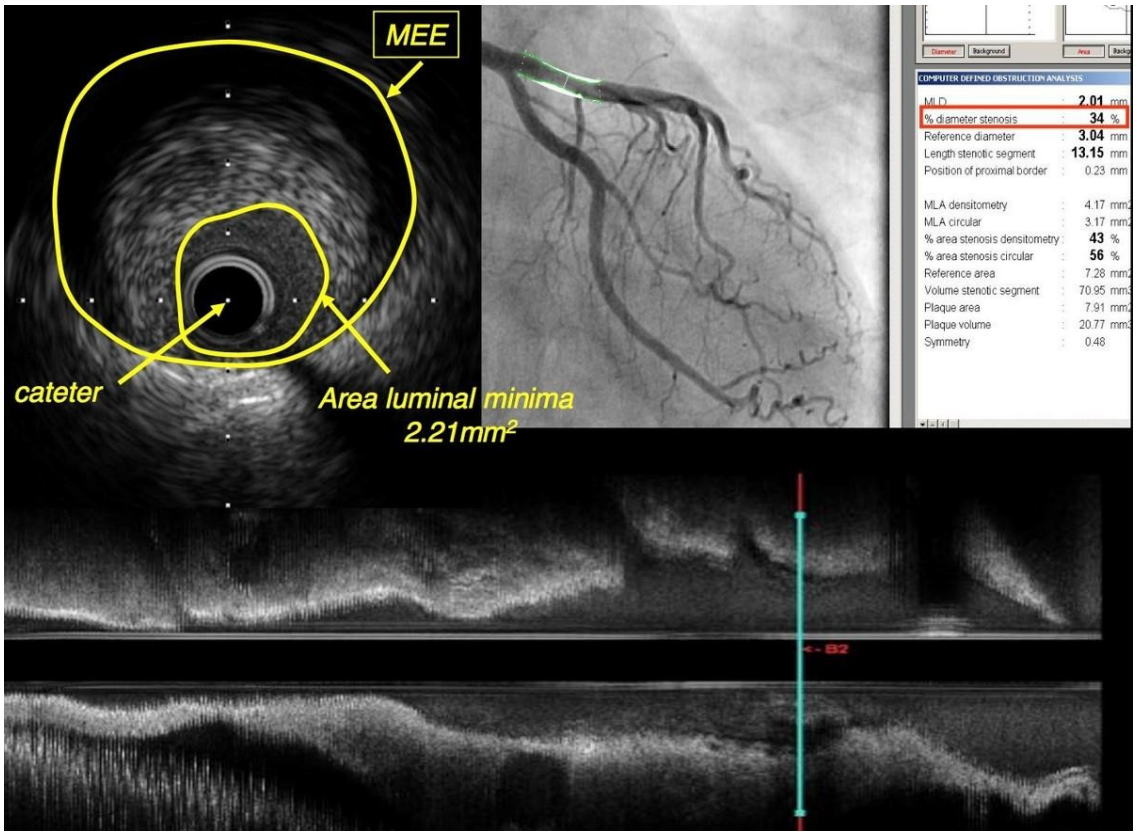
Because it is an invasive test, intracoronary ultrasound requires a hospital environmentand equipment similar to that of percutaneous coronary angioplasty [19].

Access can be femoral or brachial, using an introducer and guide catheter of at least 6 French, and a 0.014-inch guide wire over which the ultrasound catheter will slide along the target segment. Full anticoagulation with heparin (100 U/Kg) is required during the procedure, and hospital discharge can be carried out after hemostasis and rest [17].

To acquire the images, the catheter is advanced 10mm distal to the target segment. From this point, uninterrupted acquisition begins up to the aorto-ostial junction, which is automatically pulled at 0.5 mm/sec (“pullback”), with the side branches and calcified regions serving as

anatomical reference points. The pullback can also be done manually. The scan is then recorded and archived for analysis [17].

Figure 6. Intracoronary ultrasound (IVUS) is a modality for diagnostic purposes and also functions as adjuvant therapy [16].



PERCUTANEOUS TREATMENT OF HEART VALVES (MITRAL, PULMONARY AND AORTIC)

TAVI (catheter aortic valve implantation) (FIGURE 7) consists of a percutaneous (minimallyinvasive) procedure for the treatment of a condition called severe aortic stenosis [7].

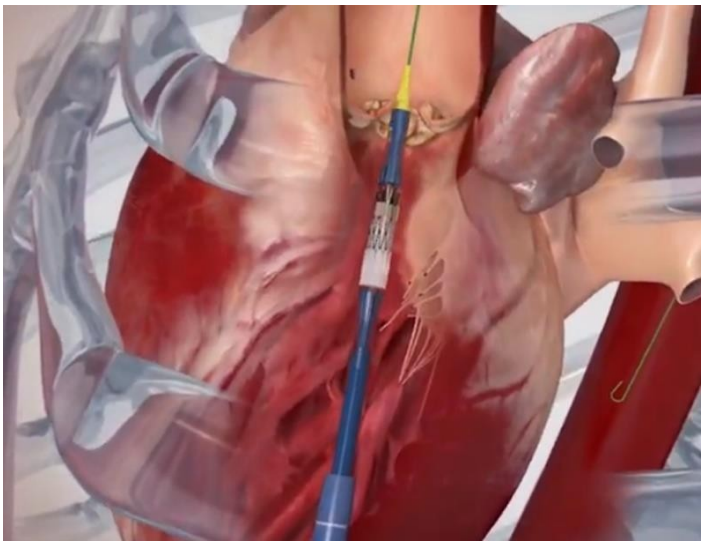
The volume of blood leaving the heart is regulated by the aortic valve, which is responsible for pumping blood to the brain via the carotid arteries, to the heart muscle via the coronary arteries, and so on. It happens that, mainly due to ageing, it degenerates, loses power, becomes more restricted in opening and compromises pumping. Over time, the condition can develop into heart failure. A triad of symptoms which, although not specific to aortic stenosis, indicate the need for further examination are: chest pain, tiredness and fainting [11].

Mitral clip implantation by catheter (FIGURE 7) consists of treating significant mitral insufficiency by implanting a clip using a minimally invasive percutaneous technique (puncture of

the femoral vein, in the "groin"). This treatment was developed for patients who cannot undergo conventional surgery with sternotomy (conventional surgery, "open chest") to correct mitral insufficiency. Many patients with mitral regurgitation are too old and at too high a surgical risk to be treated by conventional techniques [16].

Several studies have shown a significant reduction in hospital admissions, an improvement in symptoms such as shortness of breath and fatigue, and even a reduction in mortality with the implantation of this device [16].

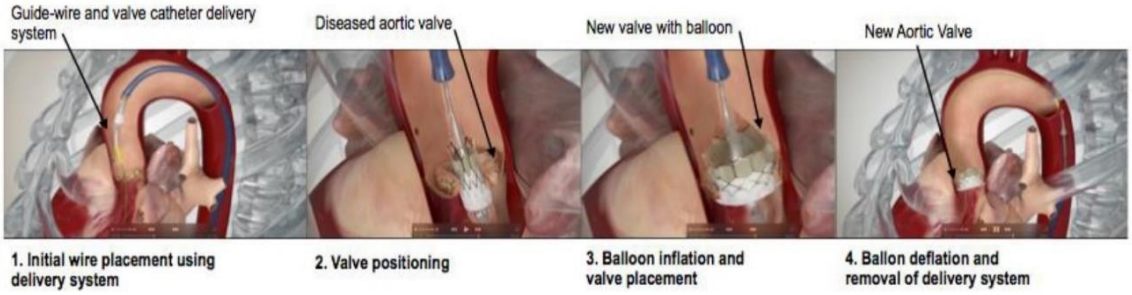
Figure 7. TAVI (Catheter-based aortic valve implantation). Source: [17].



Clinical treatment seeks to control comorbidities, coronary disease, dyslipidemia, angina, hypertension and heart failure, but these measures have not been shown to improve survival. Statins prevent ischemic events. Hypertension and angina are treated with beta blockers or calcium channel blockers and digoxin and diuretics are generally used for heart failure. Angiotensin-converting enzyme inhibitors can be used with caution once arterial outflow obstruction has been ruled out, but nitrates should be avoided due to their potential to cause unpredictable hypotension. One-year survival for patients with severe, symptomatic aortic stenosis is between 50 and 60%, unless there is surgical or catheter intervention[3].

Surgical aortic valve replacement (FIGURE 8) has been considered the gold standard treatment, improving patient survival and quality of life. In-hospital and 30-day post-operative mortality for CAVT is less than 3.2%, and life expectancy after surgery is close to that of the control population [3].

Figure 8. Illustration of the ITVA procedure. Femoral approach using the Edwards SAPIEN 3 valve Source: [17].



Patients are selected for TAVI based on clinical criteria and risk assessment by a multidisciplinary team of cardiologists, cardiac surgeons and anesthesiologists. The European Association for Cardiothoracic Surgery (EACTS) and the European Society of Cardiology (ESC) currently restrict TAVR to high-risk patients and those with contraindications to surgery [3].

CONCLUSIONS

Through procedures such as catheterization, angioplasty, intracoronary ultrasound, among others, interventional cardiology is a procedure without cuts, which allows patients to recover quickly. In this case, it can be used both to treat coronary artery disease, such as angina and heart attacks, as well as structural heart disease, such as problems with heart valves like severe aortic stenosis.

Although it's not a new technique, there have been great technological advances in the area, such as catheters that are increasingly smaller in diameter, the contrasts have improved a lot and they no longer tend to have so many side effects.

Interventional treatments are usually carried out under sedation only, eliminating the need forgeneral anesthesia, which helps to reduce the patient's hospital stay, as they usually recover quickly, which also allows them to resume their normal activities quickly.

Catheterization procedures, for example, have similar results to conventional surgeries.

The risk of an interventional procedure is much more related to the disease that leads the patient to undergo it than the procedure itself.

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