

CARDIAC CATHETERIZATION*

By

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EVER since life existed man has been struggling to fight diseases in various ways. Efforts of men of different ages have led to the advancement of scientific methods in diagnosing diseases. With the increase in heart ailments medical men have concentrated their efforts in the methods of treatment of these diseases. The result has been the introduction of various diagnostic methods with the use of electricity like Electro Cardiography, Vector Cardiograph and Phono-Cardiography. The recent addition to these series is cardiac catheterization. Cardiac catheterization is the passage of a special catheter into the right side of the heart and the pulmonary artery to detect cardiac anomalies accurately.

The history of cardiac catheterization is fascinating. About thirty years ago Dr. Fossman introduced a sterile polyethylene tube into his own atrium by passing it through a vein in the right arm. Then he instructed his assistants to shoot radio opaque dye through the tube and take quick X-ray pictures to trace the course of the dye. His experiment on himself has been the basis of today's cardiac catheterization.

Cardiac catheterization is indicated for measurement of the pulmonary pressure in mitral stenosis, assessment of size and the exact position of the lesions in congenital heart diseases, determination of success of cardiac surgery and assessment of a diagnosis when a group of symptoms such as cyanosis, dyspnoea, oedema are present.

The important equipments required for the procedure are the catheter, X-ray plant with image intensifier, electronic pressure transducers and electronic pressure recorder.

The catheters vary in length and thickness. Ordinarily the length is 100 or 125 cm. The thickness is numbered from 3 to 11; 3 being the thinnest and 11 the thickest. In structure they are nylon woven, lead coated and polyethylene lined. Nylon provides stiffness; lead, radio-opacity and polyethylene, smoothness. There are double lumen and electrode catheters. The former enables simultaneous recording of pressures from two places and the latter, pressure and intra-cardiac electrocardiogram.

The image intensifier is an improved fluoroscopic screen that can be operated in broad day light with a better visualization and with lesser degree of exposure of patient and operator to radiation.

The pressure transducers when attached to the catheter during the procedure convert the mechanical pressure in the cardiovascular system into electronic pressure and transmit it to the electronic pressure recorder.

The pressure recorder that is fitted with an oscilloscope and automatic camera is used to record and observe the pressure and E.C.G. continuously during the procedure.

Preparation of the Patient

The procedure on a child is done under general anaesthesia. Therefore preparation for general anaesthesia is necessary. With the adult, only local anaesthetic is used to expose the vein. The patient needs a good night's sleep and is to be sent to the laboratory with empty stomach, bowels and bladder. In both the cases the presence of other ailments such as pyrexia, cough, cold, congestion of the lungs, tachycardia, bradycardia, and low blood pressure are contra indications for the procedure. An antibiotic like crystalline penicillin is administered in adequate dose as a prophylactic measure.

The technique

All aseptic precautions as in a major surgical operation are to be strictly observed. The median*¹ cephalic vein, usually of the right arm in the antecubital space is exposed, the catheter inserted and advanced up to axillary vein. Viewing through "image intensifier" it is pushed further into the superior vena cava, right atrium, right ventricle, pulmonary artery and up to pulmonary capillary wedge employing a special technique described as pushing, pulling, twisting and turning. Once it is at the pulmonary capillary wedge, withdrawal is commenced recording pressure and collecting blood samples at different places. While collecting blood samples, care is taken to prevent atmospheric air mixing with the blood. At the same time attempt is also made to pass the catheter through abnormal openings. Effect of exercise on pulmonary pressure also may be experimented by making the patient pedal a cycle, fitted to the table. During the course of the procedure, the catheter is flushed frequently with heparinised isotonic saline (1,000 units of Heparin per 100 ml. of saline) to prevent clot formation.

The procedure is abandoned whenever persistent ectopic heart beats, tachycardia, bradycardia or fall of blood pressure are noticed. On final withdrawal the opening is sutured, dressings applied and the patient is kept under close observation for a few hours.

An arterial needle is also introduced either before or immediately after the procedure to record intra-arterial pressure and to obtain arterial blood sample.

* Based on experience at the Department of Cardiology, All-India Institute of Medical Sciences, New Delhi.

* 1. In infants and children the long saphenous, femoral or the internal jugular vein is selected.

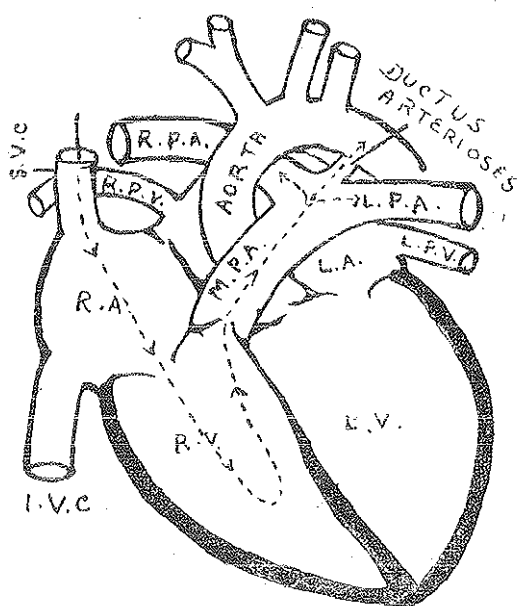


Fig. 1

Course of catheter in the Heart with patent Ductus arterioses.

The diagnosis is made by the pressure obtained and the oxygen saturation in the blood samples. High pulmonary pressure indicates advanced degree of mitral stenosis. Left ventricular or atrial pressures may be obtained when the catheter has passed through the shunts in the septum. Likewise aortic pressure in patent ductus arterioses is also detected. Higher concentration of oxygen in sample from pulmonary artery suggests patent ductus arterioses. Similarly higher saturation of oxygen in the samples of atrium or ventricle is the evidence for the cardiac shunts from left to right.

Complications

A careful procedure by an expert with good preparation of the patient rarely leads to complications. Mortality is about 0.5 per cent. Children are less susceptible to complications than adults. The likely complications are :

- (a) Knot formation and breaking of the Catheter. Cardotomy is required for removal.
- (b) Clot formation and pulmonary embolism which are prevented by the use of heparin as explained already.
- (c) Pulmonary Oedema. The prevention is by discriminate use of heparinised saline specially in mitral stenosis.
- (d) Shock and fall of B.P. A good physical and psychic preparation helps to prevent this.
- (e) Rigors, are usually followed by fall of blood pressure. Prevention is by proper sterilization of Catheter and other equipment. A good "training of the Physician" in handling the sterile materials is more important.

Retrograde Catheterization

This technique has been evolved by Professor Sujoy B. Roy, Cardiologist, All-India Institute of Medical Sciences, New Delhi to determine the left ventricular pressure in aortic stenosis. In this number 3 Catheter is passed through the Canula or an arterial needle, introduced into the femoral or brachial artery, and advanced to the left ventricle (occasionally to the left atrium also).

Error in diagnosis is an unnecessary strain for the patient and the surgeon in cardiac surgery. For instance patients diagnosed as having septal defects have been found to have only patent ductus arterioses when operated.

In mitral stenosis, necessity of surgery depends on degree of stenosis. Accurate assessment of congenital heart lesions and measurement of degree of mitral stenosis to avoid unnecessary sufferings of patient in cardiac surgery are best obtained by cardiac catheterization study.

Nursing Responsibilities

The nurse plays an important role in the preparation and management of the patient. In the preparatory phase, the nurse prepares the patient psychologically by answering all his questions tactfully and helps the Cardiologist in investigations and detecting abnormalities which are likely to be contra indications for catheterization. She also ensures a good night's sleep to the patient the night before the procedure and sends the patient to the laboratory at the appointed time with empty stomach, bladder and bowels.

The post operative care though of a short duration should not be neglected as the complications may prove fatal. The pulse, respiration and blood pressure are to be watched carefully. Bleeding and haematoma may result at the site of vein exposure and the passage of arterial needle. This is due to the use of heparin during the procedure. Bleeding, if observed, should be arrested by direct digital pressure. Indigo-carmin dye, if used for measuring the cardiac output during the procedure, will be passed in the urine. 'Coloured urine' will be a problem for the patient and needs explanation.

The nurse in the laboratory contributes the most by a good set up, thorough sterilization of equipment, close observation of the patient and readiness to act in emergency. A set for cardiac massage, Oxygen inhalation set, and cardiac and respiratory stimulant drugs should always be ready, though rarely used. To conclude, as the professor of the Department of Cardiology put it, "The honest and the hard working nurse is the right hand of cardiologist in the success of the procedure".