Progress in the techniques of anesthesia has made feasible increasingly daring, delicate and dangerous surgical procedures. The introduction of synthetic materials paved the way to replacement of arteries of any size and even of heart valves. Open heart surgery has resulted in correction of numerous anomalies, congenital and acquired. The development of exploratory techniques in radiology or in the research laboratory presents almost limitless possibilities for the future in the study of disorders of the circulatory system.

Nursing care, composed of a multitude of seemingly insignificant but vital details, is an indispensable adjunct to either medical or surgical treatment. Failure to appreciate this fact can be highly detrimental to the patient, complicating or retarding his recovery.

To co-operate effectively, the nurse must know what the doctor expects of her. She must understand the reasoning behind and the significance of every move that she makes. She must be aware of the complications and dangers inherent in various treatments in order to avoid accidents. She must be able to teach other members of the team correctly and, when required, teach the patient, since his active cooperation is an essential part of his care.

In the cardiovascular surgery unit of Hotel Dieu of Montreal, the chief of service, who has wide experience in the field of circulatory disorders and who supervises both medical and surgical aspects of treatment, has set up the nursing measures required in this specialty. There are, of course, variations in the practical application of the suggested procedures but the underlying principles remain unchanged.

Anatomy and Physiology in Review

Circulation of the blood is dependent upon a pumping organ, the heart, to start the flow through the arteries. The arteries subdivide into arterioles and capillaries which, in turn, unite to form veins through which blood leaves the tissues. The veins unittimately form veins whose function is to return the blood to the heart.

The heart is muscular and its action can be compared diagrammatically to that of a pump. Each contraction of the left ventricle forces blood into the aorta for eventual distribution of the entire body. The heart itself is supplied by the coronary arteries. The arteries are responsible for the distribution of oxygenated blood to the entire body, with the exception of the lungs.

The arterioles play a major role in maintenance of body temperature and arterial pressure.

The capillaries, the smallest of vessels, provide for the exchange of essential materials between the blood and the cells.

The veins return the blood to the heart.

Lymph leaves the capillaries and returns to the heart via the lymphatic vessels, lymph glands, and thoracic duct, eventually reaching the subclavian veins.

All of the blood vessel are under the control of the sympathetic nervous system.

The Role of Surgery

Unquestionably, surgery can be of benefit in cardiac lesions as well as in arterial and venous conditions which form only a part of the over-all total. Nor is the field limited to blood vessels alone. Nerve surgery such as sympathectomy, plastic surgery such as Thiersch grafts on post-phlebitic ulcers, adrenalectomy for arterial hypertension are all involved.

In relation to nursing care, only the specific points related to the specialty will be mentioned. Details of a general nature, such as observing for vital signs and dosages of medications, should be familiar to the reader.

Surgical Cardiac Conditions

Remedial surgery can be carried out in anomalies such as patent ductus arteriosus; aortic stenosis; interventricular septal defect; interatrial septal defect; aortic coarctation, usually distal to the left subclavian artery; Tetralogy of Fallot which encompasses pulmonary stenosis, interventricular septal defect, hypertrophy of the right ventricle, transposition of the aorta and pulmonary artery and in various acquired lesions such as mitral valve stenosis.

Modern methods of diagnosis such as cardiac catheterization, angiocardiology, and laboratory procedures such an oximetry and chromatography constitute some of the main factors in the amazing progress made in cardiac surgery.

Diagnosis

Cardiac catheterization and
angiography are instrumental in establishing differential diagnosis.

Catheterization permits measurement of pressure in the various heart chambers. Since samples of blood can be procured from each one, study of the oxygen content is possible as an indication of septal or valvular defect.

In addition, angiography which involves X-ray of the heart and large blood vessels by injection of an opaque medium, can be helpful. This is not a particularly dangerous nor painful procedure though the patient requires considerable reassurance. No restrictions are necessary as a general rule, with the exception of several hours rest for the limb used for injection. Diet is unchanged.

Complications Possible complication are hyperthermia with the same signs and symptoms as in a transfusion reaction, and hemoptysis at the puncture sites—one or both arms may be involved or the groin. The nurse must be absolutely sure of which area has dressings and keep the patient under observation for four hours. Phlebitis may develop along the catheterized vessel. The usual signs are pain and a red streak on the skin surface following the path of the vein. In each instance, the nurse must be prepared to administer the care required.

Surgery The type of intervention depends upon the type of lesion. Some defects can be corrected in a few minutes by simple suturing; others require implantation of a plastic prosthesis.

Two methods of surgery are in common use:

Closed circuit, where the procedure is not carried out under direct vision. A finger or an instrument is inserted intracardially and the heart continues to beat as, for example, in simple mitral commissurotomy.

Open circuit, where the operation is carried out under direct vision, using extra corporeal circulation—the heart-lung apparatus.

Cardiac surgery is frequently curative but in some instances may be palliative only. However, it offers the patient hope for prolonged life and improved physical and intellectual performance.

Nursing Care

Preoperatively, the patient requires thorough physical preparation for the various diagnostic examinations involved. An atmosphere of calmness and confidence should be built up around him. Tests and surgical procedures should be explained adequately to allay fear.

Postoperative care consists of the measures used following any major operation and, in particular, those involving thoracic surgery. It is important to note heart rhythm; to check the thoracotomy drainage tube; to check colour and temperature of the extremities because of the possibility of an arterial embolism in either arms or legs; to watch for any indication of cerebral embolism, such as abnormal position of the tongue, distortion of the mouth, difficulty in articulation, hemiparesis, etc.

Evidence or any abnormality should be reported immediately so that treatment can be instituted without delay. Embolectomy is sometimes necessary. The more rapidly treatment can be carried out after vascular accident, the less serious will be the sequelae in the affected extremity: ischemia, loss of function, necrosis.

Breathing Exercises

Atelectasis is one of the main pulmonary complications to be feared following cardiac surgery. Prevention is largely dependent upon breathing exercises that the patient has been taught preoperatively. These exercises form not only a necessary but an obligatory part of postoperative care. The exercises must be started as soon as possible and repeated at frequent intervals despite the patient's pain or fear. The responsibility for helping the patient and for seeing that the exercises are carried out falls upon the nurse.

With open heart surgery, there must be greater awareness of the seriousness of pulmonary and cardiac complications. Once more, breathing exercises are essential.

Cardiac Complications

Adults are prone to develop arrhythmia. Marked slowing of the pulse may be indicative of atrioventricular block. A fall in arterial blood pressure with increased pulse rate and a rise in venous pressure points to acute cardiac insufficiency. These patients receive heparin during the operation (by injection or in the blood used in the heart-lung machine). As a result there may be pericardial involvement with development of cardiac tamponade. Signs include: increased pulse rate, drop in arterial pressure, venous congestion and a rise in venous pressure (the normal rate is 15-20 cm. of water). The venous pressure level is a determining factor in differential diagnosis between hypovolemia (low or decreased blood volume), acute cardiac insufficiency and cardiac tamponade.

Patients are taken to the intensive care or recovery unit following cardiac surgery. The immediate danger of complication is over by the time the patient returns to his own ward. Breathing exercises must be carried on systematically, although somewhat less rigorously than at first. To be effective there must be complete dilatation of pulmonary alveoli. Respiration should be deep, slow, with full chest expansion, holding the breath for several seconds then breathing out very slowly and deeply. When repeated frequently the exercises induce a very pleasant feeling of physical relaxation.

Throughout this period, the nurse must avoid tiring the patient by having him up for too long at a time. She must be aware of the possibility of delayed arterial embolism.

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Arterial Conditions

Any obstacle to the normal distribution of oxygenated blood throughout the body is associated with arterial disorders. There are congenital or acquired disorders of the non-obstructive type, such as aneurysm, arteriovenous fistula and dilatation. Obliterative conditions include emboli or thrombi and chronic obstruction resulting from stenosis and hardening of the arterial wall, most often as the result of arteriosclerosis and various forms of arteritis. In addition there are various vasospastic conditions and, more rarely, inflammatory processes and infections.

Disorders of the arteries inevitably lead to gangrene of the extremities. For example, if the lumen of the femoral artery decreases, the blood continues to reach the toes but with considerable difficulty and much reduced pressure. Circulation in the limb, especially in the feet and toes, slows down; there are colour changes—the toes are pale and feel cool. Complete obstruction of the artery will cut off blood flow entirely and direct it toward collateral arteries so that it reaches the foot and toes with considerable difficulty. If obstruction develops slowly, collateral circulation builds up and compensates temporarily. Proper nutrition of the whole foot is doubtful under such uncertain circumstances. Sudden acute obliteration of an artery leaves no opportunity for development of a collateral blood supply. Gangrene quickly follows leading to probable amputation, unless treatment can be instituted very soon after the vascular accident occurs.

Signs of acute obliteration indicating need for emergency treatment are: paleness, sometimes cyanosis, of the extremity; toes and foot or fingers and hand are cool to touch; absence of arterial pulsation (pedal and posterior tibial in the foot; radial and cubital in the wrist). The patient complains of pain, more or less marked loss of function, progressive loss of sensation (paresthesia) and diminished muscle power. Obstruction at the end of the aorta produces symptoms in both lower limbs in a more or less symmetrical fashion.

The sudden appearance of pallor, coldness, and the absence of a pulse in an extremity are signals that an emergency situation exists.

Diagnosis

Physical examination determines what condition is involved. Subjective symptoms, observation of skin colour, checking the temperature and perfusion of the extremities and palpation of the arteries are the main points to be considered. In clinical observation, and in the wording of reports, exact localization of the affected area is important.

Physical examination follows a specific routine. The patient lies flat on his bed with his limbs exposed. The colour and temperature of the extremities are checked immediately, then again at the end of 15-20 minutes exposure to room temperature. The back of the fingers is used to test the temperature of toes, feet, fingers and hands. Radial and ulnar artery pulsation can be detected at the wrist while the brachial artery is palpated at the bend of the elbow. The dorsal pedal artery over the dorsum of the foot at the level of the first metatarsal head and outside the extensor muscle of the great toe. The artery can be palpatated on the outer side of the foot opposite the head of the first metatarsal. The posterior tibial artery extends behind the internal or medial malleolus. It is usually very difficult to palpate. Skin colour may be white, pink, various shades of red or may have a bluish cast.

Oscilometry is another addition to the battery of tests. It is used to check arterial pulsation in various areas of the limbs where arteries are too deep to be palpable, for example, the middle third of the thigh; the lower and upper third of the leg; the lower third of the forearm and arm.

In cases where arteriography cannot be carried out, analysis of these different facts will give the specialist a reasonably good estimation of the condition of the arterial network of the limb.

In centres where a great deal of arterial surgery is performed, X-ray techniques in relation to blood vessels should be highly developed. Angiography is dependent upon introduction of a radiopaque substance into the circulation which then carries it throughout the system. As the medium reaches the affected area, X-rays are taken. To obtain an X-ray series of the limbs, the contrast medium is injected directly or by catheterization into the arteries or the aorta and the specific areas of involvement can then be visualized, thus presenting definite information about the condition of the major blood vessels, the rate of circulation in them and the presence of collateral circulation. This procedure permits investigation of all segments of the arteries: the ascending aorta and its branches, carotid, vertebral, subclavian, and visceral arteries which include the renal, hepatic, splenic and mesenteric branches, and finally the arteries of both upper and lower limbs. The information thus obtained provides the surgeon with a total picture of the condition of the arteries before treatment is instituted, and permits objective scientific appraisal of the value of therapy. Such investigation is basic to the education of students and doctors in a teaching hospital.

The nurse’s responsibilities for general and local preparation of the patient for radiographic investigation will vary according to the routines of the radiologist and the institution; the type of anesthesia, usually local, rarely general except in transluar abdominal aortography. The nurse must be aware of the significance and importance of each little detail. For example, when abdominal aortography is ordered, the intestine must be as completely free of content as possible. Gas, fecal material or traces of barium from previous X-rays, can distort the X-ray picture of the arterial tree. The nurse should note the results of preparatory enemata and should make it her responsibility to remind responsible authorities of recent barium studies or myelography.

When the patient return to his bed following angiography, the nurse must observe him closely for four hours:

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