Introduction

Over time, the spectrum of surgical procedures available to patients with cardiac and great vessel disease continues to diversify and to mature. In parallel, our ability to match a widening range of surgical procedures with the individual needs of the patient has evolved as well. The relationships among preoperative patient-related risk factors and procedure-related perioperative care form the basis of the ongoing process of surgical care. Through a precise understanding of the long- and short-term benefits of a given surgical procedure, the risks for early and late complications can be evaluated to ensure that responsible clinical decision making occurs ***(Kirklin et al., 2007).***

Until 1953, cardiac surgery was in its infancy and was more of a curiosity, except for treatment of rheumatic mitral stenosis, beginning in 1923 with Cutler's successful case of a closed mitral commissurotomy with a tenotomy knife at the Peter Bent Brigham Hospital in Boston. The only successful heart operations done before 1953 were closed techniques for mitral stenosis, a few clinical experiments in 1952 with "open" heart by deep hypothermic arrest by John Lewis at the University of Minnesota ***(Aris, 1997).***

On May 6th, 2003, the 50th anniversary of the first successful open-heart operation performed with the use of the heart-lung machine, one of the most important forms of therapy in the history of cardiac disease.The world owes John H. Gibbon the man who invent the heart lung machine, an enormous debt of gratitude for pioneering the technology of cardiopulmonary bypass and persisting for 23 years in its development—until he got it just right, on the morning of May 6th, 1953***(Aris, 1997).***

In 1947 Thomas Holmes Sellors (1902–1987) of the Middlesex Hospital operated on a Fallot's Tetralogy patient with pulmonary stenosis and successfully divided the stenosed pulmonary valve ***(Lawrence and Cohn, 2007***).

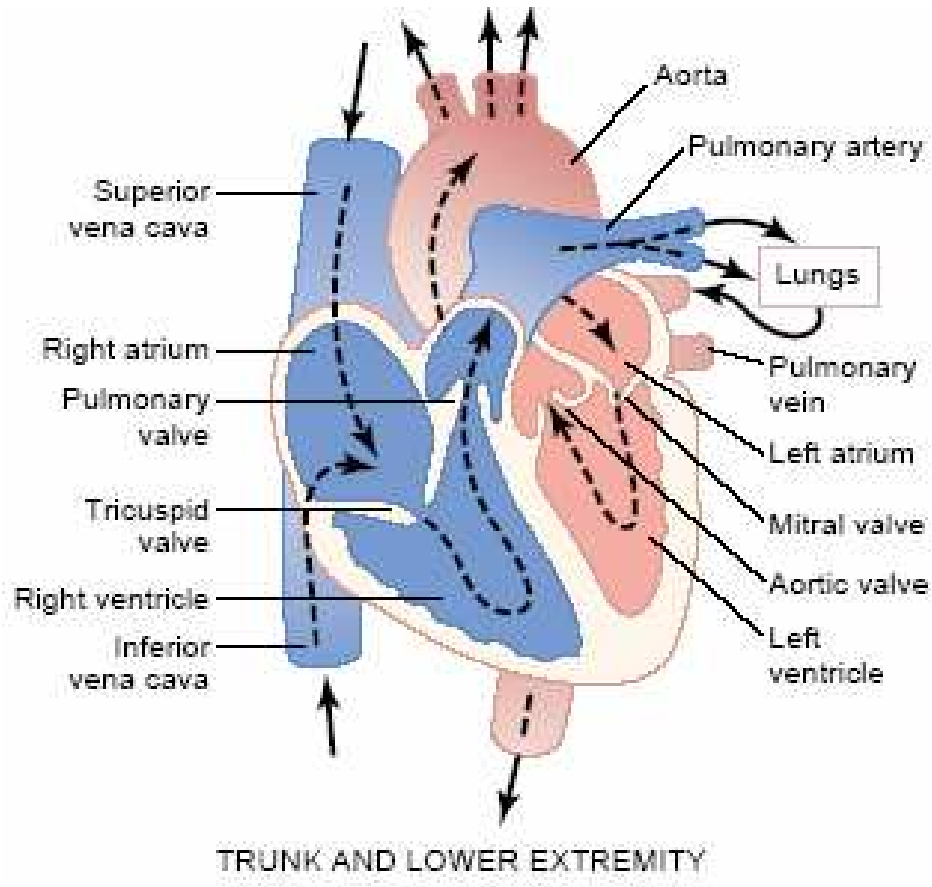
Surgery in great vessels (aortic coarctation repair, Blalock-Taussig shunt creation, closure of patent ductus arteriosus), became common after the turn of the century and falls in the domain of cardiac surgery, but technically cannot be considered heart surgery ***(Johnson, 1999).***

Since the 1990s, surgeons have begun to perform "off-pump bypass surgery" – coronary artery bypass surgery without cardiopulmonary bypass. In these operations, the heart is beating during surgery, but is stabilized to provide an almost still work area in which to connect the conduit vessel that bypasses the blockage; in the U.S., most conduit vessels are harvested endoscopically, using a technique known as endoscopic vessel harvesting (EVH), some researchers believe that the off-pump approach results in fewer post-operative complications, such as postperfusion syndrome, and better overall results. Study results are controversial as of 2007, the surgeon's preference and hospital results still play a major role***(Lawrence and Cohn, 2007)***.

Physiology and anatomy of the heart in brief:

The main function of the cardiovascular system is to transport nutrients and oxygen to the entire body. The heart can be thought of as two pumps in series that send a fluid through a series of tubes that eventually return to the pump. One pump sends the blood to the lungs to pick up oxygen in the lungs, and the other sends the blood through the rest of the body. Eventually the blood returns to the heart and the process is repeated.

Each "pump" in the heart is made up of two chambers; an atrium and a ventricle, giving the heart a total of four chambers. The atria are the smallest of the four chambers. Due to their small size they provide a small contribution to blood circulation. Their primary purpose is to receive blood returning from the circulation and pass it to the ventricles. The ventricles make up most of the heart's volume, with the left ventricle being the larger of the two. The ventricles receive blood from the atria and pump it through arteries to the rest of the body ***(Marieb, Elaine, 2001).***



<u>Figure (1):</u> (Marieb, Elaine, 2001)

The heart uses a series of valves to ensure that blood flows in one direction into and out of the heart. Heart valves are made of tough, flexible tissue that is oriented in such a way that blood can only go through the valve in one direction. Blood flows in the direction of the arrows in Fig. 1. A valve only opens when the blood exerts enough pressure on it, forcing it open for blood to flow through. When this pressure drops, the valve returns to its originally closed position, preventing blood from flowing in the wrong direction. A pressure gradient is developed as blood flows through the body, and blood only flows from a high pressure to a lower one.

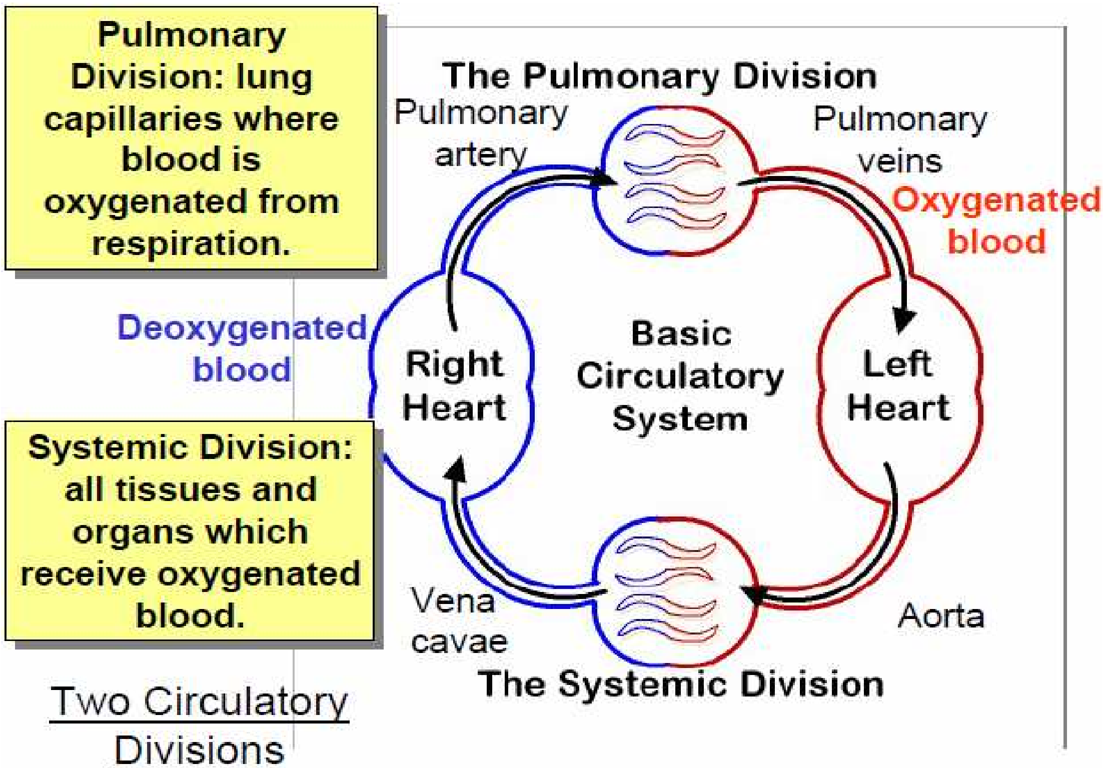
Like the heart chambers there are four heart valves, seen in the diagram in Fig. 1: two atrioventricular (AV) valves and two semilunar valves. An AV valve is located between each atrium and ventricle, with the tricuspid valve on the right and the mitral valve on the left. Thevalve opens when the atrial pressure is greater than ventricular pressure. When ventricular pressure exceeds atrial pressure, the valve closes again. The area of the valve cusps are about twice that of the passageway they cover, creating a large overlap of the cusps when they close. This overlap helps to prevent the backflow of blood into the atrium ***(Berne et al., 2007).***

A semilunar valve is located between the right ventricle and pulmonary artery (pulmonary valve) and the left ventricle and aorta (aortic valve). Similar to the AV valves, when left or right ventricular pressure exceeds aortic or pulmonary artery pressure, the valve opens. When ventricular pressure decreases, the three cusps of the valves close, preventing blood from flowing back into the ventricle ***(Darryl, 1994).***

The heart has two atria and two ventricles because there are two different blood circulation paths. The circulation path controlled by the right side of the heart is a low-pressure system known as the pulmonary circulation. Oxygen depleted blood enters the right atrium through the venae cavae and is pumped to the lungs by the right ventricle through the pulmonary artery. The blood receives oxygen in the lungs and is sent back to the left side of the heart through the pulmonary veins. The blood travels only a short distance in this system. Therefore a high pressure is unnecessary ***(Marieb, Elaine, 2001)***.

After the blood picks up oxygen in the lungs it returns to the heart through the left atrium. The left ventricle pumps the oxygen-rich blood through the aorta to the rest of the body. The blood returns to the right atrium depleted of oxygen, completing the cycle. This circulation path is known as the systemic circulation. Due to the large distance the blood travels, this is a high-pressure system. Upon entering the right atrium, the blood repeats the two circulatory paths

The blood path through the heart and both circulation systems can be seen in Fig. 2. The upper portion of Fig. 2 (blood flowing to and from the lungs) is the pulmonary circulation, while the lower portion (blood flowing to and from the entire body) is the systemic circulation. Blood on the right side of the figure (pumped by left ventricle) is oxygen rich while the blood on the left (pumped by right ventricle) is oxygen-depleted. As the blood flows farther from the body, oxygen is lost. After exchanging oxygen through the body, the blood returns to the heart through the right atrium. At this point the blood will repeat the circulation path ***(Silverthorn et al., 2000)***.



<u>Figure (2):</u> (Silverthorn et al., 2000)

Due to the different circulation paths, each side of the heart has a different workload. The systemic circulation is much longer than the pulmonary circulation and encounters five times more friction to handle the longer path, the left ventricle is larger than the right, giving it the strength to pump blood at a higher pressure. The pulmonary circulation only has to pump blood to the lungs, so the larger ventricle is unnecessary. Also, the pressure in the lungs must be lower to avoid damaging the alveoli, which are small air sacks with thin walls that exchange gas in the lungs. Systemic blood pressure is higher than the pressure in the pulmonary system to handle the longer circulation path. Pressure in the aorta is the point of highest blood pressure, while the lowest blood pressure is in the vena cavae ***(Silverthorn et al., 2000)***.

Preoperative Assessment of Cardiac Patients

The basic evaluation is required for every patient whoundergo open heart surgery. In emergency situations, this information may not be available or obtainable if lifesaving emergency surgery is the only chance for survival. In other patients, the presence of comorbid conditions or the severity of heart disease requires additional information to assess both the potential benefits and risks of operation. The basic evaluation includes history, physical examination, blood testing, urinalysis, chest x-ray, electrocardiogram, and almost always cardiac catheterization. Each of these components of the basic evaluation should be performed with the planned surgical procedure in mind. For example, if coronary artery bypass grafting is planned, the history should indicate prior phlebitis or vein stripping. If a mitral prosthesis must be replaced, a previous deep postoperative sternotomy wound infection is relevant ***(Clark et al., 2004).***

For some patients, an appropriate indication for operation and information from the basic evaluation are all that are needed to prescribe and carry out the procedure. These are nearly always patients for whom the operation has a low risk of mortality and morbidity. For others, much more information is needed, the decision to recommend operation is more complex and difficult, the operation and postoperative course are likely to be more costly, the benefits may be less dramatic, and the risk is higher. These patients are addressed at the end of this chapter ***(Clark et al., 2004).***

The history is an important source of information that usually establishes the indications for operation and the need for studies beyond the basic evaluation. The reason for having an operation should be elicited from the patient's point of view. What symptom, threat, or restriction does the patient expect the operation to remove? What quality of lifestyle does the patient expect after surgery? In addition to information regarding the severity of heart dysfunction, the history provides an inventory of comorbid diseases and compromised organ and system functions. In elderly patients, heart disease is seldom the only disease. A thorough history sometimes provides clues to occult disease not previously known (e.g., emphysema, alcoholic liver disease, diabetes, renal insufficiency, arrhythmias, etc.) or reveals long-forgotten events, such as a serious automobile accident, in a patient with a mass lesion over the aortic isthmus. During the history, the patient should be assessed carefully to determine motivation and ability to care for basic needs ***(Utley, 2001).***

The principal symptoms of cardiac disease are chest pain or discomfort, dyspnea, fatique, peripheral edema, and syncope.

Symptoms and prior manifestations of the patient's cardiac disease should be described in terms of chronicity and severity. Episodic aspects of the disease, such as pulmonary congestion, recent chest discomfort, syncope, palpitations, hemoptysis, or infection, should be described in terms of frequency, duration, and severity. Severity of symptoms is described and assessed by a standard classification of severity such as the New York Heart Association functional classification of heart failure or the Canadian Heart Association classification for severity of angina pectoris. The surgeon should particularly note combinations of symptoms, such as episodic chest pain (angina) and shortness of breath (heart failure), that may be manifestions of one disease process (ischemia) or two (ischemia and valve disease or severe left ventricular dysfunction) ***(Little and Brown, 2004).***

Past history is very important and can affect morbidity of the patient and it should be reviewed carefully and recorded prominently in the hospital chart, it include allergies, previous medications, previous illness and hosptitilization, general functionall systems must be reviewed for any pathology, family history, and social history.

Allergies

All allergies should be reviewed carefully and recorded prominently in the hospital chart and, when appropiate, on the order sheet. Antibiotic allergies influence choices of prophylactic and therapeutic antibiotics. Heparin-induced thrombocytopenia occurs in 2 to 5 percent of patients exposed to the drug, and the catastrophic form of the disease, heparin-induced thrombocytopenia and thrombosis, occurs in 0.1 to 0.2 percent., Fish allergy or use of protamine insulin may indicate a predisposition to a protamine reaction. Prior cardiac surgery may immunize a patient to bovine thrombin (fibrin glue) or aprotinin., a second exposure may cause a severe bleeding disorder from factor V deficiency (bovine thrombin) or an anaphylactic reaction (aprotinin***) (Warkentin et al., 2005), (Edmunds, 2003).***

Medications

Medication intolerance may be due to allergy or to side effects. Although allergy is uncommon (see above), undesirable side effects of various cardiovascular drugs are extremely common. In addition, combinations of drugs may produce serious cumulative or adverse effects (e.g., aspirin plus Coumadin). The history should include not only the drugs that the patient is taking but also drugs taken in the past that caused unpleasant side effects. No one can remember all drugs or combination drug side effects, but each physician should be aware of adverse effects of drugs that he or she frequently prescribes. A history that reveals an adverse reaction to a drug commonly used by the surgeon may save the patient discomfort postoperatively. Standard pharmacologic texts, the package inserts of specific drugs, and the *Physician's Desk Reference* are ready sources of information regarding adverse effects of medications. ***(Ferraris et al., 2007)***

Prior hospitalization and illnesses

It is particularly important to record prior procedures, operations, treatments, or radiation involving the thorax or cardiovascular system. Previous radiation for breast cancer may affect a decision to use the ipsilateral internal mammary artery for myocardial revascularization. Diabetes may preclude using both mammary arteries for conduits. Prior gastric resection may render the gastroepiploic artery unavailable for coronary arterial bypass. Steroid dependency for arthritis may predispose to infection. Multiple hospitalizations related to any organ system may be an indication for further investigation. The operating surgeon is in the best position to evaluate the relevance or prior operations and illness on the design of the proposed operation (i.e., are modifications needed?) and on reducing the risk of postoperative complications ***(Hannan et al., 2004)***

REVIEW OF SYSTEMS

General function

The level of intelligence and general ability of the patient to care for himself or herself independently bear on the decision to operate and on expected benefits of operation. Elderly, frail, and forgetful patients must be interrogated carefully and respectfully. The ability to live alone and care for basic needs independently aregood indications of an elderly patient's strength, motivation, and mental state. Elderly patients who require nursing home care or who cannot be trusted at home alone are poor candidates for operation. Patients with substance abuse problems, neglected dental care, or poor hygiene are not good candidates for prosthetic heart valves or other procedures that require careful regulation of postoperative medications, infection prophylaxis, or immunosuppression therapy ***(Nashef et al., 2008)***

The ambulatory status of the patient is extremely important not only for rapid recovery from operation but also for long-term care and quality of life. To a large extent, recovery from open heart surgery is based on postoperative walking as an economic and effective means to progressively increase exercise tolerance and to prevent complications such as pneumonia and decubitus ulcers. In nonambulatory or morbidly obese patients, operation is associated with a higher risk of morbidity and increased length of stay., Patients should be questioned about their motivation and determination to ambulate quickly postoperatively ***(Lahey et al., 2002)***

Eyes

Amaurosis fugax (transient losses of vision) indicates the probable presence of carotid arterial disease of atheroemboli from the aorta and should prompt further investigation by appropriate ultrasonic studies.

Ears, nose, and throat

Occasionally, the pain of angina pectoris is manifest in the throat or ear. Symptoms of cough, purulent sputum production, or hemoptysis raise the suspicion of upper airway bronchitis, infection, or malignancy that needs further evaluation, especially in smokers and abusers of alcohol. A history of difficult endotracheal tube intubation is noteworthy. False teeth, dental caps, and a history of painful teeth or dental abscesses are relevant to anesthesia and to value surgery. ***(Ferraris et al., 2007)***

Chest

Cough, shortness of breath, sputum production, hemoptysis, unexplained weight loss, chest pain, wheezing, and episodes of infection require further evaluation for primary pulmonary disease. A history of smoking, particularly a long, heavy one, is relevant to the possibility of chronic obstructive pulmonary disease that may exacerbate symptoms of congestive heart failure. The surgeon should carefully evaluate the possibility that the patient may require long-term postoperative intubation and respiratory support because of age, frailty, and intrinsic lung disease. Spirometry, pulse oximetry, and arterial