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CLINICAL
Pediatric
Emergency
Medicine

The Postoperative Cardiac Patient

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The number of children surviving medical management and surgical repair of congenital heart lesions has steadily increased. Children with complex heart defects are therefore seen with increasing frequency in emergency departments. This article reviews the epidemiology of congenital heart disease, some common types of surgical repair, and a few postoperative complications and their management.
Clin Ped Emerg Med 6:216-221

KEYWORDS congenital heart disease, cardiac surgery, postoperative complications, post-pericardiotomy syndrome, infective endocarditis

The number of children surviving surgical repair of complex congenital heart defects is increasing. These children with complex heart defects are being seen with increasing frequency in the emergency department (ED). Management of complications in these children can be difficult, often provoking anxiety in the ED physician. Knowing the types of congenital heart operations and their associated postoperative complications is valuable in the initial diagnosis, stabilization, and treatment for these children. This article discusses the epidemiology of congenital heart disease, some common types of surgical repair, and a few postoperative complications and their management.

Epidemiology

Congenital heart defects are diagnosed in 8 to 9 of 1000 live births. Currently, 1 million people in the United States live with a congenital heart defect [1]. In 2000, 25000 congenital cardiovascular operations were performed and 130000 hospitalizations were necessary, generating charges of 6.5 billion dollars [2]. Although congenital heart defects remain a major cause of death in infancy and childhood, mortality has declined 39% from 1979 through 1997 [3].

Types of Cardiac Lesions

Several main problems distinguish the pathophysiology of congenital heart defects. There may be (1) excess volume load in which one or both ventricles are forced to pump an excess volume of blood, (2) excess pressure load to one or both ventricles resulting from obstructed outflow from the cardiac chambers, (3) cyanosis due to reduced pulmonary blood flow or inadequate mixing between 2 parallel circulations, (4) diminished systemic blood flow, or (5) mixed lesions with features from more than 1 category. Table 1 categorizes the different types of cardiac lesions based on this physiologic classification.

Common Types of Repair

Dr Robert E. Gross completed the first successful surgical procedure for a congenital heart defect when he ligated a patent ductus arteriosus in 1938. In 1948, Blalock and Taussig reported the surgical creation of a systemic-to-pulmonary-artery shunt, pioneering the surgical era for the treatment of cyanotic congenital heart disease. John Gibbon performed the first successful open heart procedure using artificial cardiopulmonary bypass on a young woman with an atrial septal defect in 1953, and thus, all of the necessary building blocks for the effective surgical

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1522-8401/$ - see front matter
doi:10.1016/j.cpem.2005.09.001

Table 1 Classification of congenital heart defects. Some illustrative examples.

Volume Load	Pressure Load	Cyanotic, Diminished Pulmonary Flow	Diminished Systemic Flow	Mixed Categories
Anomalous pulmonary venous drainage	Aortic valve stenosis	Pulmonary atresia with intact ventricular septum	Coarctation of the aorta	Double outlet right ventricle
Aortopulmonary window	Pulmonary valve stenosis	Pulmonary atresia with ventricular septal defect	Hypoplastic left heart syndrome	Tetralogy of Fallot
Atrial septal defect	Subaortic stenosis	Tricuspid atresia with pulmonary stenosis	Interrupted aortic arch	Transposition of the great arteries
Atrioventricular canal defect	Supravalvular aortic stenosis		Tricuspid atresia with aortic stenosis	Truncus arteriosus
Patent ductus arteriosus	Supravalvular pulmonic stenosis			
Valvular insufficiency				
Ventricular septal defect				

management of children with congenital heart defects were in place. The last several decades have seen refinements in both surgical procedures and cardiopulmonary bypass techniques that have enabled surgical teams to accomplish complete or palliative repairs on younger and younger children. Furthermore, improvements in preoperative diagnostic accuracy and the ability to stabilize critically ill patients before surgery have improved outcomes significantly.

There are 2 categories of surgery for congenital heart defects. Ideally, complete correction of the defect results in a normal 4-chamber heart and restoration of normal blood flow to the pulmonary and systemic circulations. If complete correction is not feasible, the alternative is palliation. Rather than correcting the abnormality, palliative surgery seeks to circumvent the adverse consequences of the defect. Palliation is sometimes used as a temporary solution while awaiting complete correction at a later time. Other abnormalities are only amenable to palliation, with no option for correction. Table 2 lists examples of complete repairs.

Table 2 Examples of surgeries that result in complete repair.

Procedure	Diagnosis	Description
Arterial switch	D-transposition of the great arteries	Aorta and pulmonary artery moved to proper ventricles, coronary arteries reimplanted
Atrial septal defect closure	Atrial septal defect	Closes atrial septal defect
Coarctation repair	Coarctation of the aorta	End-to-end anastomosis
Patent ductus arteriosus ligation	Patent ductus arteriosus	Interruption of patent ductus arteriosus
Valve replacement	Valvular disease	Replaces any valve
Ventricular septal defect closure	Ventricular septal defect	Closes ventricular septal defect

Palliative Repairs

Numerous palliative repairs exist, ranging from pulmonary artery banding for control of excessive pulmonary blood flow to the Mustard and Senning procedures for transposition of the great arteries. Although a full description of all palliative procedures is beyond the scope of this article, systemic-to-pulmonary-artery shunts and Fontan procedures will be discussed in greater detail. Table 3 lists common palliative repairs.

Systemic-to-pulmonary-artery shunts include the Blalock-Taussig (BT) shunt, modified BT shunt, and central shunts; classic Waterston and Potts shunts are less common. Their purpose is to provide a secure source of pulmonary blood flow in cyanotic patients with decreased pulmonary blood flow. Variations of the BT shunt and its modifications can be performed on infants and children and may provide good long-term palliation. Systemic-to-pulmonary-artery shunts are usually used for temporary palliation while awaiting more definitive repair.

In 1971, Fontan and Baudet described a palliative procedure that resulted in complete separation of systemic and pulmonary circuits despite having only 1 functional ventricle. In the original procedure, superior vena caval blood was directed to the right pulmonary artery (Glenn shunt), and inferior vena caval flow was directed into the left pulmonary artery via the right atrial appendage; this left no communication between the pulmonary arteries. The operation is no longer done this way. Currently, the Fontan is usually performed in stages. The superior vena cava is anastomosed directly to the right pulmonary artery, and the right and left pulmonary arteries remain in continuity. The inferior vena cava return to the right atrium is directed toward the lower