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Risk assessment of the congenital heart disease patient for noncardiac surgery

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OBJECTIVES

1. Recognize the most common CHD, and their survival rates.
2. Assess the change in risk of morbidity and mortality in patients with CHD undergoing noncardiac surgery.
3. Review the available data for risk stratification of patients with heart disease undergoing cardiac or noncardiac surgery.
4. Examine possible methods for risk assessment in patients with CHD.
5. Consider the value of a risk scoring system in patients with CHD undergoing noncardiac procedures.

THE IMPACT OF CHD SURVIVAL

The incidence of CHD in the general population has remained constant at a rate of 7-10:1,000 live-births. Almost all CHD are amenable to palliation or complete repair, even the most complex lesions, and the repair is frequently done early in life. This has resulted in improved survival of patients with various CHD to adult life. Compared to a 50% survival for patients with complex CHD born in the 1960-1980, children born later than 1980 have an 80% survival rate to adulthood.

The population of adults with palliated or repaired CHD grows at a rate of 5-7% annually. The number of adults with CHD will exceed that of children by the year 2020. The incidence of extracardiac anomalies in patients with CHD is 25%, with the musculoskeletal, respiratory, central nervous and gastrointestinal systems most involved.

These adults and children with CHD will present to operating rooms for surgical procedures involving these systems, as well as for emergencies (*e.g.* Pregnancy and labor, trauma) and anesthesiologists are expected to provide adequate perioperative care.

THE RISK OF NON-CARDIAC SURGERY

Patients with CHD undergoing noncardiac surgery have an increased risk for perioperative complications and mortality. In a series of 110 consecutive patients with CHD undergoing elective surgery, Strafford et al. reported a 47% incidence of adverse events, as well as increased need for unplanned ICU admission. The highest incidence occurred in patients with tetralogy of Fallot, whether repaired or palliated.

Other investigators reported similar findings, with a higher mortality, and a complication rate of 5-30% with short term as well as 30 day follow-up. The most prominent risk factors included younger age (2 years), complex lesions, cardiac decompensation and cyanosis.

Despite the increased risk for children and adults with CHD undergoing noncardiac surgery, there is no clear method to identify, stratify or adjust and improve that risk in the preoperative period.

RISK STRATIFICATION IN ADULT CARDIAC PATIENTS

The use of preoperative risk assessment methods in adults with heart disease undergoing various procedures have resulted in a wealth of knowledge in this field.

In adult cardiac surgery, risk stratification methods showed increased severity of illness, higher morbidity as well as early and 1 year mortality in the presence of certain factors. These include older age, emergency procedures, preoperative serum creatinine, left ventricular systolic function and reoperation. A severity scoring system was studied and validated in a series of 10,000 adult cardiac patients at the Cleveland Clinic.

Similar methods were used by the American College of Cardiology and the American Heart Association to develop the practice guidelines for perioperative cardiovascular evaluation for noncardiac surgery. The guidelines identify clinical predictors of increased perioperative risk (MI, CHF or death) in three categories: major, intermediate and minor predictors. These guidelines result in a risk stratification of patients undergoing noncardiac surgery into those with high risk (> 5%), intermediate (1-5%) and low (< 1%) risk for a perioperative event.

In pregnant women with cardiac disease, a risk stratification method has been established, showing increased morbidity to mother and newborn in the presence of cyanosis, cardiac failure or obstructive lesions.

METHODS OF RISK ASSESSMENT IN CHD

Patients with CHD present for preoperative evaluation with a variety of risk factors. A system that integrates these risks can produce a severity scoring system that identifies patients with higher risk, and allow for better preparation and improved outcome for these patients.

There is an increased risk of perioperative cardiac arrest in children with CHD undergoing non-cardiac procedures. The Pediatric Perioperative Cardiac arrest (POCA) registry reported that 34% of perioperative cardiac arrests over an 11 year period occurred in children with CHD. More than half (54%) of the CA in these children were in the general operating room, compared with 26% in the cardiac OR and 17% in the cathetrization laboratory. Children with single ventricle physiology were the most common, and arrests in children with severe aortic stenosis and cardiomyopathy were associated with the highest mortality rates. Almost 75% of the perioperative cardiac arrests in children with CHD occurred in patients < 2 years old. Additional database reports have also corroborated an increased risk of perioepartive complications and mortality in children with CHD undergoing non-cardiac procedures.

Even though children with CHD are at increased risk of perioperative morbidity and mortality following noncardiac surgery, and there are multiple published guidelines for the management of children with CHD, there is no established methodology to address the magnitude of incremental risk conferred by the degree of severity and compensation of heart disease in the context of the extent of the no-cardiac surgical procedure and other conditions in these patients.

Risk factors for these patients may include the presence and degree of cardiac decompensation. Especially in smaller children, it is difficult to grade the degree of heart failure using the adult criteria. Patients with single ventricular physiology have decreased reserve, are volume dependent, and thus have an increased anesthetic risk. In addition, the presence of a single or systemic right ventricle may change the outcome of patients.

The type, complexity and stage of repair of the heart defect will also change the perioperative risk. Additional risks include the extent of desaturation, presence of an obstructive lesion, level of polycythemia, and history of arrhythmias. The number, type and dose of medications may indicate the degree of decompensation, and may have side effects or interactions with drugs used in the perioperative period.

An example of a severity scoring card is give here, where some of these risks are included, given a score and result in identifying patients with various degrees of risk.

Table I. Scoring card for preoperative evaluation of patients with CHD.

	0	1	2
CHD	Simple (ASD)	Moderate (ASD+PS)	Complex (TOF)
CHD	Repaired with no residual	Repaired with residual	Palliated
Obstruction	None	Yes gradient < 40 mmHg	Yes gradient > 50 mmHg
Ventricle	2 LV systemic	1 LV systemic	1 RV systemic
Systemic ventricular dysfunction	Mild	Moderate	severe
PVR	NL or < 2 WU	2-4 WU	> 4 WU
SaO_2	> 90%	75-90%	< 75%
HCT%	30-45%	25-30% or 45-60%	< 25% or > 65%
Arrhythmia	Rare	Atrial	Ventricular
Drugs (anticoagulants, diuretics, digitalis, antiarrhythmics, others)	1	2-3	> 3

A score of 0-6 is mild risk, 6-14 is moderate risk and 14-20 is high risk for perioperative complications.

IMPACT OF A RISK SCORING SYSTEM

The development of a risk assessment and a scoring card for adults and children undergoing noncardiac surgery can improve the perioperative outcome, decrease mortality and morbidity and assist in manpower and resource allocation:

Preoperative testing

Similar to adults with other comorbidities, there is a limit to the benefit acquired from escalating number of preoperative tests. The number and invasiveness of tests are decided by the degree of decompensation as well as the extent of surgery planned. A chest X-ray obtained in a patient less than 30 years of age, regardless of the extent of surgery, will probably result in minimal beneficial information. Similarly, we should consider the risk for a patient with CHD when deciding on preoperative tests.

Preoperative conditioning

We learn from the vast literature in adult preoperative conditioning, that certain interventions can significantly improve the outcome of adults undergoing noncardiac surgery. Simple maneuvers, as smoking cessation for 1 week, starting beta-blockers, statins, aspirin or even an exercise program, can change the risk for a patient. Can we do the same for patients with CHD? Can we take certain steps to change a high risk score patient, to a lower score? Interventions as lowering preoperative hematocrit, oxygen therapy, use of aspirin and other anticoagulants shortly preoperatively may change the patient's risk.

Manpower and resource allocation

The experience of a center can have a significant impact on the outcome of a patient with a certain disease, undergoing a specific type of procedure. This may be due to either the system function as a whole or the presence of individuals with expertise capable of caring for these patients. This fact had been shown in adult cardiology and cardiac surgery (with coronary interventions, bypass grafting and valvular repair), obstetrical practice (with number of cesarian sections, newborn mortality), and general pediatric surgery.

The same can be experienced in adults and children with CHD undergoing noncardiac surgery. The patients with high preoperative risk score will benefit from a center with large volume of care for these patients, and with the most experienced individuals providing that care in the perioperative period. However, patients with low or no risk may be cared for in other settings.

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