Anesthesia for Adult Patients with CHD Undergoing Non-cardiac Surgery
The “New” High Risk Cardiac Patient Population

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“Collaboration and multidisciplinary teamwork is the key to optimal care of the adult patient with Congenital Heart Disease undergoing non-cardiac surgery”

Adult patients with Congenital Heart Disease (AHC) have anatomic and physiological differences that are determined by the congenital lesion, the physiological adaptations to the lesion and any palliative or corrective surgical procedures already performed. With advances in pediatric cardiac surgery and pediatric cardiology, the number of children with CHD surviving to adulthood continues to increase. ACHD patients are generally classified with either moderate or severe disease. The prevalence of severe CHD (see Table 1) in adults has increased by 85%, compared to an increase of only 22% in children. These rates are from 1985 to 2000 and current estimates predict that the number of adults in North America with severe CHD exceeds the number of children with the disease. The prevalence of all types of CHD in adult patients is significantly higher in females than in males, (4.55 per 1000 females versus 3.61 per 1000 males; p <0.0001). Utilization data from Canadian hospital records have shown that 50% of the individuals in Canada with ACHD were hospitalized at least once over a 5 year period, and 16% of those admissions were to a critical care unit. Therefore, practicing anesthesiologists, especially those in cardiac and tertiary care centers can anticipate an increasing proportion of adults with CHD in their non-cardiac surgery practice.
Both the American College of Cardiology and the Canadian Cardiovascular Society have recommended that adult patients with moderate to severe CHD undergoing non-cardiac surgery should be referred for care to a tertiary cardiac center with expertise in patients with ACHD.3,4 The perioperative risks of these patients can be quite variable depending upon the nature of the congenital defect, whether successful reparative surgery versus palliative surgery has been performed, and if any other premorbid conditions are present. The perioperative risks of a patient with a successful correction of ASD as a child and requiring very little medical intervention, is substantially smaller than the risk of a patient with a Fontan circulation and multiple sequelae including arrhythmias and heart failure. There are some important considerations for the anesthesiologist when assessing CHD patients prior to non-cardiac surgery. If the patient is presenting for elective non-cardiac surgery, a formal thorough workup by both a cardiac anesthesiologist and a cardiologist well experienced in caring for adults with CHD is warranted. This workup should include detailed information about the congenital lesion including all previous cardiac repairs, revisions and palliative surgeries. Any interventional cardiac procedures such as arrhythmia ablation management and catheterization data must also be obtained.5 A recent echo, MRI and chest x-ray are necessary for evaluation of current physiologic status. CHD in adulthood should be considered a multisystem disorder with potential manifestations in multiple organ systems including cardiac, pulmonary, renal, hepatic, neurologic and hematologic. The baseline laboratory investigation includes hemoglobin,

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<td>Tetralogy of Fallot</td>
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<td>Truncus Arteriosus</td>
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<td>Transposition of Great Arteries</td>
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<td>Atrioventricular Canal Defects</td>
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hematocrit, platelet count, coagulation parameters, renal and liver function testing. In patients with a history of respiratory compromise or comorbid pulmonary disease, an arterial blood gas and pulmonary function testing is also warranted. There are recognized high risk factors that are associated with increased incidence of perioperative complications. These risk factors include the presence of pulmonary hypertension, cyanotic heart disease, severe systemic ventricular dysfunction, a Fontan circulation and severe obstructive valvular disease or severe conduit obstruction.\textsuperscript{5} The most frequent complications seen in these patients are serious and can include cardiac failure, arrhythmias, embolisation (air or thrombi) and worsening pulmonary hypertension. If any of these risk factors are modifiable, then elective surgery should be delayed to optimize the patient. In the event of urgent or emergency surgery, the presence of any of the high risk factors in a patient with moderate or severe CHD, serious consideration should be given to transfer to a regional ACHD center if possible. The perioperative risks are especially high in this population. There is no optimal anesthetic technique recommended for these patients. Meticulous attention to fluid status and preload is important as many of these patients are preload dependent for pulmonary blood flow. In the choice of anesthetic agents, consideration should be given to avoidance of large changes in pulmonary or systemic vascular resistance and agents that cause myocardial depression. It is important to review the patient’s anatomy and previous palliative procedures before insertion of an invasive monitor into either the arterial or central circulation. Vascular access may be very difficult and ultrasound guidance is highly recommended. Often the use of a transesophageal echo probe will be the most useful monitor as it will provide real-time information on filling status, ventricular function and presence of shunts or thrombi.

The presence of pulmonary hypertension is an important risk factor that challenges the perioperative management of patients with ACHD undergoing noncardiac surgery.\textsuperscript{6} The perioperative morbidity and mortality with moderate or low risk procedures has been reported to be 10\%.\textsuperscript{7} High-risk procedures are often contraindicated in ACHD complicated by pulmonary hypertension. The development of irreversible pulmonary hypertension secondary to long-standing left to right shunting from a nonrestrictive cardiac defect has been classically referred to as the Eisenmenger Syndrome. The administration of anesthesia to a patient with Eisenmenger Syndrome is considered the most challenging perioperative care managed by anesthesiologists. These patients require meticulous fluid administration and pharmacological management of their pulmonary vascular resistance in the periop course. Despite the most meticulous care and smooth intraop course, these patients often decompensate postoperatively. The role of the cardiac anesthesiologist in the care of these patients should be extended to the postoperative course to ensure adequate pain control, meticulous fluid management and optimisation of the use of pulmonary vasodilators. The concept of ACHD being a systemic disease with multiorgan dysfunction is most applicable in this subpopulation of ACHD patients.
The perioperative optimisation and care of patients with ACHD presenting for noncardiac surgery is challenging clinical care of anesthesiologists. Careful preoperative optimisation and perioperative management can reduce the perioperative morbidity and mortality of this patient population by a multidisciplinary team of anesthesiologist, cardiologist and intensivist with expertise in the care of the adult patient with congenital heart disease.


5 Schwerzmann, M and Colman JM. Noncardiac surgery in adult congenital heart disease. Chapter 14 in
6 Blaise RJ, Langleben D, Hubert B. Pulmonary arterial hypertension: pathophysiology and anaesthetic approach. Anesthesiology 2003;99:1415-32
7 Lai HC et al. Severe pulmonary hypertension complicates postoperative outcome of non-cardiac surgery. BJA 2007;99:184-90