Chapter 22
Coronary Artery Disease

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ABSTRACT

Coronary artery bypass grafting (CABG), first introduced in 1968, is now one of the most common surgical procedures and the most common cardiac procedures worldwide. It is estimated that over 800,000 CABG surgeries are performed worldwide each year. The goals of CABG are to reduce mortality, prevent the progress of heart failure and reduce symptoms associated with coronary artery disease. This chapter deals with cardiac critical care issues that pertain to the patient undergoing CABG and potential post-operative complications.

INTRODUCTION

Coronary artery bypass grafting (CABG), first introduced in 1968 (Favaloro), is now one of the most common surgical procedures and the most common cardiac procedures worldwide. It is estimated that over 800,000 CABG surgeries are performed worldwide each year. CABG is a procedure in which one or more stenosed (or occluded) coronary arteries are bypassed with an alternate blood vessel conduit to re-establish normal blood flow to the myocardium. Bypass grafts are typically done using an artery, such as internal mammary artery (IMA), radial artery (RA) or gastroepiploic artery (GEA); or vein (most commonly the greater saphenous vein from the leg). CABG is typically performed with the use of cardiopulmonary bypass (CPB) and cardioplegic arrest (most commonly using a mixture of blood and crystalloid with a high concentration of potassium) to permit the creation of the anastomosis on an arrested heart. In the past two to three decades, other techniques such as the performance of bypass grafts on a beating heart using off-pump coronary artery bypass (OPCAB) or through minimally invasive direct coronary bypass grafting (MIDCAB) have been developed. The goals of CABG are to reduce mortality, prevent the progress of heart failure and reduce symptoms associated with coronary artery disease. This chapter deals with cardiac critical care issues that pertain to the patient undergoing CABG and potential post-operative complications.

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TYPES OF CONDUITS USED FOR CABG

Patients currently being referred for surgical revascularization are increasingly complex and have a greater burden of co-morbidity and coronary artery disease than in the previous eras of cardiac surgery (Farkouh et al., 2008; Kapur et al., 2010; Mohr et al., 2013; Serruys et al., 2009). Due to the characteristics and long-term patency, the choice of conduits used for coronary artery bypass grafting impacts long-term outcomes, especially with the increasingly complex patient population (Cheng & Slaughter, 2013). Generally, conduits for bypass grafts are taken from one of four areas of the body: saphenous vein grafts (SVG) from the lower limbs, internal mammary arteries (IMA) from the chest wall, radial arteries (RA) from the forearm and infrequently gastroepiploic arteries (GEA) from the abdomen.

Arterial grafts have demonstrated longer patency than veins which translates to better long-term survival, fewer reoperations, a lower rate of myocardial infarction and less recurrent angina compared to vein grafts (Buxton et al., 2009; Cheng & Slaughter, 2013; Desai et al., 2007; Desai, Cohen, Naylor, & Fremes, 2004; Hayward & Buxton, 2007; Loop et al., 1986; Takagi et al., 2014; Weiss, Zhao, Tian, Taggart, & Yan, 2013).

Internal Mammary Artery (IMA): The internal mammary arteries course on the left and right side of the sternum. Unlike vein or radial artery grafts, IMAs are usually not removed from their original position. They often remain connected to their natural site of origin and only one end is separated from the chest wall (*in-situ*). The distal end is then anastomosed to one of the coronary arteries. The IMAs appear to be inherently "biologically privileged" as a conduit for CABG. They demonstrate resistance to the development of atherosclerosis, a thinner medial layer with less smooth muscle making it less prone to spasm, a more resistant endothelium protecting it against injury during conduit harvest and reduced proliferative response to known mitogens and pulsatile mechanical stretch (Buxton et al., 2009; Cheng & Slaughter, 2013; Tatoulis, Buxton, & Fuller, 2004).

Most commonly the IMA is used for bypassing the left anterior descending (LAD) coronary artery due to superior early and late survival after CABG (Buxton et al., 2009; Desai et al., 2007; Hayward & Buxton, 2007; Loop et al., 1986). Furthermore, use of the right IMA (RIMA) in addition to the left IMA (LIMA) otherwise known as bilateral internal mammary artery (BIMA) grafting confers additional survival advantage over the use of just the LIMA for CABG (Lytle et al., 2004; D P Taggart, D'Amico, & Altman, 2001; Takagi et al., 2014; Weiss et al., 2013). A landmark trial in 2001 by Lytle and colleagues found that the use of BIMA over LIMA conferred a survival benefit ($p < 0.0001$) of 89% versus 87% at 7 years, 81% versus 78% at 10 years, 67% versus 58% at 15 years, and 50% versus 37% at 20 years. Patency of both the LIMA and RIMA are exceptional with 10-year patency rates ranging from 88-95% depending on the territory grafted (where the higher patency value corresponds to the LIMA to LAD configuration)(Lytle et al., 2004; Tatoulis et al., 2004; Tatoulis, Buxton, & Fuller, 2011; Weiss et al., 2013; Zacharias et al., 2009).

While using the RIMA there are concerns regarding length, the ability to use it to the circumflex system and the potential risk for increased sternal complication, however recent improvements in surgical techniques have addressed many of these issues. Skeletonization of the IMA has been shown to improve length, reduce compromise of sternal blood flow, decreasing sternal infections and complications, even in diabetic patients (Tatoulis et al., 2004; Tranbaugh et al., 2014). Furthermore, excellent patency rates have been demonstrated when utilized as a "free" graft and anastomosed in a "Y" fashion to the LIMA (Nasso et al., 2009; Tranbaugh et al., 2014).

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