New Frontiers: Hyperbaric Oxygen Therapy (HBO) in Open Heart Surgery’s Complications

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Introduction

Modern open heart surgery has been made possible by development of cardio-pulmonary bypass (CPB). It is almost impossible to know who first had the idea of diverting the blood circulation to an oxygenator outside the body and pumping it back to the patient in order to allow surgery within the heart, but surely the first successful operation in which the patient was totally supported by CPB was done by Gibbon in 1953. Afterwards the field of cardiac surgery using CPB began to expand and is presently safely and widely practiced.

Nevertheless, CPB creates an abnormal situation that affects most if not all of the body’s physiological processes and can seldom carry with it severe complications such as massive arterial air embolism and sternal wound infection. These two major CPB complications can now be effectively managed by hyperbaric oxygen therapy (HBO).

The goal of our research is to lighten risk factors and describe guidelines for prevention and management of CPB complications.

HBO Therapy in Sternal Wound Infections

Median sternotomy is the preferred approach to the heart and great vessels because of the rapidity with which it can be accomplished and the optimal access it gives. Sternal wound infection is a rare, life-threatening complication in patients operated on for cardiac disease, with a reported incidence of 1.5 – 2 % of all cardiac operations [11]. Despite infrequency, mediastintis remains a potentially lethal event after an operation otherwise uneventful. If untreated, a wound infection can extend to the underlying structures (aortic and cardiac sutures, prosthetic grafts, aortocoronary grafts), leading to severe consequences such as septithrombosis or unrestrainable bleeding – even to death. Early detection of sternal wound infections is mandatory for effective management. Delay in diagnosis allows extension into adjacent bone and mediastinum increasing morbidity and mortality.

Coronary artery bypass grafting is the most commonly performed operation in cardiac surgery, and the internal thoracic artery (ITA), because of its long-term patency, is the conduit of choice for myocardial revascularization. Actually, bilateral ITA harvesting is performed in order to obtain more than one
coronary artery supplied by an arterial graft. In case of one ITA harvesting, revascularization of the sternum occurs by cross-over collaterals arising from the unharvested side and depends on a good and stable contact between the two sternal edges.

When bilateral harvesting is accomplished the sternum must heal like a free bone graft [4]. Moreover, decreased sternal blood flow jeopardizes two important factors: (a) local immune response and (b) optimal antibiotic level, when infection occurs.

**Anatomy of the Internal Thoracic Artery [8]**

Description of this vessel is useful to understand the necessity of care required during ITA harvesting from the thoracic wall. The “no touch” technique is mandatory in this kind of heart surgery. The knowledge of the ITA’s anatomy is important to understand the viability of the sternum when deprived of the ITA’s blood supply.

The ITA rises from the anteroinferior surface of the first segment of the subclavian artery, where it overtakes lung apex. The ITA is placed about 1.5–2 cm laterally to the sternal edge to bifurcate, approximately at the level of the sixth intercostal space in its terminal branches: the musculophrenic artery and the superior epigastric artery.

The lateral branches of ITA are:

1. Lateral costal
2. Mediastinal
3. Sternal
4. Intercostal
5. Perforating

Sternal blood supply comes from the sternal ITA branches that pass medially and bifurcate anteriorly and posteriorly approximately 0.5 cm from their origin.

![Fig. 1. Anatomy of the internal thoracic artery (ITA) branches (cross section)](image-url)