Innovations in coronary surgery.

From experiment to patient.

P. Gründeman, MD

Associate Professor
Heartlung center
Utrecht

ABSTRACT

Coronary artery disease (CAD) is a major life-threatening health problem with a high prevalence, a huge mortality and large morbidity. Atherosclerotic narrowing of the coronary arteries leads to ischemic heart disease eventually leading to disabling heart failure and (sudden) death (35% of all cardiovascular deaths in the Netherlands (2001).

MICABG

In 1993, a research and development program on Minimally Invasive Coronary Artery Bypass Grafting (MICABG) was initiated in Utrecht by Borst c.s.. The ultimate objective of this program is to develop coronary artery bypass surgery on the beating heart (without heart-lung machine) through small key-holes between the ribs (closed-chest procedure) using a quick vessel connector (facilitated coronary surgery). Abolishing the need for the heart-lung machine (cardiopulmonary bypass, CPB) and avoiding touching the acending aorta (reducing the risk of cerebral events) is thought to be of great potential benefit to CABG patients. Reduction of the surgical access opening will further reduce hospital stay and accelerate convalescence.

DEVELOPEMENTS

We developed a method to operate on the beating heart inside the chest including routing and target exposure and co-developed an automated end-to-side coronary artery bypass grafting method for endoscopic use. The problem of restraining the motion of the beating heart at the coronary anastomosis site has recently been solved by development of a suction device ('Octopus') which is capable of restricting the surgical target site motion to a cube of 1x1x1 mm, sufficiently to meticulously place sutures.

'OCTOPUS'

The Utrecht 'Octopus' immobilization method has been introduced in the treatment of coronary bypass patients in September 1995. By 2005, the 'Octopus' method has been applied successfully in about 400.000 patients worldwide. Experimentally, conventional multivessel endoscopic CABG was performed on the beating heart with the Da Vinci robot. In some dedicated heart centers, the latter approach has been performed in limited number of patients.

AUTOMATED GRAFTING

The present project focusses on the development of a method which will enable automated grafting of the donor artery to the recipient coronary artery of the beating heart. Three issues need to be addressed:

a. picking the right spot on the receipient vessel (routing with ultrasound)
b. bonding of the donor artery to the recipient coronary artery by stapler
c. quality control of the resulting anastomosis.

Conceptually, the Dutch Suyker brothers provided a working method whereby an side-to-side connection is stapled whereafter the anastomosis is coverted into end-to-side. The S2 connector is currently under study for patency in the animal model.

NEAR FUTURE

In the near future, the treatment for CAD will merge more towards catheter-based recanalization with drug-coated stent as first line of treatment by the cardiolo-

gist. The future role of surgical treatment of CAD will depend on innovations in CABG which may provide less invasive treatment and still long lasting result. The combination of stent placement and CABG, the so called "hybrid" procedure needs to be revisited. Endoscopic cardiac positioners like the Endo-Starfish are employed to facilitate target exposure.

Limiting the priming volume of the CPB machine may result in less usage of donor blood. For the treatment of acute myocardial infaction, bypass surgery on the beating heart is currently revisited by employing a mini-CPB as method for cardiac unloading.