

## THE RATIONALE FOR HYBRID CORONARY REVASCULARIZATION

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### Берісь дружно, не будэту грузно

There is potential for prognostic and symptomatic improvement from coronary revascularization in certain patients with multivessel coronary artery disease. The modality depends on many factors most prominent of which is the coronary anatomy itself. Recent trials including SYNTAX have helped to establish which anatomic categories are best addressed with traditional coronary artery bypass grafting (CABG) versus multivessel percutaneous coronary intervention (PCI) with drug-eluting stents (DES). Other crucial factors include the clinical setting (emergent, acute or chronic), left ventricular function, the degree of myocardial viability, the presence of absence of diabetes, comorbidities (assessed through the STS or EuroScore), associated valvular heart disease, the presence of calcification of the ascending aorta which could preclude safe cross-clamping during surgical intervention, age, patient preference, and the availability of bypass conduits. Without question either of these two modalities, CABG or PCI, will be the exclusive method for revascularization for the majority of patients presenting with de novo multivessel coronary artery disease.

Hybrid Coronary Revascularization (HCR) involves surgical revascularization of the left anterior descending (LAD) coronary artery combined with PCI to remaining vessels/territories in patients with multivessel coronary artery disease. This can be either a simultaneous or staged procedure. In the era of primary percutaneous coronary intervention for ST segment elevation myocardial infarction, it is probable that those with requiring immediate PCI of the right coronary artery or circumflex culprit artery, may require subsequent surgical revascularization of a complex LAD or left main lesion at some time in the future. Though this is, by definition, hybrid revascularization, in this lecture we will discuss specifically more elective cases where the strategy for revascularization has been strategically planned in a coordinated fashion by both interventional cardiologists as well as cardiac surgeons.

Complete revascularization reduces major adverse cardiac events in follow-up compared to incomplete coronary restoration. Certainly the utilization of the left internal thoracic artery (LITA) to bypass the left anterior descending artery (LAD) confers major prognostic benefit (long term patency exceeding 90% at 10 years) which is extended with the use of complete arterial revascularization. However, even in the comparing surgical revascularization versus multivessel stenting, **only 20% of those randomized to the surgical arm received complete arterial revascularization. Moreover, saphenous vein bypass grafts (SVG) have a definite attrition rate with up to 50% occluding by ten years.** Second generation DES stents seemingly have better long term patency rates, and offer a theoretic alternative for the non-LAD coronary artery. Indeed the rate of symptomatic SVG occlusion at one year is comparable to stent thrombosis of the first generation and more thrombogenic TAXUS stent utilized in the SYNTAX Trail (3.4% vs. 3.3% respectively,  $n=0.89$ ). Importantly, the clinical consequence, i.e. mortality, was greater in those experiencing stent thrombosis. It is therefore crucial to ensure that the non-LAD vessel suitable for stent implantation in a dedicated hybrid strategy is not overly complex, in order to ensure a favourable procedural outcome, in addition to low risk of stent thrombosis and restenosis. **The importance of proper dual**

**antiplatelet strategy following hybrid procedure is crucial to ensure sustained patency.**

As it stands the **ACC/AHA Guidelines** categorize the HCR approach as such:

### **Hybrid Coronary Revascularization**

- **Class IIa**

Hybrid coronary revascularization is reasonable in patients with 1 or more of the following (*Level of Evidence: B*):

- a) Limitations to traditional CABG, such as heavily calcified proximal aorta or poor target vessels for CABG (but amenable to PCI)
- b) Lack of suitable graft conduits
- c) Unfavorable LAD artery for PCI (i.e., excessive vessel tortuosity or chronic total occlusion).

### **Hybrid Coronary Revascularization**

- **Class IIb**

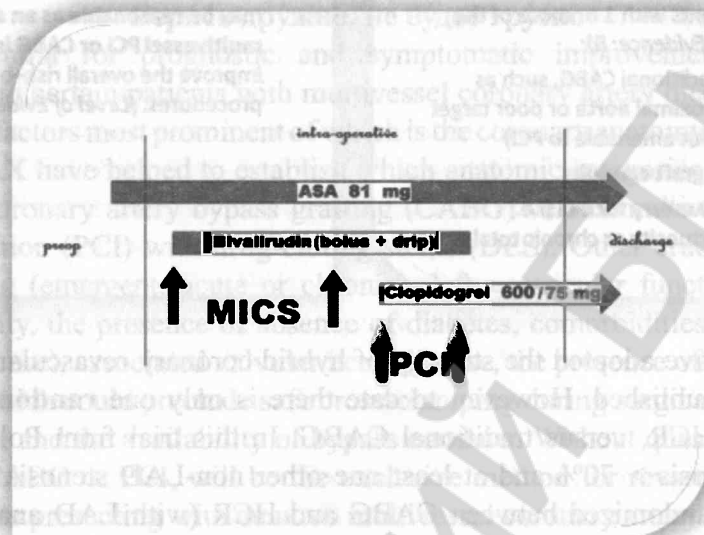
may be reasonable as an alternative to multivessel PCI or CABG in an attempt to improve the overall risk–benefit ratio of the procedures. (*Level of Evidence: C*)

Many centres have adopted the strategy of hybrid coronary revascularization and many series have been published. However, to date there is only one **randomized trial** of the hybrid approach, HCR, versus traditional CABG. In this trial from Poland, 200 patients with an LAD stenosis > 70% and at least one other non-LAD stenosis amenable to PCI or grafting were randomized between CABG and HCR (with LAD anastomosis through minimally invasive surgery followed in a staged fashion by DES stenting of the non-LAD artery). Outcomes in terms of mortality and 1 year MACE rates were not statistically different between the two strategies. **This clearly supports the need for large randomized multi-centre trials on this subject.**

Protocols vary from institute to institute. Usually the LITA anastomosis is performed initially through a minimally invasive approach. The PCI-stenting component of HCR can either be performed (**simultaneously**) immediately following the surgical procedure in a hybrid operating theatre or alternatively in a **staged fashion** one or several days later in a traditional cardiac catheterization laboratory. There is advantage to performing both components at the same setting in terms of patient convenience and the ability to convert to a full surgical approach if the LITA is confirmed suboptimal and/or the PCI is unsuccessful. However, it means more time under general anaesthetic and poses issues around bleeding given the need for dual antiplatelet therapy intra-procedurally.

At **London Health Sciences Centre** we have experience with more than 100 HCR procedures and are a proctoring centre for this technique\*. Our experience began nearly 20 years ago with Dr. Doug Boyd (CV Surgeon) performing minimally invasive LITA insertion using an early prototype of the surgical robot. Dr. Bob Kiaii (CV Surgery) subsequently pioneered the hybrid approach at LHSC with extensive experience involving the robotically assisted technique for LITA implantation along with Drs. William Kostuk and David Almond (Interventional Cardiologists) performing PCI. Dr. Kiaii (Chief) and Dr. Michael Chu from Cardiovascular Surgery now collaborate with Dr. Kumar Sridhar, Dr. Teefy and other interventional colleagues to provide this strategy to **highly selected patients** through a collaborative heart team approach. We have chosen the **simultaneous approach** in the **hybrid operating theatre**. This allows the **confirmation of the LITA patency through angiography immediately following minimally invasive (often robotically assisted) implantation (MICS)**. Note that the anastomosis often appears narrowed due to tissue edema and spasm, but provided there is TIMI 3 flow a predictable patency rate with low residual

narrowing at 6 month angiography is typically observed. Bivalirudin is the anticoagulant of choice and is continued through both phases of the procedure. Following angiographic confirmation of LITA patency and a waiting period of 30 minutes to ensure acceptable chest tube drainage, we administer 600 mg of Clopidogrel via the nasogastric tube and proceed with PCI of the non-LAD vessel through either a femoral or radial approach. Below is a diagram of this strategy at London Health Sciences Centre.



Our results have been quite favourable with long term patency rates of the LITA graft exceeding 90% and a low rate of stent thrombosis, with only a single case of acute thrombosis in our series. The newer generation of DES stents will offer better freedom from restenosis (some of our initial cases utilized bare metal or first generation DES stents). Our experience emphasizes the importance of the **Heart-Team approach** and is adopted to ensure that the **LAD is suitable for grafting**, the respiratory status is robust to allow for **left lung deflation** during minimally invasive approach through a left thoracotomy approach and the **non-LAD coronary target for PCI is not overly complex** (preferably focal lesions > 3 mm diameter not involving a major diseased side branch). **More complex disease will negate the advantage over a vein graft.**

Our recommendation for initiating this type of program is as follows:

## Implementation

- Training
- Proctorship
- Start **MICS** alone
- Progress to **Hybrid** in staged fashion
- Consider **Hybrid Same Setting?**
- Flexibility in PCI Operator

20 One cannot emphasize enough the need to **initiate larger randomized multi-centre trials** to conclusively prove its utility in the management of patients with multivessel coronary artery disease and answer important questions about the most appropriate approach (simultaneous vs. staged) and the most efficacious and safest pharmacologic agents, both anticoagulants and anti-platelet agents.

In closing, I must pay special tribute to **Dr. Yuri P. Ostrovsky** who performed one of the first hybrid surgical procedures with myself nearly 15 years ago at the Institute of Cardiology in Minsk, where the PCI was the initial procedure followed immediately by minimally invasive implantation of the LITA into the LAD in the adjacent operating theatre. It was successful and a tribute to his pioneering vision and meticulous surgical technique. A great credit and eternal gratitude is also necessary for **Dr. Natalya P. Mitkovskaya** for collaborating and facilitating the Heart Team approach between London Health Sciences Centre and the Institute of Cardiology in Minsk.

**Спасибо Вам, дорогие коллеги и друзья**

\* Dr. Teefy received honoraria for proctoring the HCR technique through Medtronic

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