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NEW STRATEGIES TO IMPROVE CORONARY ARTERY BYPASS SURGERY

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There was a time when surgery was limited to motor skills, knowledge about soft tissue manipulation and surgical text books. To optimise surgical performance was to spend additional time in increasing motor skill experience, rarely to a critical analysis of these skills and exceptionally to a re-mediation. Most surgeons applied text book procedures with all its refinements, as educated by their peers. Few applied the technologies presented in surgical literature and scientific meetings, even if they were concomitant with improved results. Hardly any surgeon applied modern methods of organizational management. The knowledge of disease, as well as outcome analysis has exploded in these last decades. In addition, there has been an explosion of new surgical and non-surgical techniques and approaches, simultaneous with an insight in the science of organizational performance, the science of knowledge, the science of knowledge application and the science of training and re-training.
An effort is made to apply all these elements into strategies to improve surgical performance in coronary surgery in this uncertain environment of surgical and non-surgical alternatives and socio-economic evolutions.

The procedural environment	The organisation of knowledge. The organisation of process.
The surgical process	Optimise risk versus benefit.
After the surgical process	Registration of early and late performance. Participation in supra-departmental data collection. Analysis of performance. Closure of quality circles.

Table-1
Strategies to improve surgical performance

1. THE PROCEDURAL ENVIRONMENT.

Surgical performance starts with knowledge followed integrally with motor skills. Attitude, is the implementation of both previous elements in the therapy of patients. Surgical performance is embedded in a complex process of interaction of different players and the patient, and between themselves. It is therefore logical that an optimization process will start with the organization of knowledge and then, organization of process.

A pyramidal departmental unit structure will need to be replaced by a web-type unit structure where nodes of knowledge and expertise are concentrated in individuals. This, understandably, impacts on the ego of surgeons believing in their universal knowledge and motor skills. This distributed authority is concomitant with distributed responsibility. It will be the responsibility of the node of knowledge and skills to distribute this surgical attitude to the whole unit, to guarantee a 24/7 optimal delivery of care and to integrate this into training and re--training. The indirect consequence of this is that smaller units, where surgeons are forced to cluster multi-domain knowledge and expertise, are very unlikely to obtain optimal performance. Only geographical requirements should therefore control the existence of smaller units, at least, if surgical performance is the primary focus. It will be the duty of these nodes of knowledge to update their know-how through meetings or journals, as well as about the clinical relevance to both surgical and non-surgical therapies concerning the various aspects of disease. Frequently forgotten is the insight in the natural life-expectancy of a diseased patient with certain co-morbidities. Few surgical groups practice evidence-driven surgery. This is the core of optimization of surgical performance and should also be followed in cardiac surgery.

Organizational science has identified that optimal organizational performance can only be achieved by standardizing procedures. This standardization process should be implemented completely in all aspects of the surgical process, from admission to discharge and from waiting lists to database registration. Standardization does not only imply simplifi-

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cation, but also allows for the complex variability of patient and procedural aspects and characteristics. It is quite possible to unknowingly deviate from these optimal pathways of care. These escapes should be monitored even more intensely and compellingly and documented, for improving quality.

The implementation of this standardization should be registered in standard operating procedures (SOP) and should include the continuous up gradation of these procedures. Some units have regular procedures for nursing and administration staff, occasional procedures for complication management and rare procedures for the modular build-up of surgical measures. Surgeons believe that they should have their own way of doing things. Preferably these SOP should not be copy/pasted from other units because they are generally dependent on local organizational environments and may be different from elsewhere. The creation of these SOP have been shown to have an extremely beneficial effect in terms standardization of procedure because the implementation of these procedures of local performance have been documented to be both effective and successful.

2. THE SURGICAL PROCESS.

This section focuses on the surgical techniques and approaches used to optimise surgical performance in coronary surgery. This section cannot be isolated from the procedural environment as identified in the first section.

The driver for optimal surgical performance in this section will be the optimal balance between risk and benefit to the patient. Surgical strategies driven by other drivers such as personal financial benefit, market share, inter-professional relation optimization, media profiling and others will not be discussed.

Surgical risk is perceived by the patient as absent, without morbidity and mortality, unless there is an immediate risk of death or permanent disability, without the procedure. In consequence, the golden standard for coronary surgery should be zero risk for mortality, stroke and severe mediastinal infection, unless the patient is in cardiogenic shock or has undergone cardiac massage. A peri-operative infarct should have a low single digit risk, but only in the presence of normal left ventricular function.

The surgical benefit should be an improvement in symptomatology and life-expectancy. This should include an insight in the natural life-expectancy of the patient with his comorbid conditions and socio-economic environment, an insight in the impact of coronary disease on life-expectancy as well as an insight of the possible beneficial impact of surgical therapy and its variations on life-expectancy. This insight is different from the illusory expectation that patients become immortal after complete arterial revascularisation. In the absence of improved life-expectancy, an improved quality of life can drive a procedure conditional of negligible peri--procedural mortality.

The surgical process will have to focus on avoiding all system instability during the anastomotic process and simultaneously creating the optimal number and quality of anastomoses.

The on-pump CABG approach allowed the dissemination of the surgical approach, reducing the motor skill demand, certainly with cardioplegic arrest, at the price of haemodynamic instability, aortic manipulation, inflammatory processes and bleeding.

Haemodynamic stability is essential to optimise the procedural risk. Banning all inotropic stimulation will maintain the patient within a physiologic range. This should be monitored using cardiac visualization (TEE) and can be optimised by the conditioning of the patient at the start of the procedure. If the unit has very strict compliance, perfect interaction with anaesthesia and very strict procedural concepts, it is possible to apply an OPCAB approach to nearly the complete spectrum of patients (excluding acute infarct patients) without any compromise in haemodynamic stability and avoiding all inotropic stimulation.

Concomitant with haemodynamic stability, is temperature stability. An unchanged normal temperature is optimal. This can easily be achieved on-pump, but also in an OPCAB approach, without the use of expensive heating blankets, by the conditional control of strict procedural protocols avoiding temperature loss in the first hour of the procedure.

The anastomotic optimisation can be obtained through different strategies. The first element is the ergonomic position of shoulders, elbows and wrists. The second is the use of pen type needle holders and forceps, allowing fine-tuned movements. Optical magnification and inside-out stitching, combined with shunting (OPCAB) sizing (on-pump) and flow measurements can further improve surgical results. There is sufficient evidence that sequential grafting improves graft patency. Whether the procedure is performed on-pump or in OPCAB approach depends on the surgeon's expertise and concept to stabilize the anastomotic area. It is possible to construct any type of anastomosis with any graft in an OPCAB approach. The total endoscopic approach (TECAB) has been restricted to the anterior surface of the heart and has failed in nearly all approaches for the postero-inferior surfaces of the heart.

Any manipulation of the aorta will minimally increase the surgical risk and the risk of stroke (considerably). There is extensive evidence available that the risk increases with the extent of aortic disease and with the number of manipulations, ie: cannulation, perfusion, cross clamping, side clamping and anastomoses. Reducing the number of proximal anastomoses mandates the use of sequential anastomoses. In the on-pump approach, optimisation is possible by avoiding aortic cross clamping and proximal anastomoses, but the risk of cannulation and perfusion remains. In the OPCAB approach, optimisation can avoid all manipulation, but frequently OPCAB is reported with extensive aortic manipulation. This considerably reduces the possible beneficial aspects of OPCAB. In certain patients, it is impossible to use arterial grafts as flow providers. Aortic manipulation can be effectively reduced by anastomotic enabling devices. These are frequently associated with additional blood loss and may require a somewhat larger graft size. Automatic connectors remain in the experimental setting with discouraging results in the first available technologies.

Arterial grafting remains the cornerstone of optimisation of surgical strategy. A single arterial anastomosis to a large and severely stenosed vessel, preferably the LAD, remains the first and most effective step towards a lasting and beneficial procedure. Adding a second in-situ or free thoracic artery graft (as single or sequential graft) can avoid the incision in the legs and create a procedure with minimal chance of late failure. The flow reserve in a normal- sized proximal LIMA is sufficient to respond to normal and even additional flow demands. Radial artery grafts have somewhat failed on the long follow-up and fare similarly to, or just slightly better than venous grafts. In patients with life -expectancies of less than 10 years, a venous jump graft can be connected to the proximal LIMA.

The hybrid approach is a combination of two approaches... CABG (preferably OPCAB) and percutaneous coronary intervention (PCI). This implies that the risks of both procedures will need to be added and that the benefit will depend on the worst of the two. The number of anastomoses is rarely an independent risk factor for additional morbidity or mortality. In consequence a hybrid approach will rarely reduce, and more frequently increase risk. The results of PCI have never attained the level results of CABG procedures. However, there remain situations where an additional graft is technically impossible. There, an hybrid approach remains the only possible alternative.

3. AFTER THE SURGICAL PROCESS.

The surgical process does not finish with the discharge of the patient. At that moment, the closure of the quality circles can start if the surgeon is willing to document every single step of the surgical process. The more variables registered, the more refined the quality circles. The surgeon also needs to collect the late follow-up data if he wants to defend his surgical therapy. The data should be shared in a supra-departmental data collection system for inter-departmental quality control, but the most interesting aspect is "auto-analysis", using complex mathematical models to study the fundamental mechanisms of risk and benefits, and the possibility of closing the quality systems driving day to day practice. Optimization of a surgical process happens each time a quality circle closes This is evidence-driven surgical optimization.