Review

The future of coronary bypass surgery

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Summary

A strength and weakness analysis is made of the current coronary surgery practice and integrated in the socio-economic and legal changes. This analysis identifies important issues for the stability of a cardio-surgical unit. Current literature studying economic survival and innovation propose a disruptive strategy as most likely towards economic survival versus an incremental strategy. A disruptive strategy is then proposed for the survival of coronary surgery; implementing this in most units will demand an unprecedented openness of mind.

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1. Current practice

Coronary bypass surgery has an uncertain date of birth, 1966 (Houston) or 1967 (Cleveland) or a lot earlier if the work of Alexis Carrell is taken into consideration, according to the geographical origins of the discussant.

The procedure, over the 38 years of its existence, has been at the forefront of knowledge generation in medicine, as well about early quality control as late performance. Interdepartmental competition and societal pressures increased the knowledge on the early impact of co-morbidity, simultaneously leading to an extremely low prevalence of early risk. Longitudinal databases, assiduous follow-up and supercomputing were the partners in this clinical research. The primary events have all been structured in performant mathematical models covering the first 20 years after the original procedure, as well survival, as return of angina or infarct as the need for re-intervention. The same is valid about the most important secondary events, where time 0 is the date of the primary non-lethal event. Progress in mathematical analysis and graphical depictions allowed the construction of nomograms and patient-specific predictions.

CABG advanced into a repeatable and teachable procedure. The anastomotic technique evolved from single grafts connecting the aorta to the distal coronary vessels, towards complex sequential grafting. The snake graft was the ultimate single graft and was rapidly halted because of its risk of graft closure. The grafting material evolved simultaneously from venous grafting, over prosthetic material to complex arterial grafting, even though the benefit of complete arterial grafting in the current CABG patient with complex co-morbidity remains unproven; CABG was well reimbursed in most countries and cardiac surgeons thrived, it was the cash-cow of most units. CABG provided the numerical volume to obtain critical mass for the survival of the unit. The repetition of the procedure made it the battlefield of the trainees. Most surgical trainees explored the difficulties of cannulation and de-cannulation on these patients.

2. Drivers for change

Too many assume that the future will be like the past. A golden age for an industry is no guarantee for long-term performance. From the original 100 top USA companies in 1917, 61 had closed shop by 1987 and only 18 remained in the top 100.

Indeed most business programs fail for the well known seven reasons: greed, ambition, lack of competence, flawed market analysis, absence of quality control, non-awareness of the socio-economic environment and non-awareness of the competition. Some of these reasons are certainly invalid for coronary surgery but some impose reflection. Indeed there are aggressive predators out there.

The first predator, the industry, seems our partner, but a change of cloth is one decision away. The domain of CABG, expressed as the number of procedures multiplied by the products used, is too small for efficient corporate strategy and investment. The number of industrial players has diminished, some remaining are struggling and have
diversified accordingly. The primary interest of this predator is shareholder value!

The second predator, the patient, is our client. But our client’s perception of therapy has changed very rapidly, supported in most European countries by very strict laws. Patients have stopped accepting risks; they only accept risk-free benefits. They are conceptually probably even right in this perception!

The third predator is our colleague working in the same hospital environment. His therapies have become more aggressive and demand also ICU resources, creating opportunistic consequences for cardiac surgery.

The fourth predator is the health service provider. Our hospital administration points at the extreme resource consumptions in cardiac surgery, as well in operating time, in nursing staff as in hospital beds. We counterpoint at the extreme resource consumption in cardiac surgery, as well in operating time, hospital administration points at the extreme resource consumptions in cardiac surgery, as well in operating time.

The fifth predator is the health service purchaser. They themselves are evaluated by fiscal year and not over the very short interval.

The sixth predator is the craft of coronary surgery. CABG is not an off-the-shelf product; it demands stress and tremor control as well as three-dimensional vision and needle manipulation. Training and retraining are fundamental elements of the furtherance of the profession.

The seventh predator is the resident. They do not accept and the governments do not allow the impossible commitments for cardiac surgery trainings, with an additional job uncertainty.

The eight predator is the surgeon and his family. The feminisation of the medical profession in combination with the European Directives [1,2] place severe constraints on the daily/nightly routines.

The ninth predator is the media [3,4]. For a while, the cardiac surgeon was beyond the human perception. Some of our senior surgeons have cultivated this superiority above humanity. This backfires, as could have been expected.

The herd of predators is incomplete without mentioning the cardiologist. They started a disruptive innovation in the late 1970s. PTCA was an inferior strategy, but it created a market because it was disruptive. The procedure seemed less invasive on the macroscopic scale at least. It did not really need a surgical theatre and gradually the number of dramatic referrals diminished. Through sustaining innovations it moved gradually up the scale of performance, the scale of performance.

The one-man suicide bomber, the 10-man pilot team on 11/09, the one-person beheading of civilians are all disrupted in their CABG production lines. They used off-the-shelf products without integrating them in their CABG production lines. They used products but did not change strategies.

Due to these issues the survival of the cardiac unit is at risk because of the loss of critical mass. The financial balance of the unit is at risk because of the 'cash cow' function of CABG. The profession is at risk. We cardiac surgeons have to retreat and build likelihood for long-term survival at a different volume.

3. Options for progress

The answers to the question of retreat and survival can be found in military history and in business management. The core solutions are exactly the same.

The corporation of the 21st century [5] differs from the one of the 20th century on several major issues. Let us focus on sources of strength and improvements. Stability is replaced by change as the source of strength of the corporation. Incremental is replaced by revolutionary as the focus of improvement for the corporation. But at the same time the corporation structures have modified from the pyramid towards the web. This same transformation and the others observed in the surviving corporations should take place in the cardiac surgery units worldwide.

Nohria [6] describes the different practices of survival for a business. The secondary practices cite talent (create top of the line training programs) and breakthrough innovations. He proposes to use new concepts to enhance all aspects of product developments even if that means cannibalising existing products. An incremental improvement is insufficient. The disruption needs to be similar to the one created by PTCA versus CABG.

The one-man suicide bomber, the 10-man pilot team on 11/09, the one-person beheading of civilians are all disruptive strategies. The civilised world was not ready for these disruptions and had to retreat.

Christensen [7] gives disruptive strategies a 37% chance of survival versus a 6% for incremental strategies.

All these scholars of survival and retreat in competitive markets are clear: only disruption is an acceptable alternative.

We have implemented this strategy in Leuven in October 1999 [8]. A complete re-engineering was realised in a few hours and applied to 99% of the patients and by all surgeons. The need for conversion to the previous CABG approach has been reduced to less than 0.3%. This re-engineering has annihilated early risk and reduced the resource consumption and the costs dramatically, without jeopardising the late benefit.

Other units have not or have had difficulty implementing the same or different disruptive strategies. Indeed most of them have not understood the disruptive nature of some new approaches, they used off-the-shelf products without integrating them in their CABG production lines. They used products but did not change strategies.

Gardner [9] defines change as “to abandon the way in which we customarily think about an issue of importance and henceforth conceive of it in a new way”. He proposes seven levers of change: reason, research, resonance,
appendix. Conference discussion

Dr R. Dion (Leiden, Netherlands): Paul (Paul Sergeant), as always, your presentation was absolutely brilliant, but, sadly, I disagree completely. I think that the so-called disruptive changes which you have implemented, have been partially dictated by special working circumstances in the Catholic University of Leuven where you exclusively perform coronary artery surgery. You are therefore in a particular situation where ‘disruptive’ change was both imperative and possible. In our department only 20% of coronary surgery is performed off pump. This percentage is dictated by the fact that the majority of our coronary surgery is associated with valves, with aneurysmectomies, and other types of surgery which preclude off pump techniques. In these circumstances OPCAB is only one of the options for treating patients. It is not ‘the’ definitive disruptive revolution.

Also you present local data in favor of OPCAB about clinical results, about diabetes, about stroke. I was recently invited to participate in a pro/con controversy and therefore I extensively reviewed the literature: I can state that the situation of the ‘on pump’ is not as bad as described by many. There was a key presentation by SELNES at a recent STS meeting. He is an independent psychologist. He is not a cardiac surgeon, he is not a cardiologist. And he showed that in fact CPB was not so terrible compared to, for instance, PTCA with regard to neuropsychological disorders. There are studies showing that there is no more stroke after CPB than after, for instance, a hip replacement.

So I feel that we indeed need to improve our communication regarding current practice and results including those related to cardiopulmonary bypass techniques. We need to publish our results and we have to try to equalize our personal results with the best available results. I was very much impressed by the mention of the Wall Street Journal article. Suddenly there was a group of surgeons showing that PTCA is inferior to CABG. They didn’t change their technique. They just showed in a very objective way that surgery was better, and they get into the Wall Street Journal. Likewise we should try to improve our profile in the Wall Street Journal. Journal for mitral valve repair, for restoration of the left ventricle, for tricuspid valve surgery, and other forms of complex surgery.

And I think it is not okay to hear from a big boss of the industry, “we invested $40 million in this direction, so you should follow this direction.” I will never follow this direction only for that reason. I will try to influence people and the industry to choose the direction that I think is the best for my patient, and I am not going to change my way of doing something because a firm or an industry invests $30 million a year in something different. Maybe this is a bit brutal, but I believe we all are here for an open debate.

Now, with respect to the cardiologists, I think we should not say that ‘they’ have the patients, ‘they’ have the control. Fuse with your cardiologists. This is the disruptive revolution I see: go to the cardiologists, go to the basic scientists, go to the imaging people, fuse with them, make a huge department, come up with new ideas. I think we should be internationally disruptive, not just locally disruptive, and I think we should join the people making progress.

For example, I don’t care about the profession of the individual who is implanting the intra-aortic stent. In our department, we have worked for the last one and a half year with the radiologists. Every time that there is a patient implanting the intra-aortic stent, the radiologist and the surgeon are called together. I don’t care where it happens. Of course, the ideal solution is to have an operating theatre with a good imaging facility, but what is the problem? If you in the meantime do an excellent job in the radiology department with a surgeon, why not? I don’t understand the problem.

Dr F. Mohr (Leipzig, Germany): Paul, I am a good friend of Robert (Robert Dion), but I completely agree with you, because I think the way you stressed that we have to improve and to really look at the best results, it is very important for our future.

I just want to give an example of a discussion we had last week in the upcoming SynTax trial when we were discussing with the cardiologists, they were also in the room, what surgeons should do to compete with cardiologists in the upcoming trial comparing drug-eluting stents versus triple vessel, and, Jose (Jose Pomer), you know what we are talking about. My strong belief also was to go for the best surgery possible, even though we know that some surgeons may not be able to do that, complete arterial revascularization using both IMAs, et cetera, and you just made the point that we have to aim at that. The question is how can we do that? I strongly believe that we have learned from the Cleveland Clinic. Just recently Bruce Lytle has given the talk about...
You did not mention at all how you want to solve the problem of training. If you do it with your nurse, you are going to die in 10 years, more or less, and who is going to be the next Paul, and this is something which has to be discussed in the concept, too, how do we go ahead, and I am not discussing whether it’s going to be OPCAB or on-pump. This may be marginal, and I agree with Robert with that. I personally favor OPCAB. But I think if we discuss it, we also have to find a way for all our young people to get them. Should we only train them for coronary bypass surgery or just maybe including the stenting or whatever? What would you suggest in this direction? It doesn’t help me to train my nurse.

**Dr Sergeant**: There are different issues that have been brought forward. First of all, if you understood that the issue was OPCAB, then you have misunderstood the complete presentation. The issue is we need a beaujolais nouveau. We need a disruptive strategy. I don’t care how that is. If it is with a robot, it is with a robot. I don’t care how that new CABG is, but it needs to disrupt, reduce resources, improve performance for the patient, be cheaper, be able to fit in the new socioeconomic environment, on the one side. Secondly, we just don’t need a disruptive strategy, we need to sustain it long enough so that it goes above the level of the current therapy. So there are two fundamental elements that are mandatory.

The issue about training is a major issue in our hospital, and I can tell you personally, I am assisting four hours a day a young trainee, assisting. He is not assisting me; I am assisting him. We have training. The training is very strict. And our residents do not train on a human being. They train in training boxes. They train to place shunts. They train to do anastomoses in training boxes in the new environments. They will place 1000 shunts in a training box before they will do it for the first time in a human. A human body is not for training. A human body is for clinical work. And I agree totally with you, we have exponentially improved the training. Fewer trainees, but exponential improvement.

Two days ago I assisted a young fellow who came to do his fifth year in surgery. He is 29 years old. He did a transplantation from the beginning to the end after the excision. In fact that is not entirely true; he even excised the heart. That is the new training. Because training, of course, is different than the trainee helping you or helping the trainee.

**Dr J. Vaage** (Oslo, Norway): When I am listening to the discussion here, I am wondering what do we mean by a symposium for the future? Are we discussing within the next 10 years or are we discussing the future, let’s say, in 30 years? And a lot of discussions here are actually most important for the next 10 years but don’t take into consideration what will happen after that. I think this discussion about OPCAB and on-pump is within the next 10 years.

But if you are looking a bit more forward, don’t you think that actually the specialty will be completely different? It will not be a question whether you want to wear a mask or lead, but in 30 years the cardiac diseases that we are treating now by surgery, the big majority of them will be treated with a combination of molecular medicine and percutaneous interventions. So in 30 years, how much do you think will be what we think is more traditional cardiac surgery?

**Dr A. Juffe** (La Coruna, Spain): We changed the philosophy in 1996 from on-pump to off-pump surgery. I think that it is very important to have a competitive approach with cardiology, have arterial non-pump or on-pump surgery, no vein, no touch the aorta, because if you look at the screen, Paul says 80%. We use 100% two mammary, don’t touch the aorta, and this is competitive surgery, and we have low morbidity and low mortality. Off-pump or on-pump, I think that this is not the issue. We do in Spain 98% off-pump, but I think that it is crucial to have a very high quality of coronary bypass surgery.

**Dr A. Kappetein** (Rotterdam, Netherlands): Are you not afraid that with the introduction of the drug-eluting stents, PCI and CAGB will also be comparable not only for long-term survival but also for angina-free survival? I think that more patients will be treated by PCI but not a lot of them. With the introduction of the drug-eluting stent the cardiologists don’t have new techniques to open a vessel, and if the vessel has a severe tortuosity, they cannot put a stent there. They will also lose patients because they have less reinterventions after PCI. I think that our patient population will decrease by about 5 to 10% because now the cardiologists are going to treat three-vessel disease and/or left main disease, but it doesn’t bring them new techniques. We can treat coronary lesions that cannot be treated by percutaneous techniques.

With the introduction of the drug-eluting stents, the angina-free survival after PCI will improve and I doubt if surgery will still I think it is very important to have a heart team meeting where the surgeon and cardiologist discuss which treatment is the best for the patient, PCI or surgery. Many surgeons and cardiologists in Germany and in the Netherlands discuss every patient which one is best treated by surgery and which one by PCI? I think that gives the best recommendation for the patient.

**Mr B. Keogh** (Birmingham, UK): I think it might seem initially as though Paul and Robert are coming from two different points, but Paul is talking about the development of new ideas. He doesn’t really care what the new idea is, but it needs to be new. Robert doesn’t want other people telling him, in a sense, or doesn’t want industry determining what the new ideas are, and he wants to be, along with the rest of us, party to those decisions.

The problem we have is that coronary surgery has been very stable over the last few years. The comfort factor is high, patients are happy with it, surgeons are happy with it, and we are only seeing very incremental changes, one arterial graft, then two arterial grafts, then three arterial grafts, then a bit of OPCAB surgery. And we have seen very eloquently from Paul that successful industries have to change and they have to change radically if they are going to survive. So industry is there looking for change, and that is what we hear from Bob (Robert Guezuraga).

Now, we have to offer them new ideas. The cardiologists are offering them new ideas, and until we offer them ideas that are attractive and offer a new future, why should they invest in our comfortable procedure, which isn’t really developing very fast? And I think this discussion has summed up what the whole meeting is about. It is about developing new ideas for the specialty and encouraging people to invest in those ideas.