EuroIntervention 2019;15:e222-e223 published online e-edition June 2019

Cardiac surgery in the time of TAVR: swan song or rebirth?

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Cardiac surgery started as the land of the nearly impossible. C. Walt Lillehei used a parent as a pump oxygenator in cross-circulation to repair congenital heart defects in children. John Gibbon developed the mechanical pump oxygenator ushering in the era of open heart surgery. Coronary artery bypass and cardiac valve replacement became possible and saved lives in previously hopeless situations. A high point seemed to be reached when Christiaan Barnard successfully transplanted the first human heart in what is arguably the most reported medical event to that date causing worldwide excitement. Technological developments started cardiac surgery and continued to build and expand the field.

I stepped into surgery in the late 1970s and spent my formative cardiothoracic training years working under Dr Michael DeBakey, Dr Stanley Crawford and Dr Denton Cooley. Those were heady times and it seemed that there was nothing too big or too difficult for cardiovascular surgeons to do. Every year brought bigger and more complex surgery for us to do. These were at this time all done through big incisions, the crown jewel of which was the thoracoabdominal aortic aneurysm incision which cut the patient practically in two. But we, cardiac surgeons, could do this as we were the masters of this deadly disease and the patient had no other real choice except potential death. Minimally invasive surgery began development mainly after my training years. I remember discussing minimally invasive surgery with Dr Cooley who promptly told me that little incisions were for little surgeons. Besides, we had a huge backlog of coronary disease, valve disease and aneurysm disease that needed our big surgery so not to worry as he predicted continued growth in big cardiovascular surgery. However, as is often attributed to that great baseball player Yogi Berra, "It's difficult to make predictions, especially about the future".

Early in my career I watched as technology expanded beyond cardiac surgery. Grüntzig opened coronary arteries with a balloon but a number of vessels collapsed early and needed emergency surgery. Then came stents which decreased this early failure but had a later restenosis. Then came drug-eluting stents and this late restenosis decreased dramatically. This technological advance was relentless. This had a dramatic effect on the most frequent surgery for cardiac surgeons, coronary artery bypass, and volumes fell drastically. Those applying for training in cardiovascular surgery saw this and applications for training spots began to fall at a rapid rate to the point where there were more training positions than people willing to fill them. Rumours of doom began to circulate.

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DOI: 10.4244/EIJV15I3A41

Stent technology was also applied to the vascular arena where I operated. Increasingly, peripheral artery stenosis was being treated by transcatheter means and stents – and often by non-surgeons. When endovascular aneurysm repair came along, forward thinking cardiovascular surgeons knew that, unless we mastered this new endovascular technology and maintained the ability to treat appropriate aneurysmal disease with this technology, we were likely to lose the field to others. This was fully embraced by a large number of vascular surgeons who committed fully to the technology and today the field of vascular surgery has done so and is expanding. Indeed, the vascular surgeons at my institution are some of the busiest surgeons we have.

With the decline in coronary artery bypass, cardiac valve surgery became an important source of continued surgery for cardiac surgeons and was a focus of my clinical work. Cardiac surgeons produced exemplary results from simple to complex cardiac valve surgery. Mitral valve repair for degenerative mitral regurgitation remains one of the great achievements of cardiac surgery and is close to curative in good hands. Surgeons also accelerated the development of minimally invasive techniques for valve surgery including robotic approaches, allowing a less invasive approach and faster recovery. The competition at this point was other surgical approaches but everyone still got surgery. Into this landscape in 2002 came transcatheter aortic valve replacement (TAVR). Although technically difficult at first, devices and the technical aspects of deployment have continued to improve. As these valves improved, they were tested against surgery in a series of landmark randomised trials across all risk spectra. In the high-risk trials, TAVR proved non-inferior or superior for a primary endpoint of all-cause mortality at one year. In the intermediate-risk trials, TAVR proved non-inferior for a primary endpoint of all-cause mortality or disabling stroke at two years. In the low-risk trials, TAVR proved superior for a combined endpoint of all-cause mortality, disabling stroke or hospitalisation and non-inferior for the more conservative endpoint of all-cause mortality or disabling stroke. These results, combined with the approval of TAVR for extreme, high and intermediate risk patients in the USA, led to more TAVR cases being performed than open AVRs by the last quarter of 2016; the difference continues to widen. The positive results in the two low-risk trials suggest that low-risk TAVR will also be approved in the USA and I suspect adopted worldwide.

This of course brings us back to the title of the discussion – is this the swan song for cardiac surgery or just a rebirth? From my perspective, this is a rebirth if cardiac surgeons adopt this new technology as active and full partners. To do so, they must be willing to master all aspects from imaging and patient selection to actual implantation, which I will argue is the simplest part of learning this. TAVR has already started to improve the outcomes of open AVR. It has made it more apparent to surgeons that transfusions, atrial fibrillation and acute kidney injury are all more common after surgery than TAVR. With TAVR rather than other open AVRs for comparison, cardiac surgeons are refocusing on all of these areas and where technology may help us to improve our outcomes. Although stroke was higher in TAVR in the first high-risk trial, every randomised trial since shows TAVR to be either numerically or even statistically lower than surgery. With a new comparator, I expect surgery to improve its stroke outcomes. Both recent low-risk trials saw surgical valves implanted that were larger than in previous trials. Surgery has had worse haemodynamics and more patient prosthetic mismatch in the previous high- and intermediate-risk randomised trials. Surgeons knew they needed to be putting in bigger valves. In the low-risk trials, the self-expanding supra-annular valve still had superior haemodynamics to surgical aortic valve replacement (SAVR) but for the first time SAVR had better haemodynamics than TAVR in the balloon expanded trial with the larger surgical valves that were implanted. Now, with new competition and the potential for valve in valve, surgeons seem finally to be doing just that. Competition is good and should be embraced and used as a stimulus to improve and not be a reason to quit or complain.

Cardiac surgery and cardiac surgeons are not going away. Heart failure and valve repair remain in the surgical arena (at least for now). Endocarditis unresponsive to medical therapy will likely always be a surgical disease. Yes, many aortic valve replacements done in the past with surgery will move to TAVR and, in the appropriate patients, it will be to their benefit. Not all cases of aortic valve disease will be appropriate for TAVR nor will all cardiac surgeons do TAVR. But the complacency that many cardiac surgeons had when they were king of the hill was shaken some by PCI and stenting and should evaporate with the arrival of TAVR to low-risk patients. I believe there is a new sense of urgency among surgeons that will lead to more surgical innovation and better surgery despite ever-increasing complexity. A good cardiac surgeon is now and will in the future continue to be essential to leading programmes. A good surgeon who learns transcatheter skills will be essential and twice as busy. For me, the time of TAVR is a new chapter in my career, adding new and exciting opportunities and possibilities. I believe that cardiac surgery in the time of TAVR will benefit from this great technological advance, greater collaboration with our cardiology colleagues and be reborn as an even more dynamic specialty.

Conflict of interest statement

The author has no conflicts of interest to declare.