

## MEDICAL INNOVATION: TRANSCATHETER AORTIC VALVE IMPLANTATION (TAVI) (MEDICAL DEVICE: THERAPEUTIC)

**Academia:** Professor Alain Cribier

**Industry:** Edwards Lifesciences, Percutaneous Valve Technologies Inc.

### Situation

#### *Few options to treat a debilitating condition*

Aortic stenosis is a type of heart disease where the aortic valve does not fully open, thus decreasing blood flow from the heart. Patients are either born with the disease (roughly 4 in 1,000 people), or they can develop it later in life, often from calcification of the valve, or by contracting rheumatic fever. Those who suffer from aortic stenosis experience shortness of breath, lightheadedness, and severe chest pain.

Patients with a serious type of aortic stenosis typically undergo heart surgery where the valve is manually expanded, or replaced altogether with a tissue-based or artificial valve. However, many patients, especially older ones, are not considered good candidates for open-heart surgery, therefore they are left with few options to treat their debilitating condition.

### Physician-Industry Collaboration

#### *A pioneering cardiologist searches for other options*

Alain Cribier, a pioneer of interventional cardiology in France, was determined to find other options for patients who couldn't avail themselves of traditional surgical remedies. In the early 1980s, he used existing cardiac catheterization techniques – where a wire is inserted in a patient's vein and moved into the heart, most often for diagnostic purposes – to experiment in finding new medical solutions for these patients.

Cribier was intrigued by a new technique whereby balloon-inflatable catheters were inserted in the main arteries, thus supplying blood the heart to push blockages out of the way. He reasoned that the same balloon catheters could be used to expand the folds of a poorly-opening aortic valve, and performed the world's first so-called "balloon valvuloplasty" on patients in 1985, with positive results. Soon thereafter, this treatment option became popular as a non-invasive way to treat aortic stenosis.

However, the procedure represented far from a complete solution, as the valves that were expanded in the balloon-catheter procedure often would re-close, leaving patients back at square one. There had to be a more permanent fix. Cribier then seized on the idea of using existing coronary stenting technology – where a metal cage was expanded in a blocked artery to prevent re-blockage – to treat valve disease in an entirely new way.

He worked to find a biotechnology company that would collaborate with him on the invention, but found more skeptics than enthusiasts. Finally, working with a small company known as PVT (later acquired by Edwards Lifesciences), he was able to develop a stainless-steel stent, or cage, that had a valve made of three leaflets of pig's tissue, and place it on a balloon catheter large enough to expand across a patient's existing aortic valve and fix the stent into its place.

### Innovation Benefits

## ***Nothing less than transformational***

The result was nothing less than transformational. After initial trials in animals, Cribier performed the first so-called “transcatheter aortic valve implantation” in a human patient in 2002. According to Cribier, “it instantaneously generated an immense interest in the cardiology community worldwide [because] it provided a therapeutic solution for a very large number of elderly patients with aortic stenosis who were originally denied valve replacement [because of their age and condition.]”

Currently approved for use in Europe, the device has been implanted in close to 25,000 high-risk patients worldwide in minimally invasive procedures. Clinical trials in the U.S. are progressing, and the *New England Journal of Medicine* in 2010 [published](#) a study of the trials that concluded, “In patients with severe aortic stenosis who were not suitable candidates for surgery, TAVI, as compared with standard therapy, significantly reduced the rates of death from any cause...”

“On the basis of a rate of death from any cause at one year that was 20 percentage points lower with TAVI than with standard therapy, balloon-expandable TAVI should be the new standard of care for patients with aortic stenosis who are not suitable candidates for surgery.”

### **Patient Benefits**

#### ***A retired grandfather with few medical options gets back on his feet***

Richard Bradley, a retired grandfather, had no good solutions to treating his disease. He was too frail to undergo open-heart surgery and had been recently diagnosed with aortic valve disease, or aortic stenosis.

Prior to his diagnosis, Richard had no problem walking a mile at the Sacramento, California jazz festival. Then, a year-and-a-half ago, he [began to notice](#) that he was “slowing down,” and instead had to walk back. He had trouble even getting up to answer the door when his daughter, Joan, would come to visit him.

Fortunately, Richard went to his cardiologist, and, once diagnosed, was given the option in participating in a clinical trial known as PARTNER of Edwards Lifesciences’ SAPIEN transcatheter heart valve implanted using the minimally invasive TAVI procedure.

After the short procedure, Richard felt like new – he could breathe again, and is now resuming all his old activities. “It’s like having your life given back to you,” he said.

According to his daughter, “He’s like brand new again!”

Dr. D. Craig Miller, one of the physicians on the Stanford team, said, “This does give [such inoperable patients], for the first time, hope, because something can be done to treat this otherwise fatal disease.”