Introduction

Over the past few decades, conventional aortic valve replacement has evolved to a highly standardized procedure resulting in excellent clinical outcome. Today, isolated conventional aortic valve replacement (AVR) in low-risk patients is associated with a 30-day mortality of only 2–3% [1, 2].

Aortic valve stenosis, usually caused by degenerative disease, is the most frequent acquired heart valve lesion and predominantly affects elderly patients. Naturally these elderly patients often present with significant comorbidities resulting in an increased operative risk profile. Even in presence of an increased risk profile, aortic valve replacement can be performed in elderly patients with an acceptable clinical outcome leading to a significant improvement in the individual’s quality of life [3]. According to the literature 30-day mortality after conventional aortic valve replacement in octogenarians is around 5–10% [4, 5], which is acceptable when taking into account the grave prognosis of elderly patients suffering from severe symptomatic aortic stenosis with mortality rates of up to 50% within the next year without surgical intervention [6].

To decrease the invasiveness of conventional aortic valve replacement several minimally invasive techniques using a limited surgical access (i.e., upper partial sternotomy) have been introduced recently to further improve clinical outcome [7].

The concept of transcatheter aortic valve implantation

Given these excellent results associated with conventional aortic valve replacement even in octogenarians, why would we need transcatheter aortic valve implantations? According to the data of the European Heart Survey one-third of all elderly patients suffering from severe symptomatic aortic stenosis were never referred to a cardiac surgeon because the referring cardiologists believed the surgical risk to be unacceptably high [8]. This is
not true for the majority of elderly (octogenarian) patients who today are good candidates for conventional AVR, but there are certainly some patients with an excessive risk profile. So even with the minimally invasive technique for conventional AVR (i.e., partial upper sternotomy) the procedure still requires (partial) sternotomy, cardioplegic arrest and cardiopulmonary bypass. In contrast, when using a transcatheter technique it is feasible to implant an aortic valve prosthesis and avoid sternotomy, cardioplegic arrest, and probably most importantly even cardiopulmonary bypass. Theoretically, all these factors together should result in less surgical trauma, less cardiac impairment, and less inflammatory response leading to improved patient outcome. On the other hand, there may be an inherent additional risk with these new procedures when comparing them to the highly standardized conventional techniques. In addition long-term durability of the transcatheter valves is unknown despite promising in vitro tests and low transvalvular gradients. Therefore, transcatheter aortic valve implantation at present is exclusively targeting very high-risk patients suffering from severe symptomatic aortic stenosis.

Transcatheter aortic valve prostheses

Presently, two systems are commercially available and have obtained CE mark approval recently. The first device is the CoreValve™ system which is predominantly designed for transfemoral access. The valve is made from porcine pericardium and is mounted within a self-expandable nitinol stent 50 mm in length. The prosthesis is deployed within the aortic annulus extending above the level of the coronary ostia with a wide mesh allowing for unabated coronary flow. In contrast, the Edwards SAPIEN™ (Fig. 1) valve is made from bovine pericardium including some anticalcification treatment (ThermaFix™) and is much shorter in height (14–16 mm). The SAPIEN™ valve mimics the design of a conventional bioprosthesis and has

Fig. 1. Edwards SAPIEN™ transcatheter heart valve