In the July issue of the European Heart Journal an experimental study was reported on the percutaneous implantation of heart valves in the systemic circulation[1]. Since the report by Bonhoeffer et al. in 2000 on the first percutaneous pulmonary valve replacement in man, the two authors felt challenged to move to the percutaneous implantation of the aortic valve[2]. Despite many commercial activities in this area, the authors are, to our knowledge, the first to report on this.

After the creation of severe or moderate aortic valve regurgitation in eight lambs, a bovine jugular vein was mounted on an expandable, metallic stent and placed through the femoral artery into the descending aorta immediately after the take-off of the brachiocephalic trunk. The device was delivered successfully and the immediate function was normal in all animals. Four lambs with massive aortic regurgitation died within 24 h despite proper graft function. Four lambs with ‘mild’ aortic valve regurgitation had valve insufficiency for 2 months but good graft function. However, the native valve insufficiency was cured after 3 months and the recovered valve graft was dysfunctional. The behaviour of all the animals was similar.

These experiments mirrored the approach of Hufnagel et al. from Washington, 50 years ago[3]. Their animal experiments were mainly committed to the development of a prosthetic ball valve and fast and secure fixation of the device in the descending aorta. With their publication in 1954, describing 23 prosthetic valve implants in the proximal descending aorta of patients with severe aortic valve regurgitation, the modern era of surgical valve replacement therapy was started. By controlling an estimated 75% of the regurgitant volume, the 17 survivors improved in functional status and there were no early catastrophic device failures.

What can be learned from the experience of Hufnagel et al. concerning descending aortic prostheses? Unfortunately the documentation of this procedure is extremely limited and over-optimistic. Twenty years after the initial report, Fishbein and Roberts conclude, in a review of the literature, that despite the distribution of 4000 prostheses for human implantation, the data of only 55 patients could be retrieved[4]. The remarkable performance of the device was based on the fact that in 26 deceased patients the cause of death was not valve related. In 1976 Hufnagel and Gomes reported on only six late survivors without stating the total number of implants during the period 1952–1960[5]. Patients had a mean age of 29 years at the time of implantation. In three of the four patients surviving after 1972, the native aortic valve had been replaced by a modern valve prosthesis. The concept of a descending aorta placement of a valve prosthesis was never revived after 1960, despite the fact that this operation could now be considered as a minimal invasive procedure.

The introduction of the Hufnagel ball-valve is a milestone in modern medicine. For the first time there was a treatment option for patients with severe valvular heart disease and it paved the way to orthotopic valve replacement. For some very sick patients a temporary solution was obtained, followed by more definitive treatment. However, the procedure itself was probably less than satisfactory.

The transluminal approach to the treatment of aortic valve disease is an area of heightened commercial activity. At least four medical technology firms are active in the field of bioprosthetic percutaneous implants, backed by venture capital companies. Two of these recently merged with major medical concerns. However, commercial interest limits information on new developments in this area. Fortunately the authors of this paper have no obligations which could give rise to a conflict of interests[1]. The authors used the Contegra valve, a product line from Venpro Corporation, recently acquired by Medtronic. The Contegra conduit is composed of a glutaraldehyde-fixed xenograft jugular vein segment. It is an investigational device, with sizes suitable for the youngest patient, and with a clear potential for application in right-sided congenital heart disease. The medium-term results in the pulmonary circulation are as yet unreported and the mechanical properties in the systemic circulation are unknown. The authors admit it is not clear how this valve could be applied in the systemic circulation of the adult patient and it is unlikely that a glutaraldehyde treated bovine venous structure will hold very long. Given the good long-term results of valves constructed from bovine pericardium, other specifically designed valves are more likely to be successful.

To define the indications for the application of percutaneous implantation of a valve in the descending aorta, the authors cite one study on the determinants of operative mortality of aortic valve replacement[5]. Known contributors to mortality are...
age, bypass and cross-clamp time, accompanying mitral valve disease and aortic insufficiency. However, patients identified at very high risk, such as age over 80 years with pure aortic regurgitation, are uncommon in our practice. Usually, in older patients aortic stenosis is involved. In addition, deployment of a stent-graft may be hazardous because of calcifications in the descending aorta. Thus the number of suitable patients remaining is very limited. Clinical practice seems to require a percutaneous approach to orthotopic valve placement and/or aortic stenosis.

An often cited quote on valve replacement devices from Dwight Harken is: 'A device is safe when it is safer than the condition it corrects and is the best available'[6]. From this perspective it seems that the paper from Boudjemline and Bonhoeffer could be a landmark in the non-surgical treatment of aortic valve disease if it is the beginning of further experimentation on the percutaneous application of a safe aortic valve prosthesis in the orthotopic position.

Recently, A. Cribier from Rouen, France has performed the first percutaneous aortic valve implantation to replace a stenotic aortic valve.

References