Association of transaortic approach and transoesophageal echocardiography as the primary imaging technique for improved results in transcatheter valve implantation

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Abstract

OBJECTIVES: The transaortic access has been proposed to perform transcatheter aortic valve implantation in patients with no other available access. We hypothesize that its coupling with transoesophageal echocardiographic guidance may further reduce procedure-related morbidity.

METHODS: Transoesophageal echocardiography was adopted as the primary imaging modality to produce high-resolution images and to guide the deployment of the transcatheter valve. This imaging modality allows continuous visualization not only of the prosthesis and of the delivery system, but also of the surrounding anatomical landmarks (aortic annulus, sinotubular junction and anterior mitral leaflet).

RESULTS: We report an initial series of eight patients, who were treated by a transaortic delivery of the transcatheter valve (SAPIEN Valve, Edwards Lifesciences Inc., Irvine, CA, USA) through an upper mini-sternotomy and guided by transoesophageal echocardiography. The procedure was uneventful in all patients; there were no cases of access site morbidity, periprocedural stroke or renal failure.

CONCLUSIONS: The association of the transaortic route and the transoesophageal echo guidance has the potential to improve the results of transcatheter valve implantation, and deserves further investigation.

Keywords: Transcatheter valve implantation • Echocardiography

INTRODUCTION

Transcatheter aortic valve implantation (TAVI) is now an established alternative to surgical valve replacement in patients with a high operative risk [1]. The transaortic route is feasible and safe in patients without any other viable access [2]. Intraprocedural transoesophageal echocardiography has been used for primary imaging in transapical TAVI, with results equivalent to those of established angiography [3]. We report a series of eight patients in whom the transaortic TAVI (TAo-TAVI) was performed using transoesophageal echocardiography with the generation of high-resolution images as the primary imaging modality guiding the procedure.

CLINICAL SUMMARY

The TAo-TAVI was performed through a 6-cm median incision and manubriotomy. The Edwards Ascendra delivery system (Edwards Lifesciences Inc., Irvine, CA, USA) was introduced through aortic purse-string sutures after guidewire insertion in the ascending aorta and the left ventricle (Fig. 1a and b). The valve deployment site was determined essentially by intraprocedural transoesophageal echocardiography (Philips VV9, Philips Inc., Eindhoven, the Netherlands and GE Ei33, General Electric Inc.) using the 110–150° long-axis scan planes of the aortic root and of the left ventricular outflow tract. During the earlier phase of the present experience, the transoesophageal echocardiographic assessment was coupled with the angiographic assessment in the determination of the deployment level. With respect to fluoroscopy, we performed at least two orthogonal projections at the beginning of the procedure; the view in which the aortic sinuses and leaflets were seen on the same plane was used thereafter (Siemens Zeego system, Siemens Inc.).

A standard TAVI procedure was then performed (SAPIEN Valve, Edwards Lifesciences Inc., Irvine, CA, USA) under double imaging control (echography and angiography). The procedure was performed within a hybrid theatre facility. Table 1 summarizes the baseline and the postprocedural clinical characteristics of the study patients. The most common indication to the transaortic approach was the coexistence of severe disease of the iliofemoral arteries, preventing proper positioning of the introducers. The average amount of administered contrast medium was lower during the second half of our experience.
(89.7 ± 8 ml) vs the first half (142.5 ± 20 ml) (P < 0.001, Student’s t-test; Fig. 2). Similar results could be obtained for the average fluoroscopy time (13 ± 3 min vs 24 ± 9 min, P < 0.001, Student’s t-test). The operation could be completed uneventfully in all cases. There were no postprocedural instances of stroke or acute renal insufficiency. Paravalvular aortic regurgitation graded 2/4 occurred in two patients at the end of the procedure; all the remaining patients had regurgitation of grade 1.5 or less. Subsequently, at a control echocardiography performed on the 30th postprocedural day, the leak was graded as 1.5/4 in one case and 1/4 in the remaining seven patients. Adequate functional results were achieved, and all patients were in NYHA class I or II at the 30th postprocedural day.

**DISCUSSION**

The transfemoral, subclavian and transapical accesses for TAVI are limited by considerable rates of several periprocedural complications. The reported incidence of stroke is 6.7% in the PARTNER study [4], i.e. about 4-fold vs conventional aortic valve...
replacement. This can be at least partially attributed to the trauma of the aortic arch, by either the valve delivery system or the stiff wire. Additionally, the transfemoral access is associated with the risk of major vascular complications, while the transapical route yields the possibility of cardiac rupture in the context of a fragile left ventricular myocardium, as far as the risk for pneumothorax and haematothorax is concerned. The subclavian access is associated with brachial plexus injury and lymphoedema.

In such a scenario, the TAO-TAVI combines the aortic arch ‘no-touch’ concept with the possibility of immediate surgical conversion. Early reports indicate no instances of stroke after TAO-TAVI [2], and our data confirm such a finding. As additional advantages, both vascular complications and the loss of left ventricular ejection fraction due to myocardial sutures are avoided. The latter is a well-known complication of the transapical procedure. In the light of such advantages, the percentage of TAVI procedures conducted through the transaortic route is reasonably expected to increase.

With the purpose of further decreasing the morbidity profile of TAO-TAVI, we propose the use of intraprocedural transoesophageal echocardiography as the primary imaging modality in guiding valve deployment. The advantages of this approach are maximized as last generation echocardiography devices, which are capable of producing also 3D reconstructions, are available. Echocardiography already plays a major role in TAVI procedures: allows last check of annular size, control of left ventricular and prosthesis function after implantation. Herein, we underscore that echocardiography is invaluable in guiding the manipulation of the valve delivery system in order to achieve the following advantages over angiographic guidance: (1) optimal coaxiality with the aortic root; (2) the finest deployment level by the continuous visualization of anatomical landmarks such as the aortic annulus, mitral valve and ventricular septum (Fig. 1c and d). The most proximal segment of coronary arteries can also be visualized. A failure to achieve these two goals is associated with suboptimal results (malpositioning, paravalvular leak). When the transcatheter valve is deployed under angiographic control only, a tendency has been observed towards deployment at a slightly lower level than desired. The echocardiographic control has the potential to overcome such a limitation by providing continuous visualization of the anatomical landmarks. Several angiographies and infusion of considerable amount of contrast medium, which are usually required for fluoroscopy-guided TAVI, are also avoided. The occurrence of contrast-induced nephropathy after TAVI causes a 4-fold increase in mortality [5]. No patient in our series developed postprocedural nephropathy. Both the average amount of contrast agent and the fluoroscopy time were significantly lower in the second half of our experience compared with the first half. Although herein we still do not present the results of a ‘fully echo’ approach, the present experience indicates the feasibility of progressing towards a transcatheter valve implantation procedure guided by echocardiography alone. As such, the average contrast medium administered in our global population appeared lower than reported in previous series of angiography-guided transcatheter valve implantation [6].

The present experience indicates that it is feasible to guide the TAO-TAVI procedure with intraprocedural transoesophageal echocardiography. High-resolution images need to be obtained in order to precisely delineate the anatomical landmarks and the position of the device being deployed. The coupling of these two strategies may determine a significant reduction of complications, namely stroke and renal insufficiency. Prospective comparison studies vs alternative access for TAVI are advised. Finally, the decision of the optimal strategy of access in individual cases may be useful to minimize the access-related complications. Such an approach will facilitate early recovery and clinical success in these elderly and frail patients.

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Conflict of interest: none declared.

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