EDITORIAL COMMENT

Transcatheter Pulmonary Valve Prosthesis and Pregnancy

Stable Hemodynamics and No Valve-Related Adverse Events*

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In many parts of the world, adults outnumber children with congenital heart disease (CHD), and subsequently, an increasing number of people with CHD are reaching childbearing age. Right ventricular outflow tract (RVOT) and pulmonary valve pathology occurs in 20% of CHD, and frequently requires reintervention after initial repair, including pulmonary valve replacement (PVR) (1). Transcatheter pulmonary valve replacement (TPVR) has established itself as a viable alternative to surgical pulmonary valve replacement (SPVR); it has been used increasingly over the past decade, mainly in patients with a history of previous SPVR, but recently patients with a native RVOT have been found to also often benefit from TPVR. Compared to SPVR, TPVR is less invasive, is associated with shorter recovery time, and offers similar hemodynamic results in cases matched for prosthesis size (2). Yet, there are reports suggestive of accelerated degeneration and higher endocarditis rate in TPVR compared with SPRV, although randomized studies confirming these observations are lacking.

There are many women under follow-up in tertiary adult congenital heart disease (ACHD) centers who are of childbearing age and have significant pulmonary valve dysfunction. If contemplating pregnancy, both the patient and her ACHD physician are faced with a dilemma: whether or not to proceed to PVR prior to pregnancy. Comprehensive pre-pregnancy risk assessment and counseling is pivotal. It needs to be a staged process, designed to assess residual hemodynamic lesions that confer a risk to the mother and baby (3). The decision to offer PVR or to defer it and proceed to pregnancy is often challenging. Evidence of how patients with right-sided valve replacement, including TPVRs, tolerate the hemodynamic burden of pregnancy is scarce, as are data on maternal and neonatal outcomes in this patient group (4). Offering PVR prior to pregnancy may be tempting in many cases. Yet, studies on the impact of pregnancy on valve function after TPVR are scarce as well, and the possibility of accelerated degeneration of pulmonary prothesis during pregnancy remains a concern. In this issue of *JACC: Case Reports*, Duarte et al. (5) present results from 9 pregnancies in 7 women with CHD, who have undergone TPVR prior to pregnancy. They report the effect of pregnancy on valve hemodynamics, assessed by echocardiography, and report on maternal cardiac and obstetric and neonatal outcomes. This is the largest case series to date focusing on women with CHD and well-functioning TPVR valve undergoing pregnancy. Overall, the findings are reassuring. There were no instances of cardiac complications, and pulmonary valve prosthesis function did not deteriorate. Only a single pregnancy ended in an unplanned Cesarean section for failure of progression of labor, and the majority underwent successful vaginal delivery. The

rate of pre-term labor, however, was high, affecting one-third of the pregnancies.

This study sheds some light on the safety of pregnancy in women with a history of TPVR. The small increase in the peak gradient across the pulmonary valve in the third trimester is attributable to the hemodynamic changes of late pregnancy: a 30% to 50% increase in cardiac output compounds a falling pulmonary vascular resistance, causing higher measured gradients across the pulmonary valve prosthesis. Post-partum, the gradients returned to pre-pregnancy levels, supporting a reversible phenomenon rather than valve degeneration. Data on longer-term performance and durability of TPVR prostheses following pregnancy are lacking, but the median age of prostheses in this study was 4.4 years at the time of delivery, providing a reassuring signal of good mid-term valve durability. This information should be combined with results from other studies to inform pre-pregnancy risk stratification and counseling of patients, but like many small registry studies, several unanswered questions remain.

The timing of RVOT interventions pre-pregnancy to mitigate the risk from dysfunctional pulmonary valves or unrepaired RVOT disease is a central issue in the management of women with CHD, who are planning for a future pregnancy. The question of pre-pregnancy–specific cut-offs has been in particular studied in repaired tetralogy of Fallot (ToF), one of the major groups benefiting from TPVR. The presence of severe pulmonary regurgitation in ToF has recently been shown to be associated with lower birthweight infants (6). There is no consensus for safe, pre-pregnancy right ventricular volumes, although the risk of progression of RV dilatation may be greater in those with a right ventricular end-diastolic volume of >152 ml/m^2 (7,8). In the absence of robust cut-offs specific to pre-pregnancy, established guidelines for intervention should be used. Certainly, individually tailored pre-pregnancy risk assessment is needed to drive multidisciplinary team discussions about intervention and to inform pre-pregnancy counselling. During such discussions, the use of transcutaneous versus surgical PVR needs to be decided.

The considerations that drive the decision of whether to offer an SPVR or TPVR are evolving as the technology advances. Currently, in many tertiary ACHD centers, SPVR is favored in native RVOTs, in patched RVOTs with unfavorable dimensions, if coronary arteries are at risk of compression during TPVR, and when an additional surgical procedure is required. TPVRs, initially used mainly in bioprostheses or right ventricle-to-pulmonary artery conduits, are being used more frequently in native or patched RVOTs. New TPVR valves are available in larger sizes and are, therefore, expanding the range of RVOTs that can be intervened on. Moreover, reducers for large RVOT, which enable future TPVR, are currently being tested. Although there are more data on the performance and durability of SPVRs in pregnancy, there is no solid evidence to suggest that they should be preferred over TPVRs when performing an intervention prior to pregnancy (9). Avoidance of sternotomy and cardiopulmonary bypass is an obvious advantage, which confers a shorter recovery and may be preferred by many patients who are in the planning phase of pregnancy.

Identification of residual hemodynamic lesions should happen prior to pregnancy when possible. Hence, it is important that routine tests are updated within a year of a planned pregnancy, and the question asked as to whether a residual hemodynamic lesion should be intervened on. Moreover, not all pregnancies are planned, and it is not a rare occurrence for a patient to present to the ACHD clinic already pregnant with significant pulmonary valve dysfunction. This situation requires careful, multidisciplinary assessment in a dedicated pregnancy heart clinic, with involvement of an ACHD specialist. Noninvasive assessment, including the measurement of valve gradients and right ventricular size and function, is essential. Cardiovascular magnetic resonance imaging, without gadolinium contrast, may be considered in selected individuals for further assessment of chamber volumes, function, and anatomic characterization. Right heart catheterization, with strict limitation of fluoroscopy and abdominal shielding, may be used to confirm any significant rise in echocardiographic gradients, although it is rarely needed. Whenever possible, any intervention needs to be delayed until the postpartum period, with continuous close monitoring and an appropriate delivery plan. After pregnancy, a full reassessment should be undertaken in the CHD clinic, including measurement of valve gradients and chamber volumes.

In conclusion, the study by Duarte et al. (5) is indeed reassuring and shows that pregnancy in women with well-functioning TPVR is well tolerated by the mother, although the underlying CHD may predispose to slow fetal growth and pre-term labor. Expert led pre-conception risk stratification, counseling and involvement of a pregnancy heart team remain integral to safe management (10). As TPVR becomes even more prevalent in the management of pulmonary valve dysfunction, greater

numbers of women with TPVRs will undergo pregnancies. International collaboration through prospective registries is essential to build up robust safety data in this population and to support interventional decisions in this growing patient group.

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