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When Valve-In-Valve Implantation Is Not Sufficient: Bioprosthetic Russian Dolls

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Valve-In-Valve-In-Valve Replacement describes successful short-term clinical result for challenging future problem. Nationally, bioprostheses are increasingly used over mechanical valves in surgical aortic valve replacements (SAVR), particularly in younger population, due to patient preference and transcatheter aortic valve replacement (TAVR) with idea of future valve-in-valve (VIV) implantation(1). Since younger age at initial surgery carries greater likelihood of valve degeneration, structural valve deterioration (SVD) will become more prevalent(2). While reoperative SAVR carries low mortality (4.6%), in patients from Society of Thoracic Surgeons database (average 66 years) (3), VIV has been used in older patients (average 78 years) with acceptable 30-day mortality, 7.6%(4), but can lead to suboptimal results from elevated gradients. The first challenge in determining appropriateness of VIV is whether elevated gradients are due to patient-prosthesis mismatch (PPM) or SVD. PPM cannot be corrected but may be worsened by VIV(5); and is best treated with reoperation if possible. The second challenge is whether SVD due to stenosis, is related to subclinical leaflet thrombosis recently reported for TAVR (6). Reduced leaflet motion was demonstrated by computed tomography without short-term consequences by echocardiography; however, such thrombosis may eventually lead to leaflet stiffening and elevated gradients with clinical SVD. Anticoagulation reduced thrombus formation. VIV may be at greater risk for thrombosis than either TAVR or SAVR, since stasis predisposes to clotting. VIV displaces bioprosthetic leaflets to their stent, creating cylindrical wall within which TAVR sits. TAVR itself has stent base covered with dacron, and leaflets enclosed within circumferential stent. Sinus blood flow cannot immediately wash over TAVR leaflets. Instead, blood flow must traverse past wall of surgical bioprosthetic leaflets, through open stent TAVR cells to reach the leaflets; meanwhile TAVR base enclosed by Dacron without interstices prevents blood egress. As such, stasis is likely more with VIV and VIV should be considered for anticoagulation to prevent future thrombosis, restricted leaflet motion, and potential early SVD. In this patient, whether initiating trial of anticoagulation late when SVD was diagnosed, could improve leaflet mobility is unknown, but worthwhile debating. The third challenge relates to surgical bioprosthesis size, where smaller size leads to greater likelihood of developing VIV PPM(7). We previously demonstrated the inadequacy of gradient reduction in small-

sized surgical bioprostheses(8) and the potential to improve gradients with either smaller 20mm TAVR(9) or supraaortic VIV placement(10). In this case report, use of 20mm SapienXT or supraannular 23mm CoreValve for initial VIV may potentially have prevented second VIV requirement. Nonetheless, successful clinical result was achieved with valve-in-valve-in-valve by high CoreValve implantation supraaorticly, to maximize inflow within surgical bioprosthesis and VIVs, and situate TAVR leaflets above prior implants(5, 10). While short-term results were acceptable, longer-term follow-up is necessary to determine whether Russian Doll VIV will maintain acceptable, though not ideal, gradients. In summary, VIV implantation can effectively treat high-risk and inoperable patients with failed surgical bioprostheses, but requires close attention to appropriate diagnosis, concern for reduced leaflet motion with potential for early SVD, surgical bioprosthesis size to avoid PPM, and depth of VIV to optimize hemodynamics.

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