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RESEARCH CORRESPONDENCE

Preliminary Evaluation of a Novel Polymeric Valve Following Surgical Implantation for Symptomatic Aortic Valve Disease

Valvular heart disease and the requirement for heart valve replacement are increasing. Prolonged durability and larger effective orifice areas (EOAs) make mechanical valves more suitable for younger patients who have less risk for bleeding, whereas bioprosthetic valves with smaller EOAs may be preferable for elderly patients despite limited durability. Approximately 80% of recently implanted valves are bioprosthetic despite the limitation of structural valve deterioration, which is more common in younger patients. As polymer properties can be controlled and the geometry of polymer valve leaflets intentionally designed to ensure physiological function, various polymers have been evaluated as candidates for valve leaflet material. A recently developed biomedical-grade siloxane-based polyurethane-urea (TRIA LifePolymer [LP], Foldax USA) has undergone extensive in vitro and in vivo evaluation (1,2). The aortic valve has 3 flexible LP leaflets solution-cast onto a radiovisible polyether-ether ketone stent with a polytetrafluoroethylene felt sewing ring (**Figure 1**). The automated robotic manufacturing process is highly precise and consistently ensures tolerances within micrometers for critical measurements such as leaflet thickness. The valve is provided in a dry state that requires no preparation prior to implantation.

We report the first human experience, early feasibility study (EFS) with the TRIA LP heart valve in patients undergoing surgical aortic valve replacement.

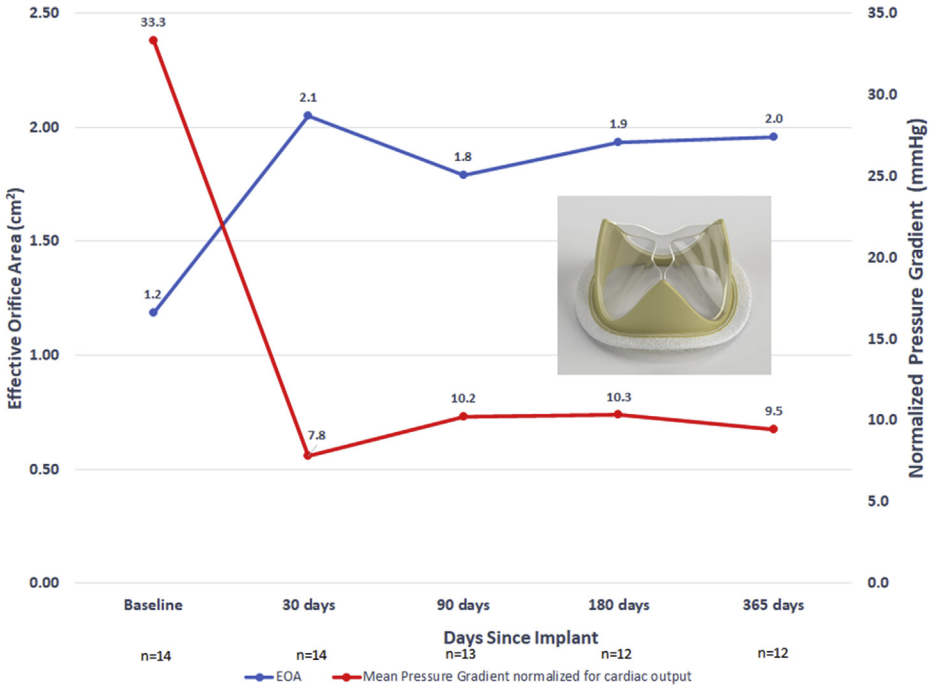
This prospective, single-arm EFS of isolated surgical aortic valve replacement in patients with symptomatic aortic valve disease (stenosis and/or regurgitation), designed to provide safety and performance information on the TRIA heart valve, enrolled 15 subjects at 5 participating centers. The protocol and consent were approved by the ethics committees of participating institutions, and all subjects provided written informed consent prior to participation. Subjects were assessed at 30, 90, 180, and 365 days and annually thereafter for 5 years. The primary clinical effectiveness endpoints included improvement in EOA and clinically significant improvement (1 grade) in New York Heart Association (NYHA) functional class at 1 year after valve implantation. Primary safety endpoints included thromboembolic events, major hemorrhage, all-cause and valve-related death, and other valve-related events (reoperation, endocarditis, explantation). All primary and secondary clinical endpoints were adjudicated by an independent clinical events committee, and echocardiographic studies were interpreted by an independent echocardiographic core laboratory.

Between July 2019 and March 2020, 15 patients (14 men, mean age 60.7 ± 7.2 years [range: 45-71 years], mean body mass index 32.9 ± 6.4 kg/m^2 [range: 25.8-47.9 kg/m^2], mean Society of Thoracic Surgeons Predicted Risk of Mortality score 1.39% ± 2.19% [range: 0.35%-9.08%]) were enrolled.

One patient was withdrawn intraoperatively for valvular regurgitation due to commissural post deflection from a low and narrow sinotubular junction (root enlargement procedures were prohibited by protocol) not related to intrinsic valve dysfunction, and a tissue valve was implanted. Anticoagulation with warfarin was initiated postoperatively, with a target international normalized ratio of 2.0 to 2.5, and was continued for 6 weeks with transition to aspirin 75 to 100 mg/d as tolerated.

There were 2 deaths (postoperative days 60 and 90) unrelated to the valve or procedure (1 bleeding from elective surgery to remove a renal tumor, 1 hemodynamic collapse and cardiac arrest due to possible pulmonary embolus after warfarin discontinuation in a morbidly obese subject [body mass index 48.1 kg/m^2] with normal valve function on

FIGURE 1 **TRIA LifePolymer Heart Valve and Hemodynamic Performance Through 1 Year**



Effective orifice areas (EOAs) and transvalvular pressure gradients at specific time points.

echocardiography) and 1 lacunar stroke on postoperative day 172. One patient had acute myocardial infarction 92 days postoperatively from thrombotic obstruction of the right coronary artery. Cardiac computed tomography demonstrated thrombus possibly involving the valve sewing ring. A stent was implanted in the right coronary artery, and anticoagulation with dual-antiplatelet therapy plus warfarin for 6 months was prescribed. Repeat cardiac computed tomography 3 months after stopping warfarin demonstrated no residual thrombus.

NYHA functional class was improved and sustained to 1 year (66.7% in functional class I at 1 year vs 33.3% at baseline). Mean pressure gradients normalized for cardiac output and valve EOA were improved postoperatively and to 1 year in all patients (**Figure 1**).

Both primary effectiveness endpoints were achieved. Improvement in EOA and mean pressure gradient were accompanied by improvement in NYHA functional class, with no patient remaining in functional class III or IV at 1 year.

The mechanism(s) for optimized TRIA LP valve hemodynamic status include site-specific (aortic or mitral) computational leaflet and stent designs that closely mimic the natural valves (1,2). In the aortic position, this includes linear closure plane of 3 leaflets, diastolic inward flexion of commissural posts, and the low elastic modulus of LP (1-3). Excellent hemocompatibility of the TRIA valve and LP leaflets has been demonstrated in 2 large animal models (1). These preclinical observations support the premise of durable hemodynamic benefit without acquired valve leaflet dysfunction.

This EFS was limited by a small sample size and a lack of necropsy evaluation in the patient who died following hemodynamic collapse. The relatively low risk population and protocol exclusion of concomitant procedures, (root enlargement or coronary bypass surgery) limit extrapolation of these results to a general surgical population.

The TRIA LP valve demonstrates marked and sustained improvements in transvalvular gradients, valve EOA, and NYHA functional class to 1 year following valve implantation. Safety outcome measures appear comparable with those reported for bioprosthetic heart valves. This EFS warrants further large-scale clinical trial evaluation of the TRIA LP heart valve.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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