

Case report

Aortic annular enlargement using the Yang technique: the first reported case in the Peruvian Ministry of Health

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ABSTRACT

Prosthesis-patient mismatch (PPM) remains an important limitation in patients with a small aortic annulus undergoing surgical aortic valve replacement. The Yang technique (Y-incision) has recently emerged as an effective alternative for achieving greater aortic annular enlargement while maintaining favorable perioperative outcomes. We report the first case of aortic annular enlargement using the Yang technique performed at our institution in a 56-year-old woman with symptomatic severe aortic stenosis and a small aortic annulus. Intraoperative evaluation revealed a 19-mm aortic annulus. After enlargement via a Y-incision and reconstruction with a bovine pericardial patch, a 23-mm mechanical prosthesis was successfully implanted without perioperative complications. Postoperative echocardiography demonstrated adequate prosthetic function, with a significant reduction in transvalvular gradients. Our initial experience suggests that the Yang technique is a safe, reproducible, and feasible option for centers introducing this procedure into their surgical practice. Although limited to a single case, the favorable outcome has encouraged our team to continue performing this technique in carefully selected patients.

Keywords: Aortic Valve; Aortic Root; Cardiac Surgery (Source: MeSH-NLM).

RESUMEN

Ampliación del anillo aórtico mediante la técnica de Yang: primer caso descrito en el Ministerio de Salud de Perú

La incompatibilidad entre la prótesis y el paciente (PPM) sigue siendo una limitación importante en pacientes con un anillo aórtico pequeño sometidos a sustitución quirúrgica de la válvula aórtica. La técnica de Yang (incisión en Y) se ha impuesto recientemente como una alternativa eficaz para lograr una mayor ampliación del anillo aórtico, al tiempo que se mantienen unos resultados perioperatorios favorables. Presentamos el primer caso de ampliación del anillo aórtico mediante la técnica de Yang realizada en nuestro centro en una mujer de 56 años con estenosis aórtica grave sintomática y un anillo aórtico pequeño. La evaluación intraoperatoria reveló un anillo aórtico de 19mm. Tras el ensanchamiento mediante una incisión en Y y la reconstrucción con un parche de pericardio bovino, se implantó con éxito una prótesis mecánica de 23 mm sin complicaciones perioperatorias. La ecocardiografía posoperatoria demostró un funcionamiento adecuado de la prótesis, con una reducción significativa de los gradientes transvalvulares. Nuestra experiencia inicial sugiere que la técnica de Yang es una opción segura, reproducible y viable para los centros que incorporen este procedimiento a su práctica quirúrgica. Aunque se limita a un único caso, el resultado favorable ha animado a nuestro equipo a seguir aplicando esta técnica en pacientes cuidadosamente seleccionados.

Palabras clave: Válvula Aórtica; Raíz Aórtica; Cirugía Cardíaca (Fuente: DeCS-BIREME).

Introduction

Aortic valve replacement is one of the most frequently performed cardiac surgeries; according to Peruvian statistics, it accounts for 23.6% of cases involving isolated aortic valve replacement ⁽¹⁾. The choice of prosthesis size is based on annulus size; therefore, a safe and reproducible annular enlargement technique is the ideal treatment to prevent prosthesis-patient mismatch, which is associated with a worse clinical prognosis and lower survival ⁽²⁾. The classic enlargement techniques (Nicks, Manouguian) remain the most widely used, having been performed since 1970 ⁽³⁾. Since 2020, the Yang technique has begun to be performed. It has demonstrated similar short-term mortality and morbidity compared with previous techniques but has also shown a greater increase in the effective orifice area of the prosthesis, as the Yang technique allows the implantation of larger prostheses. The Yang technique is based on a Y-shaped incision in the aortomitral curtain and the placement of a rectangular patch at the same site to achieve enlargement of the aortic annulus and root, with an incision extending through the adjacent coronary sinuses and the fibrous structures of the left ventricular outflow tract.

Case report

We present the case of a 56-year-old female patient with a history of controlled arterial hypertension, atrial fibrillation, and treated hypothyroidism, who, for the previous 4 years, had experienced palpitations, with precordial pain and grade II dyspnea developing approximately 1 year earlier. Body mass index was 26.2 kg/m² (weight 56 kg, height 1.46 m), and left ventricular ejection fraction (LVEF) was 70%, with severe aortic stenosis on transthoracic echocardiography: peak velocity 4.4 m/s, mean gradient 45.6 mmHg, and effective valve area 0.77 cm²; the aortic annulus measured 21 mm on transesophageal

echocardiography. Angio-CT measured the AV annulus at 21 mm (**Fig. 1A–D**). The patient was admitted to the operating room hemodynamically stable.

Intraoperative findings revealed an aortic annulus of 19 mm, which did not permit the placement of at least a No. 21 valve, the size indicated by the patient's BMI. Because conventional techniques can enlarge the aortic annulus by at most 1 to 2 sizes, adequate valve placement for this patient could not be guaranteed; the surgical team, therefore, decided to perform the first Yang technique enlargement at our institution.

Surgical technique

A median sternotomy was performed, and cardiopulmonary bypass was established using standard aortic and bicaval cannulation. Following aortic cross-clamping, Custodiol® (HTK) solution was administered for myocardial protection. An oblique aortotomy was performed, and the incision was extended in a Y-shaped fashion into the left and non-coronary sinuses. The fibrous portion of the aortic annulus was partially divided to allow for annular enlargement. A bovine pericardial patch was used because Dacron patches are not routinely available in our institution. Previous reports by Li *et al.* (2025) and Paredes-Acevedo *et al.* (2024) have demonstrated successful outcomes with bovine pericardium, supporting its use as a feasible alternative, particularly in resource-limited settings. The patch was then sutured to reconstruct and enlarge the aortic root according to the Yang technique. Valve sizing was subsequently performed using No. 21 and No. 23 sizers, with the No. 23 sizer providing the best fit after annular enlargement. A 23-mm Medtronic Open Pivot™ bileaflet mechanical prosthesis was then implanted using the standard technique. The pericardial patch was subsequently trimmed into a triangular configuration to achieve an appropriate anatomical fit and was incorporated into the closure of the aortotomy. The prosthetic valve demonstrated satisfactory seating and leaflet mobility on direct inspection, and the

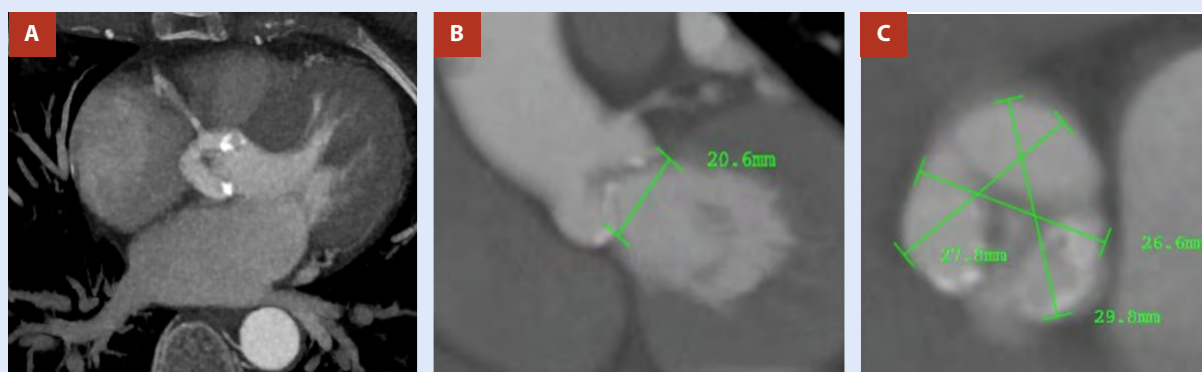


Figure 1. A. Preoperative CT imaging revealing severe aortic annular calcification. B. Aortic annular dimensions measured by CT. C. Intersinus dimensions assessed by CT.

patient was successfully weaned from cardiopulmonary bypass without difficulty. Our patient had a cardiopulmonary bypass (CPB) time of 3 hours and 5 minutes and an aortic cross-clamp time of 2 hours and 47 minutes⁽³⁻⁹⁾ (**Fig. 2A–C**).

We use a bovine pericardial patch because, in our institution, we do not have a Dacron patch; the Dacron patch is more expensive, and we do not have many resources. Additionally, there are successful cases that use a pericardial patch. Jiao Li reported five successful cases, and there is a Peruvian case with a successful pericardial patch.

Follow-up

Recent studies have shown that the Yang technique allows safe enlargement of 2 to 4 valve sizes, significantly reducing the risk of PPM.

In the first enlargement performed with the Yang technique at our center, a 3-size enlargement of the aortic annulus was achieved without perioperative complications and with good short-term outcomes. The ICU stay was 5 days, prolonged by delayed extubation due to congestion and signs of hospital-acquired pneumonia, which were subsequently ruled out; total hospitalization was 7 days. The postoperative echocardiogram reported a normally seated, normally functioning mechanical aortic prosthesis, demonstrating a significant reduction in mean transvalvular aortic gradient to 20 mmHg, a peak velocity of 3.5 m/s, and an effective aortic area of 1.25 cm², with LVEF at 58%. The patient currently has 45 days of postoperative follow-up, with no adverse events, and continues outpatient monitoring.

Discussion

The Yang technique is a novel, reproducible procedure across different centers, including our own; it carries a low rate of mortality and morbidity compared with previous techniques and demonstrates a considerable capacity to achieve substantial annular enlargement—particularly relevant in our country, where many patients present with small aortic annuli requiring enlargement for a better hemodynamic outcome of the prosthesis.

Recent evidence supports the safety and efficacy of this technique, along with hemodynamic improvement on echocardiographic follow-up after the implantation of larger prostheses. However, it remains unclear whether this hemodynamic improvement translates into lower mortality or better long-term patient outcomes.

It is also worth noting that the use of larger bioprosthetic valves, made possible by Yang enlargement, may offer an advantage should future valve-in-valve TAVR be required, as the pre-existing prosthetic valve would be more likely to retain a favorable effective area.

Long-term studies are still needed to assess the impact on quality of life, changes in cardiac structure, and additional clinical outcomes.

Authors' contributions

EC, MV: conceptualization, methodology, data curation, writing- original draft preparation. **SG:** supervision, validation, project administration, writing – review & editing.

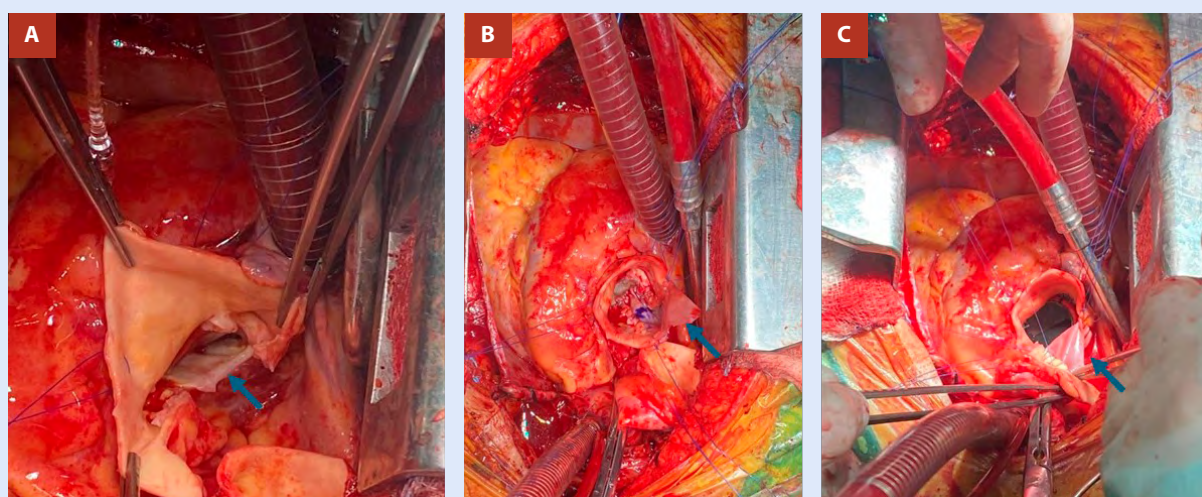


Figure 2. **A.** Extended aortotomy through the commissure between the left coronary and noncoronary sinuses, extending below the aortic annulus to create the characteristic Y-shaped incision (arrow). **B,C.** Reconstruction using a bovine pericardial patch, with suturing performed from the distal edges toward the proximal aspect of the Y incision (arrow).

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