Valve performance classification in 630 subcoronary Ross patients over 22 years

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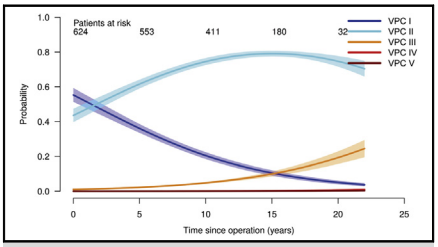
ABSTRACT

Objective: To define the function of the ''Ross valves'' and its clinical meaning in a practical valve performance classification as part of the outcome analysis.

Methods: From 1994 to 2017, 630 consecutive patients underwent the subcoronary Ross procedure at our institution. The valve performance classification combines hemodynamics, symptoms, and management criteria. Median follow-up was 12.5 years (maximum 22.3 years, 7404 patient-years, 99.4% completeness).

Results: The mean age of the patients was 44.7 ± 11.9 years. Hospital deaths was 0.3% (n = 2). Twenty years after the operation survival was 73.1% (95% confidence interval [CI], 65.4%-81.6%) and statistically not different from the age- and gender-matched general population; freedom from reoperation was 85.9% (95% CI, 80.2%-92.0%; 0.6% per patient-year), 89.8% (95% CI, 84.3%-95.7%) for autograft, and 91.0% (95% CI, 86.3%-96.0%) for homograft. Preoperative annulus diameter, aortic regurgitation, annulus reinforcement, sinotubular junction reinforcement, and bicuspid aortic valve type were no significant risk factors for reoperation. At 20 years the probability of a patient being in valve performance class I to IV was 5%, 74%, 19%, and 1%, respectively. Time to reoperation was not different in bicuspid and tricuspid aortic valves; preoperative aortic stenosis tended to have better outcome of autograft function.

Conclusions: These up to 22 years data show that the subcoronary Ross procedure continues to provide an excellent tissue aortic valve replacement. The suggested valve performance classification emerged as a practical concept for outcome analysis with the probability of 79% being in the favorable class I or II at 20 years. (J Thorac Cardiovasc Surg 2018;■:1-8)



Valve performance classes over time after the subcoronary Ross procedure.

Central Message

Up to 22 years the subcoronary Ross procedure provides excellent results. A valve performance classification emerged as a practical concept for outcome analysis.

Perspective

The presented valve performance classification might surface as a practical tool to analyze different Ross techniques and other valve substitutes. The subcoronary Ross technique includes the native aortic root as a natural dynamic external reinforcement with favorable effects on preventing root dilatation and potentially preserving autograft function, a principle that needs further evaluation.

ADULT

Life after replacement of the aortic valve is still subjected to certain prosthesis-related shortcomings. Several replacement substitutes are available for different patient conditions. For decision-making, detailed information on survival, valve performance, and adverse events is essential. These 3 components mainly influence clinical status and quality of life or life satisfaction. Grading of valve hemodynamics from normal function, over different degrees of dysfunction to reoperation and combining it with symptoms and management allows for creating a valve performance classification (VPC). More recently echocardiographic associations have defined several levels of valve function concerning stenosis and regurgitation,[1,2] paving the way for our new VPC that combines grading of valve function with valve-related symptoms and management according to recent guidelines.[3] This VPC has the aim to provide a practical and lucid tool for a more differentiated judgement of the Ross and other surgical valve procedures, for better scientific and clinical communication and more detailed information.

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Scanning this QR code will take you to the supplemental video, figure, and tables for the article.

Abbreviations and Acronyms
BAV = bicuspid aortic valve
CI = confidence interval
VPC = valve performance classification

The Ross procedure is the only aortic valve replacement method using autologous, living semilunar valve tissue, and as such has a promising potential for a permanent near physiological valve replacement. There is now clinical evidence that the Ross procedure in the young and middle-aged patients is associated with excellent outcome.[4-10] Long-term results are growing for the freestanding or inclusion technique[11-13] but are scarce for the original subcoronary technique. Furthermore, there is a lack of a practical VPC for comparison between different techniques and substitutes. Therefore we introduced a new VPC as part of the overall outcome evaluation in 630 consecutive Ross patients using the subcoronary technique over the past 22 years.

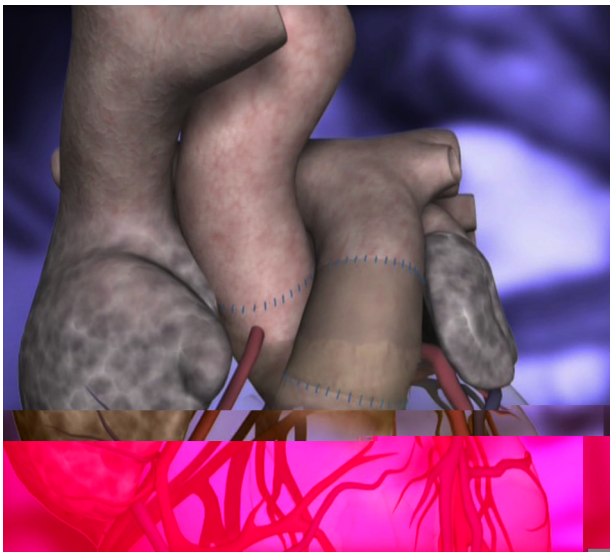
METHODS

Patients

Six hundred thirty subcoronary Ross patients were consecutively operated on between June 1994 and January 2017 in the Department of Cardiac and Thoracic Vascular Surgery of the University Medical Center Schleswig-Holstein, Campus Lübeck (Lübeck, Germany) and were included in the study. Thirty-three patients who received surgery with the root inclusion technique were included in the study group because there was no difference between the root inclusion technique and the subcoronary technique in former studies.[8,14,15] The indication for the aortic valve operation and reoperation was in accordance with the American Heart Association/American College of Cardiology guidelines.[16] These Ross patients constitute a selected patient group because patients with significantly reduced left ventricular function, coronary artery disease in more than 1 vessel, connective tissue disorders and active rheumatic disease, severe deformation of the aortic root, and pulmonary valve abnormalities or uncontrolled hypertension were exclusion criteria for the Ross procedure. Four hundred eighty-four patients with bicuspid aortic valve (BAV) of the different types[17] were included. The postoperative medication consisted of clopidogrel 75 mg/d for 3 months and ibuprofen 400 mg/d for 5 weeks and lifelong blood pressure regulation.

Surgical Technique

The surgical technique (Video 1) has been described in detail previously.[18] In brief: standard cardiopulmonary bypass and moderate systemic hypothermia of 28°C was performed. After crystalloid cardioplegia in the first years, blood cardioplegia at 20-minute intervals has been used in the past 15 years. The proximal autograft anastomosis was performed using a single suture technique (4/0 multifilament suture). The sinus suture was performed continuously with 5/0 prolene and additionally 5/0 prolene U-stitch was used to fix the commissures to the aortic wall of the patient. The sinus wall directed to the noncoronary sinus of the patient was left in toto. In BAV type 1 and 2 the autograft implantation technique was similar to that for the tricuspid valves, because in those BAV types there are 3 sinuses and 3 commissures.[17] The geometry of the autograft, which was in these cases often somewhat asymmetrical was adapted to the aortic root anatomy, meaning that the largest sinus of the autograft was placed in the largest sinus of the aortic root mostly the noncoronary artery. In type 0 BAV, a new commissure for the autograft was created between the 180° coronary orifices, normally on the left lateral aortic root aspect and the other commissures of the autograft were fixed on the right site of the root and coronary ostia so that the autograft geometry was preserved as much as possible. The homograft was implanted distally and proximally with 5/0 prolene continuously. The ascending aorta was replaced or reduced in sized by aortoplasty as described recently.[19]



VIDEO 1. The subcoronary Ross procedure.

Follow-up

The study was approved by the local ethics committee (Clinical Trials ID: NCT00708409). Follow-up was performed on an annual basis using standard echocardiography and clinical evaluation.[8,20,21] The median follow-up time was 12.5 years (95% confidence interval [CI], 11.9-13.1 years, range 0-22.3 years, 7404 patient-years, follow-up completeness, 99.4%). Patient demographic characteristics and preoperative and operative data are shown in Table 1 and Table E1. A total of 7201 clinical follow-up visits were performed, 6668 of these included echocardiographic examination. The completeness of echocardiographic follow-up is depicted in Table E2.

Valve Performance Classification

The VPC is shown in Table 2. Current echocardiographic recommendations were used for the grading of valve stenosis[2] and regurgitation severity.[1] Furthermore, the presence of symptoms was included. In an individual patient the worst single hemodynamic parameter regardless of whether it was related to homograft or autograft determined the VPC. The clinical relevance or management was adapted from the 2017 European Society of Cardiology and European Association for Cardio-Thoracic Surgery guidelines for the management of valvular heart disease.[3]

Statistical Analysis

The data were expressed as absolute and relative frequencies in nominal and ordinal data and as mean ± SD in continuous data. Median follow-up time was calculated using the reverse Kaplan–Meier approach and the follow-up completeness using the method of Clark and colleagues.[22] The probability of survival and freedom from reoperation were calculated using the Kaplan–Meier method. The long-term survival was compared