ANESTHETIC CONSIDERATION OF PERCUTANEOUS AORTIC VALVE REPLACEMENT

ESSAY

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By

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Abstract

In this evaluation process patients are stratified by the most popular scoring systems used in screening patients for possible TC-AVI are the European System for Cardiac Operative Risk Evaluation (EuroSCORE).

The anesthesiologist plays a fundamental role in this new environment, with important considerations preoperatively, intraoperatively , and postoperatively. the anesthetic considerations for each of these 3 phases of TC-AVI are imoportant because the entire perioperative management for TC-AVI requires substantial changes in comparison with the anesthetic management for conventional aortic valve replacement.

Key word: TC-AVI -anesthesiologis- LVEDV- Ejection Fraction- CABG

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LIST OF ABBREVIATIONS

AS	Aortic Stenosis
AVI	Aortic Valve Implantation
AVR	Aortic Valve Replacement
BAV	Ballon Aortic Valvoplasty
CABG	Coronary Artery Bypass Graft
CO	Cardiac Output
CPB	Cardio Pulmonary Bypass
EF	Ejection Fraction
GA	General Anesthesia
HR	Heart Rate
ICU	Intensive Care Unit
IV	Intra Venous
LV	Left Ventricular
LVEDP	Left Ventricular End Diastolic Pressure
LVEDV	Left Ventricular End Diastolic Volume
LVEF	Left Ventricular Ejection fraction
NICE	National Institute of health and Clinical Experience
RV	Right Ventricle
RVP	Right Ventricular Pressure
SB	Stand By
SV	Stroke Volume
SVR	Systemic Vascular Resistance
TAVI	Transcatheter Aortic Valve Implantation

TA-AVI	Trans Apical Aortic Valve Implantation
TC-AVI	Trans-Catheter Aortic Valve Implantation
TF-AVI	Trans Femoral Aortic Valve Implantation
UFH	UnFractionated Heparin
USA	United States of America

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INTRODUCTION

Valve disease is an important public health problem, as it carries a poor prognosis and its prevalence is strongly linked to the phenomenon of population ageing. Balloon aortic valvuloplasty (BAV) is now rarely used, mainly due to its limited long-term efficacy. Transcatheter aortic valve insertion (TAVI) is a new development that potentially offers a number of advantages to patients and healthcare providers .These include the avoidance of sternotomy and cardiopulmonary bypass, and much faster discharge from hospital and return to functional status. [(1)]

These techniques are likely to displace conventional aortic valve replacement even further in the future. The break through development of these aortic valve prostheses was recently achieved and has fundamentally changed the approach to aortic valve replacement in the cardiac operative environment.[(2)]

Early results have shown a significant mortality and morbidity rate, but the majority of procedures to date have been carried out in elderly patients with multiple comorbidities, making comparison with surgical aortic valve replacement inappropriate. Long-term outcomes are not yet known, but randomized controlled trials should allow this procedure and its application to be properly assessed.[(3)]

In addition, the conditions and environment in which TAVI is carried out are substantially different from surgical aortic valve replacement (AVR). Therefore, a team approach is essential to provide a safe and successful service. intra- and postoperative management of patients who could benefit from TAVI is a new challenge.[2] Indeed, these patients are older than those who undergo conventional surgical AVR, they have more comorbidities, and their predicted peri-operative mortality for conventional AVR is very high.[4]

The minimally invasive transcatheter surgery offers a number of potential advantages.Modern design and manufacturing techniques have led to development of anumber of valve prostheses which can be compressed or crimped, reducing their size, and allowing delivery to the heart on a catheter through a vascular sheath. Two manufacturers have recently brought such devices to market. The Edwards-sapien valve (Edwards lifesciences Inc,, IR, USA) and the CoreValve Revalving System (Medtronic, MN, USA).[3]

The anesthesiologist plays a fundamental role in this new environment, with important considerations preoperatively, intraoperatively and postoperatively, the perioperative management for TAVI technique require substantial changes in comparison with the anesthetic management for conventional aortic valve replacement.[3]

The anesthetic plan for transfemoral Aortic valve insertion (AVI) includes, General anesthesia (GA,) and sedation with anesthesia standby (SB). General anesthesia may be associated with higher periopeative complications in these high-risk patients. The advantages of anesthesia standby(SB) include continuous neurologic assessment of the awake patient and a fast recovery, which may reduce the length of stay in high dependency unites and in the hospital. Furthermore, the hemodynamic changes during TC-AVI seem to be less in awake patients as compared with patients under GA.[5]

ANATOMY OF THE AORTIC VALVE

1.Aortic Root

Aortic root is the direct continuation of the left ventricular outflow tract. It is located to the right and posterior, relative to the subpulmonary infundibulum, with its posterior margin wedged between the orifice of the mitral valve and the muscular ventricular septum. it extends from the basal attachment of the aortic valvular leaflets within the left ventricle to their peripheral attachment at the level of the sinutubular junction .[6]

Two thirds of the circumference of the lower part of the aortic root is connected to the muscular ventricular septum, with the remaining one third in fibrous continuity with the aortic leaflet of the mitral valve. Its components are the sinuses of valsalva,the fibrous interleaflet triangles, and the valvar leaflets themselves.[6] **(fig 1)**

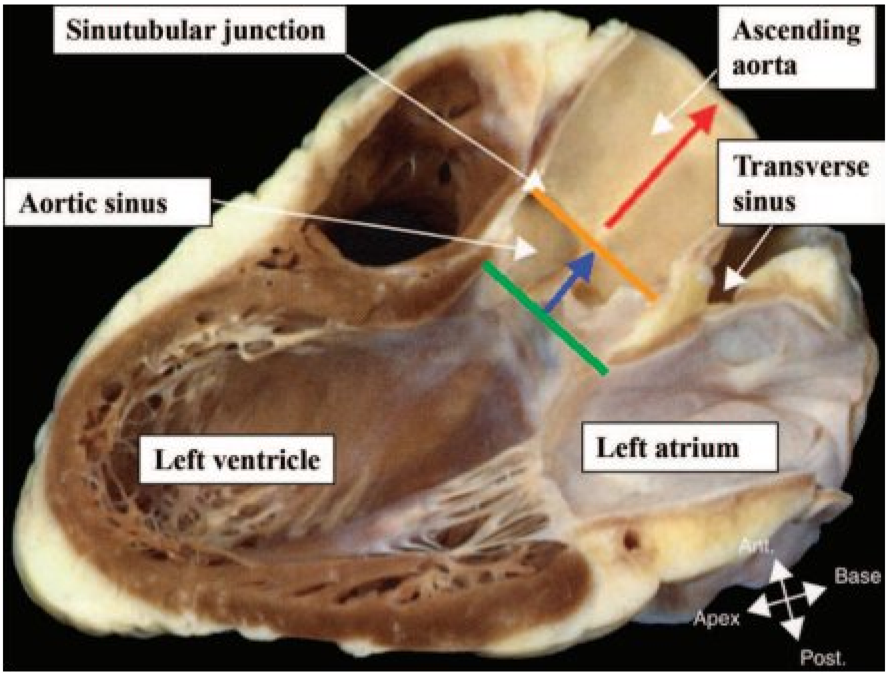

Figure 1. The long-axis view of the left ventricle corresponding with the echocardiographic parasternal long-axis view, demonstrating the extent of the aortic root. AV indicates aortic valve[6]

2-Rings within the aortic root;

An annulus is no more than a little ring. There are several such rings to be found within the aortic root. The annulus defined by surgeon as a semilunar crown like structure demarcated by the hinges of the leaflets. The aortic root contain at least 3 circular rings and 1 crown like ring.

The valvular leaflets are attached throughout the length of the root. The leaflets take the form of 3 pronged coronet, with the hinges from the supporting ventricular structures forming the crown like ring. The base of the crown is a virtual ring formed by joining the basal attachment points of the leaflets within the left ventricle. This plane represents the inlet from the left ventricular outflow tract into the aortic root.[7] **(fig 2)**

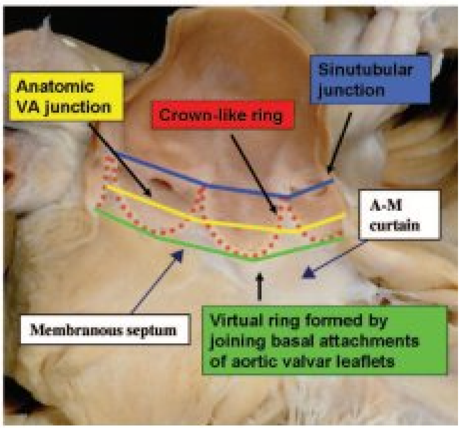

Figure 2, Three-dimensional arrangement of the aortic root, which contains 3 circular "rings," but with the leaflets suspended within the root in crown-like fashion. B, The leaflets have been removed from this specimen of the aortic root, showing the location of the 3 rings relative to the crown-like hinges of the leaflets. VA indicates ventriculoarterial; A-M, aortic-mitral.[7]

The top of the crown is a true ring " the sinutubular junction" demarcated by the sinus ridge, and the related sites of attachments of the peripheral zones of apposition between the aortic valve leaflets. It form the outlet of the aortic root into the ascending aorta . The semilunar hinges then cross another true ring " the anatomic ventriculo-arterial junction. The overall arrangement is well seen when the aortic root is opened subsequent to removal of the valvular leaflets .[7]

This preparation also show that the leaflets arise from the ventricular muscle only over part of their circumference. The larger part of the non-coronary leaflet of the valve, along with part of the left coronary leaflet, is in fibrous continuity with the aortic or anterior leaflet of the mitral valve, with the ends of these area of fibrous continuity being thickened to form the so-called fibrous trigons.

The normal aortic root has a consistent shape with varying size. Measurements of the human aortic root revealed that the diameter at the level of the sinutubular junction exceeds that at the level of the virtual ring which formed by joining together the basal attachments of the leaflets.[(6)]

3-The Aortic Valve

The normal aortic valve is trifoliate . Situated in the left ventricular outflow tract, in the center of the heart close to other cardiac cavities. It consists of the complex of the three semilunar cusps and there adjacent sinuses of valsalva.[(8)]

Terminology of the sinuses is derived from the respective coronary arteries , i.e., right,left, and non coronary. The aortic cusps coapt against each other in the center of the aortic orifice during diastole. The cusps display a mild thickening at the mid point of its edge (nodulus Arantii); whereas near the commissure they are thinner or even contain small fenestrations. Proper functioning of the valve depends on the proper relationship between the leaflets within the aortic root.

The valve doesn't have an anatomically defined annulus. The line of cusp insertion is crown-shaped with the highest point at the connection of the cusps (commisures) and the lowest points (nadir) in the middle between them. The zone between the aortic root with bulging sinuses of valsalva and the straight tubular ascending aorta is called the sino-tubular junction.[8]

4-Relationship Between the Left Ventricular Outflow Tract and the Aortic Root

The left ventricular outflow tract is composed of a muscular component (ie, the muscular ventricular septum) and fibrous component (ie, the area of fibrous continuity between the leaflets of the aortic and mitral valves), with the former being more extensive. The orientation of the outflow tract is known to change with aging. This change in geometry was examined in a series of normal human hearts, comparing findings in individuals aged <20 years with those aged >60 years.[9] **(fig 3)**

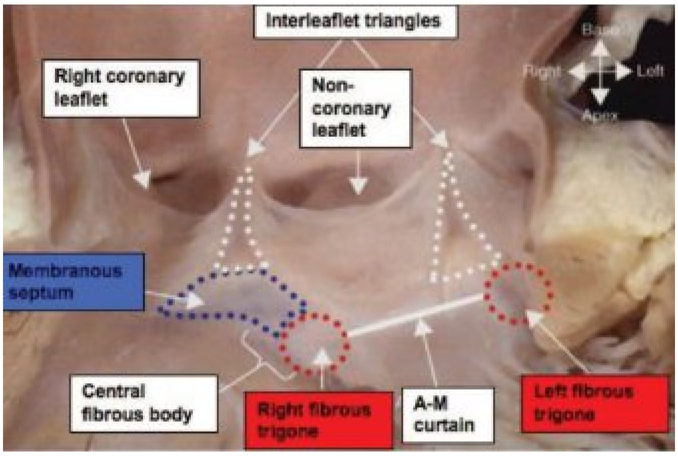

Figure 3. This image of the aortic root opened from the left ventricle shows the fibrous continuities between the interleaflet triangles, the fibrous trigons, and the membranous septum. A-M indicates aortic-mitral.[9]

Examination of the angle between the outlet and apical trabecular parts of the ventricular septum showed significant differences. In hearts from individuals aged >60 years, the angle varied between 90 and 120 degrees. In those from individuals aged <20 years, the angle varied between 135 and 180 degrees. In these younger patients, the left ventricular outflow tract represented a more direct and straight extension into the aortic root.

This would also seem to explain the additional observation that in all of the elderly hearts, the majority of the circumference of the aortic inlet projected to the right of a line drawn through the can infer that, in elderly patients, the left ventricular outflow tract may not extend in straight fashion into the aortic root but rather may show a rightward "dog" leg. The presence of a subaortic septal bulge and an extension of this producing asymmetrical septal hypertrophy may create an obstacle to proper seating of the aortic prosthesis within the left ventricular outflow tract.[(9)]

The presence of a significant subaortic bulge or a hypertrophied septum has been considered by some to be a relative contraindication to the implantation of a certain type of aortic prostheses.[(9)]

5-<u>Relationship Between the Aortic Valve and the Conduction System</u>

Within the right atrium, the atrioventricular node is located within the triangle of Koch. This important triangle is demarcated by the tendon of Todaro, the attachment of the septal leaflet of the tricuspid valve, and the orifice of the coronary sinus. The apex of this triangle is occupied by the atrioventricular component of the membranous septum. The atrioventricular node is located just inferior to the apex of the triangle