Sutureless Aortic Valve Replacement

Essay

Submitted for partial fulfillment of master degree in cardiothoracic surgery

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2016

Acknowledgement

First and foremost, thanks ***God*** the most gracious and merciful.

I would like to express my deep thanks to ***Prof. Dr. Ahmed hassouna*** , **Professor of Cardiothoracic Surgery Faculty of Medicine, Ain shams university** for his generous aid and supervision.

I would like also to express my deep gratitude to Professor ***Prof. Dr. Hani Abd_elmabood,*** **Professor of Cardiothoracic Surgery Faculty of Medicine, Ain shams university** for his support.

I would also like to express my gratitude and respect towards ***Dr. Tamer Hikal*** **Lecturer of Cardiothoracic Surgery Faculty of Medicine, Ain shams University** for his continuous encouragement in completing this work.

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2D echo	Two-dimensional echocardiography
ACC	American college of cardiology
ACT	Activated clotting time
AF	Atrial fibrillation
AHA	American heart association
AR	Aortic regurgitation
AS	Aortic stenosis
AVR	Aortuc valve replacement
CABG	Coronary artery bypass graft
C-AVR	Conventional aortic valve replacement
CE	Confirmatory European
CPB	Cardio pulmonary by pass
CT	Computed tomography
CVA	Cerebro-vascular accident
CVP	Central venous pressure
CWD	Continous wave Doppler
ECC	Extracorporeal circulation
ECG	Electrocardiogram
EF	Ejection fraction
HT	Hypertension
INR	International normalized ratio
IVSSG	International valvular surgery study group
LA	Left atrium
LV	Left ventricle

LVOT	Left ventricle outflow tract
MI	Myocardial infarction
MI-AVR	Minimally invasive aortic valve replacement
MRI	Magnetic resonance imaging
MVR	Mitral valve replacement
NYHA	NewYork Heart Association
PPM	Patient prosthesis mismatch
RVP	Rapid ventricular pacing
STS	Society of thoracic surgery
SU-AVR	Sutureless aortic valve replacement
TAVI	Transcatheter aortic valve implantation
TEE	Trans Esophageal echocardiography
TIA	Transient ischemic attack
TTE	Trans Thoraic Echocardiography
XC	Cross clamp

TYPES AND SURGICAL PROCEDURE OF SUTURELESS AORTIC VALVE

Aortic stenosis is the most frequent valvular cardiac disease in the developed world, accounting for a pooled prevalence of 12.4% in the elderly population [(59)].

The prognosis for symptomatic patients with severe aortic stenosis is dismal, with a one-year mortality of 30-50% [(60)].

Aortic valve replacement (AVR) via median sternotomy approach, using a biological or mechanical prosthesis, has been largely shown to be safe and long-term efficacious, and thus currently represents the "gold-standard" approach for aortic stenosis treatment. [(61)].

Despite excellent outcomes of conventional AVR over the past two decades, this surgical approach has evolved to become less invasive and to expand the boundaries of operability towards elderly patients presenting with multiple comorbidities and higher surgical risk. Firstly, minimally invasive aortic valve replacement (MI-AVR) has been introduced [(62)] and has slowly gained acceptance as a less traumatic alternative compared to median sternotomy [(8)].

However, due to the technical challenges involved and the lack of data showing a substantial survival benefit and a reduced

occurrence of major post-operative complications from MI-AVR over conventional management, this approach has not been universally adopted. The observation that 30% of patients with severe aortic stenosis were not referred because they were deemed inoperable .

Iung [63]**,** has recently triggered the development of newer approaches and technologies, Compared to standard medical therapy, transcatheter aortic valve implantation (TAVI) has shown to provide a 26.8% absolute reduction in mortality at 3-year follow-up in inoperable patients [64]**.**

Smith [65] has demonstrated great potential for high-risk surgical candidates While the uptake and growth for TAVI has been enthusiastic and widespread in Europe and North America, concerns exist surrounding paravalvular leakage, vascular complications, stroke, post-operative Pacemaker implantation due to complete AV block, optimal access sites, long-term valve durability, and economic sustainability meaning that the optimal treatment of high-risk operable patients remains controversial and requires further longterm follow-up and critical assessment [66]**.**

The rapid technological progress of innovative surgical approaches has also resulted in the natural evolution of sutureless aortic valves from conventional sutured valves. SU-AVR, by

avoiding placement and tying of sutures after annular decalcification, has shown to minimize cross-clamp and cardiopulmonary bypass durations [(8)]. Shortened operational durations of SU-AVR may help reduce postoperative mortality and morbidity and improve cost effectiveness, particularly in high risk patients as well as in those undergoing complex or concomitant procedures [(67)]. There is a paucity of robust, evidence-based data on the role and performance of SU-AVR in minimally invasive and conventional aortic valve surgery. It is unclear how the long term outcomes of SU-AVR will compare with existing and well-accepted procedures for patients with aortic stenosis in different risk settings. A coherent and unified international collaborative effort will be necessary to provide statistically powered multi-institutional evidence to evaluate this innovative technique and direct future avenues of research [(67)].

Sutureless aortic valves types:

There are three main types of sutureless aortic prostheses which are currently available on the market, including the 3F Enable (Medtronic, Minneapolis, USA), Perceval S (Sorin, Saluggia, Italy) and Intuity (Edwards Lifesciences, Irvine, USA) sutureless valves (Figure 23).

The 3F Enable Sutureless aortic valve, CE mark approved in 2009, consists of a 3F stentless aortic bioprosthesis, designed to closely mimic the function of the native aortic valve. The 3F Enable is assembled from three equal sections of equine pericardial material, fixed with glutaraldehyde and mounted on a self-expanding Nitinol frame, which fixes the device in the native annulus by virtue of outward radial force. This allows for the use of one guiding stitch for correct placement of the valve to the annulus and the possibility of re-position the device if needed..

The Perceval sutureless valve was CE approved in 2011.It comprises a biological component of bovine pericardium and an elastic Ni-Ti alloy stent made of two rings and nine vertical struts, with the dual task of supporting the valve and holding it in place without any permanent suture. Its elastic properties allow the stent to adapt to the anatomy of the aorta and to follow its movements, relieving the stress on the leaflets. The valve is collapsed with an atraumatic device compression, assuring that the valve leaflets are not affected. Perceval is lowered until the correct position and then selfexpands back to its original diameter.

The design of the Edwards Intuity valve, CE approved in 2012, is based on the Perimount valve family. A balloon expandable stainless steel cloth-covered frame is incorporated

into the inflow aspect of the valve. The valve is implanted with the aid of a delivery system, which incorporates a balloon catheter used to expand the frame within the left ventricular outflow tract. The expandable frame works in conjunction with the sewing ring to position and stabilize the valve at implant. The system reduces the number of sutures required to secure the valve, while establishing the seal between the aortic annulus and the frame

Figure 23 Commercially available sutureless aortic valves. (A) 3F Enable (Medtronic, Minneapolis, USA); (B) Perceval S (Sorin, Saluggia Italy); (C) Intuity (Edward Lifesciences, Irvine, USA).

Surgical Procedure of perceval sutureless valve :-

The aortic valve was approached either by upper mini-sternotomy (Fig. 24a) or full sternotomy. CPB was performed in normothermia. After cross clamping of the aorta, myocardial protection was obtained by antegrade normothermic blood cardioplegia or crystalloid cardioplegia (Fig. 24b), according to surgeons' preferences. Transverse aortotomy is made higher than usual, 1cm distal to the sinotubular junction, leaving a free edge

for closure of the aortotomy after implantation of the device. The diseased, native aortic cusps are removed. Complete aortic annulus decalcification is not mandatory; nevertheless, bulky blocks of calcium protruding into the aortic lumen should be removed [(68)].

Three guiding threads are placed at the nadir level of each resected cusp. These threads are used as reference for accurate alignmentof the inflow section of the prosthesis with the insertion plane of the native leaflets. Every stitch is positioned through the aortic annulus and inside the outflow tract of the left ventricle so as to leave a margin of 2–3mm. At the prosthesis level, each thread is passed into a slot corresponding to the median part of the prosthetic sinus. The release device is inserted into the aorta to the point at which it is blocked by pulling the previously positioned thread guides. The device should form a 90 degree angle with the aortic annulus plane (Fig. 24c). The valve prosthesis, loaded into the delivery device, is released in two phases; first, the inflow section is released, followed by the release of the outflow part [(68)].