Chapter from the book *Aortic Stenosis - Etiology, Pathophysiology and Treatment* Downloaded from: http://www.intechopen.com/books/aortic-stenosis-etiology-pathophysiology-and-treatment
Aortic Stenosis: Geriatric Considerations

Petar Risteski, Andreas Zierer, Nestoras Papadopoulos, Sven Martens, Anton Moritz and Mirko Doss

Department of Thoracic and Cardiovascular Surgery, Johann Wolfgang Goethe University Germany

1. Introduction

In developed countries, the most frequent heart valve disease is aortic stenosis (AS) (Lung et al., 2003). Approximately, 25% of the population aged over 65 years have aortic valve thickening and some 3% of people older than 75 years have severe AS (Lindroos et al., 1993; Stewart et al., 1997). Its prevalence further increases with age and since life expectancy continues to extend, it is expected that the population of elderly patients with AS will grow in future.

Aortic valve replacement (AVR) is the gold standard treatment of severe and symptomatic AS. The current American College of Cardiology and American Heart Association as well as the European Heart Association Guidelines do not restrict operative treatment in relation to the age of the patient (Bonow et al., 2006; Vahanian, 2007).

Most of the large studies now report of more than 20% of patients undergoing surgery for AS being over the age of 80 years (Charlson et al., 2006). Still, in every day clinical practise, advanced age is considered one of the main reasons to decline surgery.

In the Euro Heart Survey on valvular heart disease (Lung et al, 2003), despite presence of severe and symptomatic AS, aortic valve surgery was refused in as many as 33% of elderly patients (defined as age over 75 years). Advanced age and left ventricular dysfunction were the most striking characteristics of the patients being refused, while comorbidities played a less important role.

The decision to operate an elderly with AS must be carefully considered, and made then when the benefits of the operation, as compared to conventional treatment, outweigh the risk of the intervention.

2. Natural history of aortic stenosis and conventional treatment

Drs. Ross and Braunwald were the first to show that aortic stenosis develops latent over many years, with a near-to-normal survival until the symptoms develop (Ross & Braunwald, 1968). Once the symptoms of angina, dyspnea or syncope develop, the survival declines abruptly. Around 75% of symptomatic patients will expire within 3 years after the onset of symptoms, without valve replacement. The worst prognosis had the patients with global heart failure associated with severe AS, with a median survival of less than one year.

Some other more contemporary studies looked at the survival of patients after being medically or surgically treated for AS. Bouma and coworkers identified three predictive
factors for poor outcome of non-operated patients with aortic stenosis (Bouma et al., 1999). Advanced heart failure (New York Heart Association Class III or IV), associated mitral regurgitation as well as severe left ventricular systolic dysfunction identified patients as high-risk for mortality, with a three-year survival of only 20%. Their study showed a 3-year survival rate of 80% in the group of patients treated operatively versus only 49% in the group of patients treated medically. Still, 41% of these patients with severe symptomatic AVS were treated medically.

A similar survival pattern was observed in the study by Varadarajan and coworkers (Varadarajan et al., 2006). In their hands, surgically treated patients showed improved 1-year, 2-year and 5-year survival rates of 87, 78 and 68%, respectively, as compared with 52, 40 and 22%, respectively, in those managed medically.

With this issue in hand, Pierard and coworkers from Brussels, Belgium have looked at the determinants and their prognostic impact of operative refusal or denial in octogenarians with severe AS (Pierard et al., 2011). Advanced age, a lower transaortic pressure gradient, a larger aortic valve area and presence of diabetes were identified as independent predictors of AVR refusal or denial, which occurred in 40% of all patients with severe and symptomatic AS, and had a profound impact on long-term prognosis, leading in a twofold excess mortality of patients treated without surgery (Pierard et al, 2011).

Nowadays, there is no reason to put into question the decision to perform the operation on an elderly patient with severe AS, since optimal medical treatment remains ineffective when AS becomes symptomatic.

3. Operative treatment of elderly with AVS

Advanced age at the time of the operation has a strong influence upon the perioperative mortality and morbidity. Bridgewater and co-workers, on behalf of the European Association of Cardio-Thoracic Surgery, reported recently that early mortality following isolated AV surgery averaged 1.2% for patients under the age of 56 years, and progresses to 3.7% for patients between 71-75 years, further to 4.1% for patients between 76-80 years of age, and finally to 6.1% for patients older than 80 years (Bridgewater et al, 2010). The same authors also conclude, based on a survey on 40111 operated patients in developed countries that patients older than 80 years stay, on the average, more than 3 days longer than those under 61.

This, however, represents a significant improvement of early results in contemporary aortic valve surgery as compared to outcomes reported two or three decades ago. In a paper published in Circulation in 1994, from the group from Rennes, France, Dr. Logeais and coworkers report of higher early postoperative mortality risk, averaging 6.2% for patients age 60-70 years, and 11.2% for patients older than 70 years of age (Logeais et al, 1994). A better understanding of the role of the preoperative respiratory preparation, improved myocardial protection of otherwise severely hypertrophic myocardium, as well as normothermic cardiopulmonary bypass may be attributed to the improved early postoperative results in the recent studies as compared to those several decades ago.

Another approach to improve early and long-term survival of elderly patients undergoing AV surgery is to have them undergo surgery in due time. Surgery in octogenarians, as reported by Pipper and coworkers (Pipper, 2009) should not be postponed until chronic myocardial decompensation finally convinces patients, relatives and cardiologists that AV surgery is inevitable, as the preoperative chronic decompensation strongly increases operative mortality and morbidity and negatively impacts long-term survival.
The surgical community worked over the last two decades vigorously to reduce the trauma of the conventional aortic valve operation. Minimally invasive approaches like partial upper sternotomy have replaced the conventional complete median sternotomy when performing AVR in many centres. Aiming for smaller incision, without compromising the quality of the operation and the effectiveness of myocardial protection, improved early outcomes have been reached.

We reported the safety and reliability of AVR via a partial upper sternotomy in 2003 (Dogan et al., 2003). In a prospective randomised trial, we showed that minimally invasive AVR can be performed with only slightly longer operative times, good cosmetic results and improved rib cage stability as well as significantly less blood loss. Furthermore, limited surgical access affected negatively neither the patients’ neurological outcome nor the efficacy of myocardial protection.

More recently, the implantation technique for AVR has been also modified, without compromise in hemodynamic performance of the valve substitute, all in order to reduce implantation times, and therefore the myocardium ischemia as well as cardiopulmonary bypass times. We recently reported on the initial clinical experiences with the sutureless, nitinol-stented 3f Enable (Medtronic Inc., Minnesota, USA) aortic valve prosthesis in 32 patients. Implantation time could be significantly reduced down to 9±5 minutes (Martens et al., 2009). The first report of multicenter experience with this particular valve substitute and implantation technique in 140 patients was published in the European Journal of Cardiothoracic Surgery in 2011 (Martens et al., 2011). Reproducibility as well as feasibility and safety with the ATS 3f Enable Bioprosthesis were demonstrated. Valve implantation resulted in excellent hemodynamics and significant clinical improvement. Further comparative studies are underway to prove the clinical benefit using this less-time-consuming implantation technique versus the conventional one.

In the last few years, intensive interest has been put toward the development and perfection of a catheter-delivered valve substitutes for use in patients with aortic stenosis in whom surgical therapy has been rejected (Walther et al., 2007a). Two delivery routes have been used to deploy the valve substitute in such patients. The transapical route (TAP-AVI – transapical aortic valve implantation), is the one used by the surgeons. By avoiding the sternotomy incision, the cardiopulmonary bypass, aortic crossclamping as well as the cardioplegic cardiac arrest during the procedure, one aims at reduction of perioperative risk in an otherwise high-risk population of patients. The vast majority of patients targeted for this therapy are elderly with multiple severe comorbidities rendering them as high-risk or not suitable for conventional AVR. The mean age of the patients being reported on in the initial multicenter experience was 81 years (Walther et al., 2007b).

We went further on and compared our experience with TAP-AVI versus minimally invasive AVR through partial upper sternotomy in matched population of elderly patients (Zierer et al., JTCVS 2008). Mean age in our collectives were 85 years for the TAP-AVI group and 82 years for the ministernotomy group.

Patient age, preoperative comorbidities and perioperative risk, expressed as logistic EuroSCORE (38%±14% for the TAP-AVI group and 35%±9% for the ministernotomy group) were matched between the groups. Although the TAP-AVI approach was associated with faster postoperative recovery, early and late morbidity and mortality were comparable with those of the surgery group, suggesting that patient age and comorbidities are independent predictors of adverse outcome after AVR, regardless of the surgical approach.
4. Long-term survival of elderly patients after AVR: the issue of left ventricular hypertrophy

The long-term survival after the surgery, although superior to the medical treatment, is still not satisfactory. Reported survival rates in all age groups range between 50% and 66% (David et al., 2001; Hammermeister et al., 2000) and further decrease to 18% at 15 years in patients older than 75 years of age (Jamieson et al., 1994). Several studies have related these poor results after AV surgery with the incomplete regression of the left ventricular hypertrophy (Levy, 1991; Rossi et al., 2000).

Left ventricular hypertrophy (LVH), a known complication of aortic stenosis, has been strongly associated with increased risk of sudden death, congestive heart failure, and overall cardiovascular mortality. Incomplete regression of the LVH in patients undergoing AVR has been linked to the obstructive nature of the valve sewing ring and stent, or to patient-prosthesis mismatch, which are being held responsible for persistently elevated transvalvular gradients.

In the late 1980s, stentless valves were introduced with the goal of maximizing the effective orifice area for flow by eliminating the valvular stent and sewing ring, therefore facilitating faster and more complete regression of LVH. Over the next decade, several groups have published their initial results; many of them indicating faster and more complete regression of left ventricular mass after stentless as compared with the stented AVR (Jin et al., 1996, Thomson et al., 1998). However, these advantages have been obtained in the setting of nonrandomized trials. Our team had therefore set forth to determine, if we could measure these early and mid-term postoperative improvements in older patients receiving a stentless versus a stented bioprosthetic aortic valve, in a prospective randomized setting (Risteski et al., 2009).

Between September 1999 and January 2001, 40 patients with severe symptomatic aortic stenosis, over the age of 75 years, were randomly assigned to receive either the stented Perimount (n=20) or the stentless Prima Plus (n=20) bioprosthesis.

The aortic valve was approached through a hockey stick aortotomy. After complete resection of the native aortic valve and debridement of the aortic annulus, accurate sizing was carried out using the respective Carpentier-Edwards sizers for the Prima Plus stentless and the Perimount stented valves.

The Prima Plus stentless valves were implanted in the subcoronary position. The commissures were positioned 120° apart, with the muscular shelf corresponding to the right coronary sinus. Care was taken to suture the base of the valve subannularly, to ensure that the coaptation line of the leaflets was at the height of the native annulus. Single interrupted unpledgeted 4-0 braided polyester sutures were used for the proximal end, and the rims of the valve commissures were sutured to the native aorta using 4-0 polypropylene running sutures. For the Carpentier-Edwards Perimount stented valve implantation, interrupted mattress pledgeted 2-0 braided polyester sutures were placed circumferentially from below the annulus. The valves were implanted in the supra-annular position, with the valvular stent positioned so as not to interfere with the coronary ostia.

Clinical outcomes, left ventricular mass regression, effective orifice area, ejection fraction and mean gradients were evaluated at discharge, six months, one year and five years after surgery.

Left ventricular mass index (LVMI) was calculated using the formula postulated by Devereux and Reichek, as follows:
LVMI (g/m²) = \( \frac{1.05 \times [(EDD + PWTd + IVSTd)^3 - EDD^3] - 13.6}{BSA} \)

where the EDD is the LV end-diastolic diameter (cm), the PWTd is the LV postero-lateral diastolic wall thickness (cm), the IVSTd is the interventricular septum diastolic thickness (cm), and the BSA is the body surface area of the patient (Devereux & Reichek, 1997).

At five years, there were 5/20 (25%) deaths in the stentless group and 6/20 (30%) deaths in the stented group (all non-valve-related). There was one case of endocarditis in each group, early postoperatively. All patients displayed continuous clinical improvement after the operation; at five years, all of the survivors were in New York Heart Association class I or II.

Mean transvalvular gradients (Fig. 1a) have remained consistently low throughout the follow-up with neither clinical nor statistical relevance in the differences between the groups at any of the given time points. Also noted was the lack of significant difference in the follow-up values of the effective orifice areas (Fig. 1b) of both prostheses, although a tendency toward increase of the same in both groups was obvious early in follow-up (at 12 months with regards to 6 months) only to disappear at the 5-year follow-up examination.

Fig. 1. Hemodynamic results after AVR with Edwards Perimount Stented Valve vs. Prima Plus stentless valve in elderly. (a) Mean transvalvular gradients. (b) Mean effective orifice area (c) Left ventricular ejection fraction (d) Left ventricular mass index.

The left ventricular ejection fraction (Fig. 1c) did not change over the time of follow-up. At 6 and 12 months, as well as at 5 years it did not differ between the groups. The left ventricular mass index (LVMI, Fig. 1d) did display a continuous rate of decrease in the first years after the surgery; however, this tendency was lost after the first year as the mean LVMI at 5 years was almost the same to that at 12 months. Finally, the index failed to reach the normal range in both groups. At all time points, the difference between the groups did not reach statistical significance.

At five years, stentless valves were not superior to the stented valves, with regards to hemodynamic performance, regression of left ventricular mass and clinical outcome. Survival of the patients was not related to the nature of the biologic valve.

www.intechopen.com
Overall, the complexity of stentless valve implantation with its prolonged cross-clamping times might not be justifiable under these circumstances, if as we found, the same results can be achieved with a standard stented bioprosthesis. Our results are in concordance with some other prospective randomized studies that emerged in the meantime (Ali et al., 2007, Perez de Arenaza et al., 2005).

5. Conclusion

There is no scientific reason to put into question the decision to perform the operation on an elderly patient with severe AS, since optimal medical treatment remains ineffective when AS becomes symptomatic. Elderly patient may benefit from one of the available minimally invasive techniques for aortic valve replacement. The regression of the left ventricular hypertrophy as well as the long-term survival after aortic valve replacement is not influenced by the nature of the valvular substitute, failing to justify a rather more complex implantation of stentless valve substitute in an elderly patient.

6. References

Ali A, Halstead JC, Cafferty F, Sharples L, Rose F, Lee E, Rusk R, Dunning J, Argano V & Tsui S. (2007) Early clinical and hemodynamic outcomes after stented and stentless aortic valve replacement: results from a randomised controlled trial. Ann Thorac Surg 83:2162-2168.

Bonow RO, Carabello BA, Kanu C, de Leon AC Jr, Faxon DP, Freed MD, Gaasch WH, Lytle BW, Nishimura RA, O’Gara PT, O’Rourke RA, Otto CM, Shah PM, Shanewise JS, Smith SC Jr, Jacobs AK, Adams CD, Anderson JL, Antman EM, Faxon DP, Fuster V, Halperin JL, Hiratzka LF, Hunt SA, Lytle BW, Nishimura R, Page RL & Riegel B. (2006) ACC/AHA 2006 guidelines for the management of patients with valvular heart disease. J Am Coll Cardiol. 48(3):e1-148.

Bouma BJ, van Den Brink RB, van Der Meulen JH, Verheul HA, Cheriex EC, Hamer HP, Dekker E, Lie Kl & Tijssen JG. (1999). To operate or not elderly patients with aortic stenosis: the decision and its consequences. Heart 82:143-8.

Bridgewater B, Gummert J, Walton PKH & Kinsman R. (2010) Forth EACTS adult cardiac surgical database report 2010. Dendrite Clinical Systems Ltd, ISBN 1-903968-26-7, United Kingdom.

Charlson E, Lagedza ATR & Hamel MB (2006) Decision-making and outcomes in severe symptomatic aortic stenosis. J Heart Valve Dis 15:312-321

David TE, Ivanov J, Armstrong S, Feindel CM & Cohen G. (2001) Late results of heart valve replacement with the Hancock II bioprosthesis. J Thorac Cardiovasc Surg 121:268-277.

Devereux RB & Reichek N. (1977) Echocardiographic determination of left ventricular mass in man: anatomic validation of the method. Circulation 55:613-618.

Dogan S, Dzemali O, Wimmer-Greinecker G, Derra P, Doss M, Khan MF, Aybek T, Kleine P & Moritz A. (2003) Minimally invasive versus conventional aortic valve replacement: a prospective randomized trial. J Heart Valve Dis 12:76-80.

Hammermeister K, Sethi GK, Henderson WG, Grover FL, Oprian C & Rahimtoola SH. (2000) Outcomes 15 years after valve replacement with a mechanical versus
bioprosthetic valve: final report of the Veterans Affairs randomised trial. J Am Coll Cardiol 36:1152–1158.

Jamieson WR, Burr LH, Tyers GF & Munro AI. (1994) Carpentier-Edwards standard and supraannular porcine bioprosthesis: 10 year comparison of structural valve deterioration. J Heart Valve Dis 3:59–65.

Jin XY, Zhang ZM, Gibson DG, Yacoub MH & Pepper JR. (1996) Effects of valve substitute on changes in left ventricular function and hypertrophy after aortic valve replacement. Ann Thorac Surg 62:683–690.

Levy D. (1991) Clinical significance of left ventricular hypertrophy: insights from the Framingham Study. J Cardiovasc Pharmacol 17(Suppl 2):S1–S2.

Lindroos M, Kapari M, Heikkala J & Tilvis R. (1993) Prevalence of aortic valve abnormalities in the elderly: an echocardiographic study of a random population sample. J Am Coll Cardiol 21:1220–5.

Logeais Y, Langanay T, Roussin R, Leguerrier A, Rioux C, Chaperon J, de Place C, Mabo P, Pony JC & Daubert JC. (1994) Surgery for aortic stenosis in elderly patients. A Study of surgical risks and predictive factors. Circulation 90:2891–2898

Iung B, Baron G, Butchart EG, Delahaye F, Gohlke-Bärwolf C, Levang OW, Tornos P, Vanoverschelde JL, Vermeers F, Boersma E, Ravaud P & Vahanian A. (2003) A prospective survey of patients with valvular heart disease in Europe: the Euro Heart Survey on valvular heart disease. Eur Heart J 24:1231–43.

Martens S, Ploss A, Sirat S, Miskovic A, Moritz A & Doss M. (2009) Sutureless aortic valve replacement with the 3f Enable aortic bioprosthesis. Ann Thorac Surg 87:1914–17.

Perez de Arenaza D, Lees B, Flather M, Nugara F, Husebye T, Jasinski M, Cisowski M, Khan M, Henein M, Gaer J, Guvendik L, Bochenek A, Wos S, Lie M, Van Nooten G, Pennell D & Pepper J. (2005) ASSERT (Aortic Stentless versus Stented valve assessed by Echocardiography Randomized Trial) Investigators. Randomised comparison of stentless versus stented valves for aortic stenosis: effects on left ventricular mass. Circulation 112:2696–2702.

Piérard S, Seldrum S, de Meester C, Pasquet A, Gerber B, Vancraeynest D, El Khoury G, Noirhomme P, Robert A & Vanoverschelde JL. (2011) Incidence, determinants and prognostic impact of operative refusal or denial in octogenarians with severe aortic stenosis. Ann Thorac Surg 91:1107-12

Piper C, Hering D, Kleikamp G, Körfer R & Horstkotte D. (2009) Valve replacement in octogenarians: arguments for an earlier surgical intervention. J Heart Valve Dis. 18(3):239-44

Risteski P, Martens S, Rouhollahpour A, Wimmer-Greinecker G, Moritz A & Doss M. (2009) Prospective randomized evaluation of stentless vs. stented aortic biologic prosthetic valves in the elderly at five years. Interact CardioVasc Thorac Surg 8:449-453.

Ross J, Jr., Braunwald E. (1968) Aortic stenosis. Circulation 38 Suppl V:V-61–7.

Rossi A, Tomaino M, Golia G, Anselmi M, Fuca G & Zardini P. (2000) Echocardiographic prediction of clinical outcome in medically treated patients with aortic stenosis. Am Heart J 140:766–771.
Stewart BF, Siscovick D, Lind BK, Gardin JM, Gottdiener JS, Smith VE, Kitzman DW & Otto CM. (1997) Clinical factors associated with calcific aortic valve disease: Cardiovascular Health Study. J Am Coll Cardiol 29:630-4
Thomson HL, O’Brien MF, Almeida AA, Tesar PJ, Davison MB & Burstow DJ. (1998) Haemodynamics and left ventricular mass regression: a comparison of the stentless, stented and mechanical sortic valve replacement. Eur J Cardiothorac Surg 13:572–575
Vahanian A, Baumgartner H, Bax J, Butchart E, Dion R, Filippatos G, Flachskampf F, Hall R, Iung B, Kasprzak J, Nataf P, Tornos P, Torracca L & Wenink A. (2007) Guidelines on the management of valvular heart disease. Eur Heart J 28:230-68.
Varadarajan P, Nikhil K, Bensal RC & Pai RG. (2006) Survival in elderly patients with severe aortic stenosis is dramatically improved by aortic valve replacement: results from a cohort of 277 patients aged ≥80 years. Eur J Cardiothorac Surg 30:722-727
Walther T, Falk V, Borger MA, Dewey T, Wimmer-Greinecker G, Schuler G, Mack M & Mohr FW. (2007) Minimally invasive transapical beating heart aortic valve implantation – proof of concept. Eur J Cardiothorac Surg 31:9-15.
Walther T, Simon P, Dewey T, Wimmer-Greinecker G, Falk V, Kasimir MT, Doss M, Borger MA, Schuler G, Glogar D, Fehske W, Wolner E, Mohr FW & Mack M. (2007) Transapical minimally invasive aortic valve implantation: multcenter experience. Circulation 116(11 Suppl):I240-5.
Zierer A, Wimmer-Greinecker G, Martens S, Moritz A & Doss M. (2009) Is transapical aortic valve implantation really less invasive than minimally invasive aortic valve replacement? J Thorac Cardiovasc Surg. 138:1067-72.
Currently, aortic stenosis (AS) is the most prevalent valvular disease in developed countries. Pathological and molecular mechanisms of AS have been investigated in many aspects. And new therapeutic devices such as transcatheter aortic valve implantation have been developed as a less invasive treatment for high-risk patients. Due to advanced prevalent age of AS, further discovery and technology are required to treat elderly patients for longer life expectancy. This book is an effort to present an up-to-date account of existing knowledge, involving recent development in this field. Various opinion leaders described details of established knowledge or newly recognized advances associated with diagnosis, treatment and mechanism. Thus, this book will enable close intercommunication to another field and collaboration technology for new devices. We hope that it will be an important source, not only for clinicians, but also for general practitioners, contributing to development of better therapeutic adjuncts in the future.

How to reference
In order to correctly reference this scholarly work, feel free to copy and paste the following:

Petar Risteski, Andreas Zierer, Nestoras Papadopoulos, Sven Martens, Anton Moritz and Mirko Doss (2011). Aortic Stenosis: Geriatric Considerations, Aortic Stenosis - Etiology, Pathophysiology and Treatment, Dr. Masanori Hirota (Ed.), ISBN: 978-953-307-660-7, InTech, Available from: http://www.intechopen.com/books/aortic-stenosis-etiology-pathophysiology-and-treatment/aortic-stenosis-geriatric-considerations