

Transcatheter aortic valve replacement in high risk patients with different anaesthetic techniques

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ABSTRACT

Introduction: Percutaneous retrograde transfemoral or transsubclavian aortic valve replacement is a minimally invasive method of aortic valve replacement in elderly and high-risk patients with symptomatic aortic stenosis considered too fragile to go through conventional heart surgery. The purpose of this study was to compare two different anaesthetic techniques for percutaneous retrograde transfemoral or transsubclavian aortic valve replacement in terms of anaesthetic depth, hemodynamic stability and need for vasoactive drugs.

Methods: Forty-eight elderly or high risk patients, two third of them in their eighties, were scheduled for percutaneous retrograde transfemoral or transsubclavian aortic valve replacement. Anaesthetic induction was standardized, but anaesthesia was afterwards maintained alternately with either propofol infusion or sevoflurane. Need for vasoactive drugs was recorded and anaesthetic depth was estimated from acoustic evoked potential measuring and clinical observation.

Results: Twenty-eight percent of the patients in the sevoflurane group and 30% of the patients in the propofol group required vasoactive therapy ($P = 0.84$). Forty-four percent of the patients in the sevoflurane group and 57% of the patients in the propofol group had episodes of superficial anaesthesia recorded ($P = 0.38$).

Conclusion: We found no significant difference in the use of vasoactive drugs or in anaesthetic depth between propofol and sevoflurane anaesthesia. Both can be recommended for percutaneous aortic valve replacement.

Keywords: PAVR, AVR, anaesthesia, trans catheter

INTRODUCTION

Age related aortic stenosis occurs in 2-3% of those over the age of 65. With the aging of the population in general, aortic valve disease is rapidly increasing.

With only about 200,000 aortic valve replacements (AVR) carried out worldwide per year, a large number of patients with

symptomatic aortic stenosis are not treated. Many of them are considered at too high risk to undergo open heart surgery due to age or comorbidity (1,2) and this led to a growing interest in the development of less invasive methods of AVR.

In 1985, Cribier in Rouen (France) performed the first successful percutaneous aortic valvuloplasty, but before that, during the 80's, Henning Rud Andersen in Aarhus (Denmark), actually experimented with expanding bioprosthetic stent valves implanted in pigs (3).

In 2002, Cribier conducted the first percutaneous AVR in a human (4-6).

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In our institution, patients considered for retrograde percutaneous aortic valve replacement (PAVR) are patients with severe symptomatic aortic stenosis who are >75 years of age, **or**, are >65 years and either have a standard EUROscore (European System Operation Risk Evaluation) >15% or at least one of the following risk factors: previous heart surgery, glass aorta, pulmonary disease, liver cirrhosis, right ventricular heart failure, thoracic trauma as from radiotherapy, cachexia or obesity (7). These factors must of course be considered individually according to their severity. The aim of this study was to compare anaesthetic depth and hemodynamic stability between total intravenous propofol anaesthesia and sevoflurane anaesthesia for PAVR.

METHODS

After Danish Committee in Biomedical Research Ethics approval and patient's written consent, patients with severe, symptomatic aortic stenosis (AS) who were considered at too high a risk for conventional surgery were included in the study. Patient characteristics including age, gender, severity of aortic stenosis and comorbidity were collected as described in table 1. All underwent PAVR with the CoreValve® (Medtronic CV. Luxemburg) revalving system during a 22 months period from March 2008 till January 2010.

All patients were anaesthetized with fentanyl (0.05-0.1 mg), etomidate (16-18 mg) and cisatracurium 0.2 mg/kg and endotracheally intubated. Patients were then assigned to one of the two anaesthetic methods, simply by using sevoflurane (MAC 0.8-1) in half of the cases and propofol (4-10 mg/kg/h) in the other half of the cases, this was done in a regular alternating manner. Our routine cardiac monitoring, consisting

of ECG, arterial, central venous and pulmonary artery pressure, cardiac index, arterial and mixed venous oxygen saturation, was supplemented with transesophageal echocardiography and anaesthetic depth monitoring using the AEP Monitor/2™ (Danmeter, Odense, DK), that measures and indexes acoustic evoked potentials.

The anaesthesiologist was responsible for insertion of the temporary ventricular pace catheter and for operation of the pacemaker when rapid ventricular pacing was demanded.

Dopamine was the drug of choice in hypotension if there was a continuous mean arterial pressure under 60 mmHg (starting dose 5 mcg/kg/min), whereas norepinephrine was chosen if the patient at the same time had relative tachycardia (starting dose 0.02 mcg/kg/min).

Coughing or any other patient movements signalled by the interventional cardiologist were recorded as well as rises in AEP signals. The cardiologist could not see and was not informed about the AEP monitor. PAVR was performed through either bilateral transfemoral, or combined transsubclavian and transfemoral artery access (one access for the angiography and one access for the insertion of the stent valve device). Aortic valvuloplasty was performed during rapid ventricular pacing to minimize pulsating transvalvular flow at the moment of dilation (8). The bioprosthetic valve, which had been shrunk in ice water to fit into an extendable stent, was then deployed (9). Imaging of the procedure was provided by aortic angiography as well as by transesophageal echocardiography (10). Thus, the demands on anaesthesia were tolerance of bilateral inguinal catheterisation and tolerance of the esophageal echocardiography probe. Quick recovery after rapid ventricular pacing during valvuloplasty was especially important (11-13).

Statistics: Data are presented as mean,

range, and the percentage of patients in each group, partly requiring application of vasoactive drugs and partly having displayed movements coinciding with rise in AEP-index. Differences were compared using the chi-square test with a P-value < 0.05 considered statistically significant.

RESULTS

Forty-eight patients (26 females / 22 males), mean age 83 (67-88) with severe, symptomatic AS (mean valve area 0.6 (0.3-0.9) cm², mean NYHA class III ± I) were treated.

Patient characteristics regarding age, gender, severity of aortic stenosis and comorbidity were statistically comparable in the two groups (Table 1).

When it came to hemodynamic stabil-

ity, 28 % of the patients in the sevoflurane group and 30 % of the patients in the propofol group required vasoactive therapy (Table 2) (P = 0.84).

Patient movements signalled by cardiologists and AEP rises were coinciding. We accepted that the anaesthesia was relatively light and it was not adjusted according to these recordings.

Observation of anaesthetic depth was also without any significant difference in the two groups. 44 % of the patients in the sevoflurane group and 57 % of the patients in the propofol group had one or two slight movements or coughs, well correlated to rise in AEP index (P = 0.38). These were very short and discrete reactions that did not disturb the procedure. There were no accounts of awareness.

All patients were extubated in the operat-

Table 1 - Preoperative patient characteristics

	Sevoflurane	Propofol
Number	25	23
Age, mean (range)	80 (68-88)	83 (67-88)
Gender	11 F / 14 M	15 F / 8 M
Aortic stenosis, mean (range)	0.6 cm ² (0.3-0.9)	0.6 cm ² (0.4-0.8)
Left ventricle EF, mean (range)	50 % (15-60)	60 % (15-70)
Diabetes	12 % (3)	17 % (4)
Weight, mean (range)	69 kg (50-112)	70 kg (45-100)
COPD	28 % (7)	26 % (6)
History of neurological events	0	17 % (4)
NYHA gr., mean (range)	III (II-IV)	III (II-IV)
St. Euroscore, mean (range)	16 (9-29)	10 (5-16)

Abbreviations: F, female; M, male; EF, ejection fraction; COPD, chronic obstructive pulmonary disease; NYHA gr., New York Hearts Association group; St. Euroscore, Standard European System Operation Risk Evaluation score.

Table 2 - Use of vasoactive drugs and observations in anaesthetic depth

	Sevoflurane	Propofol	P Value
Norepinephrine Infusion	12 % (3)	17 % (4)	0.60
Dopamin Infusion	16 % (4)	13 % (3)	0.76
Patient Movement With Rise In Aep-Index*	44 % (11)	57 % (13)	0.38

*AEP-index, Acoustic evoked potentials, indexed by the AEP Monitor/2™

ing theatre, before transferring to the intensive care unit (ICU), where the first 20 patients were monitored overnight, while it has now become standard to discharge the patients from the ICU after a six-hours monitoring.

DISCUSSION

In view of anaesthetic depth, hemodynamic stability and need for vasoactive drugs, our results showed no statistically significant difference between sevoflurane and propofol anaesthesia for PAVR. It should be noted that all patients were extubated in the theatre and then monitored in ICU for a short period. Both anaesthetic techniques can be recommended for this procedure. We are conscious though, that a much larger sample size would probably have been needed to detect any difference. Potential advantages of general anaesthesia include, a part from hypnosis and analgesia, immobility and control of the patients cardiorespiratory status.

At our center however, cardiologists are getting more experienced in valve implantation, the duration of the procedure is getting shorter and the routine setting is becoming one of local anaesthesia and light sedation.

The same experience was previously described by other authors (14).

There is nevertheless still a role for the anaesthesiologist, just as much in taking part in the preprocedural evaluation of the patient as in providing appropriate monitoring and early management of side effects and complications.

Limitations

We recognize a number of limitations within this study.

There was no blind randomization of patients to one group or the other; the patients

were never the less assigned in an alternating manner without exception.

Nobody in the theatre was blinded to the anaesthetic technique that had been chosen and the indication for starting vasopressor therapy, as well as the choice of drug, was not extremely precise.

Only preoperative observations were registered, we did not collect data on cardiac biomarker levels. Neither did we do any long term follow up on outcome.

As already mentioned the study is probably underpowered as the number of patients may be too small to show any difference between techniques, if ever there was one. Our work should thus be considered a pilot study, as there has not yet been published any other works comparing terms methods for PAVR.

CONCLUSIONS

Successful management of these, generally very old or fragile patients, very much depends on a well coordinated interdisciplinary collaboration between interventional cardiologists and cardiovascular anaesthesiologists.

Clear understanding of the pathophysiology as well as knowledge of all technical aspects of the procedure is mandatory and good communication is momentous.

Our work confirms that, once the decision of performing a general anaesthesia has been taken, the choice of anaesthetic drugs is not important in terms of anesthetic depth, hemodynamic stability and need for vasoactive drugs.

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REFERENCES

1. Brown JM, O'Brien SM, Wu C, et al. Isolated aortic valve replacement in North America comprising 108,687 patients in 10 years: changes in risks, valve types, and outcomes in the Society of Thoracic Surgeons National Database. *J Thorac Cardiovasc Surg* 2009; 137: 82-90.
2. Lung B, Baron G, Butchart EG, et al. A prospective survey of patients with valvular heart disease in Europe: The Euro Heart Survey on Valvular Heart Disease. *Eur. Heart J* 2003; 24: 1231-1243.
3. Andersen HR, Knudsen LL, Hassenkam JM. Transluminal implantation of artificial heart valves. Description of a new extendable aortic valve and initial results with implantation by catheter technique in closed chest pigs. *Eur Heart J* 1992; 13: 704-708.
4. Cribier A, Eltchaninoff H, Bash A, et al. Percutaneous transcatheter implantation of an aortic valve prosthesis for calcific aortic stenosis: first human case description. *Circulation* 2002; 106: 3006-3008.
5. Cribier A, Eltchaninoff H, Tron C, et al. Early experience with percutaneous transcatheter implantation of heart valve prosthesis for the treatment of end-stage inoperable patients with calcific aortic stenosis. *J Am Coll Cardiol* 2004; 43: 698-703.
6. Cribier A, Eltchaninoff H, Tron C, et al. Treatment of calcific aortic stenosis with the percutaneous heart valve: Mid-term follow-up from the initial feasibility studies: the french experience. *J Am Coll Cardiol* 2006; 47: 1214-1223.
7. Grube E, Schuler G, Buellesfeld L, et al. Percutaneous aortic valve replacement for severe aortic stenosis in high-risk patients using the second- and current third-generation self-expanding CoreValve prosthesis: device success and 30-day clinical outcome. *J Am Coll Cardiol* 2007; 50: 69-76.
8. Webb JG, Pasupati S, Achtem L, Thompson CR. Rapid pacing to facilitate transcatheter prosthetic heart valve implantation. *Catheter Cardiovasc Interv* 2006; 68: 199-204.
9. Webb JG, Chandavimol M, Thompson CR, et al. Percutaneous aortic valve implantation retrograde from the femoral artery. *Circulation* 2006; 113: 842-850.
10. Berry C, Oukerraj L, Asgar A, et al. Role of transesophageal echocardiography in percutaneous aortic valve replacement with the CoreValve Revalving system. *Echocardiography* 2008; 25: 840-848.
11. Covello RD, Maj G, Landoni G, et al. Anesthetic management of percutaneous aortic valve implantation: focus on challenges encountered and proposed solutions. *J Cardiothorac Vasc Anesth* 2009; 23: 280-285.
12. Basciani R, Henle S, Zobrist C, et al. Retrograde percutaneous aortic valve replacement in severe aortic valve stenosis: anesthesia management and short term outcome. *Anesth Analg* 2008; 106 (SCASuppl): 1-128
13. Meineri M, Wasowicz M, Vegas A, Karski J. Anesthetic management for trans-catheter aortic valve implantation: Initial experience. *Anesth Analg* 2008; 106 (SCASuppl): 1-128.
14. Covello RD, Ruggeri L, Landoni G, et al. Transcatheter implantation of an aortic valve: anesthesiological management. *Minerva Anesthesiol.* 2010; 76: 100-108.