Predictors of cardiac conduction disturbances after transcatheter aortic valve implantation using self-expandable valves

Thesis submitted for partial fulfillment of MD degree of cardiology by

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2019

Acknowledgement

First and foremost, I thank Allah for all blessings I have and for helping me in accomplishing this work.

I would like to express my sincere gratitude to ***Dr. Maiy Hamdy El sayed***, professor of cardiology, for her precious time, great help and faithful advice. Really, wordings can never express my deep appreciation for her effort and care.

Here comes the turn to refer the right to whom it belongs; ***Dr. Ahmad El Sayed,*** *associate professor of cardiology,* ***and Dr. Diaa El Din Kamal***, lecturer of cardiology. This is actually their work and I have only arranged and presented the data. Wordings aren't enough to thank them for their valuable instructions and continuous assistance.

I should never forget to express my thanks to my colleagues in the cardiology department at Ain Shams University who helped me a great deal in collecting the data of the patients. I would also like to thank my wife and my family who gave me the enthusiasm to complete this work.

Mahmoud Baraka

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List of Abbreviations

Abb.	Full term
3D-TEE	Three dimensional transesophageal echocardiography
ACAD	Atherosclerotic Coronary artery diseases
ACC	American college of cardiology
AF	Atrial fibrillation
AHA	American heart association
AMI	Acute myocardial infarction
AR	Aortic regurgitation
AS	Aortic stenosis
AV block	atrioventricular block
AVA	Aortic valve area
AVAi	Aortic valve area indexed value
BAV	Balloon aortic valvuloplasty
BMI	Body mass index
BSA	Body surface area
CA	Coronary angiography
CABG	Coronary arteries bypass grafting
CAD	Coronary artery disease
CHB	Complete heart block
CI	Confidence interval
CT	Computed tomography
CVS	Cerebrovascular stroke
DA	Diagnostic accuracy
DI	Depth of implantation
DIi	Depth of implantation indexed value
DIMS	Percentage of depth of implantation from membranous septum
DLZ	Device landing zone

List of Abbreviations (cont.)

Abb.	Full term
DM	Diabetes mellitus
ECG	Electrocardiogram
EDD	End diastolic diameter
EDV	End diastolic volume
EF	Ejection fraction
EPS	Electrophysiological study
ESC	European society of cardiology
ESD	End systolic diameter
HTN	Hypertension
ICU-LOS	Intensive care unit length of stay
IHD	Ischemic heart disease
ILR	Implantable loop recorder
IV	Intravenous
IVC	Inferior vena cava
IVS	Interventricular septum
LA	Left atrium
LBBB	Left bundle branch block
LBBB	Left bundle branch block
LMCA	Left main coronary artery
LMCAi	Height of Left main coronary artery ostium indexed value
LV	Left ventricular
LVEDD	Left ventricle end diastolic diameter
LVEDDi	Left ventricle end diastolic diameter indexed value
LVEF	Left ventricular ejection fraction
LVESD	Left ventricle end systolic diameter
LVESD	Left ventricle end systolic diameter indexed value

List of Abbreviations (cont.)

Abb.	Full term
LVH	Left ventricular hypertrophy
LVOT	Left ventricular outflow tract
MDCT	Multidetector computed tomography
MI	Myocardial infarction
MPG	Mean pressure gradient
MR	Mitral regurgitation
MS	Membranous septum length
MSi	Membranous septum length indexed value
NPV	Negative predictive value
OR	Odd's ratio
PCI	Percutaneous coronary intervention
PET	Polyethylene terephthalate
PPG	Peak pressure gradient
PPI	Permanent pacemaker implantation
PPV	Positive predictive value
PVL	Paravalvular regurgitation
PWT	Posterior wall thickness
RA	Right atrium
RBBB	Right bundle branch block
RBCs	Red blood cells
RCA	Right coronary artery
RCAi	Indexed value of right coronary artery ostium height
RV	Right ventricle
RVSP	Right ventricle systolic pressure
SA node	Sinoatrial node
SAVR	Surgical aortic valve replacement

List of Abbreviations (cont.)

Abb.	Full term
SE	Standard error
SPSS	Statistical Package for the Social Sciences
STS	Society of thoracic surgeons
SVC	Superior vena cava
SWT	Septal wall thickness
SWTi	Septal wall thickness index value
TAVI	Transcatheter aortic valve implantation
TAVR	Transcatheter aortic valve replacement
TEE	Transesophageal echocardiography
THV	Transcatheter heart valve
TIA	Transient ischemic attack
TLOS	Total length of stay
TTE	Transthoracic echocardiography
VARC-2	Valve Academic Research Consortium-2
ViV	Valve-in-valve
YI	Youden Index
ΔMSID	Difference between membranous septum and depth of implantation

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ABSTRACT

Background: The advent of transcatheter aortic valve implantation (TAVI) represented a paradigm shift for treating patients with severe symptomatic aortic stenosis (AS) who are at high or prohibitive surgical risk. With the growing experience in this field, the rate of periprocedural complications has decreased over time and TAVI has been increasingly performed with a minimalist approach, evolving into a safe procedure with predictable outcomes. However, unlike other procedural complications, the incidence of conduction disturbances which could be in the form of bundle branch blocks, or atrioventricular blocks, has failed to decrease in recent times, with reports suggesting an increased risk associated with the use of some newer-generation transcatheter valves.

Aim of the study: To determine the predictors of cardiac conduction disturbances after transcatheter aortic valve implantation.

Patients and Methods: From January 2017 to April 2019, we included 38 consecutive patients with severe symptomatic AS underwent TAVI using self-expandable valves (CoreValve or Evolut R) or the balloon expandable Sapien XT valve at the Ain Shams University Hospitals. All patients were subjected to electrocardiographic evaluation pre- and post-TAVI and at 30 days. Several parameters were studied including preprocedural parameters: clinical, electrocardiographic, echocardiographic, and CT derived parameters, and procedural parameters: type and size of the valve, the use of balloon pre- and post- implantation dilatation, and depth of implantation. All quantitative parameters were indexed to body surface area (BSA).

Results: Conduction disturbances were seen in 16 patients (42.1%), in which 10 patients (26.3%) experienced left bundle branch block (LBBB), 6 patients (15.8%) experienced complete heart block (CHB), with only one of them (2.6%) experienced permanent CHB requiring permanent pacemaker implantation (PPI). Multivariate logistic regression analysis for pre-procedural predictors showed that the presence of basal septal calcification is the most powerful independent predictor (OR: 98.73, 95% CI: 7.63 to 1278.23, $p < 0.001$). Multivariate logistic regression analysis for procedural predictors showed that the relationship between depth of implantation and membranous septum expressed in percentage (DIMS) with cut-off >75.00% is the most powerful independent procedural predictor (OR: 16.00, 95% CI: 2.12 to 120.65, p 0.007).

Conclusion: Conduction disturbances remain a common complication of TAVI. Presence of basal septal calcification is a risk factor that increase patient propensity for developing such complication after TAVI. The relationship between depth of implantation and membranous septum is a strong independent procedural predictor and prospective validation of its cut-offs is needed.

Key words: Transcatheter aortic valve implantation, conduction disturbances, AV blocks, LBBB.

Introduction

Aortic valvular diseases are common disorders affecting elderly with multiple co-morbidities. The most common type of aortic valvular disease is calcific aortic stenosis (AS) [1]. Despite efforts for developing medical therapies for patients with calcific AS, medical therapy has no role in modification of the course of the disease, specifically once symptoms become manifest, and surgical aortic valve replacement (SAVR) remain mainstay of definitive treatment [2]. However, and because aortic stenosis is generally disease of the elderly, co-morbidities are a frequent that may render them inoperable. A percutaneous procedure to aortic valve replacement is, therefore, an appealing alternative for many doctors and patients.

Percutaneous balloon aortic valvuloplasty has a limited role in treatment of calcific aortic stenosis, as results are not usually durable [3]. On the other hand, transcatheter aortic valve implantation (TAVI) has passed great steps in the treatment of severe AS in patients at high surgical risk or inoperable by surgery [4]. The first implantation by Alain Cribier in 2002 [5], since that, TAVI has become one of the dynamic fields for research, innovations and development.

Despite these benefits, the growing clinical experience with TAVI revealed several intra- and post-procedure unpleasant events. One of these complications is the occurrence of post-operative conduction disturbances, the most common are His' bundle branch

blocks, atrioventricular blocks, and need for permanent pacemaker implantation. With the frequency at 10% to even 50%, conduction abnormalities are now among the most important TAVI-related adverse events [6].

This study aims to determine the predictors for conduction disturbances after transcatheter aortic valve implantation in patients with severe calcific aortic stenosis.