Zagazig University Medical Journal
www.zumj.journals.ekb.eg

Volume 28, Issue 6, November 2022(18-26) Supplement Issue

Manuscript ID ZUMJ-1910-1589 (R1)

DOI 10.21608/zumj.2019.18254.1589

ORIGINAL ARTICLE

Permanent Pacemaker Implantation After Trans-Catheter Aortic Valve Implantation And Surgical Aortic Valve Replacement In Zagazig University Hospitals And National Heart Institute.

Montaser Mostafa Ahmed Alcekelly[1], Hisham Samir Roshdy[2], Ekhlas Mohamed El Sayed Hussein[3], Wael Abd Al Shafei Awwad Ali[4]

1,2,3 Faculty of Medicine, zagazig university, Cardiology department, sharkia, Egypt.

4 National heart institute, cardiology specialized hospital, Egypt.

The authors admitted No conflict of interest - No financial disclosures.

Corresponding author:
Name: Wael Abd Al Shafei Awwad Ali
Email:
waelshafei.nhi@gmail.com

Submit Date	2019-10-24
Revise Date	2019-11-06
Accept Date	2019-11-13

ABSTRACT

Background: Permanent pacemaker implantation (PPI) and conduction disorders are more common with trans-catheter aortic valve implantation (TAVI). Several risk factors have been identified predicting PPI after TAVI.

Objective: This study aimed to estimate the occurrence and detect predictors of permanent pacemaker implantation after transcatheter aortic valve implantation versus surgical aortic valve replacement.

Methods: Prospective cohort study from November 2014 to April 2017 in Zagazig University Hospitals and National Heart Institute in elderly patients with severe aortic valve stenosis who were candidates for aortic valve replacement.

Results: The incidence of AV conduction disorders was significantly high in the TAVI group compared to the SAVR group 50% vs. 20% (p-value =0.03) derived mainly by the significant increment in the incidence of left bundle branch block (LBBB) and complete heart block. Permanent pacemaker implantation was done post-procedure to three cases in the TAVI group and one case in the surgical aortic valve replacement group. After one-month pacemaker implantation was done on another patient in the TAVI group.

Conclusion: Transcatheter aortic valve implantation was significantly followed by increased incidence of atrioventricular (AV) conduction disorders mainly the third-degree atrioventricular block which required permanent pacemaker implantation and left bundle branch block in comparison to surgical aortic valve replacement.

Keywords: Trans-Catheter Aortic Valve Implantation.

INTRODUCTION:

The most common valvular disease in Western countries is calcific aortic valve stenosis with an increased disease burden in the aging population. In cases of mild valve obstruction, increased hemodynamic severity occurs with time. The occurrence of symptoms with severe aortic stenosis makes the prognosis without intervention very poor [1].Transcatheter aortic valve implantation can be used for minimally invasive treatment of inoperable patients and high to moderate risk patients for valve surgery. The two commonly used TAVI systems are the balloon-expandable bioprosthesis Edwards Sapien valve (had been Food and Drug Administration approved in the United States) and the self-expandable bioprosthesis Core valve system [2]. Permanent pacemaker insertion and conduction disorders are most common with TAVI. Multiple risk factors that have been consistently identified can predict PPI after TAVI [3]. Mortality is not different in patients undergoing Surgical Aortic Valve Replacement (SAVR) or transcatheter aortic valve implantation who develop conduction disorders and require a PPI than those not require PPI. PPI is more common with TAVI. So, this complication does not increase mortality and is "part of the procedure" [4].Bagur et al. studied the risk factors that predict complete AV block and permanent pacemaker implantation after transcatheter aortic valve implantation and compared them with the risk factors in surgical aortic valve replacement [5, 6]

SUBJECTS AND METHODS:

This is a prospective cohort study from November 2014 to April 2017. The study was done in Zagazig University Hospitals and National Heart Institute in elderly patients above 65 years with severe

aortic valve stenosis who were candidates for aortic valve replacement. Inclusion criteria for patients were: Aortic valve area <1 cm^2 measured by conventional echocardiography, Mean gradient >40 mmHg measured by conventional echocardiography, Peak gradient > 65 mmHg measured by conventional echocardiography, Peak velocity >4m/s measured by conventional echocardiography, Aortic valve annulus diameters from 20mm to 26 mm measured by multi-slice CT in TAVI Population, Diameter of ascending aorta 3 cm above the annulus maximum 45 mm measured by multi-slice CT in TAVI Population and diameter of iliac and femoral arteries above 7 mm measured by multi-slice CT also in TAVI population. Exclusion criteria for patients were: Femoral, iliac, or Aortic disease hampering catheterization, Aortic Aneurysm, Carotid or vertebral arteries obstruction ≥70%, Myocardial infarction or cerebrovascular accidents within 1 month, Tricuspid or mitral valvular insufficiency of severe degree, Left ventricular or atrial thrombus, Atrial fibrillation, Previous aortic valve replacement, Sepsis or active endocarditis, Hypersensitivity or contra-indication to any medication used in the study, Previously conduction defects, Congenital Aortic valve (Bicuspid, unicuspid, … etc.), Supra-aortic and sub-aortic stenosis, Concomitant procedure on another valve (e.g. mitral or tricuspid valve repair or replacement, Patients who had done trans-apical TAVI, Aortic Annular diameter < 19 mm or > 27mm and Prior pacemaker.**We divided our patients into 2 main groups:**

A)Patients undergoing Surgical Aortic Valve Replacement (20 patients with mean age 74.4± 4.72 years 13 of them were males and 7 were females).

B) Patients undergoing Trans-catheter aortic valve implantation (40 patients with mean age 76.2± 3.69 years 25 of them were males and 15 were females): This group was divided also into two subgroups:

- balloon-expandable valve subgroup (20 patients).
- Self-expandable valve subgroup (20 patients).

Written informed consent was obtained from all participants and the study was approved by the research ethics committee of the faculty of medicine, Zagazig University. The work has been carried out by The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

METHODS:

All patients were subjected to history and clinical examination, Blood tests, Electrocardiogram (ECG), Chest radiography, Transthoracic echocardiogram, Coronary angiography. Multi-slice computed tomography (CT) was done for patients in the TAVI group. Post-procedural monitoring for conduction disturbances and arrhythmias was done for all patients. Up to 72 hours, continuous rhythm monitoring was recommended to maximize the detection of arrhythmias. One and three months after hospital discharge, clinical and echocardiographic follow up were done. At each temporal step twelve leads, ECG was collected in all patients to record conduction disorders.

STATISTICAL ANALYSIS

Data were analyzed using IBM SPSS 23.0 for windows (SPSS Inc., Chicago, IL, USA) and NCSS 11for For windows (NCSS LCC., Kaysville, UT, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. The following tests were done:

- ***independent-samples t-test*** of significance was used when comparing between two means.
- ***Mann Whitney U test*** was used when comparing two means of not normally distributed data.

Chi-square (X^2) test of significance was used to compare proportions between two qualitative parameters.

- ***Fisher Exact test*** is a test of significance that was used in the place of chi-square test in 2 by 2 tables, especially in cases of small samples.
- ***Probability (P-value):*** P-value ≤0.05 was considered significant, P-value ≤0.001 was considered as highly significant and P-value >0.05 was considered insignificant.

RESULT:

This study was done in the period from November 2014 to April 2017 and 60 patients were included. Patients were divided into two groups:

Group 1: Surgical Aortic Valve Replacement consisted of 20 patients and; Group2: Trans-catheter Aortic Valve Implantation consisted of 40 patients. Group 2 (TAVI) was subdivided into two subgroups Core Valve subgroup (20 patients) and the Edwards Sapien subgroup (20 patients).There was a high statistically significant difference between the TAVI and SAVR group as regards the level of EUROSCORE that was significantly high among studied TAVI cases with a mean of 10.3 ± 0.43% compared to 5.6 ± 0.56% among SAVR (p-value<0.001). In addition, the prevalence of DM was significantly higher among TAVI cases (67.5%) versus 30% of SAVR cases. There were no statistically significant differences between both studied groups as regards smoking (25% in the SAVR group versus 22.5% in the TAVI group) and Hypertension (60% in the SAVR and 55% in the TAVI group). Also, other risk factors showed nonstatistical significant differences.

There were statistically significant differences between both studied groups as regards aortic annulus and AV area of pre-procedural echocardiographic parameters, as the mean AV area was 0.76±0.21cm^2 in the SAVR group vs. 0.64±0.14 cm^2 in the TAVI group and mean aortic annulus was 21.3±1.44 in the SAVR group and was 20.3±1.35 in TAVI group. While there were no statistically significant differences as regards mean gradient, max gradient, LVEF, and PASP.

Regarding post-procedural conduction disturbances among studied cases, conduction disturbances as a total represented (4 patients) 20% of SAVR and represented (20 patients) 50% in the TAVI group. There was a significant increase in the TAVI group in comparison to the SAVR group (p valve =0.03). The LBBB was the most common conduction disorder observed after TAVI (27.5%) followed by CHB (12.5%), LBBB+1-AVB (5%). In the SAVR group, the incidence of LBBB, LBBB+1-AVB, RBBB, and RBBB+1-AVB was balanced as 5% of patients. LBBB was showing a significant increase in the TAVI group compared to the SAVR group (p-value=0.04) representing (1) 5% compared to the TAVI group represented (11) 27.5% while there were no significant differences between both groups regarding other types of CD (Table 1).On follow-up one month postoperative, conduction disturbances as a total represented (3 patients) 15% of SAVR and represented (17 patients) 42.5% in the TAVI group so there was a significant increase in the TAVI group in comparison to the SAVR group (p valve = 0.03). LBBB was the commonest type of CD among both groups but had no significant difference in the SAVR group compared to the TAVI group with p-value=0.249 (22.5% in TAVI compared to 5% in the SAVR group). While there were no significant differences between both groups regarding other types of CD (Table 2).On three months follow up postoperative, conduction disturbances as a total represented (2 patients) 10% of SAVR and (8 patients) 20% in the TAVI group, and there was no significant difference between both groups (p valve = 0.327). LBBB was the commonest type and had no significant difference in the SAVR group compared to the TAVI group with p-value=0.369 (12.5% in TAVI patients compared to 5% in the SAVR group). Also, there were no significant differences between both studied groups regarding other types of CD (Table 3).The study revealed that core valves were significantly associated with increased incidence of conduction disorders, as total cases presented with CD among core valve types were 15 patients (75%) versus 25% among Edwards Sapien. LBBB was the common type recorded among both groups of patients with a statistically significant difference between them (45% vs 10% respectively=0.01) while there were no statistically significant differences regarding other types of CD (Table 4)(figure 1).On one-month follow-up postoperative, CoreValve was significantly associated with increased incidence of conduction disorders compared to Edwards Sapien (65% VS 20%) especially LBBB (40% vs 5%, p=0.02)(figure 2). On three months postoperative follow up, CoreValve was significantly associated with increased incidence of conduction disorders compared to Edwards Sapien (35% in CoreValve VS 5% in Edwards Sapien). The most common presented conduction disorders were LBBB and CHB with no statistically significant difference between the CoreValve series and Edwards SAPIEN; (20% vs 5%, p=0.151 and 5% vs 0.0%, p=0.311).

Core valves were significantly implanted deeply in the LVOT than those of Edwards Sapien (7.9±2.4 vs 4.5±1.1, p<0.001) and also had a significantly larger size than those of Edwards Sapien (28.5±1.36 vs 23.5±1.1, p<0.001). Also, patients in the Core valve series had significant more aortic annulus diameters (mm), IVS thickness, (mm), and QRS duration than those in the Edwards Sapien but there was no significant difference as regards the aortic annulus to valve size ratio between the Core valve and Edwards Sapien series (table 5

Table (1): comparison between both studied groups as regards post-procedural conduction disturbances.

	Group I N=20 N (%)	**Group II N=40 N (%)**	**P***
All CD	4 (20%)	20 (50%)	**0.03 (S)**
LBBB	1 (5%)	11 (27.5%)	**0.04 (S)**
LBBB+1-AVB	1 (5%)	2 (5%)	1.0 (NS)
RBBB	1 (5%)	1 (2.5%)	0.611 (NS)
RBBB+1-AVB	0 (0.0%)	1 (2.5%)	0.249 (NS)
RBBB+LAH	0 (0.0%)	0 (0.0%)	-----
RBBB+LAH+1-AVB	0 (0.0%)	0 (0.0%)	-----
LAH	0	0 (0.0%)	-----
IVCD	0	0 (0.0%)	-----

	Group I N=20 N (%)	Group II N=40 N (%)	P*
1-AVB	0 (0.0%)	0 (0.0%)	-----
Complete heart block	1 (5%)	5 (12.5%)	0.159 (NS)
Need for PPI	1 (5%)	3 (7.5%)	0.714 (NS)

NS: P-value>0.05 is not significant S:P-value<0.05 is significant
*Fisher`s Exact test of significance

Table (2): Comparison between SAVR group and TAVI group as regards incidence of conduction disturbances at one month follow up.

	Group I N=20 N (%)	Group II N=40 N (%)	P *
All CD	3 (15%)	17 (42.5%)	**0.03 (S)**
LBBB	1 (5%)	9 (22.5%)	0.09 (NS)
LBBB+1-AVB	1 (5%)	3 (7.5%)	0.311 (NS)
RBBB	1 (5%)	2 (5%)	1.0 (NS)
RBBB+1-AVB	0 (0.0%)	2 (5%)	0.479 (NS)
RBBB+LAH	0 (0.0%)	0 (0.0%)	------
RBBB+LAH+1-AVB	0 (0.0%)	0 (0.0%)	------
LAH	0	0 (0.0%)	------
LAH+1-AVB	0	0	------
IVCD	0	0 (0.0%)	-----
IVCD+1-AVB	0	0	-----
1-AVB	0 (0.0%)	0 (0.0%)	------
Complete heart block	0 (0.0%)	1 (2.5%)	0.479 (NS)
Need for PPI	0 (0.0%)	1 (2.5%)	0.479 (NS)

NS: P-value>0.05 is not significant S:P-value<0.05 is significant
*Fisher`s Exact test of significance

Table (3): Comparison between SAVR group and TAVI group as regards incidence of conduction disturbances at three months follow up.

	Group I N=20 N (%)	Group II N=40 N (%)	P*
All CD	2 (10%)	8 (20%)	0.327 (NS)
LBBB	1 (5%)	5 (12.5%)	0.369 (NS)
LBBB+1-AVB	0 (0.0%)	1 (2.5%)	0.746 (NS)
RBBB	1 (5%)	1 (2.5%)	0.201 (NS)
RBBB+1-AVB	0 (0.0%)	1 (2.5%)	0.746 (NS)
RBBB+LAH	0	0	----
RBBB+LAH+1-AVB	0	0	----
LAH	0	0	----
LAH+1-AVB	0	0	----
IVCD	0	0	----
IVCD+1-AVB	0	0	-----
1-AVB	0	0	-----
CHB	0	0 (0.0%)	------
Need for PPI	0	0	------

NS: P-value>0.05 is not significant *Fisher`s Exact test of significance

Table (4): comparison between Core valve and Edwards SAPIEN valve as regards post TAVI conduction disorders:

	Core valve N=20 N (%)	**Edwards SAPIEN N=20 N (%)**	**P***
All CD	15 (75%)	5 (25%)	**0.002 (S)**
LBBB	9 (45%)	2 (10%)	**0.01 (S)**
LBBB+1-AVB	1 (5%)	1 (5%)	1.0 (NS)
RBBB	0 (0.0%)	1 (5%)	0.548 (NS)
RBBB+1-AVB	1 (5%)	0 (0.0%)	0.548 (NS)
RBBB+LAH	0 (0.0%)	0 (0.0%)	-----
RBBB+LAH+1-AVB	0 (0.0%)	0 (0.0%)	-----
LAH	0 (0.0%)	0 (0.0%)	-----
IVCD	0 (0.0%)	0 (0.0%)	-----
1-AVB	0 (0.0%)	0 (0.0%)	-----
CHB	4 (20%)	1 (5%)	0.151 (NS)
Need for PPI	2 (10%)	1 (5%)	0.584 (NS)

NS: P-value>0.05 is not significant S:P-value<0.05 is significant
*Fisher`s Exact test of significance

Table (5): Comparison between core valve and Edwards SAPIEN valve as regards risk factors for post-TAVI conduction disorders:

	Core valve N=20	**Edwards SAPIEN N=20**	**t-test\ MW***	**P**
Valve Size \ mm Mean ±SD	28.5 ± 1.36	23.5 ± 1.1	4.39	**<0.001 HS**
Depth of valve\mm Mean ±SD	7.9 ± 2.4	4.5 ± 1.1	5.76	**<0.001 HS**
Aortic annulus \mm Mean ±SD	24.7 ± 0.64	22.1 ± 0.73	11.98	**<0.001 HS**
IVS thickness Mean ±SD	13.95 ± 4.5	11.4 ± 2.8	3.23*	**0.01 S**
QRS duration\msec Mean ±SD	115 ± 6.8	109.3 ± 4.3	3.17	**0.003 S**
Annulus \valve size ratio Mean ±SD	0.94 ± 0.1	0.96 ± 0.02	0.877	0.386 NS

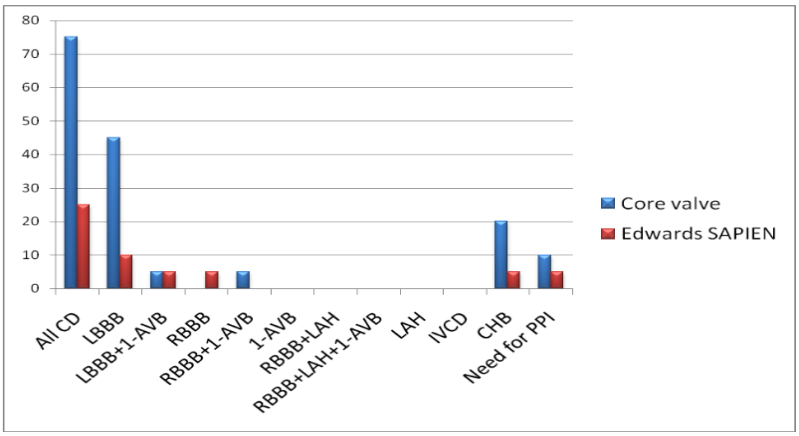

Figure (1): Difference in post-TAVI CD between the core valve and Edwards Sapien

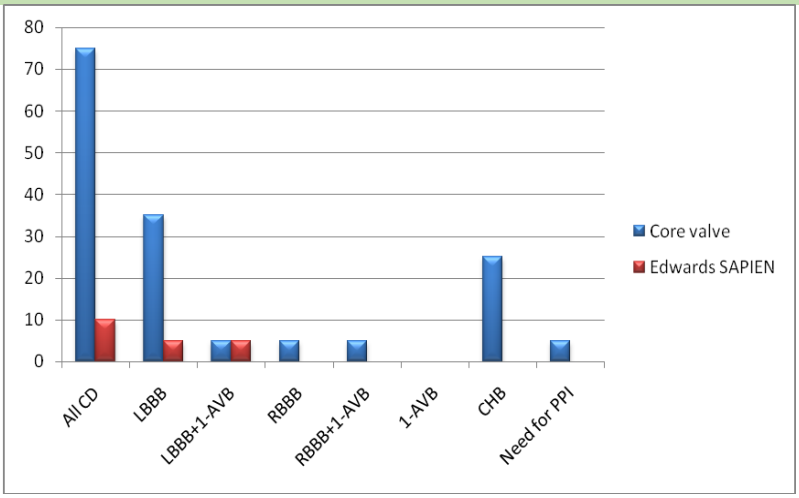

Figure (2): Conduction disorders on follow up one-month post TAVI between core valve and Edwards Sapien valve

DISCUSSION:

Trans-catheter aortic valve implantation is an ideal treatment of inoperable patients with severe aortic stenosis and a good choice for those with high or moderate surgical risk. Although, the occurrence of some periprocedural complications remains important [7]. Conduction disorders and PPI are common complications after surgery, with an incidence of about 3.2% to 8.5% [5]. Most SAVR studies included patients without isolated aortic stenosis and also included patients with different age categories and patients undergoing coronary artery bypass grafting during the same operation as well as those with both aortic stenosis (AS) and/or regurgitation as the predominant underlying aortic valve pathology. So little data was known on the postoperative incidence for PPI in elderly patients with isolated AVR due to predominant or pure severe AS, which had been selected for TAVI or surgery up to date[5]. So our study was designed to define the predictors of permanent pacemaker implantation after transcatheter aortic valve implantation in comparison to surgical aortic valve replacement in patients with severe aortic stenosis in elderly patients. To my knowledge, this was the first study to be done in Egypt.In our study, after TAVI new LBBB was observed in 13 patients (32.5%), RBBB in 2 patients (5%), and CHB in another 5 patients (12.5%). A permanent pacemaker was implanted in 3 patients (7.5%). During follow-up, CHB of two patients resolved before one month with the new incidence in 1 patient (2.5%) at one month and no incidence of new CHB at follow-up at three months. One patient with LBBB resolved at one month follow up and the other six patients resolved at three months follow-up.In our study, the only reason for PPI was complete AVB (TAVI: 7.5% SAVR: 5%). In Bagur et al.'s study, the common reason for PPI was third-degree AVB (TAVI: 5.6%, SAVR: 2.7%), then severe symptomatic low heart rate (TAVI: 1.7%, SAVR: 0.7%). The presence of RBBB at ECG on admission was associated with PPI in the TAVI group, however, no risk factors were found to be associated with PPI in the SAVR group [6]. We cannot approve this theory in our study because patients with RBBB at baseline ECG were not included in our study. Smith et al. identified a similar incidence of PPI in patients with TAVI using a balloon-expandable valve (3.8%) in comparison to SAVR (3.6%) [8].

In our study, after SAVR new LBBB was observed in 2 patients (10%), RBBB in one patient (5%), and CHB in another 1 patient (5%). A permanent pacemaker was implanted in 1 patient (5%). During follow-up, LBBB was resolved in one patient the three months post-procedure with no incidence of any new conduction disturbances.

Bagur et al. had detected an incidence of a PPI of 3.2% after isolated SAVR in elderly patients with severe AS [5]. Also, the incidence of permanent pacemaker use in the surgical cohort of the PARTNER trial was 3.6% [6]. However, several previous studies had detected the presence of preoperative conduction disturbances as a risk factor of PPI after SAVR [9], Bagur et al. failed to define any risk factor for PPI in his study [5]. This increases the importance of technical procedural aspects and the severity of valve calcification to be reasons of some injury of the conduction system during the procedure leading to conduction disorders and permanent pacemaker insertion [5].

The increased rate of AVB after TAVI is mainly caused by the anatomic proximity of theconduction pathway to the aortic valve [10]. The conduction system (especially the bundle of His) is present in the part of the membranous septum in the left ventricular outflow tract (LVOT), so it is highly prone to direct injury, compression, and ischemia during and after valve implantation [11]. In our study, the use of a Core Valve impaired AV conduction significantly to a greater extent than the

use of an Edwards Sapien valve (75% vs 25%, p= 0.002) mainly due to CHB and LBBB. The study demonstrated a significant impact of TAVI on AV conduction with differences between the 2 commercially available valve types.The variable incidence of conduction abnormalities observed with the two types of valves is mainly due to the different shapes and heights of the frames of these two valves. The self-expandable prosthesis is made by a 53-55 mm high nitinol frame, which gives a continuous radial force for anchoring at the level of the LV outflow tract. Edwards Sapien prosthesis is made by a cobalt-chromium stent varying in height between 14.3 mm and 19.1 mm (according to the size of the prosthesis) and deployed at an intra-annular position through plastic deformation and has no continuous radial force [11]. In Calvi et al.'s study, the most apparent CD observed after TAVI was LBBB with both valves [12]. In literature, the proven incidence of left BBB after TAVI ranged from 7% [13] to 18% [14] for the Edwards Sapien valve and up to 29% [15] to 65% [16] for the Core valve.The CHB was the second common abnormality detected after TAVI with both valves, with an incidence in our study of 20% in the Core Valve group and of 5% in the Edwards group. During core, valve follows up before one month 2 cases of CHB resolved spontaneously with the new incidence of one case of CHB at one-month follow-up and no new incidence at three months follow up. With Edwards valve, no new incidence of CHB at one and three months follow-up. The increased incidence of CHB with TAVI and especially the Core valve appeared to be related to the valve design, baseline AV conduction disease, and the mechanical compression that occurs during valve deployment [9]. It is supposed that fast deployment of the valve at the start and slower expansion for many days after that can lead to transient mechanical compression of the adjacent tissue and conduction disturbances that recurred within days [17].The need for PPM in our analysis was 15% in the Core Valve group and 5% in the Edwards group. There were no significant differences as regards the need for permanent pacemaker insertion between the two valve types.On the other side, Fraccaro et al. had defined an increased incidence of PPI in the Core Valve group compared to the Edwards valve group after TAVI **(41.3 vs 8%, p<0.0001)** [18]. This was not only due to the variable patients' characteristics pre and post-procedure, but also the variable threshold for permanent pacemaker implantation [18].

In our study, we reported a significant correlation between the used type of the valve and the incidence of LBBB and CHB in the univariate analysis model but no correlation in the binary regression analysis model. In the study of Gutiérrez et al., a lower (ventricular) position of the valve relative to the anterior mitral leaflet was associated with a higher incidence of new LBBB [14].

In our study, we reported a significant correlation between the increased depth of valve implantation and the incidence of LBBB and CHB in the univariate analysis model but no correlation in the binary regression analysis model. In the case of Edwards Sapien valves, higher (more aortic) implantation was also associated with a lower risk of PPM requirement [19]. Also oversizing of the prosthesis may result in new-onset disturbances, but even without mismatch, large devices are a more frequent cause of post-procedural LBBB. This relation is more noticeable in the case of CoreValve than Edwards Sapien[20]. In our study, oversizing of the prosthesis was reported to be an independent risk factor for incidence of LBBB and there is a significant correlation between oversizing of the prosthesis and incidence of CHB in the univariate analysis model but no correlation in the binary regression analysis model.

Actual implantation of the prosthesis is only one of several stages of the TAVI procedure. Other phases are crossing the aortic valve with a stiff wire, positioning, and inflation of the balloon catheter (if necessary), and positioning of the device. Over a half of procedure-related conduction abnormalities occur the first time even before the device implantation. The majority of these disturbances are caused by balloon dilatation. The rapid inflation of the balloon catheter and high pressures may irreversibly damage the AV node [21]. Nevertheless, valvuloplasty is useful in the case of severe calcifications of aortic cusps and proper selection of prosthesis size. The operator should carefully select patients requiring Predilatation and not overuse this technique. Post-dilatation of the implanted prosthesis also results in the development of some new disturbances, pressing the valve closer to the AV node [20]. This may be however one of the simplest solutions in the case of a severe paravalvular leak; therefore, we believe that post dilatation may be used in a less restrictive manner than preprocedural valvuloplasty.

Due to the sheath and delivery system sizes, the delivery route in TAVI is related to some complications. They are mostly vascular or bleeding complications, not conduction disturbances. In a study conducted by Salizzoni et al., only the trans-apical access was related to post-procedural LBBB occurrence [22].Pre-existing abnormalities in ECG play an important role in the development of TAVI-related conduction disturbances. For example, isolated right bundle block is generally recognized as a benign

condition, but it appears to be an independent predictor of the development of new complete AVB and PPM implantation [23]. In our study, patients with pre-existing RBBB were excluded from the study to minimize the pre-procedural risks of conduction disturbances. Also, the LBBB, known as a TAVI-related complication itself, is a predictor for postprocedural AVB and the need for PPM implantation [24]. In our study, patients with pre-existing conduction defects were excluded from the study to minimize the pre-procedural risks of conduction disturbances. Jilaihawi et al. found a correlation between left axis deviation in baseline ECG, with or without LBBB, and the need for PPM implantation. One could suspect that any increase in QRS duration may influence the development of conduction disturbances [25]. In our study, we reported a significant correlation between the increased left axis deviation and the incidence of CHB in the univariate analysis model but no correlation in the binary regression analysis model and no correlation between the increased left axis deviation and the incidence of LBBB.In our study, we reported a significant correlation between increased interventricular septum thickness and the incidence of CHB in the univariate analysis model but no correlation in the binary regression analysis model. Also, our study reported a link between decreased annulus/valve size ratio and the incidence of LBBB and CHB in the univariate analysis model but not in the binary regression analysis model.

CONCLUSION:

In transcatheter aortic valve implantation patients there was a significant incidence of AV conduction abnormalities mainly the third-degree heart block that required permanent pacemaker implantation and left bundle branch block more than surgical aortic valve replacement patients. Many patients in both groups required PPI due to complete AVB occurring in the first 24 h after the procedure in most cases.The presence of baseline RBBB was a strong predictor for PPI in the TAVI group and of no importance in the SAVR group. Transcatheter aortic valve implantation is an ideal modality for the treatment of high or prohibitive surgical risk patients and recently for moderate and low-risk patients with AS. Core Valve prosthesis implantation had a significantly increased incidence of conduction disturbances compared to the balloon-expandable prosthesis. The increased device size was an important predictor for LBBB occurrence. These results should help for better detection of patients at risk for PPI after the procedure and improve the clinical decision-making process of patients candidate for either TAVI or SAVR.

Acknowledgment: The authors are grateful for the patients without whom this study would not have been done.

REFERENCES

1) **Beknow RO, Greenland P.** Population-wide trends in aortic stenosis incidence and outcomes. Circulation 2015; 131: 969–971.
2) **Michael J, Mack J, Brennan M, Brindis R, John C, Fred H, et al.** Outcomes Following Trans-Catheter Aortic Valve Replacement in the United States. JAMA 2013; 310(19): 2069-2077.
3) **Nazif T, Williams MR, Hahn R, Kapadia S, Babaliaros V, Rodés-Cabau J et al.** Clinical implications of new-onset left bundle branch block after transcatheter aortic valve replacement: analysis of the PARTNER experience. Eur Heart J 2015; 35: 1599-607.
4) **Palmisano P, Accogli M, Zaccaria M, Luzzi G, Nacci F, Anaclerio M, et al.** Rate, causes, and impact on patient outcome of implantable device complications requiring surgical revision: large population survey from two centers in Italy. Europace 2013; 15: 531-40.
5) **Bagur R, Manazzoni J, Dumont E, Doyle D, Dagenais F, Mathieu P, et al.** Permanent pacemaker implantation following isolated aortic valve replacement in a large cohort of elderly patients with severe aortic stenosis. Heart 2011; 97: 1687-1694.
6) **Bagur R, Rodés-Cabau J, Gurvitch R, Dumont E, Velianou J, Manazzoni J, et al.** Need for Permanent Pacemaker as a Complication of Transcatheter Aortic Valve Implantation and Surgical Aortic Valve Replacement in Elderly Patients with Severe Aortic Stenosis and Similar Baseline Electrocardiographic Findings. JACC: Cardiovascular Interventions 2012; 5(5): 540-51.
7) **Rodés-Cab J, Webb J, Cheung A, Christ over M, James L, Robert D, et al.** Transcatheter aortic valve implantation for the treatment of severe symptomatic aortic stenosis in patients at very high or prohibitive surgical risk. Acute and late outcomes of the multicenter Canadian ex- perience. J Am Coll Cardiol 2010; 55: 1080-90.
8) **Smith C, Leon M, Mack M, Miller D, Moses J, Svensson L, et al.** Transcatheter versus surgical aortic-valve replacement in high-risk patients. N Engl J Med 2011; 364: 2187–98.
9) **Koplan BA, Stevenson W, Epstein L, Aranki S, Maisel W .** Development and validation of a simple risk score to predict the need for permanent pacing after cardiac valve surgery. J Am Coll Cardiol 2003; 41: 795– 801.
10) **Kawashima T and Sato F.** Visualizing anatomical evidence on atrioventricular conduction system for TAVI. Int J Cardiol 2014; 174: 1 – 6.
11) **Moreno R, Calvo L, Salinas P, Nabarro D, Santiago J, Sanchez A, et al.** Causes of perioperative mortality after transcatheter aortic valve implantation: A pooled analysis of 12 studies and 1223 patients. J Invasive Cardiol 2011; 23: 180-184.

12) **Calvi V, Puzzangara E, Pruitt G, Conti S, Ussia G, Tamburino C, et al.** Early conduction disorders following percutaneous aortic valve replacement. Pacing Clin Electrophysiol 2009; 32 Suppl 1: S126-130.
13) **Sinhal A, Altwegg L, Pasupati S, Humphries K, Allard M, Web J, et al.** Atrioventricular block after transcatheter balloon-expandable aortic valve implantation. JACC Cardiovasc Interv 2008; 1: 305–309.
14) **Gutierrez M, Rodes-Cabau J, Bagur R, Doyle D, Bergeron S, Poirier P et al.** Electrocardiographic changes and clinical outcomes after transapical aortic valve implantation. Am Heart J 2009; 158: 302-308.
15) **Roten L, Wenaweser P, Delacretaz E, Hellige G.** Incidence and predictors of Atrioventricular Conduction Impairment After Transcatheter Aortic Valve Implantation. Am J Cardiol 2010; 106: 1473–1480.
16) **Baan J, Yong Z, Koch K, Henriques J, Bouma B, Vis M, et al.** Factors associated with cardiac conduction disorders and permanent pacemaker implantation after percutaneous aortic valve implantation with the CoreValve prosthesis. Am Heart J 2010; 159: 497-503.
17) **Anna K, Panagiotis K, Efthimios L, Sofia T, Christos S, Doudoumis K, et al.** Permanent pacing after transcatheter aortic valve implantation of a CoreValve prosthesis as determined by electrocardiographic and electrophysiological predictors: a single-center experience. Europace 2016; 18: 131–137.
18) **Fraccaro C, Buja G, Tarantini G, Gasparetto V, Leoni L, Corrado D, et al.** Incidence, predictors, and outcome of conduction disorders after transcatheter self-expandable aortic valve implantation.Am J Cardiol 2011;107:747–754.
19) **De Torres-Alba F, Kaleschke G, Diller G, Vormbrock J, Orwat S, Radke R, et al.** Changes in the pacemaker rate after the transition from Edwards SAPIEN XT to SAPIEN 3 transcatheter aortic valve implantation. JACC Cardio- vasc Interv 2016; 9: 805-13.
20) **Franzoni I, Latib A, Maisano F, Costopoulos C, Testa L, Figini F, et al.** Comparison of incidence and predictors of left bundle branch block after transcatheter aortic valve implantation using the CoreValve versus the Edwards valve. Am J Cardiol 2013; 112: 554-9.
21) **Nuis R, Van Mieghem N, Schultz C, Tzikas A, Cheng J, Piazza N, et al.** Timing and potential mechanisms of new conduction abnormalities during the implantation of the Medtronic CoreValve System in patients with aortic stenosis. Eur Heart J 2011; 32: 2067-74.
22) **Salizzoni S, Anselmino M, Fornengo C, Giordana F, Oxide P, Marra S, et al.** One-year follow-up of conduction disturbances following transcatheter aortic valve implantation. J Cardiovasc Med (Hagerstown) 2015; 16: 296-302.
23) **Piazza N, de Jaegere P, Schultz C, Becker A, Serruys P, Anderson R.** Anatomy of the aortic valvar complex and its implications for transcatheter implantation of the aortic valve. Circ Cardiovasc Interv 2008; 1: 74-81
24) **Carrabba N, Valenti R, Migliorini A, Marani M, Cantini G, Parodi G, et al.** Impact on left ventricular function and remodeling and 1-year outcome in patients with left bundle branch block after transcatheter aortic valve implantation. Am J Cardiol 2015; 116: 125-31.
25) **Jilaihawi H, Chin D, Vasa-Nicotera M, Jeilan M, Spyt T, Ng G, et al.** Predictors for per-permanent pacemaker requirement after transcatheter aortic valve implantation with the CoreValve bioprosthesis. Am Heart J 2009; 157: 860-6.

To Cite:

Alcekelly, M., Roshdy, H., Hussein, E., Ali, W. Permanent Pacemaker Implantation After Trans-Catheter Aortic Valve Implantation and Surgical Aortic Valve Replacement in Zagazig University Hospitals and National Heart Institute. *Zagazig University Medical Journal, 2022; (18-26): -. doi: 10.21608/zumj.2019.18254.1589*