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# Early Conduction Abnormalities Following Trans Catheter Aortic Valve Implantation In Al Najaf Cardiac Center: Single-Center Experience From Iraq.

**Ammar Jabbar Majeed[1*], Khalid Ibrahim Amber[2], Karar Nadhm Obaid Aljabry[3], Hadeel Ali Yousif [4]**

[1*]Department of Interventional Cardiology, Medical College, University of Kufa, Iraq, Email: ammarjabbar48@gmail.com
[2]Al Najaf cardiac center, Najaf, Iraq. Email: khalidamber4@gmail.com
[3]Department, Medicine College, University of Kufa, Najaf, Iraq, Email: karar.n.ubaid@gmail.com
[4]Al-Sadder medical city, Najaf health Directorate, Najaf, Iraq. Email: hadeelalhakeem@gmail.com

***Corresponding Author:** Ammar Jabbar Majeed
*Department of Interventional Cardiology, Medical College, University of Kufa, Iraq, Email: ammarjabbar48@gmail.com

**Abstract**
**Objectives**: Trans catheter aortic valve implantation (TAVI) is an increasingly utilized minimally invasive procedure designed for elderly patients experiencing symptomatic severe aortic stenosis, particularly those identified as intermediate or high-risk for traditional surgical intervention. This study focused on evaluating both immediate (in-hospital) and short-term (30-day) conduction abnormalities post-TAVI at a single center in Iraq.
**Methods**: From January 2017 to March 2024, a cohort of 213 symptomatic patients with severe aortic stenosis underwent TAVI, employing both balloon-expandable and self-expanding trans catheter heart valves (THVs) at the Al Najaf Cardiac Center. All procedures were conducted under local anesthesia with conscious sedation via a trans femoral access. Patients were monitored for electrical conduction abnormalities during hospitalization and through periodic follow-ups.
**Results**: The study examined the prevalence of conduction abnormalities in 213 TAVI patients, with a mean age of 73.58 years (±6.35) and a male representation of 48.8%. The Myval valve was predominantly used (121 patients), followed by Evolute R (83 patients), and the Accurate Neo 2 valve (9 patients). Among the participants, 72.9% exhibited no conduction abnormalities, whereas 16.8% developed left bundle branch block (LBBB), 1.4% experienced first-degree heart block, and 8.4% had complete heart block (CHB). Notably, LBBB was more prevalent among female patients (21 cases) compared to male patients (15 cases); however, this gender difference was not statistically significant, indicating that gender alone is not a reliable predictor of LBBB occurrence after the procedure. A statistically significant correlation was found between pre-dilation and the incidence of LBBB ($p = 0.045$), suggesting that pre-dilation may reduce LBBB risk. In contrast, post-dilation did not significantly affect LBBB rates ($p = 0.791$). The type of valve used was a significant factor associated with LBBB development ($p = 0.02$), with Myval valves showing a higher incidence than both Evolute and Accurate Neo 2 valves. However, valve type did not significantly influence CHB rates ($p = 0.831$), indicating that factors leading to CHB may not be as related to valve type. Furthermore, valve size did not demonstrate a significant association with LBBB ($p = 0.13$) or CHB ($p = 0.861$).
**Conclusion**: TAVI, utilizing both self-expanding and balloon-expandable THVs, is a safe and effective alternative to surgical intervention for patients with symptomatic severe aortic stenosis. Nevertheless, the procedure carries a risk of significant complications, such as conduction abnormalities, particularly LBBB, which is more frequently observed with balloon-expandable valves and among female patients. CHB represents a second frequent conduction abnormality with no significant correlation to valve type or size.

***Author for correspondence: Email id:** *ammarjabbar48@gmail.com*

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**Introduction:**

Calcific degenerative aortic stenosis, an inflammatory process, is the predominant form of valvular heart disease in Western nations. It is estimated that 1% to 2% of individuals over 65 years suffer from moderate to severe aortic stenosis, with the incidence increasing to 12% for those over 85 years[1]. Aortic stenosis is often accompanied by conduction abnormalities such as LBBB, RBBB, and CHB[2]. Valve replacement procedures can further exacerbate these conduction issues, with an observed incidence of interventricular conduction defects reaching 33%, correlating with poorer outcomes[3,4].

Trans catheter aortic valve replacement, a minimally invasive option developed over 30 years ago, is intended for patients at moderate to high risk for traditional surgical aortic valve replacement. The anatomical closeness of the aortic valve annulus to the atrioventricular node heightens the risk of conduction disorders, which may arise from valve annulus calcification or mechanical trauma[5]. Various hypotheses have been proposed concerning the origins of these conduction disturbances, including patient-specific factors, characteristics of the balloon-expandable prosthesis, and interactions between the device and the native aortic annulus[6,7].

As the demand for less invasive treatment options rises, TAVI has increasingly become a viable choice for both severely symptomatic and occasionally asymptomatic patients who are not suitable for surgical valve replacement[8]. This shift has resulted in a notable increase in patient volume, but it has also proportionately raised the incidence of device-related complications. Although permanent pacemaker implantation is a well-documented complication following valve deployment, the specific mechanisms and predictive factors for the development of conduction abnormalities remain inadequately understood[9].

**Trans catheter Aortic Valve Implantation (TAVI):**

Severe calcification of the aortic valve prior to TAVI can induce conduction abnormalities. Some research indicates that the depth of valve implantation correlates with the emergence of new bundle branch blocks and conduction delays following the procedure[10]. Studies have suggested that deeper implantation may increase the risk of affecting the conductive His-bundle system[11].

The heart's intrinsic conduction system is crucial for coordinating electrical impulses that facilitate optimal cardiac performance. The conduction system, comprising the sinoatrial node, atrioventricular node, and His-Purkinje network, is susceptible to arrhythmias, including atrioventricular and intraventricular blocks, which are significant in clinical cardiology[12].

**Conduction System Anatomy and Physiology:**

The heart's intrinsic conduction system (CS) provides an organized, coordinated, essential electrical impulse within the heart for optimal cardiac performance [13]. The systolic phase is characterized by coordinated atrial and ventricular activation beginning from the SA node to the atrioventricular (AV) node, then through the His-Purkinje network distributed to ventricles. AV delays and synchronous ventricular contraction are supported by the conduction relation between the AV node and the proximal His bundle. His-Purkinje fibers have an essential role in rapid impulse propagation, triggering depolarization and ventricular myocardial contraction [14]. The CS consists of three major specialized portions: sinoatrial node (SAN), atrioventricular node (AVN), and His bundle-subsequently, bifurcating into left and right bundles-distributing throughout the septum-originated Purkinje cells. These specialized tissues are potential sites of cardiac arrhythmias, particularly atrioventricular and intraventricular blocks, which constitute important groups in clinical cardiology practice. These events can occur either after structural disease or as a result of congenital or acquired conditions [15].

**Conduction Abnormalities Post-TAVI:**

The emergence of new conduction disturbances or the worsening of pre-existing ones often necessitates prolonged or permanent pacing[16]. This need is exacerbated by the characteristics of the elderly population, who frequently exhibit higher homeostatic demands, a greater prevalence of hypertension and diabetes, and increased vulnerability to atrial fibrillation and renal dysfunction[17]. Empirical evidence suggests that patients with right ventricular apical pacing experience notable declines in ventricular function over time, while those with LBBB show less favorable outcomes post-TAVI compared to long-term follow-up[18-20]. Following TAVI, most patients experience acute conduction abnormalities, with a subset developing persistent issues. This study will specifically address three common arrhythmias associated with TAVI: LBBB, complete atrioventricular block, and high-degree atrioventricular block.

**Patients and Methods:**

**Study Population:**

This study included patients with symptomatic severe aortic stenosis who visited or were referred to the outpatient clinic at Al Najaf Cardiac Center, Iraq, from January 2017 to March 2024. Inclusion criteria

comprised symptomatic severe aortic stenosis patients at high or intermediate risk for open-heart surgery with mild to moderate left ventricular systolic function. Patients exhibiting low-gradient severe aortic stenosis were also included. Exclusion criteria encompassed those with symptomatic severe aortic stenosis at low surgical risk or with vascular anatomical prohibitions.

A total of 213 patients with symptomatic severe aortic stenosis underwent TAVI using trans catheter heart valves, with a mean age of 73.58 years (±6.35) and a male representation of 48.8%. Baseline characteristics were evaluated, including clinical history, physical examinations, and electrocardiographic and echocardiographic data. Informed consent was obtained from all patients prior to the procedure. Echocardiography confirmed the diagnosis and assessed valve morphology and left ventricular function.

**Procedural Technique:**
The structural heart intervention team comprised two trained operators, two nurses, a Cath-lab technician, and an anesthetist. TAVI was performed using both balloon and self-expandable THVs under local anesthesia and conscious sedation, employing a trans femoral approach. Valves were deployed following pre-dilatation using a rapid pacing technique, with deployment executed in a coplanar view. Access sites were closed with two 6F vascular closure devices.

**Study Endpoints:**
Endpoints, as defined by the Valve Academic Research Consortium-3, included the occurrence of conduction abnormalities (LBBB, RBBB, CHB) either immediately following or shortly after the procedure and the potential need for temporary or permanent pacemaker implantation.

**Statistical Analysis:**
Data were analyzed using SPSS (version 23.0 for Linux). Continuous data are expressed as mean ± standard deviation for parametric variables and as median (interquartile range) for nonparametric variables. Categorical variables are presented as frequencies and percentages.

**Results:**
Figure 1 illustrates the age distribution of a population across various age groups. The two pie charts depict the gender distribution of the population, with one labelled "female" (51.2%) and the other "male" (48.8%).

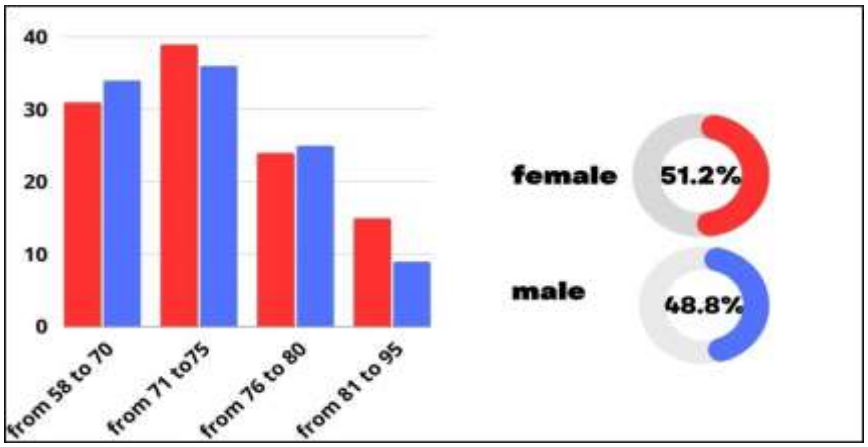


**Figure (1) Age and Gender Distribution.**

Figure 2 illustrates the frequency of three distinct types of heart valves: Evolute R, Myval, and Accurate Neo2. The chart demonstrates that Myval is the most prevalent valve, with a total of 121 instances, followed by Evolute R with 83 occurrences. Conversely, Accurate Neo2 is the least utilized valve, with only 9 instances.

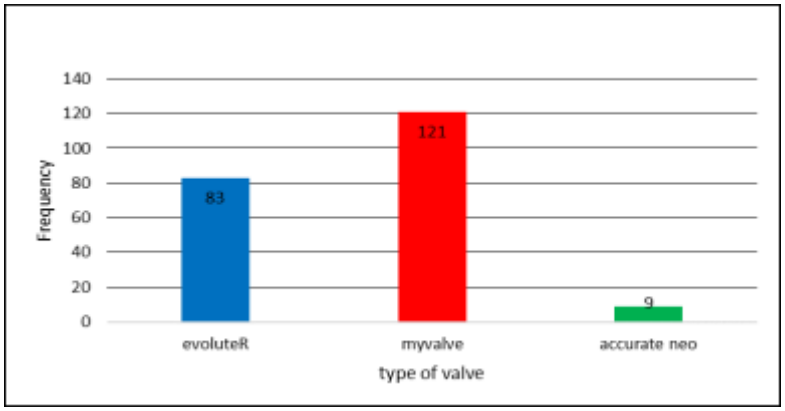


**Figure (2): Frequency Distribution of Valve Types**

Figure 3 displays the frequency of conduction abnormalities associated with three types of valves: EvoluteR, Myval, and Accurate Neo2.

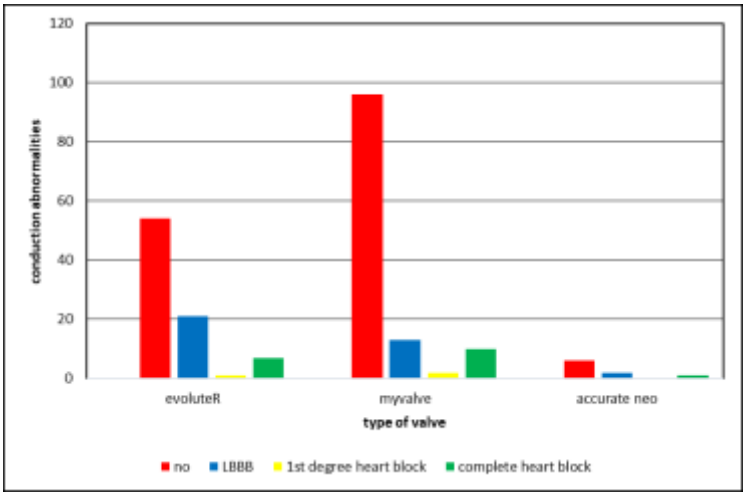


**Figure (3): The Distribution of conduction abnormalities by valve type**

The majority of patients (almost 73%) are free of conduction abnormalities, indicating that most TAVI procedures not associated with conduction abnormalities post-operation as showed in table 1

**Table (1): Frequency and percentages of conduction abnormalities.**

| Conduction abnormalities | Frequency | Percent % |
|---|---|---|
| No conduction abnormalities | 156 | 72.9 |
| LBBB | 36 | 16.8 |
| 1st degree heart block | 3 | 1.4 |
| Complete heart block | 18 | 8.4 |
| Total | 213 | 99.5 |

Chi square test was performed. The p-value for the association between sex and the prevalence of LBBB is 0.367. This p-value is above the conventional threshold of 0.05, indicating that the difference in LBBB prevalence between males and females is not statistically significant.

**Table (2): Left Bundle Branch Block (LBBB) across sex see table 2.**

| | | Sex | | Total | P_value |
|---|---|---|---|---|---|
| | | Male | Female | | |
| LBBB | No | 89 | 88 | 177 | 0.367 |
| | Yes | 15 | 21 | 36 | |
| Total | | 104 | 109 | 213 | |

Chi square test was performed. The significant p-value (0.023) suggests that there is a difference in the prevalence of LBBB among the different types of valves. Specifically, the Evolute R valve has a higher prevalence of LBBB (25.3%) compared to the Myval (10.7%). The Accurate Neo valve also shows a higher prevalence (22.2%) compared to the Myval. The data indicates that the type of heart valve may influence the likelihood of developing LBBB see table 3.

**Table (3): Left Bundle Branch Block (LBBB) across valve type.**

| | | Type | | | Total | P_value |
|---|---|---|---|---|---|---|
| | | evoluteR | Myvalve | accurate neo | | |
| LBBB | No | 62 | 108 | 7 | 177 | 0.023 |
| | Yes | 21 | 13 | 2 | 36 | |
| Total | | 83 | 121 | 9 | 213 | |

Chi square test was performed. The significant p-value (0.045) suggests that predilatation has a meaningful impact on the prevalence of LBBB. Individuals who did not undergo predilatation have a higher prevalence of LBBB (32.0%) compared to those who did undergo predilatation (14. 9%).This suggests that predilatation may be associated with a lower likelihood of developing LBBB or that it might be a protective factor against the development of LBBB see table 4.

**Table (4): Left Bundle Branch Block (LBBB) across predilatation**

| | | Prediltation | | Total | P_value |
|---|---|---|---|---|---|
| | | yes | No | | |
| LBBB | no | 160 | 17 | 177 | 0.045 |
| | yes | 28 | 8 | 36 | |
| Total | | 188 | 25 | 213 | |

Chi square test was performed. The p-value for the association between postdilatation and LBBB prevalence is 0.791. This p-value is well above the conventional threshold of 0.05, indicating that the differences in LBBB prevalence between individuals who underwent postdilatation and those who did not are not statistically significant see table 5.

**Table (5): Left Bundle Branch Block (LBBB) across post dilatation.**

| | | Postdiltation | | Total | P_value |
|---|---|---|---|---|---|
| | | Yes | No | | |
| LBBB | no | 43 | 134 | 177 | 0.791 |
| | yes | 8 | 28 | 36 | |
| Total | | 51 | 162 | 213 | |

Chi square test was performed. The p-value for the association between age group and LBBB prevalence is 0.685. This p-value is well above the conventional threshold of 0.05, indicating that the differences in LBBB prevalence across the different age groups are not statistically significant see table 6.

**Table (6): Left Bundle Branch Block across age groups.**

| | | Age groups | | | | Total | P_value |
|---|---|---|---|---|---|---|---|
| | | from 58 to 70 | from 71 to75 | from 76 to 80 | from 81 to 95 | | |
| LBBB | no | 55 | 63 | 38 | 21 | 177 | 0.685 |
| | yes | 10 | 12 | 11 | 3 | 36 | |
| Total | | 65 | 75 | 49 | 24 | 213 | |

Chi square test was performed. The p-value for the association between sex and the prevalence of CHB is 0.062. This p-value is above the conventional threshold of 0.05, indicating that the difference in CHB prevalence between males and females is not statistically significant see table 7.

**Table (7): Complete heart block (CHB) across sex.**

| | | Sex | | Total | P_value |
|---|---|---|---|---|---|
| | | male | Female | | |
| CHB | no | 99 | 96 | 195 | 0.062 |
| | yes | 5 | 13 | 18 | |
| Total | | 104 | 109 | 213 | |

Chi square test was performed. The p-value of 0.831 indicates that there is no statistically significant association between the type of valve used and the occurrence of CHB see table 8.

**Table (8): Complete heart block (CHB) across valve type.**

| | | Type of valve | | | Total | P_value |
|---|---|---|---|---|---|---|
| | | evoluteR | myvalve | accurate neo | | |
| CHB | no | 76 | 111 | 8 | 195 | 0.831 |
| | yes | 7 | 10 | 1 | 18 | |
| Total | | 83 | 121 | 9 | 213 | |

Chi square test was performed. The p-value of 0.451 indicates that there is no statistically significant association between predilatation and the occurrence of CHB see table 9.

**Table (9): Complete heart block (CHB) across predilatation.**

| | | Prediltation | | Total | P_value |
|---|---|---|---|---|---|
| | | yes | No | | |
| CHB | no | 173 | 22 | 195 | 0.451 |
| | yes | 15 | 3 | 18 | |
| Total | | 188 | 25 | 213 | |

Chi square test was performed. A p-value of 1.000 indicates that there is no statistically significant association between postdilatation and the occurrence of CHB see table 10.

**Table (10): Complete heart block (CHB) across postdilatation.**

| | | Postdiltation | | Total | P_value |
|---|---|---|---|---|---|
| | | yes | No | | |
| CHB | no | 47 | 148 | 195 | 1.000 |
| | yes | 4 | 14 | 18 | |
| Total | | 51 | 162 | 213 | |

Chi square test was performed. The p-value of 0.062 suggests a marginally non-significant trend between age group and the occurrence of CHB. Although the result approaches statistical significance (typically p-value = 0.05), it does not meet the threshold to confidently reject the null hypothesis. This means that the differences observed between age groups in terms of CHB incidence could be due to random chance rather than a true underlying association see table 11.

**Table (11): Complete heart block (CHB) across age groups.**

| | | Age group | | | | Total | P_value |
|---|---|---|---|---|---|---|---|
| | | from 58 to 70 | from 71 to75 | from 76 to 80 | from 81 to 95 | | |
| CHB | no | 63 | 70 | 41 | 21 | 195 | 0.062 |
| | yes | 2 | 5 | 8 | 3 | 18 | |
| Total | | 65 | 75 | 49 | 24 | 213 | |

**Discussion:**

This study represents earliest studies in Iraq that evaluate the incidence and risk of conduction abnormalities after TAVI procedure, the mean age of patients was 73.58 years (±6.35) and a male representation of 48.8%. The incidence of conduction abnormalities after TAVI varies between 5.7%-42.5%. With incidence of AV block varies between 24.5%-25.8% for CoreValve® and 5.9%-6.5% for Edwards SAPIEN® self-expandable valve. In this study the summation of conduction abnormalities was 27.1% with majority seen with use of self -expandable THV.

New left bundle branch block is the most common conduction abnormality seen with rate of 27.3 % for Evolute R and 10.7% for BE valves, this results were consistent with Colombo, et al. (2012) study which show New-onset LBBB occurred in 30.2% of patients immediately after Edwards implantation and had re-solved in 37.7% at discharge and 57.3% at 1-yearfollow-up.

CM Otto, et al. (2017) were shown that the risk of AV block is higher for CoreValve® due to its self-expandable design and the possible deeper implantation into the left ventricular outflow tract which is comparable with 7 (8.3%) for Evolute R vs 7.4% for balloon expandable in this study.

**Conclusion:**

TAVI, utilizing both self-expanding and balloon-expandable THVs, is a safe and effective alternative to surgical intervention for patients with symptomatic severe aortic stenosis. Nevertheless, the procedure carries a risk of significant complications, such as conduction abnormalities, particularly LBBB, which is more frequently observed with balloon-expandable valves and among female patients. CHB represents a second frequent conduction abnormality with no significant correlation to valve type or size.

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