# Characteristics and one-year outcomes of patients with advanced atrioventricular block in Saudi Arabia. *A single-center retrospective cohort study*

*Wael A. Alqarawi, MD, MSc, Abdulrahman S. Alarifi, MBBS.*

## ABSTRACT

**Objectives:** To report and describe the characteristics and outcomes of patients with advanced atrioventricular block (AVB) in Saudi Arabia.

**Methods:** We included consecutive patients who underwent pacemaker implantation at King Khaled University Hospital, Riyadh, Saudi Arabia, for advanced AVB, which was defined as second degree type 2 AVB, third degree AVB, and symptomatic atrial fibrillation with slow ventricular response. The variable "young patient" was defined as age of 60 or less, based on guidelines recommending cardiac sarcoidosis (CS) evaluation at this age or younger.

**Results:** Among 100 patients (median age: 71 males, 51%), 29 (29%) were young patients. Most patients had at least one comorbidity including hypertension, diabetes, or dyslipidemia (81%). Young patients constituted 26.6% (n=21/79) of idiopathic AVB cases and only 23.8% (n=8/21) underwent CS evaluation (8/21).

**Conclusion:** A significant proportion of AVB occurs in young patients. Yet, CS is often not ruled out. Future studies should define the yield of CS evaluation in the Saudi population when international consensus documents are followed.

**Keywords:** Saudi Arabia, atrioventricular block, idiopathic atrioventricular block, sarcoidosis, old age, prognosis

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Limited evidence is available pertaining to the characteristics of advanced atrioventricular block (AVB) patients in Saudi Arabia This is important as the characteristics of our population is different from those in Western countries, having been shown to result in unique presentations and outcomes for most cardiovascular conditions.[1-3] Indeed, the average age at presentation with acute coronary syndrome (ACS), heart failure (HF), and atrial fibrillation (AF) was found to be 10-15 years younger in the Saudi population as compared to Western populations.[1-3] Moreover, the prevalence of cardiovascular comorbidities, such diabetes mellitus (DM), hypertension (HTN), and dyslipidemia (DLP) were found to be significantly higher.[4] These factors will undoubtfully have implications on the presentation and management of AVB patients. Nevertheless, current practice in Saudi Arabia is predominantly based on evidence from Western countries, which likely have different patient characteristics. For example, age is an essential factor that determines the need for advanced evaluation of the underlying causes of AVB, such as cardiac sarcoidosis (CS).[4] The expert consensus document on the diagnosis and management of arrhythmias associated with CS recommends investigating patients with advanced AVB who are 60-year-old or younger for the presence of CS, based on the yield of this approach in Western countries.[5,6] We hypothesized that this is not routinely carried out in Saudi Arabia. In addition, we hypothesized that the characteristics of AVB patients are different than Western countries, which should challenge importing recommendations without supportive evidence from our populations. One would not expect the yield, cost and benefits of such recommendations to be the same if patients' age and risk factors are different. Against this background, we sought to report the characteristics and one-year outcomes of patients with AVB in Saudi Arabia.

**Methods.** This was a single-center retrospective cohort study. Consecutive patients who underwent de-novo pacemaker implantation at King Khaled University Hospital, Riyadh, Saudi Arabia, from January 2015 to December 2021, for advanced AVB were included. Advanced AVB was defined as second-degree type 2 AVB, third-degree AVB, or symptomatic AF with a slow ventricular response.

The study was approved by the institutional review board at King Khaled University Hospital, Riyadh, Saudi Arabia (approval number: EE-22-6602).

The study variables included demographics, baseline characteristics, investigations carried out before implant, implant details, and one-year outcomes (survival). Variables were obtained from the patients'

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electronic medical records, and missing variables were collected by contacting patients. The variable "young patient" was defined as an age at implant of 60 years or younger, which was based on a consensus document recommending assessing patients with advanced AVB for CS if the age is 60 or less.[4] Patients were considered to have had appropriate investigation for CS if either chest computed tomography or cardiac magnetic resonance were carried out (positron emission tomography was not available at King Khaled University Hospital).

***Statistical analysis.*** Continuous variables were presented as median (interquartile range [IQR]), and categorical variables were summarized as numbers and percentages (%). when appropriate, the Wilcoxon rank sum test, Chi-square test, and Fisher's exact test were used to analyze the data. Analyses were carried out using SAS, version 9.4 (SAS Institute, USA), and *p*-values of <0.05 were considered significant.

**Results.** We included 100 consecutive patients. The median age was 71, and 51% were males. A total of 29 (29%) patients were young. Most patients had at least one comorbidity, with hypertension being the most common (81%). Complete heart block was the most common diagnosis (67%), and 79% of all patients did not have a cause for their AVB (namely, idiopathic AVB). Only 5 patients underwent investigations to screen for CS. Among the 89 patients who had one-year follow-up data, 7 had passed away (n=7/89, 8%, Table 1).

A total of 79 patients had no cause identified for their AVB, and 21 cases were either secondary to cardiac surgery (n=9/21, 42%), transcatheter valve replacements (n=9/21, 42%), endocarditis (n=1/21, 5%), or myocardial infarction (n=2/21, 10%). There were no significant differences between the 2 groups (Idiopathic vs. secondary AVB), with the exception of more prevalent comorbidities in the idiopathic group (92.3% vs. 71.4%, *p*=0.009). Among patients who had one-year follow-up data, 5 (n=5/77, 7%) patients had passed away in the idiopathic group as compared with 2 (n=2/12, 17%) in the secondary group (*p*=0.223, Table 2).

Young patients constituted 26.6% (n=21/79) of the patients with idiopathic AVB. Their median age was 56 years, and 38.1% were males. Only 23.8% (n=8/21) of these cases were investigated for CS. When compared with older patients, young patients had fewer comorbidities (80.1% vs. 96.5%, *p*=0.022), and they were less likely to receive a single-chamber pacemaker (14.3% vs. 55.2%, *p*=0.001). There was no significant difference in diagnosis between the 2 groups. All deaths in the idiopathic AVB patients occurred in the older patient group (Table 3).

**Discussion.** Our study has reported the characteristics of patients with advanced AVB. A total of 3 major findings were revealed. First, the average age at implant was young, with a significant proportion of

**Table 1 -** Characteristics of patients with atrioventricular block (N=100).

| Variables | Patients with advanced AVB |
|---|---|
| Age (years), median (IQR) | 72 (58-79) |
| Young patients (≤60-year-old) | 29 (29.0) |
| Male gender | 51 (51.0) |
| Hypertension | 81 (81.0) |
| Diabetes mellitus | 76 (76.0) |
| Dyslipidemia | 35 (35.0) |
| Any comorbidity (hypertension, diabetes mellitus, or dyslipidemia) | 88 (88.0) |
| ***Diagnosis*** | |
| CHB | 67 (67.0) |
| 2nd degree AVB | 22 (22.0) |
| AF with slow ventricular response | 7 (7.0) |
| Unknown | 4 (4.0) |
| Cause of AVB (idiopathic) | 79 (79.0) |
| Investigated for cardiac sarcoidosis | 5 (5.0) |
| Type of pacemaker (single) | 44 (44.0) |
| New-onset heart failure at one year | 5/89 (9.1) |
| Death at one year | 7/89 (4.5) |

Values are presented as numbers and percentages (%). IQR: interquartile range, CHB: complete heart block, AVB: atrioventricular block, AF: atrial fibrillation

**Table 2 -** Characteristics of patients with atrioventricular block (idiopathic versus secondary).

| Variables | Idiopathic AVB (n=79) | Secondary AVB (n=21) | *P*-values |
|---|---|---|---|
| Age (years), median (IQR) | 72 (59-78) | 72 (56-82) | 0.969 |
| Young patients (≤60 year-old) | 21 (26.6) | 8 (38.1) | 0.301 |
| Male gender | 37 (46.8) | 14 (66.7) | 0.106 |
| Hypertension | 66 (83.5) | 15 (71.4) | 0.208 |
| Diabetes mellitus | 61 (76.9) | 15 (71.4) | 0.602 |
| Dyslipidemia | 29 (36.7) | 6 (28.6) | 0.487 |
| Any comorbidity (hypertension, diabetes mellitus, or dyslipidemia) | 73 (92.3) | 15 (71.4) | 0.009 |
| ***Diagnosis*** | | | |
| CHB<br>2nd degree AVB<br>AF with slow ventricular response<br>Unknown | 52 (65.8)<br>19 (24.1)<br>6 (7.6)<br>2 (2.5) | 15 (71.4)<br>3 (14.3)<br>14 (4.8)<br>6 (9.5) | 0.389 |
| Investigated for cardiac sarcoidosis | 5 (6.3) | -- | -- |
| ***Cause of AVB*** | | | |
| Post TAVI<br>Post cardiac surgery<br>Other | NA | 4 (19.1)<br>6 (28.6)<br>1 (4.8) | -- |
| Type of pacemaker (single) | 35 (44.3) | 9 (42.9) | 0.906 |
| New-onset heart failure at one year | 0 (0.0) | 5/13 (38.5) | <0.001 |
| Death at one year | 5/77 (5.7) | 2/12 (16.7) | 0.223 |

Values are presented as numbers and percentages (%). IQR: interquartile range, CHB: complete heart block, AVB: atrioventricular block, AF: atrial fibrillation, TAVI: transcatheter aortic valve implantation

patients under the age of 60. Second, there was a high prevalence of comorbidities, such as DM, HTN, and DLP. Third, only one in 4 patients with idiopathic AVB at a young age were evaluated for CS. These unique findings in the Saudi population should inform future research seeking to identify best practices pertaining to AVB patients that are tailored to their unique characteristics.

The median age at pacemaker implantation in our study was 72 years, which is lower than what has been reported in other populations. For example, the average age in the Danish and Japanese populations was reported to be 76 years.[7,8] Moreover, Mkoko et al[9] reported the proportion of young patients (<55 years) who received a pacemaker for AVB to be only 12%, as opposed to our young patients who constituted 27%, notwithstanding the difference in the age cut-off. This apparent younger age at presentation is likely due to the fact that the average age of the Saudi population is younger than that of other populations. Indeed, only 4% of the Saudi population were 65 years or older in 2021, as opposed to 20% of the Danish population.[10] However, the high prevalence of comorbidities could be another factor that contributed to a younger age at presentation, a hypothesis that needs to be evaluated in future studies. In addition, future studies need to assess the yield of looking for secondary causes in those younger than 60 years of age, given their high proportion and thus the potential cost of these investigations.

The majority of our patients had at least one cardiovascular comorbidity, including DM, HTN, or DLP. This is consistent with previous studies that examined the prevalence of these comorbidities in different cardiovascular conditions, such as coronary artery disease and heart failure.[1,2,11] However, these rates are distinctly different from those of the AVB populations in Western countries. For example, DM is only present in 21% of the Danish AVB population, as opposed to 77% in our study. Similarly, HTN is seen in 69% of Danish AVB patients, versus 84% of ours, despite the older average age in the Danish population.[7] These comorbidities might, in part, explain the young age of presentation in our study. Indeed, multiple studies have shown the association between these comorbidities and advanced AVB.[7,12] Specifically, Haxha et al[7] carried out a case-control study using the Danish nationwide registry to examine the association between DM and complete AVB. After adjusting for important confounders, they showed that DM is associated with higher rates of complete AVB.[7]

The low rate of evaluating young patients with "idiopathic" AVB for CS is worth a closer look. Cardiac sarcoidosis as a cause of AVB at a young age has been well-

**Table 3 -** Characteristics of patients with atrioventricular block (young idiopathic vs. old idiopathic).

| Variables | Young patients (n=21) | Older patients (n=58) | *P*-values |
|---|---|---|---|
| Age (years), median (IQR) | 56 (53-58) | 75 (67-79) | <0.001 |
| Male gender | 8 (38.1) | 29 (50.0) | 0.349 |
| Hypertension | 15 (71.4) | 51 (87.9) | 0.081 |
| Diabetes mellitus | 13 (61.9) | 48 (82.5) | 0.056 |
| Dyslipidemia | 4 (19.1) | 25 (43.1) | 0.05 |
| Any comorbidity (hypertension, diabetes mellitus, or dyslipidemia) | 17 (80.1) | 56 (96.5) | 0.022 |
| ***Diagnosis*** | | | |
| CHB | 11 (52.4) | 41 (70.7) | 0.473 |
| 2nd degree AVB | 7 (33.3) | 12 (20.7) | |
| AF with slow ventricular response | 2 (9.5) | 4 (6.9) | |
| Unknown | 1 (4.8) | 1 (1.7) | |
| Investigated for cardiac sarcoidosis | 5 (23.8) | 0 (0.0) | 0.001 |
| Type of pacemaker (single) | 3 (14.3) | 32 (55.2) | 0.001 |
| New-onset heart failure at one year | -- | -- | -- |
| Death at one year | 0 (0.0) | 5/56 (8.9) | 0.05 |

Values are presented as numbers and percentages (%). IQR: interquartile range, CHB: complete heart block, AVB: atrioventricular block, AF: atrial fibrillation

documented.[13,14] Nery et al[13] evaluated young patients presenting with unexplained AVB and found that 11 of 32 (34%) of them had CS. Similarly, Kandolin et al[14] found that CS was the cause of advanced AVB in 18 of 72 (25%) young adults (<55 years). As such, the expert consensus document recommends screening for CS in patients presenting with advanced AVB if they are 60 years or younger.[4] However, this determination is based on studies carried out in Western countries, and it is unclear whether the yield of this approach will be as high in different ethnic groups, especially in view of the documented variation in the incidence of sarcoidosis in different ethnicities.[15] Identifying the cause of AVB has important implications for the management and prognosis of patients. For example, the expert consensus document has a class IIa indication for implanting an implantable cardioverter-defibrillator in patients with advanced AVB and CS independent of the left ventricular ejection fraction, which is clearly different from the way we manage idiopathic AVB.[4] Moreover, Nery et al[13] suggested a close follow-up of patients with advanced AVB due to CS, given their risk of developing adverse outcomes. Indeed, they showed that 3 of 11 (27%) patients with advanced AVB had major cardiovascular events over 2 years as compared to none in the idiopathic AVB group.[13] These findings confirm the paramount importance of identifying the cause of AVB.

***Study limitations.*** Our study reported the characteristics of AVB in the Saudi population. However, it has several limitations. First, it is a single-center study. Nonetheless, it was carried out in a governmental hospital, and it is unlikely that other hospitals would have any significant differences in the patient population they serve or the way they manage AVB. Second, our sample size renders any inference regarding the prevalence of CS or the yield of evaluating young patients for CS quite limited and imprecise. However, this was not the primary goal of the study, and the results can still be helpful in informing sample size calculations for future prospective studies to assess the prevalence of CS and the yield of advanced imaging. Finally, a one-year follow-up is not long enough to reveal any adverse cardiovascular events in those in whom the diagnosis of CS might have been missed.

In conclusion, patients with advanced AVB were younger than their Western counterparts, with a high prevalence of comorbidities. Moreover, evaluating young patients for CS as a cause of AVB was not routinely carried out. Future studies should focus on examining the prevalence of CS in the Saudi population and the yield of looking for CS, as recommended by international consensus documents.

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*From the Department of Cardiac Sciences (Alqarawi), College of Medicine, King Saud University, and from the Department of Internal Medicine (Alarifi), King Abdullah University Hospital, Riyadh, Kingdom of Saudi Arabia.*

*Address correspondence and reprints request to: Dr. Wael A. Alqarawi, Department of Cardiac Sciences, College of Medicine, King Saud University, Riyadh, Kingdom of Saudi Arabia. E-mail: Waalqarawi@gmail.com*
*ORCID ID: https://orcid.org/0000-0001-5324-6993*

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